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Graduate Institute of  
International and Development Studies Working Paper  
No: 01/2011

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Marc Flandreau

Graduate Institute of International Studies

Kim Oosterlinck

Université Libre de Bruxelles

## Abstract

The emergence of the gold standard has for a long time been viewed as inevitable. Fluctuations of the gold-silver exchange rate in world markets were accused to lead to brutal and unsustainable switches of bimetallic countries' money supplies. However, more recent work has shown that the option character of bimetallism provided a stabilizing feedback loop. Using original data, this paper provides support to the new view. Using quotation prices for Indian Government bonds, we analyze agents' expectations between 1860 and 1890. The intuition is that the spread between gold and silver bonds issued by the same entity (India) and backed by a credible agent (Britain) is a "pure" measure of the silver risk. The analysis shows that up until 1874 markets were expecting bimetallism to last. It is only after this date that markets gradually started requiring a premium to hold silver bonds indicating their belief that gold would eventually become the only metallic standard.

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# Was the Emergence of the International Gold Standard Expected? Melodramatic Evidence from Indian Government Securities

January 2011

Marc Flandreau (Graduate Institute, Geneva) and Kim Oosterlinck (Université Libre de Bruxelles)\*

## ABSTRACT

The emergence of the gold standard has for a long time been viewed as inevitable. Fluctuations of the gold-silver exchange rate in world markets were accused to lead to brutal and unsustainable switches of bimetallic countries' money supplies. However, more recent work has shown that the option character of bimetallism provided a stabilizing feedback loop. Using original data, this paper provides support to the new view. Using quotation prices for Indian Government bonds, we analyze agents' expectations between 1860 and 1890. The intuition is that the spread between gold and silver bonds issued by the same entity (India) and backed by a credible agent (Britain) is a "pure" measure of the silver risk. The analysis shows that up until 1874 markets were expecting bimetallism to last. It is only after this date that markets gradually started requiring a premium to hold silver bonds indicating their belief that gold would eventually become the only metallic standard.

Key words: Exchange rate regime, gold standard, bimetallism, credibility, silver risk  
JEL: F33, N20

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\*. The authors are grateful to Riad Rezzik for excellent research assistance. Comments and suggestions from participants in the exchange rates regimes session during the International Economic History Congress in Utrecht, August 2009 are gratefully acknowledged. We also benefited from comments of conference participants during the ASSA meetings in Denver, January 8<sup>th</sup>, 2011 and in particular from Chris Meissner, our discussant. Flandreau acknowledges financial support from Yves Mirabaud, as part of his generous funding of the Historical Imagination project.

Bimetallism used to be overly exciting. Miss Prism (a Victorian governess in Oscar Wilde's *Importance of Being Earnest*) makes sure that young Cecily does not read about the depreciation of the silver rupee for it is "somewhat too sensational" -- "Even these metallic problems have their melodramatic side", she adds.<sup>1</sup> Bimetallism is less lurid a subject today but certainly still exciting. The reason is that in the last 20 years, our understanding of the era before the making of the international gold standard has undergone a major transformation. Earlier wisdom assumed that the gold standard emerged naturally from the flaws of previous bimetallism. Among the main elements emphasized by supporters of this old view is the belief that fluctuations of the gold-silver exchange rate in world markets led to brutal switches of bimetallic countries' money supplies from de facto gold standard to de facto silver standard. Bimetallism was a knife-edge (Kindleberger 1984, Redish 1995).

This alleged inherent fragility would have been put to test in the 1860s and 1870s. A first shock was the increasing silver supply following discovery of Nevada's Comstock Lode in the early 1860s (bad news for silver). Another blow would have been German unification and changeover to a gold standard in the early 1870s, which would have made bimetallism unsustainable. Combine this with the supposedly greater transaction costs from using bulkier silver and one gets a lethal mix. These factors provided for a final crisis in the early 1870s causing a scramble for gold (Gallarotti 1995). In other words, the older view assumes that bimetallism was doomed and collapsed in a bang.

Other, more recent work has disputed this notion. It has been argued that the option character of bimetallism (it gave agents the right to pay in either gold or silver) provided a stabilizing feedback loop (Friedman 1990a, 1990b, Flandreau 1996, 2004). Supporters of the new view contend that this explains the remarkable stability of the gold-silver exchange rate in world markets until the early 1870s -- for three quarters of a century it hovered inside a narrow band centered on 15.5 -- France's legal ratio between gold and silver. Accordingly, the new accounts emphasize the pivotal role of France. Through arbitrage and speculation, France's provision of a bimetallic option led to stabilize gold silver exchange rate on global markets until a change in France's monetary regime triggered global dislocation of the earlier harmony between both metals.

Flandreau (1996, 2004) examines what he calls the "French crime of 1873".<sup>2</sup> He provides empirical evidence against traditional arguments about bimetallism. He constructs a general

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<sup>1</sup> . Oscar Wilde, *The Advantage of Being Earnest*.

<sup>2</sup> . Similarly, Friedman constructs a counterfactual measure of the effect of the "US crime of 1873" (i.e. the decision whereby future silver would be discontinued in the event of a resumption of specie payment, for at that date, the US operated a paper standard). He shows that maintenance of bimetallism in the US would have helped stabilize the price of silver in the 1880s.

equilibrium model of the world economy and shows that, neither rising silver output nor Germany's demonetization of silver were large enough shocks. He also shows that silver was bulkier but the main transaction cost in international shipments was insurance (based on value, not weight). Furthermore, as was the case in silver-based Hamburg where the central bank monopolized silver balances and cleared accounts, institutions were designed to minimize actual specie movements, making both metals close substitutes. Finally, countries' inability to cooperate on protecting bimetallism was what caused the emergence of the gold standard.

Thus, according to the new view, there were plenty of fundamental reasons for bimetallism to be credible – at least until France took the material step of forfeiting the bimetallic option clause, in effect preventing the mechanism on which bimetallism had rested before from being operative. The new view explains the collapse of bimetallism by political factors and makes it a more gradual process than other accounts. It took a political event, the Franco Prussian War, for Germany to acquire the adequate technology to move to gold. It took a political decision, by France, for silver to be demonetized. The War Indemnity inflicted by Germany to France had to be paid in gold currencies (mostly sterling) and was available in London. Germany now had gold for its circulation. Provided France would honor the bimetallic option, Germany could dispose of silver coins at a favorable price. But France retaliated by temporary rationing free silver coinage in the third and last quarter of 1873. This move, by limiting the option payment to silver coins already minted in late 1873, removed the market for demonetized Thalers, hampered German reform and triggered the beginning of a silver confidence crisis. Yet trust in silver was not lost in one day. Rather a fairly protracted process of policy spillover and network externalities led France temporary moves of late 1873 to eventually become permanent in 1876 when any further silver coinage was ruled out (Flandreau 1996, 2004).

One pending issue however is to determine what did the market think and how it did react before, during and after France's policy reversal. It is one thing to show that the French economy could buffer all the monetary shocks that occurred during the 1870s just like it had done earlier. It is another one to show that markets thought that way. In other words, as exchange crises have repeatedly shown, sound fundamentals are not enough to stall a run on a currency. In this article, we address this question using a new intuition. The intuition is that the spread between gold and silver bonds issued by the same political entity is a "pure" measure of the silver risk. As a result, monitoring the silver risk is a way to track the ebb and flow of silver credibility.

Curiously as it is, the Colonial Government of India offers an opportunity to catch global trends. First, India had both sterling and silver-based rupee bonds. Second, unlike many other countries that moved to gold in the early 1870s, India's rupee remained staunchly on the silver

standard and maintained the free coinage of silver and silver-convertibility of rupees until 1894 (Keynes 1913). Third, because the bonds had the same guarantees and were issued by the same government, they only differed in one critical respect, namely the silver exchange rate risk.<sup>3</sup> We conclude that any difference between the yield on gold and silver securities ought to be traceable to silver depreciation risk.

With this in mind, this paper looks at the fall of rupee, and tells young Cecily the episode she could not read. Using data on India's bonds, we construct an index of "silver risk" and study its behavior. By tracking its changes, we detect any confidence crisis confronting silver. And by combining this evidence with earlier evidence on the main events that led to the demise of silver, we relate in a meaningful way events and market anticipations. In other words, we provide here a piece of information that has been missing in revisionist accounts and complete the "new view" on bimetallism by adding an expectation dimension to it. In other words we provide a precise answer to the question of determining whether bimetallism was credible "before the fall".

This paper is related to previous work on silver risk and interest rates during the second half of the 19<sup>th</sup> century. Garber (1986) discusses the pricing of the bimetallic option. Calomiris (1992) surveys the effect of "silver risk" in convertibility resumption of the US dollar.<sup>4</sup> Oppers (2000) and Flandreau (2002) study the relation between exchange rates and silver or bimetallic currencies' short-term interest rates. However, no recent work so far has looked at the interest rate differential between India's gold and silver bonds, although this seems to be the best conceivable proxy for long-run expectations in silver prices.<sup>5</sup> Nor are we aware of any paper that has sought to analyze the credibility of bimetallism around the fall. Our focus on long run interest rates spreads before, during, and after the early 1870s when a massive regime change occurred breaks new ground.

At a broader level, this paper is relevant for research on the interest rate implications of regime changes. The relation between the historical decline of former international currencies and international financial stability is attracting renewed interest.<sup>6</sup> Reading current editorials on the imminent collapse of the US dollar as an international currency, one gets a sense that such disaster is bound to occur with a bang. Any notion of a hushed collapse would seem to be an oxymoron. Stories of US' unsustainable current account morphing into a global credibility crisis

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<sup>3</sup> . See Accominotti et al. (2010) for a discussion of default risk in British colonies.

<sup>4</sup> . An interesting, but less directly relevant contribution is the paper by Bordo et al. (2006) which looks at paper spreads after the end of bimetallism in an attempt to measure the default risk induced by currency depreciation in countries with a large gold debt. Note that our intuition differs from theirs in that we consider in the case of India that elimination of the default risk helps interpret gold-silver spreads as pure exchange risk.

<sup>5</sup> . Indeed, in order to measure silver risk, Garber (1986) relies on the spread between silver based Prussia (before 1870) or India (after that) and British consols.

<sup>6</sup> . See Eichengreen and Flandreau (2010) for a study of the rise of the US dollar in the 20<sup>th</sup> century.

dealt with sky-rocketing interest rates have been around for a while. The when and how of the decline of the greenback are unsure. History is a guide but precedents are few. The end of bimetallism, whereby the international role of silver was dismissed, is one.

The balance of the paper is organized as follows. We first organize a summary discussion of the history of bimetallism till the late 1880s (Section I). This horizon of 1890 is imposed by the fact that beyond that date, discussion of the transition of India to some form of the gold standard gained currency, meaning that rupee bonds were no longer a pure measure of silver risk, limiting the value of their use as a way to study the decline of silver. Section II discusses the intuition underlying this paper. It further provides evidence that this intuition was understood by contemporaries: they used rupee and gold bonds to speculate on the gold silver exchange rate. Section III surveys data sources and discusses the construction of rigorous silver risk measures. Section IV reports the results. We show that the French decisions of 1873 and 1874 took markets by surprise. We also find that, rather than destroying the credibility of silver overnight, it opened the door to a gradual process of diminished expectations. We rationalize this in terms of the succession of bad news for silver that started accumulating after that date. We end with conclusions. As we argue, our findings are consistent with the new view that there was a regime change in 1874 from a credible bimetallic regime to an international gold standard with no more role for silver.

## **Section I. What Cecily could have Read: A Refresher on Bimetallism**

In 1848, gold placers were discovered in Upper California. In the twenty subsequent years, the Gold Rush revolutionized the international monetary system as outstanding gold holdings trebled. Countries on the gold standard such as Britain were exposed. Some prominent economists such as Michel Chevalier (Cobden's co-architect of the famous 1860 free trade treaty) predicted that gold would collapse dragging gold currencies with it (Chevalier 1859). Some governments made moves to protect their economy against gold inflation. Belgium attempted to demonetize gold coins. By contrast, nations with shaky finances and unsound money, such as Portugal, took advantage of the gold rush to introduce convertibility on the cheap (Reis 1996). In India, where silver fulfilled a social role, fear that gold would displace silver led to the decision to introduce the silver standard in 1853.<sup>7</sup>

But the predicted collapse never occurred. Because bimetallic countries, with France at the center, allowed free coinage of both gold and silver, people started importing surplus gold in

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<sup>7</sup>. On these events, see Mertens 1944, Yeager 1976, Van der Eng 1999, Flandreau 1996, 2004.

French Mints. French demand for coins shifted from silver to gold and while this stabilized the price of gold, it released stocks of silver. Silver in turn found its way in silver standard countries whose money supply increased. At the end of the day, all countries' money supplies were increasing including bimetallic ones, which in the course of the process, became more gold intensive, in effect trading part of their silver for gold (Flandreau 1996).

In the early 1860s, this process of “bimetallic” arbitrage” started creating problems. In regions that were most exposed to international trade and financial flows such as Brussels or Paris, silver coins became scarce. And since silver formed the bulk of subsidiary coinage, problems were encountered in paying wages or performing other important daily transactions. Governments of bimetallic countries reacted by debasing petty silver coins so as to protect them from international arbitrage. However, the decisions having been taken in an uncoordinated way by Belgium, France and Switzerland, further problems were encountered as people who had been used to accept foreign coins in payment because they were identical to domestic ones, started discriminating, creating further disruption. The policy response was the creation of a Monetary Treaty between Belgium, France, Italy and Switzerland and the adoption of a common standard for subsidiary coins throughout what came to be known as the “Latin Union” (Einaudi 2001)

The success encountered by this (admittedly, limited) attempt at international monetary cooperation created an appetite for more “international action” (Willis 1901). In 1867 during the International Exhibition in Paris a world conference considered the possibility of a global monetary standard (Kindleberger 1989, Einaudi 2001). With gold pouring all over the world, and so many important trading powers having most or all of their circulation made of gold, gold was a natural. The conference voted for the 25 franc gold coin becoming the world monetary standard. Conveniently, this coin was worth about one British “sovereign” (i.e. one pound). Several countries however – most prominently Prussia and a number of German states – were silver based and warned of their inability to move on to gold. Even in bimetallic countries, there were concerns regarding how to get rid of outstanding silver coins. Elites and policy makers realized that, as far as exchange rate stability and global integration were concerned, the bimetallic regime had served the global economy quite well. Despite efforts in many countries (Jevons tried to persuade British authorities to operate a complete re-coinage of the British stock of sovereigns so that the pound sterling would be worth *exactly* 25 francs) grand schemes were eventually shelved and calls for global peace through commerce and monetary integration eventually gave way to war between France and Germany (Flandreau 2004).

War provided the impetus for the international regime change. With the indemnity imposed to France and which was to be paid in sterling bills, Germany had now the means to secure gold

from London. In 1873 it started swapping silver coins for gold in the London market, hoping that France would be the willing counterpart to these operations. But France, despite three quarters of a century of acting as the global arbitrageur of last resort, decided it would not help Germany with this one. On September 6, 1873 French Mints were instructed to limit silver coinage to a daily maximum of 280,000 francs (11,200 £, 57,000 USD). This maximum was further reduced to 150,000 francs (6,000 £, 30,000 USD) on November 19, 1873. Similar moves were made in Belgium.

Initially, French authorities emphasized that the rationing of silver coinage was not a statement about the bimetallic option. They were aiming, they said, at preventing Germany from abusing France again (Flandreau 1996). This theme was endlessly repeated between 1873 and 1876. The handwritten instructions given by the Minister of Finance, Magne, to the French government delegation at the Latin Union Conference in January 1874 provide one example:

“The metal silver, under the influence of a possible demonetization by North Germany, has undergone a depreciation over the past several months which is making it flow towards the minting houses of the four Union countries in abnormal quantities. This fact in itself being cause for attention, the Belgian and French governments, spontaneously and without prior understanding, limited the making of coins in their minting houses. It is a purely prudential measure which in no way prefigures a change in the monetary system itself. Its purpose, on the contrary, is to protect it from the consequences of an incidental circumstance and keep it intact in its normal form”.<sup>8</sup>

The emphasis on the need to protect bimetalism was not merely semantics. In fact “wait and see” was the name of the game for France’s policy makers between 1873 and 1876 (Flandreau 2004). An important aspect of the evolution that took place was that, despite descriptions suggesting there was a “scramble” to gold (e.g. Gallarotti 1995) the process whereby silver gave way and gold emerged as the dominant international standard was a gradual and fairly protracted one, that followed slowly if perhaps inexorably from France’s initial moves (Flandreau 2004, p. 199-209).

France’s decision to provide silver coinage with daily limits created bottlenecks in the production of silver coins. At the same time, that coinage was still possible acted as a parachute either directly, since it provided a demand for silver, or indirectly, since it signaled that bimetalism might not be doomed. In fact contemporaries with a memory could see the current moves as a replica of earlier behavior that had not led to the dismissal of bimetalism. In the past, countries had typically reacted to supply shocks of one metal by transitorily discontinuing

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<sup>8</sup> . Paris Mint Archive, Quoted by Flandreau (2004), p. 199.



coinage. For instance, the gold discoveries of the late 1840s and early 1850s had led to policy responses in Belgium or Switzerland with countries discontinuing gold coinage as a way to prevent “invasion” of their domestic circulation. Therefore, contemporary observers of the decisions to limit silver coinage in the wake of Germany’s sales may not have panicked. However, uncertainties on the future of silver led agents in France to seek to get rid of their silver coins (especially foreign ones). These coins were brought to the Bank of France at an increasing rate. Should silver be eventually demonetized, the Bank, not the public would bear the loss.

One additional complication of the 1870s was the collective action problem created by the existence of the Latin Union (Flandreau 2004). International treaties forced member states’ treasuries to accept one another coins at face value. But at the same time free coinage of silver was suspended, the prerogative to mint silver was transferred to governments and became a source of seigniorage. A free riding problem emerged. At the beginning of the 1874 Latin Union conference, Italian delegates stridently proclaimed they had no desire to rein in silver minting. However, the Bank of France managed to impose a quota to all member states by threatening to refuse foreign coins (as a private agent, it was not bound by treaties that committed public treasuries).

The Bank of France started lobbying French politicians for tighter checks on silver coinage. Annual limits were superimposed to daily maximums and French Mints were eventually closed to arbitrage through adoption of the Law of August 5, 1876 which put a halt to all fresh minting of silver in France. In the same year, France managed to impose the ban on silver coinage to the Latin Union at large. Existing silver coins were still legal tender in France, so that French policy makers could repeatedly emphasize that bimetallism was still “in principle” France’s monetary system. But this neutered bimetallism could no longer have any effect on the global price of silver (Flandreau 2004). As a consequence expectations of an eventual return to the former system, which still had supporters, remained.

The experience of France and the Latin Union suggests portraying the collapse of bimetallism as a slow motion accident. Supporting this interpretation, moves tended to be gradual rather than radical and it is only in retrospect that they turned out to be unidirectional. Holland for instance, did not authorize gold coinage after it suspended silver coinage in 1873 – as investors and governments monitored the monetary confrontation between France and Germany. As a result it found itself on an inconvertible standard that was neither gold nor silver (Mertens 1944, p. 279) leaving open until 1875 the possibility to eventually revert to silver. Likewise, the United States had committed the “Crime of 1873” by deciding that convertibility would eventually resume on a gold basis but as Friedman (1990a and b) has emphasized, this decision went for a long time

unnoticed because the United States were on an inconvertible paper anyway. Countries made somewhat uncharacteristic moves, which ended up being permanent, reinforcing each other through spillovers. From the late 1870s onwards, bimetallic campaigns were waged, starting with the International Monetary Conferences of 1878 and 1881. This may have persuaded speculators that silver still had slim chances to come back, slowing its fall. However, as one campaign failed after the other, and as silver output increased, the outlook for silver became more depressing every year (Russell 1898).<sup>9</sup>

It is in this background that the melodramatic history of the rupee Miss Prim did not want Cecily to study started. The Indian currency, squarely on a silver standard since the 1850s and as a result of France's agency, enjoying stable exchange rates against the pound was the one important currency that abstained from this slow run. No consideration whatsoever was given during the 1870s to change onto gold.<sup>10</sup> Large hoards of silver coins were held throughout India. Contemporaries pointed to the importance of silver plate in local economies. Hoarding was said to be pervasive and there were fears of uprising in the case silver demonetization would be considered. The Sepoy Mutiny of 1857 was still a vivid memory. It had led to the Indian office increasing its hold on the most precious colony and bureaucrats were predominantly concerned with social peace (Leavens 1939).

One policy option— that would eventually be chosen was to keep silver in circulation while implementing a scheme to peg the value of Indian silver in a gold exchange standard fashion. But this would require large reserves and the British Parliament was always reluctant to provide resources for the Empire. The chosen policy was to fund colonies with their own resources. In the end, bankers could help manage the floating silver exchange rate by selling foreign exchange insurance to merchants. India thus remained on silver. As has been noted by many previous authors (Soetbeer 1889, Fisher 1907, Keynes 1913), with silver coinage remaining free in India, the rupee depreciated alongside with silver.<sup>11</sup> The persistent, “melodramatic” as Oscar Wilde had it, depreciation of the rupee was observed but not addressed for an extensive period of time, and authorities seemed perfectly happy with the situation. It was not until 1893, when a commission started pushing the matter towards a resolution that serious considerations were given to the change of standard in India.<sup>12</sup> This was in part motivated by rising silver agitation associated with

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<sup>9</sup> . It was only in the late 1880s and 1890s that the Sherman Act and Bryant campaign gave silver some shine.

<sup>10</sup> . Silver was also largely used in other areas in Asia such as China, and they did not join in the move to gold.

<sup>11</sup> . Note that the way Mertens organized the data adds discrepancies. Silver is an average of annual maxima and minima, while rupee is an annual series without further indication.

<sup>12</sup> . Delaying tactics were used. Between 1873 and 1893, the matter was studied by two subsequent commissions. They postponed resolution of the problem until a third Select Committee on the Depreciation of Silver, 1876; Royal Commission Appointed to Inquire into the Recent Changes in the Relative Value of the Precious Metals, 1888, Indian Currency Committee, 1893,

the Sherman Silver Purchase Act in the US in 1890, which caused speculation in markets and generated much volatility in the silver exchange rate, reverberating on the rupee, creating concerns. In 1893, the Indian Currency Act decided that free coinage of rupees be discontinued. At that point, free gold coinage was not yet introduced and a mechanism to peg the rupee onto gold was still to be found. In practice the transition of the rupee to a gold exchange standard was still a remote prospect. But the link with silver had been abolished. From that point on, silver and the rupee which had moved in tandem until the early 1890s went different ways, with the result that while silver continued its downward fall, the rupee subsided.

On February 14, 1895 Oscar Wilde's *Importance of being Earnest* premiered at the Saint James Theatre, London, featuring a malicious Miss Prim who did not want Cecily to read about the vicissitudes of the rupee, which were by then history. Figure 1, using data from Mertens (1944) for the period 1860-1900 helps summarizing the melodrama that had taken place. While movements of the rupee against sterling had closely mirrored movements of silver against gold, until 1890, the two series parted in the early 1890s as authorities put increasing restrictions on arbitrage and eventually destroyed the link that had existed so far between rupees and silver. This figure is suggestive of the whole intuition in this paper. It suggests that useful inference can be made about the gold-silver exchange rate by looking at the behavior of rupee and sterling bonds.

## Section II. Silver Bets in Theory

### A. *Silver Bets in Theory*

Consider the following decomposition of the yield of a sterling and a rupee denominated bonds respectively denoted by  $i_{\pounds}$  and  $i_{\text{R}}$ . They can be respectively expressed as the sum of the risk free rate (the rate of UK consols), plus a political (colonial risk) premium, plus a liquidity premium. Rupee bonds also incorporate an exchange risk premium compared to sterling. Recent research suggests that since India was part of the British Empire, the default risk on such securities was very limited or nil.<sup>13</sup> Whatever our take on this is, however, we can safely assume that the respective political risks on silver and gold bonds (to the extent there was any) were identical. The liquidity premium by contrast need not be identical and below we dig deeper into this matter. Both silver and gold securities were listed in London and we suspect, Indian markets such as Calcutta's. However, gold bonds were typically issued in London and were said to be predominantly for British investors. Silver bonds by contrast were issued in India and targeted India's residents (European residents and Indian elites). It can be therefore that liquidity differed within the same market.

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<sup>13</sup> . See Accominotti, Flandreau and Rezzik (2010) for a discussion.

Calling  $i$  the risk free rate on consols,  $\pi_0$  the political premium,  $\pi_{\text{L}}$  and  $\pi_{\text{R}}$  the liquidity premia on sterling and rupee bonds respectively and  $\pi_{\text{E}}$  the exchange premium we can write:

$$i_{\text{L}} = i + \pi_0 + \pi_{\text{L}} \quad (1)$$

$$i_{\text{R}} = i + \pi_0 + \pi_{\text{R}} + \pi_{\text{E}} \quad (2)$$

As a result the spread between the yield of the rupee and sterling bonds can be written by differencing the two equations or:

$$i_{\text{R}} - i_{\text{L}} = \pi_{\text{E}} + \pi_{\text{R}} - \pi_{\text{L}} \quad (3)$$

And thus provided that the liquidity premia on the two types of securities are not too different or are constant, the spread between rupee and sterling yields should track the silver risk. Now, as we discuss in greater detail in a later section, this measure of exchange rate risk is really a weighted average of expectations regarding future parities. This, we believe, is one of its main attractions. Namely, it enables us to focus not on passing fluctuations in the market regarding the future of silver, but on some deep-seated expected future trends. It is therefore the ideal tool to discuss the credibility of bimetallism and the scope for a possible silver confidence crisis, before the fall<sup>14</sup>. Moreover, in contrast to the dismal record of uncovered interest parity for short-term horizons, results have been much more encouraging for longer term bonds (See Mussa 1979, and Froot and Thaler 1990 for early insights, Chinn and Meredith 2005, Alexiuy and Sellinz 2006 for recent results and discussions).

### B. *Liquidity Risk vs. Silver Risk*

We assumed earlier that liquidity premia for both rupee and sterling debts were similar so that the spreads can be entirely traced to exchange risk. While we cannot think of a reasonable way to measure liquidity risks given available information, a word of caution regarding the effect that this may have on our results is in order before we proceed. A number of features facilitated international arbitrage between gold and silver securities. First, there was cross listing of gold and silver Indian securities. Second, the Bank of England also stood willing to pay the coupon on the various bonds at no charge in either Calcutta or London thus facilitating arbitrage operations (for silver securities this benefit was captured by the process of “enfacing” the securities, that is to say, make the interest payable at the Bank of England).

One way to get a sense of liquidity problem is to provide statistical measures of the amount of India’s silver debt held in London (Figure 2). As seen, less than one quarter of rupee debt was held there. Moreover, owing to the enfacing procedure, part of these holdings may have been for

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<sup>14</sup> . This approach is in fact almost similar to the one used by Mitchener and Weidenmier (2009) to analyze the credibility of hard pegs during the gold standard.

the benefit of European residents of India rather than evidence of diversification.<sup>15</sup> It was also said that the Calcutta market structurally lacked liquid resources and had to rely on London when new issues occurred.<sup>16</sup>

Of course arbitragers in London ought to have taken advantage of this (Haupt 1890). But in the 1860s, it took about two weeks for news in London to reach the Indian market (Flandreau 2004). Contemporaries noted that short-term interest rates were always higher in Calcutta than in London.<sup>17</sup> This could not be entirely explained by exchange risk since the effect would subside even after the stabilization of the rupee on a gold basis (Keynes 1913). In summary, the depth of Indian capital markets was less than that prevailing at the financial center of the universe and at the same time information on Calcutta in London was not perfect. This may have penalized silver denominated securities. It is a well established result that in such situation, returns across markets can exhibit persistent differences owing to the existence of informational frictions (see Okawa and van Wincoop for a recent discussion and elegant model generating this kind of effect). In sum, because London was a gold based market, investors might have required (apart from exchange risk) a compensation for holding a foreign currency such as rupee bonds.<sup>18</sup> In other words:

$$\pi_{IR} \geq \pi_{IC} \quad (4)$$

So that:

$$i_R - i_C \geq \pi_E \quad (5)$$

In conclusion, we believe that our measure of the silver risk provides an upper bound to the silver risk. But while we cannot entirely discount the possibility of rupee investment to be less liquid in London, we find no compelling reason why this should change substantially over short periods of time.

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<sup>15</sup> . The Economist Dec 13, 1884 gives the following breakdown for the rupee debt in 1883 (November 30<sup>th</sup> 1884, p. 1508): Indian holders in India: 23.5%; European holders in India 54%; “Enfaced in London” 22.5%; We see that the estimate for the amount enfaced in London closely matches the one in Figure 2.

<sup>16</sup> . According to Westland, Auditor-General to the Indian Government, quoted by The Economist (Dec 13, 1884, p. 1508): “The borrowing operations of the government of India always exhaust [...] the whole of the resources in the money market of India. To raise a loan of two and a half crores of rupees, it is necessary to begin by giving several months notice of the intended issue of the new loan. Then when the loan is offered, the Government has to wait a month for the receipt of tenders, so as to enable several of the principal tenderers to communicate with Europe, and make arrangements for meeting the call; and after that, it takes about three months to get in the money, since to call it in more rapidly would strain the resources of the market, and force up the [short term] interest rate to a high point”.

<sup>17</sup> . Westland, quoted by The Economist, (Dec 13, 1884), Haupt (1890); See Flandreau and Jobst (2009) for a systematic discussion of this phenomenon. For a discussion of liquidity premia on colonial securities, see Accominotti et al. (2011).

<sup>18</sup> . See Flandreau and Sussman (2005) for a discussion and measurement of this phenomenon in history. They argue that in international capital markets, securities denominated in foreign currencies were penalized, other things being equal, compared to securities denominated in domestic currencies.

### Section III. Silver Bets in History

In the course of our investigation, we came across abundant proof that contemporaries did reason within the framework we discussed above and speculated on silver bonds and the gold-silver exchange rate. These references to contemporary debates are useful in reminding us contemporary investors (not just later economists like us) reasoned in terms similar to the one we adopt here and looked at the sterling-rupee spread in relation to the gold-silver exchange rate. This suggests agents had the required sophistication for our index of silver risk to be a reasonable tool.

#### *A. Policy Makers: Indian Finance and British Authorities*

The choice between gold and silver is an issue for borrowers, just like it is one for investors. We found evidence of Indian authorities discussing the merits of sterling vs. rupee borrowing in relation to exchange rates. In 1884, the Select Committee on Indian Railways produced a “Blue-Book” which asked whether the Indian Government ought to fund itself through sterling loans in London or rupee loans in Calcutta. Against the borrowing in India stood the higher interest rates (higher rupee yields spreads) but they were compensated by the prospect of rupee depreciation.<sup>19</sup> The Blue-Book contained computations by one Jason Westland who suggested, based on previous experience, that sterling borrowing might be advisable.

The Economist criticized the estimate and countered that “sterling borrowing is a speculation by the Indian Government upon the future price of silver [...] and for such a speculation the present time is peculiarly inopportune”. The reason, according to The Economist, was looming silver legislation in the US and possible policy moves by continental Europe’s Latin Union. If such moves were carried through, the journal reasoned, the price of silver would rise and the *ex post* rate of return for rupee loans would be higher. This would be good for investors but bad for the colonial government. The resulting uncertainty urged to adopt a “waiting policy”.<sup>20</sup> This discussion is interesting because it shows that investors must have factored in policy moves.

One element that appears to have constrained authorities’ ability to arbitrage between gold and silver debts was the concern over mismatch problems. One goal of British financial policy in the Empire was to achieve fiscal self-sufficiency of the colonies and this stood in the way of liability diversification. As noted by The Economist gold borrowing was an uncovered speculation. In case of rupee depreciation over and beyond expectations, extra funding would have to be raised. But new taxes risked destabilizing India. The alternative would be a British bail

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<sup>19</sup> . It was also said that there was a “political advantage” in committing local Indian resources to financing Indian securities.

<sup>20</sup> . The Economist, Dec 13, 1884, p. 1509.

out of the colonial government.<sup>21</sup> Another constraint that weighed upon India's financial policy was that Britain wanted to encourage local investment in local debt and infrastructure -- a device to commit Indian elites and wealth owners to support British rule. This tilted the balance in favor of rupee borrowing.<sup>22</sup> These discussions, while they reveal constraints over the extent to which borrowers could speculate, show that contemporaries understood the issues. This suggests that when gold and silver bonds coexisted, market could price them.

#### B. *Foreign Exchange Dealers: The Case of Ottomar Haupt*

In 1890, financial economist, wealthy foreign exchange trader and bimetalist Ottomar Haupt published a small pamphlet that argued something was wrong with the way India's rupee securities were priced (Haupt 1890).<sup>23</sup> India's default risk was close to zero since Britain stood behind Indian debts. Evidence of this could be found in India's sterling bonds traded near British consols.<sup>24</sup> The remaining risk had to be an exchange risk. On this account, the adoption by US Congress of the Silver-Bill (or Sherman Act) in July 1890, which ordained large annual silver purchases by the US Federal government, implied the price of silver and thus rupees debts was to rise. Haupt viewed the Sherman Act's ability to reverse existing trends as very credible and as a result, he claimed that the yield on India's rupee bonds ought to be going below that on India's sterling bonds (there should be a negative silver spread because silver would experience a permanent rise with respect to gold). But while rupee yields were lowered they remained *above* sterling yields.

Haupt (1890) claimed that this called for profitable arbitrage.<sup>25</sup> He could think of only two reasons which were both related to possible market failure.<sup>26</sup> First, information imperfections:

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<sup>21</sup> . This problem of an "Indian mismatch" would become a recurrent topic of parliamentary discussion. In 1894, as the rupee was being stabilized onto sterling, one British MP referred to this as a relief because "India" had been until then a "mortgaged farm, and mortgaged unhappily in gold". Other MPs had different views *House of Commons Deb 16 August 1894 vol 28 cc1271-350*. Bailout expectations have been shown to be integrated in the pricing of securities at the time (Bernal et al, 2010). In our case a bailout expectation would in fact be linked directly to the likelihood of silver depreciation: that is a higher spread between silver and gold yields.

<sup>22</sup> . "By borrowing in sterling we throw on the government, that is on the people of India, the risk of loss through a fall in exchange. By borrowing in rupees they have, it is true, to pay a higher rate, but the risk of further loss falls on the holder of the loan. It is moreover politically an advantage to have local capital invested in the new works, which cannot take place if the loans are entirely brought out in England". *The Economist*, Dec 13, 1884, p. 1508.

<sup>23</sup> . Haupt began his career as a foreign exchange dealer for the Banque des Pays-Bas in Antwerp when the French government inspired the merger of this bank with the Banque de Paris to create the Banque de Paris et des Pays-Bas, from its inception a leading investment bank benefiting from government support. When the merger occurred, Haupt took over Banque de Paris et des Pays-Bas foreign exchange operations that were required by the payment of the indemnity and later became a director of the bank. He was also a fervent bimetalist and wrote several reference books on the topic. He was also the author of a handbook on international security and foreign exchange arbitrage.

<sup>24</sup> . Haupt 1890, p. 30.

<sup>25</sup> . Haupt offered a prize of £100 for whoever would come up with a satisfactory explanation. He discussed the answers he had received from traders in "leading houses" in London and Frankfurt. Correspondents suggested that certain features of the bonds (such as maturity or conversion options) might possibly explain part of the discrepancy. But Haupt showed that even under the most extreme scenarios, there remained a difference. And thus if one believed that silver would not fall further, current bond prices provided an opportunity for arbitrage (essentially a way to buy silver forward).

Uninformed investors were the victims of the anti-silver propaganda of “leading British journals”. They did not realize the “true” effects of the Silver-Bill or were unaware of the position of supply and demand on the silver market.<sup>27</sup> Second, credit constraints: given the volume of the outstanding securities, arbitrage required substantial resources.<sup>28</sup> Haupt suggested creating an “Indian Trust Company”, i.e. an investment trust specially designed for gold-silver arbitrage (it would raise resources in sterling and invest in rupees).<sup>29</sup> Obviously, there was a third possibility. Speculators understood that the Sherman Act was good news for rupee debts but remained skeptical regarding the long run prospects of silver. Haupt, on the other hand, was speculating on silver and accordingly tried to persuade markets of the merits of a long position, explaining why he sought to secure press coverage.

Again, the existence of such debates and discussion in the market suggests that speculation was active. Investors understood the connection between rupees debts and the price of silver. Finally, Haupt’s analysis tells us something about how agents could speculate on silver exchange rates. As far as we know, there was no silver forward market in Europe. But operating on forward markets for rupee and sterling bonds provided a substitute. Those betting on silver exchange rate increases could short sterling bonds and go long on rupee, with no down payment.

### *C. Macroeconomists: Irving Fisher’s Discovery of the Uncovered Interest Parity*

Such ideas also made their way into academic debate providing further anecdotal proof that using silver-gold spreads to make inferences about the global financial system are warranted. Irving Fisher is famous for its statement of the so-called “Fisher equation”, which relates nominal interest rates, real interest rates and inflation expectations (Fisher 1907). Less famous yet equally important is the discussion he provided ten years earlier and again in the same book of the uncovered interest parity (Fisher 1896, 1907). He argues that the difference between interest rates on otherwise similar assets must be related to the expected change in the relative price of the currencies in which the two assets are denominated. And the illustration he gave precisely used yields on India’s sterling and rupee bonds.<sup>30</sup>

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<sup>26</sup> . Obviously, Haupt’s emphasis on inefficiency anticipated on recent research on foreign exchange markets. At the same time, it reminds us that a critical assumption for the use of this spread as a predictor of future variations of the price of silver in relation to gold is the market efficiency hypothesis.

<sup>27</sup> . Haupt 1890, p. 23.

<sup>28</sup> . Haupt 1890, p. 37.

<sup>29</sup> . Haupt 1890, p. 34

<sup>30</sup> . Fisher, 1907, p. 265-6. The language used by Fisher is revealing of the fact that Fisher had in mind ideas really similar to those at the heart of this paper. We may [now] compare [interest rates] in gold and silver. The comparison, to be of value, must be between gold and silver contracts in the same market and with the same security. Such contracts are fortunately available in the London market for government securities. The loans of India have been made partly in gold and partly in silver, and both forms of securities are bought and sold in London. The interest on the silver, or rather rupee, bonds is paid by draft on India. The sums actually received in English money depend on the state of the exchanges.” Note that Fisher emphasized that this intuition had really a long tradition and quotes other works.



Fisher's discussion reflects a clear command of both "modern" insights from financial macroeconomics understanding of several underlying measurement pitfalls.<sup>31</sup> He provides a Table for silver exchange rates and spreads. The Table is constructed to show that the period of silver depreciation had been characterized by higher silver yields. In other words, markets worked well, and uncovered interest parity held<sup>32</sup>: "Results afford substantial proof that the fall of exchange (after it once began) was *discounted in advance and affected the rates of interest in those standards*. Of course investors did not form perfectly definite estimates of the future fall, but the fear of a fall predominated in varying degrees over the hope of a rise"<sup>33</sup> Figure 2 illustrates this, summarizing the information in Fisher (1907). As seen, the period of the fall of the rupee (1874-1894) was associated with positive rupee spreads.

Fisher's discussion is interesting because it provides some verbal evidence suggesting that he was a supporter of the view that political events could drive silver spreads. For instance, he mentions the movement that occurred around the adoption of the Sherman silver purchase Act in 1890, a silver stabilization scheme. As can be seen in Figure 3, the price of silver rallied, while at the same time the rupee-sterling spread declined, suggesting that expectations on the future of silver partly recovered. As he put it: "there can be little doubt that the disturbance was due in some measure to the operation or expected operation of the law"<sup>34</sup> The suggestion is that the decline of silver during the 1870s and 1880s was surrounded by much speculation regarding policy moves, providing anecdotal support to the new view that has emphasized the importance of such moves.

One thing Fisher did not do with his annual series database was providing a careful discussion of the credibility of bimetallism around the fall.<sup>35</sup> This is natural because he was interested in the impact of floating exchange rates on interest spreads when the gold-silver exchange rate was essentially a pegged price until France forfeited the bimetallic option. In what follows we work out a detailed database and take a careful look at the timing of possible silver confidence crisis. A key issue is whether this confidence crisis occurred before or after France forfeited the bimetallic

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<sup>31</sup> . For instance, he advises against using London's Investor's Monthly Manual computed yields, which are today notorious for being misleading as they convert units (here rupees) at official value not the market prices.

<sup>32</sup> . Note that the actual expression used by Irving Fisher to designate bond yields is "rates of return realized". There can be little doubt as to what is meant by this as a look at the definition provided by Fisher shows. On p. 267 he states that the rates of return are estimated by first converting sterling quotation in rupee and then computing the yield from knowledge of the coupon and the assumption that the bonds can be treated as perpetual annuities

<sup>33</sup> . Our italics. Fisher 1907, 268.

<sup>34</sup> . Fisher 1907 p. 269. Fisher concluded that the evidence was consistent with the notion that expectations about the future of silver drove interest differentials.

<sup>35</sup> . He only mentions that "after 1875" silver markets became bearish (p. 268): "From this Table it will be seen that the rates realized to investors in bonds of the two standards differed but slightly until 1875, when the fall of Indian exchanges began. The average difference previously to 1875 to 1892 inclusive was .7 per cent., or more than three times as much."

option. Crucial too is the question of bimetallism's collapse. Was it a violent scramble for gold with agents brutally factoring once and for all that bimetallism was passé, or a more gradual process? Was the collapse of international monetary cooperation, that would characterize the repeated international conferences on bimetallism (in 1874, 1875, 1876, 1878, 1881, 1892: see Russell 1898, Einaudi 2001), priced immediately or did markets only gradually realize that the political support for bimetallism was crumbling? We'll bring answers.

## **Section IV. Measuring Silver Risk**

### *A. Data and Methods*

To measure silver risk we need to compute spreads on silver and gold bonds issued by India. We have turned to the Investors' Monthly Manual to collect the complete array of Indian Government securities listed on the London Stock Exchange during the relevant period. The data is quarterly. The period is I 1860 until IV 1889. The reason for not going beyond 1890 is that as argued the 1890s turned out to be lethal for India's silver standard. To the extent that agents discounted this (probably after 1892, when Parliamentary Commissions started working), then rupee-sterling bond spreads are no longer relevant for making inferences about the exchange rate between silver and gold.

Next, we matched each series with information on characteristics of the corresponding security: date of issue, coupon, maturity, etc. For sterling securities, we checked bond characteristics from information in the Stock Exchange Archive in Guildhall Library. Related information is available in Burdett's Official Intelligence, the market yearbook started in 1882. For rupee securities, Guildhall and Burdett's had to be supplemented by other sources. The reason is that these were primarily Calcutta securities then cross listed in London. As a result, securities issued and redeemed before Burdett's started being available are not documented. A useful source was a list of bond descriptions contained in an official compilation of 1880 (Office of the Superintendent of Government of India, 1880). Table 1 summarizes the information on the various securities we surveyed. We report (a) the name of the security as it was listed in the Investors' Monthly Manual, (b) the coupon, (c) the date of issue, (d) the first possible date for redemption, (e) the nominal amount, and finally (f) the period for which a quote could be found in either The Economist (before September 1864) or the Investors' Monthly Manual (after that date). In a first stage, we collected all available series, because we had no prior as to what would eventually be the best source. Data was collected as the "latest" quote for each quarter and when this was not available, we took the "latest business done". As we discovered, some securities, were thoroughly dormant, i.e. seldom quoted and thus most probably illiquid and this reduced

the list of exploitable sources. We ended up with the following securities for which there appears to have been an active market in London (albeit to different degrees): (for rupee debt) the Enfaced 5,5% (until III 1860) and the Enfaced 4% until the end; (for sterling debt) the Gold 5% (until III 1863) then the Gold 4% (until IV 1880), then the Gold 3,5% (until II 1884), then the Gold 3% (until the end of the period). Actively traded securities are printed in bold characters.

### B. *Estimating the spread*

In an ideal world, one would like to directly observe the yields for two similar securities with exactly the same features but for one element: one would be issued in sterling, the other in rupees. In this ideal case, the spread between rupee and sterling yields should be equal to the expected risk of holding silver bonds<sup>36</sup>. In practice bonds differ in terms of maturity, coupon and liquidity. Furthermore, yields are not directly observable and several competing methods exist to determine returns. Valid yield comparisons ought to take these elements into account.

In order to capture bondholders' anticipations, we compute yields to maturity, which finance textbooks consider as the standard measure of the total rate of return for fixed-income securities (see for instance Bodie, Kane, Marcus, 2005).<sup>37</sup> Yield-to-maturities rely on the stream of promised cash flows and on the bond price<sup>38</sup>. They represent the internal rate of return a bondholder would receive under the assumptions that the issuer will pay coupons and principal on time and that the bondholder will hold his bond to maturity (If investors believe the security has become riskier they will require a higher yield, which will directly affect the price of the bond)<sup>39</sup>. Yields-to-Maturity have been the standard tool in macroeconomic and financial history and are a much better tool than the also often-used coupon-yield. However, as noted by Alquist and Chabot (2010), direct extraction of yields from "maturities" for comparison purposes may sometimes make little sense because of different repayment profiles across bonds. Indeed in many cases countries had an explicit right to redeem the bond before maturity. In other words the price of the bond reflected its expected discounted cash flows minus the put option held by the issuer (the right but not the obligation to redeem the bond before maturity. In our case, this

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<sup>36</sup> If one considers that the liquidity premium for each bond is the same and if one excludes anticipations of a selective default (that India would, say, default on its rupee bonds and not on its sterling ones).

<sup>37</sup> . An alternative would be to use realized returns to assess the overall performance of sovereign bonds (see for example, Eichengreen and Portes, 1986). This approach is valid if the aim of the analysis is to determine how bondholders fared. To compute realized returns, one has however to impose a holding period and to know the price of the bond at the end of that period. This price is obviously unknown *ex ante* and therefore realized returns do not capture bondholders' expectations.

<sup>38</sup> . There is in fact no perfect measure and yields to maturity, also called redemption yields, are known to suffer also from drawbacks, see for instance Schaeffer (1977).

<sup>39</sup> . In general, as shown by Malkiel (1962), five properties characterize the relationship between bond prices and yields. 1) bond prices move inversely to bond yields, 2) for a given change in yield from the nominal yield, changes in bond prices are greater, the longer the term to maturity, 3) Interest rate risk is less than proportional to maturity, 4) the price-yield curve is convex, 5) There is an inverse relationship between interest rate risk and the bond's coupon rate.

right is only explicitly stated for one silver bond (Enfaced 4% (8)). This element is however likely to have a limited impact in our case. Indeed, countries are likely to exercise their put option if the interest rates tend to fall. In this case, they reimburse former bonds to borrow at a lower interest rate. In the Indian case, interest rates on rupee bonds increased during the period under consideration. This would have made this option quite uninteresting.

Besides the existing difficulties related to the determination of the exact maturity date, one need to take into account the fact that maturities are an imperfect measure of the effective repayment date. In our study we control for this by using duration (Macaulay 1938). Duration (essentially the weighted average maturity of a bond where the weights are the relative discounted cash flows in each period) is widely recognized as a better measure than maturity to analyze the “true” or “effective” maturity of a bond. We compute the duration for each bond, at each date. Since our aim is to analyze long term expectations, and since the impact of a difference in duration is known to be smaller the higher the duration (Macaulay, 1938, Malkiel, 1962), we choose to always consider the bonds with the highest duration to compute the spread between rupee and sterling yields. Duration for the silver bonds is almost always higher than for the gold ones. For the period under study, the average duration for the silver bonds is equal to 21.73 years versus 12.21 years for the gold ones. The actual impact of this difference is low.

## **Section V. Results**

### *A. Silver-Gold Spreads*

Figure 4 depicts the spread between gold and silver bonds. The representative bonds used to construct this line were chosen to be the ones with the longest duration at any point of time. For the silver bonds we use the Enfaced 5,5% (12) from I 1860 to III 1860 and the Enfaced 4% (8) afterwards, for the gold bonds we use the Gold 5% (2) from I 1860 to III, 1863; the Gold 4% (3-4) from IV 1863 to IV 1880 and the Gold 3.5% (6) afterwards.

Figure 4 exhibits three periods. During a first period (I 1860 to IV 1863), the spread is sometimes negative and has a mean which is not statistically different from zero. This could be interpreted as a sign that the markets were expecting gold to lose its preeminence in the future. However this period coincides with the beginnings of silver securities in London and it is fairly clear from the frequency of quotations that that the market lacked depth causing behavior that may have been erratic. As a result, our discussion of spreads will mostly focus on the period after I 1864 when we become confident that the data ought to bring reliable information. From I 1864 to IV 1874, the spread stabilizes to a small figure (an average of 20 basis points) where it remains.

Finally, after IV 1874, bondholders were requiring an important premium to hold the silver Indian bonds.

The spread in Figure 4 reflects two elements (equation 3): difference in market microstructure (liquidity for example) and expectations regarding the future value of the gold/silver ratio. Even though there is no direct measure of liquidity, it seems reasonable to assume that the impact of liquidity would remain constant over time or at least would not fluctuate too much. Therefore variations in the spread may be viewed as capturing changes in exchange rate premium.

Figure 4 could be interpreted as follows: the series tends to indicate that until 1874, bondholders were requiring a small and constant premium to hold silver instead of gold bonds issued by the Indian government. Even if we assume that there was no liquidity premium and interpret the whole pre-1874 premium as pure silver risk, which is dubious, we reach the conclusion that this premium was small and stable. There was no serious credibility problem and more importantly, things did not deteriorate at all when major events emphasized in previous literature (such as Germany's decision to move to gold in 1871) occurred. This lends support to the new view. After 1874 however, markets increasingly penalized silver bonds. Between 1876 and 1882 or so, we also see that the premium was quite volatile. This is consistent with the fact that the period coincided with substantial international agitation (international conferences as mentioned earlier, press campaigns etc.) per and contra bimetallism. The observed volatility may have reflected the succession of news. We also see that markets required a time increasing premium, suggesting that they were incorporating regularly the impact of accumulating news (Section I) tending to confirm that the gold standard would prevail. This is also consistent with the new view that problems with bimetallism really started after France forfeited the bimetallic option not before.

### *B. Modeling the Melodrama*

The argument we consider now captures insights that are consistent with the above evidence and with work on the rise of the gold standard emphasizing network externalities (Flandreau 1996, Eichengreen and Flandreau 1996, Flandreau 2004, Meissner 2005). Flandreau (1996) suggests building on Dowd and Greenaway (1993) who construct a model in which the utility derived by the agents for a given currency is a function of network benefits (an increasing function of the number of members adopting the currency) and switching costs. They show that depending on the values of each parameter, several cases may arise: for instance, nobody switches to the new currency, everybody does, or only some do. Of interest is the situation where an initial shock destabilizes the existing equilibrium. In such a case, idiosyncratic shocks affecting single

countries can lead to a situation in which country switching increases in turn the likelihood of other countries switching and so on. *Ex post*, therefore, the transitional phase looks very much like a trend, although the trend is not expected *ex ante*. Each period turns out to have brought “bad news” for the currency that is being abandoned, but at each period, agents expect that the situation will stabilize at the new level. Formally, We can write

$$\pi_E(t) = \alpha + \varepsilon_t, \text{ before date T} \quad (6)$$

And:

$$\pi_E(t) = \alpha + \mu \cdot t + \varepsilon_t, \text{ after date T} \quad (7)$$

In other words, as long as agents know they can rely on a mechanism (French bimetallism) to peg the value of the gold-silver exchange rate they do not expect any change in the spread. Then the series follows a stationary process with a constant, and small, mean. However, after the regime has collapsed, and conditional upon a series of bad news for silver that flow in during every period, the series becomes trend stationary. To test this hypothesis, we look for structural breaks in the series. Then we analyze the stationarity of the spread for the periods separated by the break. If our intuition holds, the series should be stationary until the switch occurs and then become trend stationary.

### C. *Stationarity and Structural changes*

#### i- Structural Breaks Methodology

In order to identify structural breaks, we follow the methodology used in Willard, Guinnane and Rosen (1996) to analyze major turning points for the Greenback market during the U.S. Civil War. The search for structural breaks, has been extensively relied upon in economic history (Brown and Burdekin (2000), Brown and Burdekin(2002), Frey and Kucher (2001), Frey and Waldenström (2004), Oosterlinck (2003), Sicotte et al. (2010), Weidenmier (2002), as well as in economics in general (Zussman et al, 2007). The methodology used here, based on Perron (1989) and on Banerjee, Lumsdaine and Stock (1992) sequential test procedure for multiple structural breaks, allows finding breakpoints for non-stationary series<sup>40</sup>. The baseline model is auto-regressive

$$y_t = \beta_0 + \sum_{i=1}^n \beta_i y_{t-i} + \gamma_s D_s + \varepsilon_t \quad (8)$$

where  $y_t$  is the series,  $\varepsilon_t$  is a white noise and  $D_s$  is a dummy variable for the structural break that takes the zero value for all observations up to date s and t-s after date s. The number of lags to

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<sup>40</sup> The series as a whole is indeed non stationary, see Philips Perron tests in Appendix one.

include in the model (3 in our case) is determined here by the Schwartz criterion (see Appendix 2). The usual procedure takes two steps: in the first step, regression (1) is run for windows of a given length. The length of the window allows discriminating between short lived (blips) and long term effects (Willard, Guinnane and Rosen, 1996). Since we are interested in long term breakpoints, the windows cover 10 years (40 quarters). This first step aims at isolating the windows in which a break is most likely to be present. Windows are here defined as follows:

$$W_s = [y_{s-20} ; y_{s+20}] \text{ with } s = 20 \text{ to } 100$$

For each window the following equation is estimated, with  $n = 3$ :

$$y_t = \beta_0 + \sum_{i=1}^n \beta_i y_{t-i} + \varepsilon_t$$

and then, for each window  $W_s$ , we compute the  $F$ -statistic  $F(s)$  associated with a Wald Test on the omitted variable  $D_{s,t}$ . The next step is to determine the date  $s_1^*$  that maximizes  $F(s)$ . Once  $s_1^*$  is found, we take  $W_{s_1^*}$  out of the original sample and search for the next-highest peak  $s_2^*$ . The same method is applied to find  $s_3^*$ . Traditionally the second step of the procedure aims at refining the analysis by computing equation (1) in the identified windows but with shorter windows.

These shorter windows are in many cases half the size of the previous window (Willard, Guinnane, Rosen, 1996; Oosterlinck, 2003). The date with the highest  $F$ -Stat is then considered as the breakpoint date.

## ii- Results

Figure 5 provides the results for the Wald-Test. One peak clearly stands out centered on III 1873; the second, third and fourth peaks are very close and are centered on I 1874, II 1873 and IV 1873. The first peak is statistically significant at the 5% level<sup>41</sup>. The associated window  $W_1$  [III, 1868; III, 1878] includes all major peaks. The other peaks one could observe are included in windows overlapping  $W_1$  and are thus not analyzed. The second step of the procedure runs the same analysis on a shorter window, taking half the size of the original (II 1871 – I 1876). Results are depicted in Figure 6 and show that the main breakpoint falls on IV, 1874. To analyze to which extent the structural break divides the series into two periods exhibiting differences in stationarity, we run Philips Perron tests for each period. Results are presented in Appendix 3. We then run regressions including the autoregressive factors and a trend for each sub-period (Appendix 4).

As expected for the first period (I 1860 – IV 1874) the series is stationary. The mean of the spread is relatively small since it is inferior to 20 basis points. The regression further confirms that there was almost no trend before IV 1874. Indeed even though the trend is statistically

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<sup>41</sup> For III, 1873  $\lambda = 4.16$  and  $F\text{-stat} = 18.10^{**}$  (\*\* significant at the 5% level, see Andrews (1993)).

significant at the 1% level, its associated coefficient is particularly small. By contrast, for the second period the series is only trend-stationary. The mean thus increased as time went by (for the sample as a whole it is equal to close to 153 basis points). The importance of the trend is confirmed by the regression. This factor is there also significant at the 1% level but the coefficient is much higher than for the previous period. All these elements confirm again that a major shift occurred around IV 1874.

### iii- Discussion

The previous results tend to go in line with the new view on bimetallism expressed by Friedman (1990a and 1990b) and Flandreau (1996, 2004). The advent of the gold standard as *the* international monetary standard was certainly not seen as inevitable by bondholders in the early 1870s. In fact, markets started only to require an important premium at the beginning of 1875. This is rather late if one considers that by that time Germany had moved to gold, France and the US had both committed their “crimes”, The Netherlands had temporarily suspended silver coinage (1873) and other members of the Latin Monetary Union (Belgium, Italy, Switzerland) had already limited the coinage of silver coins (1874). We conclude that before I 1875, bondholders were not expecting the gold standard to prevail.

Another important finding from our statistical exploration is that after that date more and more agents revised their expectations. This was captured by a time trend in the spread’s value. One interpretation of this is consistent with earlier discussions of the diffusion of bimetallism and with the theoretical model proposed by Dowd and Greenaway (1993). Many countries were dragging their feet towards a gold standard and were monitoring the other countries’ actions and frequently revising their expectations. At the beginning of 1875, and even though many countries had not yet completely moved to gold, investors believed that they soon would. By that date, the bulk of the significant European countries had moved closer to the gold standard. Investors still considered that arrangements to stabilize the price of silver were possible (as suggested by quotes in the first section) but this possibility was receding every year as bad news for silver kept piling up and governments were proving unable to organize a concerted response. The gradual integration of news related to the confirmation that gold was becoming *the* standard can explain the time trend found in the data.

### **Conclusions**

The emergence of the gold standard has long been viewed as inevitable. Fluctuations of the gold silver exchange rate in world markets were accused to lead to brutal and unsustainable switches of bimetallic countries’ money supplies. However, more recent work has shown that the



option character of bimetallism provided a stabilizing feedback loop. As a result, as long as France did enforce the bimetallic option, the gold-silver exchange rate remained remarkably stable. It has been found that France had the resources and institutional capacity to buffer bullion supply shocks. It had successfully weathered the California Gold Rush and after 1865, it could withstand rising silver production from Nevada and even Germany's decision to adopt the gold standard. It was only when France forfeited the bimetallic option, in late 1873, and for political reasons, that bimetallism came under stress. The emergence of the Gold Standard, as Flandreau (2004, p. 212) has argued, was an accident of history.

Using original data, this paper provides a new perspective on this new view. We focus on an heretofore neglected aspect of the process. Namely we seek to infer markets' expectations from financial series. Using market prices for Indian Government bonds, we analyze agents' expectations between 1860 and 1890. The intuition is that the spread between gold and silver bonds issued by the same entity (India) and backed by a credible agent (Britain) is a "pure" measure of the silver risk. Therefore, India holds the key to an important issue in monetary history. The analysis shows that up until the end of 1874, markets expected bimetallism to last. It is only after this date that they started requiring a premium to hold silver bonds indicating their belief that gold would eventually become the only metallic standard.

Even then, the process was only gradual. This we explain in reference to the fact that there were still expectations that silver would eventually be rescued. The repeated conferences that occurred between 1874 and 1892 held the promise that some international arrangement might be found. Bimetallism kept supporters and as a result, investors might have been inclined to remain somewhat confident. However, as one conference after the other failed holding its promise, and as one country after the other gradually moved to gold, either formally or informally, the credibility of bimetallism as an alternative to gold was severely dented. This was reflected in the trend we identified for the gold-silver interest spread.

There is perhaps something theatrical in the way silver collapsed. But not so much. The process, once it was set in motion had indeed the increasingly desperate outlook of the regular melodrama. At the same time reference to melodrama may have been misplaced. Once refined and purged from exaggeration, the decline of silver and the rise of the international gold standard may have been proper reading for young Cecily.

Brussels and Geneva, January 13, 2011.

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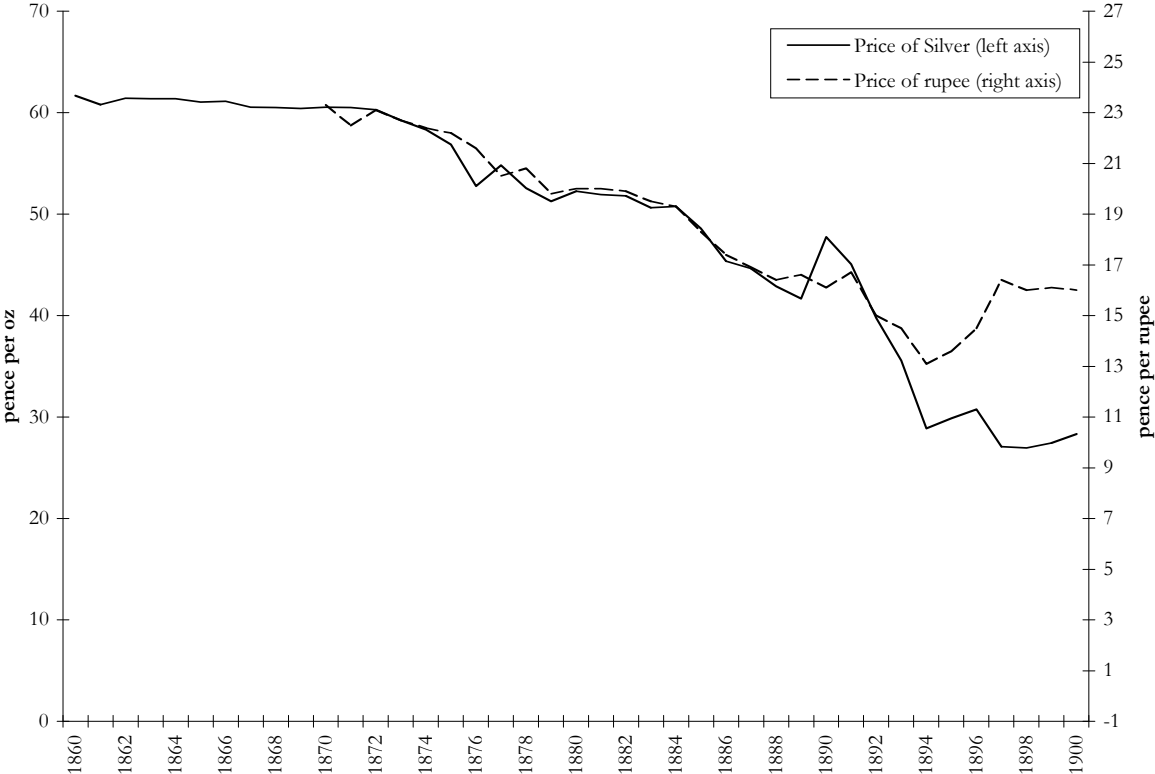
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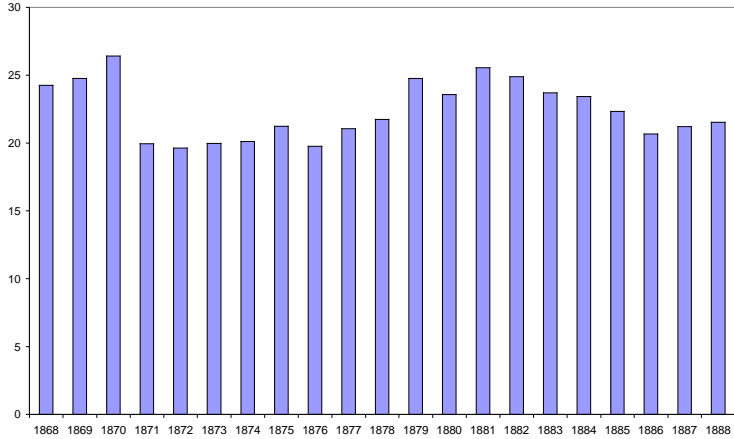
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Figure 1. Silver and rupees in the London market 1860-1900



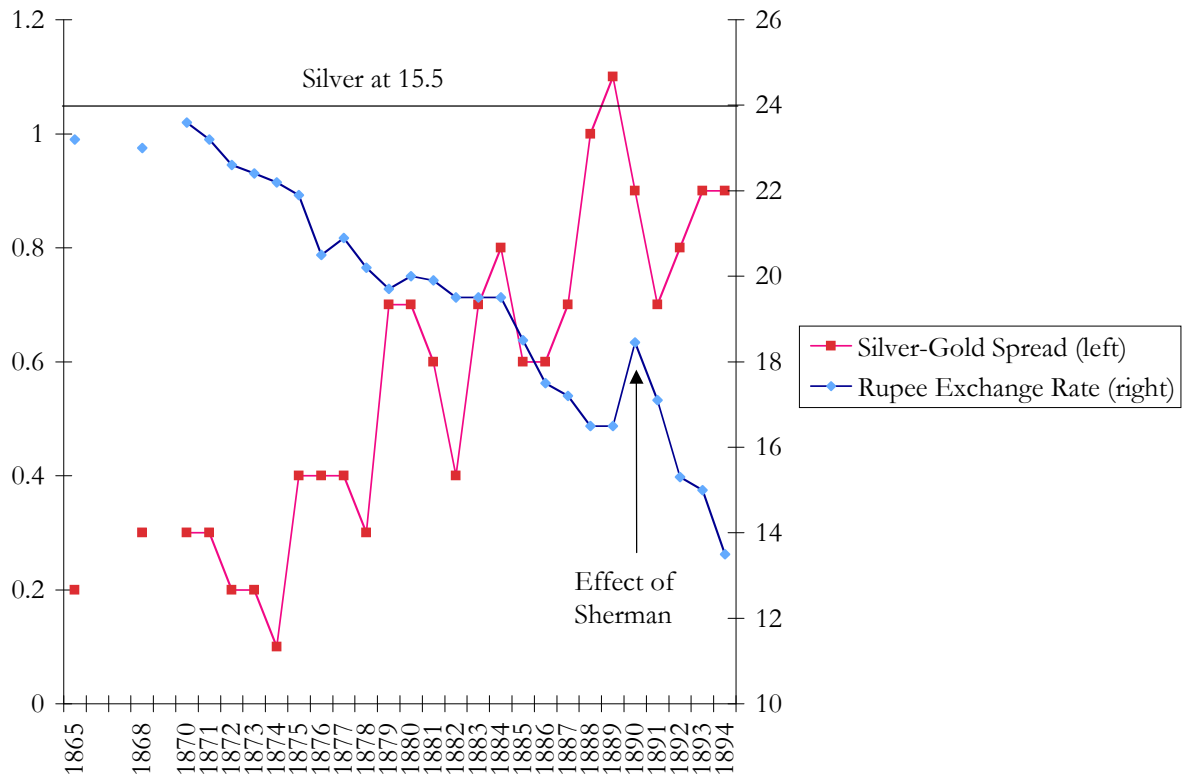
Source : Authors, from Mertens (1944), Table 38 and 47 (in appendices, no page numbering).

Figure 2. Share of Rupee Debts “Enfaced” in London (i.e. held with the Bank of England)



Source : Authors, from Shah (1921)

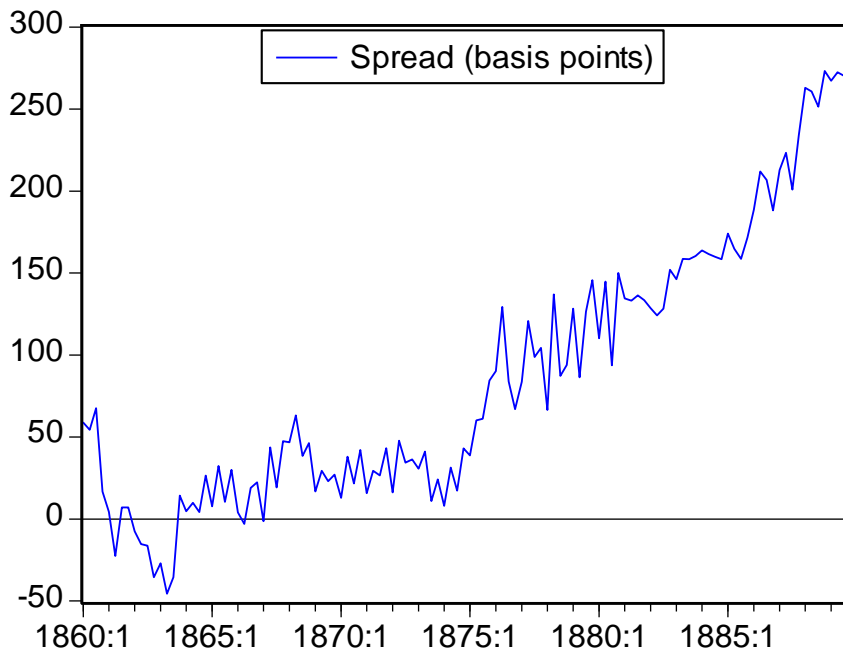
Figure 3. Sterling-Rupee Spread and the Rupee Exchange Rate according to Irving Fisher.



Source: Authors, from Fisher (1907).

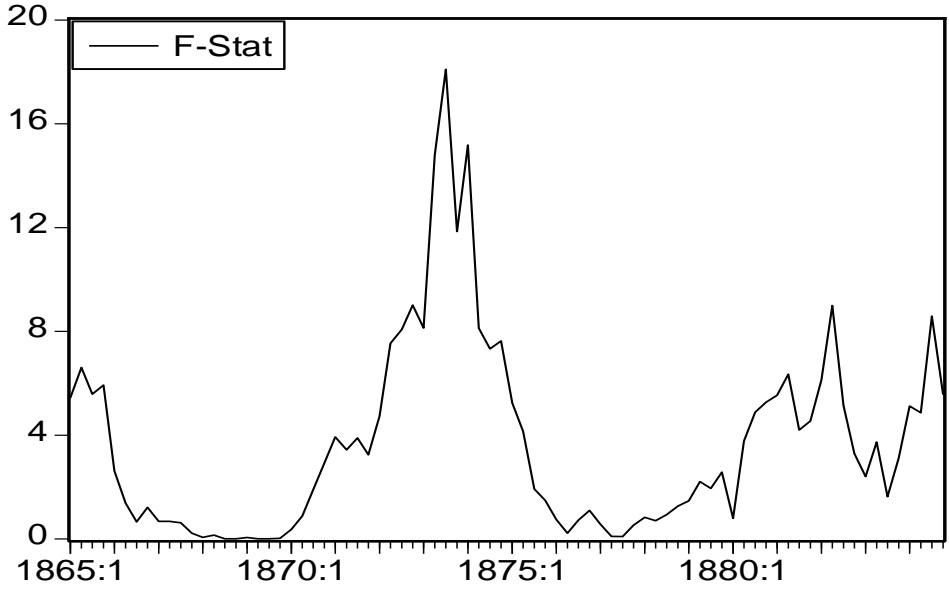


Figure 4. Spread on Indian bonds (yields of rupee bonds minus yields of sterling bonds) in basis points



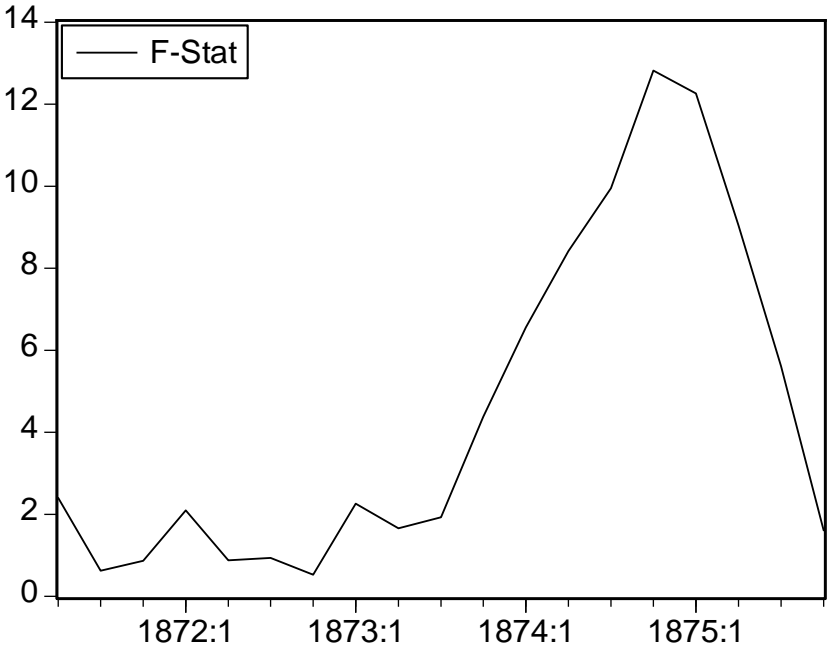
Source: Authors based on data from the Office of the Superintendent (1880) (which indicates relying on *Calcutta Gazette*), *Investors' Monthly Manual*, and *The Economist* (Cf Table 1 and text)

Figure 5. F-Stat results for the Wald Test



Source: Authors based on the Spread series (Figure 4 and text)

Figure 6. F-Stat results Wald-test for the Main Breakpoint



Source: Authors based on the Spread series (Figure 4 and text)

Table 1. Indian Securities Quoted in London (Securities used in estimation in bold characters)

NAME OF SECURITY (IN IMM)	COUPON	YEAR OF ISSUE	REDEMPTION	ORIGINAL ISSUE (£)	AVAILABILITY (a)
<b>Sterling Bonds</b>					
<b>India 5%</b>	<b>5</b>	<b>1859</b>	<b>1880</b>	<b>17'200'000</b>	<b>1860:I / 1880:IV</b>
<b>India 4% Stock Oct 1888(b)</b>	<b>4</b>	<b>1874</b>	<b>Not Before 1888</b>	<b>5'046'147</b>	<b>1863:IV / 1888:III</b>
<b>India 4% Stock 1877</b>	<b>4</b>	<b>1877</b>	<b>1884</b>	<b>3'000'000</b>	<b>1877:IV / 1878:II</b>
<b>India 3.5% Stock</b>	<b>3.5</b>	<b>1881</b>	<b>Not Before Jan. 1931</b>	<b>63'498'245</b>	<b>1881:I / 1889:IV</b>
<b>India 3% Stock</b>	<b>3</b>	<b>1884</b>	<b>Not Before Oct. 1948</b>	<b>19'748'548</b>	<b>1884:II / 1889:IV</b>
East India Co. 10% Stk	10	1833	April 1874	6'000'000	1860:I / 1874:I
<b>Rupee Bonds</b>					
<b>Enfaced Paper 4% (c) (d)</b>	<b>4</b>	<b>1832</b>	<b>3 months notice</b>	<b>73'436'519</b>	<b>1860:III: / 1889:IV</b>
<i>4% Transfer Loan of 22 April 1854</i>	"	1854	1874, then 15 months notice	NA	id
<i>4% Loan of 1832-33</i>	"	1832	3 months notice	NA	id
<i>4% Loan of 1835-36</i>	"	1835	3 months notice	NA	id
<i>4% Loan of 1842-43</i>	"	1842	3 months notice	NA	id
<i>4% Loan of 1854-55</i>	"	1854	3 months notice	NA	id
<i>4% Transfer Loan of 1st may 1865</i>	"	1865	3 months notice	NA	id
<i>Reduced 4% of 1879</i>	"	1879	3 months notice	NA	id
Enfaced 4.5%	4.5/4 (e)	1872	Not Before Jan. 1882	NA	1872:I / 1880:IV
Enfaced 4.5%	4.5	1878	Not Before Sept. 1893	20'502'753	1878:II / 1893:III
Enfaced 5%	5	1857	1872	NA	1859:IV / 1872:III
<b>Enfaced 5.5%</b>	<b>5.5</b>	<b>1859</b>	<b>1879</b>	<b>NA</b>	<b>1860:I / 1878:III</b>
Enfaced 5% Rupee Debenture	5	1867	1872	400'000	1867:III / 1873:II
Enfaced 5% Rupee Debenture	5	1867	1877	500'000	1867:III / 1877:IV
Enfaced 5% Rupee Debenture	5	1867	1882	600'000	1867:III / 1877:IV

Source: Authors, from Office of the Superintendent (1880) (which indicates relying on *Calcutta Gazette*), Investors' Monthly Manual, and The Economist

- (a) Availability in IMM & The Economist;
- (b) In 1874, a new similar security was issued under the same Act and, although it was listed separately (as the "India new 4 per cents") had exactly the same quotations as the "India 4% Stock Oct 1888". This security is identical to"
- (c) Detailed description of the various securities described under the "Enfaced Paper 4%" from Office of the Superintendent (1880).
- (d) For rupee loans, The correspondence between Investors Monthly Manual tags and names and descriptions in Office of the Superintendent (1880) are as follows: Enfaced 4.5% (for 7 yrs then 4%): four and a half per cent of 1872; Enfaced 4.5%: Four and a half per Cent 1878; Enfaced 5%: Five per Cent 1856-7; Enfaced 5.5%: Five and a Half per Cent loan 1859-61; Enfaced 5% rupee debenture: Five per cent debenture loan of 3<sup>rd</sup> January 1867; Enfaced 5% Rupee Debenture: Five per cent Debenture loan of 1<sup>st</sup> June 1867.
- (e) Coupon was announced to be 4.5% for 7 years then 4%.

APPENDIX 1.

Null Hypothesis: SPREAD has a unit root  
 Exogenous: Constant  
 Bandwidth: 3 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	0.054	0.96
Test critical values: 1% level	-3.487	
5% level	-2.886	
10% level	-2.580	

\*MacKinnon (1996) one-sided p-values.

Null Hypothesis: SPREAD has a unit root  
 Exogenous: None  
 Bandwidth: 1 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	0.770	0.88
Test critical values: 1% level	-2.585	
5% level	-1.944	
10% level	-1.615	

\*MacKinnon (1996) one-sided p-values.

APPENDIX 2.

NUMBER OF LAGS	2	3	4	5
SCHWARTZ CRITERION	-9.536	-9.496	-9.503	-9.501

APPENDIX 3.

Null Hypothesis: SPREAD has a unit root. Philips-Perron Test.

Period	P-Values*			Mean (basis points)
	Intercept	Trend and Intercept	None	
I 1860 – IV 1874	0.57%	0.56%	0.88%	19.45
I 1875 – IV 1889	69.05%	0.01%	97.76%	152.99

\*MacKinnon (1996) one-sided p-values

APPENDIX 4.

**Period 1: I 1860 – IV 1874**

Dependent Variable: Spread, Method : OLS.

Variable	Coefficient	Stand. Error	t-Stat	p-value
Constant	-0.001370	0.000972	-1.45	15.18%
Trend	$9.57 \cdot 10^{-5}$	$2.55 \cdot 10^{-5}$	3.75	0.04%
Spread (-1)	0.295164	0.126933	2.33	2.39%
Spread (-2)	0.441697	0.118259	3.74	0.05%
Spread (-3)	-0.240643	0.118591	-2.03	4.76%
R-squared	59.35%			
Adjusted R-squared	56.22%			
Durbin-Watson	1.91			
F-statistic	18.98			

**Period 2: I 1875 – IV 1889**

Dependent Variable: Spread, Method : OLS.

Variable	Coefficient	Stand. Error	t-Stat	p-value
Constant	-0.013684	0.003579	-3.82	0.03%
Trend	0.000326	$3.79 \cdot 10^{-5}$	8.60	0.00%
Spread (-1)	0.178031	0.133124	1.34	18.66%
Spread (-2)	0.263336	0.129038	2.04	4.61%
Spread (-3)	0.176322	0.133577	1.32	19.23%
R-squared	90.56%			
Adjusted R-squared	89.86%			
Durbin-Watson	2.00			
F-statistic	131.78			