A Portuguese Twist?

Sovereign Debt Management in an Emerging Country, 1869-1890

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Abstract

Portugal was an early adopter of the gold standard and one of the most indebted European nations in the second half of the nineteenth century. Despite a combination of twin deficits (budget and current account) the country held on to gold for 40 years and managed to keep low domestic interest rates. This paper explains how this was accomplished through a combination of monetary policy (FX interventions) and debt management strategies. It also raises a methodological concern about the use of paper and gold bonds in the historical literature on the 'original sin' and the credibility of the gold standard.

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1. Introduction

This paper conflates three strands of historical and contemporary literature. The first is the literature on 'original sin', i.e. the practice of governments that want to borrow abroad of issuing their debt in foreign currencies (Eichengreen and Hausmann 2005). Some authors see this as an imposition which, while protecting foreign investors from currency and inflation risks, forces the debtor country into a significant currency mismatch that has been shown several times to be associated with financial fragility and, ultimately, crises (Bordo, Meissner and Stuckler 2010). Others see it as a consequence of the historical dominance of reserve and vehicle currencies that cannot be avoided by emerging nations without internationally circulating currencies (Flandreau and Sussman 2005). Be as it may, this research has an obvious bearing on the ongoing debate on the Eurozone crisis and the 'monetary straitjacket' that binds Southern European nations, because they no longer control their own currency (Corsetti and Dedola 2013).

Second, an extensive literature has studied the credibility of exchange rate pegs and, in particular, the gold standard. Inspired by the pioneering work of Bordo and Rockoff (1996) who found a positive impact of the peg to gold on the cost of borrowing by sovereigns abroad, later contributions dismissed this effect as a 'thin film of gold' since the bond market could distinguish between credible and non-credible pegs (Flandreau and Zumer 2004, Alquist and Chabot 2011, Ferguson and Schularick 2012). Still on this line, Mitchener and Weidenmier (2015) separate currency from default risk by comparing the double spreads between British consols and gold bonds and between the latter and domestic currency bonds. They conclude that countries did not eliminate the currency premium incorporated in their yields by the simple fact of pegging to gold. In their sample of countries, the currency premium remained, on average, at a hefty 220 basis points even after pegging to gold.

The final body of research relevant to this paper deals with the unconventional monetary and fiscal policies pursued in the wake of the so-called 'Great Recession' of 2008-10, in particular, the measures taken to lower interest rates and soften the slope of the yield curve by concentrating on the market for long-dated assets (Bernanke 2009, Meaning and Zhu 2012) or by promoting the maturity extension of the stock of government debt owned by monetary authorities, the so-called 'operation twist' attempted by the Kennedy administration in the early 1960s. This operation has been recently interpreted by some authors as a laboratory to estimate the likely impacts of QE since 2009 (Gagnon et al 2011, Swanson 2011).

By studying the market for sovereign bonds of a small emerging nation (Portugal) during the classical gold standard, this paper contributes to these three literatures. The point of departure of the paper is the realization that, country to Mitchener and Weidenmier (2015), Portuguese sovereign bonds not only did not price a currency risk, but actually exhibited persistent periods when domestic-currency bonds paid lower yields than gold bonds. This is not only counterintuitive, but also surprising given the non-credible nature of the Portuguese peg in this period (Esteves, Reis and Ferramosca 2009). Part of this difference is explained by transaction costs in arbitraging similar assets across different markets, but the bulk of it is not. Instead, we suggest that the Portuguese authorities made use of a relatively sophisticated strategy to manage their debt market in order to anchor long term interest rates. Periods when the slope of the yield curve increased significantly were followed by large drops in the yields of domestic-currency bonds – large enough to bring them below the yields on comparable gold bonds. This evidence is suggestive of an early version of 'operation twist', whereby the Portuguese government intervened in the market to prevent excessive rises in its cost of credit and even to counteract them.

The fact that it was able to do so was apparently related to the barriers to arbitrage in the world markets for Portuguese debt. Until 1874 the bonds of Portuguese external debt (issued in gold) were not actively traded in Lisbon, whilst the bonds of the internal debt (in domestic currency) although quoted in London never gained a price there. Other countries explored similar barriers to market arbitrage in this period (see Tattara 2003 for Italy and Suzuki 1994 for Japan), but the Portuguese case is perhaps more extreme in that the authorities were able to revert the normal hierarchy between gold and paper bonds. Neal and Weidenmier (2003) notice that the volatility of short-term interest rates was lower in peripheral nations than in core countries, particularly during international financial crises. They surmise that this might have been due to hidden capital controls that rationed access to FX during crises in order to preserve domestic interest rate stability. Notwithstanding this

debt management strategy, the country was forced out of the gold standard in 1891 and, shortly after, had to default on its foreign debt. This stands to show that fiscal dominance of monetary policy and careful management of the bond market are only temporary palliatives to an ultimately unsustainable fiscal and external position.

The rest of the paper is organised as follows. The next section describes the data and documents the stylised facts about Portuguese external and internal debt in the period under study. Section 3 then tests the evidence against a number of alternative explanations in the literature. Section 4 proposes a different interpretation of the facts and relates them to observable measures of debt management. Section 5 concludes.

2. Stylised facts about Portuguese debt

The modern history of Portuguese debt started with a debt rescheduling after a bloodless coup in 1851 that inaugurated a period of 40 years of peaceful political cohabitation, the *Regeneração* (Quaresma 1988). Negotiated between 1851 and 1856 with the foreign bondholders, the rescheduling agreement determined a full swap of existing debts for two new perpetual loans, issued in 1852 and paying a low coupon of 3% (Esteves 2004). One of the bonds constituted domestic debt and was issued in Portuguese currency, the *real* (*fundo consolidado interno 3% de 1852*). The other bond, which was created to consolidate foreign currency debt, was formally external debt (*fundo consolidado externo*) and was denominated in and paid its coupons in gold currencies, namely sterling.[1] After the agreement with the bondholders, the *consolidado externo* was listed in the London Stock Exchange (LSE) where it remained actively traded until its conversion, 50 years later, into the new 3% 1902 external bond of 99 years.[2] Even though certainly traded there, the bonds of the Portuguese external debt were very infrequently listed in the Lisbon stock exchange prior to the mid-1870s, which suggests that their prime market was in London up to then.

The *consolidado interno* was initially only traded in Lisbon and paid its coupons in Portuguese currency. However, in May 1874 the LSE accepted it for quotation including it in the official list in the section of foreign bonds 'paying coupons abroad.' In fact, the Portuguese government promptly fixed an exchange rate to pay the coupons of these bonds in sterling in London. As far as we could ascertain, these bonds, if ever traded at the LSE, never had their price marked on the official list. Despite this, being 'officially quoted' was convenient in that it allowed trading the coupons, which although paid in Portuguese *réis*, could be cashed in sterling at the Portuguese financial agency in London at the fixed exchange rate of 53 1/3 pence per thousand *réis*. Portugal had joined the gold standard in 1851 and this rate was exactly the par against sterling. However, throughout the country's tenure in gold, the exchange was frequently under pressure, (close to the gold export point), and required frequent interventions in the FX market by the Bank of Portugal and the treasury to avoid depreciation or a gold drain (Esteves, Reis and Ferramosca 2009). By paying the coupons at par, the government created an arbitrage opportunity considering that the exchange in

[1] To be consistent with the literature we will refer interchangeably to *consolidado interno* or 'paper bonds' and *consolidado externo* or 'gold bonds.'
[2] This bond was also listed in other European exchanges, namely Paris and Frankfurt (since the 1880s).

London was usually against Portugal and more so around the dates of coupon payments, when the government bid up the price of bills on London in order to pay the service of the external debt.

The combination of these two facts suggests a segmented market for the two main Portuguese bonds of this period.[3] Before reviewing a number of possible interpretations, we document a few facts about Portuguese bonds. The data on bond prices comes from two main sources. For London prices we used the monthly average prices quoted in the *Investment Monthly Manual* (IMM) and which are available since 1869.[4] For Lisbon prices we hand-collected the data from the ads published by the stockbrokers chamber in the official journal, the *Diario do Governo*. Even though the frequency of these data is higher, we converted them to monthly averages to match with the British data. Until 1874 we found the prices of internal debt (*consolidado interno*) only, but starting on the 25 April 1874 we also have the quotes in Lisbon of the *consolidado externo* that we can compare with the London quotes. [5]

As shown in Figure 1, the prices of the bonds of internal debt (denominated in local currency) were frequently above the prices of the external debt in London. This is particularly evident in the early 1870s and the mid-1880s. Converting the prices into simple yields in Figure 2 reveals that these price differences corresponded to *negative* spreads of up to 100 basis points.[6] These spreads contrast strongly with the average of *positive* 220 basis points found by Mitchener and Weidenmier (2015) for a sample of emerging economies in the same period. Even if the negative deviations could be explained away, the absence of large spreads between gold and paper bonds is remarkable, especially for a country known for fiscal fragility and with a currency peg under almost constant pressure. Indeed, the average spreads of Portuguese gold bonds (*consolidado externo*) against the British consols stood above 300 basis points between the late 1860s and 1890 (Table 1). Although smaller than the spreads of other emerging nations of the time, these were not trivial.

Figures 1 and 2 and Table 1 about here

Table 1 contains information on the sustainability of Portuguese finances. The most significant ratio is the debt service over government revenue, which was tracked by contemporaries and reveals the slow build-up of an unmanageable burden. Of course, this characterisation can be pray to a *post hoc* bias in that the historian knows the endgame, namely, the Portuguese default of 1892. However, the cumulative burden of the Portuguese debt was also not lost on contemporaries. For instance, the 1883 edition of the *Fenn on the Funds*, a British financial handbook, duly singled out Portugal as one of the most indebted European nations.

[3] On average, the two bonds represented 87% of the total Portuguese funded debt in the period we are considering, according to the figures in Mata (1993).

[4] This is the reason why we start our study in 1869. The data can be downloaded from http://som.yale.edu/imm-data-miscellaneous .

[5] The ads were published on a daily basis since 1862 and contain more than 4800 prices of internal bonds and 845 quotes of external bonds (since 1883).

[6] The month of July 1870 was exceptional when the Lisbon yields of the domestic debt were 181 basis points below the London yields of the external debt.

As mentioned previously, from mid-1874 we also have quoted prices for Portuguese external debt in Lisbon (Figure 3). However, quotes only became regular in 1882. Interestingly, the Lisbon prices of this bond were also higher than in London at about the same time that the spreads between paper and gold bonds were negative. Considering that the same bond was quoted in the two markets this begs the question of what drove these price differences. It turns out that they can be explained away by exchange rates and, possibly, transaction costs, as we will show in the next section.

Figure 3 about here

A final salient fact about Portuguese debt is the location of the interest payments on the two bonds. The coupons of the external bonds could be paid in Portugal and abroad, initially only at the Portuguese financial agency in London, but later also in Paris, Berlin and Amsterdam. Although the payments in foreign locations were mostly for the convenience of foreign bondholders, there is considerable anecdotal evidence that Portuguese investors also used this vehicle to cash in the coupons of the external and, since 1875, also of the internal debt in foreign currencies (Martins 1895, Sousa 1916). Figure 4 depicts the share of interest on the two bonds paid outside of their prime market, based on information published by the Portuguese debt office (*Junta do Crédito Público*).

Figure 4 about here

The Figure shows a distinct trend toward a larger fraction of paper bonds being served in London, although these figures are an overestimate since they include the interest paid on paper bonds owned by the government and deposited at the Portuguese financial agency in London. There is also an episode, between 1872 and 1876, when a larger share of the coupons of gold bonds were presented for payment, at par, in Lisbon. Despite this, the two shares are fairly small throughout in accordance with our claim that the prime market for gold bonds was in London and for paper bonds in Lisbon. We defer a possible interpretation of these facts to the next section as it relates to our analysis of the differences in bond prices. However, it is clear that the implicit gold clause of the Portuguese domestic bonds does not seem to have been acted on. This stands in marked contrast with the case of the Italian paper bonds, which had a similar exchange rate clause in Paris. As a consequence of the persistent depreciation of the lira relative to this exchange clause, the fraction of Italian coupons paid abroad varied between 30% and 80% of the total during the same period we consider in this paper (Tattara 2003).

3. Price differences questioned

3.1 My gold is better than yours

Having set the facts about Portuguese yields in the previous section, we now review a number of possible drivers of the abnormal spreads of Portuguese bonds. We start with the comparison between London and Lisbon quotes of gold bonds (*consolidado externo*). As illustrated in Figure 3, the puzzle there was the substantial deviations in prices between the two markets, in seeming contradiction of the forces of financial arbitrage. Unlike our comparison of paper and bond yields, in this case both markets priced the same asset, with the same default and currency risks. Figure 5 expresses the differences in terms of yields, showing that the price differences translated into spreads of between ± 30 basis points.[7]

Figure 5 about here

It is tempting to explain these small spreads with a liquidity præmium. Since spreads were negative most of the time, this would require that the market for external bonds was more liquid in Lisbon than in London. This is a possibility and maybe the reason why Lisbon started publishing the quotes of this loan in 1874. Furthermore, the historical literature has commented on the progressive loss of interest of the LSE for Portuguese bonds since the 1880s, a period when the government preferred placing new bonds in Paris and Berlin (Esteves 2004). Nevertheless, it would be hard to justify the observed swings in spreads with changes in the relative liquidity in the two markets.

In fact, we do not need to, because two further considerations are sufficient to explain the price differences. The first are exchange rate deviations. The bonds of the external debt paid interest 'in gold' which in practice meant that the Portuguese state paid the coupons in foreign currencies at an exchange rate fixed for the life of the loans. The *consolidados externos* were denominated in sterling, so that the current exchange rate could create incentives for investors to cash in their coupons in one or other market. Let *c** be the coupon paid in sterling, P_{Lx}^{g} (P_{Ld}^{g*}) the Lisbon (London) price of the bonds and *e* the deviation of the spot exchange rate from par.[8] Because these bonds were perpetuities, we can compute their simple yields:

$$i_{Ld}^{g*} = i_{Lx}^{g} \Leftrightarrow \frac{c^*}{P_{Ld}^{g*}} = \frac{c^* e}{P_{Lx}^{g}} \Leftrightarrow P_{Lx}^{g} = e P_{Ld}^{g*} \quad (1)$$

Arbitrage requires the yields in the two markets to be the same, but the Lisbon yield has to be adjusted by the current exchange rate since the coupons were paid in sterling. A sophisticated investor could choose between receiving his coupons in sterling in London or in Lisbon, where the external bonds were priced in Portuguese currency *at par*. Consequently, whenever the Portuguese currency was depreciated ($e > 1$) market clearing required a higher bond price in Lisbon to

[7] There is a larger positive spread at the very end of the period, but that may already be driven by the expectations of devaluation and, possibly default, 13 months later.

[8] We adopt the convention that starred variables are expressed in sterling and non-starred variables in Portuguese currency.

compensate for it. On top of that, arbitrage was obviously not costless, so we still need to amend expression (1) for the likely cost of trading in Portuguese external bonds between London and Lisbon. If *d* represents arbitrage costs in percentage, the final no-arbitrage condition comes:

$$P_{Lx}^{g} \in [(1-d)eP_{Ld}^{g*}, (1+d)eP_{Ld}^{g*}] \qquad (2)$$

We have two historical sources on the size of *d*. The first is the bid-ask spread in Lisbon for these bonds, which in the period for which we have prices (1883-91) averaged 63 basis points (with a median of 51). The second source is the direct cost of actual transactions recorded in the ledgers of the Bank of Portugal. Unfortunately, we only found information about these expenses for an earlier period, between 1864 and 1868. Despite that, they are informative about the components of the arbitrage costs. The ledgers refer to three costs: broker's fee (*corretagem*), commissions, and the cost of sending telegrams.[9] Interestingly, the fees were not symmetric. When buying Portuguese *consolidados* the Bank had to pay an average of 38 basis points, compared to 18 basis points for the reverse operation. Adding the two we reach 56 basis points, which together with the bid-ask spread totals close to 120 basis points for a buy-and-sell arbitrage operation. Figure 6 plots the arbitrage bands of expression (2) against the prices in Lisbon (P_{Lx}^{g}).[10]

Figures 6 and 7 about here

There are two implications from this Figure. First, the Lisbon price was mainly within the arbitrage bands for the London price. Second, the price differences were driven by the deviations of the exchange rate from par.[11] There were two notable periods when the Lisbon price deviated persistently above the bands – 1884-85 and 1890. But these were also the periods of greater pressure in the FX market in the window considered in the Figure 6. We can measure these by using market-based expectations of devaluation. Figure 7 represents these expectations as confidence intervals of the deviation of the exchange from par.[12] Whenever the interval rises above the zero line that means that the markets incorporated an expectation of devaluation. On these occasions, the hedge value of the coupons paid in sterling increased, requiring a Lisbon bond price above the band implied by the spot exchange rate to compensate for the expected devaluation. Conversely, there is a short period, in July-August 1876, when the price of paper bonds deviated significantly below the arbitrage bands. This coincides with the height of a banking crisis, which was contained by a life-boat operation jointly funded by the Bank of Portugal and the government (Reis 2007). During the panic in Lisbon, it is possible that fire sales of liquid assets (such as government bonds) by troubled institutions could have momentarily depressed the price of gold bonds. By September, once the

[9] The data come from the ledger CG-68 'Livro 1 Títulos.'

[10] Exchange rate information comes from Esteves, Reis and Ferramosca (2009).

[11] In periods when $e > 1$ the arbitrage bands shift up relative to the London price, as was the case, e.g., between 1883 and 1886. If the deviation of *e* from par is sufficiently large, it is even possible that the band does not intersect the London price P_{Ld}^{g*}.

[12] On the details of the estimation of market-based devaluation expectations see Esteves, Reis and Ferramosca (2009).

worse of the crisis had passed, the prices of these bonds in Lisbon and London were back in alignment.

The devaluation expectations in 1890 were self-fulfilling since the country abandoned gold in May 1891. In the previous episode the authorities were able to defuse the pressure on the currency by abolishing, in March 1886, a duty on gold exports, which had allowed the currency to depreciate further while still remaining within the gold points. The Bank of Portugal had requested this measure from the government in a submission in January 1884 claiming that the duty imposed an extra cost on its FX operations. In another paper, we documented how the Bank of Portugal co-operated with the government to prevent the currency from reaching the gold export point because of the risk that entailed to the gold reserve of the Bank (Esteves, Reis and Ferramosca 2009). The preferred method was for the Bank to draw bills on its correspondents in London and offer them in Lisbon at below the gold export point to prevent gold outflows that would deplete its reserve. The Bank therefore intervened in the FX market at a loss because it sold the bills at a lower price than it had bought them for in London, and this loss was larger as long as the export duty remained. The abolition of the duty had a salutary impact, which is also reflected in Figure 5 by the permanent drop in the size of the *positive* spreads between the Lisbon and London prices of the *consolidados externos*.

Unsurprisingly, these interventions in the FX market were more pressing around the time of the payment of the coupons of the external debt (January-July) when the government's demand for bills on London was at its highest. On these occasions monetary and fiscal policy were conflated in that by preventing devaluation the authorities were also facilitating the burden of servicing the external debt. The debates in parliament about the abolition of the gold duty duly mentioned the "annual loss for the treasury from the remittance of money to London to pay for the coupons" of the external debt.[13] The loss was estimated at over £13,000 per annum. Tattara (2003) discusses a similar case about the prices of Italian bonds quoted in Paris and Milan. As the Portuguese currency, the fact that the lira was constantly under pressure against the franc created arbitrage opportunities. In order to prevent a regular migration of coupons of the Italian debt to be cashed in in Paris at greater cost to the state, the government intervened in the FX market and created other obstacles that raised the arbitrage costs.

On the rare occasions when the currency threatened appreciating against sterling, the reverse case applied (since the coupons of the external debt could be cashed in at par in Lisbon). Although we only have sparse price data for Lisbon in the period 1872-75, when the confidence interval in Figure 7 floated below the zero line, this is consistent with the ephemeral increase in the share of gold coupons cashed in in Lisbon (Figure 4).

3.2 Paper better than gold?

Having concluded that the price differences between Lisbon and London for gold bonds were explained by exchange rate pressure and arbitrage costs, we now turn to the comparison between gold and paper bonds. Exchange rate deviations and arbitrage also mattered in this case, so that a no-arbitrage condition similar to (2) applies. However, this case is a bit more involved as we are

[13] *Diario da Camara dos Senhores Deputados*, seating of 6 May 1885, p. 1463.

considering arbitrage between two different assets in two separate markets, as opposed to the same asset in two markets as in (2). The first consideration is that, as mentioned in section 2, the Portuguese paper bonds had an effective gold clause, since 1875, since the coupons were paid in London at par (e = 1). This implied that, in exchange for sending their coupons to London for collection, investors in Portugal could effectively cash them in gold (i.e. sterling), even though they had bought the bonds for Portuguese currency. A second consideration has to do with the tax treatment of the two bonds. In May 1881, the Portuguese government introduced a 3% income tax to be deducted from the interest payments of the paper bonds, while the external bonds were exempt.

Let c be the coupon paid in Portuguese currency, c^* the same coupon paid in London at par (after 1875) and t the income tax.[14] Define P_{Lx}^{p} as the price in Lisbon (in Portuguese currency), of a paper bond, respectively. Finally, let P_{Ld}^{g*} be the London price of the gold bonds (in sterling) and e the deviation of the spot exchange rate from par. Then, two no-arbitrage conditions tie the yields of the paper bonds in Lisbon and the gold bonds in London:

$$\text{Until 1874:} \qquad i_{Lx}^{p} = i_{Ld}^{g*} \Leftrightarrow \frac{c(1-t)}{P_{Lx}^{p}} = \frac{c^*}{P_{Ld}^{g*}} \Leftrightarrow P_{Lx}^{p} = \frac{(1-t)P_{Ld}^{g*}}{e} \quad (3a)$$

$$\text{Since 1875:} \quad i_{Lx}^{p} = i_{Ld}^{g*} \Leftrightarrow \frac{c^* e(1-t)}{P_{Lx}^{p}} = \frac{c^*}{P_{Ld}^{g*}} \Leftrightarrow P_{Lx}^{p} = (1-t)eP_{Ld}^{g*} \quad (3b)$$

where in the first expression, we substituted $c^* = ce$, since both bonds paid the same coupon as a percentage of the nominal value of the bonds (3%), so the coupon paid in sterling was worth more than the coupon paid in *réis* if the exchange was depreciated (e > 1). In the second expression, the Lisbon price of the paper bonds is adjusted for the gold clause of their coupons in London. This means the relevant coupon is no longer c but c^*e. The introduction of the gold clause in 1875 would have changed the way the Lisbon price P_{Lx}^{p} reacted to the exchange rate. Until then a depreciated currency increased the value of assets with income in gold, so that the price of the paper bonds had to fall to clear the market. Once even the 'paper' bonds offered the option of receiving their coupons at the par exchange rate, a depreciation increased their price in Lisbon because they were traded there in Portuguese currency and yet had their income fixed in sterling. This constituted an advantage for their owners, which required an increase in prices to eliminate any arbitrage opportunities.

Finally, adding up arbitrage costs gives us new arbitrage bands:

$$P_{Lx}^{p} \epsilon \left[\frac{(1-t)(1-d_b)P_{Ld}^{g*}}{e}, \frac{(1-t)(1+d_s)P_{Ld}^{g*}}{e} \right] \quad (4a)$$

$$P_{Lx}^{p} \epsilon \left[(1-t)e(1-d_b)P_{Ld}^{g*}, (1-t)e(1+d_s)P_{Ld}^{g*} \right] \quad (4b)$$

The available data on the transaction costs of internal debt imply that the direct expenditures in Lisbon were lower than for external bonds in London. The same ledger of the Bank of Portugal places them at 13 basis points.[15] The quoted bid-ask spreads average 34 basis points, so that will

[14] The tax started applying in May 1881; until then t = 0.
[15] Bank of Portugal Archive ledger CG-68.

imply asymmetric transaction costs. If P_{Lx}^{p} deviated above the band, an investor would want to sell gold bonds for paper bonds at an approximate cost of d_s =80 basis points. In the reverse case, costs were in the order of d_b=100 basis points.[16] Figure 8 adds the corresponding arbitrage bands to the plot of Figure 1.

Figures 8 and 9 here

Contrary to the case of the gold bonds' prices, discussed in the previous sub-section, there are frequent and persistent deviations from the arbitrage bands. It is remarkable that Lisbon prices of paper bonds moved from persistently below the arbitrage band in the second half of the 1870s to above the band in the later part of the 1880s. This behaviour immediately invites considering the impact of exchange rate expectations as a possible driver of the price differences. However, substituting the market-based expectations of devaluation for the spot exchange rates actually *increases* the positive deviations from the arbitrage bands before 1875 and the negative deviations after (compare expressions 4a and 4b). This is because investors would hedge against an expectation of devaluation by selling their paper bonds for gold bonds in the first period, whilst they would be protected from currency fluctuations in the second period. Consequently, the market would only clear at lower prices for paper bonds before 1875 and higher prices thereafter. Figure 9 illustrates.

There are several possibilities for reconciling these results with efficient arbitrage between Lisbon and London. First, we may be underestimating the arbitrage costs. Second, our measure of devaluation expectations may overrate the true scale of the expected devaluation. Third, bondholders could have differential expectations about default probabilities of external and internal bonds. Before reviewing each of these in turn, we represent in Figure 10 the scale of the unexplained price differences. The Figure plots the difference between the prices of paper bonds in Lisbon and gold bonds in London, as well as the share of that difference within the arbitrage bands of Figure 8.

Figure 10 and Table 2 about here

Table 2 reports the summary statistics of these two quantities, separating between positive and negative spreads between the prices of paper and gold bonds (using actual exchange rates). By averaging out over the whole period, the Table understates the scale of deviations in some periods, as the years 1883-86, when the prices of domestic bonds in Lisbon were almost 200 basis points, on average, above the arbitrage band for the London prices of gold bonds. Despite this, it is clear that it

[16] Details are as follows. For the first operation, the investor would pay a total of 79 basis points distributed by 13 in direct expenditures in Lisbon, 18 in direct expenditures in London, 17 for the mid bid-ask spread in Lisbon and 31 for the mid bid-ask spread in London. In the second operation, the corresponding values were 13 + 38 + 17 + 31 = 99 basis points.

would be hard to explain the unaccounted for price differences with larger arbitrage bands. Consequently, we move to the second alternative, devaluation expectations.

Our measure of these expectations is the 'credibility test' proposed by Bertola and Svensson (1993) to back-up the expectations of devaluation (i.e. after leaving the peg) within a non-credible target zone (Figure 7). Figure 11 shows that when we substitute these expectations for the actual exchange rates, the scale of the unexplained positive price deviations after 1875 is indeed reduced, but that correspondingly the negative deviations in the second half of the 1870s also increase. A possible explanation for this mismatch could be the presence of a large share of unsophisticated domestic investors in paper bonds, who either were not aware of the recent introduction of the gold clause for coupon payments in London or would not act on it. Indeed, as already mentioned, the share of coupons of the internal debt cashed in in London is remarkably small when the exchange was more frequently above than below the gold par (Figure 4). The year 1876 was also marred by a serious banking crisis which would certainly have led to capital flight, in particular to the gold bonds traded in an offshore market (London).

Figure 11 about here

The formula for these market-based expectations uses the Uncovered Interest Parity (UIP) to substitute for the expectations of depreciation within the gold points. UIP requires measures of short-term interest rates in the two markets for which we used the discount rates of the Bank of Portugal and the Bank of England.[17] Consequently, an alternative explanation for the large negative deviations after 1875 could be that the prices of the Portuguese long-term bonds reacted more to long-term expectations of devaluation than to the short-term measure we are using here. In other words, we need expectations of exchange rate realignment to be lower over longer than short horizons.

There is some support for this pattern of expectations during the gold standard. 'Currency crashes' following the relinquishing of the peg were typically larger over the short-run, while the exchange rates typically stabilised or even recovered some of the lost ground after the realignment, once the economy reacted to the gain in price competitiveness (Catão 2007). That was precisely the case of Portugal after abandoning gold in May 1891. By 1892 the currency had lost 27% of the previous par, the nadir was reached in 1898 (-58%), but by 1906 the exchange was barely 2% away from par (Esteves 2004). It is, of course, possible that markets factored in this slow slide of the currency in the prices of the domestic paper bonds (which would be irrelevant for the 3 months assets of the money market). However, the implied magnitudes are too large to explain the observed prices differences on their own.

The realignment expectations of Figure 7 are taken from the money market and are expressed in expected percentage points *per year*. In order to bridge the 144 basis points average negative deviation in Table 2 required a lower expected devaluation by 2.8% per year (relative the short-term expectations already included in the arbitrage bands). However, the average value of the upper bound of the expectations in Figure 7 (in periods of negative deviation of bond prices from the

[17] The reason being that we only have information on short-term market rates for Lisbon from 1885; but the results do not change when we use market rates instead of bank rates. From 1885, Neal and Weidenmier (2003) collected the weekly rates on 3 months bills in Lisbon, published by the Economist.

arbitrage bands) is of only 2.4% per year. Therefore, if all the price differences were to be accounted for by this mechanism, the markets would have to expect short-run devaluations followed by longer term appreciations *above par*. Even if the experience of currencies that left gold broadly follows a U shape they typically did not settle at higher levels than their previous gold pars.

The third possibility for reasoning the unexplained price differences is to interpret them as the reflection of bondholders' expectations that, in case of default, the government would penalise foreign investors more than domestic ones. This argument follows directly from a standard model of the political economy of sovereign borrowing (Alesina and Tabellini 1990) and has been recently investigated empirically. Reinhart and Rogoff (2011b) uncover a 'forgotten history' of domestic default and show, among other things, that domestic bondholders were not treated as junior to external bondholders. Their evidence, however, is far from conclusive, because it only concerns the likelihood of defaults on the two classes of debt (rather than the haircuts) and ignores the fact that resident investors can buy formally 'external' bonds (and vice-versa). Broner, Martin and Ventura (2010) have a model where the existence of a secondary market for external bonds can prevent strategic default, as foreign investors can sell the bonds back to domestic residents. Above a certain threshold of domestic ownership default becomes too costly politically.

The latter model seems to have some application to Portuguese debt history in the nineteenth century. It was certainly the perception of many contemporaries that a substantial fraction of formally 'foreign' debt was actually owned by domestic investors, albeit for the reverse mechanism as the one considered in Broner, Martin and Ventura (2010). For instance, Esteves (2002) estimates that 20% of new external bonds floated in the 1870s had been placed in Portugal, a share that increased to over a third in the following decade. There is also evidence of substantial transactions in the secondary market; however most authors have seen this as a defence mechanism by domestic investors. Many contemporaries (and historians since) described how investors thought that by joining the ranks of external bondholders they would be more protected against a future default or would get a better treatment in case of government insolvency (Sousa 1916, Oliveira 1941, Vieira 1983). This could explain the period of negative spreads between domestic and external bond prices after 1875. As already mentioned, Portugal went through a severe banking crisis in 1876 and the Bank of Portugal and the government had to co-operate to contain the crisis and prevent it from developing into a full-blown currency crisis (Reis 2007). Nevertheless, investors might have feared that the trouble in the banking system would have spilled over to the government financial position, a 'diabolic loop' for which there is considerable evidence in history and today (Brunnermeier et al. 2011, Reinhart and Rogoff 2011a).

But it would not explain the prolonged period in the 1880s when domestic bonds priced above the arbitrage band for gold bonds. If indeed bondholders discounted external bonds as subject to a higher default risk maybe this differential probability could account for the observed deviations. Unlike the case of devaluation expectations, the required magnitudes consistent with this story are reasonable. To bridge the gap between the higher price of paper bonds and the arbitrage bands in the 1880s would require that holders of external bonds expected to suffer a 3.5% higher expected loss from default than the owners of domestic bonds. This figure is not directly interpretable, because it is the product of the expected probabilities of default of the two types of bonds and the

expected haircut conditional on default.[18] Nevertheless, the magnitude of the product is reasonable. Even so, we do not believe this is a good explanation of the facts.[19] In the first place, because it contradicts all anecdotal evidence from the time and the historical analysis of this period. And secondly, because a better explanation can be found elsewhere.

4. Price differences explained

Portuguese external bonds were issued in this period with a number of enhancements. Apart from being paid in gold, they were tax-exempt (unlike the domestic bonds since 1881) and, more importantly, included a conversion option into domestic bonds at specific exchange rates. The government manipulated this rate either to encourage or dissuade the conversion at different times. According to Mata (1993) between 1853 and 1894, £21.6 million of *consolidados externos* were converted into *consolidados internos*, which represents more than 31% of the total issue of the former. Although it is possible that foreign investors also availed themselves of this possibility, all contemporary authors interpreted this as the counterpart of the investment in external debt by domestic residents, who then converted it into internal bonds whenever the exchange rate offered by the government was sufficiently favourable.[20] An early critic of this state of affairs was Bulhões (1867), who campaigned for the unification of the external and internal consolidated debts. Bulhões was a part-time journalist and life-long civil servant. One of his longest postings was precisely with the *Junta do Crédito Público*, which made him a well-informed pundit on public finance. According to him, the several enhancements of the internal and external bonds created an artificial price

[18] This value was calculated as follows. First we incorporated a differential probability of default of the two types of bonds π^g and π^p in expression (3b). For instance, the adjusted yield of the paper bonds in Lisbon is now $i^p_{Lx} \equiv \frac{c(1-t)}{P^p_{Lx}(1-\pi^p)}$. The equivalent relation between the two bonds prices is:

$$P^p_{Lx} = (1-t)eP^{g*}_{Ld}\frac{1-\pi^g}{1-\pi^p} = \tilde{P}\frac{1-\pi^g}{1-\pi^p} \quad (3c)$$

From Table 2 we know that, on average, $P^p_{Lx} - \tilde{P}$=1.56 and replacing this in (3c) we solve for the implied ratio $\frac{1-\pi^g}{1-\pi^p}$. Finally, to translate this into a ratio of expected losses i.e. $\frac{\pi^g}{\pi^p}$ we need a benchmark value for π^g, which we obtain by comparing the yields on Portuguese gold bonds and British consols (i^*_B) in the usual way: $\pi^g = \frac{i^{g*}_{Ld} - i^*_B}{i^{g*}_{Ld}}$. In the period under study, this implied expected loss averaged π^g =52%. After replacing it in the previous expression we finally get π^g/π^p = 1.035.

[19] If these expectations were incorporated in the bond prices they were not borne out by reality, once default occurred in 1892. On average, the two classes of bonds suffered a similar interest cut during the period of partial default (1892-1901): -65.6% for domestic bonds and -62.3% for external bonds. The fate of the owners of external gold bonds was also improved with the settlement of 1902, which imposed a permanent haircut of 56% (Esteves 2013).

[20] See, among others, Sousa (1916) and Martins (1895). The latter associated the conversions of external into internal debt as one of the vehicles for transferring remittances from Portuguese emigrants in Brazil, who bought these bonds as a way of repatriating their savings. A further reason why only domestic residents would be interested in this conversion is that while external bonds were bearer bonds, the law only allowed converting them into nominative domestic bonds (*inscripções*). This must have reduced their liquidity, as each transaction in these bonds required legally changing the name of the owner at the central debt office in Lisbon. Arguably this would be more dissuasive for foreign than domestic savers.

difference between the two bond issues, which was detrimental for the credit of the Portuguese state. In a book published in 1869, Bulhões summarised the issue very clearly:

> *When all our debt is unified the price difference between external and internal will disappear. Until then there will be a positive or negative difference caused by:*
> *the uncertainty about whether the conversion* [in internal debt] *will be permitted or not;*
> *the variation in the exchange rate at which this conversion has been allowed;*
> *the difference between this exchange rate and the price of bills* [on London] *to buy bonds of the external debt;*
> *the uncertainty about the exchange rate at which the coupons will be paid;*
> *the risk of transferring funds* [to abroad] *and the cost of insuring them; and finally by the commissions that have to be paid to receive the coupons abroad*.[21]

The last two items in this list have already been covered in the analysis thus far: exchange rate deviations from par (or expectations) and arbitrage costs. The first three refer to the conversion option into internal debt, which the government could facilitate by tweaking the exchange rate at which sterling bonds could be swapped for securities denominated in Portuguese currency.[22] The government could therefore offer a shortcut to the usual arbitrage between the two bonds by allowing the direct conversion between the two bonds at a favourable exchange. Notwithstanding Bulhões's complaint against the practice, there is some circumstantial evidence that the government used the conversion rate as a policy instrument.

Unfortunately, the evidence is only available at annual frequency from the reports of the Portuguese debt office (*Junta do Crédito Público*) and the annual budget reports, published by the government.[23] In particular, the budget reports included a section on the differences between the previously budgeted expenditure and the effective outlay during the fiscal year. In the case of the funded debt, the major source of discrepancies were the changes in the interest paid on external and internal bonds. These were then caused by the conversions of external bonds into internal bonds, which had occurred during the fiscal year and could not have been accurately estimated at the time of voting the previous budget law. The same source details the exchange rate at which the conversions were authorised. Figure 12 represents these data.

Figure 12 about here

The first thing to notice from this Figure is that the exchange rate offered for the conversion was almost always below par. This meant that the government offered the option of conversion of external bonds at a rate almost always appreciated against the market. For instance, in 1867 when Bulhões was writing, the conversion rate was 54 ½ pence for a thousand *réis* (a 2.1% appreciation

[21] Bulhões (1867: 96-97).
[22] On a few occasions, the government also excluded particular issues of the external bonds from this option, but later reneged.
[23] All budgets are available online from http://purl.sgmf.pt/repositorio/orcamentos/index.html The two sources disagree on occasion about the timing of the conversion operations. While we continue investigating the source of this disagreement, we use in here the series collected from the annual budget reports.

against par), while the average market exchange rate was depreciated by 1% against par. The second inference from this Figure is that there was a rough correspondence between the exchange rate at which the conversion was allowed and the take-up by investors. In general, an improvement in the conversion rate (meaning a less appreciated exchange) was followed by large volumes of conversions.[24]

By offering the conversion at an official exchange rate below par $\varepsilon \leq 1$, the government created an alternative to market arbitrage between domestic and paper bonds. In effect, the government generated a floor for the price of paper bonds:

$$P_p^{Lx} \geq \varepsilon^{-1} P_g^{Ld} \quad (5)$$

By keeping the right-hand side below the market price of paper bonds, the government offered an arbitrage opportunity to investors, who could convert gold bonds into paper bonds, later to resell them at a higher price. But this option did not eliminate the other sources of price differentials identified in Bulhões (1867), namely uncertainty about future exchange rates and arbitrage costs. Consequently, the conversion option would only be binding when the price differential exceeded the arbitrage bands previously identified. This is precisely what is shown by the data represented in Figure 13.

Figure 13 about here

The Figure adds two new series to Figure 10: the annual volume of debt conversions (in thousands pounds) and the difference between the price of domestic bonds and the price floor created by the conversion option.[25] As mentioned, only when the latter difference rose above the arbitrage bands did the investors execute the conversion option. This association is clear throughout the period, as the market price of domestic bonds closely trailed the floor provided by the conversion option. Whenever this floor rose above the arbitrage bands it triggered large conversion flows. In the later 1870s, if anything, bondholders would have benefited from a reverse conversion option as the prices of domestic bonds dipped below those of external bonds. Notice, however, how the conversion price ($\varepsilon^{-1} P_g^{Ld}$) remained above the market price of paper bonds until 1880, once the government reversed the generous conversion rate it applied until 1876 (see Figure 12).[26] Nevertheless, the joint forces of the gold clause for coupon payments in London and the exchange rate for bond conversions still provided a floor for the price of paper bonds, which would have probably dipped further were it not for these enhancements.

[24] The conversions values in Figure 12 only represent swaps between *consolidados internos* and *consolidados* externos up to 1886. In 1887 the government stopped allowing the conversion of the bonds of the external debt into the 3% perpetual paper bonds. Instead, it created a new 5% paper bond specifically for the purpose of this conversion, which was issued in two series, one in 1887 and the other in 1888. Likewise, in 1889, the conversion was allowed into the bonds of the new 4 ½% paper bond.

[25] Consistent with Figure 12, we used the 5% domestic bond (during 1887-88) and the 4 ½% bond (during 1889) to proxy for the price of paper bonds. We converted them to the price of 3%-equivalent bonds.

[26] In 1881 this inversion was pushed to an extreme, when the market price of paper bonds was both above the arbitrage band and *below* the conversion price, eliminating any advantage in using the conversion option.

Even though we only have annual data on conversion flows, the periods when the price floor intersected the arbitrage bands were characterised by no or small conversions (1883-84).[27] As visible from Figure 12, these were also periods when the government changed the exchange rate to make the conversion less attractive. In contrast, the price differential between paper and gold bonds tended to contract after periods of intense conversions. In a sense, the manipulation of the official conversion rate was self-defeating because a very favourable rate would attract large conversions into domestic bonds, which by increasing the supply of these bonds would put a downward pressure on their price in Lisbon.

However, the enhancements included in the paper bonds are not a panacea for explaining the observed price differentials. For instance, there are prolonged periods in the 1880s when the price of paper bonds was both above the arbitrage bands *and* the price floor provided by the conversion option. Some literature hints at a form of financial repression which could explain these differentials. This has to do with the compulsory sale of real estate owned by religious corporations and other charities. A law of 1861 forced these corporations to sell their real estate and to convert the proceeds into domestic debt, namely, the *consolidados internos*. The sale of church property was started in the 1830s with the confiscation and sale of male convents and monasteries, but was later extended to the property owned by the secular clergy by the 1861 law.[28] The whole operation was not completed by the end of the century, but the majority of the property had been converted by the early 1880s. In another book, Bulhões (1884) estimated that by 1883 the religious corporations had been forced to convert £2.5 million worth of real estate into bonds with a nominal value of £5.1 million. Adding to this, there were still the laws about trusteeships that required all funds under trusts to be invested in the same class of inscribed bonds. Bulhões again estimated these funds at £13 million. The two figures added up mean that, at the time he wrote, almost 41% of the domestic *consolidados* were effectively out of the market. Incidentally, several authors raised similar concerns about the increasing 'artificiality' of the market of British consols, as it was increasingly swayed by large funds invested into trusts (Playford 1856, Giffen 1904). Even though there is not a comparable central source for the total capital of British funds invested in trusts, we can surmise that it should have been at least close to 13% of the total in 1870-71, a period when the corresponding value for Portugal was already of 28%.[29] Nevertheless, Giffen (1904) stated that the share of these investments in Britain had especially increased since 1895, and conjectured that they were responsible for an artificial premium in the price of consols of between 5 and 10 percentage points.

[27] The correspondence is less clear in 1881-82 and 1886, although that may be due to the low frequency of the conversions data.

[28] Female convents were also extinguished piecemeal, as the law required the last nun to die before the convent could be sold!

[29] The information for this estimate comes from two sources. In 1870 the Bank of England reported on the stock of gilts deposited by a number of public institutions that directly held a portfolio of government stock (such as savings banks) or that managed large swathes of trustee accounts invested in the same securities (the Court of Chancery). The total reached £93.4 million (United Kingdom 1870). The second source is the report of the Universities Commission on the finances of Oxford and Cambridge universities, which stated an annual income of c. £66,000 accruing from investments in 'stocks and shares' for the year 1871 (United Kingdom 1873). Considering how restrictive trustees' acts were at the time, we can safely assume that the vast majority of these were invested in gilts. Finally, assuming a 3% average coupon we obtain a notional capital of £2.2 million. These two figures added correspond to 12.8% of the outstanding stock of gilts in 1870.

More interesting than the actual level of the share of these investments is the fact that this share increased markedly after 1878, coinciding with a particularly active period of sale of religious property.[30] Pinheiro (1986, 2014) considers that this was no random coincidence and that the government accelerated the sales to support the market for domestic debt. We could not find any corroborating statement about this policy, so will have to take this interpretation with a pinch of salt. Moreover, changing the schedule of sales of religious property looks like a blunt instrument to influence the market for public debt. It could imply significant opportunity costs, as the value realised by the religious corporations and other charities could be harmed by ill-timed sales. In an attempt to test this hypothesis we ran a VAR with five variables. The first variable included **price_out** is the out-of-band price difference between paper and gold bonds (from Figure 10), which we are trying to explain. We then added four possible explanatory variables: **pcons** the price of British consols, to control for the influence of the benchmark on spreads (Eichengreen and Moody 2000), **sales** the values of the sale of church real estate, **mide** the average deviation from par of the exchange rate and **econv** the official exchange rate ε for bond conversions (Figure 12).

From September 1872 to December 1886 we have information on the monthly sales of real estate from the reports of the *Junta do Crédito Público* so we will run the VAR with monthly data (172 data points) and an optimal lag of 2 months.[31] Since all the variables are potentially endogenous (with the exception of **pcons**) we will not try to argue strongly for identification. Instead, we focus on the impulse response functions and on a variance decomposition based on a Cholesky ordering of the individual disturbances. We ordered the variables in three groups: first **pcons**, since the price of British consols would be exogenous to the Portuguese debt market; second policy variables which would only be changed with at least one month lag **sales** and **econv**; and finally the outcome variables **mide** and **price_out**, which could change daily.[32] The IRFs are collected in Figure 14 and the variance decomposition is listed in Table 3.

Figure 14 and Table 3 about here

We standardised all variables to mean zero and standard deviation 1, so that a shock of one unit to the disturbances is normalised to one standard deviation of each impulse variable.[33] The only shock with a persistent effect on price_out is that on the official conversion rate econv. A one standard deviation increase in econv (meaning an improvement in the terms of conversion) reduced the unexplained price differential by up to 0.52 standard deviations after four months. This is in seeming confirmation of the usefulness of keeping an appreciated econv to support the price of the domestic paper bonds. Any improvement in econv depressed these prices and contributed to the convergence of yields between gold and paper bonds. Consistent with (4b), the shocks to the exchange rate mide

[30] According to the reports of the *Junta do Crédito Público*, the share of bonds immobilised either in trusts or religious corporations and charities fell from 32% in 1869 to a minimum of 26% in 1874, rising again afterwards to 30% in 1878 and 43% in 1884.
[31] However, **econv** is only available with annual frequency, which should reduce its significance in the results.
[32] We also tried changing the ordering of variables within each group and the results were very similar.
[33] We tested the residuals for unit roots and controlled for the effect of the introduction of the income tax by including a dummy =1 from May 1881.

have no significant impact on the out-of-band price differentials, which suggests that bond prices reacted to exchange rate shocks fairly quickly. However, the same shock has a negative impact on the conversion rate econv, which also makes sense since a larger devaluation above par would bid up the price of the paper bonds, relaxing the need to intervene via the conversion rate. Finally, a shock to sales has no significant impact on any variable, bar itself, which raises doubts about its use as a policy variable, at least on a systematic basis. The variance decomposition confirms these results (Table 3). In conclusion, we do not think that there is strong evidence to support the interpretation that the government purposefully timed the sales of religious property to manage the market of domestic debt. It is therefore possible that the alternative theories reviewed in the previous section may be partly applicable, especially between 1875 and 1880, particularly the possibility of larger expectations of devaluation over the short than the long-run.

Over time, the country accumulated a large net foreign debt that burdened the current account with the weight of its service in gold. The ability of the monetary and fiscal authorities to defend the peg while simultaneously maintaining a wedge between the markets for domestic and foreign debt must have waned correspondingly. In the end, the 'perfect storm' of a banking crisis in 1890, coupled with a domestic recession and the worsening of the current account (through a contraction of emigrants' remittances) was quickly followed by political instability, the exit from the gold peg and, finally, a sovereign default in June 1892. No FX interventions by the Bank of Portugal and no debt management by the government could have prevented this outcome, once the fiscal and external positions became unsustainable.

Despite this endgame, one is entitled to ask whether the authorities could have extracted some policy benefit from managing the bond market as described. Or whether, as surmised by Bulhões (1867), this was an inefficient policy that harmed the credit of the Portuguese state? In retrospect, Bulhões plea for the unification of internal and external debt is surprising in the light of the literature on 'original sin.' Our research here is less advanced, but an almost obvious gain from keeping a higher price of paper bonds was the ability to target lower long-term interest rates. Politicians from the two main rival parties during the *Regeneração* (*regeneradores* and *progressistas*) were mostly in agreement about the economic programme of government and the financial strategy to finance it. Both viewed as the main objective of economic policy the construction of infrastructure (transportation and public utilities) necessary to increase the efficiency of the internal market and the productivity of the economy. Both agreed as well on the need to backload the required fiscal effort by raising debt to fund capital expenditure. Both finally adhered to the necessity of tapping the international capital market rather than crowding out private investment by competing for the limited pool of domestic savings (Esteves 2004).

Within this broad economic programme, the debt management strategy uncovered in this paper helped with keeping lower domestic interest rates even as the government slowly but steadily built a mountain of debt at home and abroad. A piece of circumstantial evidence is the relation between the slope of the domestic yield curve, the bond price differentials (paper - gold) and the conversion option of gold bonds. This is summarised in the next figure that distinguishes the scatterplot of bond price differentials and the slope of the yield curve by years with debt conversions and years without. We define the slope of the yield curve as the difference between the yields on government paper bonds (adjusted as in 3a and 3b) and the Bank of Portugal's discount rate. This is likely to be an understatement of the true slope for two reasons. First, because the risk premium is likely to be

smaller for government than private securities. And second, because the Bank's rate was only infrequently changed and appeared to function as a ceiling on short term market interest rates. This also means that the slope is mostly driven by the long rate, apart from short periods when the Bank tightened the money market.[34]

Figure 15 about here

If we assume that the London yields were exogenously fixed and considering that the discount rate was also mostly fixed, we should expect a negative relation between the two variables. The relation is indeed broadly negative but significantly more so in years without debt conversions.[35] These were also the years when the conversion rate was less favourable by providing a higher floor for the price of domestic bonds (expression 5). Conversely, in periods when the government increased ε that triggered a decrease in the price of paper bonds relative to gold bonds, which increased the slope of the domestic yield curve (as well as opening up a flow of conversions). Notice that years with conversions were also the periods when the slope of the yield curve was higher such that the gain from limiting further increases in the domestic long-term interest rate (by adapting the conditions of the bond conversion clause) would be more valuable. Therefore, the Portuguese authorities seem to have devised an early form of 'operation twist.'

A final scruple has to do with market integration. Perhaps Bulhões was not complaining about the actual levels of price differences between paper and gold bonds, but was worried instead that this wedge could impair capital market integration. This would be a material consideration for governments that wished to encourage foreign capital inflows through new placements of sovereign debt. By harming arbitrage between Lisbon and foreign markets (here represented by London), the Portuguese authorities could be indeed adding an unnecessary præmium to the government's cost of funding. A way of checking this is to test whether the prices of paper and gold bonds were co-integrated. If they were that would imply that cross-market arbitrage was still effective outside the wider bands created by the several enhancements introduced into the two classes of bonds. We therefore estimate an error correction model of the form:

$$\Delta \boldsymbol{y_t} = \alpha(\beta \boldsymbol{y_{t-1}} + \boldsymbol{\mu}) + \sum_{l=1}^{p} \boldsymbol{\Gamma_l} \Delta \boldsymbol{y_{t-1}} + \varepsilon_t \quad (6)$$

where $\boldsymbol{y_t} \equiv \left(P_p^{Lx}, P_g^{Ld}\right)'$. The results in Table 4 show that the two series were indeed strongly co-integrated, despite the fact that the slope coefficient is statistically different from 1.[36]The estimate of β implies that the domestic price of paper bonds was 10% above the price of gold bonds which, all else equal, would allow for lower domestic yields by about 50 basis points.[37] Furthermore, the

[34] Throughout the period the discount rate spent almost equal fractions of time at 5% and 6%. In only 30 weeks (2.5% of the period) was the rate increased to 7%.

[35] Notice how in the majority of cases without conversions the slope of the yield curve is actually negative. These instances were mainly caused by the tightening of the discount rate by the Bank of Portugal to deal with short-term pressures on the FX market.

[36] The Table also shows that the null hypothesis that both price series contain unit roots cannot be rejected.

[37] Estimated at the average price of domestic bonds, which was 51% in the period considered.

estimates of the short-run parameters show that the adjustment to price deviations occurred exclusively in Lisbon confirming the exogeneity of the London yields assumed thus far.

Table 4 about here

5. Concluding remarks

This paper has uncovered a number of peculiar debt management strategies on the part of a small emerging economy that, despite a chronic case of twin budget and external deficits, was able to fund itself continuously in the international capital markets and defend its peg against gold over a period of forty years. The scale of the macro imbalances ultimately resulted in a major crisis that forced the country permanently out of gold and closed its access to foreign debt for many decades. But despite that, the combination of FX interventions by the monetary authorities and debt management by the treasury were successful in insulating the domestic capital market from the main financial disturbances of the second half of the nineteenth century and even in keeping low domestic interest rates. This was no 'honeymoon effect' as the country's peg was not credible in a target zone sense (Krugman 1991). It was rather the outcome of concerted policy efforts. Other emerging countries coped with similar challenges by adopting their own 'gold devices' from FX intervention to control the pressure of sovereign debt on the exchange rate (Tattara 2003) or rationing access to foreign exchange to insulate the domestic interest rate from external shocks (Neal and Weidenmier 2003). In fact, Reis (2000) had already noticed the relative insulation of the Portuguese money supply to external shocks during the country's tenure on gold.

The Portuguese case adds a further layer to this literature in that the authorities were able to reverse the spreads between paper and gold bonds expected from the literature on 'original sin.' Portugal was probably not the only country to attach credit enhancements to its debt (gold clauses, exchange rate clauses, conversion clauses) in this period. Methodologically, this calls for a more careful investigation of the pricing of so-called 'paper' and 'gold' bonds in the historical literature on original sin and the credibility of the gold standard.

Table 1: Summary statistics of Portuguese finances

Averages (%)	1860-69	1870-79	1880-89	1890-99
Deficit/GDP	-1.5	-1.2	-1.1	-0.7
Debt/GDP	44	63	68	69
External/ Total debt	48	42	48	51
Debt service/GDP	1.8	2.7	2.6	2.3
Debt service/ Gov't revenue	45.6	65.8	59.4	43.3
Spreads over British consols (bps)	340	333	262	911

Sources: Mata (1993) for Portuguese debt, Valério (2001) for Portuguese GDP, Esteves (2002) for Portuguese yields and Homer and Sylla (1991) for British consol yields. Spreads are the difference between the simple yields of Portuguese gold bonds and British consols.

Table 2: Summary statistics of price deviations

		Mean	Median	Std. dev.
Positive spreads	Within	36	40	16
	Outside	156	136	118
Negative spreads	Within	-35	-47	21
	Outside	-144	-92	148

Values in basis points. Deviations calculated from bands using actual exchange rates.

Table 3: Variance decomposition of VAR

	pcons	sales	econv	mide	price_out
pcons	0.9277	0.0028	0.0030	0.0419	0.0345
sales	0.0425	0.9709	0.0173	0.0443	0.0028
econv	0.0085	0.0073	0.9416	0.0002	0.0756
mide	0.0141	0.0041	0.0325	0.9106	0.0431
price_out	0.0071	0.0150	0.0055	0.0030	0.8440

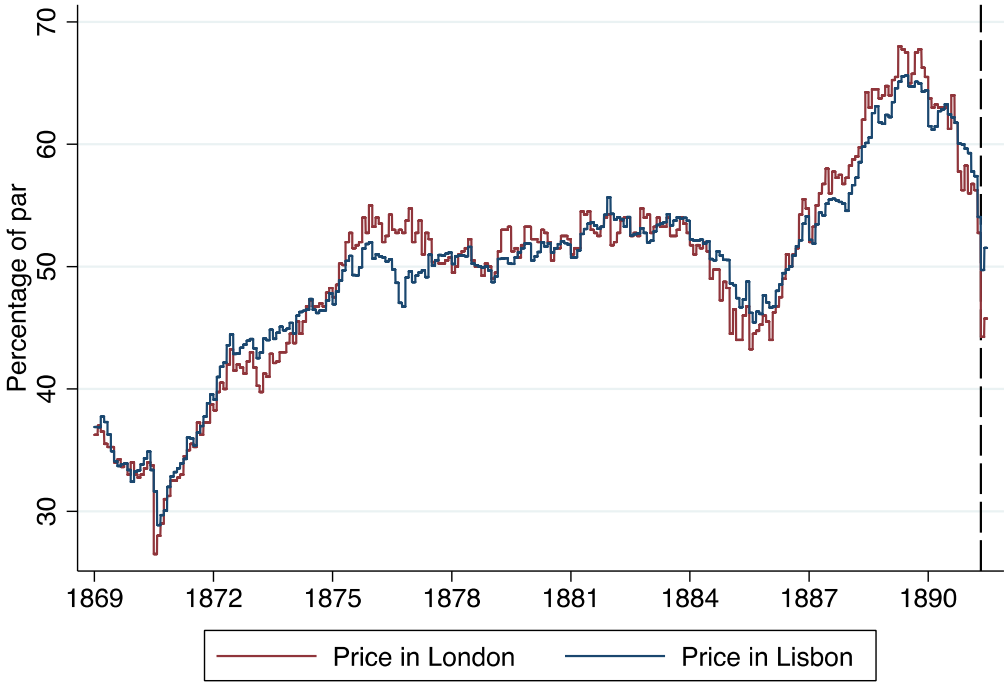
Decomposition for 4 months ahead.

Table 4: Tests of unit roots and co-integration

Cointegration equation		**Adjustment parameters**	
α	-4.7504	Lisbon to London	-0.0810**
			(0.0381)
β	-0.9084***	London to Lisbon	0.0415
	(0.0454)		(0.0604)
N	268		
X^2	399.8948***		
Unit root tests (Phillips-Perron)			
Test statistic	**Lisbon price**	**London price**	
Z(ρ)	-3.419	-4.091	
Z(t)	-1.651	-1.683	

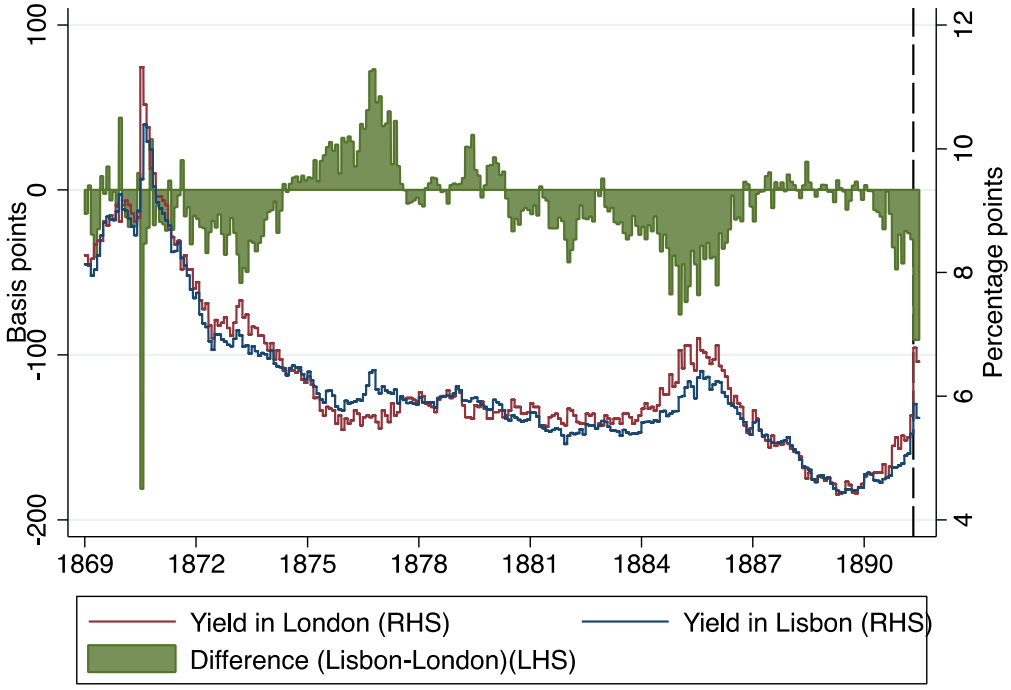
Standard errors in parenthesis. Co-integration estimated using the Johansen procedure. *** p<0.01, ** p<0.05

Figure 1: Prices of *consolidado externo* and *consolidado interno*



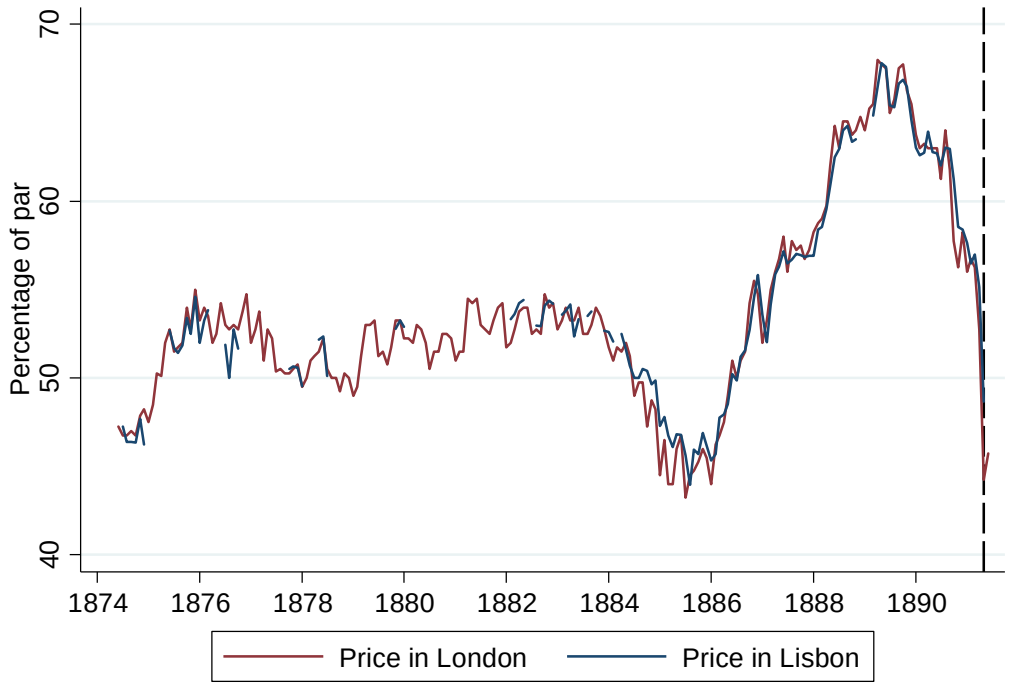
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.

Figure 2: Yields of *consolidado externo* and *interno*



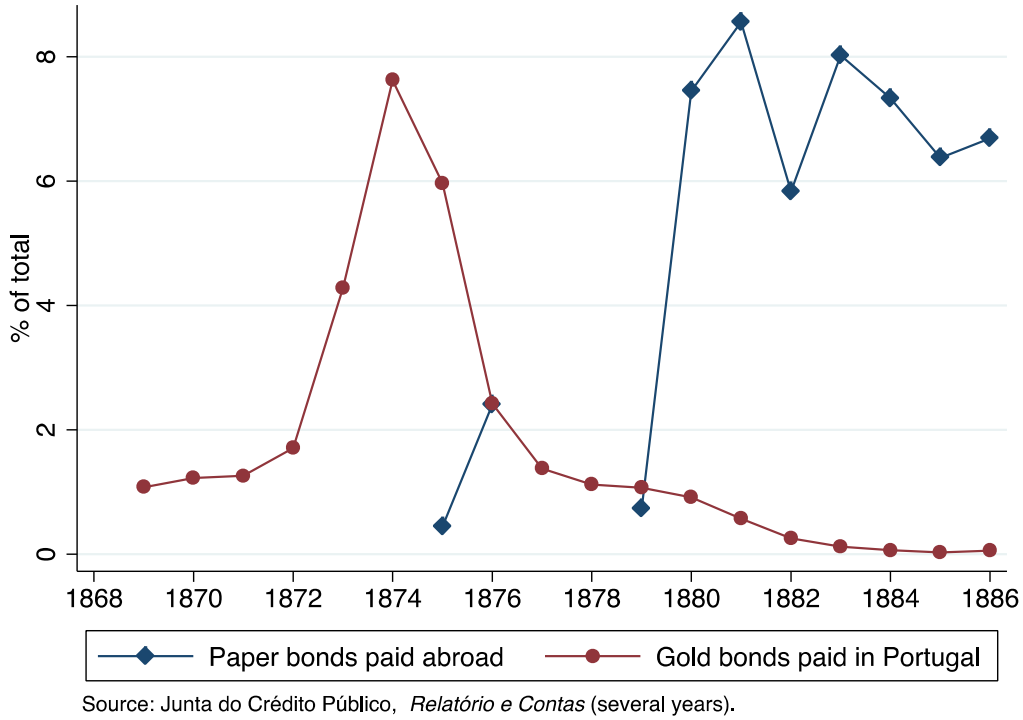
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.

Figure 3: Prices of *consolidado externo* in London and Lisbon



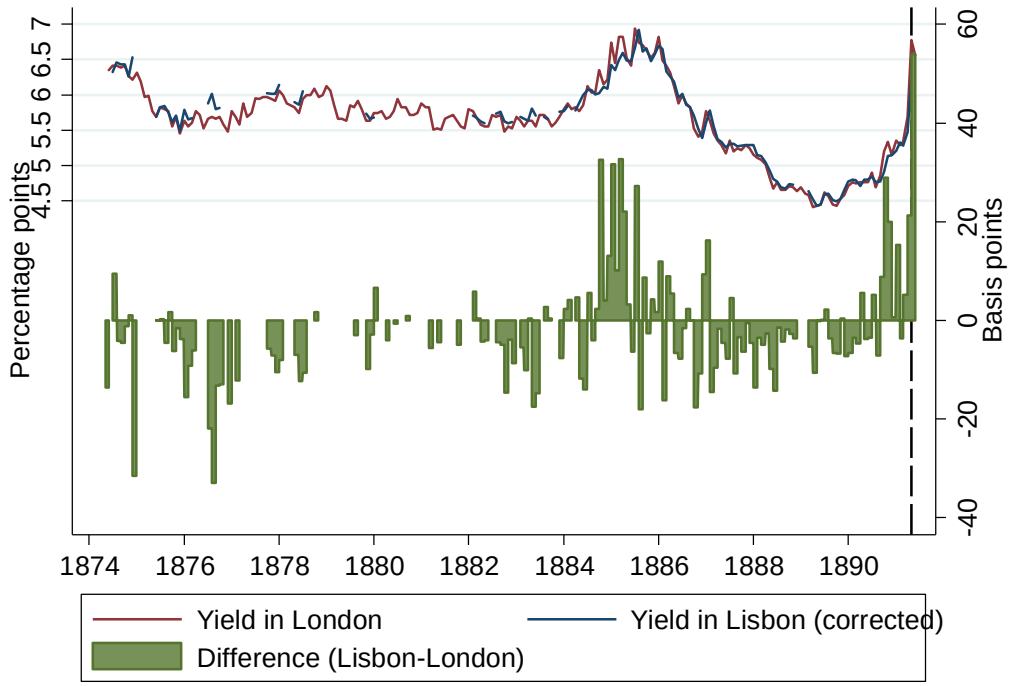
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.

Figure 4: Share of coupons of Portuguese bonds paid outside their prime market



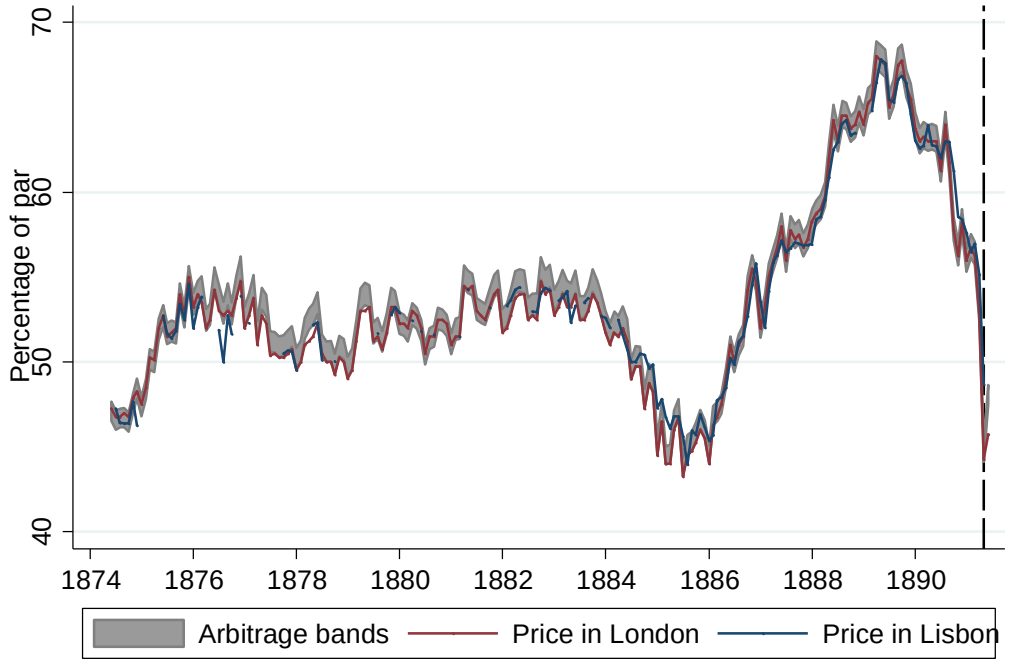
Source: Junta do Crédito Público, *Relatório e Contas* (several years).

Figure 5: Yields Prices of *consolidado externo* in Lisbon and London



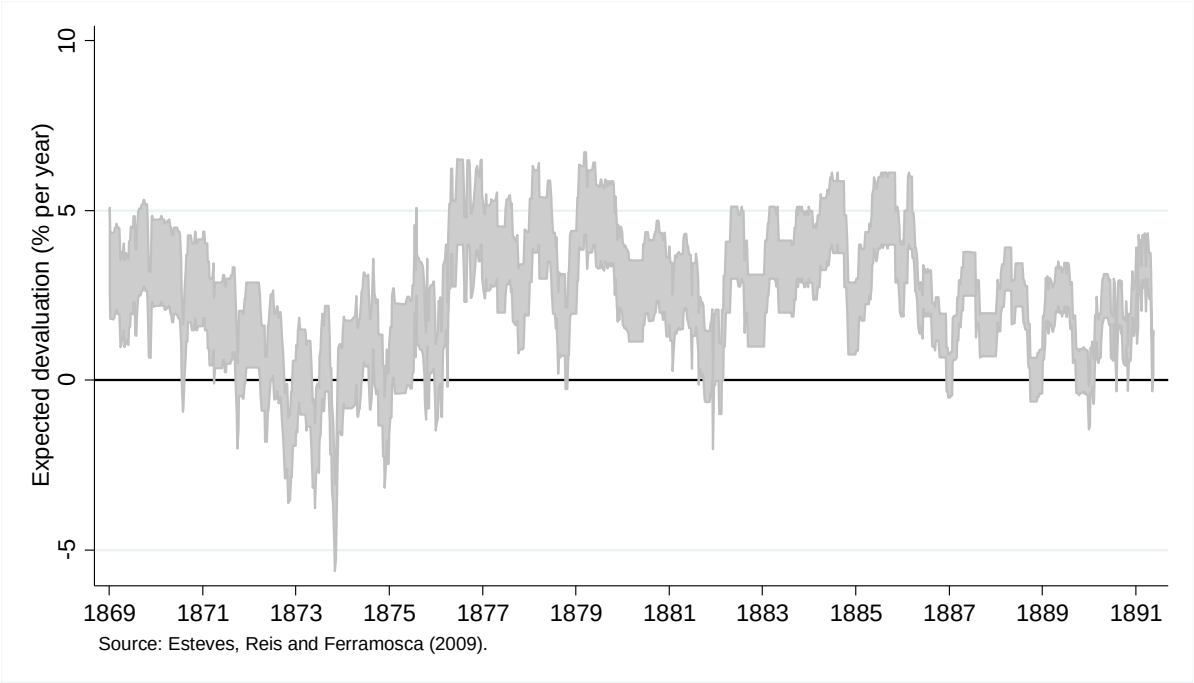
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.

Figure 6: Prices of *consolidado externo* in London and Lisbon (with arbitrage bands)



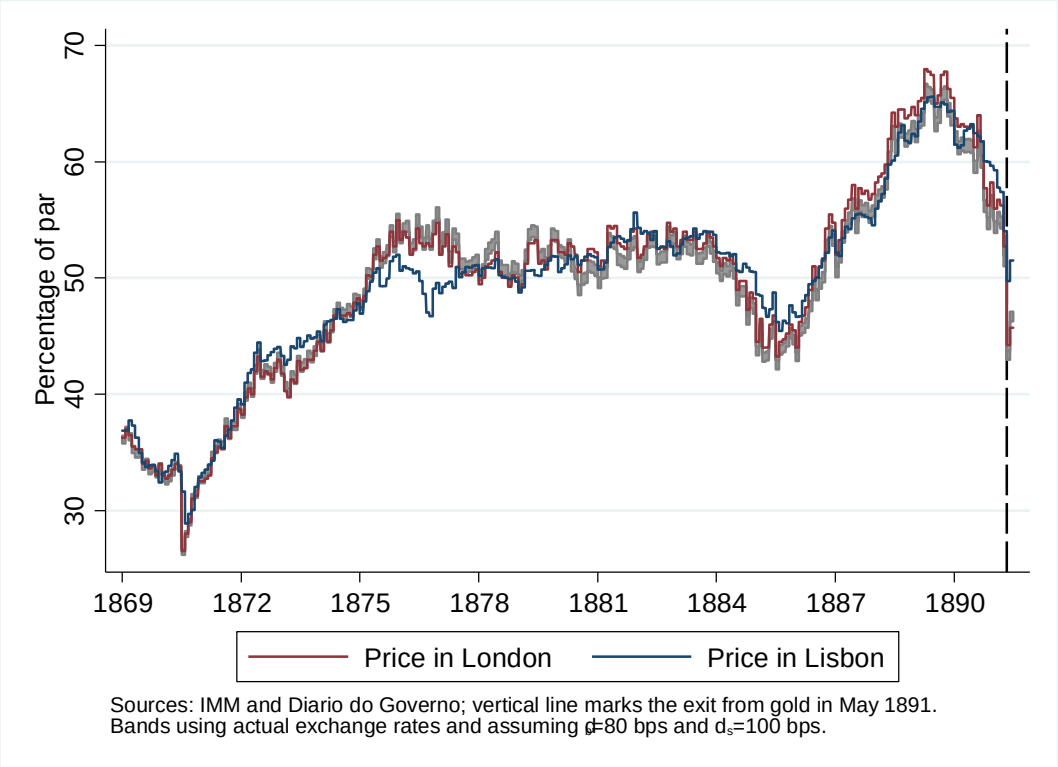
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.
Bands assuming transactions costs of 120 bps.

Figure 7: Market-based expectations of devaluation



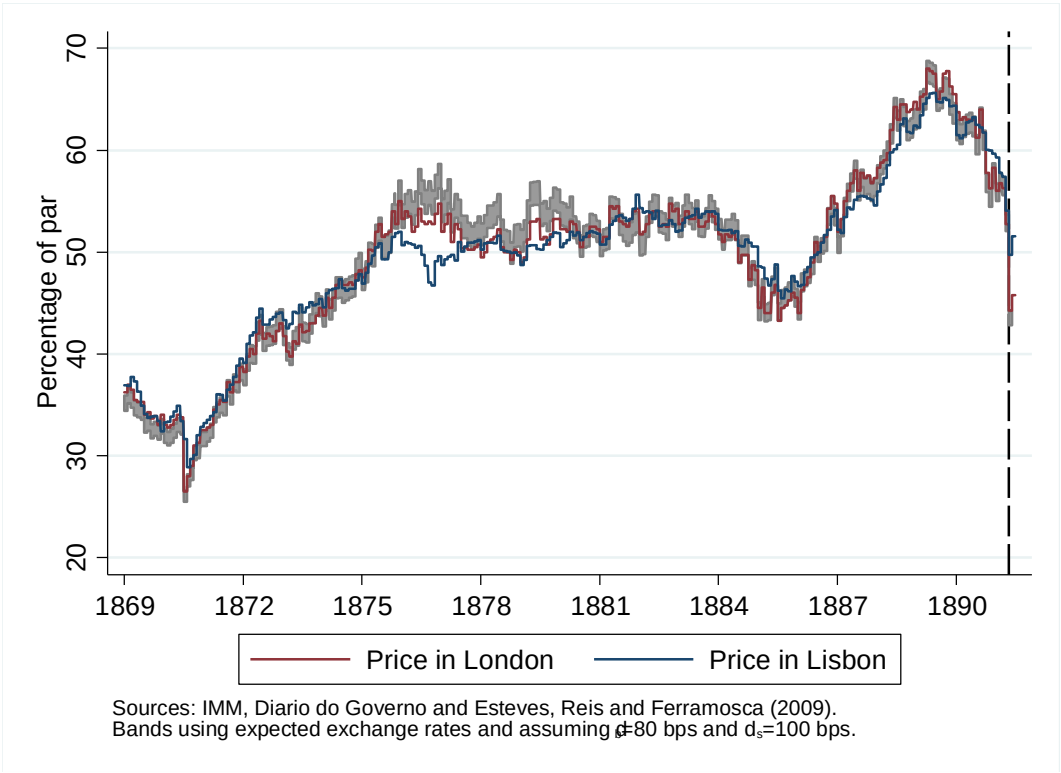
Source: Esteves, Reis and Ferramosca (2009).

Figure 8: Prices of *consolidado externo* and *interno* (with arbitrage bands)



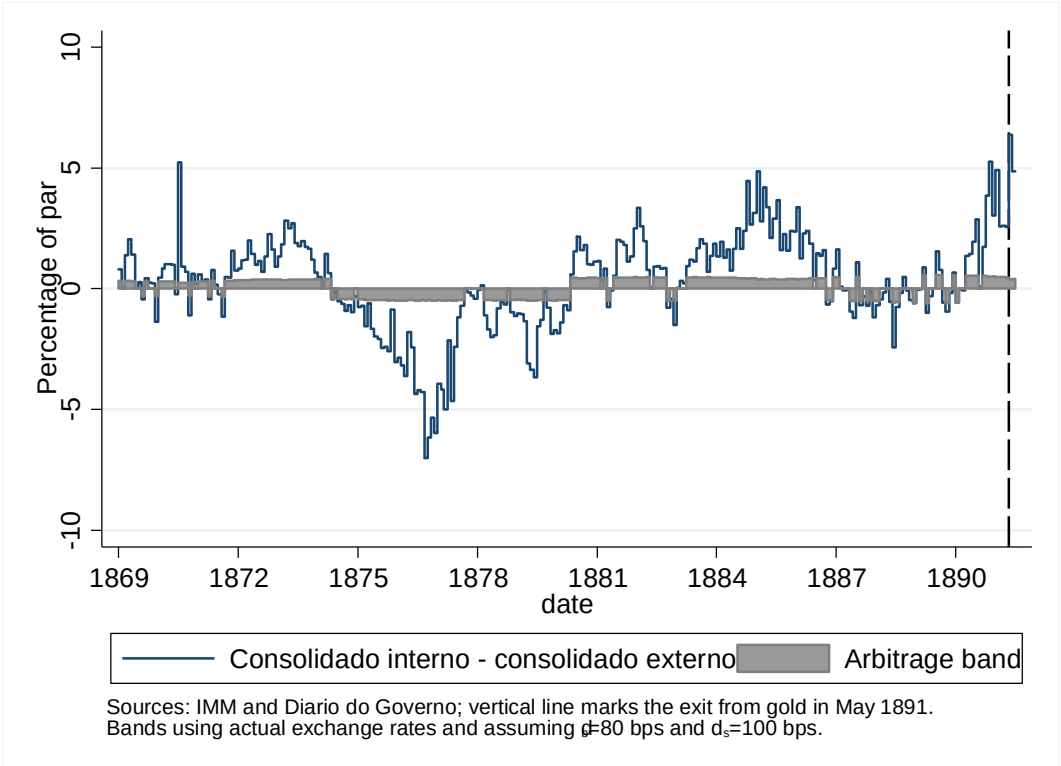
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.
Bands using actual exchange rates and assuming d_g=80 bps and d_s=100 bps.

Figure 9: Prices of *consolidado externo* and *interno* (arbitrage bands with expected exc. rates)



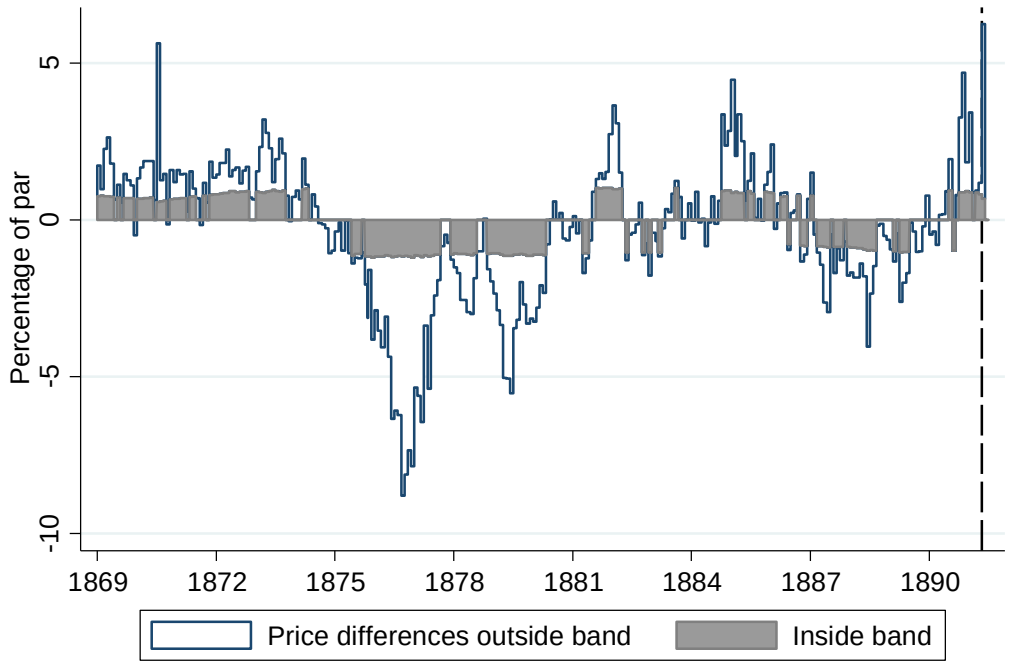
Sources: IMM, Diario do Governo and Esteves, Reis and Ferramosca (2009).
Bands using expected exchange rates and assuming d_g=80 bps and d_s=100 bps.

Figure 10: Price differences and arbitrage bands



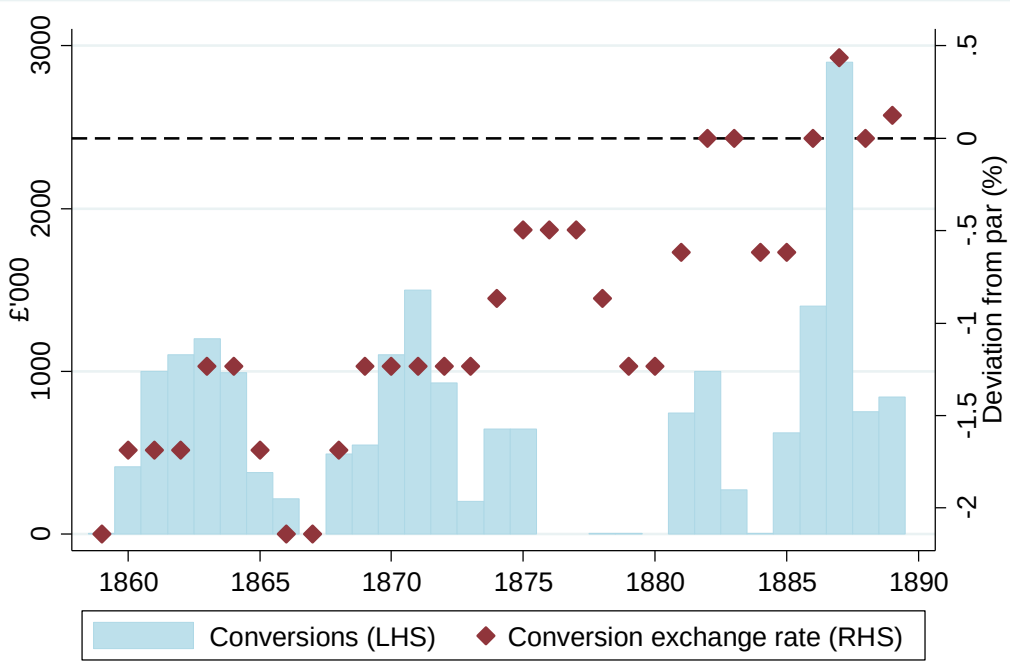
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.
Bands using actual exchange rates and assuming d_g=80 bps and d_s=100 bps.

Figure 11 Price differences and arbitrage bands (with expected exc. rates)



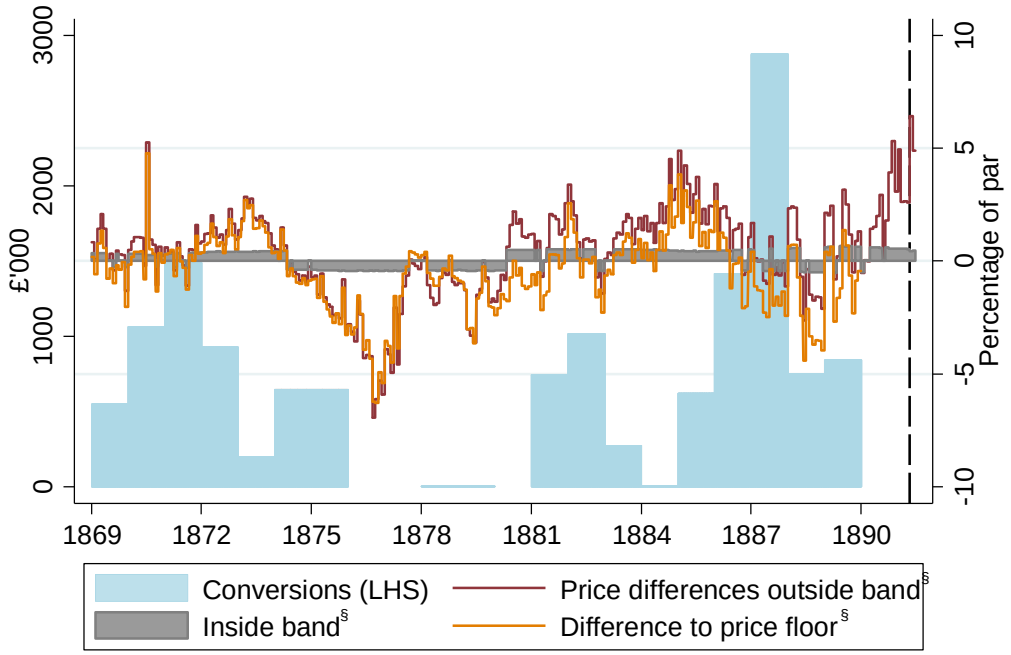
Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.
Bands using expected exchange rates and assuming d_g=80 bps and d_s=100 bps.

Figure 12: Volume and exchange rate for conversions of external into internal debt



Source: *Orçamento Geral e Propostas de Lei de Receita e Despeza do Estado* (several years)
Conversions during 1859-1886 into *Consolidado interno* bonds and into 5% (1887-88) and 4 ½% paper bonds (1889).

Figure 13: Price differences, arbitrage and conversion options



Sources: IMM and Diario do Governo; vertical line marks the exit from gold in May 1891.
Bands using actual exchange rates and assuming d_g=80 bps and d_s=100 bps.
§1869-86: *consolidado internos* prices; 1887-88: 5% bonds and 1889: 4½% bonds.

Figure 14: IRFs for VAR model

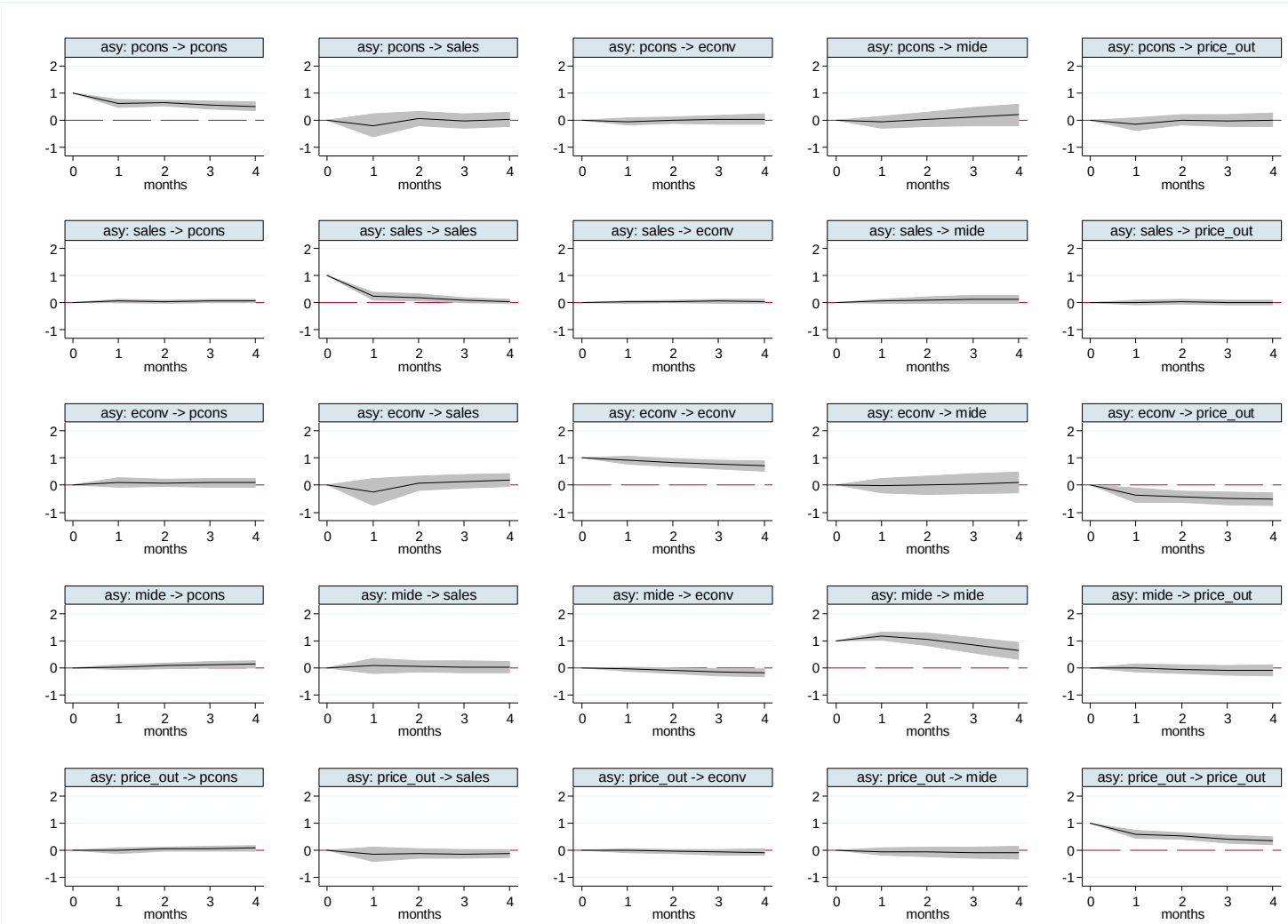
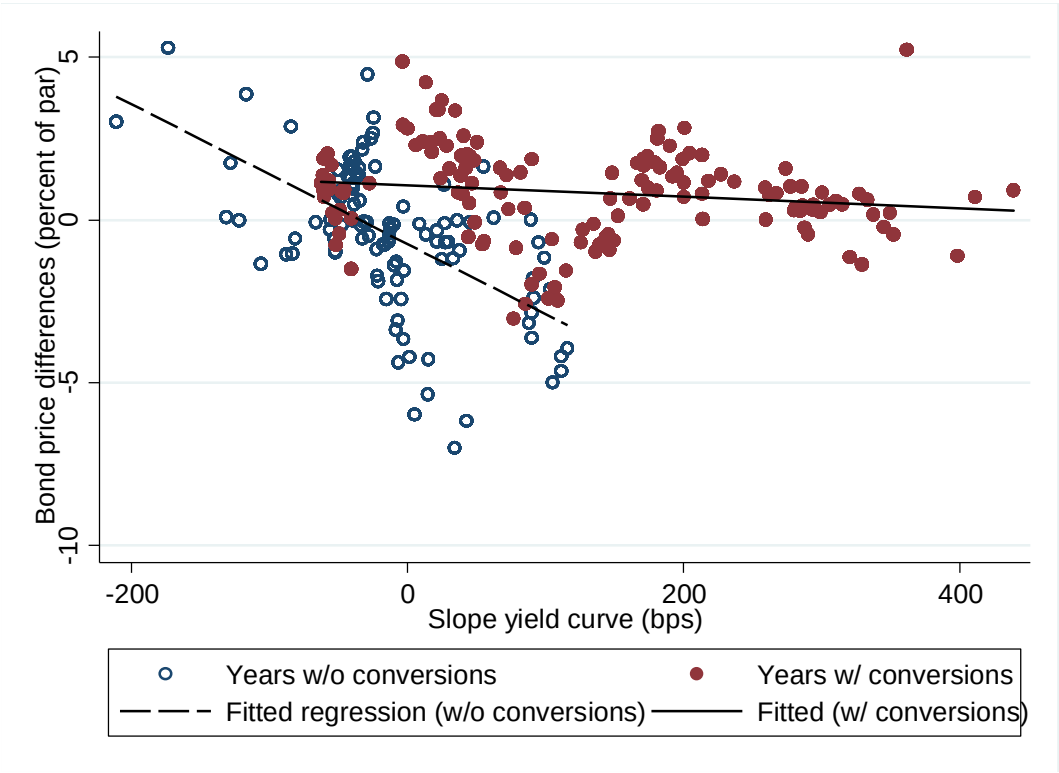


Figure 15: Relation between bond prices and the yield curve



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