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ABSTRACT

Using a new database of weekly sovereign debt prices of paper currency and pound sterling (or gold) denominated debt, we identify the currency-risk component of sovereign yield spreads for nine of the largest emerging market borrowers for the period 1870-1913. Five years after a country joined the gold standard, paper currency bonds traded at significantly higher interest rates (more than 400 basis points on average) than a country's foreign currency debt denominated in pound sterling. Investors also expected exchange rates to fall by roughly 20 percent even after emerging market borrowers had joined the gold standard. The presence of persistent positive currency risk premiums long after gold standard adoption suggests that hard pegs for emerging market borrowers may never be fully credible.

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"How many more fiascoes will it take before responsible people are finally convinced that a system of fixed exchange rates is not a satisfactory financial arrangement for a group of large countries with independent political systems and independent national policies." (Milton Friedman, *Wall Street Journal*, September 22, 1992, p.A18)

I. Introduction

At the time of adoption of a single currency for much of Europe, many policymakers believed that exit from the Euro would not only be politically difficult, but also undesirable in the sense that the new hard peg would confer greater benefits than costs. Recently, however, rising sovereign spreads and the prospect of possible default among a few Euro-area members has suggested to some market participants that the best long-term option for highly-indebted countries such as Greece may be exit from the Euro. The turmoil in European sovereign debt markets has rekindled interest in understanding how market participants perceive the durability of hard pegs and the extent to which the adoption of hard pegs enhances credibility. For example, countries may be able to borrow at lower rates if the adoption of fixed exchange rates confers credibility. Establishing regime credibility may be particularly important for emerging-market countries since their rates for borrowing tend to be higher than those for high-income countries; lower interest-rate spreads for emerging-market countries can in turn stimulate investment and economic growth (Berg and Borensztein, 2000; Schmukler and Serven, 2002).

The analysis of yield spreads is central to the debate about exchange-rate regime choice. Proponents of hard pegs argue that credible commitments to fixed exchange rates significantly reduce the premiums that emerging market countries pay to borrow in international capital markets. The premium has two components: country risk and currency risk.[1] The country-risk premium represents the risk that a country will default on its debt obligations, while the currency-risk premium represents the compensation that an investor receives for an adverse movement in the exchange rate of a paper-currency bond (Domowitz, Glen, and Madhavan, 1998). The latter component of the risk premium is particularly relevant for the debate over

[1] There is a large empirical literature in international and development economics on the country-risk and/or currency-risk components of yield spreads for emerging market debt. For example, see Edwards (1984, 1986) and Sturzenegger and Powell (2003).

exchange-rate regime choice. Advocates of hard pegs argue that they can reduce the currency risk premium, and if perfectly credible, may even eliminate it altogether. If financial markets do not consider the peg to be perfectly credible, however, then the currency risk premium will remain positive (Schmukler and Serven, 2002).

We analyze the classical gold standard era to test whether hard pegs are credible. There are several reasons why the pre-World War I gold standard is an obvious choice for examining currency risk empirically. First, many economists consider the classical gold standard to be the most credible and widely used hard peg in modern financial history.[2] Second, capital markets were unfettered, and global investors were able to buy and sell sovereign bonds throughout the world without restriction. Third, the operation of this global monetary system precedes the creation of multilateral or extra-national institutions like the IMF and European Union, which today, can provide a backstop to sovereign borrowers in crisis periods; the existence of such institutions makes it more difficult to use sovereign bond spreads to examine the durability of hard pegs.

Using a large, new database of hand-collected, weekly sovereign debt prices from the period 1870-1913, we examine the movement in sovereign yields denominated in *both* paper currency and pounds sterling (or gold) that predominantly traded on the same market in order to identify the country-risk and currency-risk components of sovereign yield spreads.[3] Our results suggest that joining the gold club did not eliminate the interest-rate differential between a country's paper currency debt and gold bonds issued on international capital markets. Five years after a country joined the gold standard, the currency risk premium averaged more than 400 basis points. We develop a simple model of expected exchange-rate movements which we use to compare expected devaluations to actual movements in exchange rates. This comparison is

[2] Eichengreen (1996) suggests that one reason the classical gold standard may have been more credible peg than later fixed exchange rate systems was that central banks were able to attach priority to defending fixed exchange rates rather than pursuing countercyclical monetary policy. Obstfeld and Rogoff (1995) argue that modern hard pegs are unlikely to be credible because central banks will generally succumb to political pressure and not defend the peg when there is a sustained increase in interest rates (that lowers investment and output).

[3] Previous studies examining the gold standard have largely focused on country risk rather than currency risk. Bordo and Rockoff (1996) and Obstfeld and Taylor (2003) find that the gold standard lowered sovereign risk by approximately 30-40 basis points. Flandreau and Zumer (2004) find that the gold standard had no effect on sovereign yields once a broader set of economic and political variables controls are considered. Ferguson and Schularick (2006b) find that the gold standard effect disappears once the sample of sovereign borrowers is expanded to include the universe of debtors on the London market. There are a few studies of currency risk for single countries during the gold standard period, but to our knowledge, we have assembled the first database which permits a systematic examination of currency risk across a large number of sovereign borrowers.

possible during our sample period because many countries issued gold, silver, and paper currencies, including Argentina, Austria, India, Mexico, and Russia. Our analysis suggests that the premium on paper exchange rates is similar in magnitude to the expected depreciation rate calculated from the paper-gold interest rate differential. The existence of large currency premiums after countries adopted gold suggests that financial markets believed that these hard pegs were not fully credible. As our calculations suggest, investors still considered devaluation and departure from gold a high probability event in emerging markets.

The next section of the paper discusses the theoretical literature on the gold standard and how the credibility of hard pegs, like the gold standard, can be tested empirically. Section III describes the new weekly database on sovereign debt prices and analyzes the time series properties of the currency risk premium for emerging market borrowers after they adopted the gold standard. Section IV provides estimates of the expected devaluations that markets likely anticipated even after adoption of the gold standard. Finally, we discuss the implications of our findings as they relate to the credibility of fixed exchange-rate regimes in general.

II. The Gold Standard as a Rule for Policymakers

A. Theory

Bordo and Kydland (1995) provide an interpretation of the role of the gold standard as it relates to the literature on rules for policymakers. Accordingly, being on the gold standard tied the hands of the monetary authorities of a country. The monetary rule served as a credible commitment mechanism that solved the classic time-inconsistency problem (Kydland and Prescott, 1977). Government policy is said to be time inconsistent when a policy plan that is determined to be optimal and to hold indefinitely into the future is subsequently revised. For example, suppose that a government sells debt to finance a war. From an *ex ante* perspective, it is optimal for the government to service its debt obligations. However, once the bonds have been sold, it is optimal for the government to default unless there is a commitment mechanism that ties the hands of monetary authorities. In the absence of a commitment mechanism, it is time inconsistent for the government to repay its debt obligations. Private agents will anticipate the government's incentive to default and they will not buy bonds, forcing the government to rely on

taxes or money creation. Overall, the existence of an enforcement mechanism, such as a credible threat to deny the government access to borrowing in the future, means that a socially optimal, but time inconsistent policy of borrowing can be supported as an equilibrium outcome.

Bordo and Kydland (1995) also argue that the gold standard was a contingent rule with an escape clause. Countries could suspend specie convertibility in the event of a war or a fiscal emergency; however, after the war or extraordinary event, it was well understood that a country would return to specie convertibility at the pre-war parity. Generally, resumption occurred after a "reasonable" delay period during which a country would impose deflationary policies to retire fiat currency printed for war finance. The United States and France, for example, fought wars in the 1860s and 1870s and issued large amounts of irredeemable paper currency and debt. Following the end of the war, both countries imposed deflationary policies to restore convertibility following the cessation of hostilities, and both had returned to a specie standard by 1880.

B. Testable Implications

The most direct way of testing the credibility of the hard peg during the gold standard era is to examine the currency risk premium. Previous research on the gold standard has focused almost exclusively on country risk or political risk.[4] Our paper breaks new ground by systematically examining the currency risk premium after gold standard adoption for a large set of emerging market borrowers in order to assess the credibility of hard pegs.[5]

We examine the interest-rate differential between paper currency and gold bonds issued by sovereign borrowers during the classical gold standard period. To understand how the currency risk premium relates to anticipated changes in the exchange rate, we define $I_{t,k}$ as the annualized (gross) yield (i.e., one plus the interest rate) at time *t* on paper-currency debt issued

[4] See Bordo and Rockoff (1996), Obstfeld and Taylor (2003), Ferguson and Schularick (2006a) and Flandreau and Zumer (2004). Bordo and Flandreau (2003) find that *short-term* interest rates remained high for several emerging market countries after they joined the gold standard. They interpret this evidence as consistent with a "peso" effect and that the gold standard was not credible in these countries.

[5] A few previous studies have examined currency risk premium for individual countries. Flandreau (2003) examines currency risk for Austria-Hungary.

by the sovereign borrower.[6] Let *k* denote the maturity of the currency bond issue. We define $I^{*}_{t,k}$ as the yield on gold debt with the same maturity as the paper-currency bond issued by the sovereign borrower. $I^{UK}_{t,k}$ is the risk-free interest rate, which is proxied in our analysis by the British consol, a perpetuity bond that is widely regarded as the world's bellwether security during our sample period (1870-1913). The total yield differential can then be written as:

$$(1) \qquad \frac{I_{t,k}}{I^{UK}_{t,k}} = \frac{I_{t,k}}{I^{*}_{t,k}} \frac{I^{*}_{t,k}}{I^{UK}_{t,k}}.$$

We can express the difference between the interest-rate on a paper-currency bond and the risk-free interest rate as the sum of two risk premiums. Setting $i_{t,k}$ equal to the natural log of $I_{t,k}$, we find that

$$(2) \qquad (i_{t,k} - i^{UK}_{t,k}) = (i_{t,k} - i^{*}_{t,k}) + (i^{*}_{t,k} - i^{UK}_{t,k}).$$

The first-term on the right hand side of equation (2) is called the currency risk premium while the second one is the country risk premium. The country risk premium (or political risk) represents the risk that a country will default on its debt obligations. We will now show that the currency risk premium, the first term on the right-hand side of equation (2), represents the compensation that an investor demands due to the possibility of a fall in the exchange rate. Under the assumption of risk-neutrality, arbitrage implies that uncovered interest parity should hold such that

$$(3) \quad I_{t,k} = I^{*}_{t,k}\left[\frac{E_t S_{t+k}}{S_t}\right]^{1/k},$$

where $E_t S_{t+k}$ is the expectation at time *t* of the exchange rate at time *t+k*. We define the exchange rate, $s_{t,k}$, as the amount of paper currency per unit of foreign currency. Taking natural logarithms of the interest parity condition, we can rewrite the first term in equation (2) as

$$(4) \qquad (i_{t,k} - i^{*}_{t,k}) = \Delta s^{e}_{t,k},$$

[6] Our derivation follows Schmukler and Serven (2002).

where $\Delta s^{e}_{t,k} = \frac{1}{k}\ln\left[\frac{E_t S_{t+k}}{S_t}\right]$. Equation (4) states that the currency risk premium equals the expected rate of change in the exchange rate. Hence, if a country made a completely credible, non-contingent, and permanent commitment to join the gold standard, then the probability of a devaluation of the exchange rate would be zero, and "paper bonds would have been as good as gold" (Obstfeld and Taylor, 2003). That is, for a country that credibly committed to the gold standard, the interest-rate differential between a country's paper currency and sterling bonds would also have been zero.[7] A large spread of paper currency over sterling denominated debt after the introduction of the gold standard, however, would suggest that the commitment to the fixed exchange rate was not seen as a credible monetary regime by financial markets.

Using the currency risk premium to identify the devaluation risk of a hard peg is conceptually straightforward, but often empirically difficult to implement. For example, the presence of capital controls can drive a wedge between the price of a country's sovereign bonds trading in paper and foreign markets. Indeed, the presence of capital controls in many emerging markets in the latter part of the twentieth century is one reason why the historical data from 1870-1913 is better, in general, for testing the credibility of hard pegs. The classical gold standard was a period of unfettered capital markets that were largely free of government intervention (Eichengreen, 1996, IMF, 1997).[8]

A measure of the currency risk premium might also capture differential default risk rather than devaluation risk if there is a greater probability of defaulting on a domestic currency bond than a sterling denominated issue. It is worth emphasizing, however, that the emerging market borrowers in our sample faithfully serviced their gold and paper bonds for the entire gold standard period. The two possible exceptions are Argentina and Brazil, which defaulted on their debt obligations in 1890 and 1898, respectively. In both instances, however, Argentina and

[7] Some studies have measured the credibility of the gold standard countries by estimating "target zones" that use short-term interest rates and parity conditions between two countries to estimate expected devaluation. The problem with this methodology is that many countries issued debt in both paper and gold. In most cases, short-term interest rates during the gold standard were denominated in hard currency, not paper, so that a currency risk premium cannot be calculated. Another problem is that short-term interest rates are not available for many emerging market borrowers during the classical gold standard era.

[8] Occasionally, during the classical gold standard period, central banks of gold standard countries attempted to alter gold flows via "gold devices." These differ from more conventional capital controls in that they worked through a market mechanism that attempted to influence international arbitrage by manipulating gold points, and stand in contrast to administrative mechanisms of a modern nature, which are aimed at preventing individuals from freely importing or exporting specie or currencies (Bloomfield, 1959; Gallarotti, 1995).

Brazil defaulted on their sterling (gold) and paper bonds employed in our analysis, suggesting that differential default risk is not likely a significant problem for our sample. Moreover, for more than half the countries in our sample, it would have been very difficult to differentially default since both of the bonds of the country were widely traded on international markets and therefore held by foreign creditors and in seven of nine countries, the gold and paper bonds traded side-by-side on the same market.

III. Evidence on the Movement of Currency Risk Premiums

To analyze the effect of the gold standard on sovereign yield spreads, we assembled a new database of weekly observations on bond prices. The database includes the universe of sovereign listings reported in *The Economist* from November 5, 1870 until June 30, 1914.[9] We supplement *The Economist* database with weekly bond yields from *The Commercial and Financial Chronicle*. For domestic bond markets, we collected monthly and weekly interest-rate data from financial newspapers located in the country of interest. Details on the terms of the bonds, amounts issued, and where the bonds traded are reported in Appendices 1 and 2.

All bonds used to measure country risk traded on the London stock exchange. We selected bonds that had maturity length of at least 10 years after the adoption of the gold standard and adjusted the current yield by any taxes assessed on bondholders according to the terms of the debt issue (see the *Official Stock Exchange Intelligence*).[10]

For currency risk, we were used long-term paper and gold bonds that traded side-by-side on the same market in seven of the nine countries in the sample. The paper and gold bonds were perpetuity debt issues for Austria, Brazil, and Italy. For the remaining countries, we selected long-term bonds that had a maturity length greater than 10 years at the time of gold standard adoption. We adjusted the current yield to account for any taxes on the debt issues.

Convertibility under the gold standard was established by law or executive decree, although in some cases, such as France, maintenance of convertibility was left at the discretion of central banks rather than the sovereign or legislature. Table 1 presents a timeline of gold standard adoption for all countries that joined in the period 1870-1914 and also had bonds that

[9] The full database is roughly 250,000 observations.

[10] For bonds in our sample with sinking-fund provisions, the average duration was greater than 10 years. For many of the countries in our sample, the maturity length at the time of gold standard adoption was greater than 20 years.

actively traded on the London Stock Exchange. Column 1 gives the date of gold standard adoption, which we define as the day that the monetary authority for a given country initiated or resumed specie convertibility. Column 2 lists the period of gold standard adherence for the 17 sovereign borrowers that joined the gold standard during our sample period. We limit our analysis to adoption and adherence episodes where a country or colony remained on the gold standard for at least two years.[11] Gold standard adoption dates for our sample are given in the Appendix 3.

Tables 2 and 3 present descriptive statistics of currency-risk and country-risk premiums as defined in the previous section of the paper. Even though the currency risk is the relevant premium for determining whether the hard pegs of the classical gold standard era were credible, we include the results for country risk so that we can examine the comparability of our data set to those used in previous studies. We calculate current yields for the "representative" long-term interest rate for each country or colony in our sample by dividing a bond's coupon by its price in period t.

The summary tables report average interest-rate differentials (in basis points) for 10-year and four-year windows or the largest available window. The use of windows is motivated by two factors. First, countries implemented reforms in the period before joining the gold standard, which means that the biggest impact of adopting the hard peg could have occurred prior to the event date (i.e., gold standard adoption). Second, if financial markets are efficient, then a study of high frequency bond data (akin to an event study) is a widely used method to identify the impact of joining the gold standard from other economic shocks such as increased financial market integration during the first era of globalization and terms of trade shocks. The windows are centered on the day that a country joined the gold standard except in a few cases where data constraints prevented the construction of a symmetric window. The four-year and 10-year windows are designed to measure long-run adherence to the gold standard. Each table reports the average yield spread (in basis points) for the 10-year or 4-year window (or largest available sample period) for each sovereign borrower along with the average interest-rate differential in the window before and after a country joined the gold club.

[11] We do not consider adherence to the gold standard for a period of less than two years to be a credible attempt to join the monetary rule. Although our choice of two years is arbitrary, the decision rule was selected to eliminate short-lived attempts by Argentina, Brazil, and Greece to join the gold standard during the late nineteenth century.

Panel A of Table 2 shows that country risk dropped an average of approximately 21 basis points in the two-year period after a country adopted the gold standard. The country risk premium declined for 13 out of 17 emerging market borrowers; yield spreads increased for India, Nicaragua, and South Africa. Turkey is the only country where the yield spread declined by more than 100 basis points. The simple summary statistics from Panel A show that the decline in interest-rate differentials was less than half the size of the drop in the 10-year windows. Panel B of Table 2 shows that the country risk premium declined an average of 39 basis points in the five years after a country joined the gold standard. The average decline of 39 basis points is nearly identical to the estimated "good housekeeping seal of approval" effect of the classical gold standard found in Bordo and Rockoff (1996).

Table 3 shows the currency risk premium for nine emerging market borrowers, all of which issued large amounts of sovereign debt: Argentina, Austria, Brazil, Chile, India, Italy, Mexico, Russia, and the United States. In 1913, these nine borrowers constituted roughly 60% of the world's outstanding external debt and secondary markets actively traded these countries' bonds.[12] Although it is clear these borrowers differ in their level of development, we consider all of them to be "emerging markets borrowers" in the sense that their governments borrowed substantial sums internationally during the sample period and their bonds traded at a premium relative to the British consol. As Section II described, the prediction of a fully credible hard peg is that the currency risk premium should be approximately equal to zero. However, the third column of Table 3, Panel B shows that the average currency risk premium five years after adoption was 403 basis points: this suggests that the hard pegs of the classical gold standard period were not credible.[13]

The desciptive statistics shown in Table 3 present average yield spreads before and after a country joined the gold standard. It may be the case that yield spreads declined between the pre- and post-event period, but a movement in the underlying trend is masked by using average interest-rate differentials. To address this issue, Figures 1-9 show time-series plots of the currency risk premiums for which sovereign debt data denominated in both home and foreign

[12] The five largest emerging market borrowers as of 1913 that were not included in our sample are Australia, Japan, Turkey, Canada, and Egypt. Australia and Canada joined the gold standard prior to the start of our sample period. We were unable to locate paper bonds for Japan, Egypt, and Turkey.

[13] The average currency risk premium for the nine sovereign borrowers declined roughly 75 basis points from the pre-gold to the "on-gold" period of the 10-year window and more than 47 basis points in the four-year window after a country adopted the hard peg.

currencies exist. The vertical line in each figure denotes when a country joined the gold standard. Because we are focusing on the interest-rate differentials between two bonds of the same country, where the primary difference between the obligations is their currency denomination, our analysis is simpler than those interested in understanding country risk: we largely eliminate the need to control for observed and unobserved differences in sovereign-specific fundamentals.[14]

As noted above, if a hard peg is perfectly credible, then the yield spread between a country's paper currency bonds and its debt denominated in pound sterling should fall to zero after gold standard adoption. Figures 1-9 show this is not the case for all nine emerging market borrowers. The currency risk premium for Argentina (Figure 1), one of the largest sovereign borrowers of the late nineteenth century, declines in the years leading up to the country's adoption of the gold standard in October 1899, but remains at approximately 1,000 basis points afterwards. As shown in Figure 2, Austria's exchange-rate risk declined around the period of adoption, but the currency risk premium nevertheless averaged approximately 120 basis points in the five-year period after the country joined the gold standard in 1892.

Figure 3 shows the currency risk premium for Brazil, another large Latin American borrower. Currency risk rose from a little under 50 basis points to around 100 basis points at the time of adoption and remained at approximately 100 basis points after the country joined the gold standard. Figure 4 provides evidence for the British colony of India, and indicates that the interest-rate differential between paper rupee and gold rupee denominated debt trading on the London market averaged 240 basis points in the five years after the country joined the gold club.

Figure 5 presents the evidence for Italy, another European emerging market of the nineteenth century. The currency risk premium for Italy also declines over the sample period, as it moved toward adopting the gold standard, but the premium hovers between 40-60 basis points five years after adoption. The interest-rate differential between Mexico's paper and sterling denominated bonds declines substantially prior to adoption, but its currency risk premium averaged almost 500 basis points in the five-year period after the country joined the gold

[14] Empirical studies of sovereign risk during the gold standard have found the ratio of debt-to-revenue, budget deficit, and exports per capita to be important determinants of yield spreads (Ferguson and Schularick, 2006a; Flandreau and Zumer, 2004).

standard (Figure 6).[15] For Russia, the currency risk premium shown in Figure 7 is large and appears to change very little over the 10-year window, averaging more than 800 basis points before and after adoption of gold in 1897. Figure 8 also shows that the currency risk premium for the United States averaged approximately 100 basis points over the entire 10-year sample period.[16] Chile was on the gold standard for a shorter period compared to other countries in our sample (it joined the gold standard in 1895 and abandoned its hard peg in July 1898).[17] The currency risk premium averaged more than 583 basis points while it was on the gold standard (Figure 9). This large interest-rate differential suggests that investors never perceived its peg to be very credible.

We next examined whether the large interest-rate differential between the paper and gold bonds that we observe might simply be explained by market liquidity. For example, it might be possible that paper bonds are considerably less liquid than gold bonds. To check for this possibility, we collected data on bid-ask spreads, a standard measure of market liquidity, for six of the nine countries for which we measure currency risk.[18] Table 4 shows the relative bid-ask spread for the paper bond, gold bond, as well as the difference in liquidity between the two debt issues. Liquidity is expressed in basis points. Liquidity does not appear to explain a significant portion of the currency risk premium given that the difference in market liquidity accounts for less than 10 percent of the interest-rate differential between paper and gold bonds in our sample. India is the only country/colony in our sample where the difference in liquidity between paper and gold bonds was more than 30 basis points; the liquidity difference in India can probably be

[15] For Mexico, a silver long-term bond is used to proxy for the paper debt issue. Mexico cut the silver content of its silver peso by 50 percent in the 10-year period before it joined the gold standard. As a result, the silver peso was quite similar to paper currency, which remained the most important circulating medium. In Mexico's case, the silver-gold bond interest-rate differential likely provides a lower bond estimate of depreciation expectations.

[16] For the United States, we used both the 4.5 percent gold bonds (due in 1891) and the 4 percent gold bonds (due in 1907) to calculate the currency risk premium. We spliced the two bond series together by subtracting 30 basis points off the 4.5 percent bonds in the period when data on the 4 percent gold bonds was not available. The 30-basis-point difference is the average yield spread differential between the 4.5 percent gold bonds and the 4 percent gold bonds.

[17] Bordo and Rockoff (1996) discuss the relationship between Chilean internal peso bonds and its sterling denominated external debt, but do not interpret the interest-rate differential as a measure of the currency risk premium and its implications for the credibility of the hard peg. Chile also briefly joined the gold club in the early to mid 1870s. However, we were unable to locate any domestic paper bonds to test the credibility of this earlier episode of gold standard commitment.

[18] We were unable to find bid-ask spread data for Chile, Italy, and Russia; however, it is unlikely that differences in the liquidity between the paper and gold bonds can explain the interest-rate differential for the three countries. First, the gold and paper debt issues for each country are quite large. Second, the actual and expected depreciation rates calculated above are quite close for the three countries. This would not be the case if liquidity were the primary determinant of the currency risk premium.

explained by the fact that an investor would have to convert their paper rupees into gold rupees using council bills which incurred substantial transaction costs (Keynes, 1913).

Overall, the time-series evidence suggests that the gold standard was not very credible for many emerging market countries since the interest-rate differential between a country's paper currency debt and its sterling bonds often remained more than four hundred basis points years after a country joined the gold standard.

IV. Implied and Actual Devaluations for Emerging Market Borrowers

An addtional way of assessing the credibility of the hard pegs of the classical gold standard era is to consider whether investors believed that countries would devalue after gold standard adoption. If the size of an anticipated devaluation were close to zero, this would indicate that investors viewed the pegs as credible; however, if the expected devaluation deviated significantly from zero, this would indicate that markets did not expect the pegs to last.

A. Estimating the Size of Devaluations

We follow the methodology proposed in (Schmukler and Serven, 2002) and derive estimates of the size of the anticipated devaluation for our sample of nine emerging market borrowers that issued both gold-denominated and paper-denominated sovereign debt. Using the assumption of risk neutrality and the definitions in Section II of the paper, we can rewrite the currency risk premium as the likelihood of an exchange rate devaluation, *p*, multiplied by the size of the expected devaluation, d_t^e:

$$(5) \quad (i_{t,k} - i_{t,k}^*) = p d_t^e .$$

Dividing the currency risk premium by the probability of a fall in the exchange-rate yields the anticipated size of the devaluation:

$$(6) \quad d_t^e = (i_{t,k} - i_{t,k}^*) / p.$$

Table 4 shows the expected size of the devaluation for our sample of sovereign borrowers. Each cell in the table provides an estimate of the size of the expected decline in the exchange rate depending on the country and the likelihood of a devaluation occurring in that country. Each column of the table shows a hypothetical probability of devaluation occurring.[19]

It is possible to narrow down the range of the size of the anticipated decline in the exchange rate by employing Bordo and Murshid's (2006) estimates of the likelihood a global financial crisis. They find that the probability of a global crisis during our sample period ranged between 10 and 14 percent. If we assume that each country's probability of a decline in the exchange-rate is equal to the probability of a global crisis and we use the lower end estimate of a global crisis of 10 percent, then the data suggest that markets anticipated that exchange rates would fall by an average of 40 percent (Column 1, Table 5). The size of the decline in the exchange rate varies significantly across our sample of nine emerging market countries. Investors anticipated that exchange rates would fall by less than 13 percent for countries like Austria, Brazil, Italy, and the United States, but would decline by more than 30 percent for countries such as Argentina, Chile, India, Mexico, and Russia.[20]

One potential criticism of the baseline results is that the probability of a crisis in a given country is higher than the incidence of a global crisis. Another possibility is that other factors, which might lead to a devaluation (including country-specific factors such as political instability), played an important role in influencing the durability of hard pegs during the gold standard. We therefore consider an alternative scenario – that the probability of a financial crisis in a given country is twice the probability of a global crisis or 20 percent. Under this scenario, the average maximum implied devaluation is approximately 16 percent. Here again, there is considerable variance across our sample. For countries like Austria, Brazil, Italy, and the United States, the maximum implied decline in the exchange rate was less than 10 percent; for other countries, it ranged from 12 to 55 percent.

[19] India is useful to include in our sample because it provides an example of a debt issuer with almost no likelihood of differential default or differential recovery since it was a colony and both gold and paper bonds were guaranteed by the metropole. Five years after joining gold, India's currency risk premium is still roughly 245 basis points.

[20] Our analysis also suggests that the currency risk premium is also capturing a factor that is largely distinct from the determinants of country risk given that the correlation between the change in the currency risk premium and the country risk premium is less than 0.20 for the seven emerging market countries with both paper and gold (sterling) bonds.

B. Comparing Expected Devaluations to Actual Devaluations

We can take this analysis one step further by investigating whether actual devaluations map into expected devaluations. Doing so provides a useful validity check on the modeling assumptions and the outcomes generated from the model. We are able to make this comparison since most of the countries in our sample either left the gold standard or issued paper currency that traded alongside money that was explicitly or legally backed by gold. Table 6 compares the actual depreciations to the expected devaluations. Chile and Italy left the gold standard in July 1898 and May 1894, respectively. In the year following its departure from the gold standard, Chile's exchange rate was, on average, 28 percent lower against the U.S. dollar in comparison to the period when it was on the gold standard. As shown Table 6, the 28 percent depreciation is almost exactly equal to the expected depreciation. For Italy, the lira fell percent approximately 8 percent against the French franc in the six months after it abandoned specie convertibility in the summer of 1893. Fratiani and Spinelli (1990) and Tattara (2003) show that movements in the lira/franc exchange rate mirrored the ratio of Italian domestic to foreign prices of rendita debt. Italy's actual depreciation is slightly larger than the expected depreciation shown in Table 5.

Argentina issued paper pesos that could only be exchanged for gold pesos at the rate of 2.27 to 1 based on the Conversion Law of 1899 (Williams, 1920). This implies that paper pesos traded at a 127 percent premium, which is consistent with more than a 100 percent depreciation. The large currency-risk premium calculated using paper and gold bonds and the observed paper-gold exchange rate suggest that Argentina's hard peg was not credible.

Austria joined the gold standard in August 1892. As pointed out by Flandreau and Komlos (2008), the Austrian exchange rate fluctuated within a narrow band around the country's mint par ratio. Indeed, the *Amsterdamsch Effectenblad* generally quoted paper florin trading at par with gold florin up until the outbreak of World War I except for the first couple of years after the country joined the gold standard in 1892.

Brazil established a government exchange bureau to oversee exchange-rate fluctuations after the country joined the gold standard in 1906. Shortly thereafter, the government bureau ran out of gold to redeem the paper notes and the currency began to fluctuate on the open market. On December 31, 1910, the President of Brazil issued a decree that paper notes would be converted into gold at the new rate of 16 pence per milreis instead of 15 pence per milreis (*Commerce*

Reports of the United States, 1910). The nearly seven percent depreciation in the milreis is consistent with the expected depreciation estimated for Brazil shown in Table 6, where the assumed probability of devaluation is 10 percent.

Mexico joined the gold standard in 1905, but continued to issue and use silver and gold coins while on the gold standard. In 1905, the government altered the mint par ratio between gold and silver by reducing the value of silver by 50 percent. This decision temporarily stabilized the peso, improved the country's trade balance, and promoted capital inflows as shown by the large decline in the country's currency risk premium. On the other hand, the 50 percent decline in the gold value of the silver peso demonstrated a willingness of the Mexican government to debase its currency, a decision that ultimately created inflationary pressure and contributed to the downfall of Porfirio Diaz (Hart, 2010).

India joined the gold standard in 1897. Paper notes issued by the government were largely backed by silver rather than gold. This accounted for India's large currency risk premium. The interest-rate differential between paper and gold bonds began to disappear only after the British government agreed to guarantee the conversion of Indian silver into gold (Appleton's Encyclopedia, 1900; Keynes, 1913). At this time, India's exchange rate is no longer an emerging market currency given that its commitment to the gold standard was backed by the British government and their sterling reserves. The fact that the British government was willing to step in and support Indian currency suggests that England was concerned about the exchange-rate risk associated with holding paper rupees.

Russia issued paper and gold bonds that traded on the Amsterdam exchange. The *Amsterdamsch Effectenblad* occasionally printed price quotes for the paper-gold rouble exchange rate. Based on these data, paper roubles traded at a 50 percent discount to the gold rouble – a figure that is consistent with the expected depreciation calculated in Table 6 (using the assumption of a market-based probability of a devaluation between 10 and 25 percent). Finally, the United States also issued gold and paper bonds during the classical gold period. The existence of a positive currency risk premium reflects "silver risk" – the possibility that the United States would adopt a bimetallic standard during the period 1870-1896. Calomiris (1988, 1992) and Hallwood et al (2000) find that expectations of a depreciation of the US dollar were quite small during the early to mid-1890s.

Overall, expected depreciations mirror actual depreciations and suggest a similar story. Market participants believed that there was significant exchange-rate risk in emerging markets during the classical gold standard period.

V. Conclusion

Are hard pegs ever credible for emerging market borrowers? We suggest that bond spreads from the classical gold standard provide a unique laboratory for understanding this issue since capital markets were unfettered and multilateral institutions for the support of sovereign debt were non-existent. We focus on the currency risk premium (the interest-rate differential between a sovereign borrower's paper and gold bonds) after gold standard adoption as this provides a straightforward test of whether the classical gold standard was a credible peg. Using a new hand-collected database of weekly and monthly bond prices, we analyze the currency risk premium for a sample of nine large emerging market borrowers during the gold standard period. The empirical analysis suggests that the currency risk premium averaged more than 400 basis points in the five-year period after a country joined the gold standard. The large and persistent currency risk premium implies that markets expected exchange rates to depreciate approximately 20 percent for our sample of gold standard countries. Given that the gold standard is considered by many economists to be the most credible fixed exchange rate system in modern history, our results suggest that hard pegs may never be credible.

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Table 1

Timeline of Gold Standard Adoption and Adherence

Country	Date of Adoption	Dates of Adherence
Argentina	October 31, 1899	10/31/1899-8/2/1914
Austria	August 2, 1892	8/2/1892-8/4/1914
Brazil	October 15, 1906	10/15/1906-12/12/1914
Ceylon	September 26, 1901	9/26/1901-9/4/1914
Chile	June 1, 1895	6/1/1895-7/11/1898
Costa Rica	October 26, 1896	10/26/1896-9/18/1914
Egypt	November 17, 1885	11/17/1885-8/2/1914
Greece	March 19, 1910	3/19/1910-12/1914
India	January 1, 1898	1/1/1898-9/5/1914
Italy	March 1, 1883	3/1/1883-1894
Mexico	May 1, 1905	5/1/1905-1914
Nicaragua	March 20, 1912	3/20/1912-1914
Russia	January 3, 1897	1/3/1897-7/1914
South Africa (Cape of Good Hope)	February 9, 1882	2/9/1882-9/6/1914
Sweden	May 30, 1873	3/30/1873-1914
Turkey	January 6, 1881	1/6/1881-8/4/1914
United States	January 1, 1879	1/1/1879-9/7/1917

Table 2. Measuring the Country Risk Premium

Panel A: 4-Year Windows

Country	Whole Period (1)	Pre-Gold (2)	On Gold (3)	Change (4)	Observations (5)
Argentina	376.49	405.42	347.57	-57.84	209
Austria	139.72	140.21	139.17	-2.40	209
Brazil	207.12	216.65	197.34	-24.31	49
Ceylon	71.53	74.65	68.39	-6.26	209
Chile	256.26	260.09	252.48	-7.61	209
Costa Rica	1410.54	1426.72	1400.14	-26.58	209
Egypt	294.84	328.07	261.94	-66.13	209
Greece	670.43	709.44	631.71	-77.73	209
India	52.83	50.05	55.65	5.59	209
Italy	147.06	131.34	162.59	31.25	49
Mexico	207.33	210.49	204.19	-6.31	209
Nicaragua	499.96	499.24	501.73	2.49	153
Russia	105.00	113.65	96.33	-17.32	209
South Africa (Cape of G. Hope)	144.37	138.99	149.75	10.76	209
Sweden	164.01	166.75	161.23	-5.51	209
Turkey	652.56	704.57	599.86	-104.71	209
United States	78.17	80.41	76.02	-4.39	209
Country Average	332.25	332.75	312.12	-21.00	

Table 2. Measuring the Country Risk Premium (continued)

Panel B: 10-Year Windows

Country	Whole Period (1)	Pre-Gold (2)	On Gold (3)	Change (4)	Observations (5)
Argentina	431.56	556.71	306.20	-250.51	521
Austria	143.79	147.79	139.74	-8.043	521
Brazil	219.325	236.436	196.103	-40.33	99
Ceylon	78.01	79.00	76.98	-2.01	521
Chile	253.02	281.78	237.45	-44.33	521
Costa Rica	1005.25	925.49	1088.90	163.41	521
Egypt	269.61	300.17	231.37	-68.80	422
Greece	640.59	699.32	572.42	-126.90	484
India	45.89	46.93	44.90	-2.03	521
Italy	145.40	125.75	161.78	36.03	111
Mexico	203.93	210.88	198.85	-12.03	452
Nicaragua	542.20	549.68	501.73	-47.95	309
South Africa (Cape of G. Hope)	118.66	134.22	103.04	-31.18	463
Russia	147.70	142.76	154.05	11.29	
Sweden	166.43	169.14	164.99	-4.15	396
Turkey	696.40	826.55	613.18	-213.37	426
United States	68.79	83.12	54.53	-28.59	521
Country Average	304.50	324.45	285.07	-39.38	

Table 3. Measuring the Currency Risk Premium

Panel A: 4-Year Windows

Country	Whole Period (1)	Pre-Gold (2)	On Gold (3)	Observations (5)
Argentina	1217.85	1271.52	1164.74	209
Austria	121.30	114.92	124.73	209
Brazil*	83.19	100.29	66.77	49
India	268.65	281.47	256.07	209
Italy*	95.72	119.40	72.93	49
Mexico	575.23	665.32	489.38	209
Russia	795.69	789.17	802.37	209
United States	101.60	103.39	99.79	209
Chile*	572.49	640.67	583.19	49
Country Average	425.75	454.02	406.66	

Table 3. Measuring the Currency Risk Premium (continued)

Panel B: 10-Year Windows

Country	Whole Period (1)	Pre-Gold (2)	On Gold (3)	Observations (5)
Argentina	1286.63	1465.26	1107.95	521
Austria	142.00	157.86	126.03	521
Brazil*	72.48	64.01	81.20	71
India	256.47	282.47	245.46	371
Italy*	89.27	124.19	60.54	111
Mexico	582.70	709.13	489.38	452
Russia	820.43	820.02	820.77	510
United States	102.02	95.46	108.57	521
Chile*	581.13	580.11	583.19	79
Country Average	437.01	477.61	402.57	

Note: * indicates monthly data.

Table 4. Relative Bid-Ask Spreads of Sovereign Bonds during the Gold Standard (Basis Points)

Country	Paper Bond	Gold Bond	Difference in Liquidity
Argentina	67	67	0
Austria	62	50	12
Brazil*	7	52	-45
Chile	N/A	61	N/A
India	88	24	64
Italy	N/A	N/A	N/A
Mexico	48	24	24
Russia	N/A	N/A	N/A
United States**	30	4	26
Average	50	40	13.5

*Bid-Ask Spreads for the gold bond only available from October 1906 through June 1910.
**Bid-ask spreads for the first year that the United States was on the gold standard.

Table 5. Implied Devaluations for Gold Standard Adopters

(Percent)

	Assumed Probability of Devaluation				
Country	10%	20%	50%	75%	90%
Argentina	110.8	55.4	22.2	14.8	12.3
Austria	12.6	6.3	2.5	1.7	1.4
Brazil	8.12	4.1	1.6	1.1	0.9
India	24.5	12.3	4.9	3.3	2.7
Italy	6.1	3.0	1.2	0.8	0.7
Mexico	48.9	24.5	9.8	6.5	5.4
Russia	81.3	41.0	16.4	10.9	9.1
United States	10.9	5.4	2.2	1.4	1.2
Chile	58.3	29.0	11.7	7.8	6.5
Average Size of Devaluation	**40.3**	**20.1**	**8.0**	**5.4**	**4.5**

Notes: Under the assumption of risk neutrality, the maximum implied devaluation is computed by dividing the average value of the currency risk premium in the five-year period after joining the gold standard by the assumed probability of a devaluation.

Table 6. Actual versus Expected Devaluation

Country	Actual Devaluation	Expected Devaluation
Argentina	122	55.4
Austria	0	6.3
Brazil	7	4.1
India	NA	12.3
Italy	8	3.0
Mexico	50	24.5
Russia	50	41.0
United States	0	5.4
Chile	28	29.0

Notes: See the text for calculations used for expected devaluations. For Argentina, actual devaluation is determined by the 1899 Law of Conversion that legally set the exchange rate between paper and gold pesos at 2.22 to one. The actual devaluation for Austria, Chile, Italy, Russia, and the United States is determined by the market exchange rate. The actual devaluation for Brazil and Mexico is determined by the change in the mint par ratio.

Figure 1
Currency Risk for Argentina, Nov. 1894-Oct. 1904
(Basis Points)

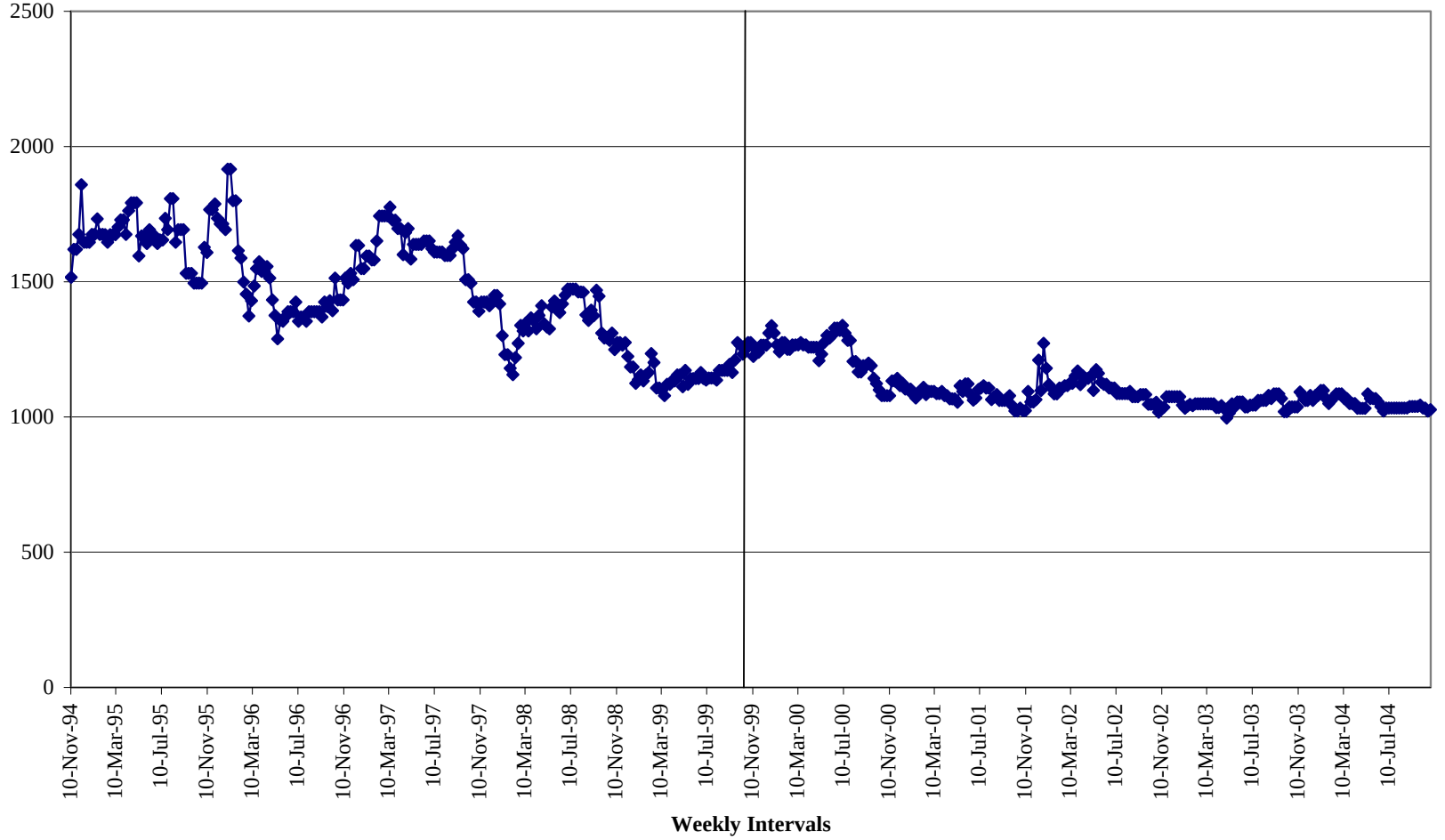


Figure 2
Currency Risk for Austria, August 1887- July 1897
(Basis Points)

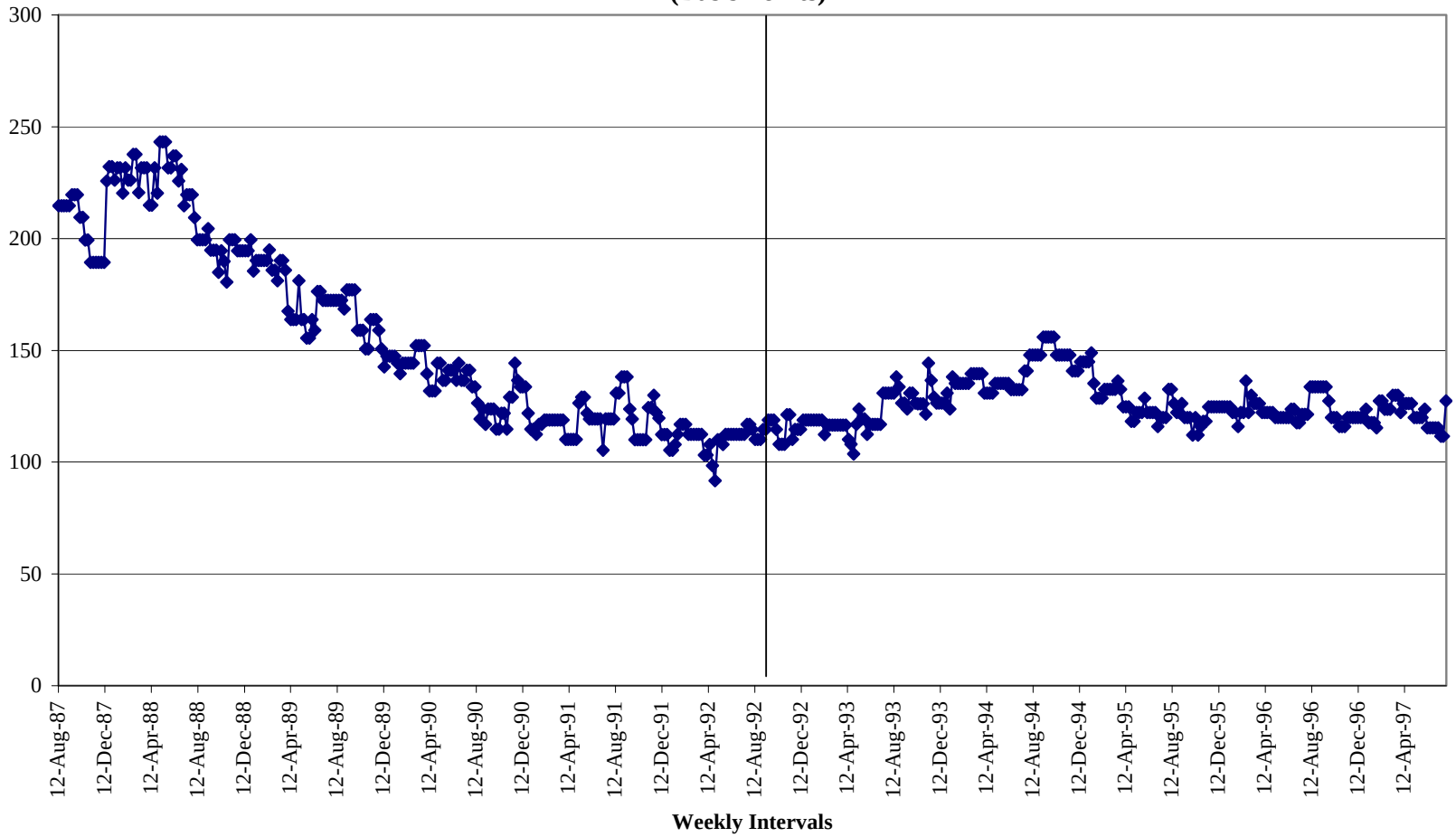


Figure 3
Currency Risk Premium for Brazil, 1902 - March 1910
(Basis Points)

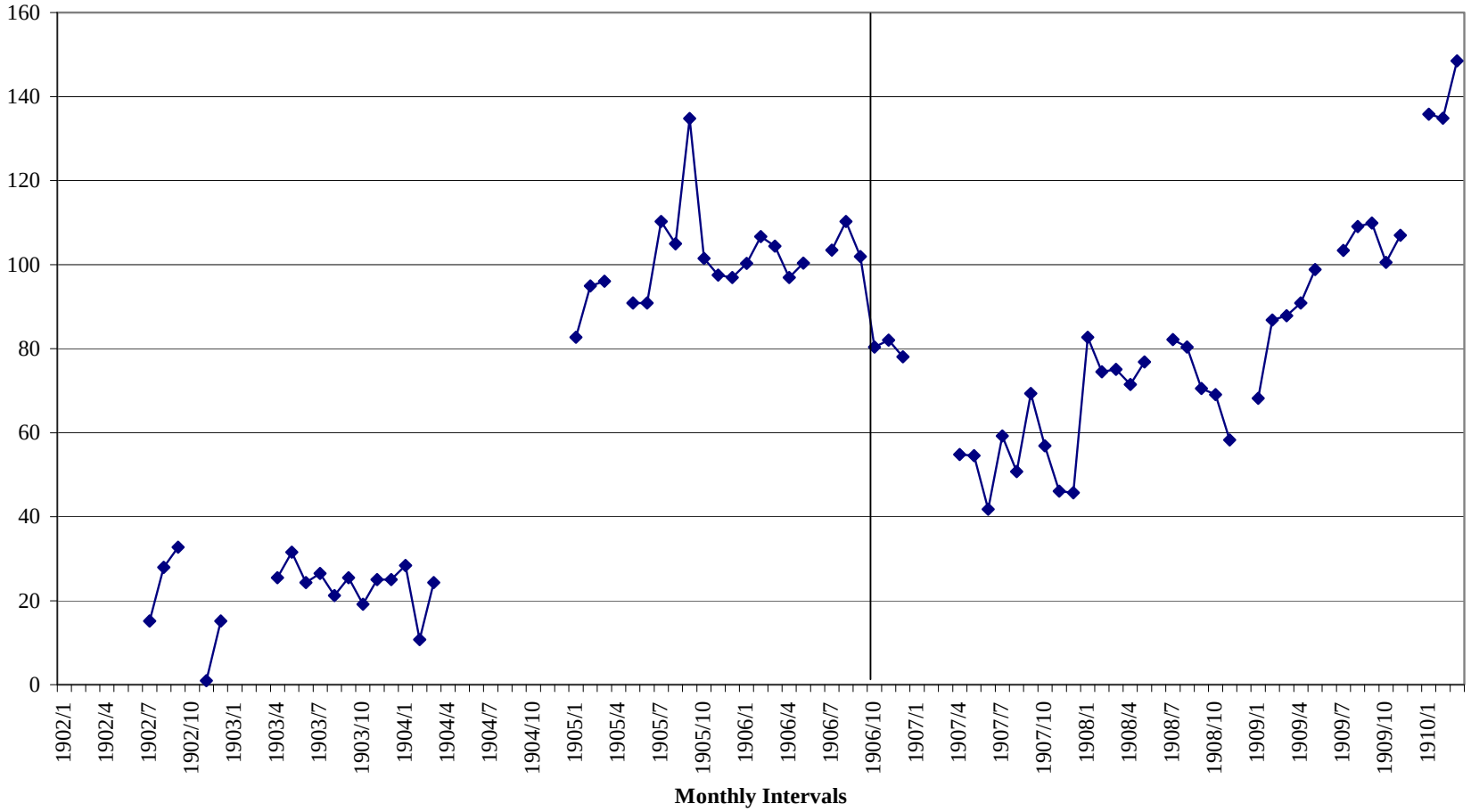


Figure 4
Currency Risk for India, Nov. 1895- Dec. 1902
(Basis Points)

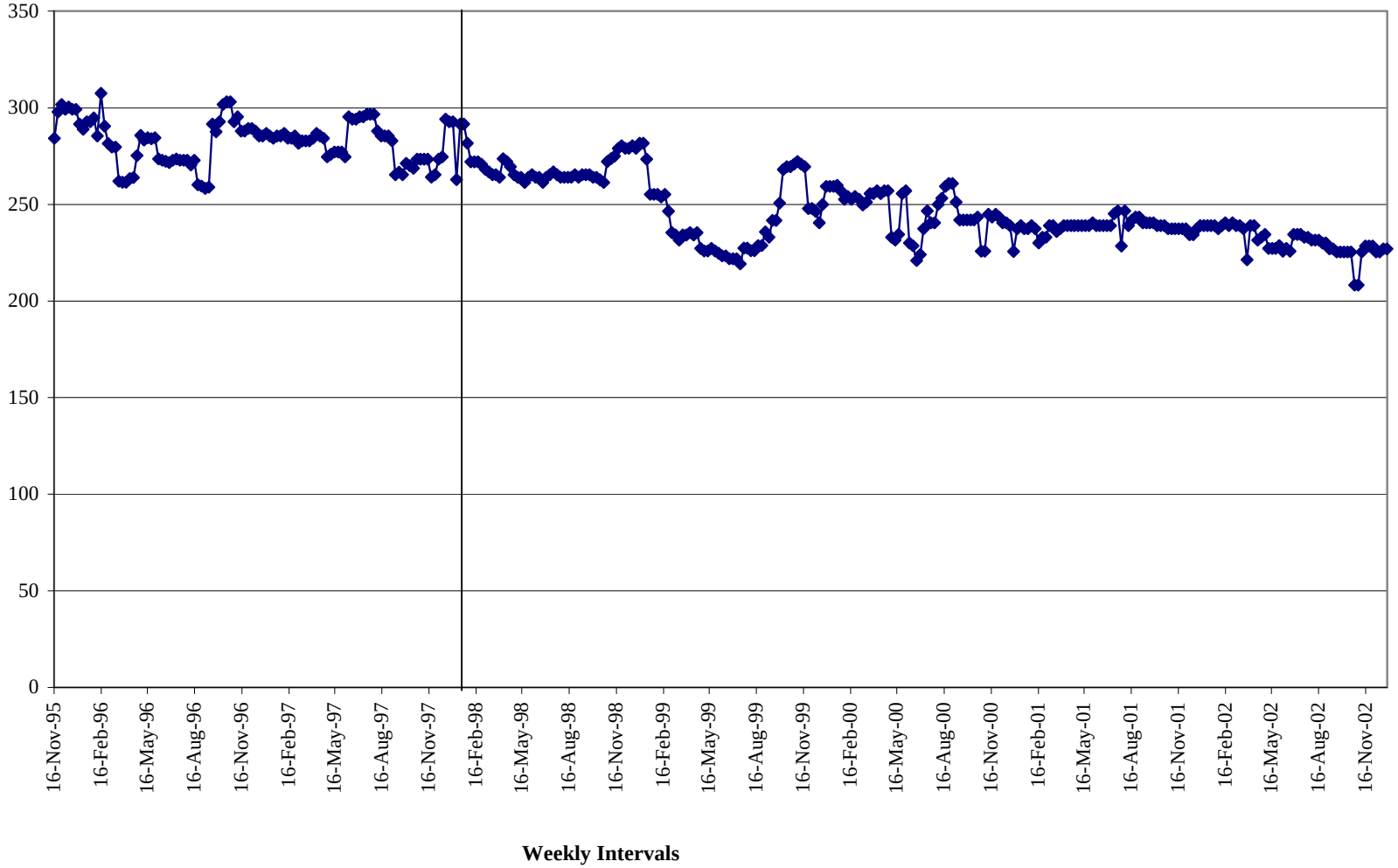


Figure 5
Currency Risk for Italy, Jan. 1879-March 1888
(Basis Points)

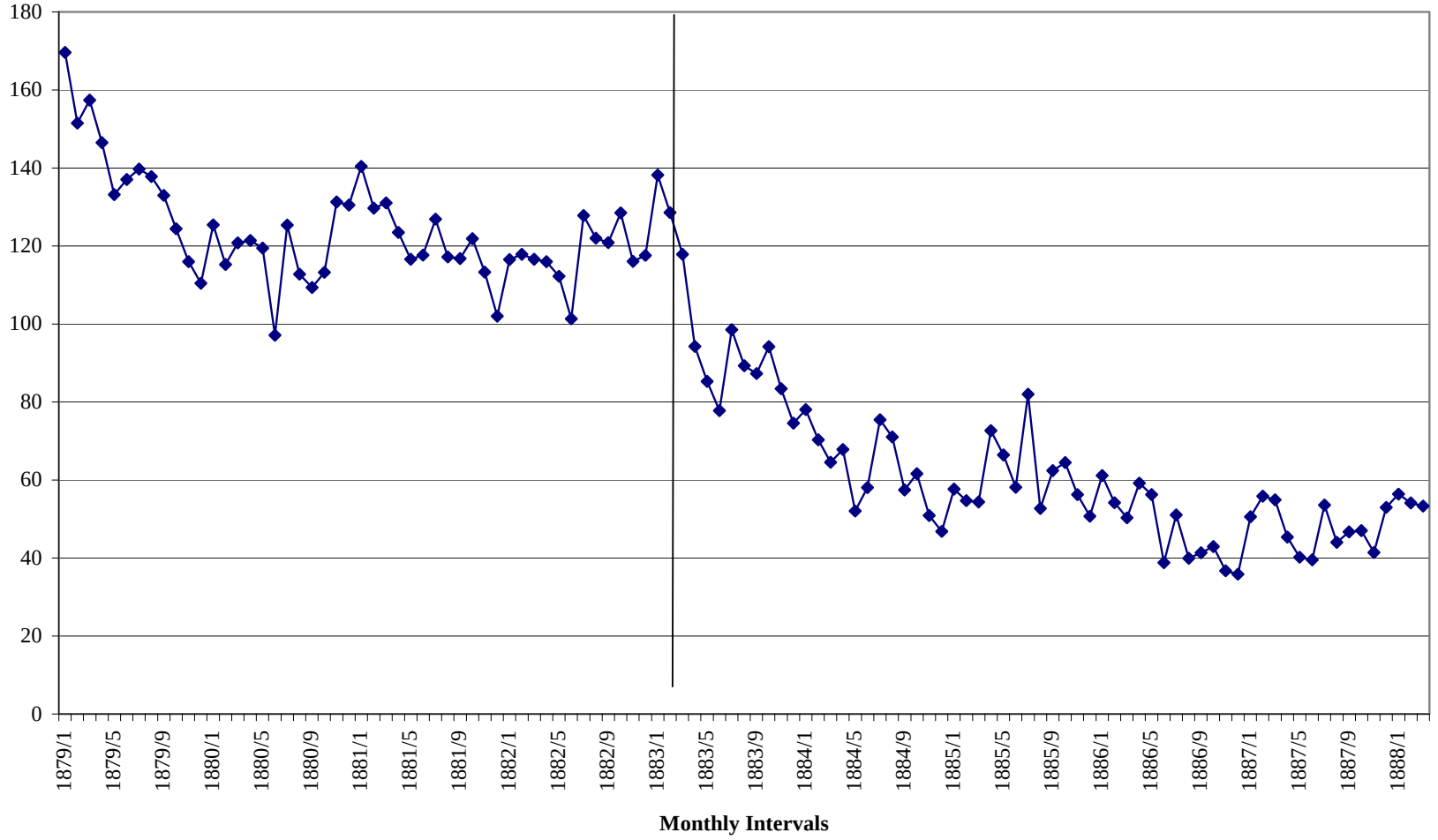


Figure 6
Currency Risk for Mexico, Sept. 1901-1910
(Basis Points)

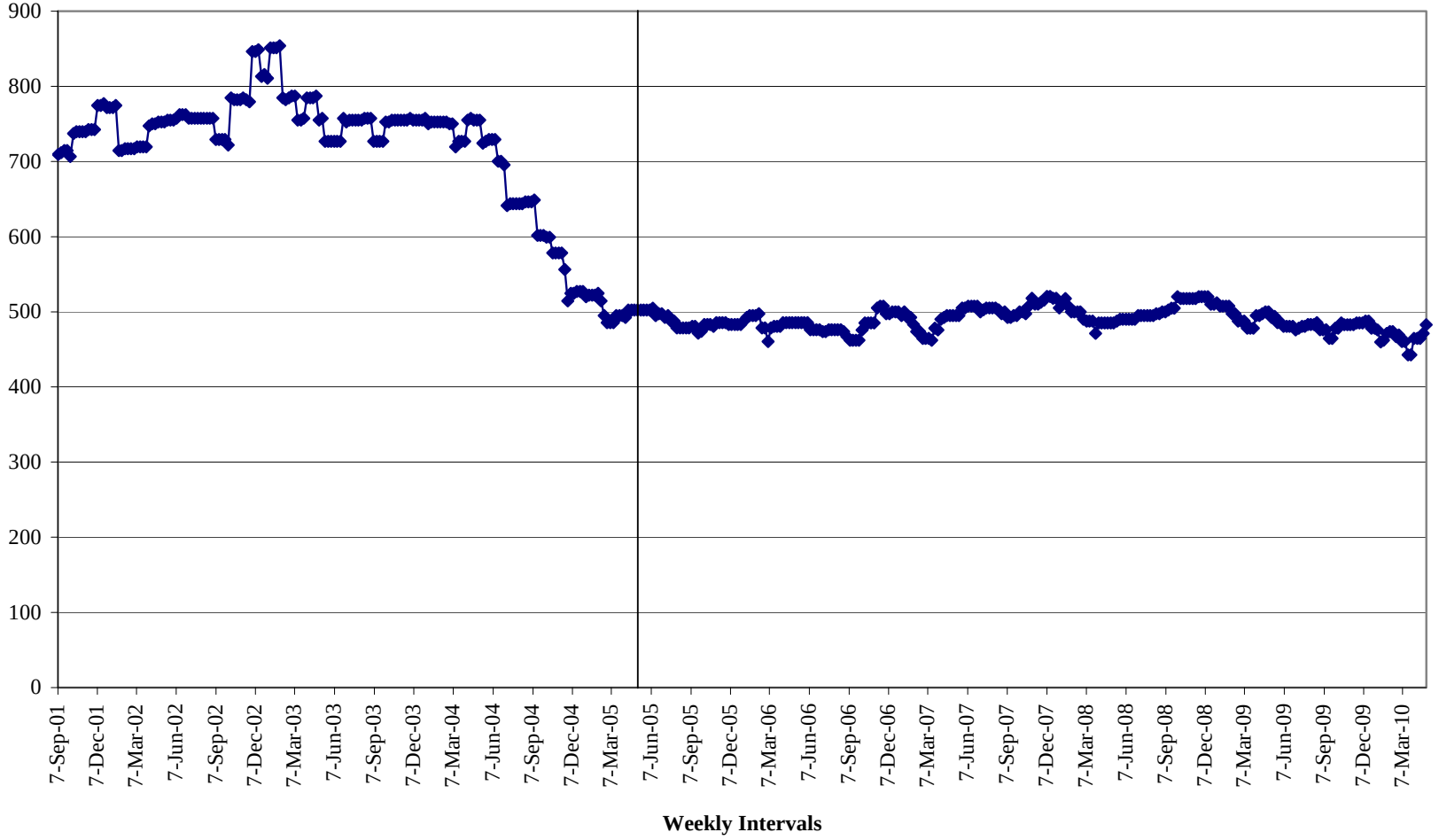


Figure 7
Currency Risk for Russia, May 1892-January 1902
(Basis Points)

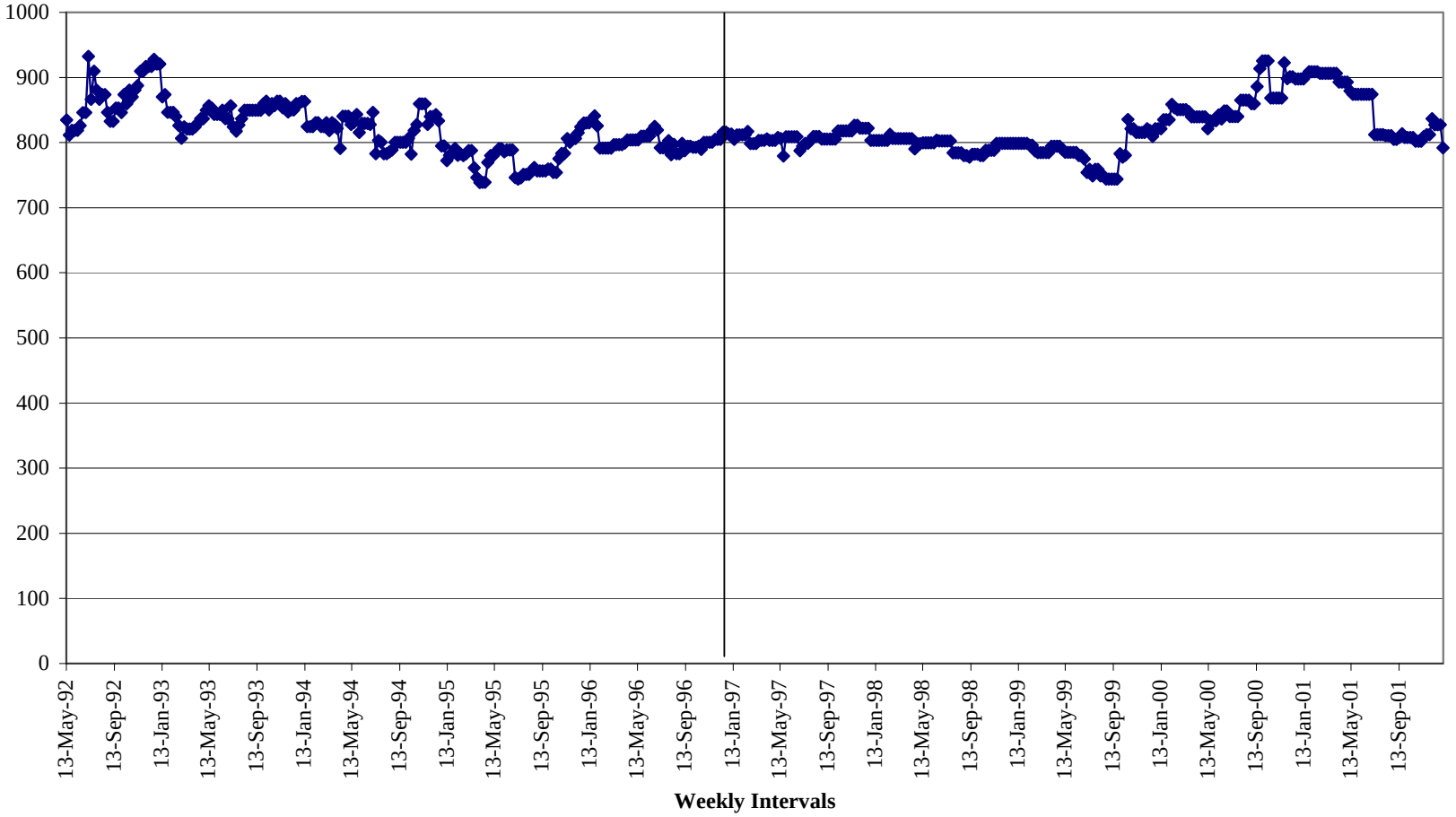


Figure 8
Currency Risk for the USA, 1874-1883
(Basis Points)

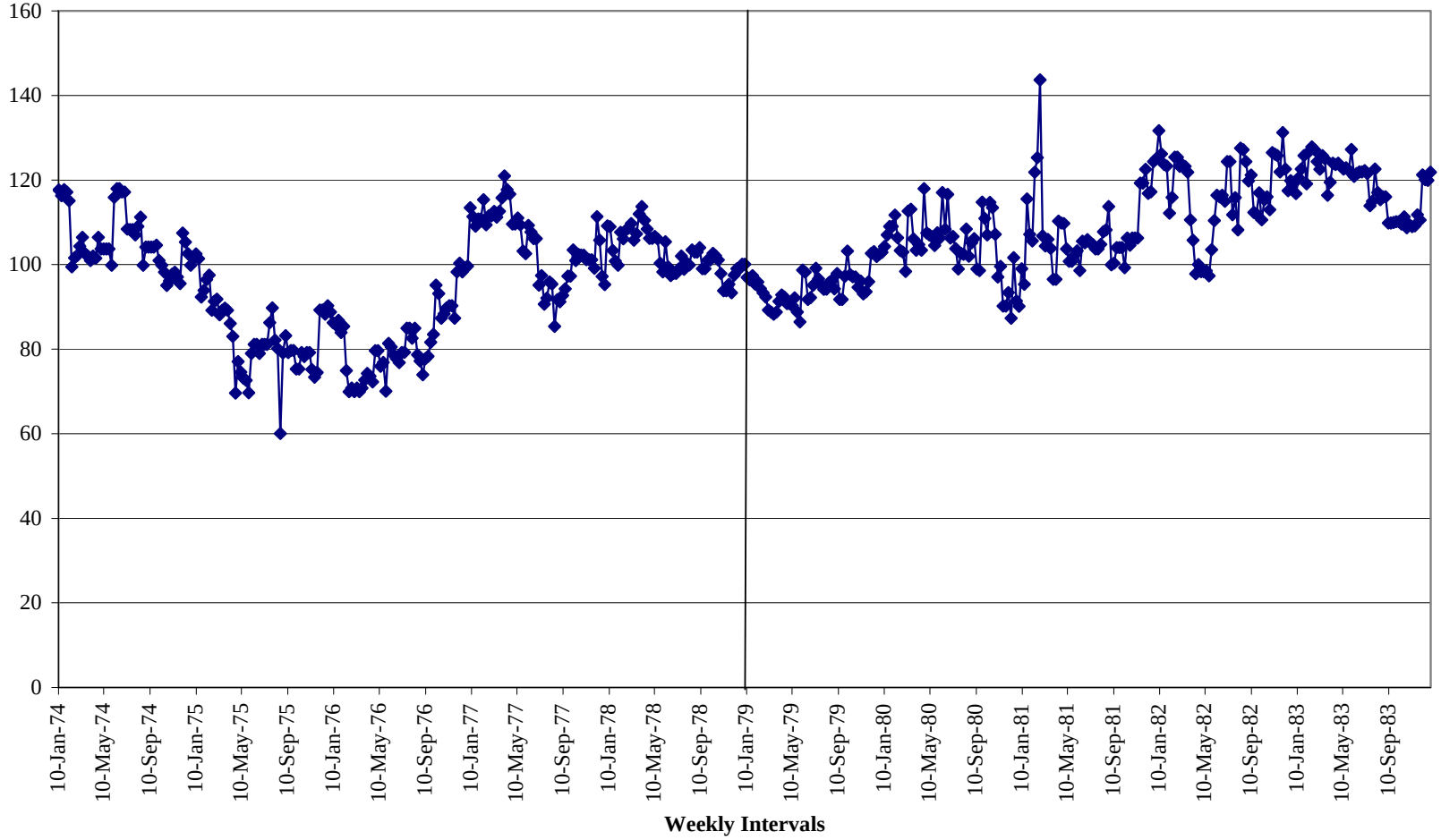
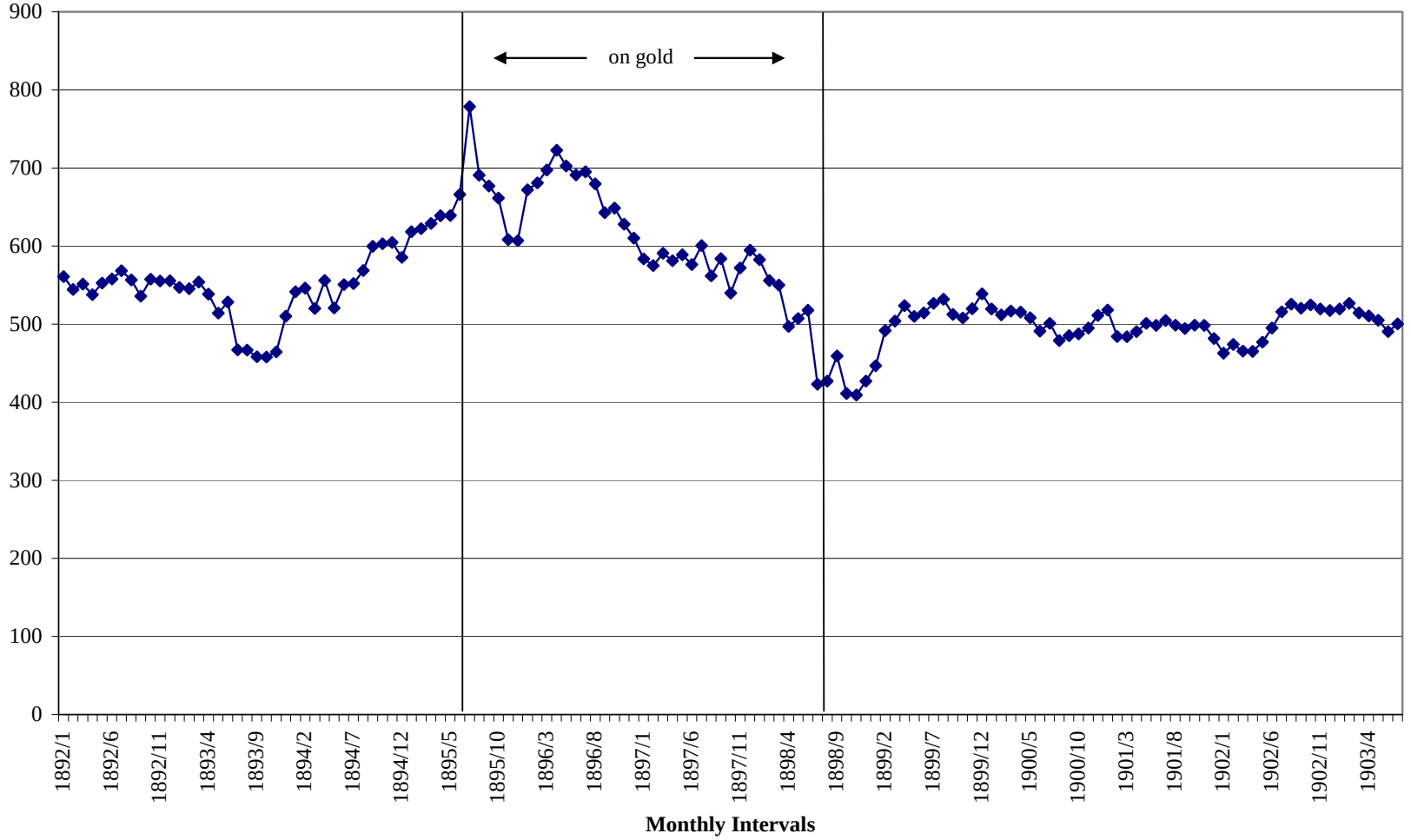


Figure 9
Currency Risk for Chile, 1892-1903
(Basis Points)



Appendix 1. Bond Data

We collected the data on weekly bonds yields from *Amsterdamsch Effectenblad*, *El Mercurio*, *El Sol*, *Investor's Monthly Manual*, *Jornal do Commercio*, *The Economist*, and *The Commercial and Financial Chronicle*. In the following table, we list the interest rate stated in the terms of the bond.

Argentina – 4.5 percent, bonds are to be redeemed within 39 years after they were issued in 1889.
Argentina – 7 percent Cedula 'B' paper bonds.
Austria – 4 percent gold perpetuity bonds; 5 percent paper perpetuity bonds
Brazil – 4.5 percent sterling bonds, bonds redeemable with a sinking-fund of 1/2 percent per annum beginning in 1911.
Brazil – 6 percent apolices (paper perpetuity bonds) and 1879 4.5 percent internal gold loan taken from *The Economist* and *Jornol do Commercio*.
Ceylon – 4 percent debentures, repayable at par on February 15, 1934.
Costa Rica – 5 percent A Series, interest rate reduced to 3 percent on April 22, 1899. The bonds were retired via half-annual drawings. Repayment begins with a non-cumulative sinking-fund that commences October, 1917.
Chile – 4.5 percent sterling bonds, bonds redeemed by ½ per annum when the bonds fall below par or by a sinking-fund provision. Eight percent bonds Bonos (paper bonds) with a 10-year maturity. Data on paper-currency bonds for Chile were taken from *El Mercurio*.
India – 3.5 percent sterling bonds redeemable on or after 1931.
India – 3.5 1854-1855 rupee bonds, repayable 3-months after notice by the government after August 1, 1904.
Italy – five percent rentes, perpetuity bonds traded in London; 5 percent irredeemable paper and gold rendita bonds.
Mexico – 5 percent external bonds redeemable not later than 1945.
Mexico – 5 percent Internal Silver Bonds, redeemable by means of a cumulative sinking-fund of 0.25 percent.

Appendix 1. Bond Data (continued)

Nicaragua – 1886/1909 six percent bonds. Redeemable in 35 years.
France – 3 percent rentes, perpetuity bonds.
Russia – 1822 five percent perpetuity, coupons payable in London, traded on major European markets.
Russia – 6 percent (1817) paper bonds, 94.5 million paper rouble issue, coupons payable in Amsterdam
South Africa (Cape of Good Hope) – Cape of Good Hope 4.5 percent, due in 1900
Sweden – 5 percent, issued in 1868, redeemable through a cumulative sinking-fund of .25 percent.
Turkey – 4.25 percent external tribute of 1871, redeemable by 1900.
UK – consols 3 percent until, then 2.75 which were redeemable in 1923.
United States - 6 percent currency bonds, due 1895-1899; 4.5 percent gold bonds due 1891; 4 percent gold bonds due 1907.

Appendix 2. Paper Bonds during the Classical Gold Standard, 1870-1913

Issue	Size of Issue(year)	Market for Paper Bonds	Market for Gold Bond
Argentine 7% Cedulas 'B' Currency	$9.58 million(1900)	London	London
Austrian 5% Perpetuity	₤177 million(1890)	London	London
Brazil 6% Apolices	Mx53.6 million (1906)	Rio de Janiero and Sao Paolo	Rio de Janiero and Sao Paolo/ London
Chilean 8% Bonos	151 million gold pesos(1900)	Valparaiso	London
Indian 3.5% Rupee	Rx13.75 million(1900)	London	London
Italian 5% Perpetuity	Half of all government debt is in paper bonds	Milan	Paris
Mexican 5% Internal	$59 million	London	London
Russian 6% Internal paper loan	38.5 million paper roubles outstanding (1895)	Amsterdam	Amsterdam/London
United States 6%	$64 million(1879)	New York	New York

Sources: *Amsterdamsch Effectenblad*, *Commercial and Financial Chronicle*, *El Mercurio*, *El Sol*, *Investor's Monthly Manual*, *Official Stock Exchange Intelligence*, *Jornal do Commercio* (October 31, 1906), and Llona (1990). Rx stands for Rupee. Mx stands for milreis.

Appendix 3. Gold Standard Adoption Dates and Source Information

Argentina – The Law of Conversion was passed on Oct. 31, 1899 restoring convertibility (della Paolera and Taylor, 2001, p. 120).

Austria – Joined the gold standard by laws passed August 2, 1892. (Mitchell, 1898).

Brazil – "Under an act which went into effect December 22, 1906, a conversion fund was established by means of import duties collected in gold." (*Monetary Systems of the Principle Countries of the World*, p.8).

Ceylon – Adopted with the Gold Ordinance Act of September 26, 1901 and maintained until 1914 (Gunasekera, 1962, p. 137).

Chile – A new conversion law of Feb. 11, 1895 set June 1, 1895 as the day for the redemption of notes. This continued until July of 1898. (Bordo and Kydland, 1995, p. 437-438).

Costa Rica – On July 16, 1900, the bank began redeeming certificates in gold (Young, 1925, p. 196).

France – Adopted the gold standard on Nov 5, 1878 (Pick and Sedillot, 1971, p. 587).

Greece – Adopted the gold standard on March 19, 1910 (Bordo and Kydland, 1995, p.439).

India – Adopted the gold standard the week of May 7, 1898. The scheme of Indian Government for establishing a gold standard published and severely criticized (*Investor's Monthly Manual*, December, 1898)

Appendix 3 (continued). Gold Standard Adoption Dates and Source Information

Italy- On April 12, 1884, the country adopted the gold standard. By 1894, it was back on a paper standard (Fratianni and Spinelli, 1997, p. 439).

Mexico- The Enabling Act was passed on Dec. 9, 1904 authorizing the establishment of a gold standard. On March 25, 1905, a decree promulgated the new system. The law went into effect on May 1, 1905 (Kemmerer, 1944, p. 524).

Nicaragua - Law of March 1912 embodied recommendations for gold-exchange system. (Young, 1925, Pgs. 147-150). A new currency system began on March 23, 1913 (Young, 1925, p. 159).

Russia – The country adopted the gold standard January 3-15, 1897 (Pick and Sedillot, 1971, p. 488).

South Africa(Cape of Good Hope) - On Feb. 10, 1882, silver coins were made clearly tokens, placing the currency firmly on a gold standard (www.dollarization.org).

Sweden – The country signed a convention in December 1872 instituting the gold standard (Morys, 2007, p. 41).

Turkey - Starting on March 13, 1880, there was in practice a "limping" gold standard, even though the country was officially on a hard peg. This system was maintained until Aug. 3, 1914 (dollarization.org, 2005).

United States – Resumed specie convertibility following the Civil War on January 1, 1879 (Kemmerer, 1916, p. 85).