Coin Memories: Estimates of the French Metallic Currency 1840-1878

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Introduction

France's monetary system during the nineteenth century has aroused numerous controversies. One important set of issues relates to the «specie-intensive» nature of France's monetary system. Until the late 1870s and even beyond, gold and silver coins formed the main part of what was probably the largest national monetary stock in the world. Rondo Cameron [1967] evaluated that specie in France represented 82% of the stock of money in 1845, 68% in 1870, and 52% in 1885. This feature, traditionally associated with France's so-called «financial backwardness», has been sometimes held responsible for

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slower growth in that country, because the economy had to divert real resources in order to purchase specie from abroad (Cameron [1967]). By contrast, Lévy-Leboyer ([1968] and [1977]) argued that specie overaccumulation had little effect — if any — on France's economic development [1].

Another important series of questions relates to the composition of France's metallic currency. The French monetary system was on a bimetallic standard, i.e. it attempted to provide for the joint circulation of gold and silver monies. Researchers disagree about its performance. At one extreme, the conventional view argues that a bimetallic regime is a fundamentally unstable system, and that it alternatively collapses to a *de facto* gold or silver standard, with brutal changes in the composition of the circulation (see e.g. Eichengreen [1985]). On the other hand, some authors (see e.g. Friedman [1990]) have challenged this analysis, arguing that in fact both gold and silver coins did circulate in France during the whole bimetallic period.

No doubt that these controversies render the construction of estimates of the French metallic currency particularly desirable. Moreover, it is said that for the purpose of econometric work, the evolution of France's monetary stock could be well proxied by the amount of specie in circulation. As Lévy-Leboyer and Bourguignon argued: «Specie in circulation could be used as an acceptable substitute to enable the following of the evolution of the means of payment» [2]. Surprisingly however, there does not exist any series for the metallic currency in France 1840-1878. Despite some statistical work for the period after 1878 (see Foville [1878], Pupin [1917], Denuc [1931/1932], and Sicsic [1989]), the period before 1878 has never been systematically investigated. For instance, Saint-Marc [1983] argued that «there is no serious statistic in order to assess the quantities of gold and silver monies at the time» [3]. Similarly,

[1] For a survey of the Lévy-Leboyer vs. Cameron controversy, see Kindleberger [1984].
[2] Lévy-Leboyer and Bourguignon [1985], p. 305.
[3] «Introduction aux Statistiques Monétaires et Financières Francaises», Journal de la Société de Statistique de Paris, [1974], which is a shorter version of her paper in the *International Review of the History of Banking*, 1974, T. VII See also *Histoire Monétaire de*

Levy-Leboyer and Bourguignon [1985] wrote: «Precise figures for the metallic stock have still not been constructed on an annual basis». This paper is an attempt to correct an omission which is quite troubling with respect to the considerable effort that cliometrics have devoted to investigating the «real side» of the French economy.

In the first section, we review and criticize the various figures that have been used in the literature to date, as well as the main statistical techniques employed in evaluating the post-1878 specie stocks. In section II, we present a new method aimed at estimating France's metallic currency during the period 1840-1878. The method — by correcting the logical flaws of previous approaches — is designed to make efficient and extensive use of the data taken from a «monetary census» conducted in 1878. Finally the third section, which contains a discussion of the new estimates, points to some important implications of our revised figures.

SECTION I:
Guesstimates vs. Estimates: Review of the Literature.

Although there are no available annual estimates for France's specie stock during the period 1840-1878 one may identify in the literature to date two main approaches to the problem. The first may be termed «guesstimation»: it uses contemporary sources to get some insights on the actual figures. The method was developed by historians (Levy-Leboyer, Cameron) who needed a rough idea of the evolution of France's metallic currency at little time expense. On the other hand, the second approach stemmed from recognition of the drawbacks of a non-systematic evaluation, but is substantially more costly in terms of the statistical apparatus involved. In our view, however, it constitutes a mandatory step for any research aimed at giving a careful account of the evolution of the French monetary system.

la France, PUF, 1983, where the 1974 paper is reproduced. See as also Plessis [1985], p. 120 for a statement of the conventional wisdom on this point.

1 — *Guesstimates: Levy-Leboyer*

In his work on the evolution of France's monetary system Lévy-Leboyer [1977] evaluated the stock of specie by collecting various figures that can be found in contemporary writings. Since the question of whether France had the right amount of currency was a matter of political debate as early as in the 1830s it is easy to find in the nineteenth-century literature various figures for various dates. In fact, the main problem is not the scantiness of these evaluations, but rather their profligacy. Hence, Lévy-Leboyer had to make some choices among an extreme diversity of results [4], and select his own bundle of «guesstimates» [5].

The main problem of this method is that it leads to implicit changes in the estimation technique depending on the source used. For instance Lévy-Leboyer evaluates that for the period 1830-1834 the French metallic stock was of about 2550 millions. This figure, which was often quoted at the time, is based on the lump sum of past coinages and does not make any allowance for losses due to exports or recoinage [6]. On the other hand, for 1865, Lévy-Leboyer relies on a figure which includes an estimate of the effect of specie exports. Another problem associated with relying on contemporary sources is that for a given date, the estimates available display a large variance. Around 1840 for instance, figures range between 2 and

[4] The contemporary sources he used for the period before 1878 are: E. Dewamin *Cent Ans de Numismatique Française* [1893]. H. d'Esterno, *Des Banques Départementales* [1838]. E. Levasseur, *La Question de l'Or* [1856]. H. Delebecque, E. Pereire et Cahen D'Anvers in *Enquête sur la Circulation Monétaire et Fiduciaire*. In addition Lévy-Leboyer relied on Thuillier's Pour une Histoire Monétaire de la France in *Annales*, 1959, reprinted in Thuillier [1983].

[5] See Levy-Leboyer and Bourguignon ([1985] p. 311): «Though the size of the overall circulation is rather uncertain, we do know its absolute variations over long periods, thanks to pointwise estimates, due to contemporary authors».

[6] Reboul, *Le Moniteur*, n. 118, p. 640, 1829: gold coins from the Ancien Régime, 100 millions. Silver coins from the Ancien Régime, 600 millions. Five franc coins struck between 1801 and 1803, 100 millions. 20 and 40 franc coins struck between 1801 and 1803, 446 millions. Silver struck between 1803 and 1812, 723 millions. Gold and Silver coins struck between 1812 and 1829, 529 millions. Total 2564 millions.

4 billion[7]. Extracting accurate information from such variance would require a careful discussion of the reasons for preferring some figures to others, but the rationale for choosing some figures and rejecting others remains elusive.

There is, however, a kind of consensus around the quinquennial guesstimates[8]. They are widely quoted, and they can be taken as representing a kind of «conventional wisdom» on the subject[9]. Indeed, a few years earlier, Rondo Cameron [1967] had produced some figures that looked very similar to Lévy-Leboyer's: from 3.5 billions, in 1845, the metallic currency was said to have steadily risen to 7 billions in 1870 and 7.4 in 1885[10]. But these figures were obtained through essentially the same method as the one used by Lévy-Leboyer (that is, collecting figures in nineteenth-century documents). Thus, the analogy was essentially the consequence of the similarity in the sources used and does not warrant the accuracy of the results.

2 — *Estimates: Foville*

It was only after 1878 that systematic efforts to obtain estimates for the metallic currency were achieved. Two competing methods

[7] See Thuillier ([1983] p.289): the refiner and Member of Parliament Poisat proposed 2 billion (1845), the economist Faucher suggested 5 billions.

[8] In 1961 however, Rondo Cameron had argued that, though he agreed that France experienced along the nineteenth century a general upward trend in the accumulation of its metallic currency, a method using bullion movements figures would probably result in overstatements of the trend: «There is no doubt that France accumulated specie throughout the century; but that it did so at the rate indicated by the official figures is most unlikely» ([1961], p. 525).

[9] Plessis ([1985] p. 120), for instance, writes «The most reasonable estimates for the late 1840 seem to be the ones suggested by Lévy-Leboyer and Cameron». However, although Lévy-Leboyer's figures are quoted by various economic historians, he did not reproduce them in his recent book on France's economic growth during the nineteenth century, where he implicitly relied on other figures.

[10] Cameron's sources were: 1845: Bigo, *Banques Françaises*. 1870: Victor Bonnet in Hollingsbery, *Handbook of Gold and Silver*. 1885: Foville, *Economiste Français*, 19 September 1891. Cameron, [1967], p. 116.

emerged. They were respectively due to Alfred de Foville and René Pupin. Later, Jules Denuc generalized them and proposed two tentative extensions that retropolated Foville and Pupin's estimates back to 1870. Unfortunately, the two series are strikingly different, which led to the view that both are wrong (see Saint-Marc [1983], who proposed to take the average). However, both methods contain interesting insights that may prove very useful [11].

2.1 «La Méthode de Foville»: Origins and Principles.

The work of the statistician Alfred de Foville was in fact the first attempt to improve the «guesstimates» of France's metallic stock that were used up to his time [12]. It seemed furthermore quite pioneering at a time when statistical inference was still in its infancy, and it is traditionally recognized as an ingenious technique [13]. One must say, however, that the technique of coin sampling was not invented in France but in England. Foville's method was directly borrowed from Stanley Jevons who surveyed in 1868 (with the help of a number of British banks) a large amount of coins taken from the British circulation. He used his sample to determine the stock of specie in England. His results were presented before the Statistical Society and subsequently published [14].

[11] Traditional discussions of Foville's and Pupin's methods may be found in Denuc [1931/1932], Saint-Marc [1983] and Sicsic [1989]. In this paper, we focus on those points of the methodology which appeared to us most relevant.

[12] Foville, «Le Stock Monétaire de la France», *Journal de la Société de Statistique de Paris*, 1879; *La France Economique, Statistique Raisonnée et Comparative*, 1890; and *La Monnaie*, 1907.

[13] See e.g. Cameron [1967], Lévy-Leboyer [1977], Lévy-Leboyer and Bourguignon [1985] who used Foville's figures for the period after 1878. Traditional presentations of Foville's technique may be found in Arnaune [1903], Denuc [1931/1932], Saint-Marc [1983], and more recently Sicsic [1989].

[14] On the Condition of Metallic Currency of the United Kingdom», *Journal of the Statistical Society*, December 1868, pp. 426-464. For a presentation of Jevons' survey, see Capie and Weber [1985].

A few months before Jevons' results became available, a first monetary survey was conducted in France. It was mostly concerned with determining the proportion of gold and silver monies in the country. Though interesting, the results were not submitted to any statistical treatment. In fact they were not collected in a format suitable for applying Jevons' technique [15]. It was only in the late 1870s that systematic censuses started being implemented, under Foville's supervision. A total of six *Enquêtes Monétaires* were conducted (1878, 1885, 1891, 1897, 1903, and 1909). Although Foville relied heavily on Jevons' seminal paper, he displayed a tendency to overlook the contribution of the British economist! [16]

Aside from questions of authorship, the census method is worth describing. Its main intuition is that the coins found at a given date in a number of public treasuries across the country can be considered as a «sample» of the total circulation. Then, the stock of metallic currency can be approximated by computing the relative size of the «sample», since estimating the latter would provide a device to evaluate the former. To do so, the various coins were grouped according to their year of coinage (i.e. 1803 onwards for twenty fr. gold coins and from An IV onwards for five fr. silver coins). One had then to compute the ratio of the number of coins of a given vintage found in the public treasuries to the total coinage of that vintage, the so-called «survival rate».

In its final step, the census method made the assumption that

[15] The returns of the 1868 survey are available as *Résumé de l'Enquête faite auprès des Trésoriers Payeurs Généraux,* Paris, Imprimerie Impériale, 1868. A more exhaustive version may be available but we were unable to retrieve it. As many documents in the French Ministry of Finances it may have burned during the Commune. The file *Enquêtes Monétaires,* found in the Archives of the Bank of France contains the return *(Encaisse de la Banque, 30 Avril 1868)* of a survey of the Bank's reserves in its various branches. The figures relate to the gold/silver composition of the reserves.

[16] See e.g. his 1907 book, *La Monnaie.* In one instance only, he did acknowledge the source of his inspiration. Not surprisingly, it was in London during a lecture before the International Statistical Society: «le Gouvemement Français a fait en 1878 et vient de refaire il y a quelques semaines, une opération dont notre regretté collègue Stanley Jevons lui avait pour ainsi dire tracé le modèle» *(La Statistique et ses Ennemis,* 1885, p. 15).

there was a one hundred per cent survival rate for the most recent years, so that the ratio for these periods provided an *approximation* of the relative size of the total «sample». One could then multiply the total amount of coins in the «sample» by this ratio to obtain an *approximation* of the total monetary stock [17]. In this manner, an estimate of the French metallic currency that circulated at the year of the census could be obtained.

2.2 Foville's Method: a Statistical Critique.

However, as applied by Foville, the census method fell short of supplying a full and rigorous analysis of the data from the 1878 Survey. His approach — as was Jevons' — was undermined by the fact that the procedure for estimating the amount of currency at census dates was incorrect. From a statistical point of view, it was inefficient and biased. To see this, let's call λ the (unknown) ratio of the sample size to the overall population (λ is the *relative* size of the sample). If one assumes that all the coins of the most recent vintage are still in circulation, λ can be estimated by dividing the number of these coins found in the public treasuries (n) by the total amount that was initially coined (N). We then have:

$$E\left\{\frac{n}{N}\right\}=\lambda$$

Clearly, provided that we assume that the most recent vintage did not experience any loss, the element within brackets provides an estimator of the proportion of circulation that was sampled. Foville's method can be easily interpreted in this context, as it approximates the overall circulation (M) by dividing the size of the sample (m) by

[17] As there were various types of coins (Five Francs, Ten Francs, Twenty Francs), the operation was reiterated for the various denominations. The final result was obtained by adding the results for each denomination.

λ. This method however, tends to overstate the true amount of currency: a well-known statistical property, namely Jensen's inequality implies that:

$$E\{\frac{m}{\lambda}\} \geq M$$

As long as we consider that the coins found in the public treasuries are obtained through a proper sampling of the overall circulation, Jensen's inequality does not matter too much. In this case it can be shown that the variance of the estimated λ is extremely small with respect to λ , implying that the bias is negligible, and that M is almost adequately estimated [18]. Things get worse, however, if we recognize that the implicit sampling procedure associated with surveying an exogenously given number of treasuries may introduce some additional variance. In this case, variations in λ, in addition to producing a bias, would introduce a huge variance in the estimated stock of metallic currency, M.

Much of the debate about the census method can be interpreted as focusing on the adequacy of the type of sampling they assumed. The first attack was formulated by Pupin [1917] who argued that since the samples were made of what the public tendered to the treasuries, the outcome was likely to be affected by the public's behaviour [19]. For instance, the proportion of gold and silver coins in the sample might not reflect their actual proportion in circulation. However, since the census method is *separately* applied to each denomination, the total number of a given denomination found in the public tellers can be correctly interpreted as a sample of the whole quantity of this denomination in circulation. More substantially, Pupin believed that within a given

[18] The variance is approximately of the same magnitude as λ/N(where N is the number of coins struck during the most recent year). Clearly, if N is large, λ is much larger than λ/N.

[19] "De quoi sont faites les encaisses recensées? De ce que le public veut bien y apporter [...] Les encaisses recensées sont donc constituées à la volonté du public, et leur composition ne peut être l'image fidèle de ses ressources monétaires» Pupin [1917], (p. 316).

denomination, older issues were more likely to be hoarded, and recent issues more likely to be exported [20]. Another similar problem which was overlooked by Pupin and subsequent researchers is that the distribution of the vintages across the country was not homogeneous. The difficulty was already noted by Jevons who reported that the estimated proportion of the most recent coinages depended on the location where the sample was drawn. For instance, he observed that while the proportion of the 1861-1867 coinage was 48.4% in samples taken in London, this proportion was only 28.7% in North Wales [21]. But as the drawing procedure cannot be closely monitored (indeed this would require knowing something about the amounts of specie held in every region), the census method itself produces a noise which is *a priori* more important than the mere uncertainty derived from proper sampling [22].

It is in fact possible to get an idea of the influence of hoarding behaviour and regional heterogeneity on census returns. Indeed in 1878, the Belgian government surveyed the French coins circulating in the kingdom (where they were legal tender); we then get two samples, one being drawn in France, and the other in Belgium. Although they are both formed of French currency, they differ in terms of geography and thesaurization behaviour (it was said that hoarding was much more limited in Belgium) [23]. Under the assumption that regional

[20] Pupin's argument has been criticized by Sicsic, who argued that since the older coins usually exhibit a higher degree of wear, they should not have been preferred for hoarding purposes, because «the good money drives out the bad» (Sicsic [1989], p. 713). This argument however is a fallacy of composition. The degree of wear depends on the number of periods during which a coin circulates: hence, old thesaurized coins which would not have circulated should still be «good money» and should consistently still be thesaurized. Coins get worn because they circulate, and coins which are thesaurized do not circulate: they remain «new» regardless of their age...

[21] Jevons [1868], p. 449.

[22] To illustrate this point, we can compare the estimated relative size of the sample λ, as measured in the 1878 census, to the figure obtained by using the returns of a similar survey implemented at the same date in Belgium, where French coins circulated. While the size ot the sample, relative to the outstanding stock of bullion is 2.90‰ for gold and 1.55‰ for silver according to the French data, the corresponding figures, according to the Belgian census are respectively 2.45‰ and 0.08‰, implying considerable differences in the estimated stocks of specie: sampling errors seem to have an enormous effect on Foville's method.

[23] See Cameron [1961] and [1967].

heterogeneity and hoarding do not matter, the distribution of vintages in the two samples should not differ too much. However standard χ^2-tests lead to an unambiguous rejection of the null (for both gold and silver monies), thus suggesting that sampling problems do matter [24].

Quite paradoxically, however, this does not mean that the returns from the two monetary censuses yield a very different picture of actual French circulation, as far as the distribution of vintages is concerned. This is illustrated on Figures 1 and 2, which display strong analogies between the French and the Belgian surveys. Indeed, more than 99% of the variance of the returns from the French survey can be explained by the returns from the Belgian survey, thus implying that the two samples convey essentially the same information [25]. In other words, although there does exist some differences between the two surveys which may for some years be «substantial» according to a χ^2-test [26], the monetary census may be thought of as giving a very good approximation of the actual circulation, provided that we do not focus exclusively on one single year. In conclusion, sampling problems create difficulties only when one focuses too exclusively on one given year (as Foville and

[24] The null hypothesis states that the two samples are drawn from me same population, and the χ^2-statistic tests whether or not the distance between the two distributions is «too large» to be consistent with the null. After regrouping some vintages (in order to meet the requirements for the asymptotic behaviour of the χ^2-test) the statistics for both gold and silver (respectively around 600 and 1000) were found well above the 1% criterion, thus leading to rejection of the null.

[25] We ran the regression with the ratios of survival (number of coins found divided by number of coins struck) instead of using the proportion of each vintage in the sample. However, it can be shown that the two procedures are equivalent, since the series of ratios of survival is a linear transformation of the series of proportions. The equation estimated was $ff_j = \alpha fb_j + y_j$, where ffj is the ratio of survival of vintage in according to the French survey, and fbj_j is the ratio of survival of vintage in according to the Belgian survey. The method used was to compute OLS on sphericized and centred ratios (indeed, by construction, the y_j are heteroskedastic and correlated). The results were for gold $\alpha = 1.0006$ (T-stat = 0.73 E-03) and $R^2 = 0.999$; for silver $\alpha = 1.0002$ (T-stat. = 0.13 E-02) and $R^2 = 0.999$. Note that the model offers a straightforward way to test and accept the hypothesis that $\alpha = 1$ in both regressions.

[26] In particular, it should be remembered that a well-known feature of χ^2-tests is that the probability of rejecting the null (for given theoretical distributions) increases with the sample size.

Jevons did). By contrast, a method that would use the whole series of survival rates could overlook sampling difficulties[27].

Figure 1
Gold Coins: Proportion of Each Vintage in the French (continuous line) and Belgian (dotted line) Samples.

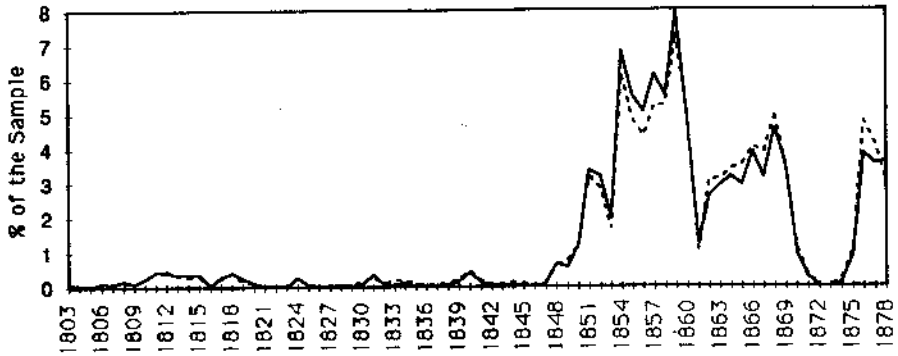
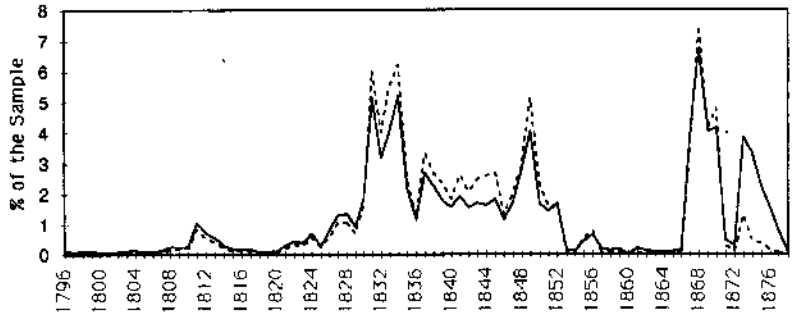


Figure 2
Silver Coins: Proportion of Each Vintage in the French (continuous line) and Belgian (dotted line) Samples.



[27] Earlier research has usually focused on measuring «French circulation», rather than «French metallic currency», as we do. With French currency circulating in countries of the Latin Union, and coins from those countries circulating in France, it is clear that the two concepts differ. However, since the coinage in Belgium, Italy and Switzerland remained very limited with respect to French coinage, and since foreign holdings of French currency are partly compensated by French holdings of foreign coins, French metallic currency constitutes a good approximation of French circulaton. Note as well that our concept of metallic currency includes the holdings of the Bank of France which until the mid-1870s remained very small with respect to the overall stock (less than 10%).

3 — Estimates: Pupin

An alternative technique to estimate the currency stock at a given date is to assess the proportion of each vintage that has been lost. This method was proposed by Pupin [1917]. It rested on the assumption that the stock of metallic currency could be estimated through an evaluation of its (constant) *rate of depreciation* [28]. It assumed that every year the quantity of each vintage that still existed was reduced by a constant coefficient which supposedly summarised accidental losses, recoinage, and «wear and tear». This coefficient was somewhat arbitrarily set equal to 0.5% per year for both gold and silver monies [29]. One had then to multiply the initial coinage of one given vintage by the loss factor — which is equal to $(1\text{-}0.005)^{(1878\text{-}i)}$ where i represents the year when the vintage was coined — to get an estimate of the quantity of coins of that vintage that was still in circulation. Finally, an estimate of overall circulation could be obtained by adding up the surviving coins. However, although Pupin's approach avoided the statistical shortcomings that undermined Foville's method, it fell short of providing a rigorous method for estimating the rate of depreciation.

In fact, Pupin's method can be improved by using the monetary censuses in order to derive the constant loss rate. To do so, one only needs to adjust the series of «survival rates» (number of coins of a given vintage found in the survey, divided by the amount initially coined) for a constant loss factor. This approach was first formalised by Jevons who wrote: «Suppose a be the quantity of coins issued in any given year, and that (1/m)th part of the circulation be indifferen-

[28] The references are: Pupin, *La Richesse de la France devant la Guerre,* Paris 1916, and «Circulation et Thésaurisation des Monnaies d'Or en France», *Journal de la Societé de Statistique de Paris,* 1917. Denuc, «Essai de Détermination de la circulation Monétaire Annuelle en France de 1870 à 1913», *Statistique Générale de la France,* 1931-1932 (pp. 419-440). Pupin's method was developed earlier but was used to estimate the French monetary stock in the early twentieth century. Denuc's work generalised Pupin's approach to a longer period.

[29] For a justification of this figure see Pupin [1917], p. 323. It is possible to formally test and reject the hypothesis of constant depreciation.

tly withdrawn every year; then at the end of n years, the quantity a will be evidently reduced to $a(1-(1/m))^n$». This model has been estimated by Sicsic [1989], using the returns of the 1878 census. He found that the rates of depreciation for both gold and silver were probably much larger than evaluated by Pupin.

However, it can be shown that this approach is not very efficient. As Jevons argued, if the hypothesis of a constant rate of depreciation was correct, «the curve [of the survival rates] *would have the form arising from a geometrical series,* and would tend constantly upwards without any contrary bends» [30], a feature which is not supported by the French data, of which an exponential trend is a crude approximation (see figures 3, 4, and 5). In other words, Pupin's method, even when improved, leaves out a large fraction of the information contained in the monetary censuses.

Finally, both Pupin's and Foville's methods provide pointwise estimates of the aggregate stock of currency at the date of the census, and do not yield an easy way to retropolate the series. A generalisation of Pupin's method was tried by Denuc. He argued that the rate of depreciation along with coinage figures could be used in order to construct the series of metallic currency before 1878. Clearly, the validity of the whole approach depends crucially on the assumption that the losses in gold and silver monies due to melting or exporting, were constant across time. In addition, depending on whether the estimated discount factor is too large or too small, Denuc's method introduces a downward or upward bias in the estimation of the quantity of metallic currency.

On the other hand, Denuc tried to retropolate Foville's evaluations by using data on specie flows. However, as argued by Morgenstern [1963], this is very difficult, due to rampant problems of underestimation of actual flows of specie in official returns. As argued by Cameron [1961], p. 525): «A possible solution would be to apply a correction factor [...]; but in absence of any reliable evidence regarding [...] the undervaluation of exports, even that procedure is unwarranted».

[30] Jevons [1868], p. 453.

We now turn to the presentation of our own method. The approach will be eclectic, since we believe that there is some boon to be taken in every and each of the various techniques we have described. The issue is not so much to determine which is the proper technique, but rather to combine them in order to improve our knowledge of the evolution of French metallic currency, 1840-1878.

SECTION II:
NEW ESTIMATES OF FRANCE'S METALLIC CURRENCY.

In our statistical analysis of the data obtained in the 1878 monetary census, we focus on the series of survival rates (or Foville's ratios) for each type of currency (f(1796), f(1797), ..., f(i), ..., f(1878)). This series is defined as:

$$f(i) = \frac{\tilde{n}(i)}{N(i)} = \lambda (1\text{-}a(i)) + \omega(i)$$

Where $\tilde{n}(i)$ is the number of coins from vintage i found in the sample, N(i) is the initial coinage, λ is the relative size of the sample, a(i) is the loss factor for vintage i (proportion of that vintage that has been lost), and w(i) is a stochastic disturbance with mean 0. If no loss was experienced by a given vintage ($a(i)=0$) we have $E\{f(i)\}=\lambda$ i.e. Foville's ratio is equal to the relative size of the sample: this was the essence of Foville's method. By contrast, our method is aimed at modelling the a(i) terms.

Foville's ratios can be computed for the main coins that were surveyed during the censuses: the five fr. silver coin, the twenty fr. and ten fr. gold coins that together formed almost 100% of the metallic currency. The series are represented in Figures 3, 4, and 5. The qualitative features of the patterns displayed by each ratio appear to be quite characteristic of the type of currency under study, and in fact the main intuition of our method is to argue that they can be easily interpreted in terms of the specific history of each type of coin. Since Foville's ratios display the comparative survival of each «generation», the old coins can tell us something about their

memories, that is, the past record of the population. To better appreciate the information conveyed in the ratios, a quick history of gold and silver circulation after the Germinal Law of 1803 is in order.

The two monetary laws of 28 Thermidor An III (15 August 1795) based the monetary system of France on silver and ordained, among other things, the coinage of five-franc silver coins. The laws of 7-17 Germinal An XI (28 March 1803) finally established the system on a bimetallic basis at a ratio of 15.5 (the «legal ratio»), and created 20 and 40-franc gold coins. Gold and silver monies were freely coined, and legal value of the old coins was set at a low level (as compared to their intrinsic value) to encourage their recoinage. In practice, the coins of the Ancien Régime disappeared slowly (especially in more agricultural and backward regions like Brittany) and continued to circulate (or were kept hoarded) along with the coinages of the Republican, Imperial, or Restauration periods, until the early 1830s.

The bimetallic nature of the French monetary system had a strong impact on the mortality and natality of the various coins. In a bimetallic system, gold and silver are both monies and goods and must have but one exchange rate. If the relative price of gold as commodity tends to rise, it pays to melt down gold coins and sell them as bullion, use the proceeds to buy silver metal and coin it. This arbitrage stabilizes the gold/silver commercial ratio close [31] to the legal ratio, but in the process, large amounts of either metal can be destroyed. This is illustrated on Figure 6, which depicts the behaviour of the commercial ratio along with the coinage and net movements of silver and gold. As this Figure clearly shows, periods of relative gold (silver) appreciation are associated with net gold (silver) exports [32]. Thus, movements in the ratio will be an important component in defining benchmarks for the periodisation of the history of France's metallic currency. I have divided the history of the silver and gold coins into six main epochs.

[31] The discrepancy reflecting the arbitrage costs (melting, transporting, coining, etc...).
[32] The consistency between the figures on net bullion exports and what we know of the operation of bimetallic regimes reinforces the idea that official statistics on bullion exports used as an index convey important information.

Figure 3
Foville's Ratio: 5-franc silver coins.

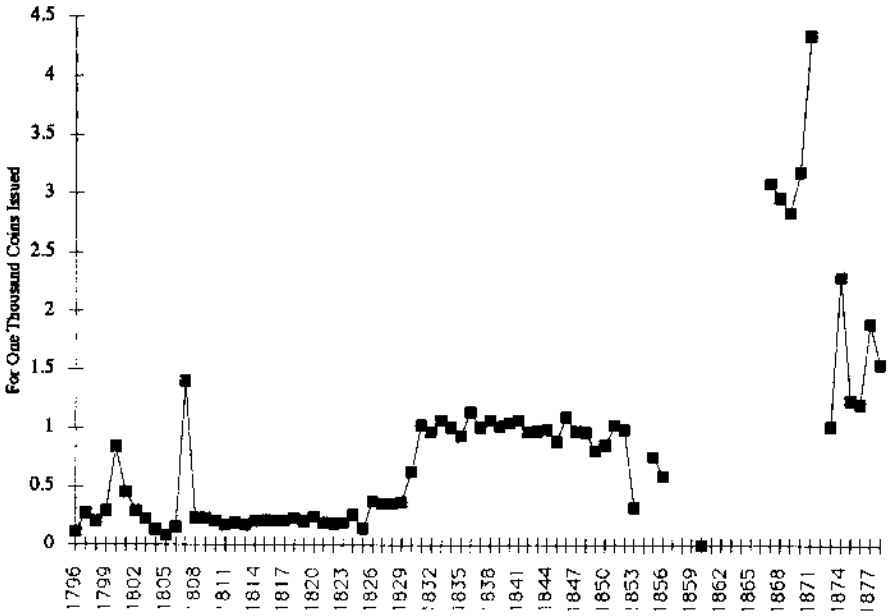


Figure 4
Foville's Ratio: 20-franc gold coins.

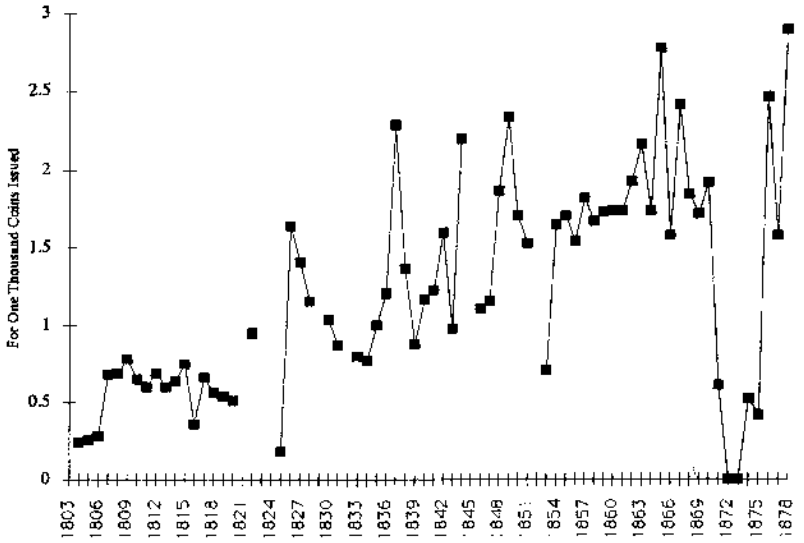
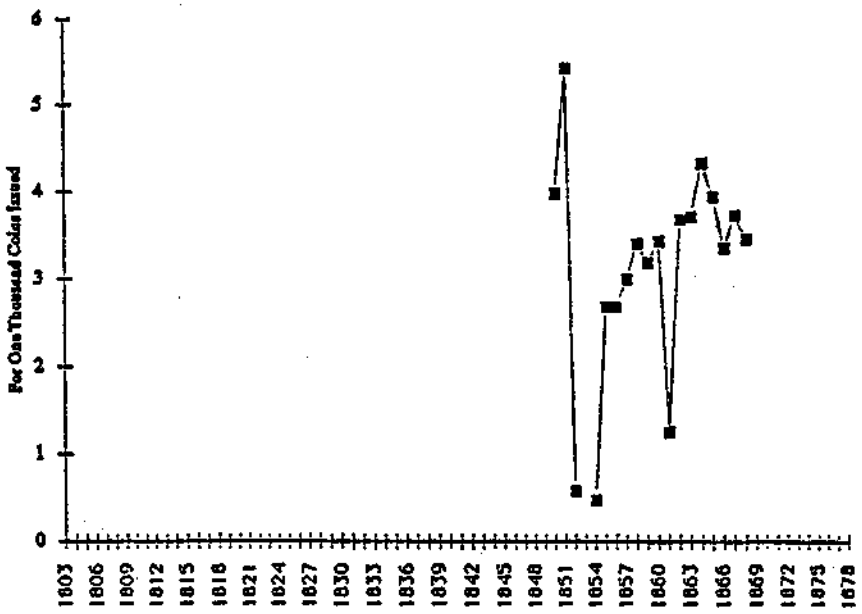


Figure 5
Foville's Ratio: 10-franc gold coins.



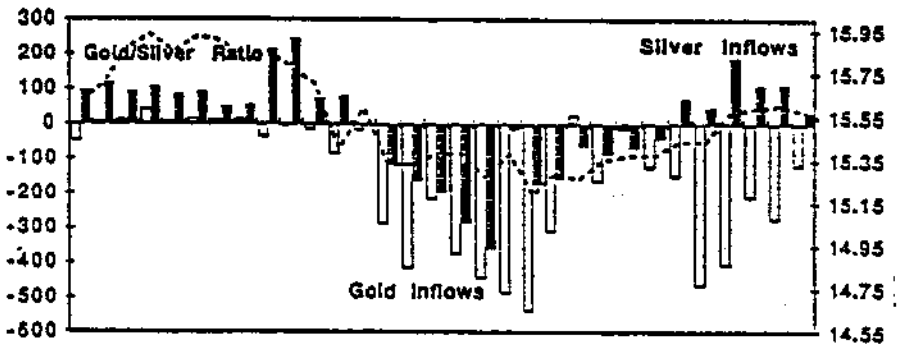
1 — Silver Memories.

1795-1829/30: Due to the fact that international arbitrages were partly severed because of the French Wars and the Blockade, to the stability of the gold/silver commercial ratio (until 1820), and to the premium on gold (after 1820), silver was coined throughout the period. However, a large part of the coinage was achieved through recoinage of the old silver coins that contained between 1/1000th and 2/1000th of gold. Indeed, silver ore is always found with some gold in it but, prior to 1830, the refiners' techniques were not efficient enough to extract it. In the late 1820s the discovery of Poisat's process[33] finally made this operation profitable, but it was only after 1830 that the refining of silver started being implemented on a large

[33] See Bertrand Gille, *Histoire de la Maison Rothschild,* [1967], Vol 1, p. 379 ff.

scale. At about the same time, the Administration of the Mint discovered that the former assaying technique undervalued the coins which were worth four thousandth more than officially measured. Hence the coins struck prior to 1830s were melted down in the 1830s. This process only spared coins that were seriously worn out: the loss in silver more than compensated the gain in gold[34]. This phenomenon is reflected by the low level of Foville's ratio before 1830.

Figure 6
Net Gold Exports, Net Silver Imports
in Millions of FF), and the Gold/Silver: Ratio: 1840-1870



1830-1852

Due to the premium on gold, this period is characterised by predominant silver coinage (part of it being recoinage[35]). Consistently, silver was the main component of France's currency in the late

[34] Once refined, the old silver coins could produce at least 6 francs per 1000 francs. Added to the 4 francs stemming from undervaluation of the assays, this gave a premium of about one per cent. This «speculation» on the «Ecus aurifères» is not very well known. Some indications, suggesting that they started in the 1820s can be found in Darnis' interesting book *La Monnaie de Paris (1795-1826)*, 1988, p. 265 and 274. See as well Foville «Combien nous reste-t-il d'Ecus de 5 Francs?» [1893].

[35] The recoinage includes as well the reminting of the Ancient Regime coins that took place in the 1830s.

1840s; this situation was reversed in the next period, starting in 1853. The silver coined during the 1830s and 1840s was massively melted down and exported to reap the profits accruing from the premium paid on this metal. Thus on Figure 3 a second plateau is obtained. Foville suggestively described the whole epoch before 1853 as «two plateaus, separated by a cliff».

1853-1866

During this period, the depreciation of gold kept silver out of the Mint. Coinage was extremely limited, implying that the variance of Foville's ratio is very large. This corresponds to the intuitive notion that since the surviving population was very small for this period, tiny variations in the number of coins found are likely to have very large effects on the ratio. Note that during this period, the silver that was exported was mainly formed of post-1830 coinages. The surviving coins of the pre-1830 period had only been rescued from the melting pot in the 1830 by their high degree of abrasion, which protected them against bimetallic arbitrages.

1867-1870

The premium on silver disappeared, and the commercial ratio remained stable around the legal ratio. «Speculation» on silver came to an end (Plessis [1985], p. 120, Ramon [1927] p. 259) and silver was minted, along with gold.

1871-1872

The defeat of France in the Franco-Prussian war, the *cours forcé* of Bank of France notes (as of August 1870), the large war indemnity that France had to pay to Germany, and the step that several countries

(including France) made toward the gold standard should have had important effects on France's currency. However, the indemnity and the *cours forcé* had smaller effects than expected. The indemnity was paid through the issue of a public debt (the *Rente Thiers)* which attracted foreign investors. This helped to spread the adjustment over several years. The transfer of wealth resulted in huge deficits in Germany in 1872, 1873 and 1874, and large surpluses in France, which offset at least half of the indemnity [36]. Finally, «the rest [...] was paid temporarily through imports of foreign capital, backflows of French capital from abroad» and in some measure «gold and currency exports [37]». Five hundred million were directly sent by the Bank of France. However the French currency, which was held in German banks waiting to be recoined, was used in preference to any other form of specie to pay for the German deficits against France, since it saved on the coining expenses. Most of the silver currency came back to France. For instance, Ramon described that in 1873, «a curious phenomenon took place: the barrels of five-franc coins that the Bank had sent to the other side of Rhine were coming back unopened [38]». nally, the suspension of specie payments by the Bank during this period resulted in very limited coinage of silver. A mild premium was paid on gold and silver against notes. At the end of 1873, however, the Bank resumed its payments in five-franc *écus.*

1873-1878

The decision to restrict the free coinage of silver was a serious blow to the smooth operation of the bimetallic system. Fearing that silver would be further demonetised, arbitrageurs would buy silver only provided that they could give it to the Bank. As a result, large quantities of silver coins were hoarded in the Bank's vaults and their

[36] Machlup [1964], «The Transfer Problem, Theme and Four Variations: Variation II, France, 1871-1875».
[37] Machlup [1964], p. 381.
[38] Ramon [1929], p. 385.

circulation remained limited (see Foville [1879]: «A large part of the five fr. coins struck during the past five years are just piling up in the vaults of the Bank. From the point of view of the circulation, everything happens as if they did not exist» (p. 36; see as well Ramon [1929] p. 385 ff.). Note that, since the reserves of the Bank were not part of the 1878 survey, Foville's assumption that the coins of the most recent issues can still be found in circulation is clearly violated in the case of silver currency.

2 — Gold Memories

1803-1820

During this period, the gold/silver commercial ratio had only limited effect on French coinage. Until 1815, an important part of the coinage was achieved by the government out of taxes collected in the Empire and occupied countries, or by recoinage of the currencies of the *Ancient Régime,* and was used to pay for the army's expenses. Arbitrage considerations were therefore rendered partly irrelevant. In addition, the Blockade affected the working of the international bullion markets, by severing the links between London, on the one hand, and Paris and Hamburg on the other hand. After the end of the French wars, the commercial ratio exhibited five years of stability. As transportation costs were still quite large, minor variations of the ratio had no effect on mint output.

1821-1847

After 1820, a long period of relative gold appreciation took place. Individuals only coined gold during the few instances when its price happened to fall [39]. On average the price of gold remained high, and it was more profitable to sell it as bullion than to coin it. During this

[39] Note that in 1825, for instance, large coinages of gold took place while precisely the average price of gold was relatively low (in Paris 15.62 and 15.70 in Hamburg).

thirty-year period, the little gold that was struck was mainly hoarded and the past vintages were melted or exported [40]. Towards the end of the period, gold prices started to go down, a trend that was reinforced by the California discoveries. As observed for silver during the period of silver appreciation, gold appreciation resulted in an average low level and a high variance of Foville's ratio (Figure 4).

1848-1870

During this period, the California and Australia gold gluts were absorbed by coinage of this metal (see Lévy-Leboyer [1977]). The monetary circulation of France became mostly formed of gold, as the 1868 survey shows [41]. After 1865 the largest part of the newly minted bullion was added to the reserves of the Bank of France, which reached an unprecedented level of about one billion [42]. This stock would be later partly released and used by the Bank to help the Treasury pay the war indemnity [43]. During this period, the average value of Foville's ratio is relatively high and quite stable.

1871-1873

Due to the payment of the war indemnity, a large part of the coinage that took place in 1871 disappeared. Interestingly, this feature is well known to numismatists. Gadoury [1989] for instance, remarks

[40] See e.g. Lévy-Leboyer's discussion of this period in *Histoire Economique et Sociale de la France,* [1977], p. 417. Lévy-Leboyer argues that the return of Britain to gold (in 1821) was a cause of the scarcity of gold on bullion markets. Note that the rather large 70 coinagé of gold in the early 1830s were in fact the product of the recoinages of the *Ancien Regime* monies.

[41] «Résumé de l'Enquête Faite auprès des Trésoriers Payeurs Géneraux», 1868, Paris.

[42] This was called by the opponents of the cautious policies of the Bank the «Billion on Strike» since the billion held by the Bank was considered as completely sterile.

[43] See e.g. Ramon ([1929], p. 384) of the (roughly) 250 million», paid in French gold, 130 million were directly taken from the Bank's reserves: Léon Say, Minister of Finances, and grandson of Jean-Baptiste Say argued that the intervention of the Bank in the process had proven highly useful, since gold was taken at par from the Bank and sent to Germany instead of being bought at a premium from the international market.

that «despite the fact that it was abundantly coined, the 1871 vintage is very hard to find. Indeed, it is today scarcer than the 1888 vintage. The most reasonable assumption would be that it was melted down or used for the war indemnity [44]». In 1872 and 1873, as the indemnity was being paid and the inconvertible paper currency slightly depreciated, not a single gold coin was struck in France.

1874-1875

In 1874, the Bank started to redeem its notes in (ten franc) gold coins (as well as in silver), and the premium on specie eventually disappeared. During this period Germany experienced massive deficits and part of the specie previously exported was shipped back to France. The Bank of France used this period to rebuild its gold reserve, and retained in its vaults a substantial fraction of the new issues. Consistently, Foville's ratio is smaller during this period than during the next period.

1876-1878

It was only in 1876, however, that the complete «normalisation» of the French monetary circulation was achieved. The full resumption of specie payments by the Bank, though nominally achieved in 1878, effectively took place in 1876, and the twenty fr. gold coins started to circulate freely [45].

3 — New Method and New Estimates.

The main insight of our method is to use the series of Foville's ratios in order to estimate the losses associated with the various events described above. In particular we want to distinguish between two

[44] Gadoury, [1989], p. 439.
[45] Arnauné, *La Monnaie, le Crédit et le Change*, [1902].

different causes that may affect the mortality of the various coins. First, it must be noted that the very fact that coins are used for transactions put them at risk: they may be exported and melted down. From that perspective, the older a coin gets, the less likely it is to survive; we will refer to that phenomenon as an «age effect». Second, the mechanics of bimetallism, by provoking the melting of some coins and the coinage of others, can also influence the mortality of some specific vintages. For instance, the relative depreciation of gold after 1848 provoked the export of previously struck silver monies. We will refer to that phenomenon as a «generation effect».

Consistently, we can decompose the loss factor from the previous equation in two terms. The first is a linear trend that reflects the «normal» losses that each vintage experiences. This «natural» death rate (r) is supposed to be constant across time. The second factor is a set of dummy variables that captures the impact k(j) of specific events, $\zeta_j(i)$ is an index variable which takes value one if phenomenon j affected vintage i, and zero otherwise:

$$f(i) = \lambda \{1 - \sum_{j=1}^{n} \zeta_j(i)k(j) - r(T-i)\} + w(i)$$

The k(j) terms can be interpreted as the (percentage) losses from vintage i due to phenomenon j. By contrast, the r term is the (percentage) loss that any vintage i experienced during the T-i periods it circulated. Clearly, this equation provides a natural way to compute efficient estimates of the λ, k(j)s, and r terms. One only needs to regress Foville's ratio on a constant, a set of dummy variables, and a trend [46].

[46] Technically, the identifiability of the model requires us to define a «reference period», i.e. a period during which no exceptional losses occured. For silver, the reference period is 1867-1870. During these years, silver was no longer exported and was not yet hoarded in the vaults of the Bank as it would be in the 1870s. For gold, the reference period is 1876-1878; that is, after the exports of the previous period, and the accumulation at the Bank in 1874 and 1875. Note that by contrast to Foville's approach that relies on

After estimating the model [47], tests of significance of the various period-specific dummies were conducted, and alternative specifications were compared. We started with a general model which incorporated all the «epochs» listed above as period-specific dummies. Restrictions of the general model to nested specifications (where some period-specifics effects were set equal to zero) were tested, and the initial model was simplified. The final output of the regression for silver and gold is displayed on Tables 1 and 2.

Interestingly, the final results exhibit a strong influence of exceptional losses. The refining of *écus aurifères* removed from circulation 84% of the coins struck before 1830. The premium that appeared on silver after 1853 resulted in the export of 63% of the coins that had been minted between 1830 and 1852, and 79% of those minted between 1853 and 1866. At the end of the period, about 60% of the newly minted silver directly went to the vaults of the Bank [48].

On the other hand, the premium paid on gold before 1848 produced additional exports of this metal that withdrew, in addition to normal losses, about 20% of the issues of the 1821-1847 period. But the losses of gold coined before 1820 were found indistinguishable from the effects of normal exports. Another important feature of the results is that payment of the war indemnity created a relatively small effect: 65% of the coinage that took place in 1871 was lost, but only 8% [49] of the coinages of the late 1860s disappeared in the event.

This finding is consistent with Machlup's claim — which he illustrated by an explicit reference to the 1871 episode — that net transfers abroad do not necessarily result in a reduction in the stock of

a «privileged period» during which not a single coin was lost, the concept of «reference period» only requires that there exists one epoch for which no exceptional losses are experienced. The hypothesis we have to make is thus much less stringent than Foville's. This is made possible by the use of a larger information set.

[47] Through Generalised Least Squares method, whose utilisation was rendered necessary by the non-sphericity of the disturbances.

[48] One implication of this is that Foville's claim that the most recent coinages can be found in circulation has to be rejected.

[49] In fact, as the T-Statistic shows it, this effect is not significant. However, since performing the same regression on the returns of the 1885 census gave a coefficient that was not much bigger but was significant, I have kept this figure.

specie[50]. Moreover, since we know that some exports took place in 1871, this suggests that most of the specie that had left France in the early 1870s did in fact come back.

Finally, in order to rebuild its reserves, the «excess hoarding» of the Bank of France amounted to about three quarters of the new issues of gold in 1874 and 1875[51].

Table 1[52]
SILVER

R-SQUARED = 0.99 DURBIN-WATSON STATISTIC = 1.76			
VARIABLE	EST. COEFF.	STD. ERROR	T-STATISTIC
λ	0.32E-02	0.16E-03	20.72
Time	-0.47E-05	0.19E-05	-2.48
1795-1829[53]	-0.27E-02	0.19E-03	-14.22
1830-1852	-0.20E-02	0.18E-03	-11.43
1853-1866	-0.25E-02	0.20E-03	-12.34
1873-1878	-0.19E-02	0.19E-03	-9.87
r = 0.15%			
k(1795-1829) = 84%			
k(1830-1852) = 63%			
k(1853-1866) = 79%			
k(1873-1878) = 59%			

[50] See as well Kindleberger [1984], p. 239, ff.

[51] This figure seems consistent with a note that we found in the Archives of the Bank of France, after the results were computed. The note (Dossier *Enquêtes Monétaires)* indicates that the Reserves of the Bank contained approximately 500 million in 20 franc gold coins struck between 1874 and 1878. Since at that date the gold reserves of the Bank represented about one fifth of overall circulation (exactly 1.2 billion in gold of which the 20 fr. gold coins formed the main part, i.e. 20% of a 6 billion circulation), this implies that the holdings of the Bank of France at that date should have amounted to 20% of the 1874-1878 coinages plus 77% of the 1874-1875 issues, in total to about 400 millions. Obviously, our approach could be improved if we had the exact distribution of each vintage in the Reserves of the Bank of France at the date of the survey. Although the Reserves of the Bank were apparently surveyed the results do not seem to have been published. This is bad news for us given the potential improvement on Foville's method that this could have produced.

[52] Since we used annual data for the mint output series, we had to decide how to link the Republican to the Ancien Regime Calendar. It was decided that An IV and An V, for which we had only joint data corresponded to 1796, An VI to 1797, and so on. Technically, the regression required us to drop one variable from the sample, so that the regression literally started in 1797. The coefficient estimated, however, is subsequently applied to 1796 and 1795.

Table 2[53]
GOLD

R-SQUARED = 0.99 DURBIN-WATSON STATISTIC = 2.27			
VARIABLE	EST. COEFF.	STD. ERROR	T-STATISTIC
λ	0.24E-02	0.62E-04	38.1
Time	-0.27E-04	0.21E-05	-12.5
1821-1847	-0.46E-03	0.16E-03	-2.80
1853[54]	-0.94E-03	0.16E-03	-5.93
1866-1870	-0.18E-03	0.15E-03	-1.16
1871	-0.15E-02	0.36E-03	-4.26
1874-1875	-0.18E-02	0.15E-03	-12.4
r = 1.1% k(1821-1847) = 19% k(1853) = 40% k(1866-1870) = 8% k(1871) = 63% k(1874-1875) = 77%			

Since they provide us with direct estimates of the proportion of each initial vintage that was lost before 1878, the results from Table 1 and 2 may be used to compute the stock of gold and silver monies in 1878. This produces results that are strikingly different from Foville's or Pupin's. While they reported respectively 5 and 9 billion in gold and 2.9 and 5 billion in silver, we find that the French currency in 1878 was made up of 6 billion in gold and 1.4 billion in silver[54].

Moreover, the advantages of the previous exercise are not limited to the production of unbiased estimates of the metallic stock in 1878. Since the regressions led us to recognize that the «exceptional losses» were the main factors that affected the evolution of France's stock of specie during the period prior to 1878, it is possible to use our knowledge of the timing of these events to compute estimates of the metallic stock at some specific dates identified as «turning points» in

[53] The year 1853 displays a surprisingly small Foville's ratio. Indeed this year was one of very large exports of gold and of reduction of the bank's reserves. This implied that most of the newly minted gold was lost and justifies the introduction of a dummy variable for that year (See Plessis [1985], p. 161).

[54] This figure includes the reserves of the Bank of France.

the history of French metallic currency. For instance, we can evaluate the stock of silver in 1840, when the refining of silver was almost over: to do so, one only needs to subtract from the sum of coinage achieved before 1840, the large losses due to the melting of *écus aurifères* (and the relatively small value of the «normal losses»). Similarly, an estimate of the silver stock in 1867 may be derived from the knowledge of the influence of bimetallic arbitrages in the 1850s and 1860s. The same method may be applied to gold in order to provide an estimate of the gold currency in 1820 and in 1848, respectively the beginning and the end of the gold appreciation period.

Finally, the path of the metallic currency between two «turning points» can be constructed by noting that at a given date, the overall stock of specie is equal to its previous year value, plus new coinage, and minus exceptional (and normal) losses. Thus what we need is a rule to break down the global effect of the exceptional losses into a series of yearly effects. Given the available information, this does not seem to be possible before 1840: it would require having data about silver refining, an activity for which no records are available so far. After 1840 however, bimetallic arbitrages became the main cause of exceptional losses and we can follow their effects by using the series for net exports of each metal as an index. As we have seen, the main problem with these series is that in order to be able to use them, they need to be cleared from the bias generated by wrong customs declarations. But in the framework of the model used, this difficulty can be easily overcome. Since the regressions tell us the overall exports during a complete arbitrage period, we are able to estimate the ratio of the total export to the declared exports: the «understatement coefficient» thus obtained may then be used to correct the series [55]. Finally, for the (few) periods

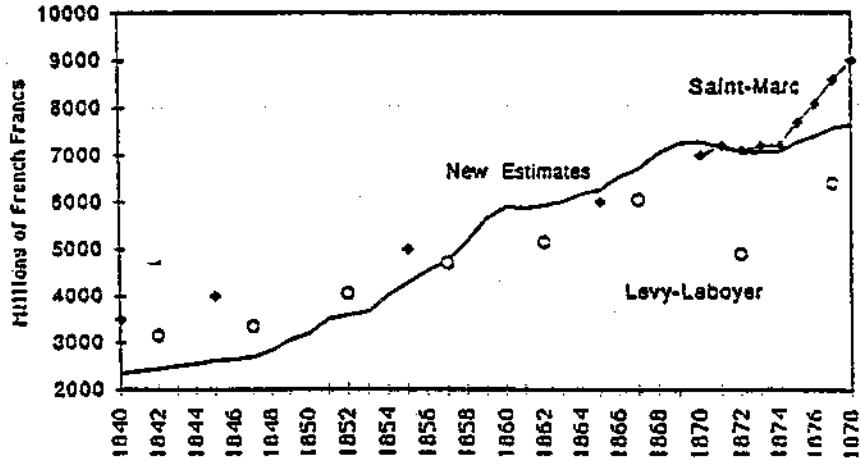
[55] We assume that, for a given type of arbitrage, the «understatement coefficient» is constant. This is compatible with very different understatement coefficients at different periods. For instance, it was noted by Say [1874] that the exports of bullion according to the official returns, and the exports of bullion according to an evaluation based on the returns of some banks, were very different in the early 1870s. But there were some reasons for that: at the outbreak of the war, several important bullion dealers (among them the Rothschilds) experienced problems with the Police Impériale, (Ramon [1929], p. 317), even for shipments that they were making on behalf of the Bank of France;

during which no exceptional losses took place, the construction of a yearly series is completed by adding up annual coinages discounted by normal losses. As a result, we eventually obtain the time profile of gold and silver monies between 1840 and 1878.

SECTION III:
The Evolution of Specie in France: 1840-1878.

As mentioned earlier, traditional (quinquennial) figures about the evolution of France's metallic currency are characterised by a steady increase between 1840 and 1870, and in fact, apart for the losses of the early 1870s (due to the war and the payment of the indemnity), a general trend between 1840 and 1878. By contrast, our (annual) estimates suggest a rather different path, in which four main phases — each roughly corresponding with a decade — may be distinguished.

Figure 7
New Estimates and Old Ones: Lévy-Leboyer, Saint-Marc, and New Results.



hence, they had some reason to increase their understatement coefficient. Finally, it should be noted that apart from the 1870-1871 period, the understatement coefficients that we obtained were relatively small, suggesting that the importance of official returns inaccuracies has been somehow exaggerated.

1 — A surprisingly late accumulation of bullion.

First of all, around 1840, the stock of specie was much smaller than what is traditionally believed. In 1840, France held approximately 2.3 billion, instead of the conventional figure of *at least* 3 billion. This discrepancy is largely due to the incorrect inclusion, in the usual figures, of the silver coins struck before 1829, and melted down during the 1830s. During the 1840s the stock of metallic currency grew at a steady rate of about 2.6% per year (which corresponds to the rate usually reported in the literature). In 1848, the quantity of specie in France was still below 3 billion and consistently well below traditional figures.

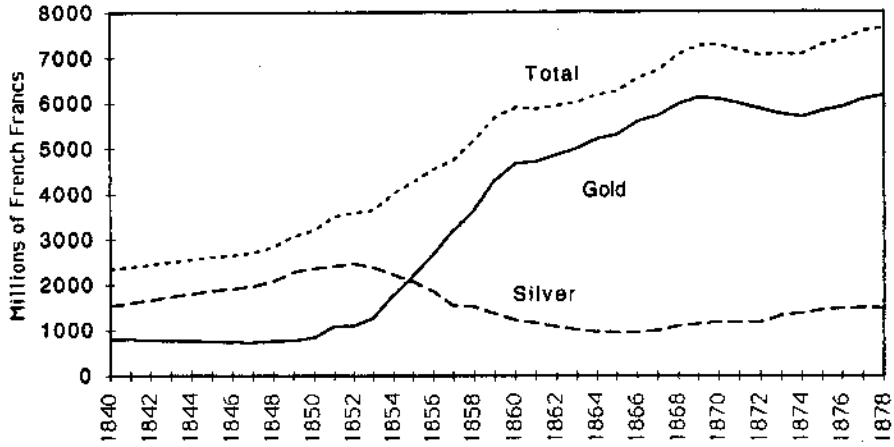
The first discoveries of California gold marked the beginning of a new period: specie accumulated in France at an unprecedented rhythm. Between 1848 and 1859 the metallic stock grew at an average rate of about 9% per year. Throughout the period, our series over-hauls conventional figures, and by the end of the decade, France's specie was approaching 6 billion. After 1860, differences between our estimates and conventional figures become smaller. The accumulation of metallic currency slowed down, which interestingly coincides with the general slowing down of the French economy initiated in the 1860s. Nonetheless, specie in France kept rising (from about 5.9 billion in 1860 to 7.3 billion in 1869), and even slightly accelerated at the end of the period. The war and the payment of the indemnity resulted in the first net decrease in France's stock of metallic currency. Quickly enough, however, specie in France was back on its upward path, being in 1878 approximately equal to 7.7 billion.

2 — Gold and Silver holdings: a scissor pattern

In addition to describing the quantitative evolution of specie in France during the period 1840-1878, our estimates shed new light on the changes in the structure of France's stock of metallic currency. In

particular, it may be useful to contrast the observed dynamics of the holdings of gold and silver currency, with traditional views about the behaviour of bimetallic regimes. The conventional wisdom typically argues that shocks in the bullion market have momentous consequences, leading to regime switches from one specie standard to the other (see e.g. Eichengreen [1985], p. 4).

Figure 8
Gold and Silver Holdings in France



By contrast to this view, the evolution of the quantity of gold and silver monies, as measured by our estimates, suggests that the adjustment of the structure of France's circulation to shocks originating on the bullion market was gradual. Their time profile, exhibited on Figure 8, displays a scissor pattern which illustrates the mechanics of bimetallic regimes. In periods of gold appreciation (e.g. before 1848) gold tended to be exported and silver imported, leading to an increase in the share of the «depreciated» metal in domestic circulation. Symmetrically, silver appreciation (during the period 1850-1866) resulted in the opposite outcome, where both the quantity and the proportion of silver decreased in the specie stock. But the whole process was progressive. Bimetallic arbitrages did not result in driving neither silver nor gold completely out of circulation. For instance, in the mid-1860s there remained about one billion in silver

in France. As the annual gross production of gold was about two times smaller (this amount being even smaller if we substract the annual world demand for monetary and non-monetary gold), bimetallic arbitrages could still operate for a long period of time. Hence the new estimates offer conclusive evidence that bimetallism operated smoothly in France[56].

Finally, it is important to note that most of gold absorption in France during the 1850s and 1860s cannot be solely attributed to the operation of bimetallism. While about 1.5 billion in silver was lost, 5 billion in gold was gained, implying a net increase in specie of about 3.5 billions. In other words, a large part of the stabilising influence that France had at the time on the gold market did not derive from «bimetallic arbitrage», but rather from France's absorption of specie. This in turn directs attention to the importance of metallic currency in France during the period under study.

3 — Specie and economic development

Cameron's [1967] traditional model of the role of banking in economic development pays particular attention to the evolution of the quantity of specie. In fact, the relative size of the metallic stock constitutes his main criterion for assessing the level of financial development[57]. In his picture the 1830s and 1840s were in France years of financial retardation and specie over-accumulation: «In the 1830s and the 1840s, when French industry was straining for its «take off», the country supported the charge of sterile metals almost five times as large as that of contemporary Britain[58]». By contrast, the

[56] Note that our estimates offer support to Greenfield and Rockoff [1992] characterisation of Gresham's Law as a gradual mechanism, where bad money only partly drives out good money.

[57] See Pollard and Ziegler for a recent assessment of Cameron's views.

[58] Concluding his classic chapter on France, Cameron ([1967] p. 128) wrote: «Had France managed with the same proportion of gold and silver in its money supply as England and invested the surplus (by means of imports) in real resources yielding a return of only 5 per cent per annum, the annual addition to real income would have

development of «specie-saving» financial institutions after 1848 — the typical case being the *Crédit Mobilier* — was identified by Cameron ([1961] and [1967]) as a major innovation. The *Crédit Mobilier* symbolized the end of a specie-intensive monetary regime, and opened an era of banking development during which the importance of specie was reduced. According to Cameron, the new banks greatly stimulated the economy through new techniques of finance that economised on the use of bullion. As he puts it, «the correlation between the rate of growth and changes in the financial structure before and after 1848 is striking [59]».

However, the behaviour of the metallic stock throughout 1840-1878, as it emerges from our new estimates, challenges this story. The comparison between the quantity of specie per head in France and in the United Kingdom in 1844, shakes the traditional *cliché*. At that date France's metallic stock consisted of 65 frs. per head, while England (where other means of payments were readily available) had *almost the same amount*.

Table 3
Specie per head: France and England
(French Francs) [60]

	1844	1855	1865	1878
ENGLAND	55	67	84	110[est]
FRANCE	65	108	132	171

As illustrated in Table 3, it was much later — and considering the timing of the development of France's banking system, surprisingly

been on the order of 1 or 1 ½ per cent — an increase in the annual growth rate of between 50 and 100 per cent! That is a measure of the costs to France of its financial system» (Cameron, [1967], p. 128).

[59] Cameron [1967] p. 127.

[60] Sources of the computations: England: Rondo Cameron [1967], p. 42. France: see text. The figures for population are from Mitchell and Deane, *European Historical Statistics* [1982]. The figures for specie do not include Central Banks' reserves i.e. they represent «circulation» rather than stock.

later — that the divergence between the French and the English ratio took place: *it happened in the 1850s.* In 1855, France's metallic stock consisted of about 108 francs per inhabitant, while in England, the ratio was only 67. This finding is rather puzzling, because it implies that the divergence between England and France took place just when the banking sector was expanding. Indeed Table 4 shows that until 1860 the evolution of the amount of specie per head paralleled the growth of the banking sector aggregate assets per head, doubling during the 1850s [61].

Table 4
Banking development and specie per head
(Index: 1840 = 100)

	1840	1850	1860	1870
Banking Sector Assets/Head	100	125	220	360
Specie/Head	100	125	240	275

Though quite paradoxical in Cameron's framework, this phenomenon may be clarified. Recent studies (Bordo and Jonung [1986]) have shown that an important feature of the evolution of payment systems in industrialised countries during the nineteenth century was the process of monetisation, reflected in an increased propensity to hold money. This resulted from «a decline in barter and payment in kind occuring simultaneously with an expansion of markets and decline of production for own consumption [62]». Thus if monetisation takes place on a larger scale than banking development, imports of

[61] Moreover, new figures on France's economic growth suggest that in the 1850s the growth rate was probably smaller than in the 1840s and 1860s. Is that to say that it was precisely during the 1850s that the charge of «sterile metals» (to use Cameron's words) became a painful burden? It does not seem very relevant, however, to reopen the debate about the correlation between specie over-accumulation and growth.
[62] Jonung [1978], p. 221.

specie will be necessary to meet the demand for money that slowly growing commercial banks cannot satisfy .

Indeed, until the late 1850s, banking development in France though quantitatively important, remained geographically concentrated in a limited number of industrial centres. The countryside was largely left out of the process (Cameron [1967], Lévy-Leboyer [1977]). In the same time, the agricultural sector experienced — especially during the 1850s — a considerable development. In particular, the 1850s were years of high growth in agricultural output, and relative increase in agricultural prices. Markets became more integrated, and regions more specialised (Lévy-Leboyer [1985]). The natural effect of this combination of factors, from the point of view of the monetisation process, was to increase the demand for money in the countryside. This, however, could not be met by bank-produced means of payments, which were not yet available. By contrast, metallic currency could be used. As Lévy-Leboyer noted, during the 1850s, specie «accumulated in the countryside, as a result of increased wages [...] and of the improvement in the terms of trade with towns [63]». But, as the agricultural sector was largely excluded from the financial networks of the economy, the specie absorbed could hardly be recycled. In this mechanism we can probably find one of the origins of the critiques against the peasants' propensity to hoard or thesaurize: but what else could they do?

Conclusions

Although it is traditionally argued that the stock of specie in France during the nineteenth century was considerable, this paper is the first attempt to construct annual figures for the period 1840-1878. Pooling methodological insights from earlier research, and developing a new technique, we have produced estimates which may help to clarify previous debates, close some discussions, and hopefully open new ones.

[63] Lévy-Leboyer [1977], p. 414.

First, while endless controversies have questioned the feasibility of bimetallism, this paper offers empirical evidence that effective bimetallism did exist in France between 1840 and 1873, when the system was altered. This performance seems quite good compared to the durability of other monetary constitutions. Thus, future research will have to explain the successful record of bimetallism in France, rather than — as the conventional wisdom still does — assume its failure.

Second, our new estimates reject the deeply rooted prejudice that the preference of France for specie stemmed from some cultural factor. In the early 1840s, the average Frenchman did not hold more coins than his British counterpart. Our analysis suggests that in fact, the «over-accumulation» of bullion — a phenomenon that took place relatively late in the century — resulted from the monetisation of the countryside where banks failed — especially during the 1850s — to provide alternative means of payments. This suggests that the massive net imports of specie of the 1850s — which the operation of bimetallism cannot account for — should be seen as an equilibrium phenomenon: bullion was imported in France to meet the rising demand for money.

	Gold	Silver	Total
1840	803	1537	2340
1841	801	1606	2407
1842	789	1666	2455
1843	776	1733	2509
1844	765	1795	2560
1845	751	1873	2624
1846	739	1910	2649
1847	731	1976	2707
1848	758	2089	2847
1849	771	2288	3059
1850	842	2362	3204
1851	1097	2413	3510
1852	1106	2477	3583
1853	1276	2386	3662
1854	1780	2235	4015
1855	2200	2079	4279
1856	2675	1867	4542
1857	3209	1543	4752
1858	3652	1523	5175
1859	4305	1366	5671
1860	4675	1221	5896
1861	4709	1160	5869
1862	4859	1077	5936
1863	5002	1010	6012
1864	5206	967	6173
1865	5296	961	6257
1866	5587	954	6541
1867	5707	1002	6709
1868	5966	1089	7055
1869	6116	1141	7257
1870	6084	1188	7272
1871	5976	1186	7162
1872	5870	1179	7049
1873	5747	1327	7074
1874	5683	1380	7063
1875	5829	1447	7276
1876	5914	1493	7407
1877	6076	1502	7578
1878	6165	1496	7661
Millions of French Francs			

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