Supplementary material for "Economically irrational pricing of 19th century British government bonds"

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Abstract. This manuscript presents a variety of materials supplementing the paper "Economically irrational pricing of 19th century British government bonds." The motivation, background, and notation are all explained in that manuscript. This one does not form a coherent work by itself.

The first three sections illustrate how the British establishment viewed gilts mispricing around 1870, and how the markets reacted to a government debt conversion proposal of that year. This is followed by a section on general government policy towards investors in national debt instruments. Next comes a series of sections discussing gilts mispricings and press coverage of them during some interesting periods. There are then several sections on the financial press of the 19th century and on gilts investments of various investor groups, such as the universities of Cambridge and Oxford. These are followed by discussions of data sources, gilts liquidity and volatility, and gilts ownership. At the end there are several sections exploring in depth the "network effects" that likely contributed to the observed gilts mispricings. This manuscript concludes with discussions of possible extensions to the research reported here.

Tables with price data utilized in both this and the main manuscript are available at the author's home page.

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1 *The Times*, Lowe's 1870 debt conversion proposal, and gilts mispricing

This section and the next two are all related to a national debt conversion proposal that was put forth in 1870 by Robert Lowe (later to become Viscount Sherbrooke), who was the Chancellor of the Exchequer at that time. This proposal was met with some opposition but mostly with widespread indifference and was not enacted by Parliament. The main reason for this reaction appears to have been the fact that the Lowe proposal offered only modest changes, described later. With market yield on CA around 3.2%, he could not refinance the debt at lower rates, and so could not save the taxpayers much money. He also could not offer investors much. Had his proposed, somewhat technical, fixes, been offered to investors and accepted, there would have been some gains for both debt holders and the government, but they would have been fairly minor.

From the standpoint of studying gilts mispricing, though, that incident is unusually valuable. CA overpricing was at a high level both before and after the Lowe scheme was announced (dipping close to the rational level around the time he made it, see Section 3 for a chart and discussion). This motivated Lowe to propose differential treatment of CA on one hand and RA and NR on the other. This differential elicited reactions both in Parliament and in the press, and that in turn provides us with interesting information about what people knew and how they thought about this topic. We also learn about the levels of financial sophistication among the British elite from such reactions. By comparison, the other conversion proposals that are discussed later in this manuscript, those of Goulburn in 1844, Gladstone in 1853, Childers in 1884, and Goschen in 1888, all occurred in periods when the market yield on CA was around 3%, when conversion to lower interest rates was widely and in some cases almost universally expected, and when the relative pricing of CA and RA was rational. Hence there was not much opportunity for discussions of gilts mispricing during those financial maneuvers.

Section 2 describes the viewpoints gathered from the contemporary press, including some letters from readers. Section 3 analyzes market action, which demonstrates some developments that have not been found in the press. Those developments included what were very likely insider leaks. In addition, the prospects of Lowe's proposals being enacted seems to have induced almost fully rational relative pricing of CA and RA, but only for a short while. Once those prospect faded, the level of irrationality that had prevailed before returned.

In this section we consider a leader published in *The Times* (of London) on 15 February 1870 about the Lowe scheme. This leader is especially valuable since it was not written by a financial journalist, unlike the vast majority of the quotes presented in this work. Thus it represents a view of the wider (although still very elite) group of observers. First we present some background, then discuss the leader, and finally print that leader in its entirety.

At that time, *The Times* was a uniquely influential press organ (although no longer quite as influential as it had been a decade or two before), and was a must-read paper for the British elite [85]. Newspaper leaders at that time often went far beyond modern editorials, and frequently were extensive mixtures of factual reporting, analysis, and opinion. The

particular leader reproduced below, published in the Tuesday 15 February 1870 issue, and already referenced briefly in the main manuscript, had all of those features. It was prompted by the official presentation by Lowe of his proposals to the House of Commons on Friday 11 February, in late afternoon, so after the official trading on the London Stock Exchange had closed. (Transcripts of his speech and the ensuing debate are available in *Hansard's Parliamentary Debates,* ser. 3, vol. 199, 1870, c. 185ff and in *The Times*, 12 Feb. 1870, p. 6. Citations in this section are drawn from those two sources.)

The previous year, Lowe had pushed the Bank of England into giving investors more convenient access to interest on their gilts holdings, through the mail. This time he proposed to move towards quarterly payments of interest, which he expected would "be very agreeable, particularly to the poorer class of stockholders." His main justification was that "the more convenient we can make this stock to the holder the more popular we render it, the better the price it will fetch, and consequently the better for the public." As part of the process of making gilts more popular, he proposed to automatically switch CA holders to quarterly payments. He did not discuss in quantitative terms the financial benefit of such a move to investors (and the equal cost to the tax-paying public), which was about £0.375 for each unit of £100 nominal value (and thus about £1.5 million in total just for CA, equivalent, as fraction of GDP, to about $25 billion for the U.S. or £2.5 billion for the UK today). This was typical of the time. Much of the press talked of the "trifling boon" investors would enjoy, without quantifying it[1].

Lowe also wished to convert NR and RA, so as to have a single security which would have high liquidity and would be likely to provide a way to finance any emergency expenditures at minimal cost. However, he drew back from simply granting NR and RA holders quarterly interest payments automatically, apparently since he felt it would be too generous for them. He claimed that NR and RA, "although bearing precisely the same interest, probably through being a smaller amount, stand at a lower price in the market than [CA]." He computed they were underpriced by £0.50, after correcting for accrued interest. (As is shown in Section 3, CA overpricing had been considerably higher than £0.50 until a few months before, but was lower than £0.50 when he was speaking, a reduction almost surely induced by expectations of his conversion proposal.) Therefore, in order for the public to get some benefit, he proposed that holders of NR and RA be offered the option of voluntarily converting their holdings into the modified CA (which were to carry quarterly interest), but only on payment of a £0.25 fee for each unit of £100 nominal amount. This was supposed to split the benefit of moving from NR and RA to CA with the government.

The proposal for the £0.25 fee was criticized in the debate following Lowe's presentation, and in the press afterwards. Sir David Salomons, one of the MPs, proposed that NR and RA holders should get quarterly interest without any fee. Another MP, R. W. Crawford, commented that trustees could not make such a payment without a change in the law. These responses, as well as similar ones from other MPs, and the lack of any surprise at the mention of CA overpricing, demonstrate that at least among MPs, this pricing anomaly was widely known.

Crawford, as well as many observers outside Parliament, claimed that long-term holders of NR and RA would not be interested in paying then for the benefit of a potentially higher

selling price many years down the road, as they would be getting exactly the same interest in the interim. This demonstrated that they did not understand that quarterly payments were worth an extra £0.375, more than the £0.25 fee. It also reflects the general opinion that investors in gilts were overwhelmingly long-term ones, holding them for the interest they produced. These concerns are reflected in the leader in *The Times* reproduced below.

The market had only a minor reaction to Lowe's proposals, most likely because of an accurate perception they would not go through. Details are presented in Section 3, and they raise some interesting questions about the influence on prices of government financial policy, as well as the influence of anticipations of what the policy might be, and the possible influence of leaks about government deliberations.

Lowe's speech to Parliament was delivered late on a Friday afternoon. The leader in *The Times* reprinted below appeared on the following Tuesday, so the author had some time to think about it and collect information. Still, he did not have much time. One of this writer's eccentricities was that he did not work past 3 pm on any day. Furthermore, he lived in Cambridge, so the delivery of the assignment with supporting material to him and then obtaining his draft took several hours each way. However, it is possible he may have had more time, as he may have been given the assignment to write the leader earlier. The date of Lowe's presentation had been announced in advance, as usual for important policy proposals, and on the day before his speech, his correspondence with the Bank of England, cited in the next section, was published. This correspondence (discussed further in the next two sections) showed what measures Lowe was thinking about, and it was analyzed in a leader in *The Times* on the morning of Lowe's speech[2].

According to *The Times Editorial Diary,* which was kindly checked by the Times Newspapers Ltd Archive staff, the author of the 15 February leader was the Rev. Dr. Henry Annesley Woodham (1813-1875). A biography of Woodham is available in [53], and the official history of *The Times* [85] has additional informative material about him. A classics scholar, he spent virtually his entire adult life, with the exception of a few married years (which ended with the untimely death of his wife) residing as Fellow in Jesus College in Cambridge. From about 1845 until a few months before his death, he was one of the main leader writers for *The Times,* typically producing over 200 each year, on a great variety of topics. He had a few specialties, such as iron-clad ships. (Those were an important topic for discussion at the time, as the technological revolution in which armored steamships were replacing the older sailing warships posed a potential threat to Britain's naval supremacy.) He was not an economist, but was well-educated, well-connected in British society, and through his link with *The Times* was well-supplied with information on a variety of topics. To maintain his position as one of the main leader writers for the famous editor John Thadeus Delane, he had to be generally knowledgeable and regarded as sound and respectable. In the leader below, he was wrong on several points, but almost surely in ways that most educated Victorians of that era were wrong.

There are several noteworthy features to this leader. For example, Woodham claimed that few readers were aware there were a variety of gilts. This was likely true. Practically every issue of *The Times* and of every other newspaper in the UK had a list exhibiting prices of the major gilts, but it is very probable that most readers skipped through those

sections without paying any attention. However, Woodham was not only acquainted with the variety of financial instruments, but even knew that until recently the overpricing of CA relative to RA had been considerably higher than at the time he was writing. It is interesting that he attributed this narrowing of the price differential to Lowe's proposal. This differential had been narrowing for about the preceding 6 weeks (see Section 3), so either Woodham was not aware of this gradual development, or else he must have attributed this action to anticipations of what Lowe might do. (Woodham's meaning on this point, reproduced below in his leader, is not clear.)

Woodham did not appreciate the greater value of quarterly as opposed to half-yearly interest payments[3]. Furthermore, he appeared to think of holders of gilts as split into two classes, the long-term investors, "who buy to hold," and the short-term speculators. This was almost universal among early Victorians of all stripes, and only the former were regarded as respectable. The notion of ordinary investors, solid members of society, rebalancing their portfolios on a scale of a year, much less a week, month, day, or hour, was far in the future.

Woodham shared the then-common notion that NR and RA were "the cheaper and quieter Stocks." And, in common with his contemporaries, he did not wonder why holders of CA were not switching into those "cheaper" instruments, even though he claimed they were more "in favour with Savings Banks, trustees, small capitalists, and other permanent holders." Also, again in common with his contemporaries, he did seem to realize that the notion of NR and RA being "quieter Stocks" was extremely questionable. Yes, NR and RA were slightly less volatile, as was widely claimed at the time, and as is shown quantitatively in Section 57. But that was just in terms of hourly or daily variability, and even in the short term, prices of NR and RA followed closely those of CA, as was mentioned in a variety of contemporary investment guides, and as is shown by the data gathered for this paper. Thus the "quieter Stocks" did not offer a real shelter from the volatility of CA. (See Section 58 for more discussion of this issue.)

Woodham also seemed to think that most holders had the convenience of quarterly dividends through splitting their investments between CA on one hand, and NR and RA on the other, an assumption that seems rather questionable, as noted elsewhere. He also brought up the point of NR being protected from redemption until October 1874 and thus having special status as an obstacle to the Lowe proposal. But this was a spurious objection, since Lowe called for a voluntary switch by investors, not one forced by the government.

Woodham considered the Lowe proposal primarily from the standpoint of investors. General consensus was that the government would benefit from having a single security, as it would enable it to borrow at lower costs in cases of great wars, and, with quarterly payment, would smooth out interest payments[4]. There were occasional voices (such as that of Gladstone in his 1853 scheme) suggesting a variety of instruments, to better match the varying investment needs of various individuals. However, the weight of opinion was that with low transaction volumes, a single security was best, and "the sweet simplicity of the Three per Cents." was highly regarded. However, Woodham did not concentrate on this issue.

Here, finally, is the leader itself, in its entirety:

The proposals of the Chancellor of the Exchequer for consolidating or unifying the public Stocks of the kingdom received little encouragement from the financial authorities of the House of Commons, and are, perhaps, regarded with indifference or uncertainty by the country at large. It must, indeed, be admitted that the interest of the public in the scheme is but remote, for the charge of the National Debt will remain entirely unaffected by the results, and all that can be said is that any improvement in the popularity of the Funds must represent, so far, an enhancement of the public credit. We shall probably, however, be doing out readers a service by explaining more clearly the case as it stands at present, and as it will stand after the proposed changes are accomplished.

It may surprise some persons to learn that "the Funds," though pictured, no doubt, in popular ideas as a species of unity, are, in fact, of various descriptions. The three principal Stocks, representing, practically speaking, the whole National Debt, bear precisely the same interest—three per cent.—and rest on precisely the same security—the faith of the State; but they are, nevertheless, not only of different designations, but, what may seem more extraordinary, of different market values. About one-half of the entire Debt, or nearly [£400 million], stands in the Stock known as "Consols;" about [£200 million] in the "New Three per Cents.," and [£100 million] in the "Reduced Three per Cents." On all these Stocks interest is payable half-yearly—on Consols in January and July, on the other two in April and October. We have said that these Stocks, though to all appearances identical in value, do not carry the same price in the market; and the fact deserves, in its connexion with the whole question, to be carefully considered. At this moment, as the quotations of the Stock Exchange will show, Consols would cost [£92.625 for a notional unit of £100 nominal amount], while [£100] New Threes or Reduced would cost [£93]. This, at first sight, would imply that the smaller Stocks were the more valuable; but then it is to be observed that, whereas the dividend accrued on these since October 10 amounts to [£1], that on Consols accrued since January 5 amounts only to a fourth of that sum. If, then, we deduct this [£0.25] from the price of Consols, and [£1] from that of New Threes and Reduced, we shall find the net value of the latter to be [£92], and that of the former to be [£92.50]. This is precisely the calculation put forth by the Chancellor of the Exchequer; but in reality he understated his case. His own proposals have tended to improve for the moment the price of the smaller Stocks, which are often not merely [£0.50], but [£0.75] or [£1] cheaper than Consols. This superior value of Consols as a Stock is caused by the greater demand for it, and the greater demand for it is caused by its relative magnitude. The demand for Stock proceeds from two classes of persons—investors, who buy to hold; and jobbers or speculators, who buy to sell again. The latter class confine their dealings mostly to Consols, because there is a larger amount of the Stock in the market, and the area for operations is wider and more favourable. Thus the two smaller stocks, generally speaking, are in request for investments only, whereas Consols are in demand for investments and speculations too.

Mr. Lowe now purposes to effect two changes in the arrangements above described. He would make the dividends on Consols payable Quarterly instead of

Half-Yearly, and, this being done, he would make the alteration instrumental in accomplishing another—the conversion or absorption of the New Threes and Reduced into Consols, so as to leave only a single Stock remaining. His calculation is that a Stock on which the interest is paid Quarterly will be considered more desirable than one on which the interest is paid only Half-Yearly, and that the holders of the smaller Stocks will, therefore, be disposed to exchange them for Consols. But Consols, as we have said, are worth [£0.50] more than the others; so that the conversion, if unattended with charge, would seem to carry with it a "boon" to that extent. Mr. Lowe, therefore, proposes to ask [£100.25] of New Threes or Reduced for every [£100] Consols, thus splitting the difference, and leaving the converter with half the assumed gain. As the reader will discern, this proposal, whatever else may be thought of it, will operate as a test of the value set on the offer of Quarterly in place of Half-Yearly dividends. Mr. Lowe does not offer this advantage to the public creditor indiscriminately, but only to the public creditor who is a holder of Consols. If the holders of New Threes and Reduced desire the same convenience, they must pay for it at the rate of [£0.25] on every [£100] held. Will they approve that bargain?

It is obvious to remark that if one public creditor receives his interest Quarterly, another might expect to do so, and that a proprietor of New Threes or Reduced may well look to be put on the same footing as the "most-favoured" fundholder. If, however, this advantage were offered to the holders of the smaller Stocks gratuitously, it is clear they would be under no inducement whatever to convert their holdings, and, consequently, these Stocks would fail to be absorbed in Consols, and the scheme of unification would fail also. Mr. Lowe, therefore, employs one change as an instrument for producing another, and we should infer, accordingly, that his object is less than of accommodating the public creditor than of consolidating the Public Debt. What would be the advantage of such consolidation? Precedents for it there are, no doubt. The very name of "Consols" expresses a single Stock formed by the consolidation or amalgamation of several; the "New" Threes, in like manner, imply a change dating in reality from only a few years back; and the "Reduced" a certain abatement from a previous value. But, though it might be clearly convenient to have one Stock or three instead of a dozen or more, is it equally desirable to substitute Consols alone for Consols, New Threes, and Reduced? The proceeding would about double the present magnitude of Consols, and speculators, therefore, would find a magnificent area for plunging operations; but the cheaper and quieter Stocks in favour with Savings Banks, trustees, small capitalists, and other permanent holders, would be lost. At this point, too, there arises a further consideration. Mr. Lowe will only allow proprietors of the smaller Stocks to enjoy Quarterly dividends on condition of their becoming proprietors of Consols, and he will only accept them as proprietors of Consols on payment of a fixed premium. This condition he justifies by the increased value which their property would thus acquire; but it is to be observed that such value is only convertible value, and what is convertible value to those who have no desire to convert? As a rule, that would be commonly the case with the holders of the smaller Stocks, who, as we have said, invest for a permanency, and who would,

> therefore, in point of fact, be taxed for a privilege given to the holders of Consols for nothing. To take an example of possible inconvenience by no means imaginary, let us suppose that an investor of [£10,000] has divided it equally between Consols and New Threes. He receives, therefore, his income of [£300] by four equal Quarterly payments—[£75] in January and July from his [£5,000] Consols, and [£75] in April and October from his [£5,000] New Threes. Mr. Lowe now tells him that his Consols, but his Consols alone, shall be payable four times a year instead of twice; so that his income would be [£37.50] in January and July, and [£112.50] in April and October—the whole symmetry of his investments being thus deranged. Of course, he can regain the lost convenience by converting his New Threes into Consols, but for this proceeding, which would merely put him where he was before, Mr. Lowe would charge him [£12.50]. There is another circumstance, too, which seems to have escaped the recollection both of the Chancellor of the Exchequer and the Directors of the Bank of England. The New Threes became what they are in the year 1854 by the reduction of the interest on the Stock from [3.25%] to [3%]. At that time, however, a pledge was given that no further reduction of interest should be made before the 10th of October, 1874. This Stock, therefore, enjoys an exceptional privilege. Mr. Lowe might, without any breach of public faith, offer a holder of Consols to-morrow either his principal or [2.5%] interest, instead of 3; but this alternative he could not put before a holder of New Threes for five years to come. Of course, practically speaking, the advantage is not very substantial, but it exists, and it has been recognized by investors. What is to become of it in the scheme of conversion?
>
> We place these considerations before the public, as showing in what various aspects the proposed scheme may be viewed. As regards the Quarterly payment of dividends, though we dare say it is literally true that no fundholder ever conceived, still less expressed, any desire for such a change, it is certainly a boon, and must tend, however little may be thought of it at present, to enhance the popularity of the Funds as time goes on. But, as regards the consolidation or unification of the three principal Stocks, the advantage is less evident, and yet, except for the purposes of this consolidation, all Stocks could be made to yield their dividends alike, and a debatable question be avoided.

2 Other press coverage of Lowe's 1870 debt conversion proposal

This section considers some other coverage of the Lowe scheme. The reason for the intensive investigation of this incident is that it offers us at least a glimpse of how a wider spectrum of the population viewed gilts mispricing. Most of the information on this topic that has been gathered has come from newspapers and to a lesser extent from other periodicals, pamphlets, and books. It was therefore generated primarily by financial journalists. This is simply a reflection of the material that exists in easily accessible form, whether in print sources in libraries, or (increasingly) online. Eventually it can be hoped that we will obtain materials from diaries, personal correspondence, and internal government or banking documents. For the time being, though, our sources are heavily skewed towards financial journalists, and for long stretches of times those are the only sources that have been found

with any coverage on this topic. The Lowe 1870 scheme presents us with at least a small sample of other voices.

Even though we do find interesting passages in the contemporary press, and will surely find far more as more material is digitized, it is not much. But then we have to keep in mind that gilts mispricing was only a small part of more general financial policy discussion, and that one was also just a minor issue as far as the public was concerned. As usual, there were heated debates about Ireland, and other pressing issues occupying the press. For example, at the time of Lowe's proposal, a controversy erupted over an essay that Frederick Temple, then the Bishop of Exeter, and later the Archbishop of Canterbury, had contributed to a volume that was accused of heresy. The space devoted to this last topic in the press far exceeded that which covered all of Lowe's proposed measures.

It is also necessary to emphasize that there were many measures that Lowe was proposing. He was extremely energetic. This was welcomed by some. For example, the *Morning Post* complained that even reforming ministers, such as Gladstone, were far too prone to just follow tradition, and that it was good to have a newcomer reconsider everything:

> Mr. Lowe, who has been in no such position of apprenticeship to a guild, and to whom tradition spoke with no authority, has not unnaturally looked at the system of which he has taken possession from a different point of view, and examined and judged it with the eye and consideration of a stranger. The result, a natural and not undesirable result, is that within the short period which has elapsed since his accession to the post of Chancellor of the Exchequer, Mr. Lowe has presented new ideas and plans which in application are sufficient to constitute the elements of an administrative revolution[5].

However, that embrace of Lowe's initiative was rather unusual. Most press organs seemed to feel that he was rushing too fast and on too many fronts at once. Thus *The Times* claimed that "at times our admiration for his energy is greater than our relish for its results"[6], while the *Standard* was more caustic, in referring to "the six proposals concerning the public stocks which the too busy brain of the Chancellor of the Exchequer devised during the recess"[7]. Some went even further. The *Devizes and Wiltshire Gazette* claimed that "[a]ctivity of mind is certainly one of the characteristics of Mr. Lowe; but, even after a year's experience of his office, we fail to discern any mark of great ability in his new proposals"[8]. The feeling seemed to be that the good old English system was working, so why rush to change it?

Still, Lowe did propose that Parliament alter many things. (This was on top of changes he was able to implement by himself, such as publication of weekly statements of the government's financial position, a move that was heartily applauded by the *Economist* but criticized by others[9].) Much of the press commentary was about his other schemes, to reorganize the administration of the Mint, to change rules relating to Friendly Societies, to lower the interest paid on funds of savings banks, and so on. Even where gilts were concerned, he actually had a whole range of preliminary ideas ("the six proposals" cited above in the passage from the *Standard*) that he had sent for comments to the Bank of England and which were published. Although he abandoned most of those ideas, based

on the advice he had received, and presented only some to Parliament, much of the press commentary was about all of them.

All the London daily papers that were checked (*The Times, Daily News*, *Morning Post, Pall Mall Gazette*, and *Standard*) carried transcripts of Lowe's speech that included his mention of CA overpricing (cited in Section 1) the next day, Saturday, 12 February. Most of them also had leaders on the topic that day, or the following Monday. Provincial papers in general were very sketchy in their coverage. The *Bristol Mercury* and the *Glasgow Herald* of that Saturday, for example, seemed fairly typical in noting just that the House of Commons agreed to let Lowe "bring in a bill to amend Acts relating to the national debt" without saying anything about the planned amendments. Some did more, others even less[10]. The few substantive discussions that have been found were based usually less on Lowe's speech, and more on an examination of his correspondence with the Bank of England.

As one example, consider the *Lincolnshire Chronicle*. Like many provincial papers, it came out just once a week, on Friday. So the first occasion it had to cover Lowe's speech to Parliament was in its edition of 18 February, exactly a week later. In that edition, its summary of Parliamentary action of the preceding week mentioned briefly Lowe's savings bank measure, but said nothing about his gilts proposal. On the other hand, it had a long leader deriding the latter (as well as the earlier ideas he had had that he had abandoned, and his weekly publication of government data, which the editor predicted would only be "a powerful instrument in the hands of jobbery"). This provides some perspective on information diffusion in that age. Readers of the *Lincolnshire Chronicle* had to wait a week to get a brief and distorted account of what was being proposed. This was likely typical of many people in the provinces.

The *Lincolnshire Chronicle*, while typical in presenting little concrete detail, was very atypical in devoting substantial space to an evaluation of Lowe's scheme. The few papers that did this seemed overwhelmingly to complain, just like the *Lincolnshire Chronicle* did, of the £0.25 fee to convert RA or NR (although most did not make the mistake this paper did in stating the fee was £5.00, likely result of confusing shillings and pounds). Yet none of the provincial papers that were examined discussed the reason for the fee, namely CA overpricing. (One partial exception was the *Glasgow Herald,* which reprinted on 16 February the 15 February leader from *The Times* that was reproduced in Section 1.) They just took it for granted.

Most of the London papers also took CA overpricing for granted, even as they in most cases pointed to the conversion fee as an obstacle. The arguments varied, but were usually based on three main ideas:

- the £0.25 fee was small, but it would still be a deterrent
- most gilts holders were long term investors, and so would not be willing to pay even £0.25 now for a benefit they, or their heirs, would not see for years
- trustees had no legal way to pay such a fee

(*Freeman's Journal* in its 15 February issue had yet another objection. It suggested that few people would pay, since "it is assumed that if the practice of the quarterly dividend payments is introduced in the case of one description of stock, it will soon, on grounds of public convenience, be extended to all without the imposition of an exceptional fine on one

class of holders.") Even the *Money Market Review* and the *Bankers' Magazine* did not feel it necessary to explain or justify this overpricing[11]. The only exceptions found so far were the *Saturday Review*, which claimed that CA "bear a higher price than [RA and NR] solely because they are larger in amount, better known, and therefore more readily saleable," and the *Economist*, which produced a slightly longer argument with some analogies to justify the same conclusion[12]. The case of the *Economist* is interesting, as its financial editor at that time was Giffen, and its general editor was Walter Bagehot, the famous writer and economist. The discussion of Lowe's proposal in that issue was in a leader, so it is possible that Bagehot was its author. The argument of that leader is reprinted in Section 28.

The most extensive discussion of CA overpricing during this period that has been found is in the leader from *The Times* in Section 1, which was published on 15 February. It is rather curious that this paper had an earlier leader about Lowe's proposal, in its 11 February edition, published in the morning of the day Lowe presented his scheme to Parliament. It was based on the published version of Lowe's correspondence with the Bank of England, not on the official proposal. It also took CA overpricing for granted (although, possibly through a mistake by the printers, it mangled the exact terms for conversion). According to *The Times Editorial Diary* (again, as checked by the Times Newspapers Ltd Archive staff), this leader was written by Leonard Henry Courtney (1832–1918) [53, 85]. Courtney, like Woodham, was one of the core leader writers at *The Times*, contributing around 200 per year between 1865 and 1881. He was much more of an economist than Woodham, and (while continuing to write leaders) was a professor of political economy at University College London between 1872 and 1875. (Later he went into politics, and ended his life as Baron Courtney of Penwith.) Did Delane (the editor of *The Times*) feel dissatisfied with Courtney's treatment of Lowe's proposal and assign Woodham to provide a more thorough discussion? Or did he just feel it was appropriate to say more once Lowe presented a concrete scheme? We cannot tell based on available information.

One of the attractive features of the Lowe proposal is that the attention it attracted led to some letters from readers being published by newspapers. Thus we obtain commentary not just from journalists, but from a broader spectrum of society, even though this commentary was filtered by journalists.

One series of 6 letters by 5 writers that was published in *The Times* was a debate about the value of quarterly payments of dividends to investors[13]. That there should have been any debate about this issue can be taken as testimony to the lack of financial sophistication of the public. It is harder to understand *The Times* devoting so much space to it, though.

Of the letters that have been found, just one dwells on CA overpricing. Its author claimed:

> ... Although [CA] are by far the largest fund, owing to their comparative scarcity on the Stock Exchange, the price of [CA], allowing for the proportion of accrued dividend, is adventitiously higher than that of the other stocks by about [£0.50]. There is no essential difference in their nature or value. The issue of a new loan in [CA], or the proposed conversion to a partial extent, would at once equalize the values; or, what is more likely, unduly raise the value of [RA], as being the smallest fund of the three mentioned. As an agent for some large trust matters I shall not

> seek to exchange such stocks. ... [Parliament] should also encourage the Court of Chancery and trustees to invest in [RA and NR] ...[14]

Although this writer did not explain in detail his reasons for not converting, the Court of Chancery recommendation suggests awareness that this agency was singularly irrational in its investments (cf. Section 39) and that RA and NR were better investments.

The author of the letter cited above complained as well of the £0.25 conversion fee. This was an almost universal complaint in general press coverage, and also in Parliamentary discussions. Nothing has been found, though, pointing out that the additional value of quarterly payments being £0.375 (as emerges quite convincingly from those 6 letters in *The Times*) more than made up for this fee.

What did seem to arouse concern were minor technical details. Thus a writer to *The Times* complained that the Bank of England did not allow multiple accounts in the same gilt for the same individual[15]. Being in charge of two trusts, he kept one in RA, the other in NR, and his own funds in CA. That allowed him to avoid mingling those funds. With conversion to a single security, he would lose that convenience.

The trustee in the case above kept his own funds in CA, but did not say whether he was aware he was losing income that way, and was doing this in order to conscientiously carry out his duty to maximize the returns for the trusts he was in charge of. More likely, he just thought all the major gilts equivalent. This seemed to be the case of another trustee, who also complained of the Bank of England policy, as he avoided comingling the funds of the three trusts he was in charge of by keeping one in CA, one in RA, and one in NR[16]. There was no trace of awareness in that letter that the trust invested in CA was losing out compared to others. It was not losing much, but, as this writer noted about the Bank policy about allowable accounts:

> The difficulty I have indicated may be thought to constitute but a small grievance. Perhaps so; but it is just small difficulties of this nature that go far towards determining the popularity or the reverse of an investment, and any curtailment of present facilities may have the effect of ultimately damaging the popularity of the Funds.

The evidence presented in this section leaves us with a puzzling picture of the rationality of British observers of 1870. They almost universally obsessed over a minor fee of £0.25, even while many of them (but clearly only a minority) knew that it would provide a benefit of £0.375. They also, with the possible exception of one letter writer, did not think of the benefits of switching from CA to RA or NR. Yet, until a few months before Lowe made his proposal public, and also a few months later, those benefits came to about £0.75. Most of them seemed to accept CA overpricing as normal, and the few who apparently bothered to think about it did not think deeply, as they accepted patently inadequate rationalizations.

3 Robert Lowe and gilts mispricing in late 1869 and early 1870

The preceding two sections concerned the coverage of the Lowe gilts proposal that has been found in the contemporary press. Here we consider the market reaction not just to

the proposal, but to some of Lowe's other activities around that time. Fig. 1 shows the overpricing, CAm*-RA*, of CA, during the 5-month period from beginning of November 1869 to the end of March 1870. Daily closing prices were collected from *CoE*, and to overcome the clutter caused by the daily variations, a smoother curve, obtained with the *lowess* function in R, is used to show the main trends. The variation in CA overpricing that is visible in this chart seemed to go almost totally unremarked in the press[17].

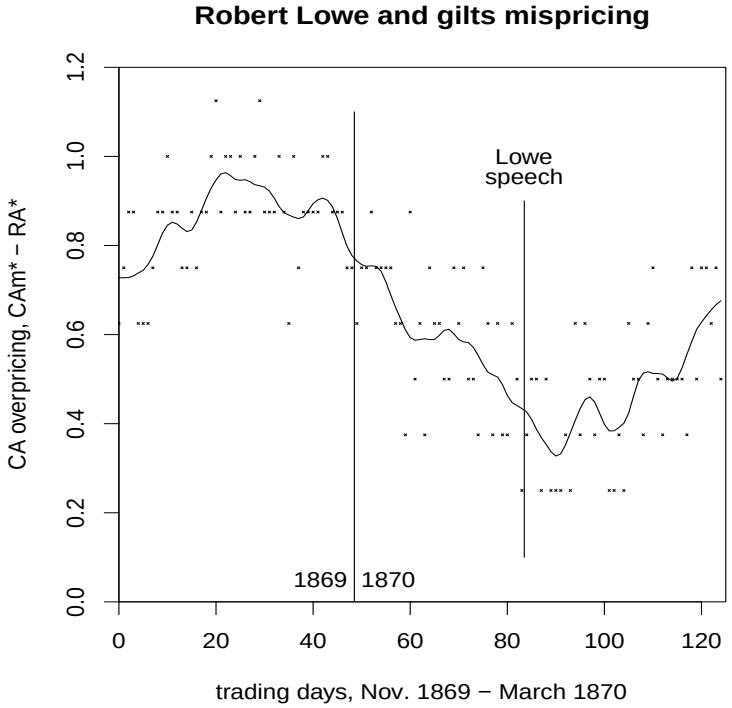

Fig. 1. Price differentials between CA and RA and NR around the time of the Lowe proposal in 1870. Points represent the overpricing of CA relative to RA, after adjusting for accrued interest, based on final daily prices in *CoE*. The solid line is a smoothed version.

Overall, that time was not only prosperous, but unusually placid. The "Great Victorian Boom" that started around 1850 was about to end, but it was still in full swing, with continuing rapid economic growth, and no serious political concerns. The financial column of *The Times,* in welcoming the New Year in the 1 January 1870 issue, wrote that "[a]t this moment there is scarcely a single feature to disturb the smoothness of the prospect. Everywhere the thought is only to hasten on material improvement ..." The financial markets reflected and contributed to this mood. The yield on CA between the start of 1869 and mid-1870 varied only in the narrow range between 3.218 and 3.284% [46]. The Bank of England discount rate, which had been lowered from 3% to 2.5% in the summer of 1869, went back up to 3% in November 1869, but then remained at that level until July 1870 (when the Franco-Prussian War broke out, in what had been a very peaceful Europe until

then). Financial journalists in the *Economist* and *The Times* often commented on the lack of speculation, especially in gilts.

One of the larger issues the markets seemed to be facing was trying to guess what financial instruments the government would use to raise the approximately £7 million needed to compensate shareholders in telegraph companies[18]. The money was to be paid at the end of January 1870. Lowe undertook a surreptitious operation[19]. Without any public notice, he sold £2.55 million (in nominal value) in CA on the Stock Exchange, £1.22 million (in CA again) to various government bodies, and then also picked up various cash balances from funds under government control[20]. Of the market sales, over 60% were accomplished in December, usually in amounts of £100 thousand per day when sales were made.

Since CA was overpriced, it was rational to sell CA, and not the other major gilts, to the public. Those sales might have been expected to lower the overvaluation of CA. On the other hand, to the extent that the other funds that Lowe took from various government accounts might have been invested in RA and NR (as opposed to CA), his activities might have served to increase this overvaluation. In any event, based on the experience of the far larger Crimean War loan of 1855, described in Section 19, a large effect was not to be expected as the amount of money was not large.

Fig. 1 does not show any substantial effects of those CA sales on CA overpricing for most of December. (Tables show there was no big effect on CA prices themselves, either, although that was disputed by some observers a short time thereafter, who claimed that in the absence of Lowe's sales of CA, gilts prices in general would have moved up[21].) But then, at the very end of December (which saw sales of £550 thousand in the last four trading days of that month) and throughout January, we do see a trend of declining CA overvaluation. It appears that the markets did not become aware of Lowe's sales of CA to the public until the gilts settlement day in early January[22]. Hence it is not clear what caused the decline in CAm* - RA* before Lowe's speech. It may have been the continuing sales of CA. Perhaps a more important reason (although this is speculation) may have been rumors of his proposals to convert all the major gilts into one security. He consulted with the Bank of England officials about his plans, and they, with his approval, consulted a number of eminent bankers and members of the Stock Exchange. Lowe's sketch of his proposals, addressed to the Bank of England, was dated 22 December 1869, and the response of the Bank was issued 25 January 1870[23]. It seems likely that information about his intentions was leaked.

In a rational world in which Lowe's proposal were expected to be enacted, CA overpricing would have settled at the 0.25 level. We see that level in the *CoE* data in Fig. 1 for the day of his speech, and thus before he officially revealed his proposal. This final decline may have resulted from wider public obtaining information about his thinking. On 10 February, the day before his speech, Lowe's correspondence with the Bank of England about possible changes to gilts was published. *The Times* in the 11 February edition called this correspondence "of great financial interest" in its financial column, and devoted a leader to analyzing it. It showed rather clearly what measures Lowe was thinking about, and in particular mentioned the proposal to charge RA and NR investors 0.25 to convert into the

new CA. Based on the daily closing bid quotes for gilts in *The Times,* the overpricing of CA over RA (and over NR, as RA and NR were quoted identically during this period) was at 0.5 from 7 to 9 February, and then dipped down to 0.375 on 10 February. The overpricing then stayed at the 0.375 level until 15 February, after which it dropped for a few days to 0.25. This was attributed in *The Times* financial column on 17 February to "an impression that the Chancellor of the Exchequer may probably forego the payment of [£0.25] required in his original plan for the Consolidation of the National Debt," with equivalent comments published in the financial column of the *Daily News* of that day as well. (Those comments seem to have caught the attention of provincial papers, as they were widely reprinted. Of course, if the "impression" were to be firmly believed, the overpricing should have come down all the way to zero.) But then it went back up to 0.375, and afterwards, as Fig. 1 shows, yet higher. The average for all of 1870 was about 0.7, about the same as during the preceding year. This was likely motivated by the unenthusiastic reception of the Lowe scheme, and the growing perception it would not be carried out.

This episode leaves many puzzles. However, it does seem pretty clear that the prospect of a conversion held out by Lowe did lead to somewhat greater market rationality than before, and that as this prospect faded, the irrationality grew back to its earlier levels.

4 British government and investors in general

British government was a sovereign borrower, and in principle could alter or abrogate contracts. It was not even restricted by a written constitution, nor by an independent judiciary. (The highest court of appeals was the House of Lords, and Lord Chancellor, the head of the judicial system, and the presiding officer of that chamber of Parliament, was a member of the Cabinet.) Under extreme circumstances the government did act extra-judicially. For example, after the bursting of the South Sea Bubble, Parliament decided by vote on the punishment to be dealt to various participants. In practice, though, Parliament was extremely careful to uphold property rights, and to treat its creditors fairly. Where the national debt was concerned, the government did engage in implicit strategic bargaining with investors, as was noted for the 18th century by Chamley [14]. Still, it did so very gently. It was widely thought that Britain emerged victorious in 1815 from more than a century of almost incessant wars with France, a larger and richer country, to a substantial extent because of ability to borrow huge amounts at relatively low interest rates. As was noted by one writer, "[t]he credit of Great-Britain for more than half a century has been, and still continues to be, greatly superior to that of any other European power, owing to the inviolable honour of our Parliament in keeping to their engagements with the public creditors of the nation. [This included paying interest on bonds owned by the rebellious colonists in North America during the American Revolution.]" ([55], p. 42).

In introducing his 1888 scheme for the grand unification of gilts, Goschen said (*The Times*, 10 March 1888, pp. 5-6):

> Mr. Goulburn, in the speech to which I have so often alluded [introducing the 1844 gilts conversion scheme], repeatedly spoke of the duty of the Government, as servants of the public, to make the best terms possible for the public but also to show sufficient

> tenderness in dealing with the creditors of the State so as not to injure the great engine of credit upon which all States must rely in times of trouble. It would be a great disaster if any proposals of this kind, though they might relieve us from a heavy burden, affected in any way the credit of the country, either for its honesty or for its power. (Hear, hear.) I believe that our present proposals are conceived in a sense of equity, both to the creditors of the State and to the taxpayers. (Hear, hear.)

In his response, Gladstone, at the time the leader of the opposition party, declared he was glad that Goschen's

> mind is fully alive to the principle which ought to govern his conduct, and to the great objects which he ought to have in view in seeking economy for the benefit of the State and the nation, but at the same time bearing in mind that economy can never be safely sought or satisfactorily attained if there be any forgetfulness of the principles of equity in the case of those with whom we deal as public creditors, and also bearing in mind the most fatal of all error undoubtedly which a Finance Minister or Parliament could commit–namely, the taking of any steps which would have the effect of lowering the standard of public credit in this country, or producing any uncertainty in the public mind as to the position which Parliament has maintained.

Thus there was vocal bipartisan support for fair treatment of investors. But it was more than words. Sometimes the British government "left money on the table" in debt conversions, by giving investors more than they were entitled to even under the most generous interpretations of the often ambiguous laws.

The 1844 conversion that created NR from four different 3.5% annuities was proposed by Goulburn on 8 March 1844, and enacted into law a couple of weeks later. There were no jumps or drops in gilts prices around the time of the announcement. This occurred most likely because Goulburn had consulted a variety of financial figures prior to formulating his proposal, and thus the markets were anticipating the terms of his proposed scheme. The press was overwhelmingly supportive[24]. The largest of the 3.5% annuities that were being converted into NR was N35. Its prices and those of CA from the period that included the Goulburn speech to Parliament and past the enactment of the necessary legislation and the deadlines for most investors to act are illustrated in Table 1.

Table 1. Gilt prices around the time of the 1844 conversion.

gilt	last price 1 March 1844	last price 12 April 1844
CAm	97.375	100.5
N35	102.125	104.125

The prices in Table 1 are the last prices recorded in *CoE* on those days, with CAm denoting CA "for money." Both CA and N35 paid interest on 5 January and 5 July, so on 1 March, valuations were about 96.9 for CAm and 101.5 for N35 without interest. On 12 April, we find that CAm was valued in the market at about 99.8, and N35 at about 103.3 (again after subtracting accrued interest). At that stage it was known that almost all of N35 was going to be converted into NR. The deadline for investors resident in the UK to demand cash instead of submitting to the default conversion to NR was 23 March. There was a complaint in the House of Lords about the deadline coming so soon, given the slow pace of passing the bill, with the Royal Assent not given until 22 March. However, this did not seem to be taken seriously, with *The Times* writing that the announcement of the measure by the Chancellor of the Exchequer, and its enthusiastic reception by Parliament, which guaranteed passage, were sufficient. *The Times* surely took this attitude because it did not expect anyone to opt for cash. It wrote that "no man will propose to accept [£100] for that which is worth [£102] and a fraction in the open market." In the end, there were 21 accounts in N35 and R35 held by UK residents, with holdings of nominal value £61 thousand, that did opt for cash, and later other claims for about £40 thousand came from overseas residents, an interesting exhibit of small-scale irrationality[25].

Based on the figures in Table 1, it is safe to say that investors in the 3.5% annuities received at least 2%, and perhaps closer to 3%, more than the nominal amount they were entitled to. That such a bonus was needed for holders of N35 and R35 annuities can be explained on the grounds of strategic bargaining. As is shown in Table 1 of the main paper, the volumes of these two gilts were extremely large, so holders of them could disrupt the financial system by not cooperating with the government. However, this argument does not apply to the other two 3.5% annuities that were converted at the same time into NR, the annuity of 1818, and an Irish annuity, which had about £10 and £15 million outstanding, respectively. Both were redeemable (although the one of 1818 required 6-months' notice), and each was small enough to redeem with money the government had at hand or could borrow easily. So there was no legal or practical reason to pay more than their nominal amount. Yet Parliament voted to treat them the same way as N35 and R35, and thus give them an extra 2-3%. Goulburn clearly felt such a move needed to be justified. He said in his proposal:

> It might certainly have been legally correct to have dealt separately with these several branches of Three-and-a-Half per Cent. stock; but I conceive that principle, in itself legally correct, would have been in itself essentially unjust. I did not think it becoming in a great country like this to take advantage of one or two smaller particular branches of Stock of smaller amount, and call on the proprietors who had invested their money in those funds to submit to a reduction which, from the smallness of the Stock, might more easily have been effected than on the whole. I, therefore, felt it my duty to bring a measure before the House, recommending, that the same rule should be applied to the whole, and that the reduction of interest should be made at once on all.[26]

No MP spoke in opposition to this proposal, showing the wide support for gentle treatment of public creditors. (MPs were overwhelmingly from the wealthy classes, while the British

tax system was highly regressive, so there was likely a dose of self-interest involved.) The cost to the taxpayers of this generosity to investors in the two small 3.5% annuities was at least £500 thousand, about 0.1% of the country's GDP at the time. That is equivalent to $15 billion for the U.S. or £1.5 billion for the UK today.

The 3.5% annuity of 1818, called here E35, is also discussed later, in Section 61. *The Times*, 11 March 1844, p. 5, in its financial column, reported a calculation by a broker that under the conditions of the Goulburn conversion, it was worth 1% more than the other 3.5% annuities because of the special rules for its redemption. This was disputed by other papers, and died quickly, as it was based on very imaginative interpretation of the law that created this annuity. Still, that some broker would make such a calculation, and that *The Times* would print it, does demonstrate the lack of clarity in rules about gilts, and fits in with the general picture that is drawn here of a market where most participants were very unsophisticated, and where even the most knowledgeable often lacked clear information.

Another interesting aspect of E35 is that in the runup to the Goulburn conversion proposal, it was trading at almost exactly the same price as R35. Both annuities paid 3.5% per year, on the same days in April and October, but the volume of R35 was about 7 times higher than that of E35, and R35 traded on the London Stock Exchange almost every day, while E35 was not traded on most days. So it seems that investors, with widespread expectation of redemption of all 3.5% annuities, were expecting E35 to be treated same as R35, and not have the Chancellor of the Exchequer drive a hard bargain.

While Goulburn in 1844 "did not think it becoming in a great country like [UK] to take advantage" of holders of smaller gilts, and insisted on treating them all the same, that was not always the case. In his generally unsuccessful 1853 conversion scheme, Gladstone offered voluntary conversion to holders of the major gilts. However, he wanted to close down the South Sea Company. This organization, the center of the South Sea Bubble of 1720, was at that time basically just a conduit for passing interest from the government to investors in several financial instruments. (Some of those instruments are discussed briefly in Section 61.) Gladstone therefore forced holders of the South Sea securities to choose between conversion into his new 2.5% and 2.75% annuities (with a bonus in the nominal amount) and cash redemption. Initial expectations, as judged by the coverage in the financial press, were that most investors would accept the proposal to convert. But then interest rates started to rise, and most holders opted for cash. This turned out to be a very profitable choice for them. By the time redemption took place in early 1854, interest rates had risen substantially, so the cash they obtained was worth about 10% more than the gilts they would have received had they accepted Gladstone's offer. However, that was just luck. For us the point is that in 1853, Gladstone did push through a different treatment of the holders of small gilts (which, in addition to the South Sea Company securities, included one administered by the Bank of England).

With time, the government did chip away at some of the rights that investors thought they had. It was widely thought that the major gilts had to be redeemed in their entirety. But the language of the law was highly ambiguous, and in the introduction to his conversion proposal of 1888, Goulburn went at some length, with citations to numerous historical precedents, to justify the claim that redemption could be accomplished piecemeal, at the

government's convenience. Perhaps as a result, while investors got a 2-3% bonus in the 1844 Goulburn conversion, in 1888 they received only about 1% (if one compares the price of CA after the Goschen scheme was published, after subtracting accrued interest, to the nominal value). Apparently the first move to change the public perception of redeemability was made in 1884, during the Childers conversion. It is the subject of Section 24, and it shows some interesting features of the interaction of the Chancellor of the Exchequer, Parliament, investors, and markets. But we first consider some earlier periods in 19th century British financial history.

5 Contemporary views on gilts mispricing

Later sections have detailed discussion of press coverage of gilts mispricings during various episodes. This section presents a brief overview of the entire period 1823–88 that was studied in this project.

5.1 Early expectations of rationality

The regular relation of CA and RA prices, which was to be expected in an efficient market, was also understood to be natural, and typical, in the early 19th century. Thus, for example, a pamphlet published in 1806 by Robert Wade, a member of the London Stock Exchange, mentioned that in principle one should compute the accrued interest exactly, but in practice it sufficed to add or subtract £0.75 from the price of RA to get the equivalent price of CA ([94], pp. v–vi). A few years later, Robert Hamilton wrote in 1814 ([36], p. 250) that

> [t]he price of Stock [i.e., any of the gilts], therefore, rises gradually, *ceteris paribus*, from term to term, and when the dividend is paid, it undergoes a fall equal thereto. Thus [CA] should be higher than [RA] by [£0.75] from 5th April to 5th July, and ..., and this is nearly the case. Accidental circumstances may occasion a slight deviation.

This was also noted in [10], p. 29; [13], pp. 59–60; and [75], p. 8 of "British Funds" section.

While there seemed to be a general expectation of rationality in pricing in early 19th century, there were also claims of relatively frequent irrationality. The 1832 volume [47], which was widely circulated because of its sponsorship and low price, noted (pp. 92–3) that "since men are usually too clear-sighted in matters of pecuniary interest to be carried away by blind partialities" it was surprising to find mispricings among gilts. Yet it noted that this was common, as "[CA] almost invariably bears a somewhat higher price in the market than [RA]." (Various rephrasings of this passage were reprinted in other publications, for example in [96], pp. 324–25.) A similar passage occurs in a publication from 1836 that is cited in Section 29. Those passages may have been inspired by earlier experiences. This study is based on price data from 1823 and later, and finds essentially fully rational pricing in the period 1823–30. However, some preliminary inspections of fragmentary data sets from earlier periods do show frequent mispricings. (This includes some rare cases where RA was overpriced relative to CA, such as that of August 1787. As is shown in the tables, RA was rather consistently overpriced, by an average of £0.29, over a period of about 7 weeks then.) But this leaves us with a puzzle, namely that of the Hamilton and Wade quotes, which reflect no awareness of such mispricing.

5.2 Transition from rational to irrational pricing

The first occurrence of CA overpricing that was discovered in this project was in 1831, and a few press mentions of it were found. They are cited in Section 7. They came a few weeks after the overpricing reached noticeable levels, and treated it as an abnormal phenomenon that was bound to be quickly eliminated by arbitrage.

After 1831, relatively few press notices of gilts pricing anomalies were found until the Railway Mania of the mid-1840s. This may very well reflect the still low degree of digitization of 19th century British press as well as the inadequacies of OCR and search tools. But it may also reflect the still small size and lack of sophistication of financial journalism of that period. The Railway Mania led to a change, as the increase in the number of tradeable securities and of invested capital led to much more detailed and deeper coverage of financial markets. It is rather noteworthy that no comments about the mispricing of N35 as compared to R35 have been found so far anyplace in the press. However, the relatively low levels of major gilts mispricing during this period may also have contributed to the lack of coverage.

A substantial number of references to gilts mispricings have been found during the Railway Mania, including several sustained campaigns by financial journalists to alert their readers to the profitable arbitrage opportunity. Many of them are discussed, with their contexts, in later sections. In the early 1850s, major gilts were rationally priced, and no discussions of pricing anomalies have turned up in the press. Then, starting in early 1854, CA becomes overpriced again relative to RA, and we find some press coverage of it. Several sections discuss what happened during some special periods. But there was coverage elsewhere as well. Here is a sampling of citations that were found just in London daily newspapers. They were not very frequent. Still, they do show that the public, in addition to seeing the discrepancy with their eyes in almost every issue of every newspaper for much of the time, in the price quotations, was getting explicit alerts from financial journalists. In essentially all the cases that were discovered, the journalists either wrote explicitly, or implied, that they found the pricing anomalous, and exchanges of CA for RA or NR, or purchases of the latter, of advantage to investors.

All the quotes below are from the financial column (usually labeled "Money market and City intelligence") in each paper:

- *Daily News,* 24 June 1854: "We hear of numerous exchanges from [CA] into [RA and NR], the latter stocks, after computing the accruing dividend, being relatively cheaper than [CA]."
- *Daily News,* 24 Feb. 1857: "It is noticed that [NR and RA] are now relatively cheaper than [CA], after making allowance for the dividend accrued."
- *Daily News,* 23 April 1858: "The government broker continues to make small investments in [RA], that stock being relatively cheaper than [CA], at present prices."
- *The Times,* 29 May 1858: "... [RA and NR] are considerably below their proper value relatively to [CA], and an advantage may be gained by changing from [CA] into either of them."

- *Morning Chronicle,* 1 Dec. 1858: "It may not be out of place to notice that [RA] is relatively cheaper than [CA]. Investments can, therefore, be made with more profit to the investor in [RA] than in [CA]."
- *Daily News,* 21 Nov. 1859: "The disproportion between the prices of [CA] and that of [NR and RA] continues to attract attention. The difference, after allowing for accrued dividend, amounts to upwards of ..."
- *The Times,* 11 June 1860: "[RA and NR], which carry more than two months' dividend and are disproportionately below [CA], were firm at ..."
- *Morning Post,* 23 Jan. 1863: purchases of gilts "appear to be principally confined to [NR and RA], they being cheaper than [CA] and more advantageous to investors."
- *The Times,* 1 Jan. 1864: "... [RA and NR] ..., both these stocks being [£1.25] below [CA], although a dividend will be paid upon them in April, and [CA] will have no fresh dividend till July."
- *Morning Post,* 14 Nov. 1865: "[RA and NR] being still somewhat cheaper than [CA], purchases are made in those stocks in preference to [CA]."
- *Pall Mall Gazette,* 4 May 1868: "... in consequence of the accrued interest upon [RA and NR] making them relatively cheaper than [CA] at ..., a rise ... was established."

An interesting case where we can infer awareness of the customary relation between CA and RA prices breaking down involves an investment guide. The 13th edition of [24], published in 1833 and edited by J. J. Secretan, did not say anything about relative pricing of CA and RA, but treated them as equivalent, as in the claim that (p. 27) "[CA] and [RA] always bear a greater price in proportion to the other stocks or funds, on account of the magnitude of their capitals, and of the transactions which are constantly doing in them." The 14th edition of this book, published in 1838 and edited by John Field, Jr., did note that CA was "most commonly selected by speculators for their operations." However, this book implied RA was on a basis of equality with CA, differing basically only in dividend dates, and that "[i]ts price is regulated by that of [CA], it being generally [£0.75] higher or lower (according to the time of year) than that [of CA]." Note that this was not correct for much of that decade, so Field either was not aware of what was going on in the market, or thought CA overpricing was too small to bother discussing. The next, the 15th, edition of this work was published in 1850, and was edited by David Morier Evans, one of the most prominent and respected financial journalists of that era. On the pages devoted to individual gilts, Evans used, *mutatis mutandis,* the exact pattern of the previous 1838 edition, usually just changing the figures for total capital of each gilt. On the RA page, though, he also dropped the line about the relation in price between CA and RA. (He also did this in the 16th and 17th editions of 1851 and 1856, the 17th being the last one in that series.) He did not do it from need for brevity, as there was plenty of unused space available on that page. But he must have noticed the old language was not accurate any longer, so he deleted it. Unfortunately he did not make any comment about this. It would have been very interesting to learn what he knew and thought about CA overpricing. Evans was also the financial editor of the *Standard* when Lowe came out with his debt conversion proposal in 1870 (see the first three sections), but nothing has been found in that paper in that period about this phenomenon.

5.3 Later acceptance and explanations for irrational pricing

By the late 1860s, there seem to have been fewer mentions of CA overpricing, although it is hard to be certain until more newspapers from that period are digitized, and search tools are improved to the point that we can make reliable quantitative estimates. It appears that the pricing anomaly became accepted as normal, and a variant of the standard rationalization for it was cited from time to time. For example, a popular arithmetic textbook noted (citing its 6th edition of 1881, p. 333 of [12], although the same or similar passage appeared also in the first edition of 1872) that "the price of [RA and NR] ought therefore to be always the same, but ought to differ from that of [CA] either in excess or defect by [£0.75]: but owing to the comparative scarcity of [CA] on the Stock Exchange, their price is adventitiously higher than that of [NR and RA]."

Similar, and similarly questionable, views were shared by financially sophisticated government officials. In his account of the Goschen conversion, Hamilton ([35], p. 6) included a table of average prices (adjusted for accrued interest) for CA, RA, and NR for each month from January 1887 to February 1888, and noted that the prices of CA were slightly more than 0.25% higher than those of the others:

> This superiority, which was the normal characteristic of [CA], was due to their being the largest stock, and consequently offering a more ready market.

A couple of years later, an official government report made a similar claim, although it tossed in the qualifier "perhaps" ([92], p. 127). Others were also uncertain. Goschen, in presenting his conversion proposal to Parliament in 1888, was clearly unsure of the cause of the disparity, but put the greatest weight on "the fact that [CA] is the great stock." (See Section 25 for an analysis of what he said and what he probably meant.) Similarly, as was shown in Section 1, when in 1870 Robert Lowe, the then Chancellor of the Exchequer, proposed another conversion of the gilts, he said that RA and NR were underpriced relative to CA, "probably through being a smaller amount." As with Goschen, it is not clear whether he thought it was a case of pure irrationality, or, probably more likely, as the *Economist* claimed in February 1870, that the liquidity argument applied. It is probable that neither Goschen nor Lowe bothered to think deeply about the subject, it was simply not very important for them.

Still, even during this period, one does occasionally find quotes such as these:

- *The Times,* 19 June 1876: "[NR and RA] being relatively cheaper than [CA], ..."
- *Daily News,* 15 June 1878: "[NR and RA] were also pushed down ..., being now ..., and having regard to the accrued interest are cheaper than [CA]."
- *The Times,* 23 June 1880: "A certain amount of changing from [CA] into [NR] is taking place, the latter stock, which remains steady, having been permitted to fall relatively below the former in price."
- *The Times,* 30 April 1884: "We understand that a few exchanges of [CA] into [RA] were made, as the latter are rather the cheaper of the two."

Usually these are short quotes, and do not explain what the financial journalists responsible for them were thinking. However, even if they accepted the standard explanation for CA

overpricing, it remained the case that RA and NR were less expensive than CA. Hence for long-term investors, such as trusts, it made sense to put their money into RA and NR. Those journalists may have felt it was a worthwhile public service to point this out to their readers every once in a while. Their attitude may be similar to those of modern journalists towards tobacco. They don't spend a lot of effort talking about all the harm that smoking does. It is not illegal, and generally speaking most people are aware it is bad for their health. But every once in a while, when a new study documenting additional harm from smoking is published, or a campaign is being waged to pass laws restricting smoking in public places, newspapers will provide some coverage of the topic. Similarly, the Victorian financial journalists may have felt that occasionally, prompted by space they had to fill, or some comment from a broker or investor, it was worthwhile reminding their readers that they were wasting their money by keeping their long-term investments in CA. However, this is speculation, we do not know what the motivations of those writers was. An example of this type is presented by an item from 1874 in the *Financier*[27]:

> The difference in the price of [CA] and [RA] and [NR] is a standing Stock Exchange anomaly. At the same time it cannot be too often pointed out to intending investors in the English Funds, or to those who hold [CA] and who wish to continue to hold English Government Stocks. At present the difference in the prices is [£1.75], and of this [£1.00] is not warranted by facts. The net difference should be only [£0.75].

A few contemporary observers have been found who clearly thought about CA overpricing and decided the standard explanation was not adequate, and that this phenomenon was the result of irrational mass psychology. They are discussed in Section 29. Perhaps the most interesting among them was Giffen, who is covered in Section 34. In 1877 he seemed very skeptical of the standard explanations that were offered for the observed mispricing. But as time went on, though, even he seemed to accept the consensus view. In a speech prepared in 1899 (thus over a decade after the mispricing went away as a result of the Goschen conversion), he wrote ([32], vol. 2, p. 193):

> It was noticed at the time when English Government securities were divided into two large classes, one [CA] and the other [NR and RA], that although these two stocks were identical in every respect in their conditions, yet the fact of the speculative dealings being in [CA] permanently raised the price about [£0.50 to 1.00] above that of [NR and RA], which was identical in every respect except that of being called by [a different] name.

6 The turbulent but economically rational (with regard to gilts) 1820s

Fig. 2 shows that relative CA and RA pricing followed almost perfectly the theoretical predictions from the start of 1823 to the end of 1830. If we compare the interest rate environment of this figure with that shown for 1831 through 1844 in the main manuscript, we find far less variation in short-term rates in the 1820s. However, this may be a reflection

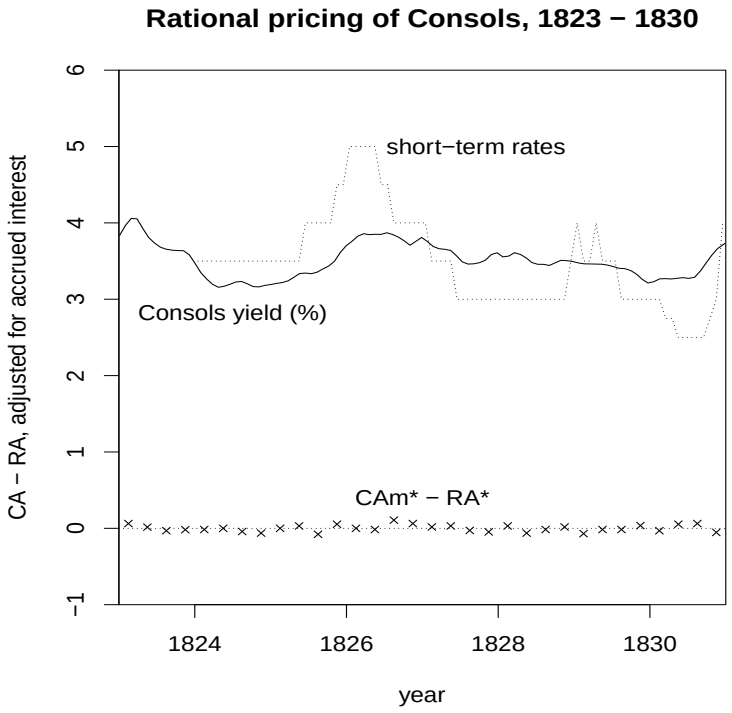

Fig. 2. Price differentials between CA and RA from 1823 to 1830, with the scatter plot showing the averages for Friday closing price differentials, after adjusting for accrued interest, for each of the four periods each year that both CA and RA were trading, in pounds sterling for each £100 nominal unit. Also shown is the market yield on CA and short-term interest rates (only for 1824–1830), in annual percentage rates.

of a less-developed money market. (See Section 48 for a discussion of data sources.) CA shows substantially more variation.

From the standpoint of the British public, 1820s were far more turbulent economically, largely because of the great investment mania of 1824–25 and the crash that ended it. This mania was frequently cited during the rest of the 19th century as representing the height of irrationality. In the words of a literary scholar investigating how 19th century fiction writers responded to the changing economy and its effects on society ([77], p. 48):

> There were other commercial crises in the nineteenth century, but none so devastating, dangerous, and alarming in the public mind as this speculative convulsion. It was to be remembered throughout the century with the same intensity that its famous ancestor, the South Sea Bubble, had created in the minds of those who had either lived through it, or heard of it as part of national folklore. Victorian economists and chroniclers of business would in their own writings hark back to that period, which to many was still within living memory, and describe its progress in a style very similar to that of a novelist.

Unlike the South Sea Bubble, the mania of the mid-1820s did have serious disruptive effects on the economy, stretching over several years, with many business and banking failures. Yet while the price of CA did plummet in 1825, and then recover, throughout this period the relation between CA and RA followed the economically rational rule.

It should be mentioned, though, that the peak of the crisis occurred in mid-December 1825, at a time when CA was "shut," so we don't have price data for CAm. Prices of CAa and RA did diverge, but this to be expected, CAa prices were for transactions that were to close on 19 January 1826, by which time some resolution to the crisis was to be expected. As usual, the tables have all the data.

Further investigation of gilts prices in the 1820s should include earlier periods, and consider in some depth the operations of Pitt's Sinking Fund [92]. From 1786 to 1829, this government fund repurchased gilts on an almost continuous basis even when it was necessary to borrow to do it (with borrowing coming in large tranches from time to time). The operation of this fund may have been important to preserving rational pricing in the 1823–29 period. However, as was mentioned in Section 5.1, there were frequent periods of gilts mispricing, including RA being overpriced, even while this Sinking Fund was in operation, so this is not the complete explanation.

7 Rational expectations, irrational pricing, and the press in 1831

Some interesting insights into gilts pricing and the contemporary financial press can be obtained by considering the first occurrence of noticeable overpricing of CA relative to RA that was detected in this investigation. It occurred in early 1831, and was not very substantial. It became serious only in the second period that year when both CA and RA were trading, during the 49 trading days between 6 April and 2 June. Excluding the one day during this period when *CoE* does not report any price for RA, the average overpricing of

CA (as based on each day's final trade recorded in *CoE*) was just £0.216, and the maximum was £0.375. (This included two days when RA was overpriced relative to CA, by £0.25 in both cases, likely just inconsequential blips caused by special circumstances or timing of sales close to the deadline for reporting.)

This brief interlude was part of a very turbulent period. In continental Europe, the French Revolution of 1830 was just one of many political and military conflicts. In the UK, there was a brewing political crisis, accompanied by civil unrest, that eventually led to the Reform Act of 1832. In the fall of 1830, the gilts market started a precipitous slide. Between mid-1830 and March 1831, CA fell almost 20%, even more than during the financial collapse of 1825-6. The trough was reached in mid-March 1831, and was followed by substantial recovery, with a gain of about 6% in April and May. However, this two-month period was full of substantial oscillations, usually blamed either on internal politics related to the reform question, or events on the Continent.

Just as during the 1825-6 crisis, most of the slide in gilts prices in late 1830 left no visible effect on the relative pricing of CA and RA. In early 1831, after CA started trading again on 6 January, some overpricing of CA began to appear. However, it was only during the second period, in April and May, when gilt prices were moving up very rapidly, that this mispricing more than doubled and became noticeable. The financial column ("City article") in *The Times* said nothing about any CA vs. RA mispricing until the very end of May. On 19 May, it mentioned that "[in RA] there is supposed to be a large surplus of stock in the hands of the jobbers, and interest at the rate of 3 per cent. has been paid for loans on that security." Then, a few days later, associated with a CA account settlement, there were insolvencies among speculators, the largest of whom had sold short around £1 million of gilts. Around this time *The Times* noticed that CA and RA were in an irrational relationship. Thus on 25 May it wrote that

> though money stock in [CA] is scarce, as this circumstance implies, there is a good supply of every other description of money stock. Interest at about [3%] can be obtained on [RA and some other gilts and short-term financial instruments] while on [CA] money can be obtained without any interest at all. This has an influence also on the value of the stock, [RA] being about [£0.25] cheaper than [CA].

The next day, the account day, *The Times* claimed, in a passage written the night before:

> The fluctuations during this account have been very considerable, and been attended also, on the whole, with a great advance in prices; the losses sustained by the speculators for the fall have been enormous, and the scarcity of stock very remarkable during its continuance. Money could always be obtained on [CA] without interest, ... This was the effect of the speculations which take place almost entirely in [CA]. ... This distinction cannot, of course, last long, because its effect will be so to raise the price of [CA], and to depress in proportion that of the other [gilts], that it will be worth while for the holders of [CA] to change the investment, which will at once bring the supply into the market which is now wanted, and again equalize prices. At present there is an advantage of full [£0.25] by transferring from [CA] into [RA], bearing the same interest and of course having precisely the same security. This will

> not in itself alter the state of money, but will merely make it equally high in value as regards the security of [CA], and that of the other stocks.

A week later, on 3 June, as [CA] was to be "shut," *The Times* noted that "[t]he difference in value between [CA] and the other stocks has thus been equalized earlier than could have been anticipated."

What we see in these passages is an expectation that CA and RA will be priced in economically rational ways. Occasional departures from rationality might be caused by special events, such as large speculators going broke, but would be quickly resolved as other players took advantage of the pricing anomaly. This attitude can also be seen in the coverage in the *Morning Chronicle* (which was checked only for the period around the crisis at the end of May 1831, it may have covered the mispricing earlier as well). On 26 May, it wrote about the previous day's trading:

> [RA] were particularly heavy to-day; the difference of price between them and [CA] does not usually exceed [£0.75], but this afternoon it amounted to [£1.125]. It is to be remarked, however, that [RA] have been heavy for some time past, although there does not seem sufficient reason for the present discordance. Many parties availed themselves of it, and exchanged [CA] for [RA], and it is expected, that when the account has been settled, matters will return to their relative position.

Two days later, it noted that its prediction was close to being fulfilled:

> The difference between the prices of [CA] and [RA], has not to day amounted to more than about [£0.125, after adjusting for accrued interest], matters having nearly resumed their usual level. Yesterday, it will be remembered, the difference between the two was [£0.375 after adjustment].

The author of the passages cited from *The Times* was almost surely Thomas Massa Alsager, the long-time financial editor of that paper, and one of the earliest and most respected financial journalists [53]. That both he and the *Morning Chronicle* writer expected rational pricing is undoubtedly a reflection of the market behavior over the previous decade, as well as basic economic logic. What is very interesting is that both writers regarded the overpricing of CA as a short-term anomaly caused by speculative moves. However, it had been in existence for much of the preceding two months; RA was cheaper than CA by the £0.25 noted by *The Times* on 25 May for most of that time. This is visible in the tables prepared for this project, and it was visible in every edition of their papers. (During this period, in addition to the verbal commentary of the "City article," *The Times* printed each day the closing quotes of gilts at 4 pm the preceding business day, while the *Morning Chronicle* printed actual gilts trades, just like those of *CoE*. The overpricing shown by the closing quotes is similar to that in the tables, which are based on *CoE*.) This can be regarded as another indication of people seeing only what they expect to see. To some extent it could also be ascribed to the low level of coverage of financial news by the press (a topic discussed elsewhere), where a single person had to cover many active commercial and financial markets, and could not pay much attention to most topics.

In May 1831, when they apparently first observed CA overpricing, both *The Times* and the *Morning Chronicle* writer expected a speedy return to rational pricing. When it

refused to arrive, the natural human tendency to rationalize appears to have asserted itself. In August of that year, we find *The Times* writing:

> There is an advantage, in the present state of the Stock-market, in investments in [RA], compared with [CA], of about [£0.25]. This ought to be generally known, as the difference is worth something; the rate of interest and the security being of course precisely the same. This would imply, and such, we believe, the fact, that [CA] being the stock to which the time bargains are wholly confined, have been raised by speculation above their proportionate value[28].

This argument, that CA was worth more than RA because it was preferred by speculators, became the standard one from that point on. Sometimes, as in the passage above, it was supported by the observation that only CA was traded "for account." In other cases it was the larger size of CA that was cited as the reason. We should note, though, that although the *The Times* writer accepted this argument as a plausible explanation for CA overpricing, this writer wished to emphasize that RA was less expensive, and so a better investment.

The tables show that during the April and May 1831 period there was also substantial growth in the gap between N35 and R35 prices. This could be ascribed to the advantage N35 had in not being redeemable until 1840. (Note that the relative pricing of CA and N35 clearly shows expectation of a substantial probability of redemption of N35. If both CA and N35 were irredeemable, N35 should have been 16.7% more expensive than CA. Yet even at the trough in the gilts market in March 1831, N35 was priced only about 12% above CA.) But the variation in the relative pricing of N35 and R35 as time went on and prices increased in general, thus making redemption more likely, do lead to some questions that we leave aside for the moment. However, it should be mentioned that neither N35 nor R35 traded "for account," so the explanation for CA overpricing put forth by *The Times* in August 1831, quoted above, did not apply here. It is also worth remarking that no discussion of N35 overpricing relative to R35 has been found so far in any of the sources that were investigated.

8 The slightly irrational 1830s and early 1840s

The tables and the figures in the main manuscript show that a low degree of CA overpricing prevailed from 1831 until almost the end of 1842. However, it was low, generally too low to make it worthwhile for outside investors owning CA to switch into RA. There were also extended periods of essentially perfectly rational pricing. (N35 overpricing relative to R35 was generally higher, and more persistent, but we leave that aside here.) The literature for this period was not searched intensively, but a few interesting snippets did surface, which illustrate again the tendency of even professional observers of markets to accept and rationalize whatever happens there, however irrational. The tables show CAm* and RA* about as close to each other as one could hope from mid-1838 to mid-1839. But then, in July 1839, CA overpricing reappeared. (This was a turbulent period, discussed in a bit more detail in Section 26.) This surprised the editor of the financial column of the *Spectator*:

> [RA] have been heavy, in consequence of extensive sales; and the proportion between this Stock and [CA] was less than usual, the real difference in value between the two

> Stocks being that of the dividend due upon them, vis. [£0.75]; and as [RA] have three months more dividend upon them than [CA], that Stock ought to be [£0.75] higher than [CA]; yet the difference between them has only been [£0.50], and on Wednesday it had fallen as low as [£0.375], but is to-day again [£0.50][29].

The level of CA overpricing that surprised this writer became common for the next few years. Then it vanished in late 1842. As the tables show, CA was slightly but rather consistently overpriced up until trading in RA was "shut" in September of that year. Once trading resumed on 11 October 1842, this overpricing reappeared, but only for three days, and then basically disappeared, and on some days, CAm* - RA*, based on closing prices from *CoE*, was even negative to the very minor extent of £0.125. The writer for the *Spectator* found this surprising. The 22 October 1842 financial column had this to say:

> The only remarkable circumstance has been the increase in the value of [RA] as compared with [CA]. From the more speculative nature of the latter Fund, its market value is generally greater in proportion than [RA]. The difference between these two descriptions of Stock ought always to be [£0.75], one of them having invariably that amount more of current dividend due upon it than the other thus: ... However, from the fact of all the speculative operations, being confined to [CA], this Stock generally bears a higher value than [RA], the difference in price being generally ... in other words, [CA] are commonly [£0.125 or £0.25] dearer than [RA]. So great, however, was the demand for the latter Stock yesterday, that this proportion was reversed, and at one period of the day [CA] were [£0.125] cheaper than [RA]: ...

It is not known if this was the same writer who was surprised by the appearance of CA overpricing in July 1839 (nor whether it was the one surprised again by another re-appearance of CA overpricing in April 1846, see Section 10).

The financial columns of *The Times* and the *Morning Chronicle* between 11 October and the end of that month were inspected, and the only one that even hinted at anything unusual in the relation of CA and RA was the one in the former paper on 21 October, which claimed that "[t]he market for [RA] is supposed to have been favourably influenced by the conclusion of a large bargain entered into a few days ago, which now, by the delivery of stock increasing the scarcity, has sent up quotations to the point at present held." This passage does suggest that there was something special about the price of RA, but does not say explicitly what this was. The fact that neither *The Times* nor the *Morning Chronicle* wrote about CA overpricing is likely a reflection of the low significance they attached to the issue. That the *Spectator* mentioned it does show, though, that this topic was paid attention to in financial circles.

The prices for the 44 trading days between 11 October and 1 December that are bracketed by the gilts "shuttings" do have some puzzling aspects. There were extensive speculations in the press about likely reduction of interest rates on gilts, especially the 3.5% annuities, with many predictions that it would happen the next year. (As it turned out, it took until 1844 for this to be carried out.) This is consistent with the observation that the prices of CA and RA rose substantially, while those of N35 and R35 barely moved, if we adjust for accrued interest. But then why did the overpricing of CA relative to RA

disappear, while that of N35 relative to R35 remained essentially constant (although low at £0.125)? There is also a rather suspicious circumstance that of the 44 values of N35* - R35* during this period, 34 are exactly £0.125. On most days, *CoE* does show at least two prices for each of N35 and R35, but on those 34 days the final trades are exactly £1.00 apart.

9 The economic environment of 1845 through 1854

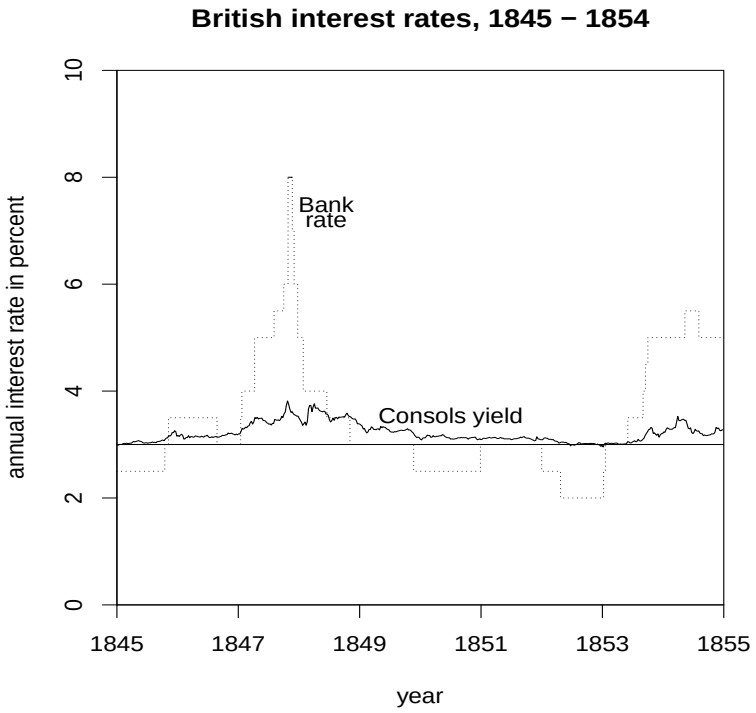

Fig. 3. British government long-term bond interest rates, 1845–55.

The next few sections, as well as the section "The glaring NR pricing anomaly of the late 1840s" of the main manuscript, deal with the period of the mid-1840s to mid-1850s. This section provides some background on that decade.

Fig. 3 depicts the interest rate environment during the decade of 1845 through end of 1854. It shows the market yield on CA, and the Bank of England rate of discount (see Section 48). This was the well known period of explosive growth in equity investments in the UK, caused by the Railway Mania.

In 1844, as the British economy was recovering from the severe depression of the early 1840s, market yield on CA (and RA) slipped below 3% for the first time in about a century. This decline in interest rates led to the creation of NR through reduction of interest on several 3.5% annuities. The low interest rates persisted into early 1845, and

were then succeeded by a multi-year rise, usually ascribed to a combination of Railway Mania speculations and investments, poor harvests (starting with the one in the fall of 1845, and followed by the disastrous one of 1846, which caused most of the deaths of the Irish Famine), and a depression in most of Europe. In the spring of 1847, there was a small financial panic with a temporary jump in interest rates. This was followed by the severe panic of October 1847, when the highest peak visible in Fig. 3 occurred. This panic was resolved by the suspension of the gold standard, and led to a substantial decline in interest rates. However, this decline was reversed by the outbreak of the French Revolution in late February 1848, leading to the second highest peak (in CA yield) in Fig. 3. The upheavals in continental Europe continued well into the 1849s, but the French situation stabilized fairly quickly, and the threats of armed strife in Britain itself receded with the fizzling of the Chartist rally at Kennington Common on 10 April 1848. Contemporary news reports cited large inflows of "flight capital" from Europe to Britain in the summer of 1848, reinforcing the decline in interest rates. Afterwards there was a gradual economic recovery, interrupted by a small railway share panic in the fall of 1848 (cf. [63]), and then the giant collapse of railway shares in 1849, which brought the Railway Mania to its close. The years 1850 through 1853 were ones of rapid growth and great prosperity, and the optimistic public view was heavily colored by the gold discoveries in California and Australia. The end of 1853, though, saw the beginnings of a rise in interest rates, which is usually attributed both to faster economic growth and to the fears of the spread of the Crimean War, which broke out at that time.

10 Rational expectations, irrational pricing, and the press in 1845–46

The relative pricing of CA and RA appears to have been essentially fully rational from late 1842 to early 1845, a period of declining interest rates. In the spring of 1845, as the Railway Mania was entering its manic phase, significant overpricing of CA started appearing, initially rather sporadically, and then more persistently. But it was still regarded as exceptional. The rare mentions of it in the press that have been found so far invariably portray it, implicitly or explicitly, as something temporary. On 17 May 1845, the *Manchester Courier* reprinted a piece from the *English Gentleman* which claimed that "[l]arge operations have been made by selling [CA] and buying [RA], whereby a [£0.25] profit can be made, and the security obtained." On 11 April 1846, the financial column of the *Spectator* noted that

> In the early part of the week, the price of [RA] was depressed, as compared with [CA]; the difference between the two Stocks, which should be governed by the different amount of dividend due upon each, and therefore calculated at [£0.75], having been [£1.00]. [RA] were consequently at one period [£0.25] cheaper than [CA]; but the difference is now disappearing.

The authors of both of these pieces clearly regarded the phenomenon described here as a temporary aberration in the market. What's amusing is that, as is related in Section 8, the *Spectator* was the same paper (although the passages were not necessarily by the same

writer) that three and a half years earlier was surprised at the appearance of rational relative pricing of CA and RA, since at that time it regarded mild overpricing of CA as normal. And a few years earlier, this paper was surprised when CA became overpriced after an extended period of rational pricing.

Even more than in the mispricing case from 1831 that was cited in Section 7, the April 1846 *Spectator* item is puzzling in that the mispricing at that moment was not particularly large. Inspection of the tables shows that for most of the first period (January and February) of 1846 when CA and RA were both trading, the difference CAm* - RA* (as measured by closing prices from *CoE*) was at least £0.25 on almost all Fridays, with several occurrences of £0.375 and one of £0.5. So why write about it at this time, in April, when the difference was not particularly large? The *Spectator* does not appear to have published anything about the equally large or even larger mispricings earlier that year. (Other papers may have, though, the search of the literature from that period was not very detailed.) It was the first week of the second period that CA and RA were both trading, so perhaps it struck the author as unusual. Or perhaps the writer was new on the job, and may have been looking for something to fill the available space, but this is speculation.

As an aside, the financial column of the *Spectator* was checked, although not very thoroughly, from the second half of 1844 through the first half of 1847. Back in March 1844, this paper appeared to be the first one in print with an evaluation of the value of NR by comparison with RA (see Section 62). As time passed, it continued to follow this question, evaluating the implied value that the market was attaching to non-callability of NR until 1874 (although it was persistently wrong in stating NR was not redeemable until 1884). The writer of this column wondered at the end of 1844 at the decline in the value of this option at a time when interest rates were dropping, and so normal logic would suggest non-callability should have been increasing in value, and then noted the recovery in its valuation[30]. This writer several times noted anomalies in the relative pricing of CA and RA, including one case when the latter was slightly overpriced[31].

Some other sporadic cases of the press citing gilts mispricing have been found during this period. On 20 November 1846, both the *Leicester Journal* and the *Lincolnshire Chronicle* wrote that "[it will have been observed that [RA and NR] have been for some time, and still continue, relatively lower than [CA]." (The language was identical, so either both were reprinting from the same source, or both relied on the same London correspondent.) In early December 1846, *The Times* noted[32]:

> The scarcity of [CA] which has for some time prevailed causes an undue price of that stock as compared with the price of [RA]. The difference arising from the periods at which the respective dividends are paid should be only [£0.75], but at this time it is as much as [£1.25], and hence an advantage of [£0.50] is derived by selling [CA] and investing the proceeds in [RA]. Some operations of this kind have taken place during the day, and one of very large amount occurred just before the close of business.

Exactly a week later, this paper noted that "[t]he undue disparity between [CA] and [RA], which we noticed a few days back, has been diminished by large transfers from one stock to the other, but it still exists to the extent of [£0.25]."

There was also active advocacy of CA vs. RA arbitrage at that time by an interesting person, the financial writer at the *Era*. By modern standards, this paper had relatively low circulation, a few thousand copies of each weekly issue. However, this was actually typical for most serials of that period, and it applied to the *Economist* and many other papers. Unlike the *Economist*, which attained a high reputation from its beginning (in late 1843), the *Era* was not held in high regard in general. That paper was an official publication of the "Licensed Victuallers" (the pub-keepers, in other words), and its strength was in its coverage of sports and entertainment. (Modern scholars use it as an important information source about Victorian theater, although its eminence in that area came later than the period considered here, which is the 1840s.) That it was an organ of the pub-keepers may have procured it a wider readership that it might have enjoyed otherwise, though. (While there is no reliable data, contemporaries thought that a typical serial was read by about 10 people in that era of very expensive newspapers.) It was also a Sunday paper, a class that was regarded with some disdain in general. Still, like most papers, the *Era* had a financial column (a "City article" as it was colloquially known at the time), which during the 1840s appeared to be edited (with a brief interruption) by the same person, who is unknown to us. As was briefly noted in [62, 63], this person was remarkably insightful. He (and it is almost certain he was male, while women were beginning to work in journalism, there does not seem to be any record of one engaged in financial reporting at that time) supported railways in their dark days in the early 1840s, when the consensus opinion was that the outburst of construction started by the railway mania of the mid-1830s had been a mistake. Then, as the railway industry moved into prosperity, and the great Railway Mania of the 1840s started gathering steam, he was an early, and possibly the earliest, to warn against it. He contributed a number of perceptive comments about the Railway Mania, generally ahead of other journalists. However, he did not appear to have any impact. And it has to be said that he never presented any quantitative arguments, just his opinions. Further, many of his opinions (for example, about joint-stock banking, and about George Hudson, the "Railway King") were eventually proved to be wrong. Still, he was one of the earliest journalists found so far in the literature of this period to explicitly alert his readers to the CA vs RA mispricing. The evidence was obvious to anyone willing to look at just about any paper and do a simple calculation. But it is one thing to have the evidence available, and another to take note of it. The writer for the *Era* did that, and he expected investors to take advantage of the arbitrage opportunities this mispricing seemed to offer.

On 15 Nov. 1846, the *Era* observed:

> [CA] are very steady at [£94.75] for money and time, and are very scarce; this arises from the speculators having oversold themselves; there is a difference of [£1.375] between [CA] and [RA]; it would therefore be a profitable operation for those who have [CA], to exchange them for [RA], as the difference in price ought not to exceed [£0.75].

Three weeks later, on 6 December, the *Era* noted that CA was "nearly [£0.375] higher in proportion than [RA]. This disproportion will, however, soon rectify itself; as, of course, the public who hold [CA] will exchange them for [RA]." At that point, trading in CA was "shut" until 5 Jan. 1847, and when it opened, the "disproportion" returned, and for

a while was even higher. There was then a spike in early February, discussed in detail in Section 11. Surely in response to it, on 7 Feb. 1847, the *Era* observed:

> There exists a great disproportion between the price of [RA] and the price of [CA]; those who have [CA] can exchange them for [RA], and pocket [£0.375 or 0.5] by the operation.

Thus the *Era* shows an extended campaign by an intelligent observer to alert his readers to what seemed to him a striking pricing anomaly that offered a great arbitrage opportunity. Later, in Section 14 we will see an even longer campaign that started about the same time as that of the *Era* and laster even longer.

11 Early 1847: Pricing anomaly, the Irish Famine loan, and the press

The earliest sustained periods of substantial overpricing of CA (at least £0.50, where one might have expected that even passive outside investors might have been attracted to the seeming arbitrage opportunity) that were discovered in this project were in 1845, and more followed in 1846. Even greater mispricing turned up in early 1847, and it was mentioned several times in the press.

Fig. 4 shows this mispricing in relation to some events that were likely correlated with it. It covers the 51 trading days (numbered from 0 to 50) between 6 January and 5 March 1847, the first period of that year when neither CA nor RA was "shut." The scatter plot shows CAm* - RA* based on the closing prices in the *CoE* for each day.

At that time, British financial markets were under stress. The ebullient phase of the Railway Mania was at an end, and investors and markets were faced with the need to finance actual construction. This consumed around 7% of GDP in 1847, a gigantic amount, especially for an economy that was still quite primitive by modern standards. There were additional disruptions caused by poor harvests and a developing depression throughout Europe, and the disastrous Irish Famine (and a similar, but smaller scale, famine in the Scottish Highlands) caused by the failure of the potato crop. The Bank of England rate of discount, which had been lowered to 3% in August 1846, was raised to 3.5% on 14 January, and to 4% a week later (and in April, outside the range of the figure, was increased to 5%). The market interest rate on CA went from 3.2% to over 3.3% during this period. In late April and early May, there was a small financial crisis. (The disastrous one that many had been fearing did not arrive until October of that year, and its effects on CA overpricing are discussed in the main paper.)

In order to provide funding for the relief of the Irish Famine, the British government went to the money market for a loan. This loan provided for the supply of £8 million in cash (in installments) for approximately £9 million (in nominal value) of CA. Since CA was overpriced relative to both RA and NR, it was an economically rational move to rely on CA. Fig. 4 shows what happened to the overvaluation of CA relative to RA.

Although CA was sold to raise the money, other financial instruments (such as terminable annuities) could have been used instead, and many politicians and other observers

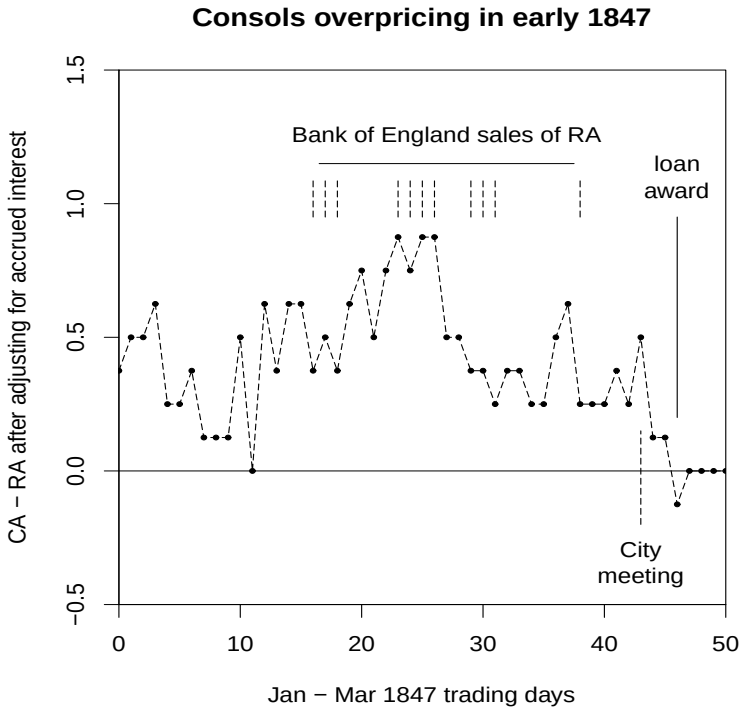

Fig. 4. Overpricing of Consols relative to Reduced Annuities from 6 January to 5 March 1847. Based on closing prices from *CoE* for each day.

argued for those. Therefore, while there was a general consensus that a loan would be raised, its precise form was not known publicly until Thursday, 25 February 1847, when the Chancellor of the Exchequer followed the usual procedure and met with "a number of the capitalists of the city [the financial center of London]" and announced the terms[33]. (This is the day marked with the vertical line marked "City meeting" in Fig. 4.) The loan award was made in the morning of Monday, 1 March 1847 (the day marked by the vertical line marked "loan award"), and it went to a combination of two consortia led by Barings and Rothschilds. (They were the only bidders, combinations were legal and frequent in those days.) It is interesting that the overpricing of CA relative to RA jumped on the day the terms of the loan were announced, but then declined, and after the loan award, for four consecutive days, there was no overpricing at all. (But this is based just on end-of-day prices, there was some variation within each day.) On the next day beyond what is shown in the figure, 6 March, trading in RA and NR was "shut," and when it was reopened in April, the overvaluation of CA resumed, but at a low level. (The big jump came later in that year, and is detailed in Section 13. It should also be mentioned that the £9 million of CA was not released to the lenders right away, but the amount and the schedule for cash transfers and releases of CA were public information, so in a rational market would be expected to have essentially the same effect as immeidate issue.)

Table 2. Bank of England sales of RA in early 1847.

date	day of week	nominal amount of RA sold
25 Jan	Mon	50,000
26 Jan	Tue	100,000
27 Jan	Wed	50,000
2 Feb	Tue	116,000
3 Feb	Wed	50,000
4 Feb	Thu	34,000
5 Feb	Fri	200,000
9 Feb	Tue	100,000
10 Feb	Wed	50,000
11 Feb	Thu	50,000
19 Feb	Fri	80,000

Fig. 4 suggests that the appearance of an additional £9 million of CA in the market did help induce rational pricing. However, this effect lasted only a few weeks.

Fig. 4 also shows that even before the Irish Famine loan was announced, CA overpricing had declined, from an elevated level at the end of January and an extremely high level, not seen before, of £0.875, in early February. What caused this rise and decline? Some, perhaps dominant, contribution may have come from operations by the Bank of England for its own account, and possibly from market operators reacting to those operations or rumors of them.

The Bank of England was a private joint-stock company (although with special status due to its ties to the government), and a lion's share of its reserves was kept in gilts. We have a record of its gilts transactions from 1825 through 1847[34]. It shows that between 25 January and 19 February 1847, it sold £880 thousand of (nominal value, sale prices were slightly above 90% of that) of RA, and no other major gilts in that period. (It also sold a substantial but smaller amount of Exchequer bills, a short-term financial instrument.) That the Bank would sell gilts was not unusual, it may have been trying to boost its cash holdings in preparation for the frequently predicted crisis, or, as some observers in the press guessed and advocated, as a way to raise interest rates. As to why it chose to sell RA as opposed to other gilts, perhaps further investigations in its archives will provide some answers. (A potential hint comes from the next section, which shows that during the previous year, it had acquired a substantial amount of the underpriced RA by exchanging the overpriced CA for it. Hence it is possible that in the eyes of its managers, the Bank's holdings of RA may have reached excessive levels relative to CA.) What we can say, based on the published record, is that this was an expensive decision, as compared to selling CA, say. Not only was CA overvaluation at record levels during many of the sales, but the prices that the Bank obtained were frequently lower than any of those recorded in *CoE*. (There were some instances where those prices were higher than any reported by *CoE*, but generally it went the other way. For example, the largest daily sale was on 5 February, when two lots of £100 thousand each were sold at 90.75 and 90.875, respectively, whereas the prices reported in *CoE* for that day were 91 and 91.25.)

It is worth delving a bit deeper into this period, in order to obtain more insight into the information flows on and around the Stock Exchange, and the effect of large trades on prices. The first set of sales, on 25, 26, and 27 January, involved £200 thousand of RA, and did not appear to affect prices or CA overpricing, and did not seem to induce any press coverage. But right afterwards, we observe an upward jump in CAm* - RA*, to a record level of £0.875, and that coincides with the start of the 4 consecutive days of large sales of RA by the Bank, of a total of £400 thousand. Did those sales cause the jump? It is possible, but another possibility is that some market participants learned of the scale of the ongoing and planned Bank sales. In the press, the first mention of Bank influence on the pricing that has been found is in the *Daily News* of 1st, 2nd, and 3rd February, which mentioned sales by the Bank broker, and in the last issue, of the 3rd, it wrote at length of the "singular state of the market" and of RA being underpriced. Much more extensive coverage came in several papers on Saturday, 6 February, the day after the heaviest sale of all, for £200 thousand on Friday. The *Spectator* of that day did not mention CA overpricing, but blamed the decline in gilts during the preceding week on a large sale of RA (and of terminable annuities) by the Bank on Monday. (As we can tell from the record in Table 2,

Bank sales did not start until Tuesday, so this news gossip item provides a calibration of the quality of rumors the press was picking up.) The *Economist* of that day (one of the many papers of that era, also including the *Spectator*, that were published once a week, on Saturdays) had a detailed account of Bank plans. It claimed that the Bank had decided to sell £1 million of RA, and had sold 80% of that during the preceding week, and that it was not clear whether the remaining 20% would be sold. (Again, when we compare this account to the actual transaction record in Table 2, we get a sense of how information got distorted in transmission.) It also wrote:

> The sale of this large amount of this particular stock has produced a phenomenon in the market to-day which no one could explain or understand. This stock, ([RA]), though giving [£0.75 more than CA], has been all day quoted at the same price, or within ... The phenomenon is thus explained.

The coverage of the overpricing in the *Era,* detailed earlier in Section 21, came a day later, as this paper was a Sunday one. It claimed that the Bank had been selling both RA and NR, in yet another distorted rumor. In the meantime, still on Saturday, the London daily *Morning Chronicle* wrote:

> It is remarked as a singular phenomenon, which has not occurred for many years, that [RA], which bear [extra £0.75 of accrued interest] above [CA], should be at a quotation precisely the same as [CA]. This has been the case all to-day, and has caused large sales of [CA], to be invested in [RA]; but still the proportionate price was not restored, as they still left off at the same price. This phenomenon we believe will be explained by the transactions of the Bank [of England] broker in the market.

The following Monday and Tuesday, this paper returned to the topic, and noted that CA was still significantly overpriced relative to RA. The *Daily News* reported on Monday a rumor that the Bank had tried to sell some of its RA quietly to some insurance companies, but that, surprisingly to the writer, they bought little, "even with the advantage of [costing £0.75 less than CA]."

Why the flurry of stories about CA overpricing right then? It could be a reflection of mere gossip on the floor of the Stock Exchange, and in particular rumors about Bank of England plans. (Actions and plans of the Bank always received careful scrutiny.) To some extent it could also be the result of CA overpricing reaching and exceeding £0.75. Everybody, broker, journalist, or investor who paid any attention to pricing, must have been used to the regular alteration in which CA was more expensive than RA from 6 April until 5 July, and from 11 October until 5 January, and less expensive at other times. With overpricing at £0.75 in February, though, CA was suddenly as or even more expensive than RA at the wrong time of year. This may have been just too strong an anomaly to be ignored, and prompted the press to write about it. (There were several isolated days in late 1845 when CA overpricing reached such high levels, but those may have been easy to ignore, since they were isolated, and they occurred as the speculative excitement of the Railway Mania was reaching a peak and starting to deflate.)

While there was extensive press coverage of the CA overpricing issue in early February 1847, it did not extend to all papers. In particular, *The Times*, by far the most important

press organ of that era, appeared to ignore it. There were some suggestive items, such as a note in the 8 February financial column, to the effect that on the preceding day, "there was also effected a very large exchange from [CA] to [RA]." But why would anyone exchange from CA to RA? That question was not even touched. On the other hand, *The Times* did devote considerable space and effort to criticizing the *Economist* for publishing the story about the Bank of England's move to sell RA. *The Times* claimed that the detailed story could only have come from a high-level official at the Bank violating his duty, and that it was unworthy of the press to contribute to such betrayals of trust. This brought forth a rebuttal from the *Economist*[35], which claimed it did not obtain its story from any insiders, and that

> ... for the *Times* to lecture any other journal as to the means of obtaining information is truly a farce; a paper notorious for having used upon all occasions the most unscrupulous means of obtaining information.

This incident illustrates the importance that journalists placed on various issues. Quotes such as those presented earlier suggest that on the Stock Exchange, attention was paid to CA overpricing, but that usually this was not regarded as important enough for the press to mention. On the other hand, issues of journalist ethics as well as competition for scoops seem to have played more important roles.

12 Bank of England and the gilts market

The previous section showed what appeared to be economically irrational action by the Bank of England in selling large amounts of RA at a time when it was significantly underpriced. However, there may have been a good reason for this move. It is possible that the Bank directors felt their reserves were too heavily weighted by RA. (Bank archives will surely provide some indication, say by telling us what the Bank gilts holdings were in early 1847.) The same source as was used in the preceding section reveals that between May 1845 and December 1846, the Bank had engaged in a series of exchanges from CA into RA. They involved in each case a sale of CA and the purchase of the same nominal amount of RA on the same day. The nominal capital of CA that was exchanged during this period came to £650 thousand.

All these exchanges of CA for RA happened in situations where CA was overvalued, so the Bank appeared to be behaving like a rational profit-maximizing long-term investor. However, the days the exchanges were executed were generally not ones with maximal CA overpricing. Hence it might be an interesting exercise to engage in a deeper investigation of both the Bank's investment policy, and its day-to-day operations. It would require care, since the Bank's primary mission was banking, not investments, so its motivation, just like that of private banks, was often different than that of ordinary investors. Liquidity was surely far more important for them than small fractional differences in rates of return.

An example of how the Bank used its gilts reserves comes from data on its behavior in November 1857, when a serious financial crisis led to the second suspension of the gold standard. On 12 November, the day the suspension was announced, the Bank had approximately £9 million in government securities, and of this amount, £2 million was in CA and

£1.9 million in RA and NR. The source for this information shows that during the crisis, most of the sales of gilts by the Bank were of CA[36]. This was likely a reflection primarily of CA's greater liquidity, although overpricing may have contributed. The prevalence of CA among the repurchases after the height of the crisis, in spite of CA overvaluation, likely reflects just the fact that Bank holdings had become unbalanced from the earlier sales. This was still in the days when trading in the major gilts was "shut" for extended periods. The Gilbart advice from the 1840s, cited in Section 54, that bankers should hold half of their reserves in CA, and half in RA, had special force under these circumstances.

Among many Bank moves that invite deeper investigation was exchange of £150 thousand of NR for CA in May 1847. This was just after the small financial crisis of the spring of that year had subsided. Carried out over 5 business days between 7 May and 13 May, it involved each day a sale of NR and a purchase of the same nominal amount of CA. At that time NR was about to enter the period of extreme undervaluation that is discussed in the main paper, but was not there yet. Still, if we disregard the first two days, when only £35 thousand was exchanged, we find from the tables that on the other days, NR was underpriced relative to CA by about £0.60 even if we disregard the value of NR being non-redeemable until 1874. Thus selling NR to purchase CA would have been a clearly irrational move for a long-term investor. But the Bank probably had other incentives.

13 The October 1847 financial crisis

Fig. 5 depicts CA overpricing during the period 11 October to 10 December 1847, when all the major gilts were trading. This period witnessed the culmination of a long-feared financial crisis, which led the government to suspend the gold standard (which had been imposed in a strict form just three years earlier, in Peel's Bank Act). The suspension was announced on Monday 25 October 1847, and is marked with a vertical line in the figure. It was accompanied by the rise in the Bank of England rate of discount to what was then an extraordinarily high level of 8% per year. The suspension had a dramatic effect in stabilizing the financial markets. Although the Bank rate continued at the 8% level for a month, other short-term rates dropped very quickly, and so did the market yield on CA (which had actually dropped even before the suspension, as can be seen in the tables, quite likely as a result of panicky "flight to quality"). Yet CA overpricing, after some wild gyrations in the wake of the suspension, experienced a gentle rise during the period following the gold standard suspension. This seems to be an instance of a common phenomenon, namely a small and delayed response to an economic shock.

14 *Illustrated London News* on gilts mispricing, 1846–49

The longest press campaign to alert readers to gilts mispricing that has been found so far was carried out by a paper that might seem a rather unlikely candidate for such a role. The *Illustrated London News*, which started publishing in 1842, is famous in press history as the first illustrated news serial in the world. After some initial struggles, it attained phenomenal success. With its average print runs rising from about 50,000 copies in 1845 to

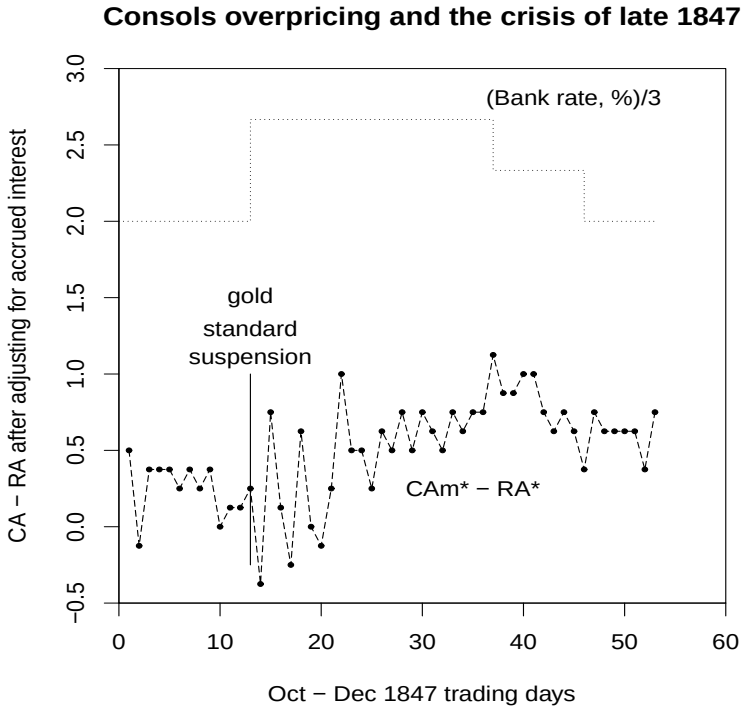

Fig. 5. Overpricing of Consols relative to Reduced Annuities in late 1847, and the rate of discount of the Bank of England divided by 3 to fit on the scale.

70,000 in 1850, this weekly had by the late 1840s become the most widely circulated paper in the UK, eclipsing the *Weekly Dispatch* which had been the champion for a long time[37].

While the *Illustrated London News* was eagerly scrutinized by all classes of British society, this was largely because of its voluminous graphics. Yet it covered general news, too, and especially after the 1848 hiring of Charles Mackay (poet, writer, and journalist, author of *Extraordinary Popular Delusions and the Madness of Crowds*, and an ardent supporter of technology, trade, and of the Railway Mania, cf. [64]), its reputation grew[38]. From the beginning, it had a small financial column, which, starting in July 1844, was entitled "Monetary transactions of the week." Results of some digital searches of the online version of this paper motivated a systematic examination of all copies of this column for the years 1846 through 1850. This effort uncovered an unusually long record of attempts to inform the public about gilts mispricing. This campaign stretched from the end of 1846 to the end of 1849. There may have been other coverage as well, in the rest of the paper, but that was not searched for in any detail.

As the tables show, CA vs. RA pricing anomalies started showing up in the spring of 1845, but intermittently. The first comment on this phenomenon (post-1845, coverage in 1845 was not examined) appeared in the *Illustrated London News* on 5 December 1846:

> [RA] have for some few days past quoted a price relatively lower than [CA], another proof that it is only the state of the market, and not any reliance upon future probabilities, which has influenced the rise. Among the keen observers of the Market

> this discrepancy did not escape discovery, and some extensive operations by the sale of [CA] and purchase of [RA], speedily adjusted prices.

This passage shows a faith that rational pricing should rule, and that temporary deviations are signs of some unusual events, and one can count on them being eliminated by smart arbitrageurs stepping in and making profits. This was a common attitude at the time, as was shown already in Section 10. It is also visible in some later columns in this series:

- 26 December 1846: "Some money investments on [RA] have given an upward tendency to the price of that Stock; ..."
- 13 February 1847: "The slight difference that exists between the price of [RA] and [CA], serves to show the scarcity of the latter Stock."
- 20 February 1847: "[RA] is now below its relative value, notwithstanding some large purchases recently made by the Government broker. This is fair proof of the state of the [CA] account."
- 13 March 1847: "[RA] continues below its relative value, in proportion to the price of [CA]."

There was then a long break, with no discussion of pricing anomalies between any of CA, RA, and NR. (There were some others, though, as in the 3 July 1847 issue, which argued that CA and Exchequer bills were mispriced relative to each other.) That can be ascribed to the turbulence of the financial system, which culminated in the crash of October 1847 and the suspension of the gold standard. That presumably limited the space available for small market pathologies, and likely also absorbed the financial editor's attention. In early 1848, though, major gilts pricing issues came back:

- 22 January 1848: "[RA] quotes nearly [£0.75] below its relative value, the market having been "banged" by some heavy sales lately, on behalf of a Life Insurance Company."
- 5 February 1848: "[RA] has attained its relative value."
- 12 February 1848: "[NR], as well as [RA], are at their full value."
- 22 April 1848: "... the price of [RA] is nearly [£0.75] below its relative value."
- 29 April 1848: "The relatively low price of [RA], mentioned in last week's *Illustrated London News*, has caused several changes from [CA] to that stock."
- 6 May 1848: "[RA] continues nearly [£0.75] below its relative value."
- 13 May 1848: "Exchequer Bills have improved a few shillings, but [RA] continues below its relative value."
- 3 June 1848: "Some large exchanges of [CA] for [RA] have tended to somewhat equalise prices, but [RA] is still the cheapest Stock."
- 24 June 1848: "The market would have probably receded to a greater extent, but a large purchase in [RA] supported quotations generally, contributing, at the same time, to equalise the price of that stock and [CA]."
- 22 July 1848: "[NR] have been in some demand. [CA] may be sold and [RA] purchased at a present profit of nearly the half-year's dividend due in October."
- 25 November 1848: "... and [NR] are below the market value."
- 2 December 1848: "[NR and RA] are still below their relative values."
- 9 December 1848: "[NR] are still slightly below the relative value."

- 20 January 1849: "... a large purchase in [NR] has tended to equalise the price of that stock."
- 27 January 1849: "[NR] have, in consequence of some very large exchanges from [CA], attained the relative value."
- 24 February 1849: "[RA] is rather below its relative value."
- 14 April 1849: "A large business has been done in [NR] raising the quotation to its full relative value."
- 23 June 1849: "Some large sales in [NR and RA], on account of an insurance office, have depressed those stocks rather below the market average."
- 28 July 1849: "[RA] are below their relative value, making an exchange from [CA] profitable."
- 18 August 1849: "[RA] quotes below the market average, and a change from [CA] at present prices may be advantageously made."
- 15 December 1849: "[NR] continue to improve, quoting a relative value with [CA]. Attention has been, at several periods, directed, in the *Illustrated London News*, to the favourable investment [NR] have hitherto offered, in comparison with [CA]. The opportunity now, however, no longer exists."

To provide some perspective on how prominent these gilts mispricing remarks were, let us consider the "Monetary transactions of the week" piece from the 11 May 1850 issue. It was chosen because it does mention RA briefly, but was otherwise fairly typical. This issue had the usual 16 pages, with text in three columns on each page. Exactly half of the pages had illustrations, which sometimes filled in most of the space there, and sometimes less, including about two thirds of the title page. On p. 14 of the issue, there was the customary "The markets" piece, occupying about 40% of one column, and listing prices of various trade items (many varieties of wheat, bread, tea, potatoes, beef, ...). "Monetary transactions of the week" occupied about 30% of another column, and had 47 lines. Of those 47, 16 lines were devoted to a listing of railway share prices, and 13 lines to some comments about and a listing of foreign government bond prices. The first paragraph, though, of 18 lines, was devoted to gilts and related securities, and is reproduced here in full. The prices in the second sentence refer to CAm and CAa, it's just that the author did not feel the need to spell it out, this was the usual format (although in most financial columns, both in this paper and in others, the name Consols was cited explicitly).:

> The English Funds have been inanimate during the week, notwithstanding that Thursday was settling day for the May account. On Monday the opening price was $95\frac{3}{4}\ \frac{7}{8}$, which shortly after declined to $95\frac{5}{8}\ \frac{3}{4}$, improving on Tuesday to $95\frac{5}{8}\ \frac{7}{8}$ for Money and time, closing at $95\frac{3}{4}$ for both. Opening at the same price on Wednesday, a decline to $95\frac{5}{8}$ soon followed, and, although it was option day, no other change took place. Continuations were done at $\frac{1}{8}$ to $\frac{1}{4}$ per cent., according to the credit of the parties. The settling on Thursday passed off without difficulty, and prices remained without material change, the market, however, being firmer. The Unfunded Debt continues in demand on the part of the public; an indisposition to purchase Stock at the present high prices, while Continental affairs remain so unsettled, being general. A large sale of Reduced, on behalf of an insurance company, slightly affected the

> market on Tuesday, making the quotation a point below its relative value. The closing prices of the week are—for Bank Stock, $205\frac{1}{2}$; Reduced, $94\frac{7}{8}$; Consols, $95\frac{7}{8}$; New $3\frac{1}{4}$ per Cent. Annuities, 97; Long Annuities, to expire Jan., 1860, $8\frac{1}{4}$; India Stock, 266; India Bonds, £1000, 91 pm; Ditto, under £1000, 92 pm; Consols for Account, 96; Exchequer Bills, £1000, June, 71 pm; Ditto, £500, June, 71 pm; Ditto, Small, June, 71 pm.

The sentence about a "large sale of" of RA was thus buried inside a paragraph, although a prominent paragraph inside this piece, which was buried fairly deeply inside the paper, alongside various other items that likely were of interest only to a small fraction of readers. The items cited before, about gilts mispricing in the period 1846–49, were usually positioned similarly.

For further perspective, it should be mentioned that the "Monetary transactions of the week" section of the *Illustrated London News* often had obvious typos, and it is not clear just how trustworthy it was. For example, in the citation above, the large sale of RA that is mentioned was supposed to produce a quote for RA a full £1.00 below its fair value. Several other papers were examined for that period (the financial columns of the dailies *The Times*, *Morning Chronicle*, *Morning Post*, *Daily News,* and *Standard* for Wednesday, 24 April, and the weeklies *Economist* and *Standard* in their Saturday, 27 April editions), and none mentioned any big pricing disparity. (The closest item was a passage in the *Morning Chronicle*, which reported that in RA "the dealings were more than usually active.") The closing quotes in those papers also did not reveal any unusual action. The *CoE* reported transactions in RA on that Tuesday, 23 April, at 94.875, 95, 94.625, 94.875, and 95. So there is some evidence suggesting that a large sale of RA depressed its price for a short while, to 94.625, about 0.375 below what it might have been otherwise. But that does not appear to leave room for a quote that was a full £1.00 below fair value as compared to CAm, even if we take into account the fact that RA was typically £0.25 underpriced relative to CAm.

There were other objections that could be raised to the gilts pricing coverage. For example, the claims in the 5 February and 12 February 1848 issues that RA was at its "full value" were not correct, if "full value" meant the natural view, namely relative to CA. RA continued to be underpriced relative to CA, and NR relative to RA. It appears that the editor of this section expected some slight degree of overvaluation of CA relative to RA. It is also fairly clear that this writer did not understand that NR was substantially undervalued relative to RA through much of this period, just by virtue of the extra 0.25% annual interest that NR was to pay until almost the end of 1854. (This was in contrast to the writer in *Freeman's Journal*, discussed in the next section.)

On another issue, one can argue whether the *Illustrated London News* financial editor was right or wrong. The last citation in the list above, from 15 December 1849, shows (along with the rest of that column, which is not reprinted here) that this person simply did not see any value in the non-redeemability of NR until 1874. (For other papers' substantial coverage at that time, see Section 17.) It took until the summer of 1850 before this column started treating this feature more seriously. But was that right or wrong? In the long term, one could argue that the position of the *Illustrated London News* turned out to be correct,

as none of the major gilts were redeemed by 1874. On the other hand, for several years in the early 1850s, as was shown in the main manuscript, the markets did value this option, and given the financial environment, with good reason.

The final conclusion is that the coverage of gilts mispricing in the *Illustrated London News* was not ideal. It contained some sins of commission, and even more serious ones of omission. Still, the coverage was there, quite prominent among all the financial coverage of that paper. It extended over an unusually long period of three years, and it was in the most widely circulated paper in the UK.

15 Irish arbitrage and Irish rationality

All the studies here, and elsewhere in the literature, where they deal with mid-19th century gilts, are based on data for trading on the London Stock Exchange. But that does not cover all market transactions. Gilts were also traded on the Dublin Stock Exchange. At the moment there do not appear to be any studies on the integration of those two exchanges in the 19th century. There are studies on relations involving the major financial centers of London, Amsterdam, and Paris, e.g. [3, 59]. It might be an interesting exercise to also study the relations of the Dublin and London exchanges, which were much more closely intertwined, sharing most of their legal, institutional, and monetary environments, yet were separated by geography and some minor institutional differences.

Until the creation of NR, the mixture of gilts was different in London and Dublin. In the 1830s, Dublin gilts consisted primarily of N35 and an Irish 3.5% annuity, in roughly equal proportions. After 1844, NR subsumed both, and made up the vast majority of the gilts held in Dublin, so the same financial instrument was trading in both London and Dublin. It was an interesting period, as communication was improving, with the spread of railways, telegraph, and also faster and more frequent steam boat travel across the Irish Sea, ending with the laying of the first successful underwater telegraph cable linking Britain to Ireland in May 1853. (However, that was just between two close points on land in Ireland and Scotland. Regular commercial telegraph service between Dublin and London did not start until January 1854.)

About 5% of the total national debt of the UK was held at the Bank of Ireland around 1860, but for NR it was about 15%. Very little of CA and practically no RA was held in Ireland. Transfers of gilts between the custodians, the banks of England and of Ireland, were routine, but no documentation has been found yet on how long they took, nor on how complicated or costly they might have been. (This is one of the issues that an examination of the archives of the Bank of England, and ideally also of the Bank of Ireland, might illuminate.) Annual volumes of transfers are available in Blue Books[39]. They show substantial moves in both directions, likely associated with people moving from one place to another, as well as deaths, bequests, and the like, but with a persistent bias towards transfers to Ireland. These transfers were well documented, likely to a large extent since they were used in political debates. Opponents of measures to help Ireland used these statistics to argue not just that Ireland had considerable liquid wealth, but that it seemed to be experiencing growth in its surplus capital, and that it was investing this surplus in gilts, and not in its agriculture, trade, or industry.

The Dublin Stock Exchange was a cozy and sleepy affair by the late 1840s, with around 30 brokers who handled the daily business in a single session of half an hour or less, and with low liquidity[40]. (In common with many cities in the UK, Dublin at the height of the Railway Mania had not just its official Stock Exchange, but three other share exchanges, but those withered, with the last one folding finally in 1850.) However, in at least one sense, the Dublin exchange (and the Bank of Ireland, since this reflected practices of both institutions) was ahead of the London one. It did not have gilts "shuttings," so there was an uninterrupted record of transactions. This was associated with gilts being quoted without accrued interest (which was then added to the price when a deal was paid for). This made it easier to compare prices and get a sense of interest rate trends.

In this section we document some insights into gilts mispricing that can be obtained by reading the financial column of one of the Dublin daily newspapers, *Freeman's Journal.* In the late 1840s, it had a circulation of about 1,500. This was small compared to the London giant, *The Times,* but not that small for that day. Some of the influential London dailies of that period, such as *Daily News, Morning Chronicle,* and *Morning Herald,* sold only two to three times as many copies[41]. *Freeman's Journal* may not have been read widely by the general public outside Ireland, but it was frequently cited in the London press, so it was prominent.

As was usual in those days, *Freeman's Journal* did carry gilts prices from both the London and Dublin stock exchanges (but in different parts of the paper, and only as simple price reports[42]). In late late 1847, this paper started running in its Monday editions a column entitled "Commercial intelligence," which had a mixture of basic price information, evaluation, and market commentary[43]. It may have been started by a new employee, and the first few appearances show some experimentation in its coverage. But very quickly this writer (and it again seems a safe assumption that this was a man) decided to make a comparison of gilts prices in Dublin with those in London a prominent part of his coverage. From his writings, it appears he thought that active arbitrage between those two exchanges was going on, and that his coverage would be of use. The first time he mentioned this was in the 18 October 1847 issue. His piece was dated the preceding Saturday, after the markets had closed, and mentioned that in the Dublin market, CA had dropped by £2.50, which was £1.00

> over the [Thursday] fall in London. As throughout the panic stock has generally ruled about [£1.00] higher here than in London, causing a steady import of stock to Dublin; the disappearance of this difference seems to indicate increased tightness here.

The next column in the series was published on 25 October, the day that the gold standard suspension was announced in London. But it was dated, as usual, the preceding Saturday evening. The writer, after discussing "the disastrous events" of the preceding two weeks, boasted that his previous column on gilts arbitrage had attracted some attention, and went into the details of how to compute interest accruals so as to make fair comparisons of prices in Dublin and London. (He also complained about the Bank of Ireland not providing information about volume of gilts transfers from England to Ireland, and made some estimates of his own. Those were not far off, as we can tell by consulting the statistics in the Blue

Books cited above.) So it seems this writer decided both that there was interest in the topic, and also that there was a lack of serious information about basic finance among his readers. In any case, from that point he started to give the closing prices of CA and NR in both London (on Thursday, and later, as postal communications improved, on Friday) and in Dublin (on Saturday), and the exact gain or loss that would be obtained by bringing those gilts to Dublin at those prices. (This was not a matter of a trivial subtraction, but required the slightly less trivial computing of accrued interest to make a fair comparison, as this writer explained earlier. So he was performing a service to his readers.) Thus the next issue (1 November) noted there was a potential gain of £1.33 on (a unit of nominal value of £100 of) CA, and of £1.43 on NR. A week later those gains dwindled to £0.39 on CA and £0.99 on NR, and two weeks after that (22 November) had turned into a loss of £0.44 on CA but still a gain of £0.41 on NR. This writer did not discuss the mechanics of taking advantage of such arbitrage opportunities, nor the risks, which must have been substantial, given the time delays. It probably did not seem necessary, since this process was not dissimilar to the arbitrage taking place constantly in merchandise and other financial instruments. (The "course of the exchange," aside from lending its name to the most prominent record of transactions on the London Stock Exchange, was a generic term used for ubiquitous tables showing the relative exchange rates between major commercial centers.) However, perhaps as a result of carrying out the computations and writing up the results, he early noticed a pricing anomaly, with the Irish market somewhat more rational than the English one. He wrote (15 November):

> It may be worth while to observe that the difference in value between [NR] and [CA] is much better sustained in the Dublin Stock Exchange than in London. In Dublin the average difference on the 18 last market days has been [£1.22]. In London in the same 18 days it never exceeded [£0.88], and the average was only [£0.79] (including, of course, the quarter's interest). In both cases, however, [NR] are undervalued, the real difference (exclusive of the 20 years' term, during which the interest on the latter is secured from further reduction) is [£1.56], the value of an annuity of [£0.25] per annum for seven years. At the present time, when so many investments are taking place, the difference is worthy of attention.

The next Monday, he pointed out that the price of NR had jumped substantially relative to CA, so that there was a large potential gain in shorting NR in Dublin and buying CA, and then reversing the transaction in London.

As 1847 was coming to a close, the British financial markets were stabilizing, and the arbitrage gains were declining. For example, on 13 December, they were £0.18 for CA and £0.47 on NR. Two weeks later, the *Freeman's Journal* writer noted that "[n]otwithstanding the very small margin, a considerable amount of stock has been imported, the steadiness of prices rendering it a comparatively safe operation." As far as CA vs. NR mispricing is concerned, though, there was no diminution, in fact just the opposite. And we find this writer coming back to it on numerous occasions:

- 3 January 1848: "[CA and NR] may be said to bear the same price in London notwithstanding the superior value of [NR]. It is difficult to account for this anomaly."

- 31 January 1848: "in both [Dublin and London, NR] are much below their relative value, being, in fact, a mere fraction over [CA], while their actual difference in value is fully [£1.50]."
- 6 March 1848: "The fact of [NR] bearing the same price as [CA] is very remarkable, the difference in value being [£1.50]."
- 24 April 1848: "[NR] is still much the cheapest stock for investment."
- 15 May 1848: "We have the anomaly of [NR] being absolutely lower in price than [CA]."
- 29 May 1848: "... a rather remarkable discrepancy. It will be seen, as has often occurred of late, that in London the two stocks are exactly the same price, taking into account the quarter's dividend on [CA]. The additional [0.25%] on [NR] is payable for six years to come, and the exact money value is [£1.35]; and there is also a guarantee against further reduction until 1874. We have given this calculation for the assistance of the many who are reinvesting their savings' bank deposits."

But then, in the face of markets that stubbornly refused to be rational, this writer seemed to give up. There are even hints that he started to rationalize irrational behavior. Thus on 15 May 1848, when NR was irrationally low compared to CA, but about £1.03 less irrational in Dublin than in London, he opined that

> [CA] being, however, the stock usually selected for investment [in London] causes it to bear a more proportionate price in Dublin.

Still, there were occasional flashes of continued incomprehension, as he wrote several times (for example, on 3 July 1848) that CA and NR "were done Wednesday at the same price," which, by his many earlier arguments, greatly undervalued NR. A week later, on 10 July 1848, he wrote that "[CA] are actually [£0.33] dearer in London than [NR]." But then he seemed to give up completely, even though the prices he printed in his column continued to demonstrate substantial undervaluation of NR. He eventually came back to this topic, but it took almost a year and a half, during which NR was consistently underpriced. However, in late 1849, this started to change, and the *Freeman's Journal* writer did mention it. On 10 December 1849, this writer had a long discussion of the prospects of CA redemption, apparently prompted by an article in the *Observer,* which predicted an imminent move in that direction. (See Section 17 for a more detailed discussion of prices and press coverage during this period.) In his piece, the *Freeman's Journal* writer noted that

> [a] considerable increase in the difference of price between [NR] and [CA] has taken place this week, ..., no doubt owing to the rumours in circulation as to a possible reduction of the rate of interest on [CA]. Even now [NR] are below their relative value to [CA]. Irrespective of the twenty years' guarantee of [3%], there is a guarantee of [3.25%] until October, 1854, and the value of an annuity of [£0.25] per annum for five years, being [£1.15], there ought at least to be that amount of difference.

As was noted in Section 14, the *Illustrated London News* also observed the irrational undervaluation of NR, and did so in numerous issues, although not as quantitatively as *Freeman's Journal*. It is likely that more examples will be found of papers commenting on this pricing anomaly. For the moment, though, these two papers alone prove that there

were financial journalists who understood the market inefficiency and strenuously sought to alert their readers to it.

16 The *Daily News* and gilts pricing in 1848

The coverage of the gilts market in the financial column of the *Daily News* in 1848 provides an enlightening perspective on how sophisticated the markets and market observers were at that time, what it is that they paid attention to, and what the financial press regarded as its responsibilities. That whole year witnessed very high levels (at least by the standards of the time, much higher levels appeared in the 1860s) of overpricing of CA compared to RA, and also of RA compared to NR. The end of 1848 was the time of the first railway share crash and then a recovery, treated in [63]. The *Daily News* financial column, perused day-by-day from April through October, and more sporadically in the other months, shows the extent to which the gilts mispricing was noticed, how sophisticated even financial writers at prominent newspapers like this one were, and the degree that other concerns tended to drown out gilts pricing anomalies.

The *Daily News* at that time was struggling. It started publishing in January 1846, at the height of the Railway Mania, and the main aims of its owners were to promote free trade and railways. Originally edited by Charles Dickens, it failed to achieve great success, largely because the bountiful flow of railway advertising money dried up as the Railway Mania subsided. It then embarked on a disruptive strategy of lowering its price, from the customary five old English pence per copy down to three pence. (This strategy was abandoned in early 1849.) This necessitated a reduction in physical size, so that by mid-1848, it almost always had 4 pages, as opposed to 8 for most of the other London dailies, and usually 12 for *The Times,* the dominant newspaper in Britain. The space normally allotted to the financial column in the *Daily News* was therefore usually far smaller than in *The Times,* say.

As with the *Era* shortly before (see Section 21), it seems safe to assume that the editor of the financial column of the *Daily News* was the same throughout 1848, and was male. Presumably as part of a strategy to differentiate his paper from others, and also to compensate for limited space, and perhaps as a reflection of his personal interests and experience, he provided much more information about the gilts market than such competitors as *The Times,* the *Morning Chronicle,* or the *Morning Post,* but less about other topics. (There was another column in the *Daily News* devoted to railway shares, likely edited by the same person, but that was usually quite short. On the other hand, there was a large table of railway share prices, part of the evolution in financial journalism that was taking place at the time.) He frequently cited the differences between CAm and CAa prices, and what that implied about availability of money for loans and about speculators' positions and intentions. He did use the Stock Exchange terms "contango" and "backwardation," which other papers seldom used, presumably as being too technical, and he wrote about options trading, which was almost invisible in other press organs. Comparing his coverage with that of other papers reinforces the impression that the records available to us today, not just in newspaper financial columns, but also in price lists like those of the *CoE*, reflect just the top layers of activity in a dynamic financial market.

Several of the columns in the *Daily News* provide a view of how this observer saw his role and that of other financial journalists in terms of providing advice to investors. At the height of the first railway share crash, in late 1848, of which more later, this writer noted that he was deluged with letters about railways, and that a correspondent was asking him to urge his readers to buy railway shares to lift them out of their depression. He responded, in the 26 October issue:

> Need it be repeated, that it is no part of our duty to interfere about prices, further than to record them, and the causes which may have led to their elevation or depreciation? In the weekly summary under this head of the rates of interest per annum yielded by various stocks and shares at the prices of the day, founded on the rates of dividend last declared and paid, and the interest according to denomination on government stock, care is advisedly taken to avoid any expression of opinion as to the relative value or superiority of one description of security over another, or the reverse. With such facts as can be so supplied, and such other information as they are left, and especially warned, to gather, the public may be safely trusted in general to lok after their own interests, and at all events may not look for counsel from us.

However, as will be mentioned later, he often did express his general opinion that railways were undervalued, and on some other occasions he did get into valuation questions where pricing seemed especially anomalous. But he was rather cautious, although often not very illuminating, in what he did. Thus on 28 August, when the inclusion of the Long Annuities (terminable issues of the British government that expired in January 1860, see Section 62) in his table of market yields of securities produced an anomalously high value, he noted that this figure was not comparable to other ones, since (in modern language, these are not the exact words he used) it represented a return of capital as well as interest. He hinted he would provide information on the proper valuation method in a later column, and wrote:

> The public at large are not disposed to enter into these calculations on making investments, and brokers, unless specially required, do not trouble themselves beyond the execution of orders. In fact also, and, very properly, they decline to give advice generally, or offer opinion, on the relative advantages of different securities, because, if casually wrong in the result from adverse circumstances they incur censure, if right, they obtain little credit, for the $\frac{1}{8}$ brokerage is conceived to answer all the claims of gratitude. The foregoing calculations, which will be gradually extended, will enable the public to judge for themselves, so far as the interest returns. For the comparative solidity of the securities, as between stocks and shares, they must exercise their own judgment simply, upon the comparison of the data which the *Daily News* supplies in its stock and share lists, assisted and explained by the reports of directors at public meetings, and such observations as appear under this head, or that of the railway market.

Two weeks later, in the 11 September issue, to accompany another edition of his table, which again showed very high yield from Long Annuities, he did provide an evaluation:

> With respect to Long Annuities, it must be observed that capital is, of course, annihilated, and dividends cease in 1860. To re-enter into capital, therefore, a certain

> rateable proportion of the dividends must be set aside yearly, and re invested in securities, so as, upon the compound principle, to accumulate and replace the capital so otherwise extinguished. At present, as an indication not exactly fractionally correct, it may be stated that the recipient of the annuity, after taking [4.5%] for use, would have in remainder enough left on re-investment to restore the capital at the end of the term (1860), supposing this excess to be re-invested in the same annuities, which may not, perhaps, be a possible case on the requisite conditions. The calculation of compound interest returns would be too narrowed, if limited solely to reinvestments in the same class of securities. There is a difficulty in the selection of a general and medium term for reinvestments, which hereafter may be arbitrated upon.

At that time Long Annuities were substantially underpriced relative to the major gilts, corresponding to discounting their cash flow at a constant rate of about 5.5%, at a time when CA was yielding about 3.5%. The *Daily News* writer apparently phrased this differently, in terms of getting an annual yield of 4.5% and getting the capital back at the end, in order to make the issue more understandable to the British readers of the time, who were used to thinking of perpetual yields and constant capital. But he was aware of the problem that the term structure of interest rates poses, so put in caveats about this. Overall, his evaluation did show the dramatic underpricing of Long Annuities, but he never came out and explicitly recommended their purchase.

How well did the *Daily News* financial editor do with respect to the CA vs. RA mispricing? He was aware of it, and did mention it tangentially a few times, but he never made much of an issue of it. And he never wrote anything that would indicate he was even aware of NR underpricing. Of course, these mispricings were all very visible in the price data printed in every issue of his paper. His column carried, in the running narrative, the closing quotes for the major gilts, and there was a separate section at the end of the column, labeled "English Funds," that had each day's prices for even more gilts, just like the data in *CoE*. But here we consider just what this editor wrote explicitly. First a few words of background for that period.

As is visible in the tables, CA#, the market price of CAm after stripping out the accrued interest, reached almost 90 in February 1848, but then, after the outbreak of the French Revolution at the end that month, it dropped precipitously. In early April, on the eve of the "monster rally" at Kennington Common by the Chartists, it was down to a shade below 80. By early June, CA# was back up, but only to about 83. June witnessed a rapid recovery, though, treated as a great surprise by contemporary observers, so that by mid-July, CA# was back up to about 87. (By February of the next year, it was up to 93.) The *Daily News* did reflect the general surprise at this development. (All citations to the *Daily News* in the rest of this section are to its financial column, labeled "Money Market," which at that time generally appeared on p. 4.) Thus on 13 June we find a note that "[a] gradual advance in the funds commenced soon after the [London Stock Exchange] opened this morning, ... This rather remarkable improvement ... in one day, without any exciting cause of public notoriety, ... was variously explained among the brokers and dealers." This advance in gilts prices was variously attributed to (i) the lessening threat of Chartist

upheaval (which historians generally regard as having been eliminated in the minds of the British elite only in June, and not after the fizzle of the Kennington Common meeting), (ii) the more stable conditions in France (and thus a lower danger of either war or trade disruption), or (iii) capital flight from continental Europe, where armed conflict was still raging in many countries.

The *Daily News* had the usual gossip, about the Bank of England unofficially discounting below its official rate, about market participants worried about new disturbances in Paris or Ireland, about capital flight leading to inflows to London, and so on. However, for a long time there was no explicit mention of the gilts pricing anomaly. But on 7 August the financial column carried a table showing how much various securities (several gilts and somewhat more railways) were yielding, based on their current market prices. (This table, with some variations, became a fixture of his column, appearing almost every Monday.) The entries were obtained by straightforward arithmetic, taking the interest or dividend yield of each security and dividing it by the market price of the day. At that time, CA and RA were trading at the same price, so came out in the table as having the same yield. The editor understood that this was somewhat misleading, so added some remarks, in his usual rather belabored and somewhat confusing style:

> It is to be observed, in respect of [RA], the rate of interest on which is the same as for [CA], and the ruling price the same also, that their real value ought to be plus the quarter's dividend, say [£0.75], which they carry more than [CA]. There ought, however, to be a difference of price corresponding in favour of [RA], because at present equalised rates with [CA] there is a difference, not noted in the calculation, in the rates of interest fractionally in favour of the former. The discrepancy between the two is only to be accounted for by the superior facility with which, beyond all other stocks, [CA] can be either bought or sold at the smallest differences of price.

There was a similar, even more explicit, although shorter, note about the advantages of RA accompanying next week's edition of the table: "[RA] are, *pro tanto*, the more advantageous investment by the [£0.75] additional interest which is due upon them." After a while, though, those notes about advantages of RA stopped appearing, and the tables that were published continued not to be adjusted for accrued interest.

As for NR, the yield tables started out misleading readers, and continued to do so. In all editions that were examined, the yield was computed by taking the nominal interest rate, 3.25%, and dividing it by the market price. This not only did not compensate for the accrued interest, but, far more seriously, did not take into account that the extra 0.25% would cease in October 1854. Hence, although NR was underpriced relative to RA and even more relative to CA, it was nowhere near as underpriced as the *Daily News* table indicated. None of the issues that were examined showed any awareness of the issues. There were a few suggestive items, though, that hinted NR might be underpriced. For example, the 24 June 1848 issue noted that £50 thousand in CA had been sold, but

> [n]o impression was, however, made by this operation. ... The Bank [of England] broker was in the market as a purchaser of [NR], and thus any unfavourable impression, that might have been produced by the sales of [CA] referred to, was counteracted by

> the greater weight attaching to action in a quarter so influential. ... For some days past [NR] has been scarce and wanted, probably owing to the recent purchases of the Bank broker.

Bank operations in the market were scrutinized very carefully in the search for hints of what the Bank officials might know, and also of the internal state of Bank affairs. The rumors published in the press about Bank operations, however, were quite often very wide of the mark, as the evidence about Bank operations in early 1847, discussed in the previous section, shows. (Most of the time, the Bank took some pains to disguise its operations, and this was facilitated by the fact that its broker, who was also the government broker cited elsewhere in the main manuscript and here, carried on business for other parties as well.) At this time, with the inflow of gold and other securities, Bank reserves were growing, so it was no surprise it would invest some in gilts. But why choose NR? The *Daily News* (and some other papers that carried similar gossip) did not say. When we look at the prices (see the tables), we find that NR was grossly undervalued relative to RA and even more so relative to CA. But we don't learn this from this paper (nor, it seems, from others, although there the scrutiny was much less thorough).

A very similar situation occured some months later. In the 20 February 1849 issue, the *Daily News* noted that "[t]he continued sales of money stock would seem to accredit the reports that the public are sellers of [CA], and, per contra, buyers of [NR], which have lately grown into much favour for investment." But there is not even a hint as to why NR might "have lately grown into much favour for investment." (It was again significantly undervalued relative to CA, by at least 1% of market price, as is visible in the tables. That was a smaller undervaluation than in the summer of 1848, but still significant.)

Thus the overall evaluation is that the financial editor of the *Daily News* was not very helpful in assisting investors in understanding gilts mispricings. However, to put this into context, we should consider the financial environment of 1848. After the big fluctuations of the first half a year, the big story was that of railways. Even as other markets were recovering, railway share prices kept dropping, to the consternation of most observers. This led to the railway share crash in October 1848, which is described in [63]. The *Daily News* was part of the consensus. Already in the 24 May issue, the financial column declared that the opinion on the Stock Exchange was that gilts were overvalued relative to railways. The yield tables that started to appear in August contrasted the gilts yields with those of railway shares, the latter usually at least twice the former. And then, in October, financial editor of the *Daily News* took the lead in pushing the Stock Exchange to muzzle the "dissections of railway accounts" that were being published in the *London Weekly Railway Share List* by Robert Lucas Nash the elder. As is described in [63], those "dissections" were far in advance of other financial analyses of that time. But, for precisely this reason, they were being blamed for sowing doubt in investors' minds about the value of railway securities. That the *Daily News* writer was in the lead in the move against Nash (and took the credit when it succeeded, when the Stock Exchange did prohibit the *London Weekly Railway Share List* from publishing Nash's analyses) shows that he was among the overwhelming majority of contemporary observers who did not understand the basic economic problem of the railway industry. Still, from that writer's perspective, the market showed dramatic

and to him unexplainable pricing anomalies, with railways yielding twice as much as gilts. Hence it was likely easy not to worry about small differences, of a few basis points at most, in the yield among gilts.

17 The press, the markets, and the trend back to rational pricing in late 1849

Fig. 1 of the main paper shows essentially fully rational relation in pricing of CA and RA for several years in the early 1850s. Inspection of the tables shows that this period stretched from mid-1850 through the third quarter of 1853. The first half of 1850 witnessed a gradual decline in CAm* - RA*. To investigate this evolution in more detail, daily prices were compiled from *CoE*. As it turned out, not much was learned from that period, and in particular no interesting newspaper articles were found. However, there was some interesting action also in late 1849, both in gilts pricing and in press coverage of this topic. Therefore daily prices were also obtained from 11 October 1849 (when trading in RA and NR resumed) to the end of that year.

Although railway share prices were at their lowest level at the end of 1849, as the protracted collapse of the Railway Mania was drawing to a close, the British economy was doing very well, and interest rates were dropping. The Bank of England rate of discount, which was lowered to 3% in November 1848, was lowered further to 2.5% on 22 November 1849, and remained at that level for a year. (Unlike today, with central banks controlling short-term interest rates, and lowering them in times of stress, during much, but not all, of the 19th century, low interest rates were associated with prosperity.) Market yield on CA dropped, with the price of CA, after subtracting accrued interest, jumping over 5% in November and December of 1849.

Section 15 showed that *Freeman's Journal* of 10 December 1849 noted that by that time, NR had jumped substantially relative to CA, but that it was still undervalued. Interestingly enough, when RA and NR reopened for trading on 11 October 1849, the price of NR tended to exceed that of RA by slightly more than £1.15, the value of the terminable annuity that was part of NR. So if we assume that pricing was rational, we could say that in mid-October 1849, the market was placing a very slight, but positive, value on non-callability of NR. However, pricing in general was not rational, as both NR and RA were underpriced relative to CA.

By the end of October 1849, the price of NR started slipping relative to RA, so that the value of non-callability became increasingly negative, reaching its local peak of irrationality at the end of November. But while this was happening, the pricing of RA relative to CA was becoming more rational. No press coverage of these developments has been found so far, at least not until the end of November. On 28 November, almost a week after the Bank of England lowered its rate, and after several days of record low underpricing of RA relative to CA, and record high underpricing of NR relative to RA (and therefore of record high underpricing of NR relative to CA as well), the *Daily News* noted that "considerable purchases" of RA had raised its price. However, it did not say whether this was the result of some chance moves, or a response to a great buying opportunity. The next day, *The*

Times was more explicit. Its financial column was rather emphatic, unusually so for that newspaper, or for other London dailies:

> Between the price of [CA] and [NR] there is a disparity which calls for notice in favour of an investment in the latter stock. [CA] are at [95.25], while [NR] are only [94.75]. The difference occasioned by the respective period at which the dividends are paid is now [0.75] on the side of [CA], but allowing for this, [CA] would stand at only [0.25] below [NR], which carry their present dividend for five years, with a guarantee for a further period of 20 years against any reduction below 3 per cent.—an advantage, looking at the existing prices of English funds and the possible contingencies of the Californian discoveries, that may before the expiration of this date prove not without a definite value.

(As an aside, it might be worthwhile to mention that there were widespread, although not unanimous, expectations that if California gold mines proved as productive as the optimists promised, interest rates would decline. Today, most people would expect an increased supply of gold in a financial system with a gold standard to lead to an increase in interest rates. But this is just one of the differences that have to be kept in mind when evaluating opinions and decisions in the 19th century.) This piece in *The Times* appeared to catch wide attention. It was reprinted in the *Chelmsford Chronicle* on 30 November, and in the *Manchester Courier* and the *Reading Mercury* on 1 December, and surely in many other newspapers as well. On the day *The Times* published its piece, the *Daily News* noted that NR "attracted more attention," without specifying what effect that had on prices, or whether NR did deserve "more attention."

So what effect did this flurry of press coverage, pointing out the irrational pricing of NR, have on the market? Judging from the price tables, none, at least not for a few days. Real change in the market took a week, and to the extent it was due to the press, it seemed to be associated with another work of journalism, a very poor one, as it turns out. On Sunday, 2 December, the *Observer* published a piece predicting that the next session of Parliament, to start in January, would see a move to reduce the interest rate on CA. (The *Observer* was not available for this study, so the 2 December date is deduced from the fact that this paper was a Sunday one, and that references to this piece started appearing during the following week. An apparently complete reprint is available, for example, in the *Manchester Times,* 5 December, p. 6.) This article (almost surely a leader) had several obvious factual errors, such as the claim that CA was about 90% of gilts. Moreover, the prediction that a reduction might take place soon was extremely optimistic, with the price of CA (stripped of accrued interest) a good 5% below par. However, the *Observer* was regarded as having close ties to the government (see, for example, the financial column in *Freeman's Journal* of 10 December 1849 that was cited earlier), so close attention was paid to it. But not right away. Perhaps there were doubts about the credibility of the article, and so its contents had to be digested, and inquiries made about the general topic. There was only a minor reaction in market prices or in the press for the first few days of the week following the publication of that piece. However, on Wednesday, 5 December, "[a] rumour of somewhat startling import was current amongst certain parties" on the Stock Exchange, concerning the possible reduction in interest rates on gilts[44]. Tables show NR falling relative to CA

that day, but then jumping the day after, and continuing to rise, so that by the middle of the following week it is no longer possible to assert with certainty that NR was priced irrationally, as the value of non-callability was no longer negative. There was substantial press coverage of this development. On 6 December the *Standard*, a London afternoon daily, reported, in a piece that was reprinted in the next two days by the *Dublin Evening Mail* and the *Newcastle Journal*, and therefore almost surely by other provincial papers as well:

> The leading topic of interest in the City circles is the impression which prevails that ministers seriously contemplate, amongst other measures for the relief of the distress of the country, the reduction of [CA and RA] to [2.5%]. There are various opinions entertained of its practicability, ... In connection with the subject, it is rather a curious anomaly that [NR], standing in the market about [0.375] lower than [CA], although the stock bears the extra quarter per cent. interest until 1855, besides being guaranteed against further reduction for twenty years from that state.

The Times wrote on 8 December:

> A large amount of business was transacted on account of parties selling [CA] and buying [NR], which latter stock, instead of being [£0.50] below [CA], as was the case a few days back, when we referred to their relative prices, is now [£0.125] above them.

Exactly a week later, the *Spectator* wrote (making a mistake in stating that NR was non-redeemable until 1884, 1874 was the correct date):

> [NR] have been in very great demand. The price of this Stock till very recently was always from [£0.50 to 0.75] below that of [CA]; but since the late rumours of the intention of Government to reduce the Three per Cent Stocks, it has been purchased very extensively, and the price of it is today about [£0.50] higher than that of [CA], nstead of being as heretofore below it. The reason is to be found in the fact of [NR], which will be reduced to 3 per cent in 1854, being irreducible below 3 per cent for thirty years from that period,–that is, till 1884.

What can be concluded from this episode at the end of 1849? The press got involved only at the end of the period of substantial NR underpricing, when natural market forces, aided by declining interest rates, may already have started to work. Newspaper coverage seems to have played a role in the dramatic upward turn in NR prices, but apparently more through a sensational and poorly prepared piece than through careful analyses. But it probably did contribute to the general information processing that led investors to the market activities that moved prices closer to rationality.

This rise in the price of NR relative to both CA and NR continued for several years, with the usual ups and downs. In the first half of 1850 this rise was accompanied by RA rising to a rational relation to CA. The price record does not reveal anything special, and the limited investigation of the press also failed to find anything interesting, at least so far. (As usual, a more detailed investigation may discover something valuable.)

18 The press, the markets, and irrational pricing in late 1854

After more than three years of apparently perfectly rational relative pricing of CA and RA, overpricing of CA reappeared at the end of 1853. Here we look at the end of 1854, a year later. That period turned up in online searches for newspaper coverage on gilts pricing disparities. Further investigation revealed rather interesting behavior of both prices and of the press.

At this time news was dominated by political and military events, as the Crimean War was in full swing, with the British, French, and Turkish forces landing in Crimea in September 1854. However, as the attack on Sevastopol settled into a long siege, the realization spread in England that the war would be longer and more costly than had been hoped for. Speculation was rising that the government would need substantial additional funding, and the £16 million CA loan described in Section 19 did follow in the spring of 1855. While money was generally plentiful, and the Bank of England rate of discount was lowered to 5% in August 1854 (to be lowered still further in April 1855), long term rates rose substantially in November 1854, and went only about half way back down the next month, as is shown in the interest rate tables.

The newspaper items that were found in the initial online search turned out to be direct reprints or rephrasings (sometimes with and sometimes without attribution) of an item in the financial column of *The Times* of 13 December 1854. It stated:

> The discrepancy between the price of [CA] and that of [NR] is attracting attention. Holders of the former are beginning to exchange into the latter, the transaction presenting not only a profit more than equal to three months' dividend, but also the advantage of obtaining stock guaranteed against reduction for twenty years.

Perhaps because it appeared in *The Times*, and perhaps because editors of other papers were already sensitized to the issue, this item was reprinted very widely. The next day (14 December) it appeared in *Freeman's Journal, Inverness Courier*, and *Trewman's Exeter Flying Post.* The day after that, it was published in *Belfast News-Letter* and *Liverpool Mercury,* and the following day, in *Hampshire Advertiser*. Given the still limited digitization of 19th century British newspapers, it is almost certain that it appeared in many more papers. It may also have helped stimulate coverage in the *Economist* and the *Spectator* of 16 December, both of which mentioned in their financial columns that investors were exchanging CA for NR, and both of which used language very similar to that of *The Times*. In a similar but slightly different tone, which again may have been prompted by *The Times* piece, the *Daily News* of 15 December claimed that "[e]xchanges continue to be made of [CA] into [NR and RA], which are relatively cheaper than the first-named stock."

However, while *The Times* coverage of gilts mispricing was the one that attracted wide attention, it was far from the first, or from the most persistent. The *Morning Chronicle* raised the issue more than two weeks earlier, and kept pounding away at it, unlike *The Times* which had just that one mention on 13 December. The coverage in the *Morning Chronicle* is worth citing at length, as it illuminates the views of financial journalists of that period. In the 28 November issue we find the passage:

> ... the downward tendency is for the present checked by the approach of the period when the transfer books of [CA] close for a period of about four weeks, ... As usual at this period of the year, therefore, the public are buyers of [CA], for the purpose of obtaining an early dividend or return of interest for their investment. In such cases they pay little attention to the ruling price of Stock, or to the fact that after the 7th December the Stock will be quoted with the dividend off. It is in consequence of these operations that there is now a difference, after allowing for interest, between [CA] and [RA] of about [£1.00] against the former. Both give a 3 per cent. dividend, and are consequently intrinsically worth about the same; but the anxiety of the public to obtain a dividend at an early day induced them to buy [CA] at say 92, while [RA] are to be had for [90.25]. This, after allowing for the three months' interest on the latter–namely, from January to April–gives the latter an advantage over [CA] of [£1.00] saved in the purchase-money for every £100 of Stock. It may here be mentioned that there is now a difference of [£0.125] between the price of [RA] and [NR], the latter being so much higher in consequence of being guaranteed free from further reduction of interest for twenty years, say from 1854 to 1874.

This piece reflects a belief, common at the time, that investors were short-sightedly chasing after quick payouts of interest. But it also shows lack of awareness that CA overpricing had by then been in place for a year. If the writer's argument had been correct, then in July and August, after the payment of CA interest, RA and NR should have been overpriced relative to CA, but that was simply not the case. Overall, though, this writer did identify the high degree of overpricing of CA that existed, and presented it as a buying opportunity.

The columns of 9 December and 11 December in the *Morning Chronicle* also stated briefly but explicitly that RA and NR were less expensive than CA. Then, on 16 December (so after the appearance of the *The Times* piece), we find the passage:

> The principal dealings have been in [NR], which, we remarked last week, are at the present moment a more eligible channel for the investment of money than even [CA], the price being lower, and the stock having three months of dividend due upon it. The public and other operators have, since our former notice of the subject, been purchasers in it to some extent; and there is now nothing like the difference between the quotations of the two securities as existed last week. The dealings to-day ... [RA] were done at ... This stock, which has also three months of dividend due upon it, is also, at the present price, a more eligible stock as an investment than [CA], yet the latter, it will be seen, continue to rise. Private capitalists are, however, beginning to understand this subject much better, and act accordingly.

A few days later, on 20 December, the *Morning Chronicle* wrote that

> [t]he principal feature to-day in the English Stock market has been an extensive range of dealings in [RA] ... [NR] were operated in at ... The former is, therefore, the cheapest security for investment, but it has not the guarantee, like [NR], of being free from reduction for a fixed period. In the present state of the Money market, this is, however, just now of but little consequence.

Two days later we find a report that investors had been moving money from [CA] to [NR].

Thus at the end of 1854 we find a high degree of CA overpricing, and also extensive press coverage that draws attention to it as an anomaly offering enticing investment opportunities that some shrewd operators were already taking advantage of. But what effect did this have on prices? Even the daily closing prices that have been collected (and are available in the tables) have considerable scatter that makes it hard to see trends. The cleanest picture that has been obtained comes from the collection of closing quotes from 5 November to 20 December that were printed in the financial column of *The Times*. After some reasonable "massaging" (which is detailed, along with the raw data, in the tables) we find that on 28 November, when the first, extensive, *Morning Chronicle* piece appeared, CA overpricing hit a new local record, up by 0.125 from the previous day. It then basically remained at that level until 13 December, when *The Times* published its piece in the morning. On that day, NR jumped by 0.25 relative to CA, and by 0.125 relative to RA. The trend continued, so that by 20 December NR was up 0.50 relative to CA, and by 0.25 relative to RA. However, RA remained underpriced by 0.75 relative to CA, and NR by 0.375 relative to CA, even if we disregard the value of NR being non-redeemable until 1874.

During this period, say from 20 November to 20 December, there were no dramatic changes in the political, economic, or financial areas. Therefore the conclusion suggests itself that the persistent arguments for rationality from the *Morning Chronicle* had no effect. On the other hand, the results were different when *The Times* got involved. This newspaper was a uniquely influential press organ, with a circulation in 1854 about twice that of all the other London dailies put together. It was blamed by many for dragging the UK into the Crimean War, and for toppling a ministry during that conflict, When "The Thunderer" (as it was nicknamed) pointed out the gilts mispricing, even if only in the form of two not very emphatic sentences, its voice, amplified by a multitude of reprintings in other papers, appears to have managed to drag the markets back about halfway towards rationality. (They remained at that half-way point until about the middle of 1855, when the relative pricing of CA and RA became fully rational again, although only for a short period.)

Was it just the action of *The Times* that reduced the irrational overpricing of CA? It could have been that its piece just precipitated a market shift in sentiment that was already imminent and inevitable. After all, *The Times* did not claim to have suddenly discovered this overpricing, rather it recorded the fact that some investors were already taking action by switching from CA to NR. Contemporary critics of this paper (of whom there were legions) often claimed that "The Thunderer" did not so much shape public opinion, but rather that it cleverly figured out which way the thinking of the British elite (who were its audience) was moving, and then jumped on the bandwagon before others realized it was a real bandwagon. It may have been the same way with gilts mispricing. Perhaps the volume of transactions and discussions became high enough by 12 December for *The Times* financial editor (Marmaduke Blake Sampson at that time) to sense this was going to be important, and to write about it, and that the partial return to rationality might have occurred anyway, even without this paper's intervention.

We can try to gain more insight into British financial journalism and its treatment of the gilts pricing anomaly by considering the *Morning Chronicle.* This paper was still prominent, although far less influential than it had been two or three decades earlier, when it was the main competitor to *The Times*. Between 28 November and 22 December, it published 6 passages that explicitly pointed out that RA and NR were better investments than CA. To put this into perspective, all the financial ("money market," or "City article") columns in this paper from July 1854 through January 1855 were examined. The only ones that mentioned gilts mispricing explicitly were the 6 at the end of 1854. To obtain a better feel for what this means, let us consider a single issue of that paper, from 3 August 1854. (With more work, one could compile statistics, but this example might suffice as an illustration.) That issue had 8 pages, of 6 columns each. Most of the economic and financial coverage was on p. 3, and occupied 4 columns. One of those columns was devoted to railways, and another to share tables (which were dominated by railways). The remaining two columns, of about 3,500 words, were the main financial column, and reports on share and commodity markets in other cities. Those two columns had the transaction prices for the main gilts and a handful of other securities, and a paragraph about gilts (which was a regular feature) which is reproduced here in full:

> ENGLISH FUNDS.—The tone of the English Stock market to-day has been very heavy, principally under the influence of large sales of money stock, and prices have fluctuated in value about $\frac{1}{2}$ per cent. Consols were done early in the morning at $92\frac{5}{8}$, but they afterwards fell to 92, and finally closed at about $92\frac{1}{4}$ to $\frac{3}{8}$. The Reduced Three per Cents., after having been operated in at $92\frac{3}{4}$, fell to $92\frac{1}{8}$, and closed at $92\frac{1}{4}$ to $\frac{3}{8}$. In the New Three-and-a-Quarter per Cents., the dealings were at from $93\frac{3}{8}$ down to $92\frac{7}{8}$. Exchequer-bills keep steady at par to 3s. prem.; Bank Stock is rather flatter, being now $209\frac{1}{2}$ to $211\frac{1}{2}$; India Stock, 222 to 226.

That CA and RA both closed at 92.25 to 92.375 immediately says that CA was overvalued by £0.75. The same conclusion follows from inspection of the transaction prices at the end of the column. But that of course requires a little financial sophistication, in being able to figure out what the accrued interest was, and some knowledge of just how the gilts were priced (with interest, unlike the Dublin Stock Exchange), and that CA and RA were equivalent. For a reader without decent familiarity with these issues, the numbers given in this issue of the *Morning Chronicle* would have been meaningless.

But how much more could be expected? The length of the "English Funds" paragraph reproduced above was fairly typical around that time. Given the space limitations, and the need to cover prices of a variety of financial instruments and commodities, as well as shareholder meetings and the like, could one expect a conscientious financial editor to devote much space to the overpricing of CA? That the *Morning Chronicle* carved out enough space for the 6 passages at the end of the year, a couple of them quite lengthy, could be taken as a sign that this paper's editors regarded the topic as having substantial public interest. On the other hand, the overpricing of CA at that time was not all that much higher than it had been in four months earlier.

The pattern outlined above is a common one. We saw some examples of this earlier, and will see some more later. A British newspaper ignores gilts mispricing for a long time (at

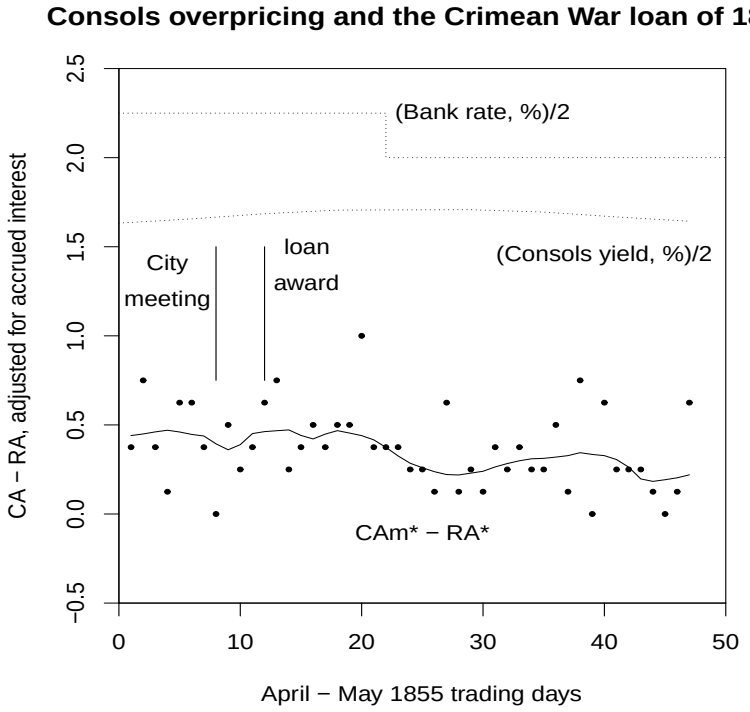

Fig. 6. Overpricing of Consols relative to Reduced Annuities in 1855, based on daily closing prices adjusted for accrued interest, Bank of England discount rate divided by two to fit the graph, and market yield on Consols, also divided by two.

least in its verbal coverage, price tables usually provided mute testimony in every issue), just like its competitors. Then it provides some coverage of the phenomenon, sometimes just a single mention, sometimes, especially where a change in degree of mispricing has taken place, over a period of time. And then it goes silent on the issue. In the meantime, other papers sometimes join in, and sometimes completely ignore the topic.

19 Crimean War loans of 1855–56 and Consols overvaluations

The British government took out three loans in 1855–56 to pay for the Crimean War. All were in CA, the overvalued gilt. The first loan, the only one in 1855, created an additional £16 million of CA, or an increase of about 4% of the total volume of that security.

Fig. 6 shows CA overpricing based on daily closing prices of CAm and RA between 7 April and 1 June 1855. The scatter plot shows the values of CAm* - RA* for each day, the solid line is a smoothed version, and the dotted lines are the Bank of England discount rate and the market yield on Consols, each scaled by two to fit the figure. The first vertical line marks the meeting of the Chancellor of the Exchequer with leading financiers on Monday 16 April to announce the terms of the auction. Accurate estimates of how much money the government would need had been made by various observers, but there was uncertainty as to the financial instrument that might be used, and it was at this meeting that the

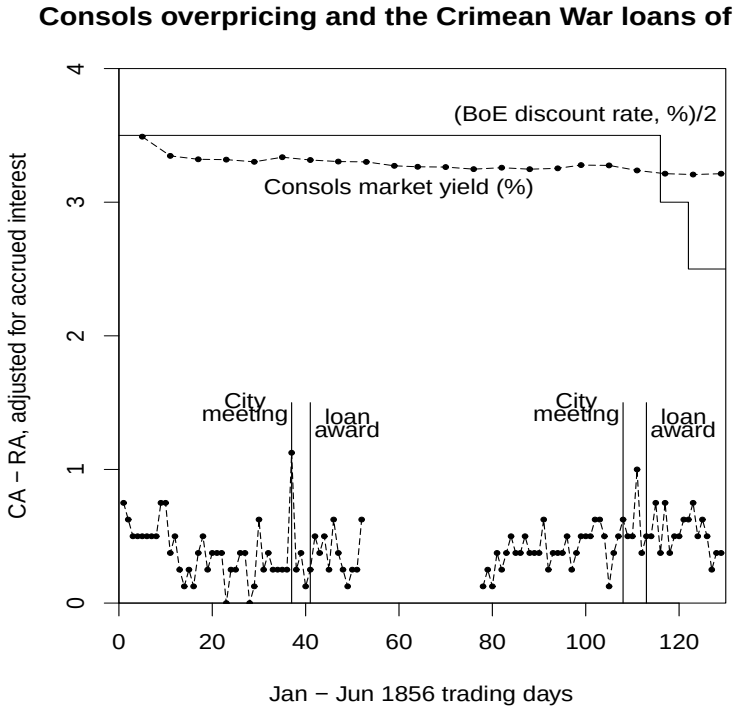

Fig. 7. Overpricing of Consols relative to Reduced Annuities between 7 January and 6 June 1856, the two Crimean War loans of that period, and long and short-term interest rates. Values of CAm* - RA* based on daily closing prices from *CoE*.

official announcement was made. The second vertical line marks the auction day, Friday 20 April. The CA overpricing was not very large at that time, so the pricing increments of 0.125 lead to substantial scatter. Still, the impression one obtains, say by looking at the smoothed curve, or taking runnning averages that discard outliers, is that the overpricing did decrease after the loan award, but not very much. One could also attempt to attribute this development to the declining interest rates and perception that the Crimean War was going to be concluded soon.

Additional loans were incurred in early 1856. At that stage the war was basically over, but there were expenses of winding it down, so the British government borrowed twice. In each case it asked for £5 million in cash, which was obtained by issuing £5.6 and 5.4 million in CA, respectively. The loans were awarded on 22 February and 19 May. Each award negotiation was preceded by the usual meeting of the Chancellor of the Exchequer with top financiers to specify the rules for the financings.

The overall economic environment was benign, with interest rates dropping, as is visible in Fig. 7. The premium in pricing of NR relative to RA, NR - RA, which should have reflected the value of NR not being callable until 1874 in case of further substantial drops in long term rates, grew from about 0.5 in January to 0.6 in February, and almost 0.8 in April (before dropping, somewhat surprisingly, to 0.5, in May). According to press reports, there was brisk demand for the CA offered by the government.

Each loan boosted the supply of CA by a substantial amount (close to 1.5%). However, this did not appear to decrease the overvaluation of CA relative to RA. Just the opposite, it appears from the data that this overvaluation grew slightly after each loan award.

The two anomalously high values of CAm* - RA* were confirmed by several sources, and can probably be disregarded as representing some unusual transactions. They do not affect the general conclusions.

20 The jump in gilts mispricing in the spring of 1860 and the press

In 1860, CA overpricing during the second period when CA and RA both traded (basically April and May) was almost double that of the first period. Daily final trade data was collected for the tables, and show a sudden jump on 18 April. One possible exogenous event that might have stimulated this jump was the famous tussle between the discount houses and the Bank of England, when the former withdrew large balances from the former for a few days, causing some monetary disturbances. Another was the discovery of the Pullinger defalcation from the Union Bank, which may have shaken faith in the banking system. (The stolen sum, about quarter million pounds, did not bring down his bank, but, compared to the size of the economy, was comparable to $5 billion for the U.S. or £500 million for the UK today.) Possible causal relationships between those events (and another one that occupied much attention in the financial press, a large loan for Australia) and the jump in gilts mispricing have not been explored yet. What has been explored was press coverage of this development, or, more precisely, lack of such coverage. The *Economist* did cite CA overpricing on 28 April, but did not mention any large recent change. (The relevant passage just noted that RA and NR were "still relatively about [£0.75] cheaper than CA.") This was part of a longer campaign by this paper to restore rational pricing to the gilts market, which is detailed in the next section.

The financial columns of several London daily papers were scrutinized in issues between 16 April and 27 April. *The Times* had just one reference, a sentence in the 26 April issue that said "[a] sale of [£100,000 of CA] was effected, and the proceeds invested in [NR], owing to the advantage presented by an unusual disparity in the respective prices." There was no indication whether this "disparity" was a new, or a more striking, phenomenon than before. The *Morning Chronicle* published nothing about gilts mispricing, and neither did the *Standard.* The *Morning Post,* just like *The Times*, had just one brief note that was relevant, although it was even weaker. On 21 April, it noted that gilts prices were holding up well, "though there has been a good supply of [RA and NR] on the market." Nothing at all was said about the effect of this "good supply" on prices (although, of course, readers who had saved their copies of this paper from earlier days could make comparisons, and even with just that issue, could easily compute the degree of CA overpricing). The only one of the dailies that were examined that had any substantial coverage of this issue was the *Daily News.* In that paper we do find extensive treatment of CA overpricing:

– 10 April: "The dealers appear to be well supplied with [NR and RA], which remain relatively cheaper than [CA]."

- 14 April: CA was scarce, "while the supply of [RA and NR] continues ample"
- 17 April: "In the Stock Exchange, owing to the loans already effected, there was no demand for money in the [CA] market, and the nominal rate scarcely exceeded [1 too 2%]. On [NR and RA] the terms were [3 to 4%]."
- 19 April: "Allowing for the accrued dividend, [CA] are now about [£0.75] dearer than [NR]."
- 26 April: "There were some exchanges to-day from [CA] into [NR], in consequence of the relative cheapness of the latter."

Moreover, the *Daily News* made its coverage of gilts mispricing prominent, by putting it either into the introductory first paragraph of the entire financial column, or in a separate paragraph. But it was unique among the examined papers in providing any coverage at all. Thus this incident provides another example of a more general phenomenon, namely that gilts mispricing was not regarded as a major issue by the press, and only occasionally led some papers to devote some attention to it, but usually only for a while.

The *Daily News* had more coverage of CA overpricing that year. While its financial column was not scrutinized carefully for that full period, this anomaly was also cited on 2 June, 12 June, 16 June, 14 July, 29 November, and 19 December 1860, and quite possibly on other occasions as well.

21 Attempts by the *Economist* to induce rational pricing

The preceding section cited the *Economist* as one of the papers that did reference CA overpricing in April 1860. This was just one incident in a long and strident campaign by this paper to awaken investors to what seemed enticing arbitrage opportunities in 1859–61. In its "Bankers' Gazette" section, from which much of the data for this paper is taken, the *Economist* each week had commentaries on the action in various financial markets, including gilts (which were referred to as the "English funds" there, and had a paragraph devoted to them with this title). In 1859, overpricing of CA relative to RA was modest for the first half of the year, averaging slightly over 0.25, the level where outside speculators could just barely hope to profit from arbitrage. (All averages cited here are based on the final trades of each Friday.) But then this overpricing started growing, more than doubling to a level of about 0.60 in the fourth quarter. This brought a brief comment from the *Economist* that RA and NR were "relatively a good deal cheaper than" CA[45]. In the first quarter of 1860, overpricing dropped slightly, but in the second quarter it jumped to a level of about 0.90. In April 1860, this led to a comment that RA and NR were about 0.75 cheaper than CA[46]. A similar comment was printed in June. A couple of weeks later this section returned to the subject in more detail, this time with an emphatic recommendation for action:

> We drew attention to great disparity in price which has existed for some time past between [CA] and [RA and NR]. It was at that time nearly [£1.00] in favour of [CA], since that period it has diminished to [0.75]; but there is still that profit to be obtained by the investor, or those who have [CA], by the exchange of them for [RA

> or NR]. It is a remarkable circumstance that such a disparity in price should exist, ...

A week later this section noted a slight further narrowing of the disparity, but claimed "[t]here is still, however, a profit ... to be obtained by the exchange of [CA] for [RA and NR]; and we understand the Court of Chancery has made the exchange to-day of about ..." Over the next few weeks, there were notes about continuing convergence of pricing of CA and RA, leading to a note that seemed to be trying to take credit for this development:

> The price of [RA] is ..., consequently it is only [£0.25] cheaper than [CA], instead of [£1.00], which was the difference when we first drew attention to the subject. It is evident the public took advantage of this difference of price both for exchange and for investment.

But the triumphal note soon disappeared, as the pricing disparity reappeared. There were occasional notes on the topic, such as the one in November, that "[w]e must again call attention to the great disparity in price between [RA and NR], compared to [CA]," at a time when this disparity was back at around £1.00.

In some weeks, one can detect a sense of exasperation, as in the following passage, which is written as if to simpletons, laying out in great detail how easy and profitable it is to make money:

> We must again draw attention to the great disparity which exists between the price of [CA] and [RA and NR]. [CA] are ..., whereas ..., consequently any one selling [CA] for money, and buying [RA or NR], would receive their dividend *at once*, pay commission, save ... income tax, and receive their dividends in April instead of July.

However, it appears that not enough people paid heed as prices did not behave rationally, and the overpricing of CA compared to RA, which averaged about 0.7 in 1860, grew to about 1.1 in 1861. Apparently the editor of that section (assuming it was the same person throughout this period) just gave up in face of markets that were insensitive to reason. In 1861, we find only some brief comments, such as

- "The public continue to sell [RA and NR], which are, therefore, now quoted relatively lower than [CA]."
- "[RA and NR] have likewise receded, and are now relatively much lower than [CA]." (This was on a day when the disparity reached the extremely high level of £1.50.)
- "[RA and NR] have been more in demand than [CA], and the prices of the former are now relatively less unfavourable than last week."

However, such comments about mispricing of CA were much rarer than in 1860, and the emphatic pointers to profitable arbitrage opportunities were gone. The *Economist* did not indicate whether any readers complained about losing money by following this journalist's advice to switch to the cheaper RA, only to watch it getting yet cheaper.

One point of this section is to provide a perspective on the treatment of gilts mispricing in the press. The Bankers' Gazette section of the *Economist* (or, to be more precise, the "English funds" paragraph in it) was examined for all issues from the beginning of 1858 to

the end of 1865. The first mention of CA overpricing that turned up was in November 1859, and was cited at the beginning of this section. It is natural to suspect that it was prompted by the sudden jump in mispricing. Once that appeared, we find a year and a half of fairly frequent and often emphatic messages to readers that something unusual is happening that offers a tempting investment opportunity. However, there were also substantial changes, both up and down, in CA overpricing in 1858 and the earlier parts of 1859, which did not bring any reaction from the *Economist*. Was this the result of a new financial journalist taking over? Or was this because the level of mispricing in 1858 had been too low to merit mention? It is not that all perceived mispricings were ignored. For example, the 19 June 1858 issue has a note about French annuities going up, while British gilts went down:

> The explanation of this diverse movement is probably to be found in the enormous discrepancy which has long existed between the price of the British and that of the French 3 per Cents. The difference is still no less than 27 per cent.

Clearly a difference of 27% is vastly larger than one of 0.5% (which is roughly what it was between CA and RA at that time). On the other hand, moving from CA to RA was risk-free, which could not be said for moving from CA to French annuities.

After the flurry of strong messages in 1860, often in very pointed terms, we find just a few in 1861, and another handful in 1862. (For example, the 5 July issue of that year noted that RA and NR "remain considerably below [CA].") After that, though, there was nothing in any of the years 1863–65, even as CA overpricing essentially doubled to a record in mid-1864, and remained at a high level. (It should be noted that this applies just to the "English Funds" section of Bankers' Gazette, there may have been other places where the subject may have come up. As one possible example, a leader about securities issued by the government of Britain's East India colony, noted that CA are popular because of their great liquidity, "and at all times ... bear a greater proportionate value"[47]. This may have been meant to include CA overpricing relative to RA.) Perhaps a different editor took over that section, or perhaps the same one continued, but decided it was not worth devoting any further effort to this topic.

The main point of this section is to show that there was at least one prominent and highly respected publication that noticed the CA overpricing of that period and tried over an extended period of time to induce rational behavior in the market. The market, however, refused to behave rationally.

22 The Overend Gurney crisis of 1866

The year 1866 is notable for the collapse of the British speculative mania of the mid-1860s, centered on banks and railways (again). The height of the panic came in early May, when Overend, Gurney, and Company, the giant London discount bank, stopped payments, forcing the government to suspend the gold standard (for the third time since its enactment in the strict form of the 1844 Bank Act, after the first two suspensions of 1847 and 1857).

Interest rates on gilts did not vary much during the year, and ended up lower than they began, as is visible in Fig. 8. This was unlike the 1847 financial crisis, discussed earlier, but

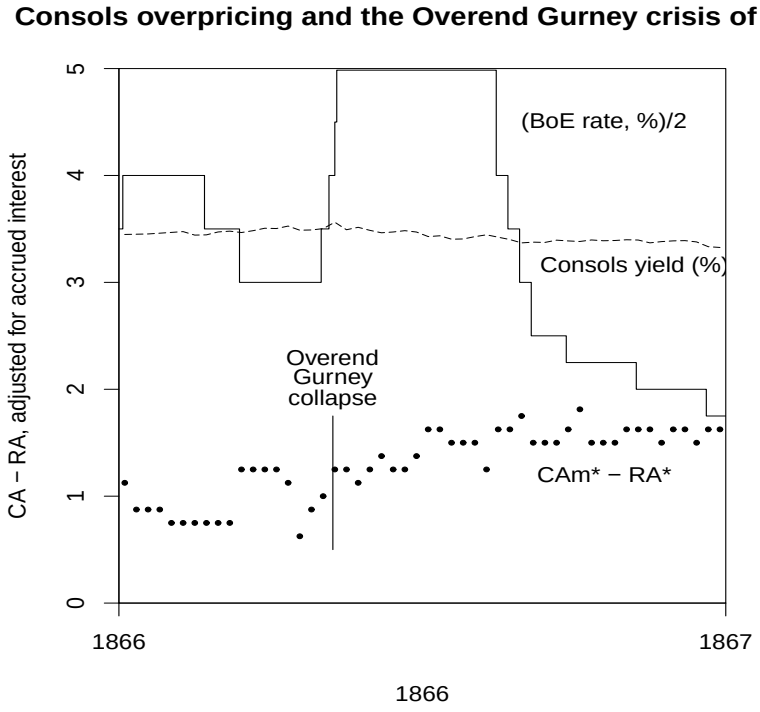

Fig. 8. Overpricing of Consols relative to Reduced Annuities during 1866.

similar to the 1857 one. It appears that by the mid-1850s, investors were rather confident of the stability of the British system and of the low probability of major wars, cf. Section 33, and so gilts were perceived as stable repositories of value. Any desperate dumping of them in order to obtain cash was counterbalanced by a "flight to quality." On the other hand, short term rates did vary wildly. The Bank of England rate of discount, shown in Fig. 8 at half its value, to fit it into the scale of the graph, was raised several times in the runup to the Overend, Gurney collapse, and went to the unprecedented level of 10% per year when the gold standard was suspended. (Walter Bagehot, the famous editor of the *Economist* at this time, appears to have based his famous advice that in a crisis, central banks should lend freely to solvent creditors, largely on the experience of this event, as well as the preceding ones of 1847 and 1857.) Although the Bank rate stayed at the 10% level for three months, commercial discount rates declined rapidly soon after the crisis, and by the end of the year, were far lower than at the beginning. (They would decline further, with the Bank rate reaching what was up to then a record low level of 2%, one that had also held for parts of 1852–53, in mid-1867.)

The overpricing of CA was at a high level at the beginning of 1866, although far below the extremes reached in 1864. Fig. 8, based on Friday closing quotes from the *Economist*, is somewhat ambiguous as to what happened just before the Overend, Gurney collapse. The daily closing price data from *CoE,* available in the tables, shows that during the five weeks preceding the week of the collapse, CAm* - RA* averaged £1.04, and in the three weeks that followed the week of the collapse, it was £1.15. However, as time went on,

and the financial system stabilized, this overpricing grew, and in the second half of the year averaged £1.57 (based on the Friday closing quotes from the *Economist*). This is consistent with the conjectured scenario from the main paper. The great mass of investors gets frightened by the financial turmoil, and so increases its preference for CA, the better known, more prestigious, and therefore safer security. However, this preference, or at least its effect on prices, is slow to develop.

23 Decline of irrationality in late 1883

Fig. 1 of the main paper, based on annual averages of the overpricing of CA relative to RA, shows something close to rational pricing in the last few years before the Goschen conversion. A detailed inspection of the source tables demonstrates a fairly quick transition at the end of 1883. CA overpricing went from a fairly steady level of £0.625 down to about £0.25, which then dominated (with some interesting exceptions in 1884, detailed in the next section) until the end of 1887. A plausible argument can be made that this drop in overpricing was due to investors deciding, with some delay, that a short government announcement of a seemingly free gift to holders of a particular gilt was a prelude to a conversion of the major gilts. As with other cases where the prospect of conversion led to greater pricing rationality, this then led investors to curtail their preference for CA (but not completely, as it remained overpriced by £0.25).

Financial markets were very placid in late 1883 and early 1884. The Bank of England rate of discount was lowered to 3% in September 1883, and stayed there until February of the next year, and then, after a few changes, it was lowered all the way to 2% in June 1884. Long term rates, as measured by market yield on CA, hovered near 3%. That, however, was surely due primarily to concerns about conversion, and Klovland's adjusted long term yield shows a declining trend from 2.871% in July 1883 to 2.701% in July 1884 [46]. National debt conversion was frequently discussed in the financial press. For example, between June and December of 1883, the *Economist* had more than half a dozen articles, or letters to the editor, that had "national debt," sometimes combined explicitly with "reduction," in their titles[48].

Fig. 9 shows the relative pricing of CA and RA, and also of CA and C25, the 2.5% annuity (one of the minor gilts to be discussed in Section 61) that had been introduced by Gladstone in 1853. It paid interest on the same days as CA, namely 5 January and 5 July, and had nominal capital of only about £10 million. The data came from the closing quotes in the *Economist*, and the difference CAm - C25 is decreased by a constant 10.5 in order to make the price variations visible. This figure shows prices for the period 26 October to 1 December. The tables cover the longer interval from 12 October to 21 December, and show even more strongly the extreme placidity of the financial environment of that day.

CA overpricing, CAm* - RA*, was a constant 0.625 on all trading days between 19 October and 16 November. Not only that, but there was little variation in prices of these individual securities. As an example, from 18 October through 25 October, all three prices, CAm, RA, and C25, were the same from day to day. (As usual in this work, this analysis is based on the closing bid prices. There were a few variations in closing ask prices, possi-

bly typos, but possibly real variations. NR was quoted identically to RA throughout this period, so is not mentioned here.)

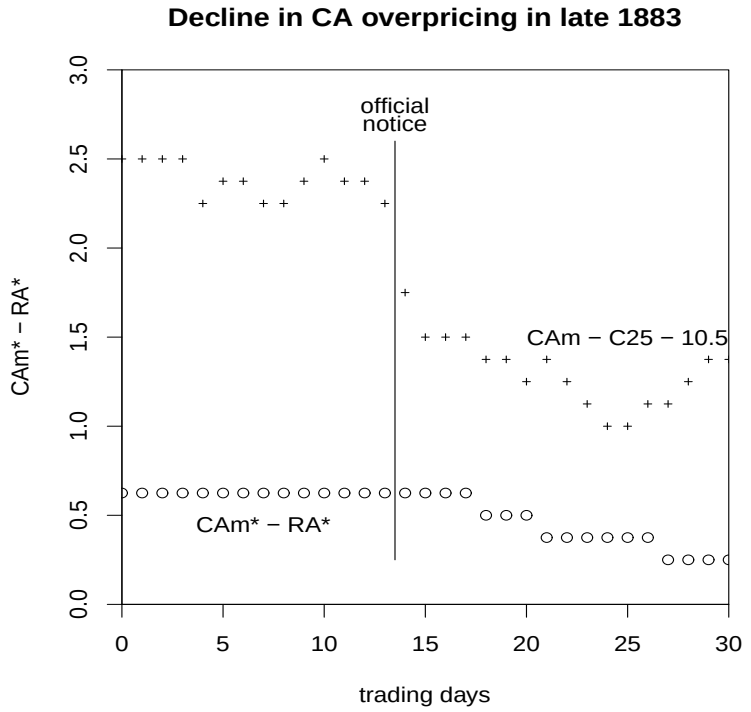

Fig. 9. Decline in the differential between CA and RA, and between CA and the 2.5% annuity, during the 31 trading days between 26 October and 1 December 1883. Prices taken from the closing quotes in the *Economist*.

If CA and C25 were irredeemable risk-free annuities, rational pricing would make CA exactly 20% more valuable than C25. With prices of C25 roughly in the range of 88 to 90 during this period, that would have called for CA to be priced around 106 to 108. (We ignore accrued interest in these rough calculations.) The observed prices of CAm were instead in the range of 100 to 102. That suggests that investors were taking the prospects of CA redemption seriously, and is the basis for the computation of adjusted long-term interest rates by Klovland [46] and others before him. Such considerations were definitely discussed in the press at the time. Thus one newspaper wrote at the start of 1883:

> The disposition of the public is now rather in favour of purchasing [C25], in view of a possible conversion of the debt some years hence; and, as the figures set forth show, the sacrifice in interest is not large. ... A conversion sooner or later seems practically a certainty, ...[49]

The differential CA - C25 did oscillate more than the overpricing CAm* - RA*. The likely reasons were the lower liquidity of C25, and the high sensitivity of the prospects of redemption of CA to changes in interest rates and to political concerns. Still, changes in CA - C25 tended to be modest. But there was a striking exception, visible in Fig. 9, when on

Tuesday, 13 November, CA - C25 dropped by 0.50, and a further 0.25 drop followed on the following day. (There was also a small drop of 0.125 on Monday, 12 November, that may or may not represent a leak of information.) Financial commentators all attributed this change to an official notice issued by the government in the evening of 12 November. This notice said that, starting in 1884, interest on C25 would be paid quarterly[50]. If C25 were irredeemable, and evaluated according to the canons of modern finance, as the discounted value of its interest payments, the switch to quarterly dividends should have enhanced its value by just about £0.3125. However, over those two days, Tuesday and Wednesday, the market price went up more than £0.75. (The prices of CAm and RA also went up 0.125, so the gain in C25 was 0.875.) So it appears (as claimed by contemporary financial commentators) that investors took the gratuitous gift of quarterly dividends on C25 as a sign that the government was trying to make this security more attractive in preparation for conversion of the major gilts, and marked up C25 relative to CA and RA. (The authority for such a change was provided by a law passed by Parliament in 1882, so this should not have been a complete surprise.) They were not valuing C25 just on the basis of discounted cash flows, but rather on how it might fare compared to other investments.

The notice of quarterly interest payments on C25 had no visible effect on CA overpricing for a few days. But then, on Saturday of that week, it dropped from 0.625 to 0.50, and then proceeded to drop, in steps of 0.125 each time, to 0.25, which then persisted as the standard value for a long time. (There were some variations, as might be expected. On the 5th, 7th, and 12th of December it dipped down to 0.125, and on the 19th it popped up to 0.375.) The most likely explanation is that investors, who quickly incorporated the quarterly interest payment notice into their evaluations of C25, were slower to think through the implications of that move for the relative pricing of CA and RA. But once they decided that conversion was likely in the near future, a conversion that would almost surely treat CA and RA the same way, their irrational attachment to CA was weakened, and prices moved closer to the theoretically expected relationship.

A puzzling observation is that the price of C25 had moved up, relative to CA, by more in the first half of 1883 than in November of that year. Yet that move, which it is natural to ascribe to expectation of an imminent conversion, did not lead to any noticeable change in CAm* - RA*, which stayed close to the 0.625 until November.

24 The Childers gilts conversion of 1884

In 1884 Hugh Childers, the Chancellor of the Exchequer of the time, attempted to convert part of the national debt. Prices of CA, RA, and NR had been close to their nominal value since the end of 1880, and he and many others felt it was time to move towards reducing the interest rate on gilts. He offered holders of CA, RA, and NR the voluntary option of converting into lower-rate gilts. For £100 of nominal value of any of CA, RA, or NR, he offered either £102 of 2.75% gilts, or £108 of 2.5% gilts, both to pay quarterly dividends. (The language used here is rather loose. Childers could not legally offer the investors anything, he could only propose the measure, as it then had to be enacted by both houses of Parliament, and receive Royal Assent from Queen Victoria. However, except for minor modifications, Childers' measure, like those of other officials in his position when dealing

with debt conversion, was carried through.) The new 2.5% gilts were to be consolidated with the existing ones created in the Gladstone conversion of 1853, which, by the notice described in the preceding section, had recently been given the nice bonus of quarterly interest payments entirely gratis.

Childers stressed from the beginning that his conversion was to be a voluntary one[51]. Comments in the press, often reflecting views of the finance industry, were not very favorable from the start, and in the end the offer did not attract many takers. Under £22 million of nominal value in gilts was converted in total, with more than half of that coming from funds controlled by the government.

The purpose of this section is to consider the effects of the Childers scheme on gilts mispricing and what those effects say about efficiency and rationality of the gilts market. In early 1884, before his speech, RA and NR had been quoted identically, and almost invariably £0.25 below CA (when adjusted for accrued interest). (See the preceding section for a description of how the premium carried by CA declined from about £0.625 to £0.25 in November 1883, almost surely based on anticipations of some conversion move by Childers.) Unlike Lowe in the 1870 proposal, but like Goschen in 1888, Childers decided to ignore the difference in market valuations between CA on one hand, and RA and NR on the other[52]. However, his speech presenting the scheme led to immediate and drastic divergence in the prices of those gilts, a divergence that took about two months to be be reversed.

It appears that holders of the three main gilts felt that each one could only be redeemed all at once. Furthermore, investors in CA and RA had the extra benefit that they had to get one year's notice before redemption. This meant that they might not only enjoy the benefits of the 3% interest rate for an extra year, but that the government might be more reluctant to move to redeem their holdings because of the financial risks of such a more. By giving the required notice, the government would be exposing itself to the danger of interest rates rising during the coming year, so that by the time redemption took place, it might have to pay far more than anticipated for the gigantic sums required to pay off investors. (That is what happened to Gladstone's redemption of South Sea securities in 1853–54, where the government was a loser to the tune of about 10%.)

The general expectations of essential irredeemability of the major gilts were reinforced by some highly respectable authorities. A particularly vocal one was John Gellibrand Hubbard, MP[53]. He had been a director of the Bank of England since 1838 (and some decades earlier its governor for a couple of years), a member of the Political Economy Club, and a few years later was made Baron Addington. His obituary in *The Times* noted that he "was an eminent City magnate for many years. ... At the House of Commons during his long career as a member Mr. Hubbard was a frequent attendant, and though he did not speak often he was well listened to on commercial and financial subjects, and notably upon the subject of the income-tax."[54] A frequent writer of letters to *The Times*, he already responded in 1883 to claims of Childers that interest rates on the national debt would likely be reduced in the near future by claiming this was impossible, and in particular that the major gilts could only be dealt with in their entirety[55]. (He was arguing that the taxpayers' burden of paying interest on the major gils could legally and in practice be alleviated only by market repurchases of those gilts.)

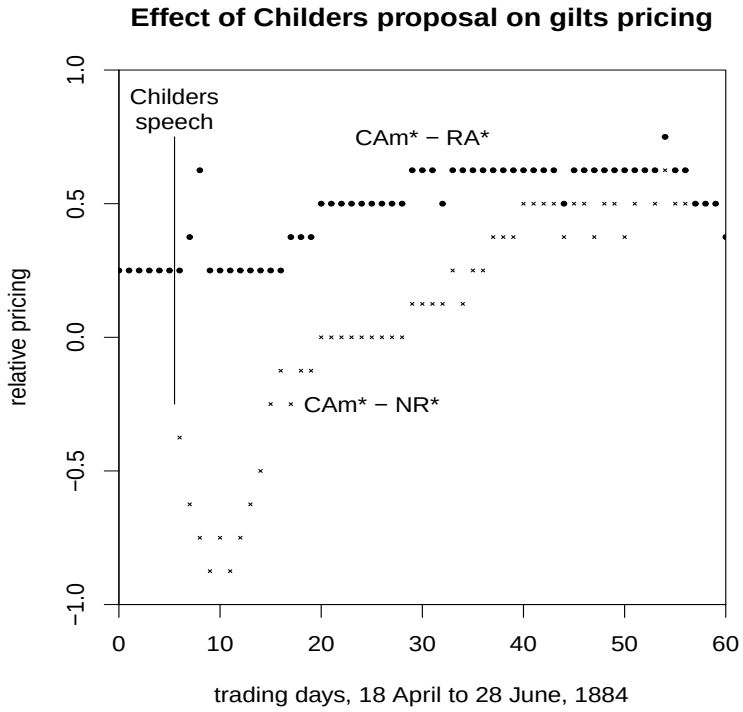

Fig. 10. Price differentials between CA and RA and NR around the time of the Childers proposal in 1884, based on daily closing quotes from the *Economist*.

These expectations of the 3% interest rate on the major gilts being unmovable were shaken by the speech of the Chancellor of the Exchequer. While Childers proposed a voluntary conversion, he was clearly trying to scare investors into thinking that a compulsory move would come soon, and he promised that they would not get an offer as good as his in the future. (This promise was honored, as the Goschen conversion four years later was less generous.) Childers agreed with the popular view that NR could indeed be dealt with only as a whole. He also accepted the need for one year's notice for CA and RA, as that was clearly specified in the law. However, he claimed that, based on his reading of the law and of conversion precedents, redemptions of CA and RA could be done piecemeal. That is, the government could announce redemption, and then, after the expiration of the required year, could redeem, say, just £10 million, with the cash at hand, then borrow this same £10 million at low rates after it had been recycled by the financial system, and continue this way by redeeming the next tranche of £10 million, and so on. His proposal for 1884 was for a voluntary offer, but he was setting a stake in the ground for future moves.

The effect of Childers' speech on relative pricing of the major gilts can be seen in Fig. 10, which is based on the closing bid quotes each day given in the *Economist*. More detail is available in the transaction and closing quote transcriptions in the auxiliary tables. He presented his scheme to Parliament in the evening of Thursday, 24 April 1884. Before his speech, RA and NR were quoted (and traded) identically, so cannot be distinguished in the chart, and £0.25 below CA (after adjusting for accrued interest). The day after his speech, CAm* - RA* did not change (although it jumped the following day, and even more the day after), but NR immediately jumped to a large premium compared to CA, as shown by the negative values of CAm* - NR*, and this premium continued growing for several days. Comparing the closing bid quotes on the Thursday of the speech to those on Saturday, two days later, we find that CA and RA went down 0.5 and 0.625, respectively, while NR went up 0.375, indicating a net loss to the aggregate of all investors in these gilts (as was to be expected, given that their position appeared to be weakened overall). The overpricing of NR relative to CA started to decline soon afterwards, and disappeared by the end of May. This was likely a result of investors deciding that Childers' position on gradual redemption was either not likely to be sustained by Parliament, or was not going to be relevant (as there were skeptics who doubted interest rates would go down far enough to warrant large scale conversions, for example).

Hubbard appeared to be the most visible opponent of the Childers position on gradual redeemability. In a series of letters to *The Times* he went over the precise phrasing of the laws as well as of past statements of government officials in Parliament and argued those refuted Childers' claims. For example, in one letter he wrote that

> while the present disturbance of the Stock Market and uncertainty as to the future lasts, nervous people are induced to sacrifice their Three per Cent. Annuities in terror of the Chancellor of the Exchequer's assumed power of compulsory redemption. ...
>
> To effect a reduction of the interest on the Debt upon terms forced upon the fundholders by threats which cannot be realized is to take an unworthy advantage of the helpless and ignorant, and I cannot anticipate that the Legislature will arm the Exchequer with a power to deprive the annuitant of any portion of his property

> acquired in confident reliance upon the national good faith. [CA and RA] have been purchased and made the matter of trusts and settlements in full assurance of their being a permanent investment subject only to the statutable but wholly impracticable process of the redemption in mass of either of these stocks being effected. ...
>
> ... Mr. Gladstone in 1853 explicitly declared that the only mode in which compulsory power could be exercised placed the use of it "out of the question." ...[56]

The jump in market valuation of NR relative to CA and RA as a result of the Childers speech that is shown in Fig. 10 is easy to accept as rational. If Childers's claims were accepted by Parliament, then CA and RA could be dealt with piecemeal, while NR would remain essentially irredeemable, except through paying investors a premium. The decline in this overvaluation is also explicable as a result of the market getting a sense as time went on what Parliament might do. What is harder to explain, though, is the substantial jump in overpricing of CA relative to RA, and then also relative to NR. Whether one accepted the Childers position, or the Hubbard one, CA and RA were equivalent, either not redeemable at all (other than offering investors a fat premium, of the sort given by Goulburn in 1844 to the holders of 3.5% annuities), or were redeemable on an equal basis at the government's convenience (after the mandatory delay of a year).

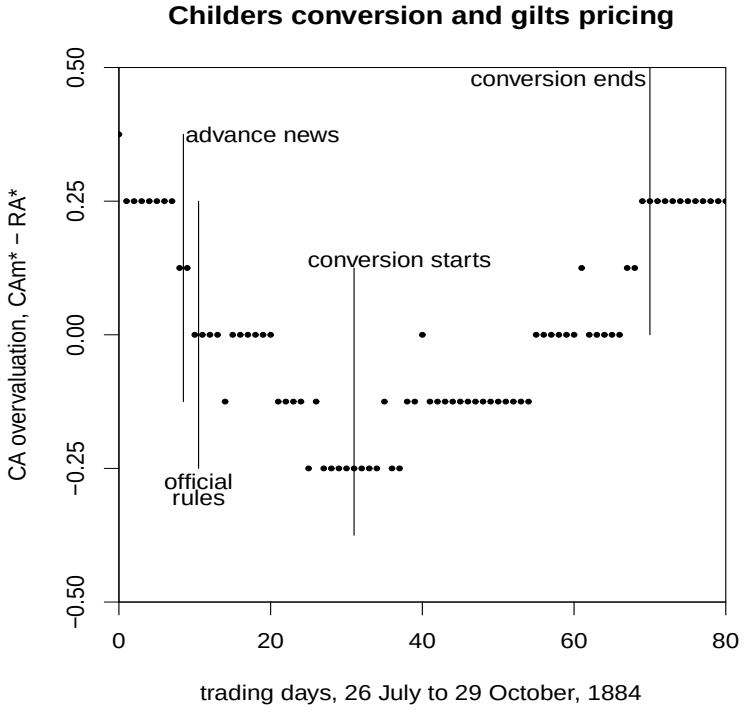

Fig. 11. Price differentials between CA and RA before and during the Childers conversion in 1884, based on daily closing quotes in the *Economist*.

One can invent a scenario that might lead rational investors to increase the overpricing of CA relative to RA. If they accepted the Childers claims, they might feel that the government would proceed to redeem just RA, at least at first, as the risks would be lower with a considerably smaller security. However, that is rather implausible, especially when one considers the behavior of all three major gilts visible in Fig. 10. If RA was in danger of redemption because of its small size, while CA was safe because of its large size, why did NR, double the size of RA and half the size of CA, trade at almost exactly the same price as RA from the end of June onwards? And why did the overvaluation of CA relative to RA grow through May, just as the overvaluation of NR was disappearing? It seems more likely that Fig. 10 reflects a "flight to safety" (represented by the more prestigious CA) by ignorant and slow-moving investors who were upset at the prospect of redemption of what they had felt were perpetual investments.

Some more puzzles about market behavior are shown by the pricing of the major gilts in the prelude to and during the conversion process. The measure enacted by Parliament gave Childers wide latitude in conducting his conversion operation. He was given a two-year limit for carrying it out, and much freedom in formulating the rules for the voluntary process to be offered to investors. Fig. 11 shows the behavior of the overpricing of CA relative to RA once the rules were promulgated, and during the conversion process, in August through October of 1884. During this period NR was priced essentially identically to RA, so it is not displayed in the chart. (The auxiliary tables have the trade prices as well as the closing quotes for all three major gilts during some of the key turning points in this process.)

By late July 1884, the pricing pattern that prevailed before the Childers speech had reasserted itself, with RA and NR priced essentially identically, and 0.25 below CA (after adjusting for accrued interest). Then, on 7 August, the daily papers carried stories that the rules for the conversion were about to be announced, and gave rather detailed and accurate outlines of those rules[57]. The actual rules were published in the evening of 8 August in the official *London Gazette,* and reprinted the next day (Saturday) in various papers, not just daily ones. The rules specified that applications to exchange CA, RA, and NR (which were to be treated equally) were to be accepted between 2 September and 17 October, inclusive.

Fig. 11 has to be treated with caution. Recall that prices were quoted in increments of 0.125, which was also the standard retail brokerage commission. Further, the bid-ask spread was usually also 0.125. However, as the tables show, it was double that with some frequency during this period, and that is not reflected in the figure, which is based just on the bid quotes. Still, it does appear that the overpricing of CA declined even before rumors about conversion rules were published, and disappeared completely the day before publication. A few days afterwards, the overpricing reversed itself, and RA (and also NR) became overpriced relative to CA! This RA overpricing persisted for a while into the conversion process. Were there many naive investors who somehow had the idea of RA being historically less expensive than CA, and placed orders for RA in order to convert those? Or was it the jobbers, trying to see if they could lure some naive investors to buy RA? (The conversion process was one-way. Investors could tender any of CA, RA, or NR on an equal basis and get the new securities, but they could not go the other

way.) As the conversion process continued, this overvaluation of RA declined, and then the usual pattern of CA being 0.25 overvalued relative to RA reasserted itself a day before the final day for electing to convert. (As the conversion process unfolded, press comments were increasingly pessimistic about its prospects and its advisability for investors. It was pointed out that they could do better by selling their gilts in the market and buying the existing C25 annuities instead of converting through the Childers process.) The most likely explanation for the observed behavior is again mass psychology inducing the bulk of the investing public to place irrational premium on CA. Threats of government action that would eliminate the distinction between CA and the other major gilts led temporarily to either greater rationality, or to even more irrational preferences for those other gilts. Once that phase was over, though, the old preferences reasserted themselves, and the old level of irrationality returned.

25 Goschen on gilts mispricing in 1888

In the March 1888 speech proposing the conversion and redemption of the major gilts, George Joachim Goschen, the Chancellor of the Exchequer, made some brief remarks about the pricing anomaly between CA on one hand and RA and NR on the other. Goschen (1831–1907), later to be the first Viscount Goschen, is characterized as a "politician and financier" in [53], and was eminently qualified to provide an informed opinion about gilts mispricing. He came from a merchant family and before moving into politics, was a successful merchant himself. Furthermore, he was a director of the Bank of England from 1858 to 1865. His book, *The Theory of the Foreign Exchanges,* was very highly regarded, and went through several revisions and many reprintings and translations.

Goschen's speech was very widely publicized. Reports on Parliamentary proceedings were in general a prominent feature of most newspapers, and a measure as substantial as a wholesale restructuring of the huge national debt was bound to attract extensive attention and comments. Most of the speech was devoted to justifications for the measure, both on general grounds (because a variety of interest rates had declined), and in details of how investors were treated (as some of their expectations were going to be disappointed). The remarks about gilts mispricing were just a minor aside that did not appear to have attracted any attention in the press. In fact, some transcripts of the Goschen speech, including the one in the official *Hansard's Parliamentary Debates,* did not include that part at all!

Reports on Parliamentary debates and other proceedings were compiled under difficult conditions, by a corps of elite reporters, see chapters 7–9 in vol. 2 of [34]. (Charles Dickens first gained professional prominence as a Parliamentary reporter, for example.) Some political debates hinged on the wording of speeches as reported in various papers, which competed to provide the best coverage. That wording often differed, and in the case of Goschen's speech, we are left with some uncertainty of what it was exactly that he said, and what he had in mind.

The passage in the *Daily News* (from 10 March 1888, the day after the speech, as is the case for all other papers' citations from that speech in this section) was among the clearest:

> I will not dwell upon the fact that [CA] have always held a somewhat higher price than [RA and NR]. On an average they have been a quarter higher. I don't know whether that price is due to their being a large stock—(hear, hear)—or to the notice. I believe it is due mainly to the fact that it is the great stock; but as a matter of fact if they were to receive precisely the same terms as the holders of [NR], they would be rather in a worse position. What I offer is this: ...

Most of the papers examined also reported that Goschen had said there had always been an overpricing of CA. It is interesting that he was not aware of the earlier periods of rational pricing, but not surprising. The last extended period of this type was in the early 1850s, when he was a student at Oxford.

The *Morning Post* reported Goschen as saying that the £0.25 excess was "during recent years," and *Liverpool Mercury* wrote that Goschen had said that he "had calculations made upon the matter." (There are some statistics in [35] that are likely based on those calculations, but only covering 1887 and the first two months of 1888.) One would expect he should have remembered other levels, as the record overpricing that has been found so far, peaking at £2 in 1864, occurred while Goschen was a director of the Bank of England.

Most papers did claim that Goschen had acknowledged that holders of CA would lose something if they were offered the same terms as investors in RA and NR, but did not explain what effect that had on Goschen's planning. The *Morning Post*, however, was rare in including in its report the sentence "I will not, however, take that into consideration in the terms which I offer," which corresponds best to the actual proposal.

As to the possible reasons for the CA overpricing relative to RA and NR, all sources agree that Goschen mentioned just two, just as in the quote from the *Daily News* above. One was that holders of CA were entitled to a year's notice before their investments could be redeemed. Goschen seemed not to take it too seriously. Although none of the reports mentioned his saying why not, it is easy to see reasons for it. The main one is that RA holders were entitled to the same length notice as holders of CA, yet RA was almost exactly equal to NR in the market. The other reason, which Goschen put more weight on, was simply that CA had higher volume. But he did not explain whether he regarded this as an irrational whim of mass psychology, or whether it came from greater liquidity. As is explained in Section 28, he may have thought that large volume was a sufficient reason by itself, but if so, he was effectively saying that the market was irrational. In any case, Goschen was explicit about not being sure about the reason for the mispricing.

One possible reason that Goschen and the public in general did not pay much attention to CA overpricing is that at that time it was at a relatively low level. It was only about £0.25 (although it spiked up in the runup to the conversion, see the next section). When Lowe had made his abortive national debt conversion proposal in 1870, which called for differential treatment of CA vs. RA and NR, this overpricing was about £0.5, although that was a trough between periods of higher mispricing. On the other hand, when Giffen wrote his book [31] (with the preface dated June 1877), the mispricing was lower, and trending down, but the preceding years of that decade had seen persistently high levels.

Another Chancellor of the Exchequer who cited size as the reason for CA overpricing was Gladstone in 1853. In the speech to the House of Commons proposing his debt conversion, in computing the value of NR protection from redemption until 1874, he said[58]:

> ... let us see what is the price borne by the best of your three per cent. stocks not fortified with such a guarantee. Take your [CA], which, being the larger stock, bear the highest price, and afford the best standard of comparison.

Gladstone, just like Goschen 35 years later, did not explain how greater size should lead to a higher price for a guilt.

Although CA overpricing was low in 1888, and Goschen decided not to take it into account in his measure, it was taken into consideration a few months earlier, when investors were offered a chance to convert their gilts into Local Loans Stock[59].

26 Pricing anomaly during some other crises and non-crises

The curious mix of rationality and irrationality that is characteristic of the CA vs RA anomaly is illustrated by its behavior during times of extreme fluctuations in the market prices of these securities. Even in panic situations, the differentials between CA and RA, as well as between NR and RA, appear to have been preserved quite closely, if we make the natural allowances for extreme volatility and for errors and omissions in record keeping. This strongly suggests that the jobbers and other speculators on the London Stock Exchange had a sense for the economically irrational preferences among the great mass of outside investors, and traded so as to preserve those price differentials.

These conclusions are based on personal impressions derived from looking at the detailed price records for some crisis events. As more data is collected, it might become worthwhile applying statistical techniques to document this quantitatively. For the moment, we can only say that this narrative is consistent with all the incidents that have been discussed so far in this manuscript, and in the main one. It is also consistent with the data we have for a number of other incidents. The tables have daily price data for many periods that seemed to offer the possibility of providing insights into market behavior. In some cases this includes both closing prices and closing quotes, and in some cases even data about intra-day activity. This section provides brief descriptions of some (but not all) of those incidents that motivated the data collection.

(1) Section 8 cited the *Spectator* noticing in July 1839 that CA had become overpriced after a year of essentially perfectly rational relation between CA and RA pricing. This can be seen in both the main weekly data set, and in the daily closing prices that are presented in the tables for the period between the June and September "shuttings." (*The Times* and the *Morning Chronicle* financial columns that month were examined, and it seems that neither one wrote anything about this phenomenon.) British financial markets were under stress, with large outflows of gold, and the Bank of England had to seek the help of the Bank of France. (*The Times* of 31 July called this "a disgrace which, certainly, never before befel the great English banking corporation.") This part of the Bank's operations was conducted in secret, but there were others that were more visible, such as increase in

its rate of discount, and the abortive attempt to sell the Deadweight Annuity (which is mentioned in Section 62).

(2) After the suspension of the gold standard in October 1847, British financial markets recovered fairly quickly, and by the middle of February 1848, the market yield on CA was down to about the level of July 1847. However, the news of the French Revolution then sent CA plunging almost to the depths of October of the preceding year. Paris street disturbances started on Tuesday 22 February. The next day the Prime Minister resigned and over fifty people were shot by soldiers, which led to more mass disturbances and the abdication of the King. A provisional government for what is called the Second Republic was organized on Saturday 26 February. As the tables show, British gilts held up well for most of that week, dropped slightly on Friday, and then plunged on Saturday and the following Monday, 28 February. Examination of the full *CoE* transaction price data shows that most of the big changes occurred inter-day, not intra-day, although there were substantial fluctuations within each day. (Some of the price drops took place in after-hours trading. For example, there was a large decline Friday, 25 February, after the official end of data collection at 3 pm, according to news reports.)

(3) Another test for British financial markets came about 6 weeks later. The Chartists organized the famous "monster rally" at Kennington Common for Monday, 10 April. There was substantial concern that this would be the starting point of an armed revolt, similar to those which were raging in many continental countries. Tables show some slight recovery in gilts prices on the Friday and Saturday preceding this meeting, and this may reflect the market assessing available evidence to conclude that this event would not attract anywhere near as many participants as had been threatened. There was then a much more substantial recovery on the day of the march, as it became clear that the participants were not too numerous, and not inclined to armed struggle. (Newspapers mentioned that trading picked up only late that day, as Stock Exchange members came back, often from duty as special constables. Those had been assembled to deal with the Chartist threat. The members of the Stock Exchange returning from such duty must have brought with them the news that the feared insurrection was not taking place.) Further recovery in prices came the next day. Overall, the price of CAm from Thursday 6 April to Thursday 13 April went up by £2.25, while the drop from Thursday 24 February to Thursday 2 March (when the news of the French Revolution led a panic) had been £6.75. Even allowing for the general tendency for markets to recover more slowly than they drop in a crisis, this suggests that the French Revolution was regarded as a more serious issue than the Chartists. (The two were not truly separate, of course, since one of the main fears of the governing elites was that the upheavals on the Continent would prove contagious.) Perhaps even more likely is that the Kennington Common event was not regarded as key to Chartist activity. Other meetings of this movement continued, and the general opinion of historians is that it was not until June that the Chartists were fully repressed and the British elites had become confident of the stability of their government. The gilts data does indeed show prices stabilizing from mid-April to early June, and then rising rapidly in June (as described in Section 16). There could have been other contributing factors to this rise, though, aside from the decline of

the Chartist threat, in particular the inflow of "flight capital" from the Continent, and the general perception that the situation there was stabilizing.

(4) The June–July 1848 recovery in gilts prices was characterized by high volatility. An illuminating incident occurred at the end of July. At that stage the Chartists were not regarded any longer as a serious threat, but an armed insurrection in Ireland (the perennial sore in British politics of that era) was still regarded as possible. In the morning of Thursday 27 July a telegram arrived in London, announcing a large scale revolt. To quote the *Economist* issue of two days later:

> There seems now to be little or no doubt that the wicked fraud practised on the public by a false report of an outbreak into open rebellion in Ireland, which was received by electric telegraph on Thursday, had no other object than that of stock-jobbing. In the morning of that day [CA] opened at [86.375 to 86.5], and even improved to [86.5 to 86.625], when on the appearance of the later editions of the morning papers, containing the *pretended* news from Ireland, they suddenly fell to [85.375], a fall of *one per cent*; they subsequently rose to 86, and finally left off at [85.75] to [85.875]. Nothing could better show the confidence which is felt in our power to maintain order than the slight fall in the face of such alarming accounts from Ireland, which were for some hours believed to be perfectly true.

Several other sources dispute the claim that the rumor had been "believed to be perfectly true." The fraud was clearly prepared carefully, to give it the appearance of veracity. For example, the sending of the telegram from Liverpool was timed to coincide with the arrival of a ship from Ireland. (There was no telegraph between England and Ireland then. The first submarine telegraph to provide reliable service was installed between England and France in 1851, and England and Ireland were linked only in 1853.) However, apparently many people were very skeptical from the beginning, not least because some of the features of the telegram seemed suspicious, such as the claim that British troops did not fight the insurrectionists. Be it as it may, this incident shows the reaction of the market to some potentially unsettling news, and also demonstrates that it was a market treated to a flood of information, rumor, and deliberate misinformation. For our purposes, the most relevant point is that the daily transaction data shows that even as price levels oscillated, the overpricing of CA relative to RA did not diverge wildly.

(5) Another set of daily prices comes from the end of 1857. That period witnessed a world-wide economic crisis. Its outbreak is usually dated to the failure of the Ohio Life Insurance and Trust Company in the U.S. in August, followed by a cascade of failures in the U.S., and then others in Europe. This led to the second suspension of the gold standard in the UK, announced in the markets on Thursday 12 November 1857.

(6) Yet another collection of daily prices comes from April and May of 1859. At that time British markets suffered a severe panic that drove the price of gilts down by about 6% in a few days, a far more severe decline than that of late 1857 (when gilts may have benefited from a "flight to quality"). Unlike 1857, which involved extensive business failures, this incident was purely financial, with no business upheavals. It was attributed to rumors that a French–Russian alliance might be turned against Britain. On Thursday, 21 April, the market closed at a slight decline, which was followed by a much more substantial decline

in after-hours trading, in reaction to news from France. The next day was Good Friday, so the Stock Exchange was closed. It had been decided earlier to make the following Saturday, 23 April, also a holiday. However, the continuing arrival of disturbing news caused many members to show up on that day:

> Mr. James Capel ... one of the managers of the Stock Exchange, very much to the satisfaction of the members, took upon himself to authorise the opening of the building. The day's business was consequently of a very anomalous character. According to the strict rules, the transactions concluded, which were to a considerable extent, are not officially recognised, though of course regarded as perfectly binding by the parties to them. No official list of prices was published. The attendance comprised from 150 to 200 individuals, being about one-fourth of the entire body, but many of the leading members were altogether absent.[60]

As with other crises, the prices at the height of the panic, especially jobber quotes, have to be treated with caution. In the words of one of the financial columns from that period, "[it was] impossible to quote prices. Dealers made very wide prices to stop transactions. Indeed, quotations, such as they are, may be looked upon as nominal."[61] The closing prices from *CoE* show a number of surprising features during the April and May period. Even if we disregard the April data, as being close to the crash, we find that in May NR was valued below RA surprisingly often. Also, CAa was priced below CAm on many days. A more detailed investigation, using all the trade prices as well as closing quotes from several newspapers, might explain these anomalies.

(7) Not all periods for which more fine-grained price data was collected correspond to crises. Some other interesting periods were also investigated, although they did not lead to any conclusive results. For example, the first few months of 1850 were studied since that is when CA overpricing basically vanished. So far nothing remarkable has been found in that data set. (Also, no press coverage has been discovered of this return to rationality in major gilts pricing.)

(8) In 1861, the 16 Friday closing quotes from the *Economist* were supplemented with all the 52 Friday closing prices from the *CoE,* as well as with daily closing prices from the *CoE* for all the trading days in April after the "shutting" of RA ended. The reason for investigating this period is that the Bank of England ended the practice of gilts "shuttings" (discussed in the Section 52) then. The announcement was made on Friday, 19 April[62]. If the "shuttings" led investors to hold more RA and NR than they wished, in order to have liquidity during the two months of the year when CA was "shut," one might expect that the end of "shuttings" might have stimulated a greater demand for CA, and led to a higher degree of overpricing. But even if such a phenomenon did operate, it might not be detectable, since the Bank of England move was likely anticipated[63], or else the rebalancing might have been spread over an extended period of time. What we find is that CA overpricing was high at the start of 1860, and it rose during 1861. But this growth in economic irrationality did not show any sudden jump associated to the 19 April announcement, nor even a sustained rise right afterwards. To the extent that it may have been stimulated by external events, there are many possible candidates. While gilts rates were not very high, and were reasonably stable, short term rates were high

(although the Bank of England rate was coming down by April). Perhaps more seriously, the American Civil War was breaking out. Abraham Lincoln was inaugurated as President at the beginning of March, and the Confederate attack on Fort Sumter was launched on 12 April. In Britain there was widespread and accurate fear that this conflict would lead to a disruption in the supply of cotton from the Southern States, on which the textile industry, key to the nation's trade, was dependent. Thus this set of data again does not provide us with any conclusive hints as to what factors may have acted to stimulate CA overpricing. (However, further research, beyond the superficial one summarized here, might produce real insights.)

(9) There is also a set of daily prices in the tables from the middle of June 1861 to early July of that year. On Saturday evening, 22 June, London "was visited by one of the most terrific conflagrations that has probably occurred since the great fire of London [of 1666]"[64]. On the succeeding Monday, gilts dropped about 0.5%, and this drop was ascribed principally to fears that insurance companies would need to sell their reserves to meet the claims, which were estimated at £1.5 million[65]. On that and next few days, it appears that CA overpricing increased, and also that NR - RA increased slightly. So this may reflect large sales of RA by insurance companies, or perhaps just guesses by other market participants that such sales might materialize. On the other hand, the overpricing of CA stabilized at a higher level over the next two weeks, so perhaps what we see in the prices was just part of the general rise of this overpricing that year.

(10) In 1878, the 16 Friday closing quotes in the main table for 1861–87 CA mispricing show a substantial jump between August, when it was a constant 0.375 during the 4 Fridays included in the table, and November, when it averaged 1.00. This was suggestive, in that the collapse of the City of Glasgow Bank took place during the intervening period. This collapse is best known to the public as the last instance of a bank run in the UK until the Northern Rock debacle in 2007. The decision to suspend payments was made by the bank directors in the evening of Tuesday, 1 October, and announced throughout the country by telegraph by the morning of Wednesday. The City of Glasgow Bank collapse has often been cited as the "death blow" to unlimited liability, as the vast majority of the shareholders in this concern, which did have unlimited liability, were driven into bankruptcy. (But see [1] for a slightly different perspective.) So it seemed worth checking if this event may have triggered the rise in CA overpricing. Price data shows that if it did, it did so through some very non-obvious and indirect way. (This cannot be ruled out, the soundness of the City of Glasgow Bank had been held in some suspicion for a few years, and perhaps rumors or real insider leaks had spread through the markets way ahead of the official closing.) The increase in CAm* - RA* took place a month earlier, as is detailed in the tables, which present closing quotes from that period. If we go by the figures from *The Times*, there was a single large jump in CA overpricing on the day (Monday, 2 September) that RA and NR went ex-dividend, followed by a slight further rise over the next few days. If we use the closing quotes from the *Daily News* or the *Morning Post,* the rise may have started the day before the ex-dividend day, and may have been spread out more. In any event, it is hard to link this jump in CA overpricing to the City of Glasgow Bank collapse.

(11) The daily closing closing quotes from 21 October 1887 to 20 April 1888 were collected to investigate gilts mispricing in the approach to, and during, the Goschen conversion, which was presented to Parliament on Friday, 9 March 1888. What is now available shows CA overpricing relative to RA (and NR, which was quoted identically to RA in this period) at a remarkably steady level of 0.25, until the middle of December 1887. At that point it started rising, and from early January 1888 it tended to be around 0.50. During this period, the press reflected a growing consensus that a major conversion of the major gilts would be attempted in the 1888 session of Parliament. This was accompanied by a variety of government maneuvers involving voluntary conversion of the major gilts into Local Loans Stock. (That one carried the full guarantee of the national government, paid 3% interest quarterly, and was not redeemable for 25 years.) Some of these maneuvers were sales negotiated privately by the government broker on the London Stock Exchange, with little public information, leading to criticism in the press[66]. This was followed by a public auction[67]. The private deals and the auction had somewhat different treatment of CA on one hand, and RA and NR (which may have been treated the same, although that is not entirely clear) on the other. Hence it is hard to tell whether the increase of CA overpricing was rational or not. It will likely require more intensive investigation, in particular of government archives (most of the required records may be at the Bank of England), to find out just what happened, and of other sources, in particular of more newspapers, to find out what was known by investors. The figures in the current tables are derived from the *Economist*, and for further studies should also be supplemented with transaction prices and quotes from other papers.

27 How widely was gilts mispricing known?

The main paper and preceding sections of this one contain many citations to contemporary sources which show awareness of CA overpricing. But how wide was this awareness? The February 1870 leader in *The Times* reprinted in Section 1 claimed that many people were not even aware there were several distinct gilts. British civil engineers, considered in Section 46, present a particularly intriguing example. They were among the most financially sophisticated professionals outside of finance, yet, in the decisions and reports of their main professional body, they seemed to show almost complete ignorance of the existence of gilts mispricing.

On the other hand, as the many quotes in the main paper and throughout this one demonstrate, there were many people aware of the overpricing phenomenon (and they usually were puzzled by it). There may have been serious discussions of it, and plans to deal with it. We get a hint of this in the following passage from the financial column in *The Times* in early 1840s[68]. As will be discussed in more detail later, among the various minor gilts were securities officially issued by the South Sea Company, the one that was central to the South Sea Bubble of the early 18th century. By the early 19th century this company acted almost exclusively as a conduit for paying interest on government debt.

> By the quotations of South Sea Stock it will be seen that the New Annuities are ..., and those of 1751 are ...;–that is to say, [£1.50 and 2.00] below the price of [CA].

> This stock, which is guaranteed by Government, is even superior in point of safety to the rest of the public securities; since, by act of Parliament, the dividends upon it are to be provided for before those of any stock, and, in case of such a dreadful event as a national bankruptcy, the holders of South Sea Stock might claim to be paid in full before the holders of [CA] receive a shilling. Nevertheless [CA] fetch a much higher price in the market than South Sea Stock. The only reason is, that the dividends on the latter security are paid at the South Sea-house, while those on the former are paid at the Bank of England, for, the public being accustomed to look at the Bank as the legitimate place for Government dividends to be paid, do not understand that the South Sea interest which is paid at another establishment is equally a Government security. The difference between the quotations being an unnatural one, it is not necessary that attention should have been called from time to time to the circumstance, as it is obviously absurd that there should be such a great discrepancy between the value of stocks which must either be considered equal, or the low-priced stock the better of the two. Some suggest that advantage should be taken of the difference, and that whenever the Government buys in a portion of the 3 per Cent. stock, the South Sea should be selected, as thereby the same amount of public debt is canceled at a smaller expenditure of public money. This was the plan pursued under the Ministries of Pitt, Bexley, and Perceval. Others conceive that the public money might be more effectively saved by removing the whole of the South Sea Stock to the Bank of England, who would manage it for [£11,000] per annum less than is paid at present. Should this transfer be made, South Sea Stock would, it is asserted, at once rise to the same price as [CA], and the present anomaly would vanish altogether.

Perhaps searches in the archives of the Bank of England, or of the British government, or in private papers of some of the statesmen or financiers of that era will reveal how extensive such discussions about eliminating gilts pricing disparities were.

Especially noteworthy in the quote above is the assertion that under Pitt, Bexley, and Perceval, the British government was consciously redeeming the less expensive South Sea securities. It would be nice to obtain an official record of deliberations on this issue, and of the redemption instructions that were issued.

Some Chancellors of the Exchequer were aware of the gilts pricing anomaly, as they spoke about it in official presentations to Parliament. But were all? A letter addressed in 1875 by C. Rivers Wilson, the Controller of the National Debt Office, to Sir Stafford Northcote (1818–87, later to be Earl of Iddesleigh), the then Chancellor of the Exchequer, noted[69]:

> It may here be remarked that securities which return the same rate of interest, and are of the same intrinsic worth, are capable of bearing very different market values; for instance, it is well known that the market prices (after allowance made for accrued dividend) of [CA] and [RA] occasionally differ by as much as [£1.00], although these securities are of precisely the same real value with reference to the interest they return, and the security on which they stand.

Was Wilson trying to educate Northcote, or the wider public? (From the tone and context of the letter, it seems that it was expected to be widely circulated.)

The general public was apparently ignorant of this issue and indifferent to it. But some observers were clearly puzzled. So far three letters have been found, asking for information. In 1865, the financial column of the *Morning Post* published the following letter from a reader[70]:

> Can any of your readers account for the difference in value between [CA] and [NR or RA]? The latter, with four months' accrued dividend, might reasonably be expected to realise about [£1.00] above the former, instead of more than [£1.00] less–a difference of [£2.00]. The security, I apprehend, is the same, excepting that 12 months' notice must be given before payment to the holders of [CA]. This, with the price above par, might be a valid reason for increased value, but certainly not at present quotations. I notice that, comparing the last Friday in January, 1864, with the same date in 1865, a reduction in price of [£1.00] has occurred, notwithstanding an increase in the stock of bullion of upwards of a million and a quarter, with discount at five instead of eight per cent. The stock certificates have not, I presume, been much dealt in, as they have as yet been excluded from the list. The political horizon, as well as the state of the money market, certainly is now more favourable than in the last year at this date.

The *Morning Post* claimed in the passage introducing this letter that the remarks at the beginning of the column "though not wholly," at least "to some extent" answered this writer's query. They did not, as those remarks were about preferences for gilts over other securities. Perhaps because of realization this response was not adequate, in the next day's column, this paper assured the readers that the prices of RA and RA were indeed "unquestionably too low" when compared to CA, but that this was a temporary situation. This paper also claimed that usually there was a difference of at most £1.00 between CA and RA, of which £0.75 was accounted for by the accrued interest, and the remaining trifling £0.25 by "the speculation consequent upon most of the trust investments being made in [CA]." This last showed an astounding degree of ignorance, as by 1865, CA had been consistently overpriced, by at least £0.50 and occasionally as high as £2.00, for all the years of that decade. So this response from the *Morning Post* was not an adequate one, and no other was found in that paper.

A decade later, we find a similar letter in another paper[71]. A writer signing as "Inquirer" thanked this paper for its article a few days earlier on foreign securities, and argued that gilts were the best investment. However,

> [a]n article giving a history and description of them would, I think, be acceptable to many. I have searched encyclopaedias, three or four works on money and investments, and asked bank clerks–none of them show me to my satisfaction the difference between [CA] and [RA], and why the latter are quoted at a lower price, or whether they are equally good security.

No response to this request was found in that paper.

Seven years later we find a similar query in a rather unexpected place. *English Mechanic and World of Science* published a query from a reader named D. Spencer[72]:

> **Difference between Consols and New Three's.**–Will some of your correspondents kindly explain their origin and why they are different in market value, seeing they both pay 3 per cent. interest?

It might seem surprising to find such a query in this (weekly) magazine, but in fact it was only slightly unusual. The issue in which this question (numbered 50,670) appeared seemed fairly typical, and contained 6 pages of reader responses to earlier queries (including one on "bicycling in Holland," and another on legal wills), and two and a half pages of fresh questions. (In that era, when information was scarce, newspapers frequently had large sections devoted to responding to reader questions, but this magazine was exceptional in the amount of space it devoted to that end.) Thus it may have been natural for this D. Spencer to hope for an answer. But that hope was not realized. This magazine had a policy of republishing queries that had not been answered 5 weeks after the initial appearance, and then again, for the last time, 4 weeks later. Spencer's question duly appeared on the corresponding two dates[73], suggesting that none of the readers of this magazine could provide an answer.

The general ignorance of the population about gilts is also expressed in a fictional short story (although one that had to preserve some verisimilitude) about a small post office[74]:

> People can now buy Government Stock through the post office, and occasionally I have a Stock transaction, but there are often a lot of preliminary enquiries on the part of would-be investors. I am asked to explain the difference between [RA] and [CA], and Mr. Goschen's Conversion Scheme has cost me a lot of trouble.

28 Explanations and justifications for gilts mispricing

No plausible and rational arguments to justify CA overpricing have been found. This likely reflects the fact that there are no arguments that hold up to careful scrutiny, as was discussed in the main manuscript. The claims that have been found in 19th century literature likely reflect the human tendency to look for simple rationalizations that could be used to explain away an anomaly that was not very important for the person making the observation. Hence they did not need to be very persuasive.

The usual explanations for CA overpricing (that CA was used for speculation, or, in a related vein, that it had greater liquidity) were usually tossed off without any arguments to substantiate them, and it is easy to conclude these were just simple rationalizations without any deep thought behind them. They started showing up early, for example in the citation in Section 7 from *The Times* in the summer of 1831, although the tone of that passage suggests the writer (almost surely Alsager) thought this was a temporary condition caused by the special needs of the speculators at that time. The *Spectator* of 22 October 1842 (cited in Section 8) claimed that what it then regarded as customary CA overpricing was because "of all the speculative operations, being confined to [CA]." Sometimes this argument was elaborated a bit more. The *Economist* of early 1867 claimed that "[t]he lower

price of [NR and RA] is explained by the absence of speculative "bear" accounts, which, constituting while they last, a demand for stock by reason of the recurring settlements, maintain at a higher figure the value of [CA]"[75]. *Saturday Review* claimed in 1870 that "[CA] bear a higher price than the minor stocks solely because they are larger in amount, better known, and therefore more readily saleable"[76].

The most elaborate of the justifications for CA overpricing that have been found so far was in the leader in the *Economist* that was cited in Section 2. In the 12 February 1870 issue, published the day after Lowe presented his scheme to Parliament, the *Economist* had a brief note, not part of the "Bankers' Gazette" financial section, which discussed several of Lowe's proposals (including those for the Mint and for the Friendly Societies), and opined that the gilts move would be a good one:

> The improvement will be a very considerable one, and will tend to raise the price of [CA], the advance in the period of payment of half the dividends being equivalent to a small bonus to the holders. At the same time [NR and RA] are to be consolidated with [CA], the conversion being proposed to be effected at the rate of [£100.25 NR or RA for £100 CA].

The "Bankers' Gazette" in that issue also had a long passage about Lowe's proposals, but this time based on his correspondence with the Bank of England, not on the more limited set of measures he presented to Parliament. This one also mentioned the fee that RA and NR holders would have to pay to convert, but did not discuss it, or the reason it was proposed. The next issue, though, that of 19 February, had a substantial leader entitled "The proposed debt consolidation and quarterly payments of government dividends," which was an evaluation of Lowe's gilt schemes. At that time Giffen was the financial editor at the *Economist*, while Walter Bagehot was the editor of the entire paper. Bagehot was an extremely influential journalist and economist, and Gladstone called him "a sort of supplementary Chancellor of the Exchequer" (as cited in [53]). It is not unreasonable to suspect that Bagehot was the author of this leader, but we cannot tell with available information (although we may be able to apply stylometry techniques to get some confirming measures). This leader summarized various arguments in favor and against, and agreed with the doubts about small holders being willing to pay £0.25 for conversion of RA and NR.

Overall, this leader was very supportive of Lowe's proposals. But when it came to CA overpricing, its message was a little muddled. It agreed that "the greater simplicity" that would result would be a plus. "The multiplication of various sorts of security is a pure evil, and may easily be a very considerable one," it claimed. It cited a French authority on the waste involved in the French government guaranteeing loans by railways, which paid 5.5%, while the government itself was able to borrow at 4.5%. But this leader also seemed to think this did not apply to the major gilts in the UK, as "[w]e can hardly see the effect here ... it may be thought, each of the great branches [major gilts] is so large that the facility of dealing must be already as great as possible, while the smaller branches are *very* insignificant." It then went into a small accounting exercise, calculating the volumes of various gilts. (As is shown in Table 1 of the main paper, CA came to about £400 million, NR to 200, and RA to 100.) Then the leader continued:

> Theoretically it may be said a stock of one or two hundred millions must be as easily dealt in as a larger one. But the fact is different. The jobbers prefer the larger article, and the stock of [£390 million] is preferred to the smaller though still bulky competitors. The quotation is [£0.50] in its favour, by no means a small difference, considering the "turns" which are sufficient for transactions. Clearly the public creditor will benefit and the State gain in credit by the amalgamation of all the stocks. [CA] will be more available for dealings than before, and the other branches will be raised to its level.

So it appears the author, faced with the market reality of CA being worth [£0.50] more than RA or NR, decided that the greater size of CA must be the reason, in spite of having a few lines earlier said that RA was large enough for size not to matter. (We can also conclude that this author was not paying careful attention to the market. As is shown in Section 3, CA overpricing was around £0.75 just two months earlier, and at the time the leader was being written, it was bouncing around between £0.25 and £0.50. The same issue in which the leader appeared, in the "Bankers' Gazette" section, showed that the closing quotes from the preceding day, Friday 18 February, yielded CAm* - RA* of £0.25.) This may very well also have been the thinking of Goschen in 1888 (see Section 25), that since the market valued securities of high volume more than those of lower ones, this provided an explanation for CA overpricing. But for the volume of a security to influence its value, the market has to be economically irrational. So the author of the leader in the *Economist* and Goschen may have thought that CA being larger than RA provided a rational explanation for CA overpricing. But what they were really saying is that the market was irrational. It's just that they did not bother to think deeply enough about their arguments to realize it.

Sometimes the claims about the use of CA for speculation were coupled with other considerations, closer to those that this study suggests were significant. In particular, on two occasions in 1867, the *Economist* also mentioned the influence of disturbing external events on pricing. One time (10 August 1867) it opined that "[NR and RA], which, during the cotton crisis [the interruption of cotton supplies from the U.S. by the American Civil War], descended to near [£2] below the price of [CA], in consequence of the continuous realisation of the societies, and others affected thereby, have recovered to [£0.375] below the quotation of [CA]," while on another (12 January 1867), it had a fuller attempted explanation:

> [NR and RA] remain somewhat lower than [CA] notwithstanding the coming dividends in March. In times of general prosperity, and with cheap money, [NR] have commanded a higher price than [CA] on account of the term for which they are secured against any further reduction in the rate of the security paid thereon. In times of difficulty they have, however, been subjected to depression, inasmuch as there is less speculation in them than in [CA], and they are consequently regarded as somewhat less available securities. The price of [NR] has lately advanced, and this shows that the investing public are again operating; and it is probable that, with increasing ease in money, the quotations will still further improve till it equal that of [CA].

It is easy to poke holes in the argument (for example, it does not explain at all why RA and NR were being traded and quoted identically, both significantly below CA, through all of that decade). But it does show some awareness that gilts mispricing might reflect to some extent disturbing economic developments.

29 Observers who concluded gilts mispricing was irrational

There were some observers who did think about gilts mispricing and decided it was due to investor irrationality. However, very few have been found in this category.

Robert Giffen was one of the most eminent economists, statisticians, and financial journalists of his time. (See Section 34 for more information about him.) Today he is best remembered as the discoverer of "Giffen goods," ones that violate the basic law of demand because increases in price lead to increases in consumption. He wrote ([31], p. 95):

> ... there is no doubt, I think, from the peculiar value of some stocks, that there grows up at times a species of customary appreciation of which a distinct account can hardly be given. Custom, for instance, keeps [CA £0.5 or 0.75] higher than [NR and RA], although they pay exactly the same rate of interest and are indistinguishable in their legal conditions of value. The speculative 'account' is in [CA] by virtue of ancient custom, and for this and for no other reason, I am assured, [CA] are always fractionally higher than [NR and RA].

It is clear from this passage that Giffen had thought carefully about the CA overpricing issue, and even asked around for an explanation. ("Giffen was known throughout his life as a lover of paradoxes," [50], p. 59.) Although he did not say this explicitly, it appears (especially when one considers the context in which he was writing, namely in a book that attempted to explain variations in prices of financial instruments) that he had his doubts about the liquidity arguments, and tended to think CA overpricing was a mysterious quirk of mass psychology. But he did not describe his thinking or his conversations with others, and only implied the mispricing was irrational.

There were even earlier observers who wrote about irrational behavior by investors being responsible for gilts mispricing. *The Companion to the Newspaper* for April 1836, in the third in a series of four articles on gilts, claimed that some gilts, such as the 3% Annuity of 1726, were always priced lower than CA because of their small volume and limited liquidity. This was followed by the assertion that "[i]n other cases, however, it is extremely difficult to assign any cause, beyond the mere caprice of the public mind, for the preference given to one species of [gilt] over another." This was a clear assertion of mass psychology producing irrational results. However, it did not specify any gilts or dates, so we cannot be sure what the writer had in mind. The London daily *Standard* was more specific, as it referred to the relative pricing of RA and NR as contrasted with CA when it wrote in 1875 that "the difference in price [was] due to the fact that [CA] have always been the more fashionable security"[77]. In 1849, Justin Brenan, in the concluding "Desultory remarks" to his pamphlet [11], wrote:

> But you may very fairly wonder why one stock, bearing the same interest as another, should nevertheless be preferred. If all have government security, why not all be

> equally esteemed? I can only answer that the public run on one more than another, and that [CA] are decidedly the favourite, for they commonly bring [£0.5, £0.75, and even £1] more than [RA], though in point of real value and security, there is no difference whatever between the two funds. ... as [CA] are more readily disposed of than any other stock, they are deemed the most eligible for those who do not intend permanent investment. Should the government be, however, at any time unable to pay the interest, they would not show favour to one more than another–all the funds would suffer alike.

The most thoughtful analysis of CA overpricing that has been found so far was published in 1876 in the financial column of the *Leeds Mercury*[78]:

> The present "dearness" of [CA] naturally directs attention to the greater cheapness of [NR and RA]. All three stocks are identical, except that on [CA] the interest is paid in January and July, and on the two others in April and October. At present [NR and RA] are only [£0.125] higher than [CA], notwithstanding that they have three months' more interest accrued. There is therefore a difference of [£0.625] in favour of [NR and RA]. Why this should be so cannot be explained, for there is no sufficient reason for it. The preference of the general public for stocks paying dividends in January and July over April and October securities is well known and natural, the claims upon most people being heavier at the half-years than at the intervening quarters, but in no other direction is this preference allowed to disturb the value of securities otherwise equal. Another small reason is that most buyers who want to invest in British Three per Cents. speak and write so readily of "Consols" that their orders are literally carried out, when probably the term is frequently used in its more general signification. But since the amount of [CA] is nearly 400 millions, while the [NR and RA] together are only 300 millions, one would suppose that the larger demand for the former would be more than outset by the larger quantity existing. Nor does the present dearness of the best stocks appear to have any influence in correcting the disparity.

This writer considered a greater range of possible explanations, but found them all wanting. This writer's conclusion about gilts mispricing, that "there is no sufficient reason for it," agrees with that of Giffen, and of this work, at least where rational reasons are concerned. The suspicion that it might be due to the term "Consols" becoming a generic term for gilts is consistent with some of the observations of this paper, but primarily for the second half of the 19th century. It does not seem to apply anywhere near so well to the pre-1823 mispricings that appear to have been frequent.

30 The (un)sophisticated Victorians

Financial sophistication is a relative concept, and undoubtedly observers a century and a half from now will be puzzled by our lack of understanding of the economy. So when we evaluate what the Victorians believed, and how they acted, we have to take into account their environment, both physical and intellectual.

The 19th century was one of great transformations, of new technologies and also of new ideas. But it was a very different world from ours. One little (true) story serves as an illustration. The income tax was brought back to Britain in 1842, as a "temporary" measure, by Sir Robert Peel, the Conservative Prime Minister, to allow for some other fiscal reforms. This measure was extremely controversial, and so led to heated debates. But it was only after the measure was passed, and the first year's results tallied, that it was discovered the budget had a large deficit instead of a moderate surplus. This happened even though the income tax was yielding much more money than had been expected. The reason was that neither Peel nor any of his vociferous opponents realized that in the first year of the operation of this tax, only half of the anticipated full year's tax would be collected[79]. Yet Peel was famed as a financier, and in his youth, as a student at Oxford, "his performance became legendary" as he became "the first person ever to be placed in the first [place in both mathematics and humanities]" [53]. This has to be kept in perspective, though. We can sneer as such mistakes by 19th century Victorians, yet we are constantly encountering catastrophes caused by simple mistakes, such as the NASA Mars orbiter that was lost because one team of engineers used metric units while another worked with English units.

19th century Britain faced problems simpler than operating spacecraft in the vicinity of Mars, but it also had much more limited resources. About half of the population was illiterate (by some measures of literacy), and even those who were not, were largely employed in menial tasks. Statistical thinking was on the rise, but there was a dearth of statistics, practically no statistical methodology, and few people to analyze the data. Section 31 will cite some information on how few journalists there were. Government was also extremely thinly staffed, by modern standards. "[T]he entire staff of the Board of Trade [the government ministry responsible for manufacturing and commerce] in 1840 numbered only thirty," while the Foreign Office (equivalent to the Ministry of Foreign Affairs in other countries) was only slightly larger, with a staff of just 39 in 1841, if we don't count messengers and the like ([68], p. 35). The Bank of England had about 1,000 employees, with 70 clerks just for handling CA accounts[80], but that was because there was no automation, not even calculating machines. Hence all record keeping and interest computations had to be done by hand. Key decisions were made by small groups of people, often a single individual. The conduct of government financial operations was entrusted to the Chancellor of the Exchequer to an extent that is hard for us to imagine. Typically he would decide on the method of financing, come to an arrangement with a group of large bankers, and only then get Parliament to ratify his decisions[81]. For new loans, such as the Irish loan of 1847, or the Crimean War loan of 1855, the minimal terms that the government was willing to accept from the bidders were apparently decided in the morning of the day for the bidding, and just by the Chancellor of the Exchequer and the Prime Minister.

Even some very sophisticated people showed what seems from our point of view to be surprising lack of sophistication. As an example, consider Gladstone, whose reputation rested to a large extent on his skill in financial affairs. In the speech to Parliament presenting his 1853 national debt conversion proposal (at a time when he was the Chancellor of the

Exchequer), he went over statistics showing the substantial value that the market placed on securities that had protection from redemption. He argued:

> Now I want, if possible, to get hold of that value for the public. Let us guarantee some of this stock which has now no guarantee, and let us appropriate for the benefit of the public the increased value which will thereby be obtained.[82]

He seemed not to be aware (and none of MPs who participated in the debate that followed pointed this out) that the call protection was not without cost to the government. It did not cost anything in terms of money, but it limited the government's ability to lower the interest rate on its debt in the future.

Many more examples can be cited. One that might be especially illuminating is that of annuities. The British government sold annuities for life to people. For a long time, they relied on the obsolete Northampton tables of mortality. Although it was widely suspected that people's average lifespans were getting longer, and that the government was losing money from this operation, it took Finlaison to demonstrate the extent of the loss, and to prepare new tables. This only happened in the late 1820s. Finlaison's career, see [53] for a brief account, shows how much one person could do, but also how few people there were to undertake such tasks. (See also [41] on the deficiencies of the new system that was adopted.) The discussion of life insurance in [75] provides additional support to the view that there were few reliable sources of actuarial information in the early Victorian times.

As for the bulk of the investing public, the general opinion of their knowledge and skills was very low, and likely correctly so. As one example, one can cite an article in the *Economist* in 1864, which praised "the gradual but very rapid diffusion of intelligence among the wealthy"[83].

31 Victorian financial journalism

The development of financial journalism in the 19th century is covered in [73, 80, 81, 93]. There is also some material on this topic in [45, 62], while [63] describes the substantial jump in coverage that occurred during the Railway Mania, with Robert Lucas Nash the elder being the outstanding pioneer of modern financial analysis during that period. Much more can, and should be said about this general subject. Here we just mention a few illustrative facts that bring out the limited nature of the information that was available to the investing public.

One of the most important facts about the Victorian press is that it was extremely thinly staffed by today's standards. Major newspapers such as the *New York Times* or the *Wall Street Journal* have newsrooms with over 1,000 employees (reporters, editors, fact-checkers, ...), even after the recent rounds of downsizing. In the 1840s, the weekly *Economist* was put together for the first few years of its existence basically single-handedly by its founder, owner, and editor, James Wilson. This was typical of the smaller papers of that era. Charles Mackay, now remembered primarily for his *Extraordinary Popular Delusions and the Madness of Crowds,* was the editor of the twice-a-week *Glasgow Argus* for several years in the 1840s. He had to make do with just one reporter to assist him [64]. The

London dailies had larger newsroom and editorial staffs, but still small by out standards, a few dozen in all. Business news coverage was greatly expanded as a result of the Railway Mania of the 1840s, introducing regular coverage of railway shareholder meetings, and daily publication of extensive railway share price tables (which later started to include prices of other joint stock companies). But it was all done on a small scale. As one illustration, even in the 1850s, the editors of *The Times* begrudged the business editor the space and manpower he used. After one of his two assistants quit, he was not allowed to replace him and had to make do with just one other newsman in his department ([85], pp. 595–96).

The contemporary description of the jobs of financial editors by Morier Evans ([23], p. 128ff) makes it clear they spent most of their time collecting information from various market participants. There were no financial analysts, with Robert Lucas Nash the elder being an unusual pioneer, and only over a short period [63].

It should also be mentioned that the status of British journalism underwent a remarkable transformation in the 19th century. At the start of that period it was regarded, and with good reason, as extremely corrupt. By mid-century, the leading papers, with *The Times* in the lead, had attained much more respected positions. Still, there were many instances of corruption, some well documented, especially during the Railway Mania of the 1840s. There is some coverage of this issue and references in [65]. The general conclusion, though, is that the press was treated with considerable suspicion for a long time.

As a concrete example of the poor quality of information available to investors, we can consider the many financial handbooks and other works in the 19th century that described the gilts (or the "Funds," or the "public Funds," as they were usually called at the time). These publications usually presented details on the total volume of outstanding gilts of various types, their repayments or enlargements, and the purchase and dividend collection processes. Not infrequently, they had mistakes. For example, the 13th edition of [56], published in 1883, also edited by Robert Lucas Nash the younger, one of the most respected financial journalists of the time, claimed (p. 25) that NR was "redeemable at par on twelve months' notice." This was incorrect, NR could be redeemed at any time, it was only CA and RA that required a year's notice. Yet this incorrect statement was printed at a time when the major gilts were trading close to par, and debt conversion was receiving increasing public attention. So one would have expected extra care to be paid to all details that might bear on how investors might be treated in a conversion.

An even more serious deficiency in investment guides was the prevailing lack of direct comparisons that would indicate why one security would be preferred to another. Thus, for example, a book from 1824 claimed that "[a]s the transactions in [CA] are much more numerous than in any other [gilt], it is more immediately affected by circumstances tending to raise or depress the price of the funds; and being, therefore, more susceptible of fluctuations than any other of the *government funds*, it has become the chief instrument of the operations of speculators and jobbers" ([25], p. 34). This same book also claimed of the 3% Annuities of 1726 that their total capital being "small in comparison with the other public funds, is generally at least 1 per cent. lower than [CA]" (p. 40). But it did not say whether this presented an opportunity for investors, say ones looking for long-term income (possibly

for a trust) to get a good deal by waiting until they could purchase those 3% Annuities of 1726. There was also no comparison of pricing of CA to RA in that publication.

An earlier publication claimed that "[CA and RA] always bear a higher price than any other in proportion to the interest they produce" ([94], p. iv), but also failed to say whether this should affect an investor's selection of funds. That pamphlet, just like many of those from early in the 19th century, was devoted primarily to conversion tables, one that today would be regarded as superfluous, since we have calculators and computers. The Preface to it stated:

> The author of the following tables having often observed the trouble experienced by bankers, merchants, and stock-brokers, when consulted by their friends on the investment of money to the best advantage in the public funds, or exchanging one stock for another, on a fluctuation in the price of particular stocks; and having found how difficult it is, in the hurry of business, to make, with precision, the necessary calculations, so as to be able to take advantage of a momentary change of price; when a mistake of a single figure may expose a broker to censure and his principal to a serious loss; it occurred to him that a table like the present one, ...

Similarly, the 1821 investment guide to the gilts [13] has many numerical examples, but those are of simple arithmetic involved in computing the yields for various market prices and the like. To appreciate the need for this, we have to remember the different environment of those days, with no calculators, and arithmetic required to be carried out with the English money of pounds, shillings, and pence. The 11th edition of [24], published in 1824, had a table (p. 67) of conversions, justified by the editor on the grounds that he had "known many persons, although possessed of property in the funds, puzzled to know the meaning of the fractional parts of the pound sterling, as inserted in the *public papers*, especially females, [so] for their information the following Table is added."

There were occasional exceptions, where the author did touch on comparative attractiveness of various gilts. Thus the anonymous investment guide [2][84], in describing the 3% annuity of 1726 (p. 23) noted that

> [f]rom the little business done in this stock, it may generally be purchased nearly [£2.00] lower than [CA]; and, therefore, a thousand pound invested in it will generally bring ten or twelve shillings a year more than in that Stock.

So here we have very clear and very sensible advice. If you were a long-term investor, possibly a trust, being able to purchase this annuity at its customary discount to CA was a buying opportunity. But this was an extremely rare case of clear investment advice.

Yet another example of the limited scope of financial information is presented by the terminable annuities issued by the British government. Those are discussed in Section 62.

One curious feature of Victorian financial journalism is that it seldom connected government operations in the gilts market to CA overpricing. As was mentioned briefly in the main manuscript, and is discussed in more detail later, most of the main government dealings (putting aside the Court of Chancery and similar semi-autonomous bodies) were rational in that loans were usually taken by selling the overpriced CA, and spare funds were invested by buying the underpriced RA. This was reflected in regular press coverage, which

often specified that the government broker was buying gilts. When such reports cited what gilts were being purchased (which was not always done), they usually specified either RA or NR. But only a handful of cases have been found where anything was said to explain this bias towards purchasing RA and NR. One example is the following quote from the *Leeds Mercury* in 1865:

> The Government broker has at least appeared as a purchaser of stock on behalf of the Commissioners for the Reduction of the National Debt out of the surplus revenue officially announced in the *Gazette.* He has bought £10,000 [RA], which are cheaper than [CA] ...[85]

But even here it is not explained whether the reason for the choice of RA was something the writer of this piece surmised, or whether it was official policy. And nothing is said as to whether private investors would be wise to follow the example of the government.

On the other hand, we need to keep this in perspective. Just how much information did the press, even the financial press, provide prior to the 2008 crash about pricing of CDOs or CDO squareds? As we learned afterwards, even many supposedly sophisticated purchasers, such as large pension funds, had little idea of what was involved in those securities.

Thus on balance, given the complexity of the financial instruments that were available, it is hard to argue that the mid-19th century financial journalism was less informative to investors than modern one. But it did leave a lot to be desired.

32 An American banker and British gilts (mis)pricings

To seriously understand the historical record one needs to have a deep sense for the context, as the written passages that are all we generally have, whether printed or in private correspondence, usually assume much about the shared background of the writer and the readers. Very often it is therefore enlightening to read an account by a contemporary observer from a different country, as that person is more likely to explain some of the features that were commonplace in that country, but are unfamiliar to us, and sometimes were also unfamiliar to that observer.

For British gilts pricing, the best source of this kind that has been found so far is a 1885 book by Claudius Buchanan Patten, entitled *England as Seen by an American Banker: Notes of a Pedestrian Tour,* [69]. Unfortunately even this source is of little help in understanding the overpricing of CA.

Patten was a respected banker, who lived from 1828 to 1886. A short biographical note is available in the Introduction to his banking book [70]. This volume was published posthumously, but was based on Patten's articles in *Rhodes' Journal of Banking.* It was apparently very popular, as library catalogs show a 12th edition (possibly a reprinting and not a revision) in 1908. Based on this fact, and the Introduction to [70], we can therefore assume Patten was an expert on American banking practices. However, Patten's position, to which he rose through a steady progression, was as head Cashier to the State National Bank of Boston. This was a far more responsible position than that occupied by cashiers in contemporary banks, more like a bank manager. Still, his work and his book [70] were

devoted primarily to the mechanics of how an American bank operated, not to larger issues of finance and banking's role in the economy. That is probably one reason he does not shed any real light on the subject of this paper, the overpricing of CA.

Patten's book on England [69] has been characterized by a modern scholar as "a better-than-average travel account by an American banker" ([79], p. 230). It is indeed nicely written, and entertaining as well as enlightening, not least precisely for the reason stated earlier, namely that it provides an outsider's perspective on England in 1884, when his tour took place.

While much of Patten's book [69] is occupied with various aspects of English geography, customs, and other issues, he did indulge in his professional curiosity and visited various English banks, especially the Bank of England. His comments on the differences between English and American banking practices are very interesting, although not very detailed. He also devoted a few pages to British gilts. The reason was that he confessed he had never "exactly understood" what they were, and thought his readers might be in a similar position, and would benefit from his newly acquired knowledge. (He claimed that "[m]any United States investors hold" British gilts to obtain diversification.) However, even after his visit to England it is clear he still did not "exactly understand" what those gilts were, as his explanation was wrong on a number of points (although not big ones). For example, he wrote that CA, RA, and NR were all "consols," with RA and NR just different issues. However, he did explain that the major reason for the difference in price was that interest was payable on different dates. More importantly for our purposes, he did not mention the mispricing of CA, and it appears he was not aware of it. As representative prices for CA, RA, and NR, he gave 102, 101.5, and 101, respectively. These almost certainly come from the end of April 1884, a few days after Childers announced his conversion proposal, discussed in Section 24, and have the prices of RA and NR transposed. (That was the only time in 1884 when such a large divergence between RA and NR was recorded.) These prices cry out for an explanation, as they are not consistent with Patten's explanation of the differences between these gilts. (He wrote that they differed just in timing of payment of interest.) The divergence from the usual pattern was caused by the reaction to Childers' proposal, discussed in Section 24. Yet Patten does not appear to have noticed the discrepancy, nor the more usual pattern of RA and NR being priced identically and underpriced relative to CA. This says something about Patten. But it likely also implies that gilts mispricing was not widely talked about among the English bankers that Patten talked to, even at the time that the Childers proposal would have been expected to lead to vigorous discussion.

33 Arthur Crump in the mid-1870s on gilts investing

An interesting perspective on the role of gilts in the British investment scene in the mid-1870s can be obtained from the book *The Theory of Stock Exchange Speculation* published in 1874 by Arthur Crump [18]. Crump had worked for the Bank of England and in private banking, and then turned to financial journalism, publishing a variety of books. In 1875 he became the financial editor for *The Times,* a position he held for almost two decades [85]. While he was not regarded as a success inside *The Times,* he was held in high regard in the press in general. *The Theory of Stock Exchange Speculation* was reprinted many times,

and in the Preface to its appearance in 1903 as the 3rd volume of Nelson's Wall Street Library in the U.S., S. A. Nelson called it "perhaps the sanest consideration of the subject that has been written."

Reprinted below is Chapter 12 from *The Theory of Stock Exchange Speculation*, entitled "The shifting of speculation from the higher to the lower classes of securities." There are several noteworthy features to it. The main point, about British gilts moving from a position where they dominated the universe of investing instruments, and becoming a placid backwater, is very clear. But others are less prominent, but are very relevant for this investigation of gilts mispricing. This whole chapter talks exclusively of CA. In fact, this book as a whole fails to even mention RA and NR, which fits into the narrative that CA became a synonym for gilts, and therefore may have acquired extra cachet. (That is also true of the book [22].) Further, while many contemporary sources talk of gilts as dominated by trust investments, Crump (and some other writers) emphasizes individual investors who buy them "for permanent holding, and purely as a means of providing income" (which is also what most trusts were after). While at present we do not have data to tell the relative magnitudes of those two groups, all the evidence suggests both were substantial, and in a rational world both should have taken advantage of CA overpricing to move to RA and NR.

Crump does mention "the absence of any internal disturbances worth mentioning," which supports the narrative of Section 47 that in earlier times, say before 1850, British investors did not necessarily regard gilts as risk-free.

Here is the Crump chapter:

> Compared with what there used to be in bygone years there is now next to no speculation in Consols at all. Merchants and bankers once upon a time used to speculate in the Funds as a hedge. But things have changed, and such a method of providing against a mercantile loss, which might be brought about by the same cause that would depress Consols, has gone out of fashion, doubtless owing in some degree to there being other modes of protecting themselves against risks which both merchants and bankers must for all time incur.
>
> The maxim which is adopted by all prudent speculators in the markets, by which we mean the dealers in the Stock Exchange, who in the nature of their business must to some extent speculate, or they would lose business, is to sell when things are dear, and buy when they are cheap, and pay no attention at all to reports. Men who have had years of experience, know how to estimate at their just value the *on dits* that are for ever floating about their ears. Right or wrong, there is no money in them in the long run, and it is with the long run that operators should have to do.
>
> One reason why speculation in Consols has been reduced to a minimum is, that speculation has of late years changed its venue. The stock markets now are the field of operations for dealers in the stocks of all nations and all climes. There are a few countries whose names are still withheld from Wetenhall's list, among which China may be mentioned, but they are few. The extent to which the world has been borrowing within the last quarter of a century may be judged of from the fact, that the indebtedness of the States of the world has increased from 1851 to 1873

by £2,218,000,000, the proportion of which belonging to Europe is £1,500,000,000. People have become used to making larger profits, by which we mean that all the world lives better and makes larger incomes than they used to. Consequently they do not care to speculate in stocks unless the fluctuations are somewhat considerable and frequent. The quieter attitude of England towards foreign states for many years past, and the absence of any internal disturbances worth mentioning, has produced much more steadiness in Government securities than was the case earlier in the century. There is not much exaggeration in the remark that a fluctuation of two per cent. in a day in Consols is now witnessed once in a life-time. The process of getting in and getting out of a stock, as a speculation, cannot be profitable when the fluctuations are so small and infrequent. Speculation consequently has shifted from the Consol market, and from the market where the highest class of securities is dealt in, to departments of the Stock Exchange where a bull or a bear stands to make something in a reasonable period, if he chance to be operating the right way. It may be supposed that speculation for this reason has decreased in extent. The contrary is the fact, speculators having simply taken up new ground, as they found it useless for any purpose to speculate in stocks in which the fluctuations were so small.

One of the reasons why speculation in high-class securities has more or less ceased is obviously because Consols and such like stocks are more firmly held than they used to be when the country was oftener engaged in wars, or disturbed by semi-revolutionary agitations. Then again, the very fact of high class stocks remaining at a uniformly high level of price, causes a certain class of investors to buy them for simply absolute security's sake. There are numbers of people who hold Consols because they are perfectly certain their £3 odd % per annum will always be paid. They never trouble themselves about the price of the stock, and continue entirely apathetic whether the price rises to 120 or falls to 50. It stands to reason that, as the country grows in wealth, so do the holders of these high class stocks increase in number, and as such securities are purchased largely for permanent holding, and purely as a means of providing income, so is steadiness imparted to the price, which tends consequently to be less and less disturbed in the absence of exceptionally adverse influences. There are always large numbers of persons in a country like England who are retiring from active life to live on an income, derived through the medium of public securities of one form or another, which is hereafter to be a purchasing power dependent upon the labour of others. One man does his share of work in the world, and in the process he provides for his future wants through the medium of saved capital. There can be no doubt that if the English national debt were to be paid off there would be a considerable commotion among those holders of Consols who would be satisfied with nothing else half as well. While the times in which we live therefore, continue quiet, the credit of the Government is firmly maintained, and the savings of the people are large, there will be always more buyers than sellers of high class securities while the return for the money is not less than about 3 per cent. Buyers would in most cases probably prefer to look in

other directions than pay anything over par for Consols. The fluctuations under such circumstances are consequently very small, and there is nothing literally but a bare bone for a speculator to pick, which is not worth the commission, and he migrates into other markets.

34 Robert Giffen

It is surprising that apparently only one contemporary economist wrote about gilts mispricing. However, it is no surprise that it was Giffen. He was unusually well positioned, by both experience and inclination, to notice and investigate the issue.

Today Giffen (1837–1910) is remembered primarily for the Giffen Paradox, in which a rise in the price of a standard commodity leads to an increase in its consumption. That is because he did not contribute much to theoretical development of economics. In his day, though, he was a very visible and influential economist and statistician, as well as a financial journalist, and he ended up his life as Sir Robert Giffen. (As a statistician, his influence was again on the practical side, so in that field he is almost completely forgotten today, as there are no Giffen tests, Giffen theorems, or Giffen distributions.) Brief biographies are available in [50, 53].

The book [31] which discusses CA overpricing, was written in 1877, and was based on many years of work as a leading financial journalist. At that point he had just completed half a dozen years as the financial editor of the *Economist,* a period when, for three years, he was simultaneously the financial editor of the *Daily News.* He also contributed to numerous other press organs (and started making serious statistical contributions). In 1876 he became in effect the chief statistician for the British government, and as he moved through various civil service positions, he continued to write extensively, both under his name and anonymously (since most newspapers did not publish names of contributors). He served on numerous government commissions, was a long-time editor of the *Journal of the Statistical Society of London* (which, during his tenure, became the Royal Statistical Society), President of that society, a member of the Political Economy Club, and a founding member of the Royal Economic Society.

It is worth quoting two passages about Giffen from the book [50] (from pages 57 and 21, respectively), which help explain why he was a natural candidate for delving into gilts mispricings:

- "Giffen was known throughout his life as a lover of paradoxes."
- "Most of all, however, he is remembered for his refusal to accept economic theories at face value, believing that many economists had a tendency to carry their theories too far at the expense of practical observation and application. In later years, he delighted in being seen as 'the *bête noire* of economic quacks and fanatics' (*Glasgow Herald*).'"

After this brief background on Giffen, let us consider some reactions to his book [31], since they illuminate contemporary thinking about shares and bonds. Large parts of this work are devoted to Giffen's arguments for the cyclical nature of economic activity and prices, and other parts to his theories about the declining rate of profit. Many reviewers

concentrated on those parts of the book, sometimes accepting Giffen's theses, sometimes disputing them. But the bulk of Giffen's work was devoted to exploring systematic influences on the price of tradeable securities, This contribution was greeted with what seems to have been universal acclaim.

Giffen's book was the first one to explain that variation in prices often arose from rational causes, driven by the basic uncertainties of business life. Stock exchanges and share and bond trading were only slowly becoming respectable. For some quotes and references from the middle of the 19th century, see [65]. By Giffen's time, there was some shift, but it was limited, and the London Stock Exchange was still widely regarded as a den of gamblers and swindlers who manipulated prices to suit their tactics. Giffen's refutation of this view struck a cord. Thus one review of his book[86] claimed that "there is an idea abroad that the price of Securities is mainly regulated by Stock-Exchange operations, ...," and then happily cited Giffen's work as showing that "[t]he effect of "rigs" and "corners," and the like varieties of artistic swindling, is very great on the fortunes of individuals, but very little on the broad market." Another wrote that "[n]o worthier occupation for an economist could be found than to endeavour to analyse what we might call the chief disturbing influences on the value of securities, and Mr. Giffen is the first in a field which it is desirable should be thoroughly explored"[87]. Yet another stated:

> I would strongly recommend [the perusal of Giffen's book] to all those desirous to invest upon a sound basis of common sense, ... Most writers on political economy deem the practical application of its principles to investment as below their notice. Indeed, although it is their business to deal with facts, they seldom apply these facts to individual enterprise. Their science is generalisation, and Mr. Giffen has done a good service to the public, in applying the results of these generalisations to a matter, in regard to which the most astounding ignorance prevails.[88]

The point of these citations is to demonstrate the primitive state of financial analysis in Britain in the 1870s, as well as the wide spread of the opinion that investing in financial instruments involved gambling in a rigged casino.

Many of the reviews of Giffen's book also show agreement with one of his theses, namely that investors are often irrational. This is nicely shown by the following quote from another work by Giffen from that time, this one in a serial [30]. (This article of Giffen's was even more widely reviewed and cited than his book, likely because of its positive outlook for the future, at a moment when the UK was emerging from a series of economic upsets, at the tail end of the "Great Victorian Boom.") It also demonstrates the difference between Giffen and his contemporaries (who generally shared his views in his area) on one hand, and modern observers on the other, in views about the origins and role of "financial innovation." Giffen wrote:

> If the class of promoters is checked in one way, they will invent new methods and new fields of deception, still keeping within the wind of any laws that may be contrived. ... Probably promoters will now go into a totally different field, which I am disposed to think may be the creation of trusts or trust companies to "amalgamate" securities, and so distribute the risks. The principle seems fascinating: more than one of the

> numerous trusts now in existence have been fairly successful: we may accordingly expect an extension of the principle by which investors will be once more encouraged in the impossible experiment of making a high interest safely. But trust companies are really as dangerous as limited companies with much uncalled capital, or foreign loans, though in a different way. They amalgamate securities and distribute risks, it is true, but they add the great risk of a new set of intermediaries between the investor and his investment. In addition to his former risks, the latter, when he belongs to a trust, runs the risk of employing an adventurer or a thief to select and keep the securities. The danger is manifest. But if promoters do not go into trusts, or trusts do not "take," we may be certain they will try something else which will probably be found to answer, so great and so enduring is the infatuation of the public; and the mischief will be done before effectual warning can be given.

35 Other contemporary economists and gilts mispricing

That many individual owners of CA might ignore the pricing anomaly and not switch to RA or NR, can easily be ascribed to inertia. The gains were not large, and *Homo sapiens* is prone to procrastination. On the other hand, it is surprising that economists did not pay more attention to this phenomenon. The mispricing is a curious intellectual puzzle, and one might think it would catch the attention of some of the people working in what was then called political economy. Yet, aside from Giffen, it does not appear that any of them wrote about it. Perhaps deeper investigations, possibly ones looking into archives of personal correspondence, will turn up some discussion.

The period of persistent CA overprising, 1854 through 1887, overlaps the careers of perhaps the last of the great classical economists, John Stuart Mill (1806–1873), and of Alfred Marshall (1842–1924), perhaps the most famous of the founders of neoclassical economics.

Classical economists were anything but empirical. But even among them, silence on CA overpricing is somewhat surprising, especially for John Ramsay McCulloch. McCulloch (1789–1864) was perhaps the most prominent British economist of the second quarter of the 19th century [53, 61], partly because of several series of reference works he edited. The most famous of these series was the *Commercial Dictionary* [54], first published in 1832. It was extremely popular, and went through more than 10 editions. (The exact number depends on how one counts minor revisions, or additions of a supplement to what was basically a reprint. There were also several slightly modified U.S. editions, revised by American scholars.) The original publication and the revisions involved prodigious labor of collecting information from a variety of sources, much of it very quantitative. In particular, the data about the volumes of various gilts, and about the numbers of accounts of various sizes, was updated regularly. Yet all the editions of this work that were checked (more than half), starting with the initial one of 1832, and including the posthumous ones of 1869 and 1875, which were edited by H. G. Reid, have an extended passage from [36] about gilts pricing, a small piece of which, about CA and RA differing almost always by plus or minus £0.75 was cited in Section 5.1. This suggests that neither McCulloch nor Reid was aware that the

relation of CA and RA prices had changed, or that they decided to ignore this awkward fact.

Even other economists of that era do discuss money markets. For example, Mill in his *Principles of Political Economy* ([52], vol. 2, Chapter XXIII, "Of the rate of interest") wrote:

> The public funds, shares in the joint stock companies, and all descriptions of securities, are at a high price in proportion as the rate of interest is low. They are sold at the price which will give the market rate of interest on the purchase money, with allowance for all differences in the risk incurred, or in any circumstance of convenience. Exchequer bills, for example, usually sell at a higher price than consols, proportionally to the interest which they yield; because, although the security is the same, yet the former being annually paid off at par, the purchaser (unless obliged to sell in a moment of general emergency) is in no danger of losing anything by the resale, except the premium he may have paid.

Mill was also an MP for a couple of years in the 1860s (starting when CA overpricing was near its peak), and spoke and wrote about current affairs. But there does not seem to be anything in his collected works about gilts mispricings.

Should we interpret the silence of contemporary economists about gilts mispricings as indicating either striking ignorance of an obvious and large-scale economic anomaly, or as willful suppression of inconvenient facts? Those would seem the obvious choices from our modern perspective. However, if we look at the situation from the context of 19th century thought, another choice appears. Contemporary observers regarded markets as full of inefficiencies and irrational behavior, as is discussed in the next section. Victorian observers regarded not just manias and crashes, but everyday behavior by investors that was economically irrational as normal. It is therefore possible that the contemporary economists shared this view, and so did not think that CA overpricing was particularly noteworthy. But if they did, and were logical, they should have understood their theories and models to be very idealized and far removed from reality. To what extent is that reflected in their work? Some further investigation of this issue seems desirable.

36 Widespread perception of irrational investors and inefficient markets

As was already mentioned in the main paper, and as is clear from the Giffen quote at the end of the preceding section, the British elite regarded the bulk of investors as naive and easily led astray. For example, the financial column of *The Times* on 1 January 1870, in a New Year's look backwards and forwards, at a time of great prosperity and quiet in the markets as well as in political arenas, noted that

> "[i]f a general disposition to hopefulness can exert much influence, 1870 should be a prosperous year. By the time it shall have run its course we shall be half-way between the troubles of 1866 [when giant mania culminated in a crash that forced a suspension of the gold standard] and the period when, according to all experience,

> a new inflation [i.e., another mania] will be due. It is, therefore, just about the date for an average and rational condition of trade and enterprise.

Another quote to this effect comes from Walter Bagehot, the famous 19th century economist and writer, who wrote [5]:

> A great deal has been written and is being written on panics and manias - a great deal more than with the most outstretched intellect we are able to follow or conceive; but one thing seems certain, that at particular times a great many stupid people have a great deal of stupid money. ... Every now and then, from causes which are not to the present purpose, the money of people of this class—the blind capital (as oculists call it) of the country—happens to be particularly large and craving; it seeks for some one to devour it, and there is "plethora"—it finds some one, and there is "speculation"— it is devoured, and there is "panic."

The prevailing opinion was that it was not just during manias that investors were easily led astray. In particular, the "foreign loans" mentioned in the Giffen quote in the preceding section were a particularly sore point. It was not just that foreign investment was thought to be harmful to Britain, a view that continued well into the 20th century. For a long time informed opinion held uniformly that investors who participated in loans to foreign governments were throwing away their money, seduced by the promise of high rates of interest, but destined to suffer from defaults. There was certainly no shortage of examples to cite, such as Greece, Spain, most of the Latin American countries, and individual states of the U.S. It came as a great surprise, therefore, when Robert Lucas Nash the younger (the son of the elder Nash who is mentioned in Section 16) demonstrated in 1880 that on average, the defaults did not cause as much damage as the consensus held, and that the average returns from foreign loans were in fact decent, at least over the preceding decade [57]. Thus, for example, *The Times* called the results of Nash's work "remarkable," in that it demonstrated that "[i]n almost every class of security which the British investor has touched he has made money, and not least in the lately much-discredited foreign securities"[89]. The point of citing this review is that it does show that until 1880, the consensus opinion of the British elite was indeed that investors were regularly behaving in economically irrational way by investing in foreign loans.

37 Perception of prevalence of pricing anomalies

Part of the explanation for why the gilts pricing anomaly persisted for so long and did not attract much attention is that it may have been seen by the British investing public as only a very small pricing anomaly among many others. The differences in yield between CA and RA, even at the peak of the mispricing in 1864, came to only about 0.06% per year. Investors often faced far greater differences in the marketplace for which they could not find satisfactory explanations. Thus, for example, in 1860, the *Economist* noted that some "guaranteed stocks, such as the Turkish 4 per Cents., give exactly the same security as Consols, and give about 1 per cent. higher interest"[90]. This was in reference to 4% bonds issued by the Turkish government in 1855, during the Crimean War, which were guaranteed

by both the British and the French governments (and thus "gave exactly the same security as Consols" according to the *Economist*). At that time, CA was yielding about 3.2%, while those Turkish bonds were paying 3.9% on the market price[91]. A dozen years later, a letter published in *The Times* wondered why the 3.5% bonds of the Metropolitan Board of Works, to be redeemed in 1929, were providing market yield of over 3.6%, even though they were eligible for trust investments, and the taxes of London "cannot but be considered always a security for their loans," even though CA was paying under 3.3% at that time[92]. Concerning these same bonds, an investment guide declared two years later that "[t]he security offered is therefore regarded much in the light of a Government guarantee" ([56], p. 129).

As another example, the *Economist* commented on another occasion[93] that

> [w]ith [CA yielding 3.375%], and with a strong tendency to a rise, ... and Exchequer bonds giving [4%], both possessing advantages so superior in many important respects as compared with [CA], cannot long continue at *par*;...

Some years later, this paper noted[94]:

> It may at first sight seem strange that the Indian Government should be able to borrow that which the Railway Companies, *with the guarantee of the Indian Government* cannot borrow for themselves, and even after every explanation it *is* rather strange. The tastes of the lending part of the public are peculiar, and it is not possible to give a scientific explanation of inclinations which are not founded upon any very careful investigation or very rational argument.

Other observers wondered about large differences in yield where the securities differed more, but to them still seemed similar ones. In 1872, as France was placing a huge loan to pay the "indemnity" to Germany, the *Spectator* was surprised that more British investors were not dumping their gilts in order to double their income from the French bonds[95].

Giffen's book [30] was warmly welcomed largely because it served to at least partially explain many of the anomalies faced by investors. But there continued to be a widespread feeling that prices were subject to shifting investor moods. A colorful expression of that view comes from the *Spectator* of 1860[96]:

> Fashion changes in commerce as well as in every field of life. A little while ago, Fashion looked down upon American securities of all kinds, but now the capricious goddess seems taking a very decided turn the other way.

That sophisticated observers of the 19th century regarded markets as frequently irrational may thus be part of the reason the gilts pricing disparity persisted for so long, and was not paid much attention. It may also have implications for the origins and nature of current financial markets, which trace their origins to those times.

38 Fiscal repression and gilts held by public agencies

Many developed economies are facing extremely high and growing debt levels. In the search for solutions, fiscal repression is increasingly being proposed as one tool. Drelichman and

Voth [20] have argued that fiscal repression was also a key reason for Britain's success in sustaining a huge debt burden in the 18th century. By itself, of course, fiscal repression is not enough, as a large pool of savings is needed to have something to repress, as Gelderblom and Junker [28], for example, show for the Dutch in the 17th century. But it is interesting to consider just how important a tool this was.

In the 1823–1187 period of this study, the bluntest tool of fiscal repression discussed by Drelichman and Voth, namely the usury limit on interest rates, was not a factor. Usury laws were gradually relaxed. More important than that, though, interest rates dropped, so usury ceilings were simply not relevant. However, there were other inducements that operated to push investments into gilts, primarily the limitations on how various trust and public funds could be invested (cf. [16]). Although the restrictions on trust investments were gradually relaxed, trustees were very conservative (as is shown through the examples of Cambridge and Oxford universities, and of the Greenwich Hospital, among the cases discussed in later sections) in taking advantage of them. Further, investments made by the government on behalf of savings banks had to go into gilts. Contemporary observers seemed unanimous in claiming such measures had a large impact in raising the price of gilts. A very strong opinion in this direction was expressed by Francis Playford, a broker, in 1855 ([72], p. 40) and then in a revised version of his pamphlet in 1865. Giffen expressed a similar opinion in 1899 ([32], vol. 2, Chapter XXI). However, that is not the topic of this paper, and we are interested primarily in large owners of gilts, and the degree to which they took advantage of CA overpricing.

We can get interesting insights by considering an accounting of the gilts held by some public agencies at the Bank of England[97]. This document shows that in February 1870, those bodies held £93.4 million, or over 12% of the entire national debt of the UK. Almost 90% of this amount was held by just two organizations, the Court of Chancery and the Commissioners for the Reduction of the National Debt, which will be discussed below. All the other institutions in that list accounted for just £11.4 million, but that was still 1.5% of the national debt. In most cases, these were long-term holdings, whose steady interest income was used to fund various long-term activities. The rational income-maximizing strategy would have been to concentrate all holdings in RA and NR. However, we find that of this £11.4 million, 55% was in CA (with 38% in RA and 7% in NR), which was far from optimal.

It is striking that the agencies in that 1870 compilation seemed to be following different policies in their gilts investments. For example, Queen Anne's Bounty (a charity to support the poorer clergymen in the Church of England) had only about 20% of their gilts in CA, with the rest in RA and NR. On the other hand, the Ecclesiastical Commissioners held about 84% of their gilts in CA. Why the disparity? Was this just because the management of Queen Anne's Bounty was more financially sophisticated? Hopefully some further research will shed light on this question.

Greenwich Hospital was among the most rational investors among the agencies discussed above. In the 1870 accounts, it showed up with just 24% of its substantial (£2.3 million) gilts investments in CA. Section 41 presents some additional information that has been found in other Blue Books about its accounts from 1859 to 1882. During that period it

went from having over 40% of its gilts investments in CA down to 10%. What happened is that it held onto its underpriced RA, and funded its investment diversification and other expenses by selling the overpriced CA. This certainly suggests some awareness of income maximization opportunities. However, no trace has been found of any attempt to simply switch from CA to RA.

The Court of Chancery was surely the largest holder of gilts for most of the 19th century. It was also among the most irrational. In 1870, it controlled £57.7 million in gilts (most apparently on behalf of over 20,000 trust accounts that it administered), and 75% of that was in CA. It is considered in some detail in Section 39. It was a complicated institution. Reformers spent much of the 19th century trying to reduce its corruption and inefficiency. Until some time in mid-century, it apparently had a rigid rule that, except in unusual circumstances, all financial investments had to be in CA. That did change, but in practice the change in investment direction was slow.

All the agencies cited above were under some degree of oversight by the British government, so their irrational investment policies could be ascribed to a general tendency for governments to be inefficient. However, we find the same phenomena among independent charities, such as the universities of Cambridge and Oxford, which are discussed in Section 42.

39 The Court of Chancery and the gilts market

Modern discussions on how to promote development in societies plagued by corruption might benefit from more careful studies of the British experience. The Industrial Revolution was born there in an environment of extreme corruption, when, in the words of a modern historian, "[t]he ruling elite ... used the existing institutions of the country for unparalleled rapacity and self-aggrandizement" ([76], p. 308). By the time "the Great Victorian Boom" started in the middle of the 19th century, what we regard as Victorian morality was beginning to dominate, but there were still many residues of "Old Corruption" [40]. The Court of Chancery was one of the most notorious of these remnants of the old system. Dickens' novel *Bleak House* is often cited for story of the Jarndyce v Jarndyce case, which went on for generations, until legal costs consumed all of the funds at stake. But the whole novel can be read, and was frequently at the time read, as a much broader indictment of the Court of Chancery. In the preface to the first book edition of 1853, Dickens went on at great length to argue that his fiction did not exaggerate the evils of this important part of the legal system, which was notorious for its slow pace and high costs. These costs provided high salaries for large staff (with the Lord Chancellor, the head of the court, in the lead) as well as high incomes for lawyers, brokers, and jobbers. This was possible because this court had under its control huge sums. Thus, for example, the report cited above shows that in February 1870, its accounts at the Bank of England held £57.7 million in gilts, of which £43.5 million, or 75%, was in CA.

It should be noted that while the Court of Chancery was notorious for its role in lawsuits, "a comparatively small number ... of accounts [belonged] to matters and causes in which litigation [was] actively going on" ([89], p. xxxii). Most of the accounts, and therefore surely most of the money, was from perpetual trusts, which were placed with the

Court for lower costs, greater security, and because trustees wanted to get rid of the hassles associated with their duty ([89], p. lvii).

"The Court of Chancery, inaccessible to the poor, vexatious to the rich, dilatory and expensive to all, ..., with a practice almost unequalled in its imperfections" was a target of reformers for decades[98]. Sale of offices was abolished, as well as numerous sinecures, and various officials were placed on salary. Eventually this court was absorbed into a new unified court system in the 1870s. Here we take a brief look at the financial side of its operations. It was handled by the Accountant General, and its procedures were elucidated and placed on the record by a Royal Commission report of 1864 [89]. The office of the Accountant General was created in the 1720s, in the wake of the South Sea Bubble. During that episode of investor exuberance, various officials of the Court of Chancery who had custody of funds held by this institution used them to speculate in the stock market, with disastrous results. To prevent such abuses, the new position was set up, and it centralized money management. But with time, it accumulated its own abuses. For example, the Accountant General selected the broker who bought and sold gilts for the Court of Chancery. The Accountant General also pocketed half of the brokerage commissions until 1819, and 60% afterwards, until this was abolished in the reform act of 1852 ([89], p. xv). But even after 1852, the 60% cut of the commission that used to go to the Accountant General personally went into an account at the court that did not appear to belong to anyone, and gave this court substantial freedom of action in terms of its expenditures. Thus the incentives to churn remained. Furthermore, even with the 60% discount, the Court of Chancery broker received commissions of £3,440 in 1862, whereas the government broker worked for an annual salary of £750. (However, it should be said that the Court of Chancery broker also provided some bookkeeping services for the Court, employing several clerks for this purpose.)

Antiquated procedures helped keep the system running in its inefficient mode. The *Economist* complained[99]:

> Each sale of stock and each purchase is made quite separately. If the court have to sell [£1,000] and to buy [£1,000] on the 1st Jan., they *do both*; they have no power to set one off against the other. They are obliged to sell the stock in the morning and buy it back in the evening. Accordingly the court is a very favourite customer to the Stock Exchange.

(Not unexpectedly, the staff of the Accountant General's office had arguments why such a procedure was not practical and would not save much money, cf. [89], pp. 43–48.) Parties to suits with money in the custody of the court had to specifically apply to have it invested, otherwise it just sat in an account with no interest being earned by the beneficiaries. (It went to the Court instead.)

The Chancery Funds Commission report [89] noted (p. 10):

> The fund heretofore usually selected by the Court for investment of suitors' money in Court was [CA], but, under special circumstances, the investment was permitted to be made in [RA, NR], or Exchequer Bills or Bonds.

No explanation was given for either the initial selection of CA, or for relaxing the restriction and allowing RA and NR.

Further research may illuminate this issue. It may not even be necessary to delve into judicial archives, as there were numerous legal treatises about the rules, procedures, and precedents of this Court, as it provided lucrative employment for legions of lawyers. As one, and surely not the best, example, the 1839 book [98] (Chapter III, pp. 21–32) cites the general rule about all Court of Chancery and Court of Exchequer investments going into CA as a praiseworthy one, but it is not very clear on its origins. The adherence to the customary preference for CA, and lack of incentives to optimize returns, are likely the reasons for the lopsided investment in gilts, with 75% going into CA. (The Irish Court of Chancery had an even stronger preference for a single gilt, in their case for NR. In 1850, 10% of its holdings were in CA and 90% in NR[100]. This was far more rational than the policy of its English equivalent.) Intriguingly, the two funds with somewhat uncertain ownership but with most of the benefits of their investments accruing to the Court (Fund A and Fund B) each had a more rational mix of about 45% CA and 55% RA (and negligible NR) in their gilts holdings in 1861 ([89], p. 87).

Some of the barriers of ignorance, high costs, and delays that hindered rational investment of funds held by the Court of Chancery may be illustrated by what happened with railway funds at the height of the Railway Mania. Railway promoters had to deposit substantial sums with the Accountant General of the Court of Chancery before Parliament would consider their projects. (The money was refunded, whether the projects were approved or not, and on average was held by the Accountant General for about half a year.) The magnitude of these financial operations was thought by some to pose a threat to the economic stability of the country. The opponents of the Mania, with *The Times* in the forefront, exaggerated both the expected volume of deposits and the cumbersome nature of the Court of Chancery procedures, while supporters of the Mania, such as Charles Mackay, the author of *Extraordinary Popular Delusions and the Madness of Crowds,* minimized both. For details, see [64]. It was especially interesting that the archaic processes of this Court were thought to be significant enough to threaten a financial crash for the nation, when dealing with the projected volume of deposits.

Railway promoters could request that their deposits be invested on their behalf while in custody of the Accountant General. During 1845 and 1846, the two peak years of Parliamentary scrutiny of such promotions, most of them did not do so[101]. For example, during the 1845 session of Parliament, deposits came to £3.4 million, and of this just £56 thousand was invested in gilts, all in CA, and £813 thousand in Exchequer Bills. Were the other promoters even aware of their options? Or were they simply too busy to jump through the hoops at the Court of Chancery?

An intriguing point about the Chancery Funds Commission report [89] is that it does not appear to ever confront the obvious question, namely of choice of gilts investments between CA, RA, and NR. There is extensive investigation of how the investments made by the broker in gilts compared to the average prices of those gilts on that day (cf. [89], pp. 84-86), but not of why particular gilts were selected. It is true that in the majority of cases the selection was surely made by the lawyers involved (although not always, presumably in

cases of wards of the court, or of trusts that the Court administered, it was the Accountant General or some other official of the Court who made the decision). Still, this issue was an obvious one, almost staring one in the face when one considered the statistics in the report, and of obvious relevance in cases of funds A and B. But it was never faced.

What this section shows is that what was almost surely the largest investor in gilts, the Court of Chancery, showed a strong and economically irrational bias towards the overpriced CA.

40 The Chancellor of the Exchequer and the gilts market

Among the agencies whose gilts holdings were included in the 1870 compilation cited in the preceding section were the Commissioners for the Reduction of the National Debt. In practice, the decisions of that body were made mainly by the Chancellor of the Exchequer.

The 1870 gilts holdings of these Commissioners amounted to £24.3 million, and consisted of 38% CA, 31% RA, and 31% NR. Thus on the surface, these investments are more rational than average. But why have even 38% CA?

The gilts holdings of the Commissioners for the Reduction of the National Debt represented primarily funds coming from savings banks, Friendly Societies, the Post Office Savings Bank, and similar bodies. Starting early in the 19th century, the British government started offering fixed interest rates on money deposited with it by such organizations, rates that were revised periodically and were typically comparable to the market rates on gilts. The money coming in from these institutions was held in special accounts. However, as was widely recognized, this was basically an accounting fiction. The government was guaranteeing the value of the deposits as well as the interest rates. Since the market value of the deposits was overwhelmingly below the nominal amount, the deposited money was really the government's, and the better it could do at investing those funds, the lower the losses that had to be covered from general tax revenues. Thus the rational policy would seem to call for investing in the underpriced RA and NR. However, these funds had special challenges. They tended to see inflows when times were prosperous, and outflows when there was economic turmoil. Hence they had to think of their gilts holdings not just as long term income producing investments, but to a large extent also as liquid reserves. So the Chancellors of the Exchequer may have felt that it was worth paying extra for the additional liquidity that CA offered. They may also have decided rationally that since markets were irrational, the hard times that led to withdrawals from savings banks, say, would lead to the underpriced RA and NR becoming even more underpriced. Therefore until a deeper investigation is carried out into the deliberations and policies of the Commissioners for the Reduction of the National Debt, we cannot be sure they were acting irrationally by having a substantial part of those funds in CA.

Aside from managing the funds for savings banks and similar bodies, the Chancellor of the Exchequer interacted with the money market in two other ways. One was in borrowing, either for short-term needs, or longer term. The second was in reducing debt. As was mentioned in the Introduction, Table 1 of the main paper suggests some economic rationality, in that it was the underpriced RA and NR that were reduced the most during the period

covered there. The bulk of the changes that are visible in that table, however, will need to be investigated in more detail before we can say much about them. They involved moves such as converting gilts held by the courts or by the Commissioners for the Reduction of the National Debt into terminable annuities, or else repurchases of Exchequer bills that were followed by conversion into gilts and cancellation. The precise terms on which these maneuvers were carried out will need to be found, and their effects evaluated. A complicating factor is that many of the operations of the Chancellor of the Exchequer in the money market were not necessarily motivated by simple financial considerations (and were often criticized for that reason by the press and even by Parliamentary committees, such as [88]).

Here we consider just a few operations where a clear choice between CA and RA had to be made. First we look at increases in debt. Heavy long-term borrowing by the British government basically stopped with the end of the French and Napoleonic Wars in 1815. But there were a few exceptions, and we consider the five largest ones.

In 1835–36, £20 million was borrowed to compensate slave owners for the emancipation of their labor force. Of this amount, £15 million was contracted for in 1835, in a mixture of CA and RA. (The 1836 loans were in 3.5% bonds, the R35 cited earlier, so are ignored here, as we are only interested in the relative pricing of CA and RA. A deeper investigation would consider the 1836 loans, as well as various other government financing operations, such as issuance of life annuities and short-term financing operations.) For each £100 in cash, the investment bankers received £75 in CA and £25 in RA, plus a terminable annuity to make up for the fact that both CA and RA were trading below par. Since CA was only mildly overpriced that year (an average of £0.17, as is shown in the tables), this choice of securities cannot be criticized too much.

The next four large additions to the national debt occurred in 1847, 1855, and 1856, and have been described in earlier sections. All four were in CA, which was overpriced at that time. Thus in all these cases of large scale gilts issuance, the government did the rational thing, namely issue the overpriced CA.

A remarkable phenomenon is that no comments have been found, in either Parliamentary debates, or in the press, about the reliance on CA as opposed to RA or NR in any of those last four loans. There were debates about the loans, with some ardent advocates of other means of financing the government's needs, such as terminable annuities. But nothing appeared to be said about selling CA instead of RA. Hopefully further research will identify some internal government documents that will reveal how the decisions were made.

Large scale debt issuance came on only a few occasions in the 19th century. But for much of that period, the government was reducing its debt by using budget surpluses to repurchase gilts and other securities in the market. The Commissioners for the Reduction of the National Debt were set up for just this purpose, and their operations are summarized in [92].

Government purchases of gilts were handled by a salaried employee, often cited in the press as the "government broker" ([88], p. 269). His purchases for debt reduction purposes were announced in advance for each quarter, and occurred on a regular basis during that quarter[102]. The table on pp. 46-47 of [92] presents market repurchases of bonds from 1829

to 1890. Much of the activity was in various short term financial instruments, which we ignore. We also ignore repurchases of gilts with interest rates other than 3%, and of minor gilts, in order to concentrate on the major gilts.

Table 3. Government repurchases of the major gilts, 1871–76, for fiscal years ending 31 March of each year.

All figures in millions of pounds sterling.

year	CA	RA	NR
1871	-	1.154	0.897
1872	-	0.064	0.750
1873	-	1.001	2.024
1874	1.212	1.771	1.253
1875	0.100	0.528	0.191
1876	0.031	0.248	0.078

The direct repurchases of CA, RA, and NR over the entire 1829-90 period amounted to £6.6, 13.9, and 7.6 million, respectively. Thus, at first sight, they do appear to have been concentrated in the undervalued RA and NR. An even more favorable picture of the financial sophistication of the British government emerges when we consider these repurchases year by year. The period 1829-90 included some stretches when CA and RA were priced at equivalent levels. When we look at individual years, we find that, generally, CA was bought during such periods (at least based on the limited data available for some years), and so this shows rational behavior. But there are some puzzles. Fig. 1 of the main paper shows that CA was consistently overvalued relative to RA during 1872–74. (NR was priced almost exactly the same as RA.) So it would have made sense for the British government to purchase RA and NR only. And indeed that is what it did in the fiscal years ending on 31 March of 1872 and 1873, as is shown in Table 3. But in the year to 31 March 1874 it repurchased a substantial volume of CA. That invites a deeper exploration. In February 1874, Gladstone's government was replaced by Disraeli's, But that was surely too late to affect the bulk of the market purchases in that fiscal year. During 1871–73, Gladstone was the Prime Minister. Robert Lowe was the Chancellor of the Exchequer until the middle of 1873, when Gladstone took on this position himself. Both Gladstone and Lowe were regarded as sagacious financiers. But perhaps Gladstone was too busy to pay much attention to the details of gilts repurchases, once he was in charge of financial operations in addition to his other duties.

The 14 June 1875 letter addressed to Northcote, Disraeli's Chancellor of the Exchequer, by C. Rivers Wilson, the Controller of the National Debt Office[103], which is discussed in Section 27, could be taken to imply that the writer was trying to educate his boss about

the overpricing of CA. Still, market purchases of gilts under Northcote were concentrated in the underpriced RA and NR even before this letter.

41 Greenwich Hospital and gilts

The "Blue Books" of the Royal Commission on Cambridge and Oxford provide us with a snapshot of the finances of those two institutions at a single point of time. Another set of "Blue Books" allows us to easily obtain at least some sense of the gilts investments of another large charitable institutions, the Greenwich Hospital, but this time over several decades. As in the case of Cambridge and Oxford, the account in this section is based on a cursory examination of the voluminous (but incomplete) documentation that is available. Far more can and hopefully will be found by more careful study of those "Blue Books," and even more by exploring the archives of this institution. But even the limited scrutiny that is documented here provides some insights, as well as more puzzles, about British knowledge about, and attitudes to, gilts mispricing.

The Greenwich Hospital was established as the Royal Hospital for Seamen at Greenwich at the end of the 17th century. For a long time it was primarily a place for disabled sailors of the Royal Navy, and it exists to this day as a more general charity. Here we ignore its operations as a charity, and consider its investments in the mid-19th century. The sources are primarily a sporadically appearing series of "Blue Books" with titles "Greenwich Hospital. Returns of the balance sheet, capital account, and profit and loss account for Greenwich Hospital ..." or small variation on this, which provide us with the capital accounts of this institution starting with the end of 1859. Also useful were the detailed 1860 report of a Royal Commission (*Parliamentary Papers* 1860 [2670] XXX.1), and a report of one of the commissioners (*Parliamentary Papers* 1864 (202) XXXVII.223).

Over the period 1860 to 1890, about half of the revenues of the Greenwich Hospital came from investments. Initially, unlike in the cases of Cambridge and Oxford, those investments were overwhelmingly (about 2/3) in gilts, and not real estate. As a result, Greenwich had higher gilts investments (of nominal value around £2.5 million) than Cambridge and Oxford combined (which, including those of their colleges, totaled about £2 million).

As was mentioned earlier, the 1870 "Blue Book" with gilt figures for some public institutions[104] showed Greenwich Hospital as among the more economically rational bodies, with only about 24% of its gilts holdings in CA. How it got to that position, and where it went afterwards, presents an interesting picture that probably comes from a conflict of economic rationality on one hand, and inertia and some cultural inhibitions on the other.

The first detailed accounting we have from the sources mentioned above, for year-end 1859, shows £1.1 million in CA and £1.5 million in RA (and a negligible £46 thousand in NR). That is a lower fraction of CA than among all the outstanding gilts, but it is still substantial, at over 40%. Over the next two decades, while CA was consistently overpriced relative to RA (sometimes more, sometimes less), we do find a few questionable moves, such as small purchases of CA (apparently coming from the surpluses that this institution was generating). Overall, though, we do see economic rationality dominating, in that most of the substantial sales of gilts were of the overpriced CA. Thus, for example,

when the Hospital had to purchase annuities for some officials whose positions were being eliminated, it did so by selling £171 thousand of CA (in nominal value). Its first major diversification in tradeable securities (there had been various real estate purchases earlier) took place in December 1869, "when [CA of nominal value £592 thousand] was sold to produce the sum of [£544 thousand in cash], which was invested in the purchase of [nominal value £500 thousand of] Indian Railway Stock"[105]. Subsequent diversification moves (more Indian railways, British railways, loans to municipalities, ..., as well as more real estate investments, purchases or mortgages) were also financed by sales of CA, so that in April 1882, the investment account had just £162 thousand of CA, and £1,450 thousand of RA (just about the amount two decades earlier). This certainly suggests awareness that CA was overpriced.

On the other hand, the "Blue Books" do not show any awareness of the risk-free gain that exchanging CA for RA offered. It was not done, and various discussions of improving the financial position of the Hospital don't mention it. Was this perhaps because it was regarded as unseemly, either because trading one government security for another was thought as too much like the much-despised "jobbery," or because the gain was so small that it was not appropriate for gentlemen to even talk about it? In the "Blue Book" that was cited above on the £544 thousand investment in Indian railways, it is remarked that this increased the annual income by £7,253 per year. Those railway securities, guaranteed by the colonial government of India, paid 5% on the nominal amount, so the Hospital moved from earning 3.26% on the market value of CA to earning 4.59% from Indian railways. The move from CA to RA at the end of 1869 would have increased the yield by only about 0.02%.

Still, even a 0.02% gain in yield on the Hospital's investment in CA would have yielded £200 per year. That was not much. The 1860 report of the Royal Commission recommended changes that it anticipated would save many thousands of pounds per year. On the other hand, it also went into minute details of various expenditures, and it did note that "[a]n additional [1%] will be derived from [£50 thousand] about to be lent on mortgage," which was an annual gain of £500. Further, £200 was about the annual income of a lower middle class household. (That is about what the Brontë sisters' father earned around 1850, while Charles Darwin, comfortably in the upper middle class by virtue of his family wealth, lived on about £1,000 per year.) Yet, when asking witnesses about the Hospital's investments, the Commission went into considerable detail about real estate ones, but when it came to gilts, it only asked the witnesses some superficial questions, and never raised a question of how those were allocated.

Thus at the end we find ourselves with another example of a large investor that to some extent did behave in economically rational ways, but not completely.

42 The universities of Cambridge and Oxford and their gilts (mal-)investments

We can thank a Royal Commission of the early 1870s for a detailed account of the finances of the universities of Cambridge and Oxford and of the colleges at those universities (which

ran their affairs separately). The report came out in three "Blue Books" of almost 1700 pages [90]. In this section we only briefly mention some of the statistics about those bodies' investments in gilts.

The total annual income from investments for all these universities and colleges came to £615 thousand. The overwhelming majority was derived from real estate. Only £61 thousand came from "Stock, Shares, &c.," and that is the only part we discuss, just about 10% of the total. So it was not a huge amount, but it still represented about £2 million of capital, more than 0.25% of the total national debt, and was a key source of support for some administrative subunits, such as libraries and museums. Hence there were incentives to maximize returns from it. However, it appears that little attention was paid to this goal.

The comments that follow should be regarded as provisional. They are based not on careful analysis of all the accounts, but on sampling (although biased towards sampling accounts of colleges that had the largest funds invested in tradeable securities). Still, this sampling reveals many glaring examples of economically irrational investments. For example, the trust funds of Cambridge University (that is, funds that were dedicated to supporting particular causes, and were administered by the University as a trustee, the Royal Commission asked for separate data for funds controlled completely by the various bodies being examined, and those for which they were trustees) were overwhelmingly in CA. There was £192 thousand in CA, £10 thousand in RA, £6 thousand in NR, £10 thousand in East India and railway securities, and £2 thousand in some unspecified mixture of CA and RA in the Court of Chancery (which is covered in the next section). The practical absence of NR and of non-gilts investments appears to have been typical, although some units had closer balance between CA and RA. Thus, for example, Magdalen College at Oxford had, of its own funds, £24 thousand in CA and £32 thousand in RA. However, of the £63 thousand of trust funds administered by Magdalen College, about 60% was in CA, and about 20% in each of RA and NR. At St Catharine's College in Cambridge, all the investments were in CA. An exceptional case was found at St John's College in Cambridge (which is discussed in more detail later). There, of the college's own funds, slightly more was in CA than in RA, but its trust funds were about 90% in RA.

Trinity College in Cambridge is an interesting example. It had all of its own money in CA, but that was a minor amount, about £2 thousand. Its trust funds were just about evenly balanced (in their gilts investments) between RA at £36,314 and CA at £35,169. However, the largest of the trust accounts, that for the Pigott Fund, was exclusively in RA at £26,786, perhaps for historical reasons, as it had been established by a donation of RA. The accounts for this fund had a note that in the past few years £23,105 of RA had been sold in order to purchase real estate (with income from that going to the Fund, naturally). So a few years earlier the trust funds run by Trinity College were biased strongly towards RA.

What the Pigott Fund shows is that some thought was given to maximizing returns, and some rebalancing of investment portfolios did take place occasionally. But, considering all the Cambridge and Oxford colleges, there seemed to be a reluctance to go into slightly riskier but higher yielding securities (such as railway preference shares). And the cursory

inspection of the voluminous "Blue Books" shows no sign of an awareness that there was a riskless way to increase income by shifting from CA to RA.

The Universities Commission of the 1870s presents a one-time snapshot of Cambridge and Oxford finances. Another view from two decades earlier, but one much less detailed on the finances, since it concentrated on more general issues of the educational mission of those universities, was the Graham Commission Report[106]. The few data points we find there also suggest lack of awareness of gilts mispricing, and gilts are typically referred to by the undifferentiated term "Stock."

A different view that appears to provide some deeper insights into this topic, and into gilts mispricing in general, can be obtained from the Henry Fraser Howard book [43] which summarizes four centuries of the finances of St John's College in Cambridge. Howard had had a long career before coming to St John's, where he was Senior Bursar, and thus had extensive first-hand experience with that college's finances. His book does not show any indication that an exchange of CA for RA was ever considered. (Possibly some evidence of such proposals will be found by careful investigation of the archives of this or other colleges.) But among the references to gilts investments that are scattered throughout this volume, we do find a mention of an exchange of both CA and RA into 4% annuities in 1794 (p. 165). Thus at least occasionally moves among the gilts were not only considered, but made. And there were occasional portfolio rebalancings over the years (putting aside those that were forced by circumstances). However, even when a decision had to be made, it was not infrequently made in an economically irrational way. Thus, for example, we learn that on 26 November 1846, it was decided to invest £3,411 in CA, even though at that time CA was overpriced relative to RA by about £0.50 (p. 176).

As with the other colleges, gilts were never a large part of the total balance at St John's. The first tradeable financial instrument in the College's portfolio came from a donation in 1749 (p. 80), and

> for many years to come no securities were purchased with the idea that they should constitute a permanent investment; securities were only held as part of the College stock or as an investment for temporary purposes pending the ultimate application of the money. Real property was regarded as the only form in which the permanent investment of the College could be held, and no alternative appears ever to have been discussed or even to have occurred to the College.

Financial investments were of so little interest, that until 1827, the College tolerated the practice "of the Bursar investing the College balances for his own benefit" (p. 135). Comparison of the average annual revenues of the College in 1844–50 (£21,569) to those of 1882 (£37,977) on p. 203 shows that in both periods only about 5% came from securities investments[107]. Careful attention was paid to the bulk of the College property, which was in real estate. Much of that was concentrated in the Cambridge area, but there were properties all over England, necessitating travel that was arduous until the spread of railways. Even aside from poor information and poor control over distant properties, which were unavoidable in those days with low technology and primitive transportation infrastructure, we observe in the history of St John's the slow development of efficient administration

methods. Thus in concluding the coverage of the period up to 1845, in preparation for discussing the improvements that followed, Howard noted ([43], pp. 172–73):

> In its later years however the period is marked by serious mismanagement of the College finances. It is difficult to condone the application to College finance of methods following the lines of the hire purchase system. ... Other transactions, such as those connected with estate management, were even more open to criticism. Accounting methods were also very defective. The building accounts, for example, contain at least two elementary mistakes in arithmetic, and these and other accounts are obscure in many respects, ... There can clearly have been no pretence of any real audit. The redeeming feature appears in the very active measures ultimately taken in 1846 to probe the facts to the bottom and then to straighten out the whole position.

There are some intriguing items in the Universities Commission report that it would be nice to have clarified. For example, of the approximately £18,000 of RA that St John's held in the trust accounts it administered, £8,125 was marked as being "[i]n loco same amount of [CA] sold per incuriam by the Copyhold Commissioners" ([90], Part III, p. 385). Just how did the Copyhold Commissioners commit their error, and why did the College agree to accept the underpriced RA in place of the overpriced CA? Was it because for a long-term investor, as this trust fund certainly was, only the flow of dividends mattered, and from that point of view CA and RA were equivalent, no matter what the market prices were? The College or the Copyhold Commission archives may have the answer.

Overall, St John's College finances suggest that various cultural and institutional factors, of the kind discussed in the main manuscript, may have contributed to its policy regarding investments in gilts. There was little sophistication in general, with the heavy reliance on real estate. Thus when the College did find itself with a large amount of cash in the late 1860s, it put it (over several years, so not acting hastily, but presumably looking for promising opportunities) into real estate. It had "a very favourable opportunity of making some re-distribution of its investments, and thus securing at any rate some insurance against the risks involved in putting all the eggs in one basket. But those responsible for the College policy at that time seem to have assumed that the agricultural boom would go on for ever, ..." ([43], p. 213).

43 The Equitable life insurance company and gilts

Yet another perspective on gilts mispricing comes from the history of the Equitable Life Assurance Society. Around the year 2000 it caught public attention with its spectacular crash, caused by market shifts that were larger than it had prepared for. From a longer-term perspective, its main claim to fame comes from its pioneering contributions to the development of insurance and to actuarial theory and practice. It was the world's oldest mutual insurance company, and the first insurance company to grant long-term policies. It was officially founded in 1762, but with plans and deliberations going back to 1756. It gave the world "the first premium scale to be drawn up, the first valuation to be made, the first reversionary bonus to be allowed, the first surrender value to be calculated" ([66],

p. 8). Walford, in his *Insurance Cyclopaedia* [95] devoted over 60 pages to the Equitable, and wrote (p. 571):

> It has been said that the history of the *Equitable* is the history of Life Insurance in [the UK]. If that be not strictly true, it is yet much nearer the truth than the uninformed could imagine. The events in its history have reflected themselves upon the later established insurance associations in a very marked manner.

The Equitable's chief actuary from 1775 to 1830 was William Morgan [53], and from 1830 to 1870 his son Arthur. Both were Fellows of the Royal Society, and William especially was highly respected for his contributions to a variety of fields. Thus this concern did not lack for financial sophistication among its staff (although its history [66] shows many instances of either self-centered greed or lack of understanding among the members).

Table 4. Equitable Life Assurance holdings of major gilts, at year end.

In thousands of pound sterling, nominal value.

year	CA	RA	NR
1870	210	425	120
1871	230	315	125
1872	230	290	220
1873	230	250	260
1874	45	300	300
1875	25	255	275
1876	25	215	210
1877	110	165	235
1878	170	120	235
1879	140	40	235
1880	115	40	200
1881	90	90	195
1882	100	90	100

In its early years, all investments of the Equitable were in gilts, and it appears those were primarily in CA and RA. Reports from 1817 and 1822 show that only about 10% of investments were in mortgages during those two years, around 5% in gilts with nominal yield 4%, and the overwhelming rest in CA and RA, with slightly more in CA than in RA. The Ogborn history of this company [66] discusses pressure in the early years from some members to restrict investment to gilts. In later years, this was replaced by pressure to move into mortgages, and eventually, after 1860, into other investments. However, there is no mention in that book of any discussion about moving from CA to RA.

Here we consider what we can learn about the Equitable's gilts investments from other sources. A report published by this company in 1854 presented summaries of the financial affairs of the company in 1829, 1839, and 1849 [21]. The 1829 statement showed about 80% of the assets in CA and RA, but let's disregard it, since it valued CA at 89, and RA at 90, which does not correspond to any market prices at that time, so is likely due to a mistake. The 1839 statement showed CA and RA investments at about 59% of total assets of £10.7 million (with some R35 and some Exchequer bills investments, but the bulk of the remainder in mortgages). The £3.2 million of nominal value of CA is valued at 90.625, and the £3.8 million of nominal value of RA at 89.625 on 31 December 1839, so this implicitly demonstrates overvaluation of CA by 0.25. The next statement, for 31 December 1849, shows 52% of all assets in CA and RA, and this time £2.275 million of CA is valued at 93.625, and the £2.68 million of RA is valued at 92.5, showing CA overvaluation by 0.375. So it appears that £0.925 million of CA and £1.12 million of RA (nominal value in both cases) were liquidated in the intervening decade. That appears to show poor financial stewardships, since CA was overvalued most of that time, sometimes very deeply. Furthermore, NR was extremely undervalued during some of that time. But it seems management did not take advantage of that opportunity. Note that a marine or fire insurance company might have an understandable desire to hold a substantial amount of CA, to be able to deal with "shuttings" in RA and NR, and possibly also to have greater liquidity, since in those lines of business sudden disasters might call for large payouts. But those considerations did not apply to life insurance.

In 1872, British government started publishing annual reports on finances of life insurance companies. For year-end 1883, Equitable lists just a total for all major gilts. (This is how almost all the other companies listed their investments in all years.) But for the preceding years, the Blue Books[108] yield the data shown in Table 4. Holdings of major gilts were under 20% of total assets for these years, so some of the changes might have come from money coming from liquidation of other investments being temporarily parked in these securities. But over all, it is hard to see the logic for the moves. CA was consistently overvalued during this period, so the apparent switch of a large part of CA holdings in 1874 into RA and NR was sensible. However, what seems like a switch of £40,000 of RA into NR in 1873 is hard to justify. Both of those annuities were quoted identically during this period, and the call protection of NR was set to expire in October 1874, at a time when the prospects of redemption of the major gilts were negligible. Many of the other moves visible in the table, such as substantial purchases of CA in 1877 and 1878, when RA was being liquidated, appear to come from very poor financial management.

44 The gilts investments of Post Office Savings Bank customers

After considering gilts investments of some large public agencies and of the government itself, we next look at an intriguing example of the decisions of very small investors.

In 1880, Parliament passed a law allowing customers of the Post Office Savings Bank to invest directly in gilts. From the start of operations of this new service on 22 November 1880 through 31 March 1881, customers made the investments shown in Table 5. Data is from the annual report of the Postmaster General[109].

Table 5. Post Office Savings Bank customer investments in gilts, 22 Nov. 1880 to 31 March 1881.

gilt	number of investments	aggregate investments	average investment
CA	3,202	£173,133	£54.07
RA	481	26,301	54.68
NR	3,291	187,309	56.92

As was noted in Section 59, the average size of an account in the major gilts was around £3,000. The accounts represented in Table 5 on average were less than 2% of that. So they represented holdings of much poorer strata of the population[110]. The report of the Postmaster General did note that the high prices of gilts seemed to discourage investments. It even cited some of those prices, noting that on 27 November 1880, CA was at 100.625, while RA and NR were at 98.875. However, it did not make any remarks at all about the disparity in these prices, which meant that CA was overpriced by £1.00. Over the four-month period of the report, CA was overpriced by a minimum of £0.615 and a maximum of 1.063, and by 0.82 on average[111]. Hence these poor customers do show some, although limited, rationality. CA was a noticeably smaller fraction of their portfolios than among the entire population of investors, about 45% as opposed to 57%. But why the preference for NR over RA? It would have been unreasonable for anyone at that time to anticipate that Goschen in 1888 would offer holders of RA more than the holders of NR (even if only £0.25 more), but there did not seem to be any reason to regard RA as less desirable than NR. Market transactions and jobber quotes around 1880 were identical for the two.

The next few Post Office annual reports do not contain information about which gilts customers were investing in, only about totals. However, we can make some inferences from the first Post Office report that deals with the inevitable changes caused by the Goschen conversion[112]. It mentioned that of about 43,000 accounts holding £3.8 million, there had been "over 21,000" (and thus almost surely under 22,000) in NR. That suggests that NR investments had been about half of the total in 1888, which is what we observe during the initial account opening period depicted in Table 5. Also, at the end of 1888, the Post Office Savings Bank held £270,784 of CA (in nominal value), and £40,386 of RA. Those amounts could only have belonged to customers who owned those gilts through the Post Office Savings Bank and who refused the Goschen offer to convert, and were waiting to be paid off in the summer of 1889. If those refusing to convert were the same fraction among CA owners as among RA owners, we could extrapolate that in early 1888, before the conversion, all the Post Office gilts accounts held about 7 times as much CA as RA, which is again remarkably similar to the ratio we find in Table 5. This suggests that the biases among Post Office customers which determined where among the gilts they put their

money were stable over the entire period from the end of 1880 to early 1888. So far nothing has been found in the literature about those biases, and where they came from.

45 Various non-profit organizations and gilts

There are numerous other sources that provide information about trust investments, although none have been found that would provide a comprehensive look at all trusts. For example, the City of London Livery Companies' Commission produced 5 volumes of detailed reports in 1884, coming to over 3,200 pages. Many of the trust funds covered by those reports dated back to the Middle Ages (just as in the case of Cambridge and Oxford). No attempt was made to compile systematic statistics, but a quick scan shows numerous cases of substantial investments in CA that in an economically rational world would have been moved to RA. As just one example, among the funds administered by the Drapers' Company was Bancroft's Charity, which dated back to a donation in 1727. Around 1880 about half of its income was coming from real estate, and half from gilts. The latter came from £47,700 in CA and £32,454 in RA[113].

Many more examples of investments by trusts could be cited, and some of the sources (such as those cited above) could be used to get comprehensive statistics for at least collections of trusts. It is to be hoped that an investigation of the Bank of England account books will provide such comprehensive data for all trusts. But that will require substantial effort. In the meantime, let us close this section with a modest but probably statistically valid sample that demonstrates a high degree of rationality on the part of organizations whose numerous members were predominantly poor, the Friendly Societies. In the report for the year 1881, the Chief Registrar of Friendly Societies wrote[114]:

> It is perhaps worth notice that for the past two years such directions have only applied to sums in [NR], the slightly lower price of these, as compared with [CA], apparently making them a favourite security for friendly societies investing in the public funds.

The "directions" referenced here were about changing the names of trustees on accounts at the Bank of England, and were invoked only under exceptional circumstances. Still, reports in this series for calendar years 1880–87 show 9 accounts containing a total of £3,592 of CA and 15 accounts with £13,883 of NR (and none with RA). Since the circumstances that called for the transfers that were listed were unlikely to be related to the nature of the gilts in the accounts, we can take these statistics as indicating that the Friendly Societies were among the most rational non-profit investors in gilts in this period. (The lack of investments in RA, which was shared with the gilts purchases at the Post Office in late 1880 and early 1881, discussed in the main paper, may reflect some widespread prejudice against RA among the lower classes.)

It is also interesting that the Chief Registrar for those societies recognized that Friendly Societies tended to favor NR, and mentioned it in his report. What is not clear is why he thought this would be of interest to his readers. And who were the readers he was aiming these remarks at? Normally these annual reports would go the the MPs and various

government officials, but would sometimes be invoked by the press or public figures. The Chief Registrar at that time was John Malcolm Ludlow, a well-known reformer and one of the main creators of Christian Socialism [48, 51, 53]. So it seems unlikely that he was disdainfully pointing out that the poor classes represented by the Friendly Societies were stooping down to decisions that were not becoming to proper gentlemen. It seems far more likely that he was trying to show those poor classes were astute in handling their finances, to help him and his allies argue for assistance. This would be consistent with a comment in the next report in the series, which stated[115]:

> It was observed in the [previous year's report] that for the past two years such transfers had been confined to [NR]. It will be noticed that [CA] predominated, on the contrary, during 1882.

This time he may have been trying to be scrupulously honest and avoid being accused of distorting reality by presenting just one snippet that happened to be supportive of the thesis that the Friendly Societies were good stewards of their funds. (Other reports in this series simply gave figures, with no comments.) But we just don't know what he meant. Perhaps some further research into his voluminous writings will provide some information.

In any event, Ludlow's comment just adds to the general puzzle of gilts pricing anomalies. He recognized, in a public document, too, that NR were trading at lower prices than CA. But he did not say anything about the big question, namely why investors were not switching from CA to NR.

46 The Institution of Civil Engineers and its gilts investments

The Institution of Civil Engineers (ICE) was established in 1818 and is regarded as the world's oldest professional engineering organization. In this section we consider this body's gilts investments during the period 1850–88, as presented in the reports published annually in the *Minutes of Proceedings of the Institution of Civil Engineers,* from now on referred to as *MPICE*. References here are primarily to *MPICE*, and (vol. 10, 1850, p. 71), for example, refers to volume 10 of *MPICE*, which covers the session of 1850–51 (which started in late 1850, with most meetings in the first half of 1851), with the financial data in the report in that issue covering the fiscal year that ended 30 November 1850. (In the early 1880s, the ICE changed its fiscal year to end on 31 March, but this affects only a few years covered here, so is disregarded.)

Membership of ICE grew from about 700 in 1850 to over 3,000 in 1880, and so did the prosperity of the institution. For the purposes of this study, ICE is valuable, since its members were among the most sophisticated in financial affairs at the time, outside those in the financial industry itself. Civil engineers were mostly employed in small firms, and had to be intimately familiar with the intricacies of cost estimates, cash flows, time value of money, and the like. Many ICE members became very wealthy as results of their investments or running their own businesses, in addition to any professional fees they may have accumulated. Also, the ICE Treasurer was for many years the senior partner of Coutts, the respected private bank (vol. 51, 1877, p. 168), so they did not lack for knowledgeable financial advice.

Another reason ICE provides intriguing insights into gilts mispricings is that its reports were printed in the *MPICE*, so were visible to all members. Thus if there was anything that seemed questionable to a substantial number of those members, one can expect they would have brought it up at the meetings or in correspondence with the volunteer officers or the secretary. (As is usual in such situations, we should expect that most members paid little attention to the ICE financial reports most of the time. But when there are many members, and all receive copies of the reports, we should expect a few to take a careful look.)

In the early years, the ICE was on rather shaky financial grounds, with publication of *MPICE* often delayed for lack of money to pay the printer. Charles Manby [53], the Secretary, often had to lend it money (vol. 10, 1850, p. 70). By 1880, though, it was very prosperous, and its invested funds amounted to about £50,000, with about 30% of that in trust funds it administered (vol. 63, 1880, p. 234). Relative to the size of the economy, the total of £50,000 was comparable to perhaps £100 million for the UK today, and $1 billion for the U.S. Income from its own investments amounted to about 10% of the ICE budget.

In the 1840s, the ICE had little money, and the financial reports were only printed sporadically in *MPICE*. So we consider only the period from 1850 to the Goschen conversion of 1888–89. We also concentrate on the trusts administered by the ICE. Its own funds were invested primarily in railway debentures, and the wisdom of the selection of this type of investment, or of the division of funds among securities of different railways, is not examined here. The small fraction of funds that went into gilts (about 4% in 1880) was placed primarily in RA or NR, which were undervalued relative to CA, so this suggests some economic rationality. There was an implicit recognition of a tradeoff in security and yield in the reports, as several noted that gilts were providing 3% on the par value, while railway debentures usually gave about 4%. Thus the ICE was willing to take slightly higher risks with the money that was its own for the additional one percent in yield, but was more careful with the trust funds, which were invested primarily in gilts.

There are some arithmetic mistakes and some inconsistencies in the published accounts, so what follows is not a careful analysis, but a general overview. ICE's trusts started with a generous bequest from Thomas Telford, its first President, and one of the most eminent civil engineers of his era. Telford died in 1834, and his will ([82], Appendix X), specified that from this money "the interest [was] to be expended in annual premiums under the direction of the Council [of the ICE]." (The Telford Medal, which originated from this bequest, is still the highest honor bestowed by the ICE today.) Thus it was clear this was meant to be a perpetual fund, with a long-term investment horizon.

A certain sum was obtained from the estate for the Telford Fund by the ICE in 1835 (vol. 86, 1885, p. 173), apparently all in the form of CA. More came later, with the largest accretion in 1850, this time all in RA. The 1850 gain resulted from a lawsuit launched by James Walker, another eminent engineer and Telford's successor as President of the ICE (vol. 10, 1850, p. 71), which illustrates the defects of the Court of Chancery, discussed in the main paper and in Section 39 in this one. It is likely that the ICE had little influence on the gilts that were involved until those were received, so there is little we can conclude

from this. Once they came under the control of the ICE, though, it could invest them at its pleasure, subject to general restrictions on trustees.

From 1850 to 1866, the principal of the Telford Fund, £2,552 in CA and £2,343 in RA, was held untouched, and the interest that was not spent was invested mostly in CA (£1,776 vs. £602 in RA, according to vol. 26, 1866, p. 131), showing substantial irrationality, as CA was overvalued for most of this period. What is perhaps most intriguing is that the accounts from this period show confusion about the names of the gilts. Various designations are used, and in many years, for example in (vol. 15, 1855, p. 88), the listing of interest ascribes all four of the quarterly dividends as being derived from a non-existent security, the "3 per Cent. Reduced Consols." Further, the dates those dividends were due, listed as "Lady-day 1855" and the like, were those that prevailed in the first half of the 18th century, before England switched to the Gregorian calendar. These accounts were signed off on by the auditors, selected from among members of the ICE (and thus not professional auditors), two each year, with one new one coming in each year for a two-year appointment, and were seen by all members of the ICE. Such inattention to an obvious misstatement, year after year, in the presence of scrutiny by the entire membership, and with a changing cast of auditors, is rather strange.

After the mid-1860s, it appears that the "unexpended dividends" of the Telford Fund were invested in RA, which shows greater rationality.

Another trust fund was set up around that time, from a bequest of Joseph Miller. It was meant to establish a prize for students, as opposed to the Telford Medal, which was meant to honor mature professionals. It again had no stipulation as to direction of investment, and specified only "that the said sum of £3,000 be invested, and the dividends and interest thereof applied accordingly" (vol. 26, 1866, p. 125). After a short time in a bank account (vol. 20, 1860, p. 130), it was invested in railway debentures (vol. 21, 1861, p. 146) that paid 4% on the nominal amount. The interest kept accumulating in some undefined account, and then was put into the fund as £583 in CA in "unexpended dividends" (vol. 26, 1866, p. 131). In the next few years, additional income for this fund that was not spent showed up as RA, demonstrating increased economic rationality.

In 1879, the railway debentures in the Miller Fund were liquidated, and the money invested in NR. The report said just that it had "been thought desirable that the whole of the Trust Funds should be placed in national securities" (vol. 59, 1879, p. 194), so clearly the ICE wanted to be ultra-conservative. The choice of NR was not explained, but as it was underpriced relative to CA, it was the better choice for a long-term investment, and again suggests economic rationality at work. That the switch was made demonstrates that the ICE was not committed to keeping its trust investments static, and was devoting some thinking to its investment strategy.

The 1883 report (vol. 75, 1883, p. 139) had a substantial section on trust fund investments. It explained that "[w]ith a view to the simplification of the accounts of the Telford and Miller Trust-Funds, the Council have sold [£435] Consols, and purchased a like amount in Annuities." The language is surprising, as Consols were also "Annuities," and clearly RA was meant where "Annuities" were put down. But even stranger is the maneuver. In the case of the Telford Fund, for example, the accounts until then had been showing four

figures, two for CA (for principal and for unexpended dividends) and two for RA (in the same fashion). Afterwards, there was just one account for principal (all in CA), and one for unexpended dividends (all in RA). This was a simplification, but why not simplify further, and move all the funds into the underpriced RA? Further, the accounts show that the sum of nominal amounts of all the gilts in the Telford and Miller funds remained the same. It appears that CA and RA were shuffled among the accounts, so that, for example, the Miller Fund had its CA, of nominal value £644, replaced by RA of the same nominal value, and thus lost market value. (The Telford Fund was enriched by a smaller amount.) This was not just poor accounting, but also surely illegal. And, unless the transaction occurred in the last couple of weeks of November 1883 (see Section 23), there was a cash gain from the exchange of £435 of CA for RA. Where did it go? The published accounts shed no light on these issues.

Overall, ICE's gilts investments leave us with another puzzle that shows how hard it is to understand the thinking of people of a different time and culture. ICE members were among those financially most sophisticated at the time, and their behavior shows some economic rationality. But why did they not take advantage of CA overpricing relative to RA and NR to a greater extent? Perhaps it was thought unseemly to take advantage of such small pricing discrepancies. The difference between 3% on gilts and 4% on railway debentures may have been large enough to require serious thought and sometimes action. But the small disparities in yield on CA and RA might have been in a different category. We get some hints of such thinking in some of the reports. For example, in 1887, the ICE petitioned the Queen for a revision of its charter, to allow it to hold a larger amount of property than had been permitted in the original charter of 1828. The petition boasted of "the Institution never having been conducted in a trading or commercial spirit, nor was there any intention to vary the practice in this respect" (vol. 94, 1887, p. 136). A year earlier, we find (vol. 90, 1886, p. 209):

> By the will of Sir Joseph Whitworth the Institution was left eighty shares £25 each in the firm of Sir Joseph Whitworth and Co., Limited. The Company has lately paid dividends at the rate of 15 per cent. per annum, and it has been urged that the Institution should retain the shares instead of accepting their par value, as offered by the Executors. Although the Institution may not legally invest any portion of its funds in trading or commercial undertakings, yet the Council has been advised that it may lawfully hold shares in a manufacturing company which (as in this instance) have been bequethed by a testator for the benefit of the Institution, and particularly when such shares are under limited liability and are fully paid up.

Perhaps taking advantage of CA vs. RA pricing discrepancy was seen as too much "jobbery" and of conduct "in a trading or commercial spirit," and it it was thought that a dignified institution like the ICE should not engage in it. Yet that is not totally convincing. The ICE was willing to trade £435 of CA for same nominal amount of RA to achieve a slight simplification of its trust accounts. Why not exchange all of CA for RA, simplify the accounts further, and gain about £25 net for the trust funds? Whatever the reasons for its behavior, the ICE does provide an intriguing example of conduct that by our modern standards was economically irrational.

47 Government bonds, riskless and risky

As Dimson et al. [19] have shown, much of the accepted wisdom as well as scholarly literature on equity returns is affected by survivorship bias, relying primarily on the experience of the UK and U.S. markets. History contains records of once-flourishing share markets, such as that of czarist Russia, which destroyed their investors' stakes.

In valuing securities, it is standard to assume a riskless rate of interest, which is typically taken as that of a government bond. However, historically government bonds have been anything but risk-free. Again, the experience of the UK and U.S. is misleading. Those nations have not defaulted (at least not in recent centuries, if we disregard their going off the gold standard). But plenty of others have. Moreover, during the first half of the 19th century, it appears that British investors did not necessarily regard British gilts as riskfree. That can be seen quantitatively in Fig. 1 of the main paper, which shows the yield on CA stabilizing in the 1850s, as opposed to the earlier decades when it gyrated wildly in response to economic and political upheavals. This is also reflected in contemporary opinion. For example, the next section consists primarily from a citation from a book by Arthur Crump, a financial journalist of the 1870s. He explicitly wrote that his time saw much decreased (as compared to earlier decades) concerns about either a major war or domestic upheaval.

Domestic stability was certainly not taken for granted in the first half of the 19th century. In particular, the drop in gilts pricing after the outbreak of the French Revolution in 1848 was probably due to a substantial extent to fears of a Chartist rebellion.

There may also have been a general concern about the willingness of taxpayers to continue shouldering the huge burden of interest payments. The British regarded themselves as the most highly taxed nation in the world, and in mid-century about half of the national debt went to payments of interest on the national debt. In the late 1840s, John Whitehead, a prominent share broker and writer on finance (and previous to that a railway manager and railway reporter) penned a pamphlet arguing that railway preference shares were superior to gilts [97]. He argued that this was

> because Railway guarantees carried with them *reality* and *unalterability*, the Government guarantee being deficient of both qualities. The Railway guarantee has the security of that which is tangible; the Government guarantee has the national faith as its bond, and as long as England shall remain what England is, the security will be ample and complete. Whilst however the Government stockholder would, under circumstances of violent political change, suffer more or less as the extent of that change might be, the Railway shareholder would feel its blighting effects for a period comparatively brief; ... When dynasties and political parties shall have passed away and been forgotten, Railways will be, and so must continue to be, the property of those whose means have been embarked in them.

This pamphlet was originally written in 1847, but it kept being revised and reissued. That a 7th edition could be published in 1850, after the collapse of railway share prices in the aftermath of the Railway Mania, suggests that many people regarded Whitehead's argument as at least plausible. (It also has to be said that following Whitehead's recommendation

to invest in railway preference shares instead of gilts would have been profitable, although nerve-wrecking, to those who did so with adequate diversification. Very few railways failed to pay on their borrowings or preference shares.)

An interesting feature of Whitehead's argument, one that would be regarded as questionable today, is that while he was envisaging the possibility of "violent political change" that might affect the payment of interest on the national debt, he expected that such change would leave railways in their owners' hands.

However, while gilts may not have been regarded as riskfree by British investors before 1850, say, this still does not provide any help in explaining the overpricing of CA. Not only did this overpricing persist and intensify during the 1860s, when stability of the British government was being taken for granted, but there was no reason to expect that any "violent political change" would treat CA and RA differently. As Brenan wrote in the 1849 pamphlet that was cited in Section 29, "[s]hould the government be, however, at any time unable to pay the interest, they would not show favour to one more than another–all the funds would suffer alike."

48 Interest rate computations

For the period 1861–87, the average annual yield on CA that is shown in Fig. 1 of the main paper was taken from the paper of Klovland [46]. Klovland corrected for some biases that had been present in earlier compilations. For the years 1881–87, Klovland's figures adjust the yield to compensate for the expectations of conversion to lower interest rates. His paper has monthly estimates for 1850 through 1914, and is based on the closing quotes at the end of each month for CA from the *Economist*.

For the years 1823–60, an independent computation was carried out, using the weekly Friday closing prices from *CoE*. The resulting figures are available in the auxiliary tables. For the overlapping period 1850–60, these estimates are similar to Klovland's. The largest difference in estimates of average annual yield occurred for 1859, where this study yielded 3.177% as opposed to 3.195% for Klovland. The root-mean-square difference for those 11 overlapping years was 0.009%. This difference is almost surely due to sampling error, which is substantial, since the pricing increments on CA were 0.125.

There were two small differences between the computations of this project and those of Klovland, aside from weekly vs. monthly sampling periods. One was that here, interest accrual was performed on a linear scale, without invoking the compounding of [46]. The justification for this is that the difference is negligible, that it is simpler, and that it is what Victorians did.

The other difference was in dealing with missing prices. Both Klovland and this project relied on CAm when it was available. When CA was "shut," Klovland used CAa. In this project, which demonstrated that CA overpricing relative to RA was rather stable, the average of CAm - RA for the three Fridays preceding each "shutting" was added to each RA price during the shutting to obtain the synthetic price for CAm (denoted CA^ in the tables). The issue with relying on CAa is that the difference between its price and that of CAm depended on a variety of factors, such as the level of interest rates, the length of time until the next account period, and the level and direction of speculative activity in CA.

This project did not attempt to compute adjusted yields for CA during the periods in the early 1840s and early 1850s when CA was trading close to par. (It should be noted that this was also not done by Klovland for the latter period, which is covered by his paper.) It is clear from press commentary (and also from the figure in the main manuscript that compares prices of NR and RA in the 1845–54 period) that investors were taking the prospects of early reduction in CA interest rates seriously. Thus for a better view of long-term interest rates in Britain in the 19th century, such adjustments should be made. However, that would require some technical work, and is left aside. (That any such adjustments rest on shaky ground as a result of the pricing irrationality demonstrated in this project adds to the complications. However, it seems that when faced with the likelihood of imminent gilt conversion, markets did tend to become rational, so the methods of Klovland and his predecessors should still yield useful results, even if they have to be treated with caution.)

The short-term interest rates for 1824 through 1844 that are used in some of the figures were taken from "Secret Committee of House of Lords to inquire into Causes of Distress ...," *Parliamentary Papers* 1847-48 (565) (565-II) VIII Pt.III.1, 537, Appendix C. They were provided by S. Gurney of the Overend, Gurney discount bank, and cover January 1824 through February 1848. Based on the description in Appendix 3 of [44], which contains a similar listing, but only through September 1844, these are probably the average rates of discount of first-class bills on the first day of each month, at Overend, Gurney. Thus they do not capture the volatility of those rates in periods of crisis, such as the crashes in December 1825 and October 1847. (It may also be that interest rates were not very meaningful during those episodes, as markets were seizing up, and credit was being rationed by non-price means.)

The Bank of England discount rates were taken from the Bank compilation, ⟨http://www.bankofengland.co.uk/statistics/rates/baserate.pdf⟩. That compilation has some inaccuracies. For example, it claims that the rate was set at 5% on 2 October 1856, and then at 7% on both 29 October and 15 November. This is incorrect. The "City article" of *The Times* demonstrates that the 5% rate was introduced on 1 October, while on 6 October it was moved to 6% for short bills and 7% for longer ones, and on 13 November a uniform rate of 7% was set. Similarly, the increase put into effect on 4 July 1878 was to 3.5%, not 3.2%. The values used in the graphs in the main paper were verified by checking against other sources.

49 Arbitrage

Was gilts mispricing partially a result of the well-known Victorian attitudes towards money? That is quite likely, especially given the wide ignorance of this mispricing that the evidence demonstrates. Still, money did attract considerable interest, even if it was not talked about in polite company.

Relatively small price changes were thought to produce large changes in investments. For example, the 1844 reduction in interest on about £250 million of national debt from 3.5% to 3.25% (with eventual decline to 3%) was widely cited as an important reason for the virulence of the Railway Mania, as yield-starved investors looked for higher incomes. In

1888, Goschen and others in the British government thought that offering an extra 0.25% one-time payment to holders of CA and RA would make them switch into the new Goschen Consols, as opposed to taking their chances on compulsory redemption a year or more in the future. Whether they calibrated the extra payment well or not, most investors did take up the offer and convert right away.

The Goschen conversion also involved the payment of 0.075% of the nominal amount to brokers, bankers, and lawyers who persuaded their clients to participate in the voluntary CA and RA conversion offer. As was noted by Hamilton ([35], pp. 20–21), this was the provision of the conversion scheme that aroused the greatest controversy, as it was felt it bordered on a bribe. However that may be, the main conclusion for us is that knowledgeable people thought 0.075% of clients' money would be sufficient to induce those who had some influence over it to argue for conversion (and handle the paperwork).

The 1877 book [49] cited in the previous section appears to be an excellent source of solid information about the functioning of the Stock Exchange, and the costs and hazards facing investors. It was written by E. Maddison, a broker, and has several sections that seem to address exactly the issue of mispricing of CA relative to RA (and NR), but on closer reading, taking into account the context, clearly don't. Thus, for example, we find a passage discussing variation in market prices around the time dividends are due, and are told (pp. 202–204) that

> When the price of a stock is constantly fluctuating during each period of six months, it is, of course, not possible to trace exactly the process of recovery of the dividend from time to time. When, however, there are several stocks of one kind, with dividends due in different months, the recovery may, to some extent, be ascertained by comparisons of the relative prices at different dates. And such comparisons will sometimes enable an operator to detect a case presenting a great probability of a rise in price in the course of a short time. ... For such comparisons to be of use, however, it is necessary to know what the relative prices of the different stocks ought to be. As a rule, the relative prices current in the *same months* of former years will prove a very safe guide to ascertaining this, although it will also be as well for the operator to use his own knowledge in testing the relative prices. ... when one stock of a class reaches a price much out of its level in relation to the quotations of the other issues, it is almost certain that, sooner or later, there will be a rise (or fall, as the case may be) in that stock, ... Sometimes, these peculiar movements in the price of one particular stock indicate that a discrepancy in relative values of the kind to which we are referring is being rectified. Some shrewd operator has detected the difference in the *relative* prices, and, after he has abought largely for himself, he is not slow to point out the discrepancy to his friends: thereupon the price soon responds, if his arguments are well founded. The Stock Exchange "jobbers," or dealers, are themselves not generally slow to detect such cases; indeed, it behooves them to do so for their own protection. Sometimes, however, when they are very busy, and when prices are fluctuating widely and rapidly, such instances get overlooked by them; and it therefore frequently proves remunerative for operators to study carefully the prices of some of the less speculative securities.

This seems to be almost a perfect description of the gilts mispricing. But later in the book we find a chapter (pp. 273–76) that starts with:

> Few things puzzle an occasional observer of Stock Exchange prices more than the wide differences existing between the market values of some stocks of the same description. Stocks which are guaranteed the same rate of interest by the same Government may be found quoted at prices differing as much as 20 per cent. As examples, take the several Egyptian and Turkish Loans.

This chapter then goes on to explain such wide differences. The mention of differences of 20%, and explicit naming of Egyptian and Turkish loans, show that gilts mispricing was far from Maddison's mind. His book does mention "the 'sweet simplicity' of the Three per Cents.," but concludes that the gilts were a "very safe but very unprofitable security" (pp. 154–5), and devotes very little space to them. (This is a great contrast with similar books from earlier in the century, such as early editions of [24] from the 1830s, which dealt primarily with gilts. This reflects the well-known growth and diversification of financial markets in Britain during the 19th century.) The only discussion that points out any difference between CA and RA is when it is mentioned that by splitting one's holding between them, one can obtain an even quarterly flow of income (p. 116).

Yet we can't conclude that only large arbitrage opportunities attracted public attention. In mid-April 1888, after most of the Goschen conversion scheme had been accomplished, the *Economist* noted that investors who had held onto their CA and RA could sell them at 100.875, while the new Goschen consols could be bought at 100. Hence it claimed that such investors

> can convert with a present profit–allowing for commission–of about [£0.75], or about [£0.5] more than the bonus of [£0.25] which Mr Goschen has paid to assenting holders. This, however, is obviously a transaction which, if it is to be effected at all, must be effected promptly, for it would take comparatively little of such buying and selling to alter the relation between the prices of the two stocks.[116]

The *Economist* was wrong in its overall evaluation. The reason CA and RA were priced high compared to the Goschen consols is that they were going to be redeemed at par in July 1889. Hence, as was remarked by *The Times* in its financial column on the same day that the quote above appeared, CA and RA were "considered as a twelvemonths' bill." Therefore, as long-term interest rates continued rising over the next year (before resuming their decline), the gap between prices of CA and RA on one hand and the Goschen consols grew, often to the level of 2%. The point of this quote, though, is that even though the *Economist* was incorrect in its overall evaluation, it did feel it worthwhile to point out what it thought was a profitable arbitrage opportunity at a relatively low level, similar to the levels that prevailed between CA and RA over many years in earlier times. Many of the newspaper remarks about CA overpricing in earlier sections of this manuscript also reflect this attitude.

Part of the explanation for the observed behavior is likely the fact that the gains from switching from CA to RA were not that large. The *Economist* and the finance industry might be sensitive to small profit opportunities. But the bulk of the population may not

have been. Consider, for example, the parcel of £13,717 of CA listed in Return A.15 for St John's in [90]. At an overpricing level of CA by £0.75, the one-time gain would have been equal to about £100. That was about one third of the annual stipend for a Fellow, so not completely trivial. But from the standpoint of a permanent investment, it would have boosted the annual income by just £3 or so. One could easily imagine that people might have shrugged at such gains, or even (recall the discussion of cultural factors in the main manuscript) felt embarrassed at getting involved with something so minor.

If Victorian culture inhibited some trustees of charities from switching investments for small gains, it did not inhibit all. We don't have any statistics, but we can find snippets of information showing rational behavior even when the gains were small. One example is the report of the 1850 meeting of the Brewers' and Distillers' Clerks Annuity Fund[117]. The report presented there stated the Fund's assets to be £5,481, and that of that, £4,000 in CA had been sold and placed with the Commissioners for the Reduction of the National Debt, in order to gain £26 per year in higher interest. Yet another example comes from a report of the 1879 meeting of the Court of Governors of the North Devon Infirmary[118]. The main issue of debate was a resolution to liquidate £2,802 in CA and £5,515 in NR that were held by this charity's endowment in order to invest the proceeds in railway debenture stock, for a gain of £46 in annual income.

Of course, a proper perspective on the role of culture in charity endowment investments calls for a more quantitative approach, with a sampling of a large collection of charities. Hopefully further research will provide that.

The North Devon Infirmary report cited above can also illustrate the inertia and deep conservatism in investments that have been noted before about 19th century British public. Although the resolution to switch from gilts into railway debenture stock (which was senior not just to common shares, but also to preference shares) was "carried by a large majority," there was opposition from a small but vocal minority. (One member of that opposition even wanted to bar investments in bonds of the East India government, since, in his words, "England ... was attempting to govern two hundred millions of Hindoos by means of a hundred thousand Europeans, and that was a state of things which could not, he thought, always last." He was then reminded that the Infirmary already had £4,000 of such bonds.) Further, the move had been under consideration for a while, and was preceded by consultation with lawyers as well as with "Earl Fortescue, the Patron of the Institution."

50 Gilts trading

This project relied on the published records of gilts trading on the London Stock Exchange, the only place in Britain that provided a regular market in these instruments. (The trading in Dublin, where about 5% of the gilts were held, was mentioned in Section 15 but was not investigated.) These transactions were only some unknown fraction of all transactions in gilts. Gilts could be transferred between investors' accounts at the Bank of England at no cost (although with some hassles caused by the need to authenticate the parties involved). This was surely how most transfers arising from gifts or inheritances were handled. Further, there were advocates of the use of private transfers for ordinary financial sales, who railed at the inequities of jobbers [55]. They do not seem to have had much impact on

trading among retail investors, at least not in terms of strangers finding each other and agreeing on prices. (The numerous attempts to set up auction-like markets for transactions between investors did not have much impact in general, and in any case they appear to have specialized in illiquid securities, not gilts.) However, there may have been substantial number of such private transactions, arranged by brokers, and using the Stock Exchange prices as a reference point, thus avoiding the jobbers' markup[119].

In the future, we should be able to learn more about relative volumes of transactions and many other issues from the archives of the Bank of England. As is mentioned in the main manuscript, they appear not to have been explored in detail by any modern scholar. However, they do contain a wealth of information. For example, separate accounts were kept for jobbers, which should simplify the task of classifying gilts transfers. Further, the Bank maintained some kind of daily average of prices for various gilts. It was key to many laws (for example, the Government Annuities Act, 1829, 10 Geo. 4. c. 24; draft in *Parliamentary Papers* 1829 (178) I.27, p. 6), and was cited in various official documents. However, nothing has been found so far in printed sources on how those averages were computed, nor how they compared with what we can compute from published prices. Thus, until those Bank archives are explored, we have to make the best we can with what is available in print.

Our knowledge of even the transactions on the Stock Exchange is limited. An *Official List* was maintained, from which publications such as *CoE* and newspapers drew their information. Gilt transactions had to be for at least £500 (of nominal value) to be entered in the *Official List*, and there were some mild safeguards against fraudulent entries. The reporting threshold was quite high. Relative to the GDP of the UK around 1840, it was equivalent to $15 million for the U.S. or £1.5 million for the UK today. If we compare the £500 threshold to lower middle class incomes (which were about £200 per year in mid-19th century), we find it equivalent to perhaps $100 thousand for the U.S. or £50 thousand for the UK. Thus we can conclude that in the available record we only see traces of very large transactions.

Another large deficiency of the *CoE* data is that many transactions were not reported, and so did not enter the *Official List*. For example, all transactions before and after the official hours of business were excluded. (Until the early 1840s, the official hours were 10 am to 4 pm, 6 days a week. By the mid-1850s, they had evolved to 11 to 3 from Monday to Friday, and 11 to 1 on Saturday. But there was trading both before and after the official hours, cf. [49, 91].) There was no mandatory reporting of transactions even during regular business hours. For trades involving the public (but not those among the jobbers), brokers had some incentives to report their transactions, in order to justify to their customers the prices they had obtained. But even then, this incentive existed primarily for prices at the extremes of the day's range[120]. It is easy to imagine that a jobber who bought a large parcel of a particular gilt, beyond what he could comfortably handle, and which he then might want to resell to others, might like to keep the transaction quiet. This is what may have happened to some of the transactions by the Bank of England in early 1847, cited in Section 12, which did not show up in *CoE*.

The largest gap in our knowledge of gilts transactions is in the almost complete lack of information about the volume of trading. (This is discussed later, in Section 57.) Even the

pricing data we do have is highly imperfect. The reports of transactions in *CoE*, even aside from not covering many transactions, do not reflect the nuances of real pricing and special conditions of transactions. Jobber quotes and official price reports for the major gilts were all in increments of £0.125. (This began to change in the 1860s.) However, in practice, for large transactions, a jobber quote was apparently just a prelude to a negotiation. (Jobbers were obliged to honor their quotes only for £1,000 of nominal value in gilts, as specified by Rule 75 of the Stock Exchange, [56], p. 97.) The Bank of England trades in early 1847, mentioned above, show one price at an increment of 0.0625, and such behavior was apparently common ([91], Q5220). Furthermore, although transactions "for money" were supposedly for immediate settlement, in practice this could mean anything from 20 minutes ([91], Q5358) to several days (as in the financial column of the *Daily News* of 7 April 1848, which mentioned a purchase of either RA or NR on a Thursday for delivery the following Tuesday). What this means is that there was extensive "trading within the tick," and so the price increments of £0.125 that we see do not represent the full nuances of many activities.

There is much more we don't know about trading on the London Stock Exchange. Aside from trading of CA for the current account, there was also trading for the following account, and we don't have much data about it until late in the 19th century. The volume of such trading may not have been high enough to warrant keeping track of. In some cases, deliberate concealment may have been a factor. For example, efforts were made to compare the volume of transactions between members of the Exchange to that involving outside customers[121]. These attempts were inhibited by the Stock Exchange refusing to make public the records of its Clearing House (which was only set up in the early 1870s). This was apparently motivated by the concern that the public, which often regarded the Exchange as a disreputable place, would see in the volume of speculative activity a confirmation of its biases. (As an interesting aside, the *Economist* in one of the pieces cited in the endnote above advocated a small tax, now usually referred to as a "Tobin tax," to dampen the gambling element on the Exchange.)

Much of the activity on the London Stock Exchange was of questionable legality, and even more of it was, in the eyes of the public, of questionable morality. One of the core activities of the Exchange, namely the trading of CA "for account," was, until the repeal in 1860 of Sir John Barnard's Act from the early 18th century, theoretically not just illegal, but subject to heavy fines. Other activities were simply not enforceable under the law, but were under the rules of the Stock Exchange. Yet others (such as options trading, cf. [49], p. 197) were not even sanctioned by the Exchange, so those engaged in them had no recourse to any authority in cases of disputes.

That we don't have a full record of transactions on the London Stock Exchange should be kept in perspective. Just how much do we understand of current markets, with all the "dark pools," high frequency trading, and derivatives such as CDO squareds that every once in a while blow up in a spectacular fashion? Even the "flash crash" of 6 May 2010 is apparently not fully understood. Each age has its markets, and typically lacks full understanding of how they really function. All we can say is that Victorians did rely on the published prices, whether in financial journalism, in lawsuits, or in public policy discussions

and laws. So it seems reasonable to base our studies on them, and to assume that within the margin of £0.125, they do represent real market clearing prices.

51 Relative pricing of gilts in an economically rational world

In this study, CA* denotes the value of CA after subtraction of accrued interest, with CAm* and CAa* specifying whether we are dealing with CA "for money" or "for account" (see the next section for more details), and similarly for RA*. In practice, we are interested almost exclusively in the difference CAm* - RA*, which in a rational market should have been zero. The values of CAm* - RA* that are used were computed by taking the difference of CAm and RA and either adding or subtracting 0.75, depending on where the date fit in between dividend due dates. As we next show, this is not exact, but good enough for the purposes of this study, where the granularity of the data is 0.125.

What should have been the relation in prices of CA and RA, if they were both truly perpetual and risk-free? (We will consider their callability later.) They, and all the other gilts, were sold with the accrued interest (at least until early 1861, when a slight modification described in the next section was introduced). Hence on dividend day (as interest on gilts was called a dividend), the price should have dropped by £1.50, and then (if interest rates remained constant) started climbing. If the four dividend days for CA and RA were spread evenly through the year, and interest accrued evenly each day and did not compound, we should therefore expect that just before CA's dividend was paid, it should have been priced £0.75 higher than RA, and right after the dividend, £0.75 lower, and should have remained £0.75 lower than RA until the RA dividend.

For CA and RA, the assumptions above were not quite correct, but violations of them do not change the conclusions by much. Standard interest computation shows that the difference between interest accruing and compounding each day as opposed to accruing in a linear fashion comes to less than £0.003 (assuming a 3% annual interest rate). Uneven intervals also do not create much error, in that moving the dividend rate by 5 days (and still holding the discount factor at constant 3%) leads to a difference in value of not much more than £0.02. (Dividend days were 5 January, 5 April, 5 July, and 10 October through 1869, and after that, the October date was moved to 5 October.)

Finally, we consider the effect of the term structure of interest rates. By modern theory, each interest payment should be discounted using the interest rate appropriate for that maturity. The interest rate curve is usually either positively or negatively sloped for short and intermediate maturities, and then levels off. Let's consider the effect of two extremes. Suppose that right after CA dividend is paid, interest rates half a year or more out are all taken at 3% per year, while that for a quarter out (corresponding to the next dividend due, on RA) are either zero or 10% (the highest that the Bank of England rate of discount reached, and for only a brief period, in the 19th century). That means the value of that one impending RA dividend varies between £1.50 (for zero discount rate) and £1.46 (for a 10% annual rate), for a range of just £0.04. Thus almost all the time the term structure of interest rates could not have been responsible for more than £0.01 of a difference in price of CA and RA. (Furthermore, any differences in prices caused by a constant term structure

would mean that the roles of CA and RA would switch at every interest due date, instead of CA being consistently overpriced relative to RA.)

Given the £0.125 granularity in pricing, we can therefore conclude that the simplifying assumptions in the first paragraph are appropriate, and that economically rational pricing does call for CA to be priced close to £0.75 either above or below RA, depending on where the date falls between dividend payments. That is indeed what various early 19th century observers saw as proper, and at least some knew this was an approximation, but one that was good enough [94].

The argument above about the negligible effect that the term structure of interest rates could have had on gilts mispricing applies just as well to seasonality. There were certainly substantial seasonal effects (explored for the first time in a scientific fashion by Jevons in the 1860s). The rhythm of the harvest seasons caused increased pressure on interest rates in the fall, for example. Perhaps most important, the quarterly interest payments on the national debt caused some perturbations in the financial system. Table 1 of the main paper shows that in the early 1840s, interest payments amounted to about 5% of the GDP (since interest was at 3% on most of the debt, which is shown in that table at its nominal amount, not market value), and were about half of the national budget in a still primitive economy. These large fund flows led to complaints about tightness of money just prior to those payments, the provision of special loan facilities from the Bank of England for such events, and the like. One of the features of the Goulburn conversion of 1844 was that it equalized interest payments, from a state where about 71% went out in January and July, necessitating extensive short-term borrowings, to almost exact equality. Goulburn boasted of this feature in his speech, and was applauded by the MPs who listened to it[122]. For individuals, though, there continued to be inconveniences, as many payments, for rents, in particular, fell on 25 March, while the interest on gilts was not due till 5 April, and was not paid until a few days later[123]. Still, these were effects that caused some inconvenience and some perturbations in interest rates, but relatively mild ones that the British banking system was able to accommodate routinely. They were nowhere near sufficient to account for the CA overpricing that has been discovered. Further, if seasonality were a factor, why were there extended periods of rational pricing?

The rational relation in prices of N35 and R35 should have followed the pattern of CA and RA, except that the difference should have been close to £0.875 in favor of one or the other. Hence the values of N35* - R35* computed in this study were obtained by either adding or subtracting £0.875 from N35 - R35.

52 Gilts trading and "shuttings"

The price records for gilts that were used in this study came from the London Stock Exchange, the only organized place for gilts trading in Britain. (As is sketched in Section 50, there was also some gilts trading in Dublin, Ireland, and some informal trading elsewhere in Britain.) This exchange operated 6 days a week, excepting a few holidays, and each of the major gilts has an official record of trades on almost every trading day that it was open for trading. (For minor gilts, as well as for most joint-stock company shares, including those of the Bank of England, there were often extended periods with no record of trades,

a reflection of the low turnover rates of 19th century markets, and of the high threshold for a transaction to be accepted for the *Official List*.) Except for CA, gilts traded "for money" (or "for delivery"), meaning with the transaction taking place and money changing hands right then, although there were some variations. In contrast, joint-stock company shares almost invariably traded "for account," with the transactions completed at the twice-a-month settlement days. (This was futures trading, in effect.) In gilts, trading "for account" was officially done only in CA for most of the 19th century. CA account settlement days, initially somewhat irregularly spaced at an average of about 6 weeks apart, were moved in the late 1840s to a more regular monthly schedule. In this paper and in the tables, prices for CA are often denoted CAm when referring to prices "for money" and CAa when referring to "for account" transactions.

For a long time, trading in gilts "for money" was suspended ("shut," standing for the transfer books being shut) for about a month before the dividend due date, to allow the Bank of England to prepare its accounts for the payouts. (These "shuttings" actually extended for some days beyond the dividend due date, but trading started up right away, with the actual transfer delayed until the books were opened again.) Starting in June 1861, this was dropped, in that the Bank of England would declare a date about a month before the dividend was due, and the dividend would be paid to owners of record as of that date, while that gilt would trade on ex-dividend basis. Hence from that point, we have a continuous series of CA and RA prices "for money" to compare. (The valuation formula changes slightly when a security goes ex-dividend before the due date, but the difference between the simplified formula that adds or subtracts 0.75 from CA - RA to compute CA* - RA* and the correct formula with compounding at a constant 3% per year is still under £0.005 so was neglected in the tables and figures.) Until 1861, though, there were about 4 months each year when it was impossible to compare prices of CA and RA "for money," as one or the other was shut. The data collected for this study, and available in the tables, lists prices for both CAm and CAa. Use of CAa would enable comparison of prices of CA and RA during two of the four months that are missing. However, it was decided not to do this. Differences between CAm and CAa depended on a variety of factors, such as the remaining time until the next CAa settlement day, the interest rate on the Stock Exchange (for which we have only sporadic records), and the volume and direction of speculative activity. Any attempt to compensate for all these factors would have some elements of choice that could be questioned, and so it was decided to stick to the unambiguous comparisons of gilts trading "for money," even though that limits the coverage. Similarly, even when the official record show some trades in gilts when they were shut, this was recorded in the tables, but not used in the study. Such trades most likely represented unusual transactions, various distress sales or purchases, and so may not have been the same as what an active market would have produced.

53 Transaction costs

Transactions in almost all joint stock company shares were subject to a stamp tax, which was about 0.5% of the value. However, gilts (as well as shares of the Bank of England, and a few other securities) were free of that tax (e.g., [84], pp. 724–25).

The income tax, which was brought back in 1842, after its first test in the French and Napoleonic Wars, was at a low rate (a bit under 3%, somewhat more than doubling on a temporary basis during the Crimean War, and then moving up and down, but never exceeding 5% through the end of the 19th century, except for the Crimean War period). In any case, income tax did not apply to capital gains, and so would not have inhibited arbitrage. Hence taxes are disregarded in considering trading of the major gilts[124].

CA, RA, and NR were all conventionally quoted in units of £100 of nominal value. For company shares, or even so-called "stock" of such companies (which, like the gilts, were book-entry entities, normally without issuance of paper certificates), brokerage charges were based on market value. For the gilts, broker commissions were based on nominal value. In the 19th century, the standard commission on the London Stock Exchange was 1/8, or £0.125 for a unit of a gilt with nominal value £100. (Rates were higher for shares of companies.) This commission rate was not enforced by the Exchange, and one can find occasional ads for brokers who advertised discounted rates, but those were rare, and contemporary investment guides throughout that period all cited this standard rate of £0.125 as the prevailing one. But this was only for small investors.

Large investors could obtain brokerage commission discounts ([78], p. xxxii), but there does not seem to be any information on how often this happened. The *Economist* claimed that "large transaction in [CA] can always be effected at a commission of [half the standard level]" but it did not quantify what it meant by a large transaction[125]. Investors could also have their own broker, as admission to the London Stock Exchange was easy, with no need to buy an expensive "seat" as on the New York Stock Exchange, for example. As was mentioned in Section 39, the Court of Chancery paid less than 40% of the standard rate, while the government employed a salaried broker, so its marginal brokerage costs were zero. Some investors were members of the Stock Exchange just as speculators for their own account so also did not have to bear the costs of commissions.

In considering regular retail investors, on the other hand, it appears best to assume that they paid the standard £0.125 rate. It is certainly a safe upper bound on their expense. However, when they sold a security and immediately purchased another one, they usually paid only one commission[126].

Short sales of gilts were generally done only in CA, since it was the one that traded "for account." That would not have been an impediment to arbitrage aimed at eliminating CA overpricing, since that called for selling CA short and buying RA or NR. However, transaction costs would have been a heavy burden for a retail investor if the short position had to be maintained for any significant length of time. At each account day, half of the regular commission was charged ([49], p. 215).

The London Stock Exchange had brokers who transacted business on behalf of the public, and jobbers (in other venues or other times also called specialists, dealers, or market makers) who bought and sold to brokers. Retail investors would go to brokers to buy or sell gilts. Brokers (assuming they were members of the London Stock Exchange, otherwise they would have to go through corresponding brokers who were members) would then go to the floor of the Exchange, and ask the jobbers for quotes. The usual rule was that the jobber would give a quote, without knowing whether the broker was interested in selling

or purchasing. If the broker found the quote acceptable, he would then reveal whether he wanted to buy or sell at the quoted price, and the transaction would be completed. Thus retail investors had an additional cost, on top of the commission, namely the jobber's bid-ask spread, known then as the "turn." For CA, RA, and NR, the jobbers' spread was almost always £0.125, equal to the brokerage commission. Occasionally, especially in times of panic, it would get wider, but this was infrequent. (See Section 57 for some statistics. Not unexpectedly, this happened more frequently for RA than for the larger CA.) Large investors could do better, and jobbers and speculators who were members of the Stock Exchange could also limit that cost.

The general conclusion is that small retail investors usually faced transaction costs of £0.25 for a unit of nominal value £100, but seldom more than that. Larger traders, and of course members of the Stock Exchange, could profitably exploit much smaller mispricings. But a small investor who had CA and wished to exchange into RA could do so with profit once CA overpricing exceeded £0.25, since he or she would pay a single commission and a single "turn," each of £0.125.

The language of various investment guides from the 19th century makes it clear that the writers regarded most of their readers as very unsophisticated, and unlikely to be familiar even with the simple calculations needed to compute accrued interest. However, even the least sophisticated investors should have seen the advantage of exchanging CA for RA once overpricing reached £1.00, as it did for extended periods. At that point, say in February of some year, after CA interest had been paid, the quoted price of a £100 unit of CA that was printed in any newspaper would be at least £0.25 higher than the price of RA. So, the commission and jobber's "turn" involved in swapping a unit of CA for a unit of RA would be covered by that £0.25, potentially with a bit of cash to pocket if the overpricing exceeded £1.00. Afterwards, the amount paid out in interest would stay exactly the same, but the next interest payment would come on 5 April, instead of 5 July. Afterwards, all other interest payments would be similarly accelerated by a quarter. The benefits of that should have been clear to anyone, even those not able to do simple interest accrual computations.

54 Differences among the major gilts

This section considers differences among the major gilts. They were not quite identical. Hence we need to consider whether the variations among them could have led in a rational market to the differences in prices that have been observed.

Each of CA, RA, and NR carried the full faith and credit of the British government. Furthermore, ever since their creation in the middle of the 18th century, CA and RA were regarded as the basic financial instruments of the government, and were treated as fully equal. For example, the government determined the price of annuities it sold to individuals by averaging the prices of CA and RA after adjusting for accrued interest (pp. 26-27 of the 1840 edition of [56]).

The most obvious difference between CA and RA (and after 1844 also NR) was in the dividend payment dates. Many investment guides suggested splitting investments between

CA and RA in order to obtain quarterly payments (for example, [36], p. 250, which was reprinted in [54]; [13], p. 60; and [49], p. 116). The general opinion seemed to be that this tactic was widely practiced, but there are some reasons to doubt whether this was correct.

Until 1861, the "shuttings" at the Bank of England (described in Section 52) provided a strong incentive for large institutional investors to split their holdings between CA on one hand, and RA and NR on the other. This is reflected in the advice of James William Gilbart, a banker and prominent writer on banking, who wrote in the 1840s ([33], vol. 1, pp. 82-83) that CA was the best security for a bank to hold, since it was the most liquid. However, because of the approximately two months in the year when trading in it was restricted,

> [i]t is not advisable, however, that all the stock a banker holds should consist of [CA]. ... it is better he should divide his stock [i.e., gilts], and hold half the amount in [CA], and half in [RA or NR].

After mid-1861, this advice was not as relevant, and so it is possible that institutions, such as banks and some insurance companies, which might be faced with sudden demands for cash, may have preferred to put most of their reserves in CA.

The other major differences among CA, RA, and NR concerned their callability. All were redeemable by the government, but not by investors. But the government was constrained by the magnitudes of these instruments, as well as by some legal conditions, discussed in the next section. In order to redeem them, it had to borrow, and the only place it could borrow enough was in effect from the people who were about to receive the cash (even if those sums went through banking intermediaries). So in effect it was a strategic game, in which the investors had some power. This was already apparent in the 18th century, when national debt was far smaller [14]. In the 19th century, the government usually tried for voluntary conversion with the implicit or explicit threat of forced redemption. Details of some of those operations were discussed earlier in this paper.

NR could not be redeemed at all until the end of 1874. After that, though, it was subject to immediate redemption. CA and RA, on the other hand, could be redeemed before as well as after 1874, but both required a year's notice. This long notice period was felt to be a major constraint by many Chancellors of the Exchequer, since monetary conditions could change drastically in a year[127]. This pretty much limited them to quasi-voluntary measures. Edward Hamilton provided a very interesting and apparently completely frank account by a high-level insider of the deliberations that went into planning the Goschen conversion [35]. He wrote that a variety of combinations were considered, and that there was some thought given to having different treatment for RA than for CA, since the amount of money in RA was much smaller. In the end, NR was redeemed with a couple of weeks' notice. (The default, in the absence of specific request from an investor for cash, was conversion into the new "Goschen Consols," as they were sometimes colloquially called. Very few holders made such requests.) On the other hand, CA and RA holders were treated equally, and were invited to voluntarily switch into the Goschen Consols, with a £0.25 bonus in cash (for £100.00 of nominal value of their security). This offer was accepted by an overwhelming majority of CA and RA holders[128].

Could the different conversion features account for the gilts mispricing that is documented in this paper? This possibility has to be considered seriously, since, as was described in Section 24, the Childers 1884 speech, with his conversion proposal, did cause a substantial perturbation in pricing. However, this was an anomaly, and had a substantial (although short-lived) impact largely because it occurred in a low interest rate environment where a conversion was widely anticipated, and where CA overpricing was slight. The largest CA overpricing occurred in the 1860s, when redemptions did not seem to play a major role in investors' thinking. We can see this quantitatively by comparing pricing of NR and RA. NR had the advantage of being absolutely irredeemable until 1874, and of being larger, so that it was harder to redeem than RA. After 1874, though, it could be redeemed quickly (although size still made that harder than for RA), whereas RA required a year's notice, with its attendant risks. Yet, as the tables show, prices for NR and RA were essentially identical from 1858 until the Childers speech in 1884, a period of 26 years that saw record levels of CA overpricing and the expiration of NR call protection. They were also essentially identical in 1885–87, after the disturbance occasioned by the Childers speech had died down. Given this disregard by investors for the differences between RA and NR, it seems safe to conclude that the different conversion features did not provide a rational basis for CA overpricing as compared to RA. That was also the view of contemporary observers. Giffen wrote that the major gilts were "indistinguishable in their legal conditions of value" (see the full quote in Section 5.3), and others made similar comments.

55 Sources for gilts prices

As was mentioned in the main manuscript, most of the data used for this project, available in the online tables, came from the *Course of the Exchange*, denoted *CoE*, and the *Economist.* The former provided most of the data for the period 1823–60, the latter for 1861–87. This choice was due not to careful selection, but rather to the availability and quality of copies of various publications that were available at the start of this project.

A growing fraction of the 19th century British press is being digitized. However, very often the copies (and, based on some experience, very often also the originals) are not of high quality, which matters when prices are printed in small font, and fractions such as $\frac{3}{8}$ and $\frac{5}{8}$ have to be distinguished. In general, *CoE* data was of considerably higher quality, both in terms of legibility and freedom from obvious typos. The *Economist* was considerably worse in both respects, as the notes to the tables show. (Some of the suspicious values were checked against data from other sources and occasionally modified when it seemed appropriate. Such changes are detailed in the tables.) However, initially *CoE* was only available for 1823–60, and so the *Economist* was used for later periods most of the time.

Although the *CoE* is sometimes called an official publication of the Stock Exchange, it did not become that until the end of the 19th century. Through 1898 it was a private publication of the Wetenhall family (who were brokers, and carried on the publishing business on the side). For most of that period, it was subject to some oversight by the Stock Exchange, with the strictness of that oversight varying over time. It came out late on Tuesday and Friday afternoons (with occasional variations to accommodate holidays), and incorporated data from trading that day and the two preceding business days. For

gilts, each issue provided transaction prices drawn from the *Official List* separately for that day and the preceding two. (For joint stock company shares, usually just a single list summarizing trading over those three days was printed.) The *CoE* did not report every trade that was reported in the *Official List*, just enough to show the course of prices. Thus a daily transaction report with prices (rendered here as elsewhere in this manuscript in decimal, in the original fractions were used, as is visible in a few reprinted fragments in earlier sections) 91.25 91.375 91.25 91.5 might represent many more than just 4 trades. For the purposes of analysis of liquidity and volatility later, in Section 57, such a report counts as 4 prices, even though it represents just 3 distinct values.

Gilts price information printed in newspapers varied. Sometimes it was the list of trades, such as those in the *CoE*, sometimes closing quotes, and sometimes both, and sometimes something else, such as a range of prices. The variety of sources opens up the possibilities of obtaining additional information about gilts trades by combining data from a variety of papers. For example, the *Standard* was a London daily published in the afternoon, and the edition of Wednesday, 2 August 1848 had a table with gilts transaction prices through 1 pm that day, a financial column about that day's action dated 2 pm, and at the end of that column, 2:45 pm quotes for CAa. The timing was surely due to the production schedule of this newspaper. But it does offer us a more detailed look at gilts transactions than *CoE* alone does. As the 19th century advanced, individual newspapers often provided more details. For example *The Times* of 31 August 1878 carried quotes for major gilts from both 3:00 pm (the official closing time) and 4:30 pm on 30 August.

There are clear and dramatic differences between our current world, where special fiber optic cables or microwave links are built just to save a few milliseconds in transmission between major financial centers, and that of the mid-19th century. This is nicely illustrated by the Dublin daily *Freeman's Journal* (featured in Section 15) of Wednesday, 14 January 1852. It carried a brief report from the London Stock Exchange dated 2 pm on Monday, 12 January, with a final line giving the closing quotes for CAa at 2:45 on that day. This timing was likely forced by the need to get the message delivered to the Post Office by 3:30 pm in order to catch the 5 pm mail train, which allowed the letter to be delivered in Dublin on Tuesday morning[129]. But there was also a brief telegraphic report (delivered by telegraph to Holyhead, and then by boat from there to Dublin) about the London Stock Exchange on Tuesday, something that was not available just a few years earlier. (The establishment of direct telegraphic communication between Dublin and London in 1854 did not change what newspapers printed, at least for a while, although it might have affected the integration of the markets in Dublin and London through exchange of messages by brokers. The financial sector was one of the largest customers of the telegraph companies in the 19th century.) The point of citing these amusing items is that they demonstrate that much of the British investing public had access only to prices that were a day or two old. Thus some of the slow changes that have been observed in the degree of overpricing in CA may represent not just the slowness of investors processing information, but also the slowness of basic data dissemination.

Many investment sources in the 19th century warn against relying too heavily on the closing quotes, e.g., [15], pp. 4–5; [49], pp. 43–44. Such quotes, unlike transaction prices,

where there was at least a process in place for challenge and verification, were just numbers provided by jobbers. Hence they were subject to manipulation. After the Stock Exchange assumed greater control over the most important Wetenhall lists in 1867, it insisted, for example, that *The London Daily Stock & Share List* (which, unlike *CoE*, carried closing quotes) carry a prominent notice that it was published "under the authority of the Committee of the Stock Exchange, and superintendence of the Secretary of the Share and Loan Department, with the exception of the "closing quotations," for which the publisher is alone responsible." (This changed later in that century, when even the closing quotes acquired the saction of this Committee.) For the major gilts, with their substantial trading volumes, price manipulation through publication of false quotes was probably not a major issue. A more serious issue likely was lack of uniformity, due to consulting different sources, or else due to variations in timing. (Newspapers typically did not specify whether the closing quotes were at the official close of 3 pm, or the closing of the Stock Exchange building at 4 pm, or some other time. It seems safe to assume they did not include after-hours trading, which was sometimes reported in their financial columns, but seemed to be labeled as such.) To provide some insights into how large the differences were between various sources, a few illustrations are provided in Table 6 and Table 7. The latter table shows the information we have for the 4 days in the summer of 1848, where the *CoE* closing prices show the peak of RA vs. NR pricing irrationality, discussed in the main manuscript. The same price for RA and NR meant that the extra 0.25% interest per year for the next 6 years, plus 20 years of protection from redemption after that, which belonged to NR, were valued at zero. Closing quotes show a slightly less irrational pricing. There is some variation among the different sources, but it seems that NR was valued at about £0.25 higher than RA.

Table 6. Examples of available price data at a quiet time.

Prices in pounds sterling.

date	gilt	transaction prices *CoE*	closing quotes *The Times*	closing quotes *Morning Chronicle*
2 May 1845	CA	98.875 98.5 98.875 98.625 98.875	98.5 - 98.625	98.625 - 98.75
	RA	97.625 97.75 97.5 97.625 97.5	97.5 - 97.625	97.625 - 97.75
7 May 1845	CA	98.625 98.375 98.625 98.5 98.375	98.375	98.25 - 98.375
	RA	97.375 97.25 97.5 97.25 97	97 - 97.125	97.125 - 97.25

Still, even though there are differences in closing quotes among different sources, they tend not to be large. Further, comparison of those quotes with closing prices from *CoE*, as was done for 1864, for example, where both are available, show that differences are not substantial, and are not systematically biased. Hence the statistics of CA vs. RA mispricing are not affected by which one is used.

The main source of the closing quotes data was the Bankers' Gazette of the *Economist*. In late 1847, that section started printing a table showing closing quotes from the preceding Friday and the current one (the day before this paper went to press) for major securities, including CAm, CAa, RA, and NR, and continued this until the 1888 end of the period

Table 7. Examples of available price data during period of high volatility.

Prices in pounds sterling. The ones from *CoE* are transaction prices, those from other source the closing quotes for each day.

date	source	RA	NR
14 July 1848	*CoE*	87.375 88	87.875 88.125 87.75 88 88.25 88
	Daily News	87.75 - 87.875	87.875 - 88
	Morning Post	87.625 - 87.875	88 - 88.5
	The Times	87.5 - 87.625	87.875 - 88
	Economist	87.375 - 87.5	87.875 - 88
19 July 1848	*CoE*	88.5 88 87.5 88	88.875 88
	Daily News	88 - 88.125	88.75 - 88.875
	Morning Post	88 - 88.125	88.75 - 88.875
	The Times	88 - 88.125	88.25 - 88.375
28 July 1848	*CoE*	86.25 85.75 86	86.625 86
	Daily News	86.125	86.375 - 86.5
	Morning Post	85.875 - 86	86 - 86.125
	The Times	86 - 86.125	86.25 - 86.375
	Economist	86.125 - 86.25	86.375 - 86.625
1 August 1848	*CoE*	87.25 87.375 87.125 87.625 87.5	87.625 87.375 87.75 87.5
	Daily News	87.125 - 87.375	87.5 - 87.625
	Morning Post	87.5 - 87.625	87.5 - 87.625
	The Times	87.125 - 87.25	87.5 - 87.625

considered in this study. (In August 1881, the format changed slightly, and closing quotes were given for the major gilts for each day of the preceding week.) It was these tables that were drawn upon for the preparation of the tables of this study.

There were other gilts price tabulations published by the *Economist*. In the text of the Bankers' Gazette, for much of the period under investigation, there was a table of extreme CA prices for each day of the preceding week. There was also a Bankers' Price Current, which from January 1845 to October 1870, gave for each day the opening and closing prices of the major gilts (and then, for much of the rest of the 1870s, just the Friday closing quotes). These were not used, except occasionally to check on values in the main compilations that seemed suspicious.

A few technical details: When Friday was a holiday, the data for the preceding Thursday was used. When the Friday issue of *CoE* was not available, so neither Thursday nor Friday prices were available, those from the following Saturday were used. When even that was not available, no entried were made into the weekly price tables. In some cases, missing values were inserted from newspapers (and are marked as such in the tables).

56 Deeper analyses of market action

The analyses of CA overpricing presented in this paper and the main one use either closing prices or closing quotes. Combining both (and ideally the full record of transaction prices, and possibly even mid-day quotes where they are available from evening papers) might provide valuable insights into the interaction of jobbers with investors. This has not been done to any substantial extent, but here is an example of what might be accomplished.

Recall (Section 8) that the financial column of the *Spectator* on 22 October 1842 expressed surprise at the disappearance of CA overpricing (relative to RA). It had been low earlier in the year, typically 0.125 or 0.25, but on Friday, 21 October, at one point the quotes (at least it seems likely the writer meant quotes) were higher by 0.125 for RA than for CA. (This is after subtracting the accrued interest for both securities.) The tables contain the daily closing prices from 11 October to 1 December of that year (the full period between gilts "shuttings"), as well as daily closing quotes from *The Times* from 8 October to 4 November, and the full record of CAm and RA transaction prices from *CoE* from 11 October to 29 October. What we see in that data is that CAm* - RA as computed from closing prices dropped to zero, and even went slightly negative, even as jobbers maintained the level of CAm* - RA in their closing quotes at 0.125. This suggests that it took the jobbers a couple of days to realize that investor sentiments had changed, and the irrational preference for CA had vanished. If this conclusion is correct, that tells us how long it took for the jobbers to realize a fundamental change in the market had taken place.

This is just a simple example, and clearly much more data needs to be collected and analyzed. However, this small experiment suggests that it might be possible to tease out additional insights into market action by combining the record of transaction prices from *CoE* and the closing quotes (ideally from several papers).

57 Liquidity and volatility for major gilts

As was noted in Section 50, jobbers had to honor their quotes only up to £1,000 of nominal value in gilts. In practice, though, far larger amounts could be bought or sold without affecting prices. Several witnesses before the 1878 London Stock Exchange Commission [91] talked of transactions on the order of £200,000 being handled routinely, without noticeable effect on the market. Lowe's sales of CA in late 1869, cited in Section 3, and Bank of England sales of RA in early 1847, cited in Section 12, support those claims. For a while those sales seemed not to affect the market, and when they may have started to, this was likely due to the market learning who the seller was. Markets are primarily information processing mechanisms, and the gossip that occupied London Stock Exchange members most of the time (in addition to the amusing pranks and other activities that filled in slack times, cf. [4]) was frequently about the identities of buyers and sellers. As one example, we can cite the following quote[130]:

> A sale of [£50,000 of CAa] reduced the quotations at once [£0.25], and they subsequently declined still further to ... The sale referred to, although not of particular magnitude, had the greater effect upon the market because supposed to be grounded upon some exclusive intelligence of importance possessed by the operator.

It appears safe to conclude that a regular investor, at other than crisis times, could switch £100,000 from CA to RA at the quoted prices in two coupled transactions. Since there were very few accounts over £100,000 (see the next section for quantitative data), and a move of a large amount from CA to RA could be spread over several days, it seems that liquidity was not a barrier for the overwhelming majority of investors, whether individuals

or trusts. Thus if liquidity was what caused them to overpay for CA, this was an irrational preference, without fundamental economic justification.

A variety of contemporary sources mentioned that CA was more liquid than RA (and in later years, when this became more relevant, NR), and that it was the gilt favored by speculators. There is no reason to question these claims, in particular since CA could be traded "for account," whereas the other gilts could not (at least not until late in the 19th century). We can obtain some quantitative measures that also support this conclusion. Unlike the minor gilts, considered later, CAa, CAm, RA, and NR (as well as N35 and R35 until 1844) show prices almost every day. Exceptions were rare. As is shown in the tables, during the 308 days that the London Stock Exchange was open in 1864, CAm and NR have prices every day. On the other hand, RA had no transactions recorded in the *Official List,* on 3 days, and CAa did not show up in trades on 7 days.

Table 8. Comparison of trading activity among major gilts in 1825, 1848, 1853, 1864, and 1879.

gilt	average number of daily prices	average daily trading range
1825 CAm	3.27	0.298
1825 CAa	3.88	0.274
1825 RA	2.35	0.207
1848 CAm	4.54	0.476
1848 CAa	4.84	0.456
1848 RA	3.47	0.430
1848 NR	3.79	0.422
1853 CAm	5.27	0.549
1853 CAa	4.65	0.505
1853 RA	3.37	0.457
1853 NR	4.43	0.515
1864 CAm	2.96	0.197
1864 CAa	1.85	0.111
1864 RA	2.73	0.201
1864 NR	3.12	0.221
1879 CAm	3.40	0.215
1879 CAa	1.56	0.080
1879 RA	2.76	0.185
1879 NR	2.92	0.185

Some statistics were collected from *CoE* for the 5 periods 6 July to 5 August 1825 (26 trading days), 6 April to 13 June 1848 (57 trading days), 11 October to 7 December 1853 (49 days), 6 July to 4 August 1864 (26 trading days), and 2 May to 31 May 1879 (25 trading days), which happened to be periods when none of CA, RA, and NR was "shut." What was recorded for each security were the number of prices for each security printed for that day and the difference between the high and low prices of the day. (The number of prices was not the number of different prices, but the number of prices printed in *CoE*. Thus on 24 April 1848, *CoE* lists the following prices for RA: 80.375, 80.625, 80.875, 80.625, and this is counted as four prices.) Average values of these are given in Table 8. Trading in CAa, which seemed to be equally if not more active than in CAm in early years, shows

a substantial decline in 1864, and to have become even lighter in 1879. This is consistent with observation in the preceding paragraph that CAa had no trades recorded on 7 days in 1864. This was almost surely the result of the end of the "shuttings" in 1861, which enabled trading in CAm year-round.

Table 8 does show somewhat more activity in CAm than in NR, and more in NR than in RA. Still, there was considerable trading in each, and so no visible barrier for most investors to switching from CA to the other major gilts.

Another indicator of somewhat lower liquidity in RA and NR than in CA comes from the bid-ask spread. If we ignore the fact that there was trading inside the spread, and go just by the reported figures, we do find the spread somewhat higher for RA and NR than for CA. Most of the time these spreads were at the expected 0.125 level, and exceptions were usually associated with periods of stress and uncertainty. During the three years 1872 through 1874, the Friday closing quotes from the *Economist* show the bid-ask spread on CAm invariably at the usual 0.125 level (with one possible exception that is ambiguous), while CAa has the spread as 0.25 during 2 out of the 157 Fridays. On the other hand, the RA spread was 0.25 on 20 occasions (plus one case where it is shown as zero), and the NR spread is exactly the same as that for RA except for one or two occasions (which may represent typos). So we obtain yet more evidence of lower liquidity in RA and NR than in CA, but again to a slight degree.

The 1872–74 statistics enable us to estimate the systematic bias in the computed overpricing CAm* - RA* that comes from using just bid quotes, as is done in this and the main manuscript. Compared to use of the average of bid and ask quotes, this overpricing is overestimated by an average of $(20 \times 0.125 - 1 \times 0.125)/(2 \times 157) = 0.0075...$ That was judged small enough to justify ignoring this difference in the interests of simplicity.

Similar computations have been attempted for some other years, with similar results. The data was often harder to interpret properly. For example, in some earlier years, there were a substantial number of dates where the *Economist* gave just a single number as the closing quote for a gilt. (This happened also with some frequency in various newspaper reports, and is visible in one instance in Table 7, for example.) For 1864, among the 53 closing quotes, a reasonable interpretation is that the bid-ask spreads for CAm and RA were the same (mostly 0.125, but on a few occasions 0.25) on 43 days, were 0.125 for CAm and 0.25 for RA on 11 days, and were 0.125 for CAm and 0 for RA on 1 day. So in this case, computing the average value of CAm* - RA* using the averages of the closing bids for each security would reduce the result by $(10 \times 0.125)/(2 \times 53) = 0.011....$ Thus the difference was again negligible.

A serious deficiency in our knowledge of the operations of the London Stock Exchange is in the almost complete lack of knowledge of the volumes of transactions. (This is one of the many issues that will surely be clarified through examination of the records at the Bank of England.) Thus Mihill Slaughter declared before the Royal Commission investigating the London Stock Exchange in 1878 that he thought the annual turnover, excluding gilts, came to about £100 million, but that some brokers felt the actual number was several times higher[131]. This is very telling, in that Slaughter was the Secretary of the Share and Loan Department of the London Stock Exchange and its chief statistician. (He was hired initially

in 1845 as little more than a clerk, to start a basic data collection effort about railways. He then rose in experience and responsibility, and eventually was elected a Fellow of the Statistical Society of London.) Moreover, his was not an ad-hoc estimate in response to a question from the Commission, but something he had thought about before, and discussed with members of the Stock Exchange.

If we go beyond London Stock Exchange transactions, we find some interesting statistics about total turnover in the main gilts held in London (thus excluding the holdings in Dublin, which were almost completely in NR) for the 25 years from 1855 to 1879. They are contained in a series of Blue Books starting with *Parliamentary Papers* 1857-58 [2427] LVII.41, and ending with the 11th issue of this series, 1878-79 [C.2332] LXXIV.145. (It is possible that the same or similar statistics are available for other years in other Blue Books, but they have not been found so far.) They show for each month of each year the volume of each of CA, RA, and NR that were transferred in the books of the Bank of England. If we compute average turnover for each gilt each year as the ratio of the turnover figure given in those Blue Books divided by the total amount of each gilt held in London, we obtain the picture presented in Table 9 (with average being the straight arithmetical average of the 25 annual averages, and the minimum and maximum values the extremal annual values).

Table 9. Annual turnover among major gilts, 1855–79.

gilt	average	min	max
CA	33.7%	24.2%	44.1%
RA	27.1	18.2	38.3
NR	31.9	18.7	41.0

It is to be expected that most of the turnover came from non-market transactions, such as gifts and inheritances. Still, we see that the turnover figures were not dramatically different among CA, RA, and NR, which goes counter to the contemporary image that CA was the playground of the speculators trading in and out, while RA and NR were the sleepy securities for the buy-and-hold investors.

The highest annual turnover figures for CA and NR came in the crisis year 1866, when RA experienced turnover that was only slightly above average, namely 30%. For RA, the highest turnover occurred in 1870, when the turnovers of CA and NR were 35.8% and 33.4%, respectively.

We can get some more snippets of information from other sources. For example, in 1870, the office at the Bank of England that handled CA had 70 clerks, and handled 78,000 transfers for the 120,000 accounts[132]. Since the total CA transfers that year came to £141 million[133], the average transfer was for a bit under £2,000. Also, in the year ended 1 October 1861, the Accountant General of the Court of Chancery (whose operations are the subject of Section 39) purchased £3.4 million in CA in 5,783 transactions, for an average

of about £600 per transaction, and sold £2.2 million of CA in 2,100 transaction, for an average of about £1,000 per transaction ([89], pp. 84–86). Thus the Accountant General, who was in control of about £40 million of CA around 1860, was likely responsible for about 10% of transactions in this gilt (and thus surely a far higher fraction of the London Stock Exchange deals in it), but just 5% of the amount of transfers.

The general conclusion we can draw from these figures is that even in CA, most accounts likely had no activity other than drawing dividends in a typical year, and that holdings of all three major gilts were dominated by long-term investors[134].

58 Volatility and the myth of "quieter Stocks"

The 1870 leader from *The Times* reprinted in Section 1 called RA and NR "the cheaper and quieter Stocks," and argued that moving to a single annuity would lead speculators having a larger and "magnificent area for plunging operations," which would disturb investors who preferred the "quiet" of the "quieter Stocks." This was a common opinion for much of the 19th century. But it bears little resemblance to reality. As was shown in the previous section, there are some signs of slightly higher volatility in CA than in RA and NR. But the difference was slight, as common sense says it had to be. All investment guides pointed out that prices of British government annuities followed the trend set by CA. In the words of a publication from 1825 [83], CA "is THE GRAND PUBLIC BAROMETER of the current rate of INTEREST; it greatly influences the price of all government securities, ..." The data compiled for this project show that while RA and NR were irrationally underpriced relative to CA most of the time (between 1823 and 1887), the degree of underpricing was fairly stable over periods of months and sometimes years.

As another measure of whether some major gilts were "quieter" than others, a measure was computed of the daily variation in prices. In 1864, for which the tables have daily closing prices for all 307 trading days, the average of the absolute value of the difference between consecutive trading days was computed. (For RA, where no prices are recorded in *CoE* for 3 days, those days were simply deleted, and the computation was done with the resulting 303 differences.) The averages that were obtained were 0.155 for CAm, 0.160 for NR, and 0.169 for RA. (Computing the root-mean-square of the differences yields 0.209, 0.215, and 0.223, respectively.) Thus by this objective measure, CA was the "quietest" gilt, and RA the least "quiet."

What could account for the myth that RA and NR were the ""quieter Stocks"? Perhaps the way gilts trading was reported in the press. This manuscript has two verbatim reprints of the paragraphs reporting daily gilts action, one from the *Illustrated London News* in 1850 in Section 14, and one from the *Morning Chronicle* in 1854 in Section 18. The latter devotes almost as much space to RA as to CA. The former, however, devotes most of the attention to CA, although without naming them that. This was typical. Although many financial columns were very perfunctory, basically saying just that nothing interesting happened in the market, the most common procedure was to describe market action in terms of what happened to the price of CA, and then list closing prices of other gilts. For illustration, here is another exact reprint, this one from *The Times* of 3 August 1854 (the same day that the *Morning Chronicle* reprint in Section 18 came from):

> The English funds opened this morning at the slightly lower prices of last evening, and were again dull throughout the day, some rather heavy sales by the broker for the Court of Chancery having easily affected the market in its present inanimate condition. Consols for money were first quoted $92\frac{3}{8}$, and, after having touched 92, they closed at 92 to $\frac{1}{4}$ for money, and $92\frac{1}{8}$ to $\frac{3}{8}$ for the account. There was increased ease in the discount-market, and the impression is that the Bank, owing to the diminished demand upon them, would willingly reduce their rate to 5 per cent., but that they will wait until the harvest shall have been in a great measure secured. There was no news of importance to-day, and the prolonged absence of definite intelligence creates a disposition on the part of the public to look upon everything unfavourably. Bank Stock left off at 210 to 212; Reduced, $92\frac{1}{8}$ to $\frac{3}{8}$; Three-and-a-Quarter per Cents., $92\frac{3}{4}$ to 93; Long Annuities, $4\frac{5}{8}$; India Stock, 223 to 226; India Bonds, 2s. to 5s. premium; Exchequer-bills, par to 3s. premium; and Exchequer-bonds, $98\frac{1}{8}$ to $\frac{3}{8}$.

In this case, all the action centers on CA, and RA and NR show up just in the closing quotes. So the conjecture is that the public impression of speculators taking CA on wild rides while RA and NR sat quietly on the sidelines may have resulted from the bias in press coverage towards CA.

59 Gilts ownership

Most of the contemporary rationalizations for CA overpricing relied on the greater liquidity of this security, or on its use by speculators and other financial institutions. This argument would be persuasive if the supply of CA had been limited, and the financial sector were the main holders of them. But that was clearly not the case. It is not plausible even from a very high level point of view. Table 1 of the main paper shows that as late as 1860, the volume of CA was close to half of the UK GDP, which is far more than what one could imagine would be needed for liquid reserves. But there are other ways to see this argument could not be correct.

The evidence so far shows that while CA was likely used preferentially by speculators, its turnover rates were not dramatically different from those of RA and NR. This argues against the theory that speculators were the dominant holders of CA, while regular investors were confined to RA and NR. Further evidence against this theory comes from looking at the distribution of account sizes.

We have little solid knowledge of the distribution of gilts ownership. (Studies such as [38], which looks at gilts ownership in the 18th century, are based on records of a few individual investors only.) However, we do have precise data about the number of accounts, and somewhat less precise data about the distribution of account sizes. For example, in early 1860, there were 131,990 CA accounts, 35,695 RA accounts, and 85,334 NR accounts[135]. If we compare that to the capital of each of these annuities, as given in Table 1 of the main paper, we see that the average size of an account was around £3,000 in each. This already suggests that the holders of these accounts did not differ much, and is therefore

not consistent with claims that CA was owned primarily by the financial sector. Had that been true, we would surely see far more large accounts in CA than in the other gilts.

Let us consider the distribution of account sizes in more detail. The series of Blue Books cited in Section 57 before, as well as various other ones (*Parliamentary Papers* 1833 (202) XXIII.275 will be used here for the 1833 data), contain information, usually in the form of the number of accounts entitled to various amounts of dividends from the major gilts. Table 10 presents the data for early 1857. The notation $(5, 10]$ means dividend exceeding £5 but no larger than £10. The dividends are semiannual ones, so an account in the $(5, 10]$ category would have between £333.34 and £666.66 of the nominal value of the corresponding gilt.

Table 10. Account sizes of major gilts, 1857.

dividend	CA accounts	CA fraction	RA accounts	RA fraction	NR accounts	NR fraction
≤ 5	44983	34.4%	13011	35.1%	30890	35.4%
$(5, 10]$	19645	15.0	5375	14.5	15715	18.0
$(10, 50]$	42727	32.7	12197	32.9	28403	32.5
$(50, 100]$	11832	9.05	3379	9.12	6919	7.93
$(100, 200]$	7094	5.43	1911	5.16	3513	4.02
$(200, 300]$	2058	1.57	621	1.68	935	1.07
$(300, 500]$	1412	1.08	309	0.834	579	0.663
$(500, 1000]$	662	0.507	160	0.432	246	0.282
$(1000, 2000]$	181	0.138	58	0.157	69	0.079
> 2000	105	0.080	30	0.081	34	0.039
total	130699	100.00	37051	100.00	87303	100.00

This table displays consistent distribution of account sizes among the major gilts. For the years 1833, 1857, and 1880, these distributions were investigated more carefully. When one considers just the accounts with over £100 in semiannual dividends (and thus with at least £6,666 in nominal value), one obtains very good fit to the Pareto distribution. (This distribution does not fit at all the small accounts.) The exponents do vary among gilts and over time. Thus for 1833, CA and RA have exponents -1.66 and -1.58, respectively. For 1857, CA, RA, and NR have exponents -1.60, -1.56, and -1.72, respectively, and for 1880, they are -1.46, -1.40, and -1.44. So we can see some flattening (and there is also a decline in the number of accounts, presumably as investors react to the wider range of options), but for any given year, there is not much difference among the three major gilts.

For 1865 through 1872, the statistics for total monthly turnover in London of CA, RA, and NR that were cited in Section 57 were investigated. The variation from month to month was substantial, but there did seem to be an underlying seasonality to the observed pattern. To see it, the yearly profiles of month-by-month transfers for each gilt were averaged over those 8 years. That produced separate profiles for CA, RA, and NR that were very similar to each other (with July and August showing the largest transfers, September the lowest). Those of RA and NR were closer to each other than to that of CA, but not by much, again reinforcing the image that differences among the major gilts were not very large.

(The results were essentially the same when the data for 1866, the crisis year and also the year of record high turnover, was excluded.)

So far all the evidence suggests that the financial sector was not the dominant holder of CA. We can find more data to support this conclusion. We do have some comprehensive and apparently reliable figures for British joint-stock banks. In 1884, the *Economist* estimated they held about £46 million of various forms of British government securities, and that of this slightly under £40 million was in gilts[136]. One can imagine that insurance companies might have held similar amounts. But that is still far from the total volume of CA. Further, we do have snippets of evidence that demonstrate that banks and insurance companies did hold substantial amounts of both RA and NR[137].

The general opinion was that gilts were held primarily by trusts and very cautious individuals. There are certainly many examples of both classes, as is shown throughout this paper. It would be nice to know what fraction of various gilts, and in particular of CA, was held by such investors. But for the purposes of this paper, that is not essential. It is enough to show that there were many long-term gilts holders who owned CA. In an economically rational world they would all have switched from CA to RA or NR during periods of CA overpricing. That they did not demonstrates the main point of this paper, that the market was inefficient.

60 Individual investors

That CA should not be dominated by short-term traders is certainly consistent with all the anecdotal evidence, ranging from Victorian fiction to press accounts of inheritances and lawsuits. CA was held very widey, and apparently was often the main source of income for many people. The 1841 census of Great Britain showed 511,440 "Persons returned as independent," although we don't quite know what that means ([87], p. 57). The next census, of 1851, provided a more detailed listing of "Annuitant," with 23,394 men and 122,702 women falling in this category ([87], p. 154). While we still don't know exactly how many of them relied primarily on gilts income, these snippets of information do support the popular notion of substantial classes living off ther national debt holdings, and thus with motivation to be very interested in them.

The previous sections showed that of the plethora of accounts in major gilts, most were of modest size, and that the distribution of sizes did not differ much between CA, RA, and NR. (We do find different distributions for some of the minor gilts.) That serves to dispose of the argument that CA was more valuable since it was used by speculators for their operations. Most of the accounts had to be from small holders.

Far more definitive results about gilts ownership and turnover will likely emerge from examinations of the Bank of England archives. But even without that, we can find extensive evidence that there was a lot of CA in the hands of individual owners, not trustees, who therefore had incentives to shift from CA to RA (or NR). Ordinary fiction literature from that period, which often mentions CA, cannot be relied upon, since, as was discussed in the main paper and is covered in more detail in Section 64 here, CA, or Consols, was often used to denote any of the major gilts. However, we can rely on newspaper reports about

lawsuits, which often present details of bequests being litigated, or estates of bankrupts being liquidated[138]. (Legal publications are also a source of such information.) Here we present a sample of data from auctions of financial instruments.

There were several auctioneers who specialized in facilitating sales of various types of financial property, in particular reversionary interests (ownership of gilts, joint-stock company shares, insurance policies, etc., that paid off on the death of the owner). As one example, consider the full column of ads from the firm of Shuttleworth and Sons in *The Times*, 1 March 1850, p. 12. They noted the firm had been in this business since 1803, and was conducting monthly auctions of reversionary interests. The ads in that issue were for an auction of such securities to be run that day in London. (The same firm also has ads on that page for various other items, primarily related to real estate, to be auctioned off later.) Of the reversionary interest items listed, the major gilts items were tallied. In cases where only part of an account was being sold, as when the ad offered "[t]he Reversion to One-third of [£5,776.175 of CA], receivable on the decease of a lady aged 68, provided a gentleman aged 49 survive her," the full account value of £5,776.175 was counted. This produced 6 items of CA, for a total of £19,236, one item of RA for £3,350, and 3 items of NR, for a total of £3,407. One could obviously select a larger sample if one wanted a statistically significant result. But at this point it does not appear necessary, as this example, chosen at random, and at first sight not much different from other ads, which almost always had a mix of CA, RA, and NR, demonstrates there were many individuals owning CA.

61 The minor gilts

Both the main paper and this one deal primarily with pricing anomalies involving CA, RA, and NR, with some limited consideration of N35 and R35 during the 1831–44 period. These were the "major gilts" of the 1831–88 period. All had large capital, and had trades recorded in the *CoE* almost every day. But there were many other British government securities, a few dozen, in fact, that existed for at least part of this period. Authoritative information about them can be found in [92]. They are called in this paper the "minor gilts." Each had small total capital, few investors, and traded infrequently. This section and the next one describe a few of them, present some fragmentary data about their prices, and argue that a thorough investigation of their market record would illuminate the evolution of British finance and might help provide insight into the overpricing of CA.

At a simple technical level, the level of activity of the minor gilts could be used to construct a model for major gilts that might enable us to estimate the number of transactions that took place in the latter. Right now we have just the prices in the *CoE*, and it appears that in most cases a single price may have come from several trades. For almost every one of the minor gilts, though, there was usually just one price on each of the rare days that it traded, so it seems reasonable to assume there was just one transaction. Since we do have records of the capital and number of accounts in each gilt, we could extrapolate from the minor to the major gilts. However, given all the uncertainties in this procedure (such as possibly varying investor populations, not all trades being reported to the *CoE*, ...), it is probably better to try first to get data on trading from the Bank of England archives.

At a deeper level, a study of the mispricing of the minor gilts relative to each other, and to the major gilts, might provide insight into the crowd psychology that distorted gilts valuations. The main manuscript has a brief comparison of the overpricing of CA when compared to RA, and of N35 when compared to R35, in the 1831–44 period when both pairs were traded. The two overpricing series were correlated, but far from perfectly. It seems worthwhile to investigate the relation of those two series in more detail, and to look at all the other pairs of gilts, to see if some common patterns can be discerned.

A serious question that is very relevant in this context concerns the degree to which low liquidity justifies lower valuation. This principle is widely accepted in general. But to what extent is it justified when dealing with risk-free government bonds? As we'll see below, 19th century British gilts market gave different answers at different times.

The Gladstone 1853 national debt reforms gave birth to C25, the 2.5% annuity that was cited briefly in Section 23 and will be considered in more detail below. It also swept away several minor gilts. Let us consider some pricing data for three of them:

- B1726 = annuities of 1726, paid the same 3% interest as CA, on the same days. Nominal capital on 5 January 1853 was £0.676 million[139].
- SN = New South Sea annuities, paid the same 3% interest as CA, on the same days. Nominal capital on 5 January 1853 was £1.998 million.
- SO = Old South Sea annuities, paid the same 3% interest as RA, on the same days. Nominal capital on 5 January 1853 was £2.775 million.

(There were few accounts holding these securities, although that was not reported systematically. For example, on 5 January 1833, there were 447 holders of B1726[140].)

Many investment guides noted that at least some of these minor gilts usually traded at a discount to the corresponding CA or RA. Thus the 1838 edition of [24] noted that B1726 was normally 1-2% below CA, "[f]rom the smallness of this capital, and the consequently limited amount of business." However, a book published in 1843 claimed that CA and RA carried higher prices than the minor gilts "because Government will always find more difficulty "in paying off" these stocks than others of smaller amount" ([17], p. 187). (In the end, the holders of B1726, SN, and SO who refused Gladstone's conversion offer in 1853 and were paid off in early 1854 gained about 10%, since CA and other gilts had dropped in price by then! That the claim about easier redemption of the minor gilts would show up in a book published in 1843 might be a reflection of the declining interest rates of the time, and thus the growing likelihood that a redemption might indeed be carried out. Such a move was not likely in 1838.) But actual numbers show some interesting patterns.

In 1844, there were 78 days when at least one of B1726, SN, or SO was reported as trading in the *Course of the Exchange.* Only the final price for each day was used for this study. On 57 of those days, both CAm and RA traded, and the average overpricing of CAm over RA (after adjusting for accrued interest) was an insignificant 0.002. On the other hand, for the 21 days with trades of B1726, the average underpricing relative to CAm was 0.9%. For the 39 days with trades in SN, the average underpricing relative to CAm was 1.2%. And for the 29 days with trades in SO (there were actually 30, but one did not have a price for RA), the average underpricing relative to RA was also 1.2%. Thus all

three of these minor gilts were priced rationally relative to each other, and the consistent underpricing relative to CA or RA could be attributed to lack of liquidity.

Another study was undertaken for 1850. Like 1844, it was a placid period, with low interest rates. CA overpricing relative to RA, which was fairly low at the beginning of the year, disappeared by summer. This study found 96 days with some trades recorded for at least one of B1726, SN, or SO. (There were actually 97, but the 15 February 1850 entry was ambiguous, so was discarded.) This time, for SN and SO this study used the average of the prices that appeared (there were just 13 days, in each case with two prices), and for CAm and RA used the average of the low and high prices that were published in *CoE*. For 82 days of those days, both CAm and RA prices were available, and they showed (after compensating for accrued interest) CAm overpriced relative to RA by an average of 0.191, or 0.2%. B1726 was underpriced relative to CAm by an average of 0.86%, SN relative to CA by 0.74%, and SO relative to RA by 0.64%.

By comparison, during the somewhat more turbulent 1849, there were 12 days with prices recorded for B1726 and 19 for SN, and they showed average discounts relative to CAm of 2.2 and 2.7%, respectively. (Tables show overpricing of CAm relative to RA of about £0.61 in 1849, and £0.21 in 1850.) Thus 1849, a year of relatively high CAm overvaluation relative to RA, was also a year of substantial undervaluation of B1726 and SN. On the other hand, 1850, a year of minor discrepancies in pricing of CAm and RA was a year of much more modest underpricing of B1726, SN, or SO. This certainly suggests that liquidity was just one factor, and probably not the most important, in the underpricing of the minor gilts compared to CA.

What about the argument cited above, that the minor gilts were at a discount to major ones because the government would be able to redeem them more easily? It certainly sounds persuasive, and the 1853 Gladstone scheme did redeem B1726, SN, and SO (although holders had an option to convert into C25 and another gilt), whereas the holders of CA and RA were only offered that conversion on a voluntary basis. However, if that was so, why was the discount on B1726, SN, and SO lower in 1850, when conversion appeared as a serious prospect (as shown both by press coverage, and the premium on NR over RA) than in 1849, when the prospects seemed considerably more gloomy?

Section 23 used some data for C25, the 2.5% annuities that, apparently almost uniquely among the non-CA gilts in the period before 1888, have been investigated in modern literature, cf. [42, 46]. They were created as part of the Gladstone conversion attempt of 1853, and started trading in January 1854. Interest on them was payable on the same days as for CA. They were not redeemable until 1894, but given the low coupon rate, that should have had negligible effect on their pricing. At the beginning of 1860 the total nominal capital was £2.98 million, held in 698 accounts[141]. (The capital was higher, about £10 million, during the period in the early 1880s considered in Section 23. Closing quotes were given for it in the *Economist* for every trading day at that time, whereas they were not covered systematically by that paper through the 1870s.) In 1870, Lowe wanted to get rid of them, but in the 1880s, other Chancellors of the Exchequer moved to increase their capital in order to get a gauge of market rates in preparation for reduction of interest on the major gilts.

If C25 and CA were perpetual risk-free annuities without any possibility of redemption, rational pricing would call for the ratio

$$6 \times C25/(5 \times CA)$$

to be almost exactly 1. As was noted in Section 23, this ratio was higher than 1 in 1883–84, almost surely primarily because of growing expectations that CA would be redeemed. (There were even some voices predicting that interest rates would drop below 2.5%, and C25 would also be redeemed, but those seemed to be fringe opinions.) But the relative behavior of C25 and CA prices in earlier periods was quite different.

Table 11. Market prices of Gladstone 2.5% annuity compared to Consols.

year	days C25 traded	average ratio of C25 to expected
1854	38	1.032
1855	29	1.007
1860	40	0.997
1862	54	0.989
1863	38	0.991
1864	32	0.966
1865	46	0.961
1866	29	0.953
1867	55	0.969
1868	41	0.969
1869	33	0.968
1874	24	0.967

Market prices for C25 were collected for 1854–55, 1860, 1862–69, and 1874. The main results are summarized in Table 11, and the raw data is available in the auxiliary tables. The "days C25 traded" entry is the number of days for which *CoE* reported any activity in C25[142]. In almost all cases only a single price was given, on a few occasions there were two, and once there were three. For each such day, the average C25' of reported C25 prices was compared to the closing price of CAm, and the ratio $1.2 \times C25'/CAm$ computed. The last column in Table 11 presents the average of that ratio for each year.

The number of transactions was low, so it seems that only 5-10% of the accounts in this security were involved in market transactions each year. Still, there is enough data to draw some conclusions. In 1854, the slight premium on C25 was likely the result of

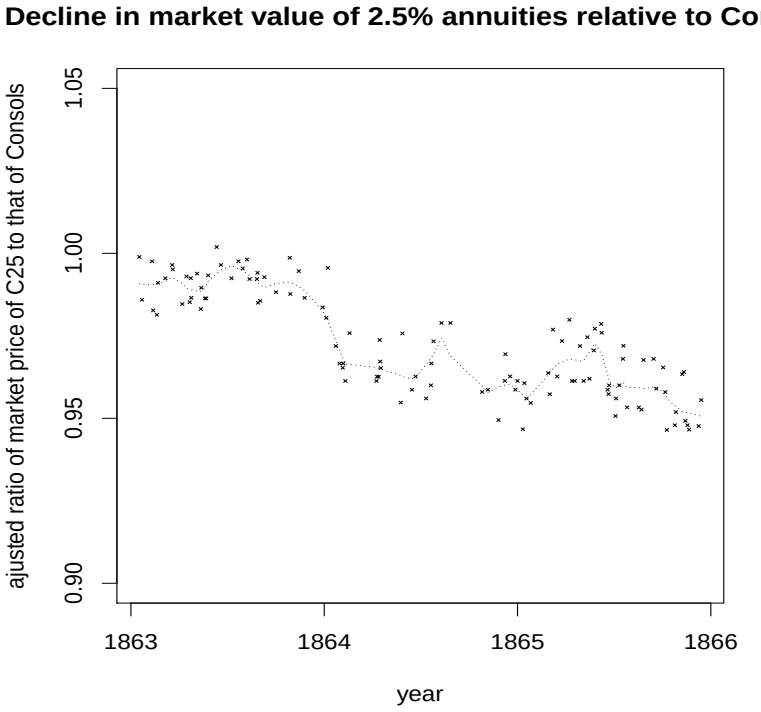

Fig. 12. Average daily price of the 2.5% annuity divided by 5/6 the price of Consols in 1863–65. The scatter plot represents actual values, the dotted line a smoothed version of the plot.

the expectations held for much of 1853 that there was a high likelihood interest rates would continue declining, and that CA would be redeemed. In 1855 and 1860, the average ratio is close to what would be expected in a rational market in which C25 and CA were irredeemable. Not only that, individual trade prices seemed to be close to that standard. For 1860, a more careful study was done in which the average price of C25 for each day was compared to the average of the low and high prices of each day (when C25 traded) for CAm. That ratio varied only over the range 0.985 to 1.010 (and its average was 0.997, same as when using closing prices for CAm). Hence, if rational pricing applied (which we know was not true for CA relative to RA), the closeness of the observed ratio to the theoretical one suggests that if there was some underpricing of C25 because of their lower liquidity, it was almost exactly counterbalanced by the premium for C25 because of the low likelihood of their being redeemed. (CA, with average price of 94, including accrued interest, during those 40 days, might reasonably have been expected to have some danger of redemption, if interest rates dropped. On the other hand, the essentially negligible premium that NR enjoyed over RA that year, just £0.04 on average, in spite of 14 years of call protection, suggests that redemption was not being treated seriously by investors.) This seems rather unlikely, and it is more probable that investors and jobbers just fell into the habit of thinking of C25 as being worth exactly 5/6 as much as CA, and of both being irredeemable.

This relation of almost perfect equivalence of C25 to 5/6 of CA started to waver in 1862–63, and broke down decisively in 1864, when C25 dropped in market value compared to CA. After that, it appears to have stayed down for some years. (The transition to C25 being higher than 5/6 of CA, observed in 1883, has not been studied.) What is interesting is that the drop was abrupt, involving just a few transactions in late January 1864. Fig. 12 shows all the 116 ratios for 1863–65, with the lowess function in R used to draw the smoothed curve. No discussion of this drop has been found anyplace in the contemporary press. (And in general, C25 was hardly ever mentioned in the press.) One could easily explain a jump in prices of C25 relative to those of CA as reflecting expectations the latter security might be redeemed in the near future. But it is hard to think of any rational reason for a drop.

The main manuscript discussed the very substantial increase in CA overpricing relative to RA (and NR) that also took place in 1864. However, that jump took place later, in the spring of 1864, so is very hard to connect it to the changes in C25 pricing.

Clearly the data cited above is too limited to draw any firm conclusions. But it does suggest that the discount on minor gilts, as compared to the major ones, was a reflection more of mass investor psychology, possibly influenced by general economic stress and uncertainty, than of any liquidity and redeemability concerns. More intensive studies appear justified.

Yet another interesting case, one that leads naturally to the next section on terminable annuities, is that of C50, the 5% annuities of the mid-19th century. They originated in the refunding of 1830, paid £2.50 on 5 January and 5 July for each unit of nominal £100, and could not be redeemed until 5 January 1873. Given the interest rate environment post-1830, it should have been clear to everyone that they would be redeemed in 1873 (as indeed they were). At the beginning of 1854, the total capital was just under £0.5 million, held in 231 accounts[143]. Naturally, with so few holders, there was little turnover. The *CoE* records 8 trades in 1842, none at all in 1843, 2 in 1844, 14 (with 2 on the same day) in 1848, and 10 in 1860.

In early 1850, the financial environment was very placid, with low interest rates. We find two transactions in C50 on 9 April and 11 April at 122 and 125, respectively. Such large differences when the market as a whole was not changing suggest a substantial market inefficiency. Further, this security appeared to be persistently undervalued by a significant amount. For example, in 1851, an even more placid and prosperous year than 1850, there were 9 trades (on 8 days), at prices ranging from 122 to 125. With the market yield on CA around 3.1% throughout the year, conventional valuation of this security (as a 5% bond maturing in January 1873) suggests it was undervalued by at least 5%.

62 Terminable annuities

The undervaluation of the 5% annuity cited at the end of the previous section seems to reflect a general distrust, dislike, and lack of information about terminable annuities. These securities, which consist of a finite number of fixed payments, with no repayment of principal at the end, were frequently used by the British government, but only in modest amounts. Perhaps the most common use was in raising large loans. In the Crimean War

loan of 1855, discussed in the main manuscript, for example, the bidders had to provide £16 million in cash in return for £16 million in CA and a terminable annuity. The bidding (or negotiation, as there was just a single bidder, a syndicate led by the Rothschilds) was then about the amount of that annuity. Terminable annuities were never a very large part of the national debt, with their capitalized value between 1815 and 1871 never exceeding 10% of the total[144].

Occasionally investors were provided with solid information that conforms to our valuation standards. As was argued in the main paper, NR consisted of a perpetual 3% annuity that was essentially identical to RA, plus a guarantee against redemption until October 1874, plus a terminable annuity of 0.25% per year that expired in October 1854. This was stated, and a valuation was provided, in *The Times* of Monday, 11 March 1844. (The Goulburn proposal was presented to Parliament on Friday evening, 8 March.) While *The Times* did not get into the mechanics of compound interest and annuity valuation, it was very explicit about its method, specifying that a 3% discount rate was used. (One could argue that a somewhat lower rate was appropriate. While the market yield of CA was only a bit under 3%, this may have been artificially high because of potential for redemption in CA as well as the N35 and R35 whose interest was getting reduced.) This part of the entire financial column was reprinted in numerous places, for example, the *Leicester Journal* of 15 March and the *Newcastle Journal* of the following day. *Bankers' Magazine* also reprinted it in its April 1844 issue and prefaced it with the comment that "[t]he talented Editor of the City Article in the *Times* observes that, ..." This seemed to imply that the *Bankers' Magazine* writer thought the computation was an uncommon feat. A similar impression is obtained by the coverage of the issue in the *Birmingham Gazette* on 11 March, which describes its value estimate as one "which has kindly been calculated for us by a gentleman of the Stock Exchange well versed in such matters." On the other hand, other publications gave similar estimates without any comments, as if they were routine ones. (For example, the *Spectator* on Saturday, 9 March, the only one that has been found so far that was this quick, and the *Morning Chronicle* of the following Monday.) We can be fairly sure there were several independent computations, since the valuations all came in (in the old English system) at 2 pounds, 2 shillings, but included either 6, or 7, or 8 pence.

The basic principles of compound interest and valuation of annuities were well understood, at least among experts, and covered in a variety of publications, such as [7]. There was also a growing recognition that discounting at a fixed rate was not always appropriate. Thus, for example, we find the 1825 book [83] that studid historical pricing of terminable annuities and argued for a more flexible rule for valuing them. What is especially interesting about [83] is that it was apparently published through a subscription (not uncommon in those days) that involved the Governor of the Bank of England, the Chancellor of the Exchequer, the London Stock Exchange, and most of the famous bankers (Barings, Rotchschilds, ...) and share brokers of the period. This shows that the markets were getting more sophisticated, and major players were willing to invest some money into research on developing a more systematic understanding of the financial instruments they were dealing with. But there was no clear concept of term structure of interest rates, and no clear view that anything like it existed, given the limited number of debt instruments on the market.

As far as the general investing public (which was just a small fraction of the total public, and so with much more sophistication, and presumably hardly any illiteracy), they had little to guide them. Let us consider Long Annuities, the ones that had the largest capitalized value, and were most prominent. They expired in January 1860, and towards the end of their life paid out about £1.3 million per year. (After a modification of terms in 1786, they paid £0.50 on 5 April and 10 October, with a final terminating payment of £0.25 on 5 January 1860.) There were about 10,000 accounts in this security in the early 1850s, so holdings were far smaller than in the major gilts[145]. These annuities traded frequently. For example, in 1850, there were just 46 days when they did not show up in *CoE* (in addition, of course, to the two months when they were "shut"). Yet when we perform discounted cash low analysis of Long Annuities, using the market yield on CA (after stripping away accrued interest) as the interest rate, we find that the market price as a fraction of that value varied from close to 1 in October 1834, October 1844, and October 1852, down to 0.83 on 15 October 1847 (just as the crash of 1847 was accelerating) and still just 0.91 in October 1848. Taking one day in each of April and October (the Friday after Long Annuities started trading after being "shut") from 1831 to 1858, we find the average of this ratio was 0.95, so Long Annuities were underpriced by 5%. (One could argue that they may have been underpriced even on some occasions when the ratio was close to 1, as in October 1844 and October 1852, since at those times the market yield on CA likely reflected to some extent the possibility of redemption, just as during the 1880s, cf. [46].)

Investors did not get much help valuing Long Annuities. Section 16 presented the *Daily News* coverage of 1848, which implied rather strongly that these annuities were undervalued at the time. An earlier case, with a more emphatic message, was found in *The Times* in 1839. The business column of that paper claimed that

> There is no subject on which the public are more imperfectly informed than on the value of terminable annuities relatively to stock, or fixed annuities, and they consequently often purchase them at a higher or sell them at a lower, rate than they ought to do, while more experienced calculators reap the advantage of their ignorance[146].

It then proceeded to give a lengthy and not very clear prescription on how to value Long Annuities in comparison to CA or the 3.5% annuities (with the implicit, and clearly false, assumption that the latter should be worth exactly 7/6 of CA). But this was an exceptional case, in general investors were left on their own[147]. For example, the 1821 investment guide to the gilts [13] does list Long Annuities, and gives some basic facts about them, such as their amount, but offers no guide at all to valuing them. Of later guides that were popular in mid-century, [24] has a little more information about details of transactions, but also nothing on valuations, while the 1840 and 1854 editions of [56] do not even tell the reader when the interest is payable. But even [75], which is the most detailed about Long Annuities, says nothing that would tell a potential investor whether they are worth purchasing.

Another example of the market not valuing terminable annuities properly is provided by the Deadweight Annuity. It was owned exclusively by the Bank of England, and it paid a bit less than £0.6 million per year, expiring in April 1867. During the July 1839 crisis that

is mentioned briefly in Section 26, the Bank tried to auction off all or part of it. According to rumors (as reported by the financial column of the *Morning Chronicle* from middle to the end of July, which had more extensive coverage of this affair than *The Times*), 15 or 16 bids were received, but the highest was for £17.125, and so none were accepted, as the Bank wanted to get £18. At that time the market yield on CA was a around 3.25%, and a value of £18 corresponded to a discount rate of about 3.5%, while £17.125 would have yielded about a 3.8% rate of return. The *Morning Chronicle* (which opined that the Bank was just trying to influence the market, and was not going to sell any of the Deadweight Annuity) argued that a good price was about £16.25. Based on the current market price of Long Annuities, it extrapolated to a price of £16.75 for the Deadweight Annuity, and argued that that should be discounted by about £0.50 to compensate for the lower liquidity.

The topic of terminable annuities is one that deserves a much more detailed investigation. One obstacle is simply the sheer volume of material that would have to be looked at. There was extensive discussion of such instruments as ways to handle the national debt. Many argued that perpetual annuities, such as CA and RA, made it too easy for the government to tolerate high levels of the national debt, and that a switch to terminable annuities would compel more effective reductions in what was felt was a barely tolerable burden. Hence there were extensive debates inside and outside Parliament, and they should be investigated to see how sophisticated they were and what they imply about British policy makers and investors[148]. Some participants in the debates argued that terminable annuities were more expensive than perpetual ones, and so they may have made some observations on market valuations.

There were also extensive British government operations that moved funds held by the government for savings banks and other institutions in the form of major gilts into terminable annuities. (There are summaries of them in [92].) The precise terms and the justifications for such moves should be examined.

Any investigation of terminable annuities has to take into account the fact that the full payment on them was taxable, even though it was partially a return of capital (as many critics continued pointing out in various forums). Thus the level of the income tax (which was abolished after the Napoleonic Wars but reintroduced in the early 1840s), and fears and anticipations of that level rising, must have played a role in the valuation of these instruments.

63 Causes of gilts mispricings

The usual rationalizations offered by contemporaries for CA overpricing are not credible. Even if speculators or banks preferred CA, that could only have caused the price of CA to rise relative to RA if other holders of CA refused to switch to RA. And, as we have seen, there were plenty of such holders. Liquidity in RA was more than adequate for the vast majority of investors. And the notion that RA and NR were the "quieter Stocks" (in the words of *The Times* of 1870) is simply incorrect, they were just as volatile as CA.

Modern thinking would tend to look for causes of gilts mispricings in government action. But it is hard to make a credible argument along those lines. As was mentioned in

the Introduction, a high level examination of the financial moves of the British government shows that in an economically rational world, they should have served to reduce CA overpricing. More detailed examination of policies of various government and quasi-government bodies in sections 38–40 shows that while some agencies, such as the Court of Chancery, were pursuing irrational investment strategies, the government itself was largely rational in selling overpriced CA and buying underpriced RA and NR, which should have reduced the pricing anomaly. While the government did take advantage of the mispricing, it had no incentive to maximize it, as its main goal was to have a liquid market with low interest rates in order to be able to borrow easily in emergencies. The changes it introduced, or tried to introduce, were aimed in that direction, and culminated in the Goschen conversion that produced a single security.

As another argument absolving the government from responsibility for CA overpricing, we find that the prospect of a government move, or an actual move, led to greater pricing rationality. This was true on occasions such as the Lowe conversion proposal of 1870, or the Childers moves in late 1883 and in 1884, both detailed earlier. Once those moves were gone, irrational pricing resumed.

Finally, the 19th century was in many days the heyday of *laissez faire,* with widespread suspicion and disdain for government. Yet we do not find contemporary observers blaming the government for gilts mispricing. All they could think of were the liquidity and speculative funds arguments cited above. Hence it seems safe to conclude that the government was not the cause of the observed mispricing. So we have to look for the reasons elsewhere.

There were surely many contributors to gilts mispricings. Even though there was a very sophisticated financial market, many of the investors appeared to be uncomfortable even with basic arithmetic. This mattered, since there was no large mutual funds or pension funds industry, and so decisions were being made by large collections of individuals. Furthermore, they made investment decisions infrequently. Although the volume of gilts was huge, turnover was low. So most of them did not have an intimate knowledge of how the Stock Exchange functioned. In the English market, there was the complication that prices of gilts were quoted with accrued interest. As a result, to compare CA to RA, it was necessary to have some knowledge of just how prices varied over time. Perhaps the reason the Irish market for gilts appeared to be slightly more rational than the English one in the late 1840s (see Section 15) was that in Dublin prices of gilts were quoted without accrued interest. (The essentially identical pricing of RA and NR after 1860 may be due to interest on them being payable on the same days, so their prices could be compared easily.)

There was widespread suspicion and ignorance of that market. The "financialization" that is often talked about was still in the early stages. As Karl Marx, Max Weber, Werner Sombart, Karl Polanyi, and others have pointed out, capitalism required not just institutional, but also sociological changes. (See [74] for some modern treatment of this issue.)

The approach to investments, especially of trusts, was extremely conservative. As has been documented by many scholars, British investors were slow to put their funds into novel types of ventures (aside from mania periods). The heavy presence of CA in various trusts (discussed in various sections of this paper), as well as the rarity of NR, may often

have reflected simply the nature of the original donation, often made decades earlier, and left untouched.

The basic conservatism of British society was reinforced by prejudices involving money. Some ways of making money were more acceptable than others. Gilbart, the banker and prominent writer on banking who was quoted in Section 54, wrote ([33], vol. 1, p. 77) that "[i]t is not deemed creditable for a bank to speculate in the funds, or to buy and sell stock frequently, with a view of making a profit by the difference of price." This might be taken for fluff. However, there is evidence that the Victorians were influenced in their financial decisions by non-monetary considerations. As just one example, one can consider railways splitting their common shares into A and B shares. This was an accidental innovation of the late 1840s. Yet, even though it showed an obvious way to "unlock shareholder value," to use a popular modern term, it took several decades before it became widespread, as the prejudice against something that seemed to encourage speculation was very strong.

It is likely that the principal-agent problem was a contributor to the reliance on CA by charities and general trusts. As many contemporary observers noted, trustees were often negligent in performing their duties. It was common for a change in investments by a trust to require the consent of the beneficiaries, but those beneficiaries could not compel trustees to make a change.

Still, while all these reasons likely contributed to the (economically) irrational overvaluation of CA, they do not seem to provide a plausible way for this overvaluation to arise. There had to be something that made British investors value CA more than RA or NR.

Most likely that missing factor was one that Giffen himself noted in his 1877 book [31] for another security. Before concluding that CA overpricing was "a species of customary appreciation of which a distinct account can hardly be given," he discussed market prices of Bank of England shares. He decided they were overvalued on the basis of fundamentals, and maintained their market price because of

> the extraneous value some securities come to acquire through their giving a status or some such advantage. It is, for instance, 'respectable' to hold bank [i.e., Bank of England] stock, as giving an ownership in the national bank, and – the list of holders being published – as an indication of the wealth of the holder. No poor man can afford to hold bank stock: and important city firms who wish to have a partner in the bank direction, or to be in a certain kind of credit, will accordingly invest in bank stock when they would not otherwise do so.

It appears possible that a similar effect operated to distinguish CA from RA and NR. It may be that as the 19th century progressed, the word "Consols" acquired an exalted status, and also that to a large extent it came to encompass all gilts. (That would not explain the apparently frequent mispricings that occurred before 1823, though.) A simple example of that is connected with the Post Office Savings Bank scheme allowing customers to purchase gilts that was discussed in Section 44. Many newspapers hailed it as offering a chance for the small savers to invest in CA (although many others listed all three major gilts). The *Glasgow Herald* was unusual in that it went to some lengths to explain that it was not just CA that could be invested in, but also RA and NR, which were "almost identical save in name" to CA, all three "following each other very closely in fractional rises or falls in the

market; so that they not only yield the same annual interest, but afford almost precisely the same chance of profit or loss of principal when they are sold"[149]. What is interesting here is that this paper felt it had to explain that RA and NR were not inferior to CA, but seemed to be unaware that they were in fact superior, about 1% less expensive than CA. (They thus offered slightly higher rates of interest. Further, as we know in retrospect, they provided higher capital gains if held until the Goschen conversion of 1888. The prospects of such a conversion, and its necessarily higher payoff for RA and NR than for CA, were something that it would not have required any special leaps of the imagination for investors to realize, since interest rates were declining, and CA was close to par.) There is some discussion there of more quantitative studies that would map how usage of various words and phrases changed over time. Similar studies with modern media, press, TV, email, Twitter, and the like, are beginning to yield interesting insights into diffusion of information and opinions. With a growing corpus of digitized material from the 19th century, we might be able to obtain some insights into what led British investors to place irrational valuations on gilts.

The scenario sketched above, or CA assuming a higher status than RA and NR in the minds of investors, is consistent with much of the evidence we see of market action. For example, the preference for CA was very deep, as even large additional supplies of it (as in the loans of 1847 and 1855–56) had only modest and short-lived effects in suppressing its overpricing. Prospects of government moves that would eliminate the distinction between CA and RA served to reduce CA overpricing, but only temporarily.

Generally changes in CA overpricing were not sudden. Further, in quite a few cases CAm* - RA* increased after a financial shock (such as the crises that led to the suspension of the gold standard in 1847 and 1866), but again at a measured pace. One could imagine this might be the result of dialogs such as the following (purely imaginary) one:

- Investor: Please sell £1,000 of my RA holdings, I need the money to pay for an extension to my house.
- Broker: But why don't you sell CA instead? It's more expensive, you will not need to sell as much of it.
- Investor: But I prefer to keep my CA.
- Broker: It's your choice, but you would only need to sell £995 of CA to get the same cash as £1,000 of RA would give you.
- Investor: Well, if the difference is just £5, I would rather keep the CA. My friends all tell me it is the best investment.

Turmoil in the markets, or some wild rumors going around, might then have led to increased preferences for CA, so that our imaginary investor might not change his or her instructions even if the difference was £10. Such a scenario would help explain the slow changes in CA overpricing (along with slow communication in the 19th century). Most investors would not have rushed to change their investments, only the marginal customers would have increased or decreased the pressure on the supply of CA.

While the above scenario is purely imaginary, it might be possible to test its plausibility with more material and the improved tools that are being developed for textual analysis.

Much more intensive study of 19th century materials, both printed, and in personal correspondence, government or bank archives, and other sources, is also desirable to il-

luminate a striking phenomenon associated to gilts mispricings. That is the existence of several communities that had divergent views on gilts valuations. This is covered mostly in Section 66.

64 Consols, mass psychology, branding, and other network effects

It is possible that a change took place in the most common figures of speech, so that people from the middle of the 19th century on tended to say and write Consols in situations where earlier they might have said "funds," "government stocks," or something similar. That might have made them identify the safe government securities with CA, and regard other gilts as being of somewhat uncertain and therefore inferior status, one worth a fraction of a percent to avoid.

Section 44 referenced the Post Office starting to sell the major gilts (CA, RA, and NR) in late 1880. It cited the *Glasgow Herald* as a newspaper that felt it had to explain to its readers that RA and NR were just as good as CA (without noting, and perhaps without even being aware, that they were superior). Here we cite a few other instances connected with the introduction of this service that graphically illustrate the degree to which CA became a synonym for all the major gilts. The sales of gilts by the Post Office had been advocated long before they were authorized by Parliament in the 1880 session. Without making an exhaustive search, we find that in 1872, a question was raised in the House of Commons by Thomas Hughes as to whether the Postmaster-General "intended next Session to bring in a Bill with the object of placing Consols within the reach of small investors through the agency of the Post Office." Did Hughes really mean just CA? Or did he use CA as a shorthand for any gilt? Or did he even know the difference? That is hard to tell, although perhaps a more detailed investigation of that person's speeches and writings will shed some light on the issue.

Nothing was done in 1872 about Post Office handling gilt investments, but the issue was not forgotten. In the 1880 session in which such a measure was enacted, it was again first mentioned in the form of a question by Henry Fawcett, the famous blind (in the literal sense of the word) economist, politician, and reformer. He inquired whether the government intended "to introduce any measure to afford greater facilities for the investment of small sums in Consols"[150]. Later that year, Fawcett was placed in charge of the Post Office, and proceeded to push through a number of reforms, including sales of gilts. The first draft of the 1880 law (presumably written by Fawcett himself) actually allowed investments in CA only[151]. At some point on its passage through Parliament, this was changed. The law as it was enacted allowed investments in any gilt at the direction of the depositor[152]. In early 1881, Fawcett authored a pamphlet on how the Post Office could facilitate savings by the population, of which about a million copies were distributed free [26]. This pamphlet discussed only investment in "government stocks," without mentioning any by name, not even Consols.

When the Post Office regulations for gilt investments were announced in early November 1880 (as operations of this service were to start on 22 November), there was extensive press

coverage. Many papers reprinted at least a summary of the regulations as issued, and those explicitly listed CA, RA, and NR as eligible investments. However, many of the general stories or leaders mentioned just CA, and sometimes even the title of the story indicated that just CA was involved[153].

During that time, *The Times*, still a uniquely prestigious and influential press organ, had a leader on the more general issue of declining interest rates and prospects of the economy[154]. It talked only of CA, and said the new Post Office service (whose anticipation was being given credit for lowering interest rates) "will enable Consols to be purchased for sums not less than ...." The *Standard,* another London daily, first had a leader praising the new measure ("one of the most useful products of last Session"), in which the three main gilts were listed explicitly as equal options. But then, two days later, it had another leader, this one prompted by the appearance of detailed Post Office regulations, which referred just to CA, as a measure "under which the thrifty poor may become holders of Consols"[155]. These examples illustrate the surprisingly large extent to which CA came to mean all gilts.

The Post Office gilts accounts are just one of many examples we can cite. Up until the middle of the 19th century, investment guides such as [13, 24, 25] were full of detailed information about various gilts. But as time went on, and the range of investments offered on the stock exchanges grew, the space devoted to gilts declined, to the stage that in the 1870 book [9] there is just a brief discussion of "English government stocks" as the safest but low-yielding investments, without even enumerating them by name. A few years later, the 1876 book [22] appears to mention neither RA nor NR, and while it devotes pages 126–36 to historical record of "English Funds," the section is subtitled "Principal Events affecting Consols since 1800," and only CA is discussed. Thus as investment horizons and activities widened with time, gilts receded, and only CA retained some prominence.

As yet another illustration of the strong hold that CA had on the public imagination, consider James Hall Nasmyth (1808–90) [58, 53], a pioneering mechanical engineer who built a flourishing business based on his inventions, and then retired early, while still in his 40s, and devoted himself to astronomy and other scientific pursuits. If his fortune at retirement was the same as at his death (about £240 thousand [53]), it represented about 0.03% of his country's GDP, equivalent to about $5 billion for the U.S. or £500 million for the UK today. In his autobiography, he wrote ([58], pp. 372–73):

> I may mention that when I retired from business, and took out of it the fortune that I had accumulated during my twenty-two years of assiduous attention and labour, I invested the bulk of it in Three per cent Consols. The rate of interest was not high, but it was nevertheless secure. High interest, as every one knows, means riskful security. I desired to have no anxiety about the source of my income, such as might hinder my enjoying the rest of my days in the *active leisure* which I desired. I had for some time before my retirement been investing in consols, which my dear wife termed "the true antibilious stock," and I have ever since had good reason to be satisfied with that safe and tranquillising investment. All who value the health-conserving influence of the absence of financial worry will agree with me that this antibilious stock is about the best.

Did Nasmyth invest all his money in CA? Or was he using CA as a synonym for all major gilts? Without finding his accounts (and the ones in gilts are likely available at the Bank of England), we cannot be sure, but in either case this passage does demonstrate how CA dominated public discourse in late 19th century Britain. (It also reflects the overwhelming desire for safety and stability, which was an impediment to the development of the economy, but that is another topic we leave aside.)

An even more extreme example, one that is rather surprising, is that of Cornelius Walford (1827–85), a prominent expert and writer on insurance [53]. In his *Insurance Cyclopaedia* [95], the entry on CA starts off by noting they "represent[ed] the largest portion of the funded debt of the British Empire." But then it goes on as if they were the only significant part, and claims that when the nominal debt of the UK reached its maximum in 1817, it was all in CA. Walford must have known better, but this slip of the pen seems indicative of how CA became a synonym for all gilts. Yet another example comes from an 1863 book ([8], p. 38):

> In some odd way or other a dockyard appointment has come to be regarded in much the same light as the inscription of one's name for Consols in the books of the Bank of England.

One does not find similar expressions with "Consols" replaced by "Reduced," which likely reflects the special status that CA attained in the popular imagination.

Still, one has to be careful of anecdotal evidence. We can also find strong preference for CA in earlier times. For example, a legal treatise from 1839 praised the Court of Chancery for using just CA for the funds under its control, and claimed that "[i]t therefore appears clear that trustees and executors should, unless otherwise directed, invest their trust-monies in [CA]" ([98], p. 28).

However, one can collect quantitative evidence to support the observations about growing predominance of CA. A primitive form was mentioned above, in the discussion of investment guides, where CA came to dominate discussion of gilts. But we can do more. For example, as was suggested by Michael Hancher, we can use the Google books Ngram Viewer to look at frequency of occurrence of words and phrases in books published in various periods. (This service looks at a frequency with which a word or phrase occurs in a given period as a fraction of all words or phrases found in the given period.) A comparison of "consols" and "Consols" shows that references to both together grew steadily, with a large jump in the late 1850s. "Consols" became more popular than "consols" in the mid-1840s, and was exclusively responsible for the jump in the late 1850s. The increased predominance of the capitalized form of the word likely indicates greater prestige being attached to it. This has to be treated with some caution. For one thing, capitalization norms were changing. Further, there was an increasing number of "consols" that were not gilts, as this term (which, after all, was just an abbreviation for "consolidated annuities") was also being used for railway, mining company, and foreign government securities. Also, the literature represented in the Google books Ngram Viewer is primarily that of books, and so says little about newspaper usage. Still, the results are suggestive. Other comparisons yield similar results. For example, pairing "Consols" with "public funds" shows the latter (which was a frequent designation for gilts and a few other securities, such as shares in the

Bank of England) declining slightly, while the former grows. More sophisticated searches are likely to produce more conclusive results.

65 Automated scanning

The preceding section introduced the notion of quantitative analysis of 19th century literature in order to shed light on gilts mispricings. This appears very promising, in either fully automated, or semi-automated fashions, and should enable us to do for the period what is being done today in studies of the press and more informal information communication media, such as Twitter, blogs, and so on.

British newspaper and other periodical literature of the 19th century is huge. As of the time this is written, in April 2014, it appears that under 10 million pages of newspapers from that period have been digitized. That is a small fraction of the total, and the British Newspaper Archive, which right now has about 7.5 million pages, is aiming for 40 million. Hence in a few years we can expect a substantial increase in the volume of material that is available. However, even the material that has already been digitized could be used in far more productive ways with some minor technical software development, provided the organizations that control the digital versions cooperate.

Many of the newspapers that are being scanned are in poor physical condition. As a result, available digital images are hard to read, and automated OCR (optical character recognition) software often produces gibberish. However, in the study of CA overpricing, say, these deficiencies could be remedied to some extent with modest effort. The key words are fairly distinctive, and if the bit images from the scanning project were made available, could be searched using specialized pattern-matching algorithms. The word "consols" was used almost always for CA (with occasional appearances of phrases such as "Cons. Three per Cent. Ann."), and when utilized for other securities (such as Carthew Consols, or Polsaith Consols, both mines) it could be distinguished. RA would introduce slightly more ambiguity, but NR should also be easy, as it was almost always designated as "Three-and-a-Quarter per Cents." between 1844 and 1854, and as "New Three per Cents." afterwards (or minor variants on these). Searching for such patterns in bit images would surely produce much better matches than going through text produced by conventional OCR.

Once appearances of terms designating CA, RA, and NR are identified, the next issue is to discard the overwhelming majority of them, those that are simple price reports. Even current digital versions of 19th century newspapers, when searched using existing user interfaces, produce an overwhelming number of "hits," simply because the names of those major gilts occurred so often. However, most of those occurrences are just price reports, which show up either in tables or in some common styles in financial columns. (See the paragraph from *The Times* in Section 58 for an example.) It should be easy to identify such cases automatically. That ought to dramatically reduce the search space, to a level that could be handled by human investigators.

Aside from newspapers, books, pamphlets, official government reports, and eventually even the diaries and correspondence archives will hopefully be scanned and made available for automated searches.

66 Mapping information flows and divergent views

Access to more digitized material and improved search tools should enable us to get a better sense of how financial information diffused through society, and in particular how it was possible for different communities to have varying views on the values of gilts. Who noticed gilts mispricing, what did they say or write about it, and how did they react? What were the roles of the press and other communication media in disseminating information?

Section 18 presented a simple study of press coverage of gilts mispricing at the end of 1854. Extensive presentations on the subject by the *Morning Chronicle* did not find any response in the rest of the press. But when *The Times* chimed in, many other papers echoed it, and the British public was exposed on a far larger scale to the observation that the market was producing irrational prices. Perhaps with more digging (say in diaries of brokers) we may eventually learn something deeper. It may be that the *Morning Chronicle* did stimulate some investors to switch from CA to NR, and perhaps it was such market action that spurred *The Times* to publish its note. At the moment we have just the limited knowledge cited here. As more newspapers become digitized, and search tools improve along the lines mentioned in the section above, we might even obtain a better idea of how newspapers reacted to that market anomaly.

In some cases even currently available databases enable us to obtain a deeper sense of how some people and organizations reacted to gilts mispricings. The *Aberdeen Journal* issues of 1860 were examined for possible discussion of gilts mispricing. (This was prompted by some intriguing finds in automated searches.) At that time, this paper was one of the largest and most influential in the North of Scotland. It was published on Wednesdays, and usually had 8 pages. It typically had a full column (of which there were 6 per page) devoted to the latest news, obtained by telegraph. These included London Tuesday closing prices or closing quotes for the major gilts and major railways, and various news items, usually culled from London dailies published on Tuesday. On another page each issue of this paper carried the Tuesday closing quotes from the Aberdeen Stock Exchange. Usually below that, there was a section entitled "The Money Market" which was always a substantially condensed version of the Bankers' Gazette section from the *Economist* of the preceding Saturday. The telegraphic news column must have been prepared largely by someone in London, as transmission costs would not have allowed for sending anything long. (However, there may have been some minor editing at the main editorial office in Aberdeen.) "The Money Market" section may have been prepared entirely in Aberdeen, as the *Economist* would have been received there by Monday.

For us, the interesting observation is that both the telegraphic news column and "The Money Market" section did cite the gilts pricing anomaly. During the April through July 1860 period for which the *Daily News* financial column was examined (see Section 20), there were two Tuesdays when CA overpricing was explicitly mentioned, on 10 April and 12 June. In both cases, the telegraphic news section of the *Aberdeen Journal* reprinted those citations. Given the limited space available for the telegraphic news, this surely indicates that the London correspondent regarded the issue as newsworthy, deserving of wider publicity.

"The Money Market" columns quite frequently, but not always, reprinted the passages from the *Economist* about RA and NR being better investments than CA, including the emphatic message from the 17 November issue, "[w]e must must again call attention to the great disparity in price between [NR and RA], compared to [CA]"[156]. Thus this newspaper, which by necessity had to select a very small fraction of available material for publishing, did find the CA overpricing of sufficient public interest to devote substantial space to it. For this to happen, there must have been at least two people who thought the issue a substantial one. One was the London correspondent, responsible for the selection of the material to be telegraphed to Aberdeen. The other was William Forsyth [53], the editor of the paper.

Much more research along these lines can be carried out. Ideally, it will incorporate source materials from a variety of sources, including handwritten diaries and correspondence. For the next few years, though, most of the material that will become available is going to be newspapers. Therefore it will be necessary to pay attention to the balance of viewpoints. The financial columns of newspapers, which is where most of the press material in this manuscript comes from, were written by people who were generally more sophisticated than the general investor population. However, even some of their columns may reflect divergent viewpoints, say when they responded to letters from readers. (An example of that is the passage from the *Morning Post* cited in Section 27.) In addition, we should be able to find many more letters to the editor, asking about gilts pricing, as well as some leaders, such as the one in *The Times* that is reprinted in Section 1. In addition, reports of shareholder meetings of joint-stock companies, or of management boards of charities or joint stock companies, might yield records of discussions about gilts investments.

Investigations of this nature should shed light on how mass psychology interacts with markets. They might be able to utilize the insights that are being derived from studies of modern markets and modern media.

Notes

[1]For example, the financial column, the "City article," of *The Times*, 14 Feb. 1870, p. 7. That column said that it was "an important fact that the change is one that will not cost the nation a shilling," although later, in a slightly schizophrenic turn, admitted the change would involved for the taxpayers "some little pecuniary cost." See Section 2 for more on this issue.

[2]*The Times*, 11 February 1870, p. 7. The correspondence itself was published in *Parliamentary Papers* 1870 (4) XLI.105.

[3]At that time, it does seem that the opinion was split. For example, the *Money Market Review*, 12 February 1870, p. 163, in its comments on Lowe's proposal, claimed that it had been advocating quarterly interest payments for a long time. By the 1880s, their value was much more widely appreciated, to a substantial extent because of the popularity of various

new securities that offered this feature. Hence had Woodham lived to write a leader on either the Childers or the Goschen conversion proposals, he likely would not have been skeptical about the importance of quarterly payments.

[4]See, for example, the article "Mr. Lowe and the debt" in *Saturday Review,* 19 February 1870, pp. 235–237, or a later piece in that same press organ, "The conversion of the national debt," 25 February 1888, pp. 231–232.

[5]*Morning Post*, 14 February 1870, p. 4.

[6]*The Times*, 11 February 1870, p. 7.

[7]*Standard*, 12 February 1870, p. 4.

[8]*Devizes and Wiltshire Gazette*, 17 February 1870, p. 3.

[9]*Economist*, 19 February 1870, pp. 217–18. For criticism, see, for example, *Lincolnshire Chronicle*, 18 February 1870, p. 4.

[10]For example, *Western Daily Press* noted that "[t]he sittings in both Houses of Parliament last night were very brief, and the business does not call for special remark."

[11]*Money Market Review*, 12 February, p. 163 and 19 February, pp. 187–88; *Bankers' Magazine*, March 1870, pp. 193–96.

[12]*Saturday Review*, 19 February 1870, pp. 235–37; *Economist*, 19 February 1870, pp. 219–20.

[13]*The Times*, 16 February 1870, p. 10; 17 February, p. 5; 21 February, pp. 4, 7; 22 February, p. 7; 24 February, p. 5.

[14]*Daily News*, 14 February 1870, p. 5.

[15]*The Times*, 15 February 1870, p. 8.

[16]*Standard*, 21 February 1870, p. 2.

[17]One of the few exceptions was a note in the financial column of the *Pall Mall Gazette* of 11 February 1870, p. 5, that "[s]ales of [CA] are taking place, and [NR and RA] are being purchased on account of the consolidation proposals of the Chancellor of the Exchequer." This was just before Lowe's speech, and so the "consolidation proposals" were likely deduced from Lowe's correspondence with the Bank of England that had just been published. Nothing was said in that report in the *Pall Mall Gazette* about CA being overpriced, or whether relative prices of CA and RA had moved as a result of the transactions being reported.

[18]The *Economist*, 9 July 1869, p. 815.

[19]Details are in "Telegraph Act (1869). Return showing the total amount of consols or other stock ...," *Parliamentary Papers* 1870 (267) XLI.809.

[20]This action brought a complaint from the *Economist,* 12 February 1870, pp. 185–6. In a leader entitled "How far should the monetary operations of the Exchequer be secret?," this publication complained that "[t]he Chancellor of the Exchequer is the greatest banker in the country," yet was able to operate with no oversight or public notice.

[21]See, for example, the financial column of *The Times*, 13 April 1870, p. 7.

[22]The *Economist*, 8 Jan. 1870, p. 38.

[23]"National debt. Copy of correspondence between the Chancellor of the Exchequer and the governor of the Bank of England relative to the national debt," *Parliamentary Papers* 1870 (4) XLI.105.

[24]There were dissenting voices, of course. A letter to the *Morning Post,* 12 March 1844, p. 2, claimed government had no right to redeem any of the annuities unless it had cash in hand to pay for them, an obvious impossibility. It claimed that in the United States, Russia, and Prussia, "the public credit is held inviolate; but England and France, it seems, are too refined for such scruples." The inclusion of the U.S. among the faithful creditors in this list likely made many readers question the author's credibility. At that time, Americans were regarded in Britain as immoral reprobates, since many individual states were in default on their debts, and a few had even "repudiated" those debts, by finding technicalities that were claimed to excuse them from paying back even the principal.

The press also carried numerous complaints of how the lowering of interest rates was going to hurt small investors.

[25]The references for this passage are all in *The Times*: 13 March, p. 7; 22 March, p. 3; 23 March, p. 3; 23 March, p. 7; and 25 March, p. 3.

[26]*Hansard's Parliamentary Debates,* ser. 3, vol. 73, 1844, cc. 735-6.

[27]*Financier*, 2 June 1874, p. 3, reprinted in an abbreviated form in *Leeds Mercury*, 2 June 1874, p. 4.

[28]*The Times*, 25 August 1831, p. 5.

[29]*Spectator*, 27 July 1839, p. 702.

[30]*Spectator*, 12 October 1844, p. 970; 30 November 1844, pp. 1137–38; 14 December 1844, pp. 1185–86; 21 December 1844, p. 1208; 4 January 1845, p. 9; 25 January 1845, p. 82; 12 April 1845, pp. 347–48; and others.

[31]*Spectator*, 13 July 1844, pp. 658–59; 30 November 1844, pp. 1137–38; 17 May 1845, p. 465; 13 December 1845, pp. 1186–87; 11 April 1846, p. 346.

[32] *The Times*, 3 December 1846, p. 3

[33] *The Times,* 26 February 1847, p. 3.

[34] Appendix No. 34 to "Secret Committee on Commercial Distress Second Report, Minutes of Evidence," *Parliamentary Papers* 1847–48 (584) VIII Pt.I.505.

[35] The *Economist*, 20 February 1847, p. 212. The attacks by *The Times* were printed in its financial column on 12 and 19 February.

[36] "Select Committee on Operation of Bank Acts, and Causes of recent Commercial Distress," *Parliamentary Papers,* 1857–58 (381) V.1, p. 33.

[37] "Return of Number of Stamps issued at One Penny to Newspapers in United Kingdom, 1837–50," *Parliamentary Papers* 1852 (42) XXVIII.497. This does not count some publications, such as *Punch*, which were not classified as newspapers, and so escaped both the heavy taxes this entailed, and the detailed scrutiny that provides us with rather reliable circulation statistics.

[38] Mackay was initially the political and literary editor, and then, in 1852, became the main editor.

[39] *Parliamentary Papers* 1847-48 (196) XXXIX.571; 1864 (341) XXXIV.395.

[40] *Freeman's Journal,* 19 December 1849, p. 3; *Parliamentary Papers* 1841 Session 1 (410) V.5, especially testimony of Robert Murray, q2892ff.

[41] *Parliamentary Papers* 1852 (42) XXVIII.497.

[42] It should be noted that Dublin gilts prices were often available in London papers, such as *The Times.*

[43] Occasionally there were items with the same title on other days of the week, typically on Saturdays, but those usually had just reports of prices of various types of merchandise in many markets.

[44] *Daily News*, 6 December 1849, p. 7.

[45] The *Economist*, 12 Nov. 1859, p. 1271.

[46] This was in the 28 April 1860 issue. The other comments in the rest of this section are taken from the issues of 23 June 1860; 7 July 1860; 14 July 1860; 18 August 1860; 17 November 1860; 8 December 1860; 11 May 1861; 29 June 1861; and 19 October 1861, in all cases from the "Bankers' Gazette" section of the *Economist.*

[47] *Economist*, 2 February 1861, pp. 114–15.

[48] Starting on pp. 632, 693, 720, 727, 754, 878, 937, and 1471.

[49] *Standard*, 12 February 1883, p. 6.

[50] *The Times,* 13 November 1883, p. 11. Many other papers carried the official notice, or had news stories about it.

[51] However, there seemed to be some confusion on this issue. See, for example, the letter cited in the financial column of *The Times,* 30 August 1884, p. 11.

[52] It should be noted that in January 1888, just before his grand conversion and redemption proposal, Goschen offered investors the opportunity to voluntarily convert their major gilts into Local Loans stock. The terms of the conversion, which involved an open auction, had slightly different terms for CA than for RA and NR, cf. *The Times*, 11 January 1888, p. 11.

[53] Hubbard was just one of many. As another prominent proponent of this view was Robert Hogarth Patterson (1821–86), "journalist and writer ... [who] gained a reputation as a financial expert, and was consulted by the Bank of England and the Bank of France on financial and currency questions" [53]. He wrote ([71], p. 674) that the magnitude of the major gilts was such that "[t]hey cannot be dealt with in part."

[54] *The Times*, 29 August 1889, p. 4.

[55] *The Times*, 1 Sept. 1883, p. 4.

[56] *The Times*, 5 May 1884, p. 6

[57] *The Times*, p. 11, *Daily News*, p. 5, and *Morning Post,* p. 4, for example.

[58] *The Times*, 9 April 1853, p. 3.

[59] *The Times,* 11 Jan. 1888, p. 8.

[60] *Daily News,* 25 April, 1859, p. 7.

[61] *Morning Chronicle,* 28 April, 1859, p. 2.

[62] *The Times,* 20 April 1861, p. 11.

[63] *Aberdeen Journal* of 10 April, p. 5, had a note that arrangements to end the "shuttings" were about to be adopted, and said that "the measure will be of much importance in facilitating the business of the country."

[64] *The Times*, 24 June 1861, p. 12.

[65] *The Times*, 25 June 1861, p. 10/

[66] For example, *The Times*, the "City article" in issues of 5, 6, and 7 January 1888, all on p. 11.

[67]See the leader in *The Times*, 9 January 1888, p. 9, and the official notice of the auction in that same paper, 11 January, p. 8

[68] *The Times*, 22 March 1843, p. 7.

[69] "Savings Banks and Friendly Societies Fund. Copy of a letter addressed to Mr. Chancellor of the Exchequer, on 14th June 1875, by the controller of the National Debt Office on the subject of the Savings Banks and Friendly Societies Funds," *Parliamentary Papers* 1875 (261) XLII.665.

[70] *Morning Post*, 6 February 1865, p. 8.

[71] *Western Daily Press*, 17 April 1876, p. 3.

[72] *English Mechanic and World of Science*, vol. 37, 8 June 1883, p. 323.

[73]20 July, p. 466 and 17 August, p. 562.

[74] "In a village Post Office," *All the Year Round,* vol. 63, 1 September 1888, pp. 205–208.

[75] *Economist*, 16 March 1867, pp. 302–303.

[76] *Saturday Review*, 19 February 1870, pp. 235–37.

[77] *Standard*, 6 January 1875, p. 6.

[78] *Leeds Mercury*, 26 July 1876, p. 4.

[79]See pp. 42–43 of [60]. As that writer noted, "[f]ew budgets have presented so remarkable a picture of miscalculation."

[80] *Parliamentary Papers,* 1870 (4) XLI.105.

[81]As another example, consider the diary [6] of Edward Hamilton, who was one of the top assistants to Goschen around the time of the 1888 debt conversion [35]. It appears that the basic scheme was planned out by Goschen alone, without any serious discussions with people like Hamilton.

[82] *Hansard's Parliamentary Debates,* ser. 3, vol. 126, 1853, cc. 822–23.

[83] *Economist*, 7 May 1864, pp. 575–76, "The influence of increased education upon the stock market."

[84]It is listed in the references as being from 1848, since that is how it is listed in several several library catalogs, although, that of Cambridge University, gives the date of publication as 1855. However, internal evidence shows it was published much earlier. It discusses the 3.5% annuities as among the main currently trading gilts, so it could not have been published later than 1844. The nominal outstanding capital it lists for for various gilts

appears to come from *Parliamentary Papers* 1837 (155) XXXIX.1, so it was most likely published in 1837 or 1838.

[85] *Leeds Mercury*, 15 February 1865, p. 2

[86] *Spectator,* 17 Nov. 1877, pp. 1442–43.

[87] *Examiner*, 8 Dec. 1877, pp. 19–20.

[88] *Truth*, 1 Nov. 1877, p. 524.

[89] *The Times*, 10 December 1880, p. 7.

[90] The *Economist*, 27 October 1860, pp. 1174–75, "The most important circumstances which affect the present value of the funds."

[91] Furthermore, they continued to pay more than CA. The *Belfast News-Letter* of 19 October 1875, p. 3, remarked that one could still get 0.75% more on that security than on CA, and so it deduced: "Moral—Sell Consols, and buy Turkish Loan, guaranteed by England and France."

[92] *The Times*, 25 March 1872, p. 6. The financial column of *The Times*, 1 August 1870, p. 7, was surprised by this earlier.

[93] "The money market and the rate of interest," *Economist*, 27 May 1854, pp. 558–59. This piece was widely reprinted.

[94] The *Economist*, 18 May 1861, pp. 566–67.

[95] *Spectator*, 27 July 1872, pp. 941–42.

[96] "English and American railways," *Spectator*, 25 August 1860, pp. 808–809.

[97] *Parliamentary Papers* 1870 (52) XLI.213.

[98] Quote from *Leeds Mercury,* 16 March 1850, p. 4. The ultimate source of the quote was apparently Lord Brougham, a famous politician of that era, a leading law reformer, and a wit famous for his eloquence and shart tongue.

[99] The *Economist*, 6 February 1864, pp. 162–63.

[100] *Parliamentary Papers* 1850 (538) LI.235.

[101] *Parliamentary Papers,* 1846 (208) XXXVIII.351 and 1847 (139) LXIII.221.

[102] Thus the financial column of *The Times* of 12 July 1844, p. 6 mentioned that "[t]he Government broker continues a purchaser, and took both [CA and RA] at advanced prices." The *CoE* also sometimes listed this broker's purchases. On 19 April 1873, the *Economist* wrote that "[o]n Tuesday the Government brokers commenced buying [RA and NR] for

the sinking fund, on which account [£1.624 million] has to be invested during the current quarter." The *Economist* of 30 July 1870, p. 943, argued that it was foolish to spread the purchases evenly over a quarter, and that the Commissioners for the Reduction of the National Debt should be clever enough to engage in effective market timing.

[103] *Parliamentary Papers* 1875 (261) XLII.665.

[104] *Parliamentary Papers* 1870 (52) XLI.213.

[105] *Parliamentary Papers* 1870 (222) XLIV.639.

[106] *Parliamentary Papers,* 1852-53 [1559] XLIV.1.

[107] However, there was a period from 1864 to 1871, when proceeds of some substantial property sales were parked in gilts before being reinvested back in real estate. At the peak, interest in gilts brought in around 10% of total revenue, see Appendix VIII of [43].

[108] Drawn from *Parliamentary Papers,* 1872 (15) L.283; 1873 (21) LIV.413; 1874 (63) LV.15; 1875 (295) LV.377; 1876 (150) LXX.1; 1877 (165) LXXVIII.1; 1878 (161) LXVIII.201; 1878-79 (295) LXVI.1; 1880 (186) LXIX.1; 1881 (216) LXXXV.1; 1882 (187) LXV.1; 1883 (147) LXVI.1; and 1884 (205) LXXV.1.

[109] *Parliamentary Papers* 1881 [C.3006] XXIX.583, p. 27. There were also some liquidations, which are not shown in this table. The next few reports in this series do give the total amount invested by customers in gilts, but without providing separate figures for CA, RA, and NR, so they provide no useful information for us.

[110] By the mid-1880s, gilt investments by customers of the Post Office Savings Bank averaged about £80, as opposed to about £15 for regular savings accounts.

[111] Based on weekly figures from the *Economist*, for the 20 Fridays from 19 November 1880 to 1 April 1881.

[112] *Parliamentary Papers* 1889 [C.5850] XXVIII.573.

[113] *Parliamentary Papers* 1884 [C.4073-III] XXXIX Pt.IV.1, p. 124.

[114] "Friendly societies, industrial and provident societies, and trade unions. Reports of the Chief Registrar of Friendly Societies, for the year ending 31st December 1881. Part I.–(A)," *Parliamentary Papers* 1882 (373) (373-I) (373-II) LXVI.1, 97, 177, p. 24.

[115] *Parliamentary Papers* 1883 (340) (340-I) (340-II) LXVIII.613, 679, 757, p. 12.

[116] The *Economist*, 14 April 1888, pp. 467–468.

[117] *Era*, 24 February 1850, p. 6.

[118] *North Devon Journal*, 26 June 1879, p. 5.

[119]For example, in his testimony before the 1878 London Stock Exchange Commission, George Cawson, a jobber who deal in foreign government bonds, thought that possibly not much less than half of the business in his securities might be done that way, [91], Q5519ff. It seems reasonable that if that was the case for foreign securities, it might be even more true for gilts, which traded more frequently, although lower jobber markup on gilts might have decreased the incentives to bypass them.

[120]The best source on the information that appears to be summarized in *CoE* is the testimony of J. H. Daniell, the government broker, before the 1878 commission that investigated the London Stock Exchange[91].

[121]See, for example, the Giffen paper [29] or his testimony to the Stock Exchange Commission in [91] and reprinted in [31]. Also, see the *Economist*, 6 October 1883, pp. 1160–61 and 5 April 1884, pp. 411–12.

[122] *The Times,* 9 March 1844, p. 4.

[123] *Pall Mall Gazette,* 24 February 1870, p. 6, letter of W. R. Smee.

[124]However, the income tax should be considered in evaluating pricing of terminable annuities, which are discussed briefly in Section 62. This tax was applied to the full payment from such annuities, which were partially repayments of capital.

[125]The *Economist*, 10 March 1888, pp. 307–8.

[126]See [86], p. 14 and [78], p. xxxii, as well as the ad of the Marvel, Geary, and Co. brokerage firm in *Herapath*, 20 Jan. 1849, p. 49.

[127]The potential losses were illustrated well by the Gladstone conversion of 1853. By the time the various minor gilts that were subject to redemption were paid off at the beginning of 1854, interest rates had risen by about 10%.

[128]The small but substantial minority who refused, and were paid off a year later, were winners, as long term interest rates rose in the meantime.

[129] "Report from the Select Committee on Communication between London and Dublin; ...," *Parliamentary Papers*, 1852-53 (747) XXIV.611.

[130] *Daily News*, 19 August 1848, p. 4.

[131] *Parliamentary Papers* 1878 [C.2157] [C.2157-I] XIX.263, 295, pp. 35-6 of testimony.

[132] *Parliamentary Papers* 1870 (4) XLI.105.

[133] *Parliamentary Papers* 1872 [C.669] LXIV.23, p. 261.

[134]The Accountant General of the Court of Chancery showed turnover of only about 14% in 1861. He handled about 25,000 accounts, of which about 19,000 had gilts in them, [89],

p. xvii. Since about 75% of the gilts investments were in CA (see Section 39), we can guess that he had about 12,000 accounts with CA. Thus about 8,000 transactions per year involving 12,000 accounts again suggests that most of those accounts had no transfers in a typical year.

[135] *Parliamentary Papers* 1861 [2895] LXII.397, p. 200. However, these were likely just the accounts at the Bank of England, and so excluded the ones at the Bank of Ireland.

[136] The *Economist*, 25 October 1884, pp. 1289–90, "The amount of government securities held by banks." The source used by this paper, which was the semi-annual statistical compilation of finances of joint-stock banks, did not distinguish between different government securities. As a point illustrative of the lack of solid knowledge among financial journalists, the *Daily News* had earlier that year estimated that perhaps £200 million of gilts was in the hands of country bankers, 8 August 1884, p. 2.

[137] For example, the *Salisbury and Winchester Journal* of 12 February 1870, p. 2, had an ad from the Eagle Insurance Company reporting its financial results for the year to mid-1869, and at that time it had, among assets valued at £3.2 million, £200 thousand of nominal value of CA, and an equal amount of RA. The *Daily News* of 24 September 1884, p. 2, even claimed that "[NR] are the favourite stock among bankers."

[138] An illustrative case with somewhat different circumstances that can be quoted is presented in *The Times*, 2 November 1853, p. 11. It concerned many complaints against William Le Grand, a broker who absconded with his clients' money. One of those clients had ordered the purchase of £400 of NR. Another had requested sale of some CA and purchase of NR, for about £300 in each case. This case illustrates that there were investors of modest means who engaged in exchanges among the major gilts. However, by itself it does not provide us with any quantitative estimate of how frequently this happened.

[139] *Parliamentary Papers* 1854 [1843] LXVI.1. Many investment guides, such as the 1850 edition of [24], claimed that this security was "irredeemable, except by purchase," However, they were redeemed compulsorily at the beginning of 1854, and there did not seem to be any public controversy about this issue, so it seems safe to assume this claim was incorrect. This case provides another illustration of the low quality of investment information available to the Victorian public.

[140] *Parliamentary Papers* 1833 (202) XXIII.275. Thus accounts in B1726 were smaller, on average, than those in the major gilts. In general, there was substantial variation in account sizes among the minor gilts, which will have to be kept in mind in investigating their market prices.

[141] *Parliamentary Papers* 1861 [2895] LXII.397, pp. 197 and 200.

[142] There was one exception. On 7 June 1855, a trade was recorded in C25, while CA was already "shut." This entry was discarded.

[143] *Parliamentary Papers* 1854 [1843] LXVI.1.

[144] "National debt (terminable annuities). Return of the gross capital value of all terminable annuities ..., *Parliamentary Papers* 1871 (478) XXXVII.75.

[145] *Parliamentary Papers* 1854 [1843] LXVI.1.

[146] *The Times*, 25 July 1839, p. 5.

[147] Another instance occured in the financial column of the *Spectator,* 22 May 1847, p. 490, which pointed out that at the market price that prevailed then, purchasing Long Annuities gave a yield to maturity (ignoring taxes) of 5.5%. But that column just made this statement, and did not advise readers to invest.

[148] Some references in this area are the 1839 book by Richard Page [67] and the comments in the financial column in *The Times*, 30 July 1860, p. 7.

[149] *Glasgow Herald*, 19 November 1880, p. 4.

[150] *The Times*, 5 August 1872, p. 5 and 17 February 1880, p. 6.

[151] *Parliamentary Papers* 1880 (309) V.673.

[152] [27], p. 24. However, the Postmaster-General's (i.e., Fawcett's) initial regulations restricted investment to CA, RA, and NR only, *Daily News*, 3 November 1880, p. 5.

[153] For example, the *Newcastle Courant* of 5 November 1880, p. 4, had a leader entitled "Small investments in Consols," as did the *Belfast Morning News* of the next day.

[154] *The Times*, 4 November 1880, p. 9.

[155] *Standard,* 1 November 1880, p. 5, and 3 November, p. 5. It should be mentioned that on the former occasion, the praise was not just for Post Office sales of gilts, but also for other features of the law, which relaxed the limits on both the Post Office and other savings banks.

[156] *Aberdeen Journal*, 21 November 1860, p. 7. Other citations from the *Economist* to the same effect occurred in issues of 2 May, 18 July, 1 August, and 8 August.

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