

## Paper Money but a Gold Debt. Italy in the Gold Standard

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### Abstract

During the 52 years between the Unification of the Kingdom of Italy and World War 1, the lira was legally convertible into metal for a limited period of time. Although not formally committed to gold, the lira exchange towards the gold standard countries proved remarkably stable, “shadowing” gold.

It is widely claimed that being one of the successful members of the gold standard circle entailed a number of advantages. If the lira was closely linked to gold, suggesting that there was only a small cost connected to adopting the gold standard, then why did Italy not make all possible efforts to resume as soon as possible and adhere more strictly to the gold standard?

Italy had a large foreign debt that was basically the result of Unification. This debt was denominated in lira, but foreign holders could convert their coupons into gold at the official rate in Paris. Italy could exploit its domestic bondholders by allowing the lira to depreciate, while insisting that domestic holders of the debt accept lira. But there were limits to this process because Italians could take the coupons to Paris have them paid in gold and because payments abroad, in gold, became more expensive following depreciation.

The paper explores the various measures the Italian government used to prevent arbitrage, and the strategies bondholders used to circumvent them. In the end, however, it was clear that if devaluation went too far, most of the coupons would be presented in Paris, the debt would *de facto* become a gold debt, and the Italian Treasury would suffer a substantial loss of gold. Hence the convenience of letting the lira float downward and exploit seignorage any time domestic conditions became more critical. At the same time it was necessary to keep depreciation within a certain range, “shadowing” the lira par value.

## **Paper Money but a Gold Debt. Italy on the Gold Standard<sup>1</sup>**

The core countries of the gold standard - Britain, France and Germany – strictly adhered to convertibility. However, during the second half of the 19th century, in the European periphery, the gold standard rule was repeatedly broken and, once abandoned, a considerable time passed before the old parity was resumed. Many countries experienced persistent fiscal problems and issued paper money to gain seigniorage. This behaviour usually occurred in periods of military conflict. In the face of declining economic activity, Latin American countries suspended convertibility in wartime, and returned to gold at heavily depreciated parities. The European periphery suspended on several occasions.

In Austria-Hungary the national bank was forced to suspend convertibility in 1848 following the revolution in Hungary and the subsequent military conflict. Greece abandoned convertibility in 1868 as a result of the revolution in Crete and twice again in other wars. A similar course was followed by Russia and Spain. Japan adhered to the gold standard only in 1894. Gold convertibility was abandoned in the US at the outbreak of the American Civil war (Bordo and Kydland, 1995, 438; Eichengreen and Flandreau, 1996, p. 117).

The Kingdom of Italy was unified in 1861 and the lira adopted the bimetallic French system. Convertibility was suspended after a few years, following the war with Austria in 1866. While proclaiming its firm commitment to resume the old parity, seventeen years went by before the government declared resumption in 1883; yet a few months later the banks of issue halted free conversion. Convertibility was never resumed.

During the 52 years between Unification of the kingdom and World War I, Italy was legally on a bi-metallic exchange regime for 15 years (from 1861 to 1866 and from 1883 to 1893), but the

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period of official lira convertibility was much shorter, at most seven years. Although not formally committed to gold, the lira exchange rate was remarkably stable, 'shadowing gold' (Figure 1).<sup>2</sup>

Close adherence to the gold standard provided countries with certain benefits. They signaled their commitment to orthodox policies that refrained from creating fiscal and monetary surprises prejudicial to lenders' interests, and probity was rewarded through the low cost of capital in the international financial market. If the advantages of adherence to the gold standard were as large as Bordo and Rockoff (1996) and Bordo and Kydland (1997) have argued, and if Italian exchange depreciation tended to be small, suggesting that it might have cost little to adopt the gold standard, why did Italy not make a greater effort to resume as soon as possible and adhere more strictly to the gold standard ? Did lira depreciation allow the Italian government to gain seigniorage ? Was seigniorage on government debt an important source of revenue ?

This paper discusses the constraints that the government debt market imposed upon Italy's collection of seigniorage. Contrary to what Bordo and Rockoff have assumed<sup>3</sup>, one of the main constraints on Italian policy was the fact that there was no paper or gold debt for Italy, but rather a gold debt priced in gold abroad and in paper currency in Italy.

The paper is structured as follows. First, Italian fiscal policy and tax smoothing is discussed. Taxation was politically costly to enforce and was not a flexible instrument, particularly with the fiscal structure of the new kingdom. Given the large budget deficit, in 1866 and in 1888-89, the Italian government rationally preferred debt and advantageously smoothed the tax burden over several years; only for a limited period of time (1866-1873) did the government turn to deficit

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<sup>2</sup>From 1861 to 1913 the floating of the lira took place within very strict margins with a standard deviation of 4.2: the standard deviation decreases to 2.9 if the war years are skipped, and it is with this time span that we are mainly concerned. The maximum divergence from the average yearly exchange with gold standard currencies on a few occasions only reached values of 12% and Italy never resorted to competitive devaluations. On the whole, the lira exchange proved remarkably stable against gold standard currencies and it is said to have "shadowed" gold rather closely; the lira exchange against a typical gold currency, the British pound, is a stationary variable (Tattara and Volpe, 1997, pp. 246-47). The lira exchange was, on the whole, much more stable than the ruble, the Austrian florin, the peseta, the US dollar itself, which depreciated heavily in 1864-65 (Flandreau, 1998).

<sup>3</sup> Italian Rendita yields in lire are derived from the prices of the Rendita paper bond and are meaningfully compared with Rendita yields in gold as if they referred to two different bonds in Bordo and Rockoff (1996, table 3). The comparison has not the meaning attributed to it by Bordo and Rokoff, as the price of the Rendita paper bond is in fact the price of the Rendita gold bond, expressed in lire.

monetization. Second, the high level of the Italian public debt is discussed. Debt placement on the international market is examined and a common misunderstanding about the Rendita prices in Italy and abroad is corrected: Italian public debt was a gold debt, domestically priced in lire. Third, the close integration between the Italian and foreign (French) capital market is explained: capital could move with very low transaction costs between the domestic and the foreign markets. Nearly perfect capital mobility during the period implied that the rate of interest on the Italian government debt was established on the international market, and the gold clause on most of the debt “anchored” the exchange rate of the lira to gold, making large depreciations unprofitable to the government both in the long and in the short run. The Italian government’s attempt to segment the market and to force Italian investors to be paid in lire when the lira exchange weakened was successful, although its success was limited by the lira depreciation being kept within narrow margins.

The conclusion is that there were serious constraints on a debt devaluation policy since what looked like a paper debt was really a gold debt, and the gold debt acted as a stabilizing device for foreign and domestic investors. The key to borrowing cheaply abroad was neither the lira’s legal adherence to gold nor its convertibility (Bordo and Rockoff, 1996; Eichengreen and Flandreau, 1996, 114), but debt convertibility. Exchange flexibility was nonetheless important in promoting economic development of the young kingdom, as it enlarged the choice of the policy instruments available to the government and helped the adjustment process.

*<Figure 1 approximately here>*

## **1. Italian Fiscal Virtue**

Immediately after Unification, Italy had a huge public debt inherited from the constituent states. Previous debts were merged and transformed into the new kingdom’s public debt, which from the onset amounted to 50% of Italian GNP (Ministero del Tesoro, 1988).<sup>4</sup> A high nominal and real rate of interest on debt and a low GNP growth rate drove the ratio of the Italian debt to GNP upwards. The unbalanced budget due to the protracted emergency added to the precarious initial

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<sup>4</sup> Almost all the previous debts of the states were recognized: 50% of the total was Piedmontese and derived from the wars of independence fought by Piedmont and the Kingdom of Sardinia (Sachs, 1883, pp. 459-463).

situation. In addition to the military costs from unification, the fight against *brigantaggio* in the south and the need to build basic railways and other infrastructures increased the debt. Public debt to GNP doubled in eight years, reaching 100% by the end of the 1860s. Interest on debt constituted from 30 to 40% of total government expenditures (Ministero del Tesoro, 1969, IV, table 5).

Politically, tax increases were ruled out and when, the war against Austria imminent, the Italian Prime Minister asked the Rothschilds to endorse a new debt, they refused. The Rothschilds acted as Rendita dealers, not simply brokers, and kept a large stock of Italian debt in their portfolios (De Cecco, 1992, doc. 49). They feared that a request for additional funds on the international capital market would reduce Rendita prices, and was thus to be rejected at all costs (De Cecco, 1992, doc. 51). If revenue had to be raised to face war costs and taxation and new debt issues were ruled out, the alternatives were printing money and selling public assets. The Rothschilds enhanced such a policy, which was convenient to them and possibly to the Italian government, as it preserved a valuable reputation for the Rendita in the “elastic demand” international capital market.

The government tried hard to find new sources of revenue. Land and railways were privatized (Zamagni, 1990, p. 225) and a compulsory low interest debt (5%) was issued in 1866.<sup>5</sup> Rendita purchases by the Banca Nazionale – a commercial bank and the largest bank of issue – reached a peak in 1866 under government pressure (De Mattia, 1967, 1, table 2), but the Rendita price declined. At the same time, the Banca Nazionale was pressed to make huge discounts and advances in favour of small banks heavily involved in the crisis of the domestic silk market in Genoa and Turin. In 1866, 83% of all Banca Nazionale discount and advances operations were channelled to four small banks to which the Banca Nazionale was tied, leaving other customers empty-handed.<sup>6</sup> In the same year, the government pressed the Banca Nazionale for a loan. The credit market experienced unprecedented stringency, and convertibility was suspended, releasing banks of issue from their metal reserve requirements.<sup>7</sup> Inconvertibility paved the way for new requests for loans

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<sup>5</sup> One percent interest was added, as a lottery premium, and the debt maturity was 13 years. In 1866-1868 interest in foreign markets on Italian public debt averaged 10% (Rendita interest in Paris).

<sup>6</sup> Credito Mobiliare di Torino e Firenze, Banco di Sconto e Sete di Torino, Cassa Generale di Genova and Cassa di Sconto di Genova (Di Nardi, 1953, pp. 122-25).

<sup>7</sup> It is questionable, and was indeed questioned by the Parliamentary Commission on Forced Currency, whether the abandonment of convertibility in 1866 was an inevitable consequence of war expenditures or whether it was the first-lender-of-last-resort operation undertaken by the government in favor of the banking system. The Commission

from the government.<sup>8</sup> Although current deficits were reduced by the 1870s, the Treasury did not renew all the debt coming to maturity and thus monetized part of the stock because of the high cost of new Rendita placements both on the domestic and on foreign markets.<sup>9</sup> (Ministero del Tesoro, 1969, vol. 4, 5). The bank had become a fiscal device for the government, to which it offered a flexible source of low-cost credit, and from which it was remunerated by creating rents from its unique charter.<sup>10</sup>

Half the current budget deficits for the eight years 1866-1873 was monetized, and money provided to the Treasury amounted to three-quarters of the circulation increase in the same period (De Mattia, 1967, 1.1, table 2). During suspension, circulation could not exceed the ratio of one-third between paper money and silver and gold reserves, and in 1868 a maximum amount of issues was established.<sup>11</sup>

The fiscal effort made by the Italian government after Unification was strenuous. During the first fifteen years of the kingdom, public revenues rose rapidly and their source changed. In 1872 the current budget was almost brought under control because of a rise in taxes and the deficit remained

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argued for the latter while it viewed the Treasury's financial situation in 1866 with relative calm (Di Nardi, 1953, pp. 121-138).

<sup>8</sup> Almost exactly the same path had been followed in financing the 1848 War of Independence: international market closure, monetization of part of the Treasury deficit and depreciation (Conte, 1990). The situation returned to normal within a couple of years.

<sup>9</sup> The amount of debt coming to maturity that was not renewed from 1867 to 1873 was 811 million lire. (Ministero del Tesoro, 1969, vol. 4, table 5). Total advances from the Banca Nazionale from 1.4.1866 to 30.6.1874 were 790 million lire. (Di Nardi, 1953, p. 139).

<sup>10</sup> Loans to the Treasury had a service cost that was, on average, less than one-third the price of interest-bearing debt. Banks of issue balance sheets prove, on the other hand, that their net income, until the late 1870s, was increasingly due to operations with the Treasury: interests on advances, commissions etc. (De Mattia, 1977, tables 101,102). The close link between Banca Nazionale and the Treasury raised a lengthy debate that resulted in the 1874 monetary reform. *Biglietti consortili* substituted money previously issued on the Treasury's account and all the banks of issue were now put on an equal footing.

<sup>11</sup> A few numbers are sufficient to document the Banca Nazionale's increasing importance. Banca Nazionale reaped the main advantage from the law, as its loans to the Treasury were counted as reserves; other banks of issue could include their credits towards Banca Nazionale in their reserves.

The ratio circulation/metal reserves for Banca Nazionale went from 0.50 in 1865 to a low of 0.11 in 1873; it stayed around 0.50 for the other banks of issue. Banca Nazionale issued 43% of total circulation in 1865, 79% in 1873. (De Mattia, 1967, vol.1, table 2).

within very narrow limits until 1874; 1875 saw the first - albeit slight - surplus. Total revenues were 7% of GNP, and rose to 12% in 1873, and 13% in 1880 (Brosio and Marchese, 1986, table 8A). In 1862-65, 40% of public revenues came from land taxes, the rest mainly from indirect taxes and customs duties. In just a few years, land proceeds fell to 9% of total revenues and income taxes were raised from nil to 15% (Ministero del Tesoro, 1969, vol. 3, table 12 and 13).

The deficit rose again in 1885-1891. Expenditures for railways and for the army reached high levels in 1888-91, while revenue declined. Debt grew almost continuously until 1897 when it reached 120% of Italian GNP (Ministero del Tesoro, 1988). In Europe, Italy's per capita debt stock was in third place after France and Portugal (Fenn's Compendium, 1889).

In the late 1880s-early 1890s the current budget deficit declined as expenditures fell, and revenues increased when the economy entered a phase of rapid economic growth. Money creation for the Treasury was now insignificant. The international capital market requested a low real interest on the Italian debt, but it was particularly the high growth rate of GNP and the primary budget surplus that accompanied the country from 1897 to the First World War that made the debt/GNP curve bend definitively downward.<sup>12</sup>

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<sup>12</sup> The debt/GNP ratio is expressed by  $B_t/Y_t - B_{t-1}/Y_{t-1} = (r - g)B_{t-1}/Y_{t-1} + (G_t - T_t)/Y_t$  where B is debt, Y is GNP (Istat, 1957, table 36), r the rate of interest on debt (Spinelli and Fratianni, 2001, pp. 51-52), g is GNP rate of growth, G - T is the budget primary balance computed taking the current balance (Ercolani, 1969, pp. 432-433) and deducting from it the interest on the public debt (Ministero del Tesoro, 1988).  $B_t/Y_t$  is from Zamagni (1998).

	$B_t/Y_t - B_{t-1}/Y_{t-1}$	$(r - g)B_{t-1}/Y_{t-1}$	$(G_t - T_t)/Y_t$
1862-1866:	3.9	1.4	2.5
1866-1873:	3.1	4.3	-1.2
1881-1893:	0.4	2.7	-2.4
1894-1901:	-1.2	2.6	-3.8
1901-1913:	-1.9	1.4	-3.3

## 2. Debt Overhang Management: Italian Rendita Issues

Public debt over GNP stayed at high levels over the whole period, and its management was the main task facing the Italian government of the time. In the early 1860s, two-thirds of the Italian public debt was represented by a perpetuity: Rendita Italiana. The remaining one-third was represented by short-term bonds (Ministero del Tesoro, 1998). Rendita market interest went as high as 12% in June 1866. Interest expenditures accounted for 40% of yearly current budget expenditures and made the Italian budget structure very inflexible (Ministero del Tesoro, 1988, IV, 5).

Various classes of Rendita were marketed, according to the nominal interest paid and to the owner's status. Rendita 5% prevailed. Rendita was either made out to the bearer or registered. In 1877 a mixed Rendita was devised: the bond was registered but the coupon was payable to the bearer. Coupons related to the bearer and to mixed Rendita could be cashed abroad, either by Italians or foreigners, and were paid in foreign currency. Bearer Rendita was (almost) the only bond negotiated abroad.<sup>13</sup> Registered Rendita was negotiated domestically, subscribed by renter investors: insurance companies and other private institutions, non-profit organisations, minors, etc. (Felloni, 1964, p. 153). Coupons cashed domestically were paid in lire (Piccinelli, 1897, p.17).

Rendita was traded on foreign markets such as Paris, Berlin, Vienna and London. More than half of the Rendita were issued in Paris, with the intervention of the Rothschilds.<sup>14</sup> It is henceforth referred to as the Paris Rendita. Rendita abroad was exactly the same certificate as Rendita negotiated in Italy. The value of the Rendita coupon paid abroad was always larger than 10% of the interest burden on total Rendita stock, but varied between 25 and 85% of Rendita to the bearer, which was the "marketable" part of the whole stock.

Rendita in the international market competed with various other assets, capital was free to cross the national borders, and Italian investors could shift towards foreign competing assets: French

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<sup>13</sup> See Compagnie des agents de change (1882, p. 127). Actually, there is evidence of very limited payments abroad for registered Rendita, less than 1.5% of the total value outstanding (Ministero del Tesoro, 1896, p.120).

<sup>14</sup> See Sachs (1883, ch. VII). On the role of Paris in funding European government debts, see Fishlow (1985).

Till the late 1880s Paris was the only center where Rendita coupons were paid abroad. In the 1890s Berlin got half of the Rendita coupons paid abroad went through Berlin (Ministero del Tesoro, 1896, p. 127).



Rente, British consols and other foreign assets.<sup>15</sup> Coupon payment abroad was made in foreign currency.<sup>16</sup> Whoever collected the interest was of no importance: a foreign owner or an Italian owner presented his coupon abroad and transferred the amount into lire at the current rate of exchange. Of course, a perspicacious Italian investor would collect his coupon abroad whenever the exchange weakened. Not all Rendita owners arbitrated the coupon payment: naive investors were numerous and would cash their coupon domestically, despite the devalued currency. These were presumably low denomination bond holders and registered Rendita holders.

The uniqueness of the bond certificate and the almost perfect capital mobility made the Rendita price in French francs in Paris (henceforth, the Paris price) equal, except for the lira-franc spot exchange and transport negotiation and information costs, to the Rendita price in lire in Italy (henceforth, the Milan price).<sup>17</sup> As no impediments pended to coupon transferability, the coupon cashed in Paris in French francs (directly or because it was sent there from Italy) was equal to the coupon cashed domestically in lire, expressed in francs.

Imagine a Rendita certificate with a face value of 100 lire, priced in French francs in Paris at 74.77, and a lira exchange depreciation of 7% from parity; the Milan price in lire is easily computed from the Paris price multiplied by the exchange depreciation 80.00 (i.e.  $74.77 \times 1.07$ ). This equilibrium condition is reflected in Rendita yields. Freedom of capital movements and the uniqueness of the Rendita certificate ensured that a Milanese could go to Paris, buy a Rendita there and cash the coupon in francs for the rest of his life (5 French francs, annual, for a certificate of 100 face value, i.e. a yield of 6.69 at the current price of 74.77). He could get the same coupon in francs from a Rendita certificate bought in Milan and subsequently taken to Paris. Less shrewd Italian investors would cash the coupon in the domestic market and receive 6.25 lire.<sup>18</sup>

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<sup>15</sup> Much of the Rendita abroad was in Italian hands, according to Minister Scialoja in his financial statement to the King, 28 July 1866 (De Cecco, 1990, p. 25 n. 30)

<sup>16</sup> It was subject to the same fiscal treatment as domestic interest (Felloni, 1964, p. 167)

<sup>17</sup> Genoa was initially the most important stock exchange in Italy. We refer to Milan simply because it was the stock exchange that grew in importance and eventually assumed a leading role.

<sup>18</sup> Fratianni and Spinelli compare the Rendita prices in Florence and in Paris, implicitly assuming that the two are expressed in the same currency. (Fratianni and Spinelli, 2001, p. 154 n. 40) and, in the same direction, Avesani and Spinelli (1995, p.128 n.9).

Sophisticated investors operated on the Milan market (via Paris) and on the Paris market as if it were a single market in all respects: a very competitive market where Rendita coupons were traded in convertible currencies “offshore” or in gold.<sup>19</sup>

Rendita market	Rendita price	Nominal rate of interest	Rendita yield
Competitive: Milan, via Paris	80.00 lire	5 francs	6.69%
Paris	74.77 francs	5 francs	6.69%
Secluded: Milan	80.00 lire	5 lire	6.25%

$e_t$  is the spot rate of exchange defined as lira per unit of foreign exchange.  $P_{Mt}$  and  $P_{Pt}$  being the price of the bond respectively in Milan (lire) and Paris (francs), the arbitrage condition is:

$$P_{Mt} = P_{Pt}^* e_t \quad (1)$$

Working with Rendita yields produces the same result. Rendita yield in the competitive market is computed as a ratio of the coupon face value  $c^*$  (in francs) and the price of the bond, where the bond has infinite duration.  $i_{Mt}$  is the Milan Rendita yield (lire) and  $i_{Pt}^*$  is the Paris Rendita yield (francs):

$$i_{Pt}^* = c^*/P_{Pt}^* \quad (2)$$

$$i_{Mt} = c^* e_t / P_{Mt} \quad (3)$$

Unsophisticated Italian investors had their coupons paid in lira,  $c$ , and received a lower interest,  $i_{Mt}^\circ$ .

$$i_{Mt}^\circ = c/P_{Mt} \quad (4)$$

$$i_{Mt}^\circ \leq i_{Mt} \text{ whenever the lira exchange depreciated, i.e. } c^* e_t \geq c.$$

Spot arbitrage requires

$$i_{Pt}^*/i_{Mt} = P_{Mt}/e_t P_{Pt}^* = 1 \quad (5)$$

The exchange at parity, prices and interest rates in the two markets are equal.

<sup>19</sup> As has already been said, Rendita was a single consol and the only currency relevant both to the debtor and the creditor was that in which the coupon was paid. Such a choice varied with demand, according to profitability, except when explicitly limited by law.

Rendita yield is exogenously established in the international market,  $i_{Pt}^*$ , and for a specified nominal interest, Rendita price abroad is computed (2). Given the spot rate of exchange, the domestic yield and the domestic price are immediately settled.

The Milan Rendita price differed from the Paris price expressed in lire because of transfer and information costs. Rendita transfer abroad was performed through foreign intermediaries. The commission paid to negotiate Rendita on the Paris stock exchange was 0.10-0.125% (Crampon, 1863, p. 21; Haupt, 1894, p. 569) to which a stamp had to be added on a yearly basis, varying between 0.12, bearer Rendita, and 0.15-0.30, registered Rendita (Deloison 1890, pp. 732, 781, 786-787). Commission varied according to the number of transactions in a year and the value of the bulk transferred. To this are to be added the telegraph cost<sup>20</sup> and the cost of collecting the relevant information.<sup>21</sup> Transfer and related costs declined exponentially with the value of the traded bundle. The estimated overall transfer costs were not inferior to 0.40% - 0.50%.

The lira value of the Paris Rendita ( $P_{Pt}^* e_t$ ) is multiplied by  $(1 \pm \quad)$ , where  $\quad$  represents transfer and information costs paid by an investor willing to buy (sell) Rendita abroad. Transfer and information costs build a band around the arbitrage parity, whose upper ( $U_{Bt}$ ) and lower ( $L_{Pt}$ ) boundaries are:

< Figure 2 approximately here >

$$+P_{Pt}^* e_t = +c_t^* e_t / i_{Pt}^* = U_{Bt} \quad (6)$$

$$- P_{Pt}^* e_t = - c_t^* e_t / i_{Pt}^* = L_{Bt} \quad (7)$$

Figure 2 plots the Rendita weekly price series in Milan (the “onshore” market) and in Paris (functioning as an “offshore” market), computed as explained in the Appendix; deviations between Milan and Paris prices closely parallel the lira/franc weekly exchange series, expressed as deviations from parity. Milan prices were invariably higher than Paris prices, whenever the lira exchange

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<sup>20</sup> For basic telegraph prices see Istat (1958, table 105) and the following footnote 24.

<sup>21</sup> Rendita abroad might entail a limited risk due to fear of discrimination. But the foreign market was so important to the placement of the Italian debt that discriminating action against foreigners by the Italian government was very unlikely.

depreciated with respect to gold. At times the Milan price reached the Paris price without overtaking it: the reason being that lira exchange was left free to float downward but was pegged upward so that the Paris price could exceed the Milan price only for a very limited number of weeks and by a tiny amount.

< Figure 3 approximately here >

Residuals from the arbitrage relation in equation (1) move around zero (Figure 3). The arbitrage residuals are heteroschedastic: a higher deviation marks the first decade, when the market and our knowledge of it was less perfect. The standard deviation is 0.9 for the whole period, which declined to 0.3 from 1875. A band size of 1%, i.e.  $\pm 0.50\%$ , includes 90% of the observations in the period 1875-1911 and 84% of all the observations from 1865.<sup>22</sup> No substantial deviations and breaks emerge in the Rendita arbitrage relation. After 1875, spikes are limited to a couple of observations and materialize during few periods of policy changes and market turbulence.

Arbitrage residuals are affected by the poor appropriateness of our data base. First, our data are daily averages of extreme prices (daily maximum and minimum), and although spot transactions by small investors were often performed at the “average”,<sup>23</sup> proper ask and bid prices would be needed. Moreover, the gap between the extremes varies in time. Second, the poor matching of the first decade is possibly the result of exogenous shocks. Two wars were fought: the war between Italy and Austria-Hungary in 1866 and the war between Prussia and France in 1871. Just after that, from June 1874 for a couple of years, because of a brokers strike, Rendita prices in Italy were “imputed” prices (Da Pozzo, 1964, p. 36); many stock brokers performed illegal transactions outside the market, making price fixing unrepresentative. Third, Paris Rendita prices were received

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<sup>22</sup> To make things simpler the band size is computed on the Rendita nominal value. The same in Figure 3.

<sup>23</sup> According to contemporaries “the average price” was often preferred in order to avoid purchases being performed at the highest price and sales at the lowest (Crampon, 1863, pp. 27-28).

daily on the Italian Stock Exchange as of 1871.<sup>24</sup> Even then a certain amount of friction prevented people from instantaneously transferring funds even in very perfect markets, and an element of inter-temporal deviations was frequently embedded in data published daily. Transfers were probably slower for relatively small amounts of funds and some operations could shift from Thursday to the following Monday (for example, in the case of public holidays or other events during which the stock market in one country was closed). In such a situation, the Rendita yield included a very limited inter-temporal component, which adds to the above-mentioned inappropriateness of the data set.

Looking at the weekly Rendita prices in Italy and in Paris, and at the weekly exchange figures published by Pantaleoni (1895, enclosure E) concurrent with the depreciation of the lira, Fratianni and Spinelli note “the appearance of a significant arbitrage differential between domestic and international prices of Rendita Italiana” (1997, p. 94; 2001, p. 191). From the second semester of 1893, the lira started to depreciate, and from the month of July the ratio between the Milan and Paris Rendita prices remained above the lira-franc exchange rate. According to the authors, this was because of the high lira depreciation, and provided room for arbitrage activities.<sup>25</sup>

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<sup>24</sup> Inadequate communications meant that national exchanges could operate without knowledge of their foreign neighbors during the working day and make adjustments at the beginning of the next trading session, when information regarding conditions elsewhere had been received. In the case of Rendita Italiana 5% in 1853, for example, the members of the Genoa Stock Exchange were making deals based on Paris prices that were three days old. Prices were two days old from 1860, one day old from March 1864 (Da Pozzo, 1964, p.11). Rendita Paris price was received daily in Turin from 1871, and from the Turin Stock Exchange was delivered the same day to Alessandria, Milan, Venice and Genoa Stock Exchanges.

A temporal delay, of any length, caused considerable problems in settling bargains, which the Italian buyer or seller expected to complete by selling or buying abroad, if prices had changed substantially from those current in Paris at the time the sale or purchase was agreed.

It was possible to minimize the risk by purchasing a put or a call option in Paris. Through such options the purchaser obtained the right to buy or sell a security for a fixed price at a certain date in the future. This allowed the Paris price to be fixed and provided sufficient time to allow conditions in other markets to be investigated, with the hope of a profit resulting for any differentials that were found to exist. Naturally, those guaranteeing to buy or sell at current prices in several months time charged for the privilege they were extending, and such a charge could be quite high. For a similar account, relating to the London stock exchange, see Michie (1987, pp. 39-41).

<sup>25</sup>The concomitant introduction of limitations to coupon collection abroad by Italians (*affidavit*) might have raised the elements of uncertainty relating to the freedom of capital movements, but this would only marginally have

There was no reason whatsoever for the spot arbitrage not to operate with a depreciating currency, as Romanelli clearly related in his statement to the Prime Minister in March 1875.<sup>26</sup> The opening up of the ratio between the Rendita price in Milan relative to Paris, if there were such a thing, was very limited indeed, and lay within the brokerage fees independently of the exchange regime (Figure 3).<sup>27</sup>

### **3. Throwing Sand under the Wheels of International Finance. Rendita Market Segmentation.**

The stakes for the Italian government to increase seigniorage through inflation and depreciation on its huge public debt were high, but the government was strongly constrained by its dependence on the international capital market. The total Rendita outstanding was made up of bearer Rendita and registered Rendita. Interest was paid in lire on registered Rendita and bearer Rendita on the domestic market. It was paid in gold on Rendita collected abroad.

The lira exchange at parity, Milan Rendita and Paris Rendita bore the same rate of interest; interest was collected at no cost either in Milan or in Paris. Each time the lira devalued, Italian registered Rendita holders and less sophisticated Italian bearer Rendita holders collected interest domestically, in lire, and had a lower return.<sup>28</sup> Smart Italian Rendita holders went to Paris and were paid a higher interest. Should lira appreciate over parity and shift foreign investors' preferences towards interest in lire, any Frenchman (or any Italian keeping his bonds abroad) could take the

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affected spot arbitrage. Weekly data point to a limited enlargement of the arbitrage margin, during the 1893 Italian banking crisis, but not to a systematic deviation.

<sup>26</sup> Alessandro Romanelli was the secretary of 'Consiglio del commercio e dell' industria' (Trade and Industry Board) and was asked for a statement to the Prime Minister by the Minister of Finance and by the Minister of Agriculture, Industry and Trade (De Cecco, 1990, doc. 123, p. 628).

<sup>27</sup> Interestingly enough, Pantaleoni had made an entirely different point. He had argued that in the case of depreciation, although Rendita owners abroad felt safe because of the interest in gold, the existence of the gold clause itself would have burdened the budget and raised fears of Italian government default among foreign investors. (Pantaleoni, 1895, p. 377).

<sup>28</sup> Insurance companies, trade companies, banks doing business with the government were subject to government regulation and kept part of their investments in registered Rendita, as a guarantee (Nina, 1911-1915, p. 1210). They were unwilling to endanger their relationship with the government in order to profit from a small discount on the Lira. In effect the government was imposing a tax on Italian institutional investors.

coupon to the authorized bank in Paris and collect it in lire with no charge. Coupon flow was asymmetric. When the lira depreciated, Italians went to Paris; Frenchmen never went to Italy.

Each time the lira depreciated, the government collected seigniorage on debt by exploiting domestic Rendita investors. The divergence between the Paris interest in lire net of transfer costs and the Milan interest is a measure of the cost of the institutional rigidities that separated the two classes of Italian investors.

Commission on coupons paid in Paris was modest. It varied widely between 0.5% to just three weeks' loss of interest, i.e. 0.15-0.18% (Dubois, 1890, pp. 287-294).

Arbitrage on coupon collection in the domestic and in the foreign market must take directly into account the cost of collecting abroad,  $\tau$ . To make arbitrage profitable, domestic interest must be inferior to the interest collected in Paris (Milan via Paris) net of all cost:

$$i_{Mt}^{\circ} = i_{Mt}(1 - \tau) \quad (8)$$

This sets a lower bound,  $L'_{Bt}$ , to the bi-annual interest difference between the domestic secluded market and the domestic competitive market:

$$-i_{Mt} \tau / 2 = L'_{Bt} \quad (9)$$

Italian investors facing depreciation were induced to look for safer investments abroad, but Rendita coupon transfer guaranteed the real value of their domestic investment at a very limited cost. Coupon transfer implied a repeated burden through time, but it was a much easier operation than capital transfer; it did not require any knowledge of the international market and was free of any risk as it was completed in a couple of days. When the lira depreciated, the Treasury was faced with a high amount of payments in gold to service its debt: coupons were collected in large quantities by Italians in Paris, which inflamed the debate in the Italian Parliament (De Cecco, 1990, doc. 45, p. 123; Ministero del Tesoro, 1896, pp. 104-105).

Rendita cashed abroad varied between 20 and 85% of the total bearer Rendita value. People moved quickly between the two markets: a limited devaluation of 3%, in 1882 - 1883, no impediment pending, was sufficient to double the amount collected abroad (Figure 4 and Ministero del Tesoro, 1896, p. 120). Depreciation induced people to move from registered Rendita to bearer Rendita, which was much more difficult to subject to fiscal controls, and this was something that the Italian Treasury wished to avoid at all costs.

Let AB be the Rendita in circulation. CB is the registered part plus the quota of the bearer Rendita, whose interest is collected domestically because of institutional rigidities, AC is the Rendita whose interest can be collected either in Milan or in Paris. The actual shift is a function of the lira devaluation (AE), and on the cost of collecting interest abroad (ZF), which increases with the quantity arbitrated, but for a fixed quota AZ.  $Y^*$  is a possible equilibrium solution. A high depreciation would shift  $Y^*$  to the right,  $Y'$ , inducing less sophisticated Italian investors to rush to collect their coupons abroad, eventually reducing their registered Rendita holdings (from CB to  $Y'B$ ). Such a move would have reduced the possible seignorage to the Italian government.

A legal segmentation of the Rendita market was a way out of the puzzle. All Italians would be paid in devalued lire and foreigners would be paid in gold; Italian domestic investors were exploited while the Italian government's reputation over the international market was maintained.



Rendita interest collected abroad in gold by Italians was denied in January 1873; the denial was reinforced with the introduction of the affidavit in 1874 (first semester coupon).<sup>29</sup> Affidavit was subsequently made less stringent in 1879, abolished in 1881, re-introduced in 1893 (second semester coupon) and abolished again 11 years later, i.e. towards the end of 1904. Affidavit was a sworn declaration (or a solemn promise, if addressed to a non-religious person) that the principal in question did not belong to an Italian citizen, and it was required when collecting interest abroad. The coupon presented to the bank was to be accompanied by the principal (at various times) and this made interest collection abroad expensive and risky.<sup>30</sup> In addition to this, monetary incentives for Rendita owners to cash their coupon in Milan were variously provided.<sup>31</sup>

The use of the affidavit allowed the Italian government to raise seigniorage on the whole Italian public debt, except for the part owned by investors of foreign nationality, which was a small part, according to Minister Antonio Scialoja in his financial statement to the King (De Cecco, 1990, p. 25, footnote 30).

When affidavit came into force, the Rendita market was divided up according to nationality (and no longer according to the place where the coupon was collected), and Italians were forced to be

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<sup>29</sup> There were rumors that the first affidavit was weakly enforced and that the second was much more rigorous. A French commentator, Georges Deloison wrote that “Italy required the affidavit, but never requested for registry dues and did not require that the bearer came in person to sign the affidavit” (1890, p. 291).

<sup>30</sup> The government wanted to prevent the transfer of the coupon by passing it from hand to hand just to collect the interest abroad. The transfer of the principal made the operation much more expensive, as it related to a value that was ten to fifteen times larger than the value to be collected.

<sup>31</sup> Interest was paid on the domestic market in advance of maturity (up to 60 days) and the interest claim could also be used to pay taxes (custom duties and other fiscal charges) before the coupon came to maturity (up to 5 months). (Piccinelli, 1897, pp. 17-19).

paid in lire both at home and abroad. In addition, the Italian government provided incentives to induce nationals to cash on the domestic market, basically paying interest in advance with respect to maturity. The latter amounted to a (very limited) increase of the domestic interest, and it was an open admission that legal impediments were not of much use when lira devaluation overflowed certain limits.

Rendita market	Rendita price	Nominal rate of interest	Rendita yield
Competitive:Paris	74.77 francs	5 francs	6.69%
Secluded:Milan	80.00 lire	5 lire	6.25%

The affidavit was far from an absolute impediment. It was legally dodged by the more astute Italian investors, who transferred the property of their bonds to French nationals just before the coupon came to maturity, and purchased it again at the next settlement date. Italians, the possibility of perjury excluded, transferred their Rendita selling spot and buying long (Stringher, 1884), i.e. through a repurchase agreement (repo). Contracts were long available in Paris for Rendita bulks exceeding 2500 francs, and were settled on the first and the fifteenth of each month (Lefevre, 1870, pp. 215-217). A time component, as well as a risk component, was now included in what had been a spot arbitrage.

Because of the fear of further discrimination towards nationals who had their capitals abroad, repo costs and monetary incentives reduced the margin for cashing abroad to a tiny amount even for large investors.<sup>32</sup> In the second semester of 1893, lira depreciation reached 13%, repos were cheap (0.05-0.07 cents), Rendita implicit interest was around 3% (semi-annual). Costs for arbitraging the Rendita through a repo operation varied widely with the value exchanged, nonetheless they can be tentatively summarised as:

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<sup>32</sup> I am grateful to Marc Flandreau and Pierre Sicsic who forwarded me their series of Rendita repo prices in Paris.

### Italian making a repo in Paris 1893, 29<sup>th</sup> December

Rendita price in Paris	79.850
Coupon/Paris price	3.131
Repurchase agreement brokerage fees (0.1%, Lefèvre, 1870, 218)	0.080
Repurchase agreement cost	0.060
Interest on money advance between settlement dates (15 days) at 6%	0.008
Coupon collection charges (0.25%)	0.001
Implicit interest on repurchase agreement	2.982

### Italian cashing on the domestic market 1893, 29<sup>th</sup> December

Rendita price in Milan	90.700
Coupon/Milan price	2.756
Opportunity cost: advance payments in Italy (60 days) at 6%	0.010
Implicit interest on the domestic market	2.766

The return accruing to Italians cashing abroad from lira depreciation (13.6%; the bi-annual interest collected in Paris was 3.130 instead of 2.756) was thus reduced to 7.8%, from which telegraph and transfer costs were further to be deducted. At the end of 1893, people shifted to the domestic market, and the margin that remained nonetheless might be assumed as a measure of the increase in risk perceived by Italian investors when keeping their capital abroad, following the strict enforcement of the affidavit. In the early 1880s, before affidavit, a much less reduced margin was required to induce Italians to cash abroad.

The working of the affidavit with a repo contract can be easily formalized. To induce an Italian investor to collect in Paris through a repo, domestic interest must be inferior to Paris interest net of all cost.

$$i_{Mt}^{\circ} (1+i_t)^n - i_{Mt} (1+i_t)^m [1 - \infty - (q)] \quad (10)$$

This sets a lower bound to the bi-annual interest difference,  $L_{Bt}^{\infty}$

$$- i_{Mt} [\infty + (q)]/2 - L_{Bt}^{\infty} \quad (11)$$

$\infty$  are repo fees,  $\infty$  repo cost, function of the quantity traded,  $q$ ,  $i_t$  the interest on money advances between settlements dates, which is assumed equal to the interest on advance payments in Italy. Brokerage fees and repo cost are much larger than collection charges, and the lower boundary to the interest difference is larger, in absolute terms, than before:  $L_{Bt}^{\infty} < L'_{Bt}$ . In addition affidavit acted as an announcement that the return of the whole operation was becoming more uncertain.

Five-percent Rendita coupons paid abroad went from 85% of the total value of the bearer Rendita in the second semester of 1893 to as little as 35% six months later, when the affidavit was enforced (Figure 4 and Ministero del Tesoro, 1906, p. 120).<sup>33</sup> Various factors strengthened the effect of the affidavit. French owners sold much of their Rendita possessions: Italy's country risk, measured by the difference between the French Rente and the Rendita yield in France (both in the same currency) increased radically from July 1893 as the Italian budget worsened again, and this induced French investors to turn to other government bonds. In spring 1893 a new tax was imposed on the French stock exchange,<sup>34</sup> and there was a rumour of a similar measure on foreign securities (Felloni, 1964, p. 206).

Subsequently, the recovery of Rendita prices under pressure from operators in the German market, paralleled by exchange appreciation, made it less profitable for Italians to cash their coupons abroad.<sup>35</sup> The saving on the debt service for the Treasury attributable to the decline of the coupons paid abroad (affidavit and other concurrent circumstances) was around 6% of the Rendita net interest payment on 1<sup>st</sup> January 1894.<sup>36</sup>

Affidavit did not work as an absolute dam. It raised the threshold to make interest collection abroad profitable: a much larger depreciation was now required to perform the same transfer operation that 10 years earlier had been profitable with a lira exchange falling 2% or 3% short of parity. Had the lira devalued more than, say, 15%, people would have flocked abroad again and the Treasury would have spent a larger sum in servicing its debt.

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<sup>33</sup> The decline of the value of coupons cashed abroad is matched by a corresponding increase in the amount of the coupons for which advance collection was claimed domestically (Ministero del Tesoro, 1896, pp.122-123, 127-128; 1906, p. 120).

<sup>34</sup> Art.28 of the law 28.4.1893. It created a real stir in the Italian press, see, for example, *L'economista*, 22.1.1893. pp. 53-55;18.6.1893, pp. 386-387; 12.11.1893, p. 735.

<sup>35</sup> In the mid-1890s, according to the Italian financial newspaper *Il Sole*, repo prices became "outrageously" expensive, reaching 30 cents (*Il Sole*, 5.01.1895 and 30.06.1895), and as the lira exchange depreciation declined in time, it was more profitable to cash domestically.

<sup>36</sup> Measured by the exchange depreciation times the variation in the bearer Rendita interest payments domestically collected, plus the commission to be paid to the French intermediary.

The fluctuation of the number of coupons paid abroad had nothing to do with capital flows in and out of Italy, as is frequently alleged.<sup>37</sup> With transfer costs short of return, people sent their coupons abroad, just to cash a larger amount, independently of where their capital stayed. It was simply the additional costs placed on collecting interest abroad and the recovery of the lira exchange that explained the decline in the Rendita interest paid in the foreign market in gold.

<Figure 4 approximately here>

#### 4. A Test of Capital Markets Integration.

The Italian government was variously constrained by the need not to discourage private capital that was abundantly entering the country and by the need to keep the door open to possible placements of new government issues. Rendita market integration between Italy and its most important partner, France, is tested in terms of equilibrium prices: Rendita prices in Paris and Milan, the lira/franc exchange, transfer costs and incentives when needed. Rendita arbitrage condition in (1) is estimated. There is no reason for (1) to occur whenever there is a break in Rendita transferability between the domestic and the foreign market.

The model to be estimated in its simplest form, is:

$$P_{Mt}/P_{Pt}^* = a_0 e_t + u_t \tag{12}$$

$a_0$  is a parameter,  $u_t$  is a white noise disturbance.

$P_{Mt}$  and  $P_{Pt}^*$  are I(1) variables, the exchange deviation,  $e_t$ , is a stationary variable I(0).

$a_0 = 1$  can be imposed:  $H_0: a_0 = 1$ ,  $H_1: a_0 \neq 1$ .

A cointegration estimation has been performed using both the Engle and Granger and the Johansen procedures. Results appear self-reinforcing and we report the cointegrating vector obtained with the Johansen estimation method:

$P_{Mt}/P_{Pt}^*$	1.00000
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<sup>37</sup> For most of the period, interest collection abroad required the presentation of the accompanying principal; as a consequence capitals would move following the coupon transfers. But this was a kind of “anomaly”, capitals “shadowed” the coupon for just the time necessary to collect it abroad. Possibly capitals were left abroad to save recurrent transfer costs. Zamagni (1999, p. 339) writes that the amount of coupons paid abroad “is useful as it provides an idea of the amount of the Italian debt placed abroad”. This might be true in a period of exchange convertibility, but not in other periods.

$e_t$  - 1.00132  
st.error (.005)

The result points to the acceptance of the null hypothesis,  $a_0 = 1$ . It is very robust to a wide range of lags specification in the underlying VAR models. Residuals have been tested and are stationary.

Had capital been effectively discouraged from flowing abroad and had the affidavit prevented people from collecting Rendita coupons abroad, there would be no reason for the arbitrage relation to hold. Various dummies have been added to (10) in order to test the effect of the lira depreciation and of the affidavit on the arbitrage relation, with no result. The restricted estimates were never significant.

A further point would be to assess for a possible correlation between lira exchange fluctuations and the loosening of financial market integration between France and Italy. The hypothesis is that market efficiency is somehow connected to the exchange regime, or at least to exchange stability. Fluctuations in the exchange do not make a significant difference and the zero Rendita arbitrage assumption worked rather smoothly both in periods of exchange tranquillity and in periods during which the lira exchange underwent relative rapid fluctuations. Figure 5 shows the absence of correlation between an exchange variability measure (the six-month standard deviation of the weekly lira exchange deviations from parity) and a measure of the exchange fluctuations (the six-month standard deviation of the weekly Rendita arbitrage deviations).<sup>38</sup>

Italy was very effectively integrated in the international financial market, even though it had a fluctuating exchange for such a long period of time.<sup>39</sup>

<Figure 5 approximately here>

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<sup>38</sup> The same basic idea underlies one of the recent IMF reports where exchange flexibility diffusion is parallel with the process of capital market globalization. (IMF, 1997).

<sup>39</sup> Both the *affidavit* and exchange fluctuations can be viewed as a sign of the weakness of the Italian situation, which is accompanied by an increase risk in collecting the coupon abroad and in investing abroad. Coupons abroad declined both after 1874 and 1893, and investments abroad declined too, but this is quite a different matter from the arbitrage relation!

## 5. Conclusions.

The choice of the lira exchange regime was not primarily dictated by the government's aim to wipe out the value of the Italian huge public debt overhang. It was the need to keep the banks of issue – which were also commercial banks – solvent and to foster the economy that made suspension a necessity, both in 1866-1873 and for a few years after the 1883 resumption. In 1866 the creditors themselves favored suspension in the attempt to limit the fall of Rendita prices. Currency holders suffered a decline in the market value of their assets whenever the lira depreciated; similar discrimination affected domestic Rendita holders. The government collected seigniorage both on short-term advances from the Banca Nazionale and on its public debt, which was serviced on the domestic market. Other countries resorted to the same procedure, as Calomiris (1991) has studied for the United States and Bordo and Redish (1990) for Canada.

Seigniorage on debt was limited as the Italian debt was basically a gold debt. A large part of the Italian public debt was represented by Rendita, a consol placed both in the domestic and in the international market. Rendita gold coupons were created in order to protect Italian and foreign investors against possible lira depreciation during risky periods. The alliance between Italian politicians and financiers was very strong, and Italian financiers operated directly on the French capital market.

There was a unique market for bearer and mixed Rendita holders, even though transactions were made either in Rome, Milan, Genoa, Paris, Berlin, London or Vienna. Registered Rendita and small Rendita holders were limited to the domestic market. Each time the lira depreciated, coupons cashed domestically had a lower interest rate: smart holders cashed abroad and registered holders and less sophisticated investors suffered a loss. The government attempted to exploit the Rendita market segmentation by allowing the lira to depreciate, while insisting that domestic holders accept lira. But the international capital market was a sophisticated market, and Paris offered Italian investors a large selection of foreign bonds and various forms of deferred agreements on the Rendita, frequently settled, that variously constrained the action of the government and prevented the Italian government from taking full advantage of the lira depreciation.

Had the exchange lost more than 10-12% of its value, notwithstanding the affidavit, Rendita holders would have flocked abroad, Italian public debt would have become a gold debt, and the

Treasury would have suffered a substantial loss of gold.<sup>40</sup> Hence the convenience to the Italian government to let the lira float downward and exploit seignorage any time domestic conditions became more critical, and at the same time the need to keep depreciation within a limited range, “shadowing” the lira par value.

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<sup>40</sup> Toniolo, in assessing the effects of the forced currency circulation, speculates that suspension resulted in an “increase in domestic prices (that) produced a reduction in the real value of the outstanding debt” (1990,63). In fact, the ability of the Italian government to profit from seigniorage was rather limited.



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## Appendix 1.

Weekly Rendita Italiana prices and weekly lira exchange rates.

Rendita italiana 5% in Italy. Friday published prices refer to Thursday stock exchange prices, registered each Friday in *Il Sole* from 1865 to 1911.

Price is “fine corrente”, except “fine mese prossimo”, which is the last Friday of each month. This was the price at which the bulk of Rendita transactions took place both in Italy and in France, where foreign government bonds were mainly exchanged ‘à la Coullisse’. See *L’economista*, 22.1.1893, 55.

Generally prices are registered in Milan, sporadically Turin, in subordinate places Genoa, Florence. Prices are extreme daily values: maximum and minimum. Daily ranges are replaced by their midpoint of the buying and selling rates. Missing values are substituted by the next day’s prices. After 8 May 1908 interest was converted to 3.75%.

Rendita Italiana 5% in France. Thursday prices registered each Friday. Almost always in Paris, except for a few cases in Lyons or Marseilles. *Il Sole* from 1865 to 1911. *L’économiste français* and *Cours Authentiques*.

Exchange Lira French Franc in Milan. Thursday prices registered each Friday. Milan. Published in Spinelli F.(1990, vol. 2). Lire per a fixed unit of foreign currency. Among various prices we have chosen “lettera” o “a breve” meaning at sight. From 1865 to 5.6.1868, 30 days after sight. From 12.6.1868 to 30.4.1869, 90 days after sight.

A consistent series requires that all observations pertain to bills of a given maturity  $t$ . Logically,  $t = 0$ , the series should refer consistently to sight billls. Because the lira purchaser of a time bill obtains his franc-fund later than the purchaser of an equivalent sight bill, the interest component of the time bill reduces the exchange rate . To factor out the interest component of a  $t$ -day time bill, an annual interest rate is needed. The appropriate rate of interest is registered alongside the exchange price.

When the lira was convertible the lira price 30 days after sight was discounted at the official rate of discount to get the sight price. This was done until convertibility was abolished in 1866.

The discount procedure was no longer feasible with unconvertible exchange. In this case the exchange at maturity contains a forward premium or discount, i.e. an expectation element on the future sight price, which is not easily computable. For this reason the lira exchange from 1866 to 30.4.1869 has not been transformed into sight.

## Appendix 2

### Integration test

Summary of Unit root tests (constant and trend).

	Exchange	Rendita Milan/Paris price
<i>Test Statistics</i>		
Wtd.Sym.	-3.02693	-3.00749
Dickey-F	-3.61704	-3.71681
Phillips	-25.57075	-76.99540
<i>P-values</i>		
Wtd.Sym.	0.07892	0.08325
Dickey-F	0.02843	0.02127
Phillips	0.02247	0.00000
<i>Number of lags</i>		
Wtd.Sym.	10	9
Dickey-F	10	9
Phillips	10	14

p-values from McKinnon Tables.

### Johansen estimate for cointegrating vectors.

The value of the trace statistic for system: rendita relative prices, exchange (no constant, no trend).

Num lags	9
Eigval1	0.06385
Eigval2	0.00162
H0:r=0	160.47793
P-val	0.00000
H0:r<=1	3.84476
P-val	0.049851
Num obs	2394.00000
LogLike	-4278.04870
AIC	33.60739

### Cointegrating vectors

Rendita Milan/Paris price	1.000000	1.00000
Exchange	-1.000132	1.44325
(st. error)	(0.005)	

Integration test:

Summary of Unit root tests (no constant, no trend)

	Cointegration Residuals
<i>Test Statistics</i>	
Wtd.Sym.	-7.98772
Dickey-F	-7.99322
Phillips	-1059.33377
 <i>P-values</i>	
Wtd.Sym.	-----
Dickey-F	0.00000
Phillips	0.00000
 <i>Number of lags</i>	
Wtd.Sym.	9
Dickey-F	9
Phillips	9

Figure 1. Lira-French franc nominal exchange rate. Parity = 100.

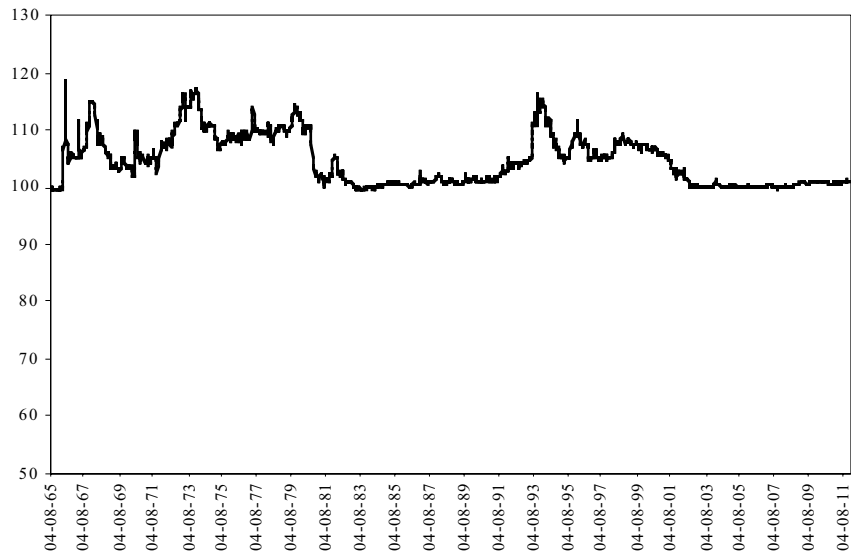


Figure 2. Rendita weekly prices in Milan and in Paris.

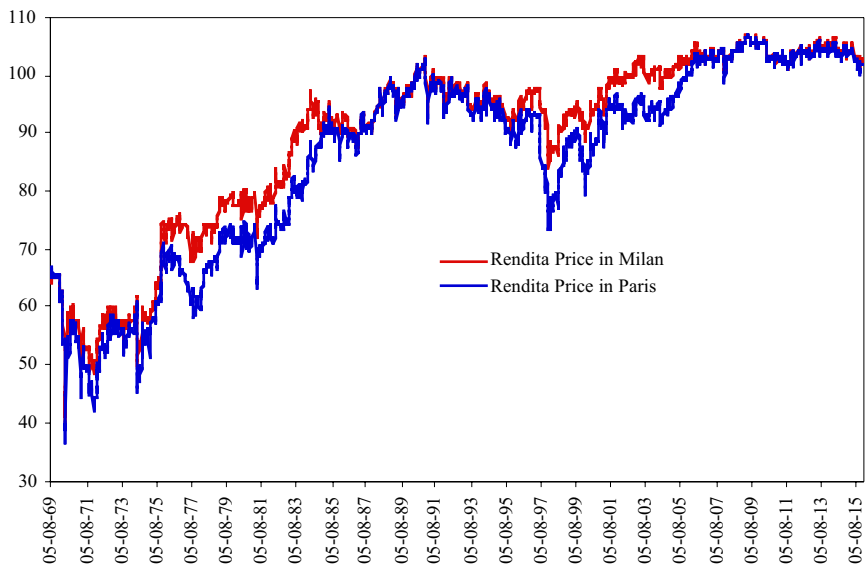


Figure 3. Residuals from the Rendita spot arbitrage and  $\pm 0.50\%$  fluctuation band .

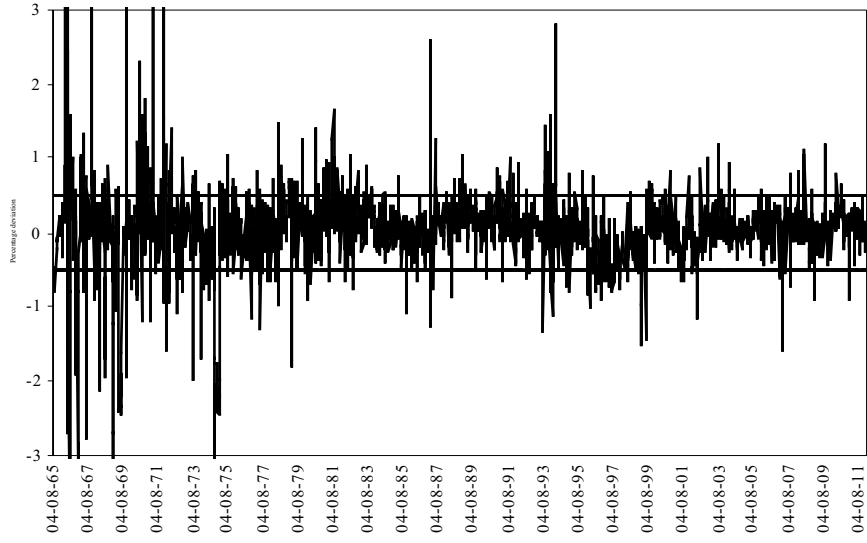


Figure 4. Percentage of bearer Rendita paid abroad.

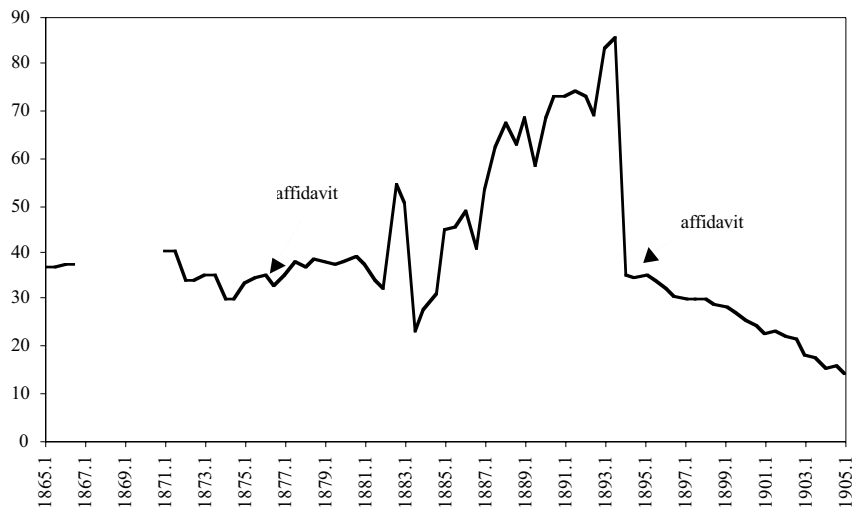




Figure 5. Exchange deviations and deviations from Rendita spot arbitrage.

