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## *The Financial Market and Government Debt Policy in France, 1746–1793*

FRANÇOIS R. VELDE AND DAVID R. WEIR

This article offers a new quantitative history of the market for government debt in France before the Revolution. The monarchy was a persistent default risk because of institutional obstacles to raising taxes. Default followed observable rules in targeting specific assets. The financial market reflected both facts: interest rates were high on the safest assets and ranged higher on the most likely default targets. The cost of all forms of new borrowing became substantially higher than the yields on old debt, resulting in increasing government reliance on expensive life annuities.

**T**he vast historical literature debating the financial policies of the last years of the Old Regime and the early years of the Revolution is rich with institutional detail, biographical insights, and political judgments.<sup>1</sup> Until recently, however, it has paid little attention to the interactions between those policies and the financial market that constrained them. A shortage of quantitative data has long held back the economic history of public finance under the Old Regime. On the fiscal side, a new economic history is now being written, built on painstaking efforts to produce quantitative estimates of government accounts.<sup>2</sup> A more com-

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<sup>1</sup> The quintessential example is Marion, *Histoire financière*, whose enormously detailed and highly opinionated style built on the approach of Clamageran, *Histoire de l'impôt*, and Vührer, *Dette publique*. More recently Lüthy, *Banque protestante*, integrated policy history with banking history and Boshier, *French Finances*, offered an important new interpretation of the post-1775 period that integrated institutional and biographical perspectives.

<sup>2</sup> Despite their widespread destruction, archival sources have not yet been exhausted. Guéry, "Les finances de la monarchie," reconstructed accounts for the reign of Louis XIV. Riley, "French Finances, 1727–1768," found new accounts covering most of the reign of Louis XV and provided a review of the literature and a discussion of the limitations and potential of the source

plete quantitative history of the financial market is also needed to help resolve a number of persistent controversies.<sup>3</sup>

Controversies persist because the stakes are high. The incomparable drama of events between July 1789 and June 1815 has imposed on the historiography of the late Old Regime an insatiable search for origins—for causes with the moral, political, and economic magnitude to balance the consequences. The result has been a distortion of the history of population, agricultural productivity, living standards, and most especially public finance.<sup>4</sup> Whereas the revolutionary implications of population growth or real wages are indirect at best, the political impasse over the budget deficit led directly to the collapse of the Assembly of Notables in 1787 and to the convocation of the Estates General in 1789.<sup>5</sup> All historical discussion of policy and policymakers has carried this awesome weight: who was responsible for the deficit that opened the door to the French Revolution?

Most of the debate centers around the two strongest finance ministers of the reign of Louis XVI. Necker first broke the veil of secrecy by publishing his *Compte-rendu* in 1781, claiming that his reforms of the bureaucracy had restored balance in the “ordinary” budget.<sup>6</sup> In 1786/87 Calonne convened an Assembly of Notables to seek endorsement for his tax reform (increase) and revealed to them the deficit, claiming he had inherited it from his predecessors, Necker included.<sup>7</sup> The debate was joined, with Calonne the loser.<sup>8</sup> Necker was reappointed in 1788 and rode the wave of public opinion to a peak in 1789 before his humbling departure from France in 1790. Marcel Marion captured nineteenth-century France’s utter disdain for this self-important Genevan Protestant, viewing his “balanced budget” as a fabrication, his ruinous mode of borrowing as a key cause of the later crisis, and the false hopes raised by his public arguments as an obstacle to a true

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materials. Valuable information can also be extracted from published sources, as evidenced by Mathias and O’Brien, “Taxation in Britain and France”; Weir, “Tontines”; and White, “Was There a Solution?,” which compiles the published budget data for the years 1773–1789.

<sup>3</sup> Riley, *International Government Finance*, and Neal, *Rise of Financial Capitalism*, are valuable surveys of eighteenth-century financial markets, with quantitative information for London and Amsterdam (but not Paris) in our period. Earlier efforts at estimating French interest rates for a small number of assets (Weir and Velde, “The Financial Market”) and for the subperiod after 1770 (White, “Was There a Solution?”) have established some important general trends but cannot be properly interpreted outside the context of the full spectrum of assets and rates of return viewed over more than one cycle of war and peace.

<sup>4</sup> For a new perspective on population, agriculture, and living standards, see Weir, “Crises.”

<sup>5</sup> The story is told well by Egret, *La Pré-Révolution française*. Aftalion, in *L’économie de la Révolution française*, traces the political consequences of the deficit through to 1794.

<sup>6</sup> Necker, *Compte-rendu*. The precise meaning of Necker’s “ordinary” budget is arguable. It was a projection of a peacetime budget to follow the American War and ostensibly included all charges incurred by the war as of early 1781, but certainly not the war bills that arrived later.

<sup>7</sup> Calonne, *Discours... dans l’Assemblée des notables*.

<sup>8</sup> Necker, *Mémoire publiée au mois d’avril 1787*; Calonne, *Réponse à M. Necker*.

solution.<sup>9</sup> Necker has found new support among Anglophone historians who find his budget estimates convincing and find in Calonne's expansion of venal offices an explanation of the growth of the deficit.<sup>10</sup>

In our view, the question itself is wrong. The financial crisis that brought down the Old Regime repeated a pattern observable in previous episodes. It stands out because of what followed it, not what brought it on. The repeated crises of the Old Regime owed more to institutional, even constitutional, flaws than to errors by individuals. There are two ways to prove such a claim: justify individual policy choices or show the persistent influences of the institutions. Our quantitative study of the financial market makes a start on both. Borrowing at excessive rates of interest has been a frequent example of policy error. It is a quantitative question whether the prices set by the government conformed to market constraints and whether its choice of assets minimized its costs. Institutional flaws should also give rise to predictable quantitative patterns in the market for government debt.

The most important controversy over debt policy concerns the life annuities (*rentes viagères*). They were the major source of new loans after 1750 and the largest component of the debt by 1789.<sup>11</sup> Historians are unanimous in condemning these loans as too expensive, especially the life annuities sold after 1770 at a flat rate for lives of all ages.<sup>12</sup> The case was made with admirable clarity in 1794 by Joseph Cambon, the man charged with restructuring the national debt, in his report to the *Convention Nationale*. After a lengthy and sophisticated description of the financial and actuarial techniques used by investors to extract the highest possible yields, he concluded “*c'est ainsi qu'on se jouait de l'imbécillité de notre ancien gouvernement.*”<sup>13</sup> Cambon's conclusion that the market had outsmarted the government persists, even if some of his actuarial expertise has not.<sup>14</sup>

That conclusion was drawn and endorsed without reference to market data. To prove that life annuities were a bad asset choice for the government, one would need to show an alternative source of new borrowing with a lower market rate of return. Cambon and many of the historians who have followed him compared the life annuities with the legal maximum interest rate of 5 percent. To prove that the official

<sup>9</sup> Marion, *Histoire financière*, pp. 291–337; and Lüthy, *Banque protestante*, vol. 2, pp. 519–20.

<sup>10</sup> White's “Was There a Solution?” provides a lucid synthesis of the staunchly Neckerite views of Harris (*Necker: Reform Statesman; Necker and the Revolution*), and Bosher's (*French Finances*) emphasis on venal office as the source of Calonne's budget troubles. Similar arguments are made by Brewer in *Sinews of Power*.

<sup>11</sup> See Weir, “Tontines,” for a discussion of the composition of the debt, and Table 2 of this article for a list of the major loans.

<sup>12</sup> We discuss the history of life annuity pricing in detail under “Life Annuities.”

<sup>13</sup> *Archives Parlementaires*, vol. 87, p. 79.

<sup>14</sup> Marcel Marion, for example, savages Necker for his expensive life annuity loans, but relies on calculations by eighteenth-century polemicists that assumed a constant annual extinction rate in calculating the total (undiscounted) value of the loans (Marion, *Histoire financière*, pp. 295–96).

government prices for life annuities offered excessive yields, one might hope to show that the market was willing to pay a premium for them. Until now, no one has looked closely at the secondary market for government life annuities.

We began our study of the Paris financial market with the modest goal of addressing these two challenges. We compiled weekly series of prices for a wide array of government bonds from French newspapers between 1746 and 1793. For several of the important life annuity loans, we observed market prices for short periods immediately after issue.

Asset prices have little meaning until they are paired with their expected future dividends, as in the calculation of an internal rate of return. Reconstructing past promises of dividends proved more difficult than collecting the prices. In Old Regime France, each new loan was unique and all were complex. The government sometimes changed its obligations later, so we could not necessarily apply the terms of an original plan to market prices of the asset at all future dates. We therefore complemented our study of market prices with a search of the archival materials recording loan edicts and subsequent changes.<sup>15</sup>

Naively, we hoped to find a single asset analogous to the British consol: a perpetual bond whose yield on the market represented both the valuation of past debt and the cost faced by the government for new borrowing. No single asset served both roles in France before 1815, however, and the yield on old debt was not the same as the cost of new borrowing. In this article we therefore examine about a dozen different assets demonstrating a wide and changeable range of market yields. Although the market clearly responded to changes in the general fiscal condition of the monarchy, the yields on different assets responded very differently. When seen in its entirety, this pricing of government bonds by the market reveals a logical structure based on realistic expectations of the differential default risks of the different assets. The flat-rate life annuities fit into this structure in a way that can be explained without recourse to assumptions of noncompetitive behavior, conspiracy, or irrationality on the part of the government or any other party.

In seeking to understand the data, we were inevitably drawn back into the political history of public finance in the eighteenth century. We had to take account of the government's past behavior to understand the market's expectations. Conversely, our observations of the market yielded fruitful insights into the constraints placed on policies by the market and shed new light on the events leading up to the fiscal crisis of 1788.

The first section of this article summarizes key elements of political history to describe the institutional flaw in the Old Regime, establish its relationship to default, and follow the evolution of default policy. The

<sup>15</sup> *Archives Nationales*, Série AD IX, contains these documents.

second section describes the data sources used to obtain market prices for French government debt and the methods used to estimate rates of return. It describes our choice of assets to represent the long-term bond rate in France as a measure of the valuation of old debt. The third section compares that rate with English bonds from 1746 to 1870 and finds a persistent premium on French debt, which we show cannot easily be attributed to any source other than default risk. In the fourth section, we review the many forms of borrowing used in France and compare the yields on new loans at the government's prices with the yields on outstanding debt. We then trace the market yields on a large number of representative issues before turning to a closer analysis of the life annuities in light of the other findings. The article concludes with some implications for understanding the origins of the French Revolution.

#### AN HISTORICAL PERSPECTIVE ON PUBLIC FINANCE AND DEBT POLICY

##### *France Versus England*

A comparison with England serves to highlight the peculiarities of Old Regime France.<sup>16</sup> The central problem of early modern public finance for both countries was how to pay for their increasingly expensive periodic wars, mainly with one another. Wars were financed by various mixtures of borrowing and taxation. Fiscal crises arose during or after wars, when tax revenues were insufficient to cover the costs of servicing the rising debt. Prior to 1688, both monarchies resorted to default in times of fiscal crisis. Default was never total; nor was it randomly assigned. Specific targets were selected, and some justification was offered for the Crown's action: typically, excessive gouging by the lender. Some creditors were subject to criminal trials in which their lives as well as their fortunes were at risk.

Following the Glorious Revolution of 1688, Britain developed a better system.<sup>17</sup> War expenses were paid for in short-term paper debt, which was then exchanged for perpetual debt, mainly after peace was restored. New perpetual debt was "funded"—assigned specifically to a tax revenue. New taxes were levied as needed to cover the interest charges of new debt. There were no defaults. The constitutional reforms that followed 1688 engendered those practices, not by direct mandate but rather by restructuring the rules of the game between Crown and Parliament to reduce the incentives for strategies leading to default.<sup>18</sup>

<sup>16</sup> Space does not permit a more complete historical narrative, and we do not cite sources for well-known facts. See the sources in notes 1 and 2 for narratives from different perspectives. Velde and Sargent, "Macro-economic Causes and Consequences," offers an explicit link to macroeconomic theory.

<sup>17</sup> The reform of British public finance is described by Dickson in *The Financial Revolution*.

<sup>18</sup> See North and Weingast, "Constitutions and Commitment."



Reform was successful because it simultaneously accomplished two things: it substituted a new (Protestant) king and a more powerful Parliament who were committed to avoiding default, and it empowered them with the fiscal authority to make that commitment credible. The new credibility allowed England to move toward nearly exclusive reliance on perpetual debt. The English reforms were also followed by increasing tax rates and international belligerence that continued for a century.<sup>19</sup>

Old Regime France evolved too, but more slowly. Government debt became more widely and anonymously held, reducing reliance on the venal officeholders as lenders and eliminating personal culpability as a rationale for default.<sup>20</sup> The last *chambre de justice* was held in 1716, shortly after the death of Louis XIV. The chaos created by John Law's overly ambitious schemes in the financial market did not long deter this historical trend. But the restoration of fiscal and monetary order in 1726 that accompanied the end of the Regency and more direct involvement by the young Louis XV did not have the same lasting consequences for France as did the Glorious Revolution for England. Default was used twice again: in 1759 and 1770. These episodes drew public attention to the persistent structural flaw leading to default and revealed to investors the assets most likely to be default targets under the new rationales used for default on publicly held debt.

The crucial enduring flaw of the Old Regime was the political stalemate over taxation, the result of a separation of spending and tax authority. Spending was decided entirely within the royal administration: by the king himself and by officeholders whose purchase of the right to manage part of the administration carried with it an exemption from paying most direct taxes. Although this system has been widely criticized, we do not consider excessive spending to have been the crucial flaw, for the following reasons. Military expenditures and debt service on past military costs were by far the largest share and most important destabilizers of spending, and they were largely determined by external threats and opportunities. By 1789, France's primary international antagonist—England—whose spending and tax authority were integrated, had a balanced budget with substantially higher levels of spending, taxing, and debt relative to GNP than did France.<sup>21</sup> We therefore consider inadequate tax revenues to be the more likely source of French fiscal imbalance.

Privilege, in the limited sense of tax exemptions for the nobility, was not the only nor the most important obstacle to increasing revenues.<sup>22</sup>

<sup>19</sup> O'Brien, "Political Economy," pp. 1–4; and Brewer, *Sinews of Power*, chap. 4.

<sup>20</sup> However, Bien, "Offices," describes how the monarchy and venal office continued their mutual dependence in the eighteenth century despite the growth in direct public loans.

<sup>21</sup> See Mathias and O'Brien, "Taxation in Britain and France"; and Weir, "Tontines," table 1.

<sup>22</sup> See Bossenga, "Taxes," for an introduction to the complexity of French taxation.

Taxation even of the nonexempt was subject to constitutional limitations. Any new taxes or public loans required that a royal edict be registered by the regional *parlements*.<sup>23</sup> The principle of absolutism applied insofar as the king could forcibly register his edicts through a *lit de justice*, but such moves often proved self-defeating, as his ability to enforce them was weakened by the opposition of the *parlements*. Their refusal to accept permanent tax increases would occasionally be accompanied by the claim that they did not have the power to approve them; that such consent could only come from duly constituted bodies (particularly the Estates General, which had not met since the early seventeenth century). The “price” of permanent tax increases was therefore wider political participation, as in England, or much greater repression (a strategy hesitantly attempted in 1770 to 1774 by the temporary suppression of the *parlements*). The benevolent absolutist monarchs of eighteenth-century France would commit to neither strategy. Within the constitutional structure of the Old Regime, the best the government could do was to add temporary taxes during wartime.

This impasse over permanent taxes is the best explanation of why France did not follow England’s reliance on funded perpetual debt. Instead, France had a wide variety of loan plans, into which amortization (repayment) schedules were built in one of three main ways. Life annuity debt expired with the life on which the contract was made. Simple term loans, in which the investor received a fixed payment for a finite period of years to cover both interest and amortization, were relatively rare. Sinking fund plans were more common. The government paid out a fixed sum each year for interest and amortization, just as for a term loan, but instead of implicitly amortizing a part of each bond each year there was a random draw of some of the bonds to be reimbursed in full each year.

These diverse loans had diverse connections to tax revenues. Whereas England had a simple form of funded debt, France had a complex and differentiated structure of liens, a hierarchy of obligations. Roughly half of French tax collection was farmed out to quasi-private agencies, the most important of which was the General Farm. Some government obligations were paid directly out of tax revenues before the net tax proceeds were sent to the royal treasury. For example, the most secure of all French debt was the perpetual *rentes sur l’Hôtel de Ville de Paris*, largely because the General Farm sent the money for interest payments directly to the *payeurs des rentes* of the city of Paris. The royal government never touched the money. This offered considerable protection against behind-the-scenes royal encroachment in

<sup>23</sup> Unlike the English Parliament, the French *parlements* were judicial rather than legislative. They could attempt to constrain executive action but had no power to make independent initiatives. See Shennan, *The Parlement of Paris*; Egret, *Louis XV et l’opposition parlementaire*; and Doyle, “The Parlements of France.”



comparison with assets paid out of royal treasury funds. Some of the medium-term sinking fund loans issued before the Seven Years' War were matched to temporary taxes of the same duration (see "Asset Pricing"), but this practice was abandoned.

### *Default Policy and Reform*

The institutions of Old Regime France established a pattern that repeated itself with each war of the eighteenth century: borrow to fight the war, struggle in vain to raise taxes sufficiently to pay the debt, borrow even more to service the debt, and, unless the cycle was postponed by another war, ultimately default on part of the debt to restore balance. Thus, after the War of the Austrian Succession (1740–1748), Machault attempted to establish a permanent tax to fund a plan to reduce the debt, only to have the tax plan slashed by special interests and to be forced to borrow in peacetime to make payments on the debt.<sup>24</sup> The modest scale of the problem allowed the situation to persist until the next war.

As Riley has emphasized, the Seven Years' War (1756–1763) was an enormous shock to French public finance.<sup>25</sup> England had escalated the cost of war beyond the (politically determined) capacity of French fiscal resources. Silhouette's mild wartime default of 1759 was an obvious consequence. But the cost of the war ultimately doomed the efforts of the 1760s to restore the prewar equilibrium in public finance by debt retirements. The result was an even more severe peacetime fiscal crisis, leading to Terray's default in 1770.

We can distinguish three categories of default on publicly held debt. The mildest and most frequent was a suspension of reimbursement payments during a temporary crisis. In both crises of Louis XV's reign (and again in the fiscal crisis of the 1780s) a key feature was a high level of debt service relative to tax revenues *and* to the value of debt—a direct consequence of the modes of borrowing. As taxes lagged behind spending, there was an accumulation of the short-term paper issued by the venal officeholders as payment for goods and services supplied to the government. Term loans and sinking funds had scheduled amortization. In each case, the government was also embarked on a policy of voluntarily reimbursing perpetual debt. Suspensions therefore targeted the immediate cause of the crisis: short-term paper was forcibly converted to longer-term debt, and reimbursements were suspended. In 1759 the suspension was announced for the duration of the war and payments indeed resumed with peace in 1763. In 1770 the suspension was announced for eight years but became permanent. In 1788 the suspension was announced for one year and lasted for two.

<sup>24</sup> Vührer, *Dette publique*, pp. 202–7.

<sup>25</sup> Riley, *The Seven Years War*.

The second type of default was often called “reform.” The legal maximum interest rate was 5 percent. It was also considered the “ordinary” rate for government borrowing. When the government borrowed at higher rates, the newly created assets earning “excess” interest were vulnerable to a subsequent “reform” that would restore them to the ordinary rate. For example, in 1763 the government reduced the reimbursable capital value of some loans sold during the war at a discount. Reform was easier to justify if the excess interest could be blamed on the mistakes of previous administrations. In 1770, Terray forcibly converted tontines to life annuities, thereby lowering the future payments due. He claimed that tontines earned excessively high rates of return due to mistakes on the part of previous administrations who had designed them.<sup>26</sup> The most complete articulation of this type of default was Cambon’s consolidation of the national debt in 1793 and 1794.<sup>27</sup> Blaming the incompetence of the Old Regime, he reduced life annuity payments by complicated actuarial formulas intended to purge them of interest over 5 percent. All other debt was consolidated into a single asset, a nominal 5 percent bond. The conversion procedures make it clear that he sought wherever possible to provide a 5 percent return on the amount of capital actually provided.

The third category of default was repudiation, by which we mean reduction of the yield on the original capital contribution to a rate below 5 percent. Some of Terray’s actions went this far, making the default of 1770 a much more serious attack on the rights of government creditors than was the suspension of 1759. It coincided with the suspension of the *parlements*. Some assets were “reformed”; others were cut to 4 percent nominal yields or less. Terray also converted the *dixième d’amortissement* from a tax on dividends earmarked to pay for debt retirement into a permanent 10 percent tax on all interest payments. As severe and objectionable as Terray’s default was, it was far surpassed in 1797 by Ramel’s declaration of default on two-thirds of the value of government debt.<sup>28</sup>

Louis XVI came to the throne in 1774 determined to avoid many of his grandfather’s mistakes and eager to gain credibility with an enlightened public.<sup>29</sup> He dismissed Terray and reinstated the *parlements*. As the new government was concerned about the high interest rates, the king sought to wring out the default expectations by announcing his intentions not to default.<sup>30</sup> The only question was how much political change he would accept to defend that promise.

<sup>26</sup> Vührer, *Dette publique*, pp. 244–45.

<sup>27</sup> His report on debt other than life annuities can be found in *Archives Parlementaires*, vol. 72 (Aug. 1793); his report on life annuities is in *Archives Parlementaires*, vol. 87 (Mar. 1794).

<sup>28</sup> See Marion, *Histoire financière*, vol. 4, pp. 55–70.

<sup>29</sup> Véri, *Journal*.

<sup>30</sup> The first edict of the new reign, in May 1774, was a promise not to default, probably drafted for the new king by the departing Terray (Marion, *Histoire financière*, vol. 1, p. 280).

Turgot and Necker built their policies upon the conviction that spending restraint and bureaucratic reforms would suffice to maintain the budget that Terray's defaults had balanced, thereby avoiding a constitutional confrontation over new taxes. The expenses of the American War eventually undermined that strategy, but neither Necker nor his successors repeated the defaults of the Seven Years' War. Instead they borrowed, honoring past debts but creating worse problems for the future. Calonne sought to raise revenues by expedients such as sales of offices and seigniorage on a long-overdue recoinage of gold to correct its price relative to silver. Finally, by calling up an Assembly of Notables, he tried to achieve a major tax increase and reform with a minimal extension of political involvement to the elite. When that failed, the royal commitment to avoid default approached the limits of acceptable political compromise to raise revenues.

Nevertheless, Louis XVI refused to return to the old ways of default. In July 1788 he called for a meeting of the Estates General, the only constitutional way to raise taxes. His one-year suspension of reimbursements in August and September was clearly based on the expectation that the Estates General would authorize new revenues to honor them.<sup>31</sup> In his hopes for a constitutional solution that would avoid default, the king tolerated the doubling of the Third Estate and ultimately agreed to work with the revolutionary National Assembly.

#### DATA SOURCES AND METHODS

##### *Market Prices*

We have assembled new weekly data on the market prices of a variety of governmental and quasi-governmental assets from January 1746 through June 1793.<sup>32</sup> The market is the Paris Bourse, which opened in 1724.<sup>33</sup> We rely on newspaper reports, which apparently did not begin systematic reporting of multiple assets before 1746.<sup>34</sup> The main limita-

<sup>31</sup> Unlike during previous suspensions, reimbursement drawings continued to be held. The *Journal de Paris* published lists of "winning" ticket numbers, and its stock market reports included prices for some of the drawn tickets, which earned 5 percent until the government could pay off the principal.

<sup>32</sup> An appendix describing the assets used here and the calculation of internal rates of return for each is available from the authors upon request.

<sup>33</sup> The Paris Bourse was established by a royal *arrêt* of September 24, 1724, ending the chaotic decentralized trading of government paper created by the liquidation of John Law's system. The number of brokerage positions, with monopoly rights over transactions in government assets and company shares, varied from 40 to 60 over the century.

<sup>34</sup> Antoine Boudet included stock market reports in his biweekly newspaper begun in 1745, *Les Affiches de Paris*. Extant copies date to 1746. The official national paper, the *Gazette de France*, arranged to have Boudet's license revoked in 1751 and in April began publication of their own *Annonces, Affiches, et Avis Divers*, which continued the detailed coverage lacking in the *Gazette* itself. We followed its reporting until its coverage was bettered by the newly created daily *Journal*

tion of newspapers is their coverage. Some important assets that we know to have been traded were not reported. Future research into other sources might remedy this, but we are unlikely ever to have systematic coverage of the futures contracts that formed the staple of the financial scandals of the late Old Regime.<sup>35</sup>

### *Internal Rate of Return Calculations*

Converting the price data into meaningful economic measures is neither obvious nor trivial. Prices must be matched to the dividend streams for each asset.<sup>36</sup> We calculated an internal rate of return (IRR), which is the (annual) discount rate that sets the present discounted value of a dividend stream equal to the price at a point in time. In most cases we estimated the IRR from monthly averages of prices, taking account of the precise scheduled dating of future payments.

We calculated an IRR based on the legal obligations in force at that date; when the government announced a change in its obligation, we changed the computation formula. Based on the information available to investors at any date (or, more precisely, the information available to us about that information set, which we hope is the same thing), we projected the stream of nominal payments for interest and reimbursements expected at each future time from ownership of the asset.

Objections to using the IRR measure might be raised. For instance, were eighteenth-century investors sophisticated enough to make the necessary calculations? Although the dividend projections are sometimes complicated, they often can be reduced at any given date to equivalent simple term loans for which the formulas were well known and price tables available.<sup>37</sup> Even for the most difficult loans, we have been repeatedly impressed by the evidence that contemporaries could at least approximate them closely.<sup>38</sup>

On the other hand, the IRR is a very crude measure for the analysis of default risk, especially when comparing loans with different structures of dividends. The IRR calculation does not distinguish between different types of dividends. For each asset  $i$  at each date of price

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*de Paris* after November 1779. The less inclusive biweekly *Gazette de France* was used occasionally as a supplement, as was *Le Moniteur Universel* for the revolutionary period.

<sup>35</sup> See Taylor, “The Paris Bourse,” and Lüthy, *Banque protestante*, vol. 2, pp. 686–733, for descriptions of stock market intrigues in the 1780s.

<sup>36</sup> Secondary sources such as Vührer, *Dette publique*, and Shakespeare, *France: The Royal Loans*, offer useful summaries of some of the necessary government documents.

<sup>37</sup> See, for example, the entry for *intérêt* in *Encyclopédie, ou Dictionnaire Raisonné*.

<sup>38</sup> Take as an example the December 1784 loan, which was, as White said, “difficult for any investor to calculate” (“Was There a Solution?,” p. 563). In 1790, Montesquiou claimed its yield at issue to be 6.81 percent—very close to our estimate of 6.76 percent (*Archives Parlementaires*, vol. 20, p. 110). In May 1787 Mirabeau claimed its yield on the market to be 8 percent (*Lettres*, p. 34). We get 8.02 percent.

observation, it is simply the (annualized) discount rate  $r_{i\tau}$  that satisfies the present value equation

$$P_{i\tau} = \sum_{t=\tau+1}^{T_i} \frac{D_{it}}{(1+r_{i\tau})^{t-\tau}} \quad (1)$$

where  $P_{i\tau}$  is the market price of one share of asset  $i$  at time  $\tau$ ,  $T_i$  the date of the last scheduled payment,  $D_{it}$  all the scheduled payments on one share of asset  $i$ , and  $r_{i\tau}$  equals the internal rate of return on asset  $i$  at time  $\tau$ . As described earlier, investors had different default expectations for different components of dividend payments, excess interest over 5 percent and reimbursements being more likely targets than interest payments at 5 percent or less. That suggests a different equation:

$$P_{i\tau} = \sum_{t=\tau+1}^{T_i} \frac{(1-\alpha_{it}^r) \times I_{it} + (1-\beta_{it}^r) \times E_{it} + (1-\gamma_{it}^r) \times R_{it}}{(1+r)^{t-\tau}} \quad (2)$$

where  $I_{it}$  is interest at 5 percent or less,  $E_{it}$  interest above 5 percent,  $R_{it}$  reimbursements, and  $\alpha_{it}^r$ ,  $\beta_{it}^r$ , and  $\gamma_{it}^r$  are default risks by type of payment at future time  $t$ , evaluated at time  $\tau$ . In this model the discount rate  $r$  is a constant, but default risks vary by time period, type of payment, and asset. Assets with more of their future income scheduled at riskier dates, or consisting of excess interest or reimbursements, would have higher estimated internal rates of return even if there were no discrimination against the asset itself. Thus, while the IRR is an improvement over raw prices for comparing differently structured assets, we cannot ignore dividend structures in interpreting the results.

### *The Long-Term Interest Rate*

As our analysis of the market will show, there were different interest rates on different assets. Nevertheless, for some purposes it will be useful to single out one asset that is as similar as possible to the British consol. The consol had four important properties: it was perpetual, so its yield was a long-term interest rate; it was the major component of British public debt, so its price was representative; it was negotiable, so its price is easily observed; and it was relatively risk free.

No single French asset matches this description. The largest component of debt in 1789 was life annuities, which did not trade on the Bourse once the lives were specified. The bulk of French perpetual debt was in *rentes sur l'Hôtel de Ville de Paris*, most of which were created in 1720. Newspapers reported prices for the *rentes* through 1768, but not after. Prices appear to have been "sticky," probably because the *rentes* were not easily negotiable. They were considered *biens immeubles*, like land, so they could be mortgaged. A waiting period of several months was required to clear any claims on the income before it could be trans-

ferred.<sup>39</sup> In December 1764 the government further hampered their negotiability by placing a tax of one year's interest on every transfer.

Only two assets have newspaper coverage for the entire period. Both originated with the *Compagnie des Indes*, which until 1770 was a trading company with monopoly rights over much of French colonial trade.<sup>40</sup> The *actions des Indes*, or shares in the company, traded most frequently. Prior to 1770 they were technically a stock, subject to dividend fluctuations based on earnings.<sup>41</sup> Dividends never exceeded the fixed minimum, but we cannot be sure that the prospect did not affect the price. There were also several calls on the stock and changes in dividends during the early period, but to infer an interest rate from the share price would require imposing strong assumptions about the market's expectations of those changes. After the company's liquidation, however, the payout structure stabilized. Interest payments per share remained constant, but by a royal *arrêt* of February 28, 1771, they were made subject to a 10 percent withholding tax used to fund reimbursements at face value: a sinking fund designed to liquidate all shares by 1822. The tax-for-reimbursement plan makes this an interesting asset to compare with simple perpetual bonds.<sup>42</sup>

The only asset available to represent the yield on long-term government bonds over the second half of the eighteenth century appears variously as *billet d'emprunt d'octobre*, *billet d'emprunt*, or *Emprunt d'octobre*. We will refer to it as the October Loan. It was created by the *Compagnie des Indes* in 1745.<sup>43</sup> The October Loan was unequivocally a

<sup>39</sup> The *rentes* were contracts between the Crown and a specific recipient, requiring a formal new contract at each transfer of title. See Pothier, *Traité de la constitution de rente*; de Massac, *Manuel des rentes*; *Encyclopédie Méthodique* (under *rentes*); and Martin, *Etrennes financières*, for details.

<sup>40</sup> In April 1770, eight months after the suspension of its trading monopoly, the company's shareholders arranged its liquidation. After some modifications, its debts were absorbed by the king. Weber, *La Compagnie*, covers the whole of its history but is not always accurate. We prefer his primary source (Morellet, *Mémoire*) for the period before the liquidation of 1770.

<sup>41</sup> We do not report here the details of "Shiller tests" of the volatility of Indies stock prices, which are analogous to those performed by Mirowski ("What Do Markets Do?") for the British East India Company in the eighteenth century. Like eighteenth-century Britain's and most other stock markets, the Bourse appeared to be more volatile in stock prices than would be consistent with observed changes in dividends, rational expectations, and the pricing of assets as the discounted sum of future earnings with a constant discount rate.

<sup>42</sup> White ("Was There a Solution?," p. 557) calculates yields on the Indies shares after 1770 without taking account of either the tax or the reimbursement. The same series appears in Bordo and White, "A Tale of Two Currencies," fig. 3, as "French 'Consols'." Because the reimbursement schedule was slow in the years before 1793, the correctly calculated yields differ from his by less than 50 basis points in most years. Indies share yields did, however, differ more substantially from the yields on true perpetuals, with some consequences for interpretation (see our section titled "Asset Pricing").

<sup>43</sup> In 1745, during the War of the Austrian Succession, holders of the 50,000 shares in the *Compagnie des Indes* were required to contribute 200 *livres* per share, to which would be added their unpaid dividends from the years 1744 and 1745 for a total nominal capital of 500 *livres* on each of 50,000 bonds—all of which would earn a nominal 5 percent interest paid once per year. *Billets* were issued with interest commencing in different months, but the newspapers reported prices for the October (first) issue, and adjusted prices of other issues accordingly.



TABLE 1  
ANNUAL AVERAGE YIELDS ON SECURE LONG-TERM ASSETS, 1746–1793

Year	Rentes	Oct. Loan	Year	Rentes	Oct. Loan	Indies
1746	6.21	6.54	1770		9.52	
1747	5.90	6.10	1771		10.12	12.33
1748	5.92	5.89	1772		9.08	11.02
1749	5.75	5.42	1773		7.59	9.11
1750	5.27	4.82	1774		6.75	7.56
1751	5.01	4.75	1775		5.69	6.38
1752	5.00	4.59	1776	5.13	5.68	6.53
1753	4.96	4.57	1777	5.43	5.86	6.85
1754	4.91	4.18	1778	6.14	6.15	7.59
1755	4.81	4.70	1779	5.83	6.15	7.08
1756	4.81	5.04	1780	5.83	5.94	6.59
1757	4.82	5.10	1781	5.83	5.97	6.52
1758	5.02	5.19	1782		5.90	6.52
1759	5.58	5.42	1783		5.82	6.47
1760	6.25	6.78	1784		5.82	6.31
1761	5.90	6.87	1785		5.54	5.86
1762	5.69	6.93	1786		5.50	5.82
1763	5.37	5.95	1787		5.70	6.22
1764	5.20	5.67	1788		6.02	6.78
1765	5.07	5.93	1789		6.47	7.46
1766	4.90	6.30	1790		6.34	7.27
1767	4.85	6.75	1791		5.14	5.50
1768	4.85	6.36	1792		5.44	6.38
1769		7.14	1793		5.77	6.79

*Notes and Sources:* Annual yields are averages of monthly estimates of internal rates of return calculated from market prices and the promised stream of future payments as of each month. *Rentes* are the nominal 2.5 percent *rentes sur l'Hôtel de Ville de Paris*. Oct. Loan is the *billet d'emprunt d'octobre*, and Indies are shares in *Compagnie des Indes*. Yields on the *rentes* for 1776 to 1781 are from annual price averages given by Panchaud, *Réflexions*.

perpetual obligation of the French government after the liquidation of April 1770; its nominal yield was reduced from 5 to 4.5 percent after June 1771.

Before 1770 the bond was in principle a private debt of the *Compagnie des Indes*, and as such had some institutional independence of the government. Moreover, a rapid reimbursement schedule liquidated about half the bonds between 1749 (the end of the War of the Austrian Succession) and 1756 (the beginning of the Seven Years' War).<sup>44</sup> The influence of reimbursements on yields and the comparison of the October Loan with the *rentes* are examined in more detail in Figure 3.

Table 1 shows in summary form our conclusion that the October Loan was generally a close substitute for the perpetual *rentes*. Their yields were very similar during Necker's first ministry (1776 to 1781). October

<sup>44</sup> Approximately 21,000 bonds were reimbursed by random drawings every January from 1750 through 1756, when reimbursements were suspended. We calculated yields from April 1749 through March 1756, using a projected schedule of reimbursements that conforms to those observed and that would have extinguished the debt by 1761. For all other dates, we treated the asset as a perpetual bond.

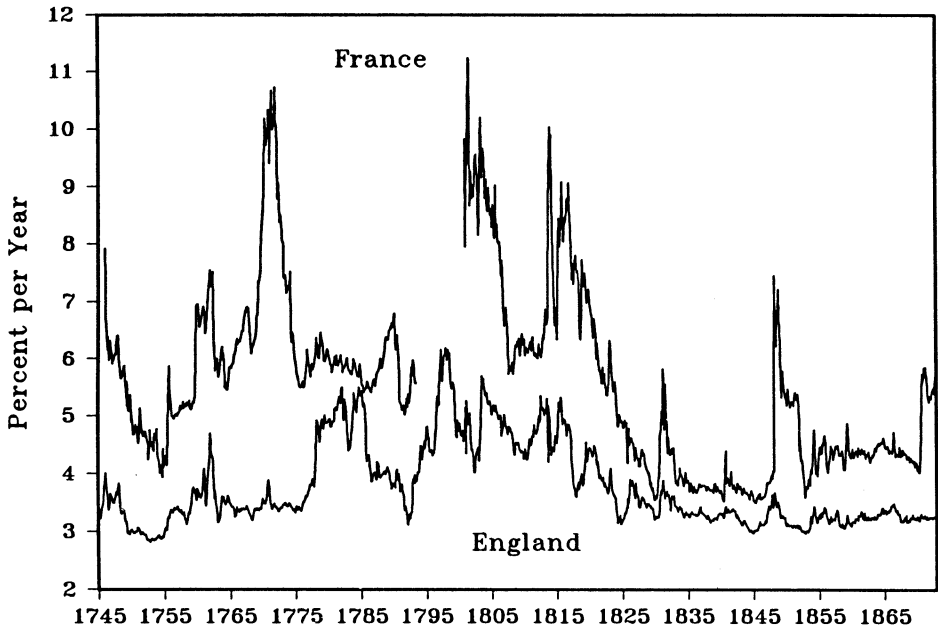


FIGURE 1

MONTHLY BOND YIELDS IN FRANCE AND ENGLAND, 1746–1873

Loan yields were higher in crises and lower during its rapid reimbursements of the early 1750s; the divergence was greatest in the late 1760s. All this is consistent with the obstacles to negotiability of the *rentes* and the association of the October Loan with the Indies Company. It is most unfortunate that no data exist on the price of the *rentes* during the crisis of 1769 to 1774. The very high yields on the October Loan at that time are surpassed by the only other series available: the Indies shares. After 1770 we show that yields on the Indies shares were higher than the perpetuals by 50 to 200 basis points. This was mainly the result of the market's valuation of the reimbursement scheme. We will develop all these points more fully.

## AN INTERNATIONAL COMPARISON OF THE LONG-RUN INTEREST RATE

*A Long-Run Perspective*

Figure 1 shows the implied annual nominal yield on (mainly) perpetual government bonds in France and England on a monthly basis from 1745 to 1873.<sup>45</sup> This long-run perspective serves to highlight episodes of

<sup>45</sup> French data before 1793 are monthly average yields on the October Loan just described. French yields after 1793 were computed from averages of monthly high and low rates of the 5 percent consolidated bond (1797–1825) and 3 percent bonds (1826–1873) taken from Courtois, *Tableaux*. Monthly average yields on British 3 percent bonds are from Rogers, *History of Agriculture*, vol. 7, part 2, pp. 884–940 (from the average of weekly prices for 1730–1789); Gayer,

special interest and to point out anomalies that will be addressed later when we consider a broader spectrum of French assets.<sup>46</sup> These are market yields on existing debt; the relationship of these yields to the cost of new borrowing is discussed under “Asset Pricing.”

Wars raised the yields on government bonds. Up to 1815 France and England mainly fought each other, so their war costs were highly correlated. Our French data begin in 1746, in the middle of the War of the Austrian Succession. In the ensuing peace, French rates settled down to around 5 percent, falling to almost 4 percent on the October Loan during its brief reimbursement phase; English rates were around 3 percent. In the Seven Years’ War both sides saw increases in bond yields. English rates returned to prewar levels until the next war began in 1776, but French rates did not. There, fiscal instability persisted through the 1760s until Terray’s partial defaults in 1770 launched rates upward. Although there were no new defaults after 1771, rates did not return to “normal” levels until 1774. Investor confidence was evidently an important determinant of government interest rates.

The period of the American War of Independence (1776 to 1784) was anomalous. British rates climbed as new debt was issued, but the yields on old French bonds remained fairly stable despite the enormous increase in debt of other kinds. This raises the question of whether the market yields on older assets are a fair measure of the French government’s cost of new borrowing. By 1784 the international differential had all but disappeared. The following year Britain raised taxes and balanced its budget; the yield on consols dropped. In France, the peace of the 1780s repeated the peace of the 1760s: persistent deficits leading toward fiscal crisis and rising yields without new wars.

The significance of the structural change following the Seven Years’ War can be seen in the patterns of correlation. Prior to 1765, monthly bond yields in France and England were highly correlated over time, reflecting the shared influence of war borrowing.<sup>47</sup> From 1765 to 1793 British rates continued to reflect war borrowing, while in France the fear of peacetime defaults became ever more important. The cross-country correlation turned negative (–.32)—or weakly positive (+.11), if we look only at 1775 to 1789.

The fiscal crisis of the “pre-Revolution” and the events of 1789 had surprisingly little impact on long-term yields: much less than did the revolution of 1848 or the partial bankruptcy of 1770, and barely as much

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Rostow, and Schwartz, *Growth and Fluctuations*, pp. 1444–45 (monthly average yield for 1790–1851); and Great Britain, *Statistical Abstract* (monthly average price for 1852–1873).

<sup>46</sup> The international comparison was considered over a shorter time span with similar data but a different interpretation by Bordo and White, “A Tale of Two Currencies,” pp. 306–9. English interest rates in the eighteenth century have been analyzed by Weiller and Mirowski, “Rates of Interest.”

<sup>47</sup> The correlation was .87 for consols and the October Loan, .62 for consols and *rentes*.

as did the revolution of 1830 or the Seven Years' War. We will therefore need to reconsider the impact of the crisis through the yields on other assets.

We leave a detailed analysis of the revolutionary period to future work.<sup>48</sup> Some comment is required, however, on the remarkable fall in rates after March 1790. The nationalization of church lands and the issuance of paper *assignats*, backed by the national wealth, to pay the obligations of the government is clearly the cause. The move toward fiat money affected the market in two ways. To some extent, it restored the public's confidence that bankruptcy could be averted. Far from being viewed as the beginning of the end, the *assignats* were viewed as the solution to the problems that had brought on the Revolution.

We are convinced, however, that the reported asset prices were quoted in terms of *assignats* that themselves sold at increasingly discounted rates against gold.<sup>49</sup> This places the stability of asset prices after 1790 in a new light. The "real" (gold) value of government obligations (now paid in *assignats*) was declining as the gold price of *assignats* fell. But the current *assignat* price of future *assignat* obligations was holding steady.<sup>50</sup> This implies that at any given date the markets thought the current gold value of the *assignat* would be maintained.<sup>51</sup> Even the execution of the king, regional counterrevolution, and the informal beginnings of what would soon be institutionalized as the Terror did not cause a panic in the Bourse. In June 1793, just before the Bourse was closed by the government, the October Loan traded at rates not much different from those during the pre-1787 years.

Later in 1793 the government consolidated most of its debt other than life annuities into a single 5 percent *rente*, analogous to the British consolidation into three percents in 1751. Although the Bourse reopened sporadically over the next four years, regular and continuous market quotations did not resume in France until 1797. During that time the depreciation of the *assignats* made interest payments nearly worthless. Finally, in 1797 the government reduced all obligations by two-thirds. At that time the market returned to gold-based pricing, while the government continued to struggle with its debt payments. Figure 1 does

<sup>48</sup> See Velde and Sargent, "Macro-economic Causes and Consequences."

<sup>49</sup> From an economist's perspective, Harris, *The Assignats*, remains the best study of the *assignats*. By June 1793 their value against gold had fallen to about 50 percent of face value. The period of hyperinflation had not yet begun.

<sup>50</sup> There were some declines in asset prices quoted in *assignats*, especially after 1792, but these declines were small relative to the depreciation of the *assignat*.

<sup>51</sup> French investors' only prior experience with this sort of monetary regime was the John Law episode, after which the government eventually restored the value of the currency and honored much of the real value of its debt. It does not seem unreasonable that a repeat of that experience was considered to be equally or more probable in 1792 than the near-total default that actually ensued.

not show the implied rates until January 1801, because they remained fantastically high. Specie payment of interest resumed in 1802.

Napoleon's balanced budgets and regular payments on the debt did not restore anything like prerevolutionary market conditions until the uneasy Continental peace of 1807. Despite persistent deficits, English rates generally stayed below 5 percent. Renewed warfare and the end of Napoleon's Empire launched French rates upward again. French rates remained higher in the nineteenth century, though the gap was smaller. We do not propose a complete explanation, but the market's sharp response to each change of regime (1830, 1848/51, 1870) suggests that default fears associated with constitutional instability may have been important.

### *Risk and the International Differential*

French bond yields exceeded English yields by about 200 basis points (2 percent) from 1746 to 1793, with little trend in that differential. Was this a risk premium, or can it be explained by differences between the two countries in expected inflation or in the risk-free real rate of return?

The modeling of inflation expectations remains a controversial topic in macroeconomics. We confine ourselves to the question of whether there were good reasons for investors to expect a difference between the two countries. In the eighteenth and nineteenth centuries both France and England were on a fixed-specie standard; indeed, most of their money supplies consisted of specie coins.<sup>52</sup> Both currencies were essentially stable in specie content from 1726 to World War I, except for temporary disturbances between 1790 and 1820. Under this fixed exchange rate regime, international trade could be expected to maintain a stable ratio of prices in the two countries in the long run, as the empirical evidence seems to confirm.<sup>53</sup> French investors might have had a greater fear of currency depreciation based on historical experience, but this is arguable and is more logically subsumed under default risk.<sup>54</sup>

Private capital markets in eighteenth-century France and England remain a vital topic for future research. From what little we know, it appears that the structure of private interest rates was very similar in the two countries. Both had usury laws that set a maximum of 5 percent on private loans. Mortgages in England and similarly secured private

<sup>52</sup> France departed from this standard with the introduction of the *assignat* in 1790 and returned in 1797 with the *franc germinal*, valued at the same silver content as the old *livre tournois*. Britain renounced gold convertibility in that year and only returned in 1821.

<sup>53</sup> Weir, "Crises," table 1. Inflation rates are sensitive to the composition of the price indexes, but for both countries they fell in the range of .5 percent to 1 percent per year between 1726 and 1786. Any French differential must have been small relative to the gap in bond yields.

<sup>54</sup> According to tables in de Wailly, *Mémoire*, France nearly doubled the number of *livres tournois* per gram of gold between 1670 and 1726—an annual rate of 1.2 percent per year. The British pound remained stable.

*rentes* in France were recorded in the 4 to 5 percent range.<sup>55</sup> The ratio of annual rents to the price of land should be close to the real rate of interest, as land prices could be expected to rise with inflation. In England the rental/price ratio on land was about 3.5 percent in the second half of the eighteenth century.<sup>56</sup> French regional historians find ratios of between 3 and 4.5 percent, with no clear evidence of change in the second half of the eighteenth century.<sup>57</sup> In the debates over the sales of national lands, the delegates to the revolutionary assemblies seem to have agreed on a rental/price ratio of 3 to 3.5 percent.<sup>58</sup>

Neither inflation nor private real rate of return differentials accounts for the gap between French and English government interest rates. It appears, therefore, that the financial market did extract a risk premium for holding even the most secure debt obligations of the French monarchy.

#### ASSET PRICING

##### *Government Pricing and the Long-Term Market Rate*

It has long been conventional to treat the market yield on British consols as a measure of the interest rate faced by the government for its borrowing. This assumption seems reasonable because most British government borrowing took the form of increasing the stock of the same debt instrument. That was not true in France, which raises the question of whether the market yield on existing assets such as the October Loan or the *rentes* is a good measure of the cost of new borrowing.

Table 2 summarizes the major royal loans issued directly to the public during the second half of the eighteenth century. We show the net sums raised on each loan to help establish the relative importance of different loan types: the rarity of perpetual debt loans and the tendency toward increasing reliance on life annuities instead of term annuities and sinking funds. The loan “term” shown in the table is the length of time to final payment, as specified in the original edict. The sums borrowed should not be used uncritically as a guide to the magnitude or timing of changes in the debt or the deficit, and one cannot calculate annual debt service from this table.<sup>59</sup>

<sup>55</sup> Drawing on French notarial archives, Rosenthal, in “Credit Markets,” finds the majority of private *rentes* to be 5 percent, with a substantial number around 4 percent and a small fraction over the maximum rate. Dickson (*Sun Insurance*, p. 257) quotes English mortgage rates of around 4.5 percent but ranging up to 5 percent; Parker (*Coke of Norfolk*, pp. 30, 131) shows rates mainly near 4.5 percent.

<sup>56</sup> See Clay, “The Price of Freehold Land”; Clark, “The Cost of Capital”; and Allen, “The Price of Freehold Land.”

<sup>57</sup> See Frêche, *Toulouse et la région Midi-Pyrénées*, pp. 568–73, for a discussion of the Midi; Poitrineau, *Basse-Auvergne*, pp. 513–14, for Auvergne; Deyon, *Contribution à l'étude*, pp. 310–19, for Picardy; and Saint-Jacob, *Les paysans de Bourgogne*, p. 292, for Burgundy.

<sup>58</sup> *Archives Parlementaires*, vol. 13, p. 81; vol. 19, pp. 150, 456; vol. 41, p. 139.

<sup>59</sup> Part of the total debt was in indirect loans through regional or urban governments. Some direct loans were left “open” for long periods or reopened later, so the total sums include borrowing in



TABLE 2  
DIRECT LOANS OF THE FRENCH GOVERNMENT, 1747–1788

Date of Edict	Finance Minister	Loan Term	Net Sum Raised	Loan Yield	Bond Yield
November 1740	Orry	life	6.0	5.88	
October 1741		life	8.0	5.82	
June 1742		15 years	12.0	5.00	
December 1743		life	8.4	?	
November 1744		life	4.7	8.18	
July 1747	Machault	life	11.8	7.95	6.03
October 1747		12 years	30.0	6.71	6.22
September 1748		12 years	20.0	6.71	5.70
May 1749		12 years	36.0	5.00	5.18
May 1751		22 years	<30.0	?	4.88
May 1751		life	21.8	6.04	4.88
October 1752		9 years	22.5	6.17	4.55
November 1754	Séchelles	life	56.7	5.10	4.36
November 1755		12 years	30.0	5.86	5.86
July 1756	Moras	10 years	36.0	5.00	4.95
March 1757		12 years	36.0	6.20	5.02
June 1757		11 years	40.0	7.35	5.08
November 1757	Boullongne	life	60.0	6.4–9.0	5.15
April 1758		30 years	40.0	6.65	5.19
November 1758		life	39.0	7.0–9.0	5.20
April 1759	Silhouette	“shares”	72.0	6.50	5.23
December 1759	Bertin	tontines	46.9	9.53	6.85
May 1760		10 years	20.0	9.66	6.87
May 1760		32 years	<60.0	?	6.87
July 1761		32 years	<30.0	?	6.58
November 1761		life	43.5	6.4–9.0	7.30
January 1766	Laverdy	life	60.3	5.2–8.0	6.15
December 1768	Maynon d’Invaux	life	44.6	5.2–8.0	6.34
June 1771	Terray	life	62.4	8.8–11.0	10.32
January 1777	Necker	life & perpetual	24.0	5.8–7.0	6.07
December 1777		7 years	25.0	5.00	5.87
November 1778		life	48.4	5.2–8.0	6.08
November 1779		life	69.4	5.2–8.0	6.12
October 1780		9 years	36.0	6.29	5.79
February 1781		life	77.3	6.4–9.0	6.04
March 1781		life	90.5	5.2–8.0	6.02
January 1782	Joly de Fleury	life	190.3	7.6–9.0	6.07
December 1782		15 years	50.0	8.00	6.00
April 1783	d’Ormesson	8 years	24.0	7.49	5.79
October 1783		8 years	24.0	7.49	5.78
December 1783	Calonne	life	100.0	7.0–9.5	5.95
December 1784		25 years	125.0	6.76	5.90
December 1785		10 years	80.0	6.67	5.49
September 1786		27 years	30.0	6.50	5.58
May 1787	Brienne	life	67.4	6.4–8.0	5.58
November 1787		life	120.0	7.6–10.0	5.79

*Notes:* The Loan Yield is the expected internal rate of return on the loan at the government’s offer price. Yields on life annuities are based on Deparcieux’s life table. When the age distribution of annuitants is unknown, we show rates for lives age 52 and age 7 at nomination, respectively. Bond Yield is the market yield on the October Loan at the date of the edict. Sums raised (in millions of *livres*) exclude the value of old debt accepted as payment. Question marks indicate noncalculable yields.

*Source:* *Archives Nationales, Série AD IX; Archives Parlementaires*, vols. 11, 30, 87.

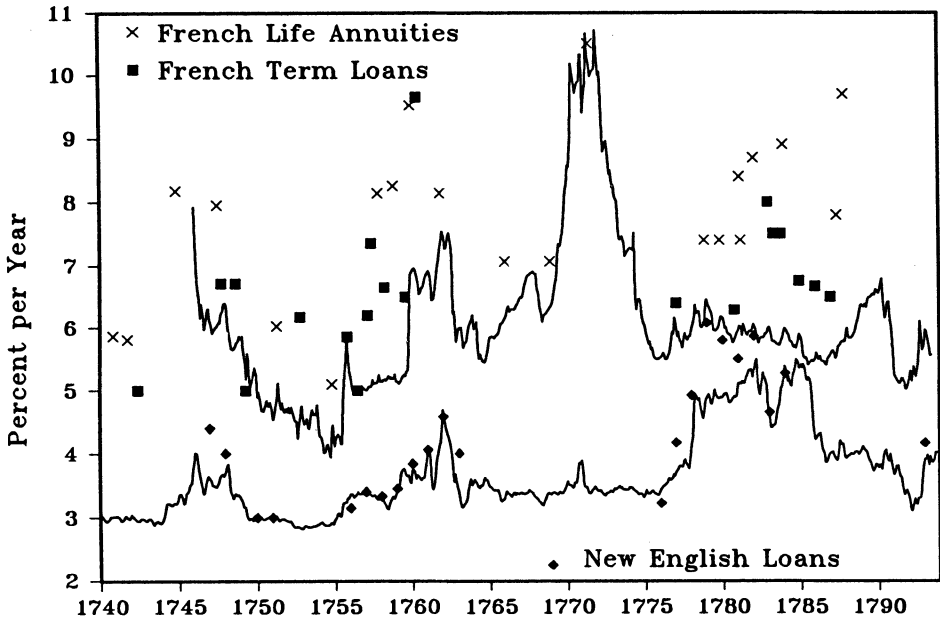


FIGURE 2

YIELDS ON NEW LOANS AND OLD BONDS, 1740–1793

We have attempted to calculate for each loan an expected IRR based on the terms specified in the loan edicts.<sup>60</sup> For flat-rate life annuities we show two yields: one for a contingent life of age 52 and one for age 7. Roughly speaking, the age 7 yield was the maximum obtainable, whereas the age 52 yield represents the typical return to an adult insuring his own retirement.

Figure 2 compares the yields on new loans with the market yields on long-term bonds in France and England from 1740 to 1793.<sup>61</sup> Quite obviously, new English loans (mainly new consols) were targeted closely on prevailing market rates (on old consols). War borrowing created small gaps in the 1740s and the Seven Years' War. The only substantial deviation occurred during the American War of Independence, when the government augmented perpetual annuities with addi-

later years. By "net" sums we mean new cash, net of any exchanges of old debt for new. For some point estimates of debt service charges, see Weir, "Tontines," p. 103.

<sup>60</sup> When the government allowed investors to purchase new loans with old debt redeemable at face value or some other price above its current market price, we lowered the nominal offer price of the new loan to take account of the maximum attainable discount. This affects the yields of the November 1752, April 1758, May 1760, June 1771, and December 1782 loans. Similarly, when investors had more than one option for dividend payouts we chose the one with the highest expected yield.

<sup>61</sup> Yields on British loans were calculated as internal rates of return directly from loan terms in Grellier, *The Terms of All the Loans*, and differ somewhat from Grellier's own shortcut estimates. Point estimates of life annuity yields are based on a best guess of the age composition of subscribers. (Again, we discuss these annuities in detail in "Life Annuities.")

tional short-term payments.<sup>62</sup> Fiscal pressure that forced up market rates led to a premium on new loans.

The same phenomenon occurred in more exaggerated form in France. Before the Seven Years' War most new loans of all types tended to be close to the market rate on the October Loan. During the war and for most of the rest of the period, new loans were at higher rates and life annuities generally higher than the others. Terray's 1771 life annuity loan matched the peak of the October Loan rate but sold poorly until after 1774.<sup>63</sup> During the American War, when England borrowed at rates close to the old bond rate in France, Necker and his successors raised their new funds at much higher rates, with the exception of some small lotteries. Life annuities were avoided between the end of the American War and the crisis of 1787, but even those new term loans offered rates well above the old perpetuals.

Table 2 and Figure 2 show that the yields on new loans traced out a cost of borrowing that was systematically higher and more responsive to fiscal pressure than the market rate on older long-term bonds. Financial historians have previously pointed out in anecdotal form that one loan or another seems to have been issued at rates of return higher than the yield on older *rentes*, implying incompetence on the part of the government. By pushing further into the complex structure of the financial market, we find a very different story.

### *Market Prices and Yields, 1746 to 1793*

We now follow some of the new assets through their lives on the financial market. Were the observed yield differentials at the original government prices bid away in the secondary market? That would be evidence of errors in government asset pricing. If not, does the pattern of differentials in yields shed light on how the market evaluated the risks of investing in the monarchy?

Figure 3 displays market rates from 1746 to 1770. The period can be divided into three regimes. Prior to October 1759 the government was honoring the initial terms of its loans. An edict of that month suspended reimbursements indefinitely, rendering income streams on some assets uncertain until the government re-established reimbursements in June 1763. During the third regime, from 1763 to 1770, reimbursement rules were frequently revised. The legal maximum interest rate on private *rentes* was lowered to 4 percent from 1766 to 1770, but this has no direct consequence for the payment streams on government debts.

<sup>62</sup> The excess yield on new loans cannot be attributed entirely to the fact that part of the new loans consisted of nominal 4 percent bonds that ran the risk of being repurchased by the government when the market rate fell back under 4 percent.

<sup>63</sup> A discount of about one-third the subscription price was attainable by exchanging government paper devalued by Terray's defaults. It languished in Holland, where it was first launched, and in Paris. See Marion, *Histoire financière*, p. 264; and Lüthy, *Banque protestante*, pp. 487–96.

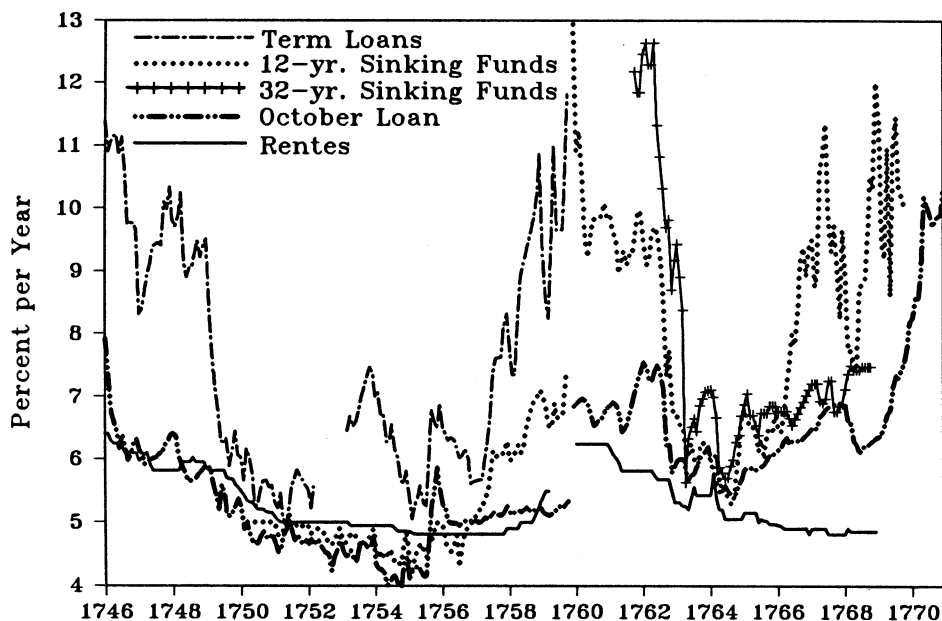


FIGURE 3

## YIELDS ON GOVERNMENT ASSETS, 1746–1770

The perpetual *rentes* were not directly affected by reimbursement rules. Yields evolved slowly from just over 6 percent during the War of the Austrian Succession to under 5 percent in the years of peace that followed. The Seven Years' War took rates up again to their earlier wartime levels. Prices were not reported in the months just before the partial default of October 1759, so we do not know whether that event had a noticeable effect on the *rentes*. In December 1764 the government placed a tax of one year's interest on transfers of titles in *rentes*. We show the net yield to the purchaser, but note that this further obstacle to negotiability may make this asset a poor guide to the market.

The October Loan was not directly affected by government reimbursements either, but the brief period of reimbursement by the *Compagnie des Indes* made it even more attractive than the *rentes* in the peace between 1749 and 1756. The outbreak of hostilities caused a sharp spike in the yield at the end of 1755, returning to the 5 percent range before reimbursements ended.

The series labeled 12-year Sinking Funds refers to two successive royal loans issued on a simple sinking fund design, with about 12 years to complete reimbursement and funded by specific tax revenues.<sup>64</sup> From 1750 to 1756 the implied yields on the sinking funds closely paralleled

<sup>64</sup> The first was created in May 1749 and funded on Machault's *Caisse d'amortissement*, the second in July 1756 and funded on the *deux sols pour livre*: a surtax of 10 percent of the *dixième* tax. These were also the first "bearer" bonds issued without a specific name on the title.

the very similarly structured October Loan. In the peacetime boom investors were willing to take a lower yield for this secured medium-term commitment than for the *rentes*, but their rates rose more sharply at the start of the Seven Years' War. The suspension of 1759 maintained the 5 percent per year interest but postponed reimbursements indefinitely. We calculated yields at each date during the suspension as if the market expected the government to immediately resume reimbursements on a new 12-year sinking fund plan, which is roughly what finally happened in 1763. This was a perfectly arbitrary choice on our part.<sup>65</sup> It shows that the market had little confidence in an immediate resumption of reimbursements until prospects for peace improved at the end of 1762. In 1763 and 1764 yields were not far from the *rentes*, indicating confidence in the new reimbursement plan. In the years that followed, the government tried to accelerate reimbursements while struggling with its deficit. By calculating yields at each date, based on the government's most recent reimbursement schedule, we found that the market doubted this acceleration could be accomplished as scheduled.

In 1760 and 1761, the government issued new sinking funds, with a tax on leather as the revenue source. We were unable to estimate the effective yield at issue because they were sold at an unknown discount. The nominal interest rate was 3 percent, with reimbursements scheduled over 32 years. It first appeared on the market at a price of only 40 percent of par, so the discount must have been considerable. The prospect of reimbursement at full cash value for a bond purchased at discount adds tremendously to the value of its future income. However, the market evidently did not believe the government would pay off in full, because the implied yields were very high. In April 1763 the government announced that reimbursements would be at a 20-to-1 capitalization rate (consistent with a 5 percent interest rate) rather than the 33-to-1 rate, and scheduled them over 25 years. This reduced and modest commitment was thereafter at least as credible as the promises made on the older sinking funds.

The importance of the quasi-fundedness of the assets described so far can be seen by a comparison with the yields on simple term loans.<sup>66</sup> Payments on these term loans came from the royal treasury and not from the receipts of a particular tax farm. Their yields were higher and much more responsive to fiscal pressure and war.

The pattern of yields before 1770 indicates a fairly simple structure of expectations about the government's reliability during crises. As expenses outstripped revenues, the treasury could be expected to post-

<sup>65</sup> The yields shown fall midway between the very high yields obtained by assuming the market expected the government to resume its obligation as it stood in October 1759 and the lower yields obtained by assuming that reimbursements would never resume.

<sup>66</sup> They were known as "*annuités*," were created in November 1743 and November 1752, and provided for ten annual payments to extinguish the debt.

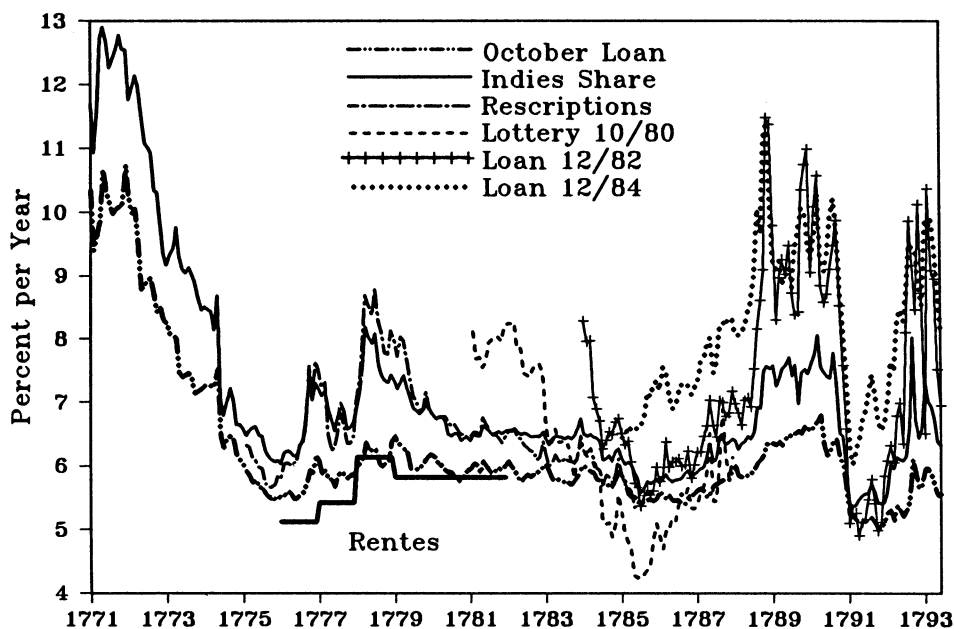


FIGURE 4

YIELDS ON GOVERNMENT ASSETS, 1770–1793

pone or even cancel payments on its own account. As the crisis grew, the revenues for funded debt payments could be diverted. Interest payments on funded assets were considered fairly safe, but reimbursements were recognized as an easy default target.

After 1770 many assets disappeared, new ones appeared, and newspapers changed their coverage. Figure 4 shows the yields on a number of important assets. The *rentes* were not quoted, but we include the rates based on annual average prices reported by Panchaud between 1776 and 1781. The October Loan, now a simple perpetual obligation of the government, was a similarly safe asset with a similar, relatively low yield. Nevertheless, these did not return to the 5 percent levels of the early 1750s. Market yields on the safest assets were closer to 6 percent than to the legal rate of 5 percent.

We show two other assets having pre-1770 origins: the Indies share and the *rescriptions*; both were reimbursable. Eugene White has shown separate graphs of the yields on these two assets as evidence that the market had no confidence in fiscal policy until Necker eliminated the “ordinary” deficit in 1778.<sup>67</sup> But we see that perpetuals did not show the same dramatic responses. Reimbursable assets were responding to something much more specific: the refusal of any of Louis XVI’s

<sup>67</sup> White, “Was There a Solution?,” pp. 554–58.



ministers to repeat during the American War the suspension of reimbursements that had occurred in 1759.

The Indies share was a long-term sinking fund plan, with reimbursements scheduled for completion in 1822. The yield on the Indies share was always above the yield on the October Loan, though they moved in very close parallel. After recovering from the crisis of the Terray regime, the gap between the Indies share and the safer perpetuals rose again with the onset of the American War of Independence, repeating the pattern of the onset of the Seven Years' War. In 1778 the Indies share hit 8 percent, whereas *rentes* were around 6 percent. But the suspension of 1759 was not repeated, and rates fell in 1779. Necker's commitment to fulfill the obligations of past governments despite war demands helped restore some measure of confidence in reimbursements.

The *rescriptions* were originally very short-term obligations of government ministries that were forcibly converted by Terray into reimbursable bonds earning 5 percent, as was a similar asset, the *billets des fermes*, whose yield is not shown here.<sup>68</sup> These reimbursable bonds were obviously close substitutes for the Indies Company share until about 1782. In December 1782, the government announced an accelerated reimbursement of the *billets des fermes*, paying them off entirely by the end of 1783. This boosted confidence in the *rescriptions*. Their yield fell from the levels of the reimbursable Indies Company share in 1782 down to the levels of the perpetual October Loan by early 1785, at which point the government announced accelerated reimbursement of them, too. Thus, Necker's successors also honored the debts of the past while continuing to borrow.

Necker's borrowing was primarily in life annuities, with the remainder in lotteries that were smaller in size and that quickly redistributed part of the cash raised in the form of prizes. What was left to trade on the market were coupons good for future payments or tickets for future lottery drawings. We show one such: the ticket for the 1789 draw of the lottery loan created in October 1780. It was a simple claim on one payment to be made in January 1790 with an expected value of 210.7 *livres*.

The first really substantial new loan other than a life annuity created since the Seven Years' War was Joly de Fleury's of December 1782. It was a straightforward 15-year sinking fund plan based on an interest rate of 5 percent, but it could be purchased from the government at a discount by using other debt titles. It sold slowly, and when it closed in December 1783 it appeared on the Bourse at a 19 percent discount on the cash price—almost exactly the maximum discount available from the government—and raised the implied yield to about 8 percent per

<sup>68</sup> *Encyclopédie Méthodique* (see entries for *finances*, *article billet*, and *rescriptions*).

year. Once it became clear that peace would not bring a reduction of the capital value eligible for reimbursement, as had occurred in 1763 with the wartime loans of 1760 and 1761, yields fell to the level of the Indies share.

The scanty evidence on market prices of new loans other than life annuities during the American War is consistent with a cost to the government of closer to 8 percent than to the old bond rate of 6 percent, let alone the “ordinary” rate of 5 percent. Even older assets like the Indies share and *rescriptions* sold at near 8 percent in 1778. The 1780 lottery ticket was in that range in 1781 and 1782. The lotteries of April and October 1783 offered 7.5 percent yields and opened on the market at a 3 percent premium and par, respectively. The December 1782 loan struggled to sell at 8 percent throughout 1783.

Calonne came to power in December 1783, and after his big life annuity loan of that month, the market for government debt staged a major rally. By mid-1785 the Indies share was close to the October Loan at 5.7 and 5.5 percent yields, respectively. The December 1782 loan was in the same range, and a ticket for the 1789 drawing of the 1780 lottery was well under 5 percent.

The last major non-life annuity loan of the Old Regime was Calonne’s of December 1784. At the government’s offer price, it yielded 6.75 percent and sold out immediately. It opened on the market at a 3 percent premium over par, implying a yield of around 6.4 percent. This was about equal to the yield on the December 1782 loan and somewhat higher than the Indies share. Its yield quickly rose, however, and remained consistently above the others thereafter.

The edict announcing the loan is a remarkable document. It states clearly that the overall yield was set to match the current market prices on other debts. Equally clearly, it states that the part of the yield representing excess interest over the ordinary rate of 5 percent was to be paid in the form of bonuses on reimbursement: the longer a bond was held before being drawn for reimbursement, the greater the multiple of original capital that would be repaid. Pamphlets were quickly circulated urging the king to rescind this excess.<sup>69</sup> Cambon did not resist this clear-cut opportunity for reform: he credited holders of the loan with the original capital only.

The composition of the different assets explains their yield differentials. The December 1784 loan’s excess interest was the easiest default target, and it also shared with the December 1782 and the Indies shares an expectation of reimbursement. When an alternative set of yields is estimated under the assumption that the market fully expected Cambon’s 1793 consolidation into 5 percent perpetuals, all three follow very closely the yield on the October Loan. That the market did not consider

<sup>69</sup> See Marion, *Histoire financière*, vol. 1, p. 365.

TABLE 3  
LIFE ANNUITY BORROWING, 1730–1789

Years	Millions (in <i>livres tournois</i> )
1730–1739	34
1740–1749	61
1750–1759	197
1760–1769	164
1770–1779	197
1780–1789	643

*Notes and Sources:* Same as for Table 2.

a crisis imminent before 1788 can be seen in the yield on the lottery ticket. This short-term commitment carried a lower yield than did the other new assets and was below the October Loan until 1787.

We can compare the crisis of 1788 to 1790 with previous ones. The October Loan rose somewhat less than in 1760/63 and 1769/73. Evidently the market was less fearful of an all-out repudiation. The reimbursable loans were more sensitive to the fiscal crisis than was the October Loan, but again rose less than comparable assets had in earlier crises. The mild response cannot be explained by the degree of severity of the crisis: the deficit was no smaller in 1788 than in earlier crises, and the public was better informed, so we infer that the market retained some confidence in the no-default policy of Louis XVI and held out some hope for the tax reforms needed to support it.

The French government was not, then, incompetent in its pricing of new term loans. It offered yields targeted closely on the market's willingness to pay. The higher default risk attached to new loans explains why the cost of new borrowing was higher than the yield on old bonds. Differentials between assets, old and new, can generally be explained by differences in vulnerability to default. We now explore how the life annuities fit into this structure.

#### LIFE ANNUITIES

##### *Government Pricing Policy in Historical Perspective*

Life annuities (*rentes viagères*) were first used by the French government during the Nine Years' War (1688 to 1697), the same time that tontines were introduced. Large amounts were also created during the liquidation of John Law's *Systeme*, to retire the masses of banknotes issued in 1719 and 1720. Life annuities became a more significant component of the debt after the 1740s. By the end of the century they had become the major method of borrowing. Table 3 summarizes the amounts of new cash raised through life annuities and tontines.

Life annuities were created by loan edicts, which specified the total amount to be sold. If the market was unwilling to buy them the total might be less, but only rarely did the government accept oversubscrip-

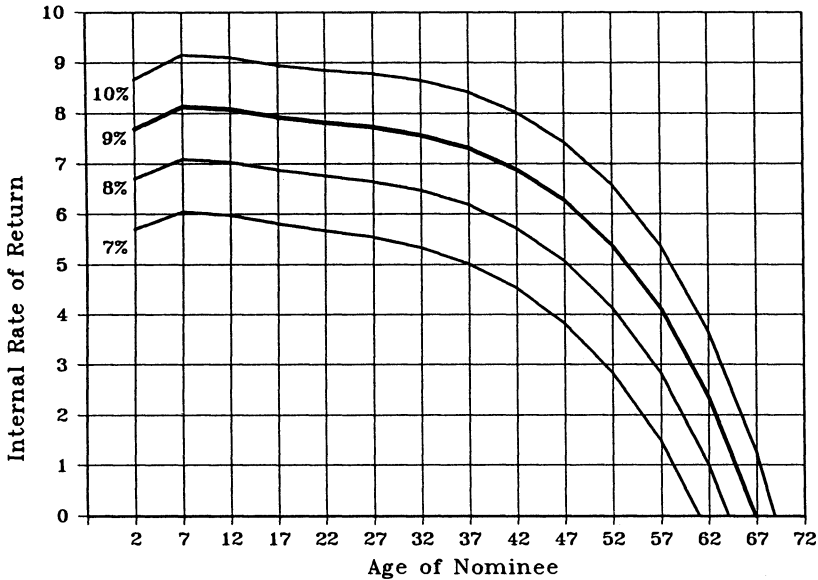


FIGURE 5

LIFE ANNUITY YIELD SCHEDULES

tions. When the government sold a life annuity, it set a price that was a multiple of the annual annuity income. We will refer to the inverse ratio (income to price) as the nominal yield.

The effective yield, or internal rate of return, would be lower than the nominal yield by a margin that would depend on the duration of payment (length of life). The development of actuarial science in the eighteenth century was very much related to the question of pricing life annuities by age. There is reason to doubt whether either the public or the government could accurately evaluate the cost of life annuities before 1746.<sup>70</sup> All doubt vanishes with the publication that year of Deparcieux’s book in Paris.<sup>71</sup> He integrated an exposition of the formal mathematics of the pricing of life annuities and tontines with a new empirical life table, solidly based on the mortality experience of subscribers to the French tontines of the 1690s.<sup>72</sup> He provided simple tables of prices by age and effective interest rate that could be used even by those unable to make calculations for themselves.

<sup>70</sup> The pure mathematics were worked out earlier, but the empirical life tables constructed by Petty and Halley at the end of the seventeenth century were scientifically unsound. In 1725, de Moivre published the first edition of what became a well-known treatise on probability that discussed the mathematics of life annuities but relied on Halley’s defective life table. See Alter and Riley, “How to Bet on Lives,” for more on early actuarial history.

<sup>71</sup> Deparcieux, *Essai*, also reviewed the pricing of term loans.

<sup>72</sup> Age-specific mortality rates estimated from the records of tontine participants up to 1770 are very similar (Weir, unpublished research). Mortality rates were very low compared with the general population, reflecting both the greater wealth of government creditors and the self-selection of relatively healthy individuals into tontines. The same selection effects applied to life annuitants.

Figure 5 shows how the IRR varies by age when the nominal yield is a single flat rate for all ages, calculated from Deparcieux's life table. It also shows that to provide an internal rate of return of 6 percent, for example, the nominal yield should be set at about 7 percent at age 7, 8 percent at age 40, 9 percent at age 50, and 10 percent at age 55.

One might suppose that the growth in life annuity borrowing was a result of the development of pricing technology. Quite the contrary: the massive life annuity loans of the 1770s and 1780s not only ignored the detailed age-grading information available, they were nearly all at flat rates for all ages. Cambon's remark about the Old Regime's "imbecility" was meant to imply that the flat-rate pricing scheme was due to incompetence, stupidity, and sloth. A closer look at the history of pricing policy suggests something more deliberate.

The life annuities of the 1690s had a rough structure of age grading, based more on common sense than on any rigorous calculation. The flat rates on life annuities of the early eighteenth century were arbitrarily set to liquidate debt; they provide little insight into actuarial knowledge or intent.<sup>73</sup> Age grading reappeared with the loan of November 1740 and carried on through the War of the Austrian Succession and the peace that followed the Treaty of Aix-la-Chapelle. The eight life annuity loans in the fifteen years between 1740 and 1754 were all graded for age, at rates that came close to being actuarially fair.<sup>74</sup> Moreover, as is evident in Table 2, the government could manipulate the prices and enrollments by age to raise and lower the overall yield in accordance with market conditions, without abandoning actuarial fairness.

Age grading was abandoned during the Seven Years' War, beginning with the November 1757 loan. The finance minister who initiated the return to flat-rate pricing was Jean de Boullongne, born of a family of important court painters but making his own long career in various offices of government finance.<sup>75</sup> Eleven years earlier, Antoine Deparcieux had dedicated his masterpiece on life annuities and tontines to this same Jean de Boullongne, then an *Intendant des Finances*, in gratitude for the attention and support given to his work. Ministerial competence had certainly not taken a turn for the worse. The fiscal health of the monarchy, however, clearly had. It would seem that fiscal pressure in the form of war borrowing influenced life annuity pricing policy.

Of the fourteen major life annuity loans raised over the last thirty years (1757 to 1787) of Old Regime policy, only three had any age grading at all, and even those were clearly not designed for actuarial

<sup>73</sup> Large quantities created by the liquidation of John Law's devalued paper in the 1720s were arbitrarily assigned a flat rate of 4 percent for all ages. Similarly, the life annuities created by the lotteries of 1737 and 1739, designed to reimburse perpetual debt, did not make distinctions by age.

<sup>74</sup> See Weir, "Tontines," table 7, for more on the prices of these early life annuities.

<sup>75</sup> For a family history, see Caix de Saint-Aymour, *Les Boullongne*.

purposes.<sup>76</sup> The implications of flat-rate pricing for the government's cost of borrowing depended on the age structure of annuitants. Technological changes on the demand side of the market for life annuities made the flat rates increasingly costly over time.

### *Who Bought Life Annuities?*

In the 1750s and 1760s flat-rate pricing had relatively little impact on the total cost of government borrowing because most life annuity purchasers continued to be adults who bought annuities on their own lives, their spouses', or their adult servants'.<sup>77</sup> The flat-rate prices gave near-market yields on adults around the age of 50. Older adults were discriminated against by the flat-rate prices. There were few major alternative suppliers of life annuities, so the government may have profited from public demand for assets to smooth out life-cycle consumption.<sup>78</sup>

To earn a higher yield, annuities had to be bought on the lives of children.<sup>79</sup> There was no legal restriction on naming third parties as contingent lives. The two main impediments were (1) the risk that all the income would be lost to the investor if the third party died and (2) the transaction costs involved in documenting survival of the third party every year to collect the annuity.

The technical solution to the problem of investing on children's lives emerged in the early 1770s in a famous scheme known as the "*trente demoiselles de Genève*."<sup>80</sup> It began as the exclusive domain of Genevan banks, through their branches in Paris. The banks developed lists of young girls from Genevan families to name as contingent lives. The families were selected for their record of health and longevity. The girls were mostly between the age of five and ten, and were selected only after surviving smallpox (or after inoculation, which was introduced in the 1780s).

The Genevan banks purchased large amounts on each life to reduce transactions costs, but pooled together annuities on enough different

<sup>76</sup> The November 1758, January 1782, and May 1787 edicts offered higher yields beginning at age 50.

<sup>77</sup> *Archives Nationales*, Série P, has the account books of life annuity subscriptions. Age was always recorded for age-graded annuities and tontines. It was not recorded in those accounts for the flat-rate annuities, but it is still possible to use indications of social status to distinguish adult nominees as the great majority. The age distribution for later issues is discussed below.

<sup>78</sup> Edicts of 1661 and 1690 forbade "*gens de mainmorte*" from selling life annuities at nominal rates above 5 percent. That category included all religious and other charitable institutions. See Pothier, *Traité de la constitution de rente*, chap. 8, article 3.

<sup>79</sup> Beginning with the November 1758 loan, the government offered annuities on two lives at nominal yields that were usually one percentage point lower than single-life offerings. Perhaps one-third of life annuity subscriptions were on this plan. We do not consider it here, because the single-life annuities on children offered a higher yield than any two-life annuity at that yield differential.

<sup>80</sup> Cramer, "Les trente demoiselles de Genève"; and Lüthy, *Banque protestante*, pp. 464–96.



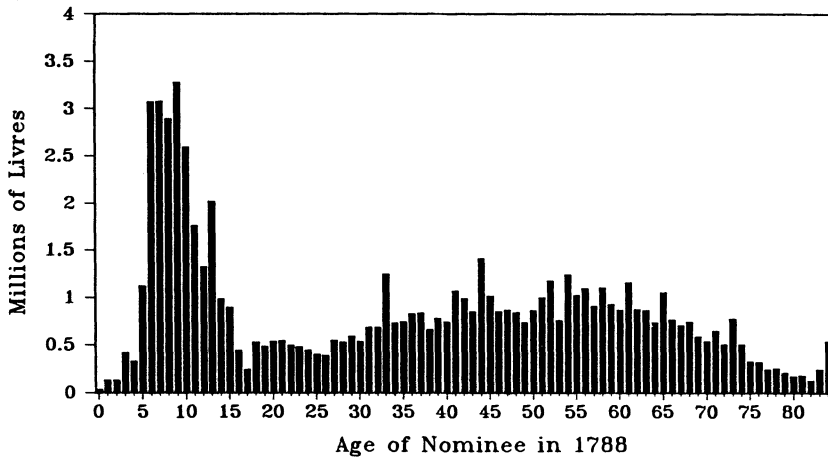


FIGURE 6

## ANNUAL LIFE ANNUITY PAYMENTS BY AGE OF NOMINEE IN 1788

lives to reduce the risk. The most common number of individual lives in a pool was 30, hence the name of the scheme.<sup>81</sup> Equally important was innovation in marketing the life annuities to the investment public. Genevan plan life annuities became an easily negotiable asset, unlike life annuities bought on one's own life or the lives of family members, because the bank's dispassionate selection of lives eliminated problems of asymmetric information and moral hazard. The banks resold small fractions of their pools of annuities to individual investors and usually collected the annuity for them. They restructured the dividends into other packages, including tontines.

The invention was first tested on Terray's June 1771 loan, spread rapidly with the Necker loans, and probably accounted for a majority of flat-rate life annuity subscriptions in the 1780s. We can follow its evolution from several sources, none of them entirely adequate. The best approach would be simply to account for the age distribution of life annuitants subscribing to each loan. Records must have existed at one time, because in 1794 Cambon calculated the age distribution of all life annuitants and the total number from each separate issue. Unfortunately, he did not publish the cross-tabulation of age by loan issue.

Cambon's distribution of total life annuity payments on single-life annuities by age of contingent life for 1788 is shown in Figure 6. It shows a clear bimodal pattern with heavy concentrations around age 10, reflecting investment in children during the 1780s, and a much broader mode around age 52, reflecting a combination of adult lives named in

<sup>81</sup> Thirty was probably close to the optimal number. Because the law required annual proof of survival to collect the annuity, administrative costs rose with the number of nominees, while the marginal reduction in variance became small after thirty. Note also that the Genevan banks eschewed the two-life annuities in favor of the higher returns available on single-life loans.

TABLE 4  
LIFE ANNUITIES AND ALTERNATIVE DEBT INSTRUMENTS

Date	Life Annuities by Age				Market Premium	Other Debt Instruments	
	Nominal Yields		Net Yields			Indies	Most Recent Issue
	7	52	7	52			
November 1778	9	9	7.98	5.24		7.32	
November 1779	9	9	7.98	5.24		6.97	
February 1781	10	10	8.99	6.44	105	6.02	lotteries at 7.5%
March 1781	9	9	7.98	5.24	97	6.01	lotteries at 7.5%
January 1782	10	11	8.99	7.61	101	6.57	lotteries at 8%
December 1783	10.5	10.5	9.50	7.03	104	6.74	12/82 at 8%
May 1787	9	10	7.98	6.44	100	6.34	12/84 at 8.2%
November 1787	11	11	10.00	7.61	101	6.37	12/84 at 8.5%

Sources: Archives Nationales, Série AD IX; *Journal de Paris*; Deparcieux, *Essai*.

recent years and survivors of much earlier loans. If we eliminate from the payments on adult lives the maximum amount attributable to loans other than the flat-rate loans after 1775, we arrive at the rough estimate that about three-quarters of the flat-rate subscriptions after 1775 were placed on young children.<sup>82</sup>

Lüthy worked with records of the Genevan banks and found their participation to be enormous relative to their capital resources, but still a minority share of the loans.<sup>83</sup> For the December 1783 loan Lüthy was able to work with a complete government account and found 44 percent placed on Genevan plan purchases, nearly half of it by banks outside of Geneva. It seems unlikely that Genevan banks alone accounted for more than one-quarter of the life annuities bought after 1775. Rival banks adopting their technology must also have exploited the opportunities offered by the government. Private individuals probably shifted their purchases, too, if we accept the high share of annuities bought on children. Nevertheless, adults naming themselves or close relatives probably accounted for one-quarter or more of all new issues—still a large total value in comparison with earlier years.

### *Life Annuities on the Paris Bourse*

New life annuity issues appeared in the marketplace for short intervals.<sup>84</sup> Table 4 compares life annuities with some relevant alterna-

<sup>82</sup> Of the 43.5 million *livres* in annual payments on lives over age 25 in 1788 (born before 1763), some 34.6 million can be attributed to loans other than the flat-rate loans after 1775. That leaves 8.9 million to adults out of a total of 35.9 million raised in flat-rate loans after 1775, or 25 percent. All figures are taken from Cambon's report (*Archives Parlementaires*, vol. 87, annexes).

<sup>83</sup> Lüthy (*Banque protestante*, vol. 2, pp. 496–570) finds that Genevan banks took 16 percent of Terray's June 1771 loan; less than 10 percent of Necker's loans except for the November 1779 loan, from which they took 31 percent; 22 percent of the enormous January 1782 issue; and 17 percent of the November 1787 loan.

<sup>84</sup> After the royal edict creating the loan was registered by the *parlements*, the royal treasurer

tives. We show the after-tax nominal yields for children and adults, including lottery prizes. We adjusted these for expected mortality, to give the net yields for each. For the loans of the 1780s, we show the average market price of the asset in its first three months on the market as a premium relative to the government's price: an index of 100 meaning that the asset traded at par, an index of 105 indicating a 5 percent premium in the market (and a lower yield to the purchaser).

Whereas adults purchasing annuities on their own lives received a return comparable to a relatively safe reimbursable asset like the Indies share, the maximum attainable yields on children's lives typically exceeded the yield on the Indies share by two to three percentage points. Mirabeau drew attention to this fact in his 1787 attack on Necker's policies.<sup>85</sup> Other new loans provide a fairer comparison: Genevan plan annuities typically exceeded them by about one percentage point.

The market prices of life annuities thus remained fairly close to the government's prices. There is certainly no evidence of the rapid increases in price that we would expect to see if shrewd investors were capitalizing on the mistakes of a foolish government. On two occasions, however, the market price suggests that the government did offer overly favorable terms: Necker's February 1781 loan, and Calonne's of December 1783. Necker corrected quickly, issuing another (larger) loan the very next month at a lower yield. This signaled the government's close attention to market prices. Calonne entered office to face an administration in disarray and a market not yet recovered from war. His loan was basically a flat 9 percent, like most of Necker's, but he ensured its success with another 1.5 percent from lottery prizes. He closed the loan as soon as it had raised the desired capital and turned to other types of loans afterward. Even on these loans, the market premia over government prices did not eliminate the yield differentials vis-à-vis other assets.

Two questions are raised by Table 4: why didn't the market bid up the prices of life annuities to eliminate the yield differential, and why did the government repeatedly use such an expensive form of borrowing? The answer will depend on whether the market was freely competitive or not. The evidence suggests that it was, but we first consider the alternative.

A noncompetitive cartel dominated by the Genevan banks might have sought to manipulate the market. They bought new issues of life annuities directly from the government. As Necker demonstrated in 1781, the government could respond to a bidding up of prices in the

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accepted subscriptions from bankers and investors. Once the subscription was closed, the annuities started trading on the market until the legal deadline for naming the contingent life.

<sup>85</sup> Mirabeau, *Lettres*, pp. 37–44.

secondary market by raising its own prices in the future. It would therefore have been in the long-run interest of a cartel to stay out of the secondary market, except perhaps to sell a few annuities at low prices to adult investors or less astute speculators. The profit opportunities from the next round of government borrowing would easily compensate for letting a small share of each issue go to others at government prices.

There is at present no evidence anywhere in the voluminous documentary history of banking and finance to suggest the existence of a cartel. Lüthy's evidence does show a diffusion of the Genevan technology to other banks during the 1780s, but the yield differential did not decline, which would mean that cartel discipline would have to have been extended over more and more banks. We would also need to explain why the government tolerated this exploitation. Future research may give new credibility to the cartel hypothesis, but at present it seems more appropriate to consider explanations based on a competitive market.

The government was borrowing money without sufficient projected future revenues to cover its debt obligations. That created default risk. The more it borrowed, the worse the problem. Because most of the old debt had already had any excess interest wrung out of it by previous defaults, and because Louis XVI's government showed a strong commitment to honoring it, default risk was greatest on the new issues. Of all the new loans, the life annuities were used to raise the largest sums and at the most desperate times of war and fiscal crisis. They sold well even when others did not. Had the government attempted to use other forms to raise comparable sums, the rates might have been equally high. Genevan capital represented an apparently inexhaustible source of foreign funds that helped ease the burden on French capital resources of financing the war. Geneva's eagerness may have encouraged domestic lenders to buy annuities that ultimately named adult lives.

The market had ample reason to fear default on life annuities. Excessive interest was always a likely target for default. Terray's earlier treatment of tontines had shown that life-contingent debt could be defaulted on if its interest rate was deemed too high. There was growing public discussion of the Genevan plan annuities and their high yields; even the government's loan edicts apologized for being forced by circumstances to return to this mode of borrowing.<sup>86</sup> Moreover, the excess interest resulted from the greater longevity of children. One could only realize the excess yield if the government abstained from reforming its debt for a lifetime. That leaves the question of whether the fairness of adult yields might have protected the others. Could investors

<sup>86</sup> In 1784 Necker himself lamented the growth of speculative investments in place of life cycle-smoothing motives (*De l'administration*, vol. 3, chap. 23).

have expected a default on some life annuitants but not others? If they did, they were proved correct. Cambon did precisely that in his 1794 restructuring of the life annuity debt, relying on actuarial techniques, government records, and policy precedents that were in place well before the Revolution.

#### CONCLUSION

The financial market was the economic conscience of the Old Regime. By neglecting it, historians have managed to maintain false condemnations of individual policies and policymakers while retaining equally unjustified confidence in the structural integrity of the late eighteenth-century French monarchy. We found instead that the money managers of the Old Regime were closely attuned to investor preferences and market conditions.

Debt policy cannot be isolated from the rest of the political economy of public finance in the Old Regime. The whole package was a system under stress from the military competition posed by England, which had a better system. We have sought to understand government policy and market behavior as joint responses to a constitutional flaw exposed under this stress. Persistent deficits were not the result of bad planning, court extravagance, economic weakness, or even an administration built on venal officeholders. Cleverer or more honest administrators could not have eliminated them. They arose from a political system that completely separated the privilege of spending from the obligation to pay taxes and at the same time left the public enough political power to resist taxation.

The financial market recognized that the constitutional impasse over taxation made occasional partial defaults inevitable. Consequently, the French government paid default premia throughout the eighteenth century. The market also recognized how the government selected its targets for default: reimbursement payments were likely to be suspended or forcibly converted to permanent debt; loans that could be castigated as earning excessive returns were at risk of reduction; and assets that had already been defaulted on were unlikely to be cut again. Interest rate differentials reflected all of this knowledge, and widened during periods of fiscal distress.

To raise new funds on the market the government had to offer yields above the current market rates on older, safer debt. It turned increasingly to life annuities. Although the high yields they offered to shrewd investors have seemed excessive to many historians, we found that the market did not think so, and traded them at close to government prices.

We would not claim that the French system was optimal or even stable in the long run, but it almost certainly could have survived the crisis of 1788 with a package of defaults only slightly worse than that of

1770. Riley describes the high interest rates paid by the French government as a “prepaid repudiation.”<sup>87</sup> The market expected default, was paid in advance for it, and received it in every crisis until 1788. Louis XVI rejected the practice. Without it, the old system could not last. A satisfying historical explanation of why he opted for calling up the Estates General instead of renouncing some of his more expensive debts would go far toward explaining the true causes of the French Revolution.

<sup>87</sup> Riley, *Seven Years War*, pp. 184–90.

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