PRELIMINARY DRAFT
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The Sustainable Debts of Philip II: Revenues, Expenditures and Primary Surplus in Habsburg Spain, 1560-1598

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The defaults of Philip II have attained mythical status as the origin of sovereign debt crises. Three times during his reign the king failed to honor his debts and had to renegotiate borrowing contracts. Far from being fiscal disasters that reflected irrational spending policies and a hopeless fiscal position, we argue that Spanish debt in the sixteenth century was sustainable throughout. New evidence from primary records, combined with existing estimates, allows us to derive comprehensive estimates of debt and revenue. These show that primary fiscal surpluses were sufficient to repay the king's debts in most scenarios. Our findings explain the rapid and relatively painless reschedulings that followed fiscal crises.

JEL Classification codes: N23, N43, F34, H62, H63, H68

I. Introduction

Spain under the Habsburgs ruled an empire on which the sun never set, and its financial troubles seem to have stretched every bit as far. Philip II declared bankruptcy three times. Much of the period is dominated by a desperate search for fresh sources of tax revenue. When modern journalists write about the origins of debt crises and the dangers of fiscal profligacy, they refer to his reign.[1] In the view of most scholars, easy access to credit combined with an expensive taste for warfare led to excessive borrowing by the Spanish kings. Braudel (1966) famously argued that new groups of financiers were lured into lending to the sovereign by the false hope of high profits. In successive waves German, Italian, Spanish and Portuguese bankers were have been ruined as the resources of the monarchy were poured into expensive warfare. The naval contest with the Turks, the Dutch Revolt and the Invincible Armada all combined high costs with few financial gains. Reinhart et al. (2003) argue that a country's history of default is a key determinant of its "debt tolerance", the extent to which it can borrow without a fiscal crisis. Early modern Spain is one of their key examples, with 13 defaults between 1500 and 1900. If "history matters" in the sense of Reinhart et al., we need to know more about what caused paths to diverge. To this end, we examine the origins of Spain's sorry history of repeated default.

While American treasure provided repeated windfalls, all the king's silver appears to have been insufficient to defray the enormous expenditures and service the Crown's debts. The consensus today is that Spain's fiscal position had become unsustainable by the second half of the sixteenth century – that excessive spending had to lead to default, sooner or later. In the words of one

[1] "The dark side of debt", The Economist, 21.9.2006.

prominent historian, "if by fiscal crisis we simply mean an unbridgeable gap between unavoidable expenditure and disposable income, then the Spanish Monarchy was in an almost continuous fiscal crisis." (Thompson 1994, p. 158).

We challenge this view and argue that Spain's fiscal position was sustainable for the entire period of Philip II's reign. Assessing fiscal health for the sixteenth century is a surprisingly difficult task. The low quality of fiscal record keeping and the idiosyncrasies of early modern financial accounting reinforced the impression that Habsburg Spain was a prime example of fiscal mismanagement. We begin by compiling a comprehensive revenue series for the period 1555-98, carefully avoiding the pitfalls of existing data. We also use a new dataset on short term debt contracts from the Archive of Simancas. We then combine these data with the fragmentary information on long term debt to estimate an annual series of outstanding debt. Since there was no proper accounting of the kingdom's expenditure on an annual basis, compiling the most complete revenue and borrowing series possible is the only way to assess the king's overall financial situation.

Conventional wisdom has applied ex post logic to Philip's defaults – because he defaulted on the letter of his contracts with bankers, his fiscal position must have been unsustainable. Based on the new, comprehensive view of Spain's fiscal position, we are able to replace this approach with a detailed assessment of the kingdom's finances as they must have appeared ex ante to lenders. This is a crucial step in assessing their rationality (or otherwise). We first use the traditional approach to debt sustainability to derive maximum levels of indebtedness that the kingdom could

[3] Here, we take access to international lenders for granted. In other papers we explore the connection with the literature on sovereign borrowing that started with Eaton and Gersovitz (1981) and Bulow and Rogoff (1989). See Conklin (1998) for an application to the case of Spain.

have shouldered, using ex-post revenue growth and interest rate figures. Next, we develop a set of analytical tools that calculate ex ante default probabilities, using an analogy with Value-at-Risk (VaR) modeling from the banking literature. Finally, we show that movements of the primary surplus in response to debt and revenue shocks were overwhelmingly in the right direction – that, in line with the argument in Bohn (1998), the Spanish government took corrective actions to avoid fiscal difficulties at a time of high expenditures.

Our results show that Philip's defaults were not the inevitable, cataclysmic events portrayed in much of the historical literature – and that they offer little information on the health of his finances. While the king's fiscal situation was not comfortable, it appears that it was ex ante sustainable throughout. A closer look at the payment stop of 1575 shows that these were not defaults in the proper sense. Philip II broke contracts and failed to live up to obligations he entered into, but these were liquidity crunches, not cases of insolvency. Agreements on rescheduling payments were reached quickly, and the "haircut" imposed on lenders was relatively mild. Continued access to funds depended on fiscal adjustments.

Our paper relates to the literature on sustainable fiscal policies and repeated defaults.[3] Recent work has examined the role of history in shaping debt capacity (Reinhard et al. 2003). Other authors have argued that macroeconomic volatility and institutional weakness are more important determinants of "debt intolerance" (Catão 2004). Numerous papers have explored the stochastic properties of the debt to GDP ratio in an attempt to determine if borrowing is stustainable – essentially by testing for unit roots (Hamilton and Flavin 1986; Kremers 1989). Bohn (1998) shows that the power of these tests is low, and that debt-to-GDP processes with a near-unit root

can be sustainable. He introduces a new test based on estimating a fiscal policy function. Our results contribute to the literature by demonstrating that even in one of the most famous cases of fiscal profligacy and serial defaults, ex ante sustainability was high.

We proceed as follows. Section II provides historical context and background, while section III summarizes how our data are derived. The main empirical results are presented in section IV, where we examine the sustainability of debt and the fiscal responses to growing expenditure pressures. Section V concludes.

Historical context and background

In 1556 Charles V abdicated his many crowns and titles. His brother Ferdinand became Holy Roman Emperor, while his son, Philip II of Spain, inherited Castile and its overseas colonies, as well as all the European dominions of Flanders, the kingdom of Naples and some Northern Italian states. Philip started his reign by obtaining a decisive victory over France at Saint Quentin in 1557, which ushered in a decade of relative peace. In the same year, he also suspended payments on the large loans his father had contracted with the Fugger and Welser banking families, setting off a major change in the Early Modern approach to sovereign debt.

The Spanish Crown obtained the bulk of its financing through two main debt instruments: *asientos* and *juros*. *Asientos* were short term loans contracted with individual bankers or companies. Their term typically ranged from six months to three years. When the contracts called for disbursements abroad, usually to pay and supply warring armies and fleets, the

stipulated exchange rate was normally used to increase the effective interest rate while circumventing usury laws. During Philip's reign, *asientos* usually included a license to export bullion from Castile, as well as clauses protecting the bankers against variations in the metallic content of the currency.

The second financial instrument were bonds called *juros*. A *juro* was defined by its face value, its yield, and by the revenue stream from which its payments would be met. *Juros* were normally perpetual, although lifetime bonds, which were extinguished at the death of their holder, were not uncommon. While *juros* could only be collected by the person in whose name they had been issued, a secondary market of sorts in them existed as the Crown was all too willing to grant licenses to transfer them in exchange for fees, loans or other favors. Since their annual or semi-annual interest payments were directly disbursed by the treasurer or tax farmer in control of the revenue stream that guaranteed the bond, the value of a *juro* was directly related to the liquidity and reliability of that particular revenue stream.

Charles' loans with the German banking families were exclusively *asientos*. Charles used loans provided by the Fuggers to bribe the Grand Electors and secure the imperial crown in 1519, and since then he repaid *asientos* of growing amounts in a more or less timely fashion. These loans were not secured by any kind of collateral, and their repayment depended entirely on the Emperor's decision. While delays in payment were not uncommon, Charles did not hesitate to put the bankers' claims ahead of everybody else's, even confiscating private shipments of bullion from the colonies to meet *asientos* payments.[5]

[5] The standard account of the financial relations of Charles V with international lenders is Carande (1987), who also

Philip's first debt rescheduling unfolded in two stages in 1557 and 1560. The settlement, which included handing over control of several Crown monopolies to the Fuggers, was not fully negotiated until 1566, the year in which lending resumed in earnest, spearheaded by several Genoese banking families. 1566 also marked the resumption of Spain's large military commitments abroad with the flare up of the Dutch Revolt and the progressive build-up of the Mediterranean fleet that would defeat the Ottomans at Lepanto in 1571. The Genoese *asientos* that financed these and other expenses differed from those previously extended by German bankers in that they collateralized their principal through *juros*. In the first few years after 1566 the bankers held onto these *juros* (called *de resguardo*, or safeguards) until the *asiento* they guaranteed was repaid. Soon, however, many *asientos* allowed the bankers to sell the collateral on the secondary market, even when the *asiento* guaranteed by it was in good standing.[6] When an inventory of the outstanding *asientos* and *juros* was taken prior to the negotiations to settle the suspension of payments of 1575, it was found that about two thirds of outstanding short-term loans were collateralized by *juros*.[7]

The crisis of 1575 is the single most studied episode in the Spanish financial history of the sixteenth century.[8] The Dutch Revolt and the Holy League had put severe strain on the royal finances, and the king did not seem to care about expenses when it came to building his gigantic palace-monastery at El Escorial. When Philip asked for a threefold increase in the sales taxes that were the mainstay of fiscal revenue, the Cortes, in their first show of force in half a century,

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reports data on confiscations (p. 597); the value the emperor placed on maintaining his reputation and thus preserving access to credit is thoroughly documented by Fernández Alvarez (2004).

[6] For a description of the interplay of *asientos* and *juros* see Ruíz Martín (1965).

[7] This number emerges from our calculations based on the full text of the final settlement with the bankers. *Asiento y Medio General de la Hacienda*. Archivo General de Simancas; Consejo y Juntas de Hacienda; Libro 42.

[8] For a meticulous description of the suspension and ensuing settlement see Lovett (1980; 1982).

refused to oblige.[9] The king eventually managed to obtain a large increase in revenues, but not before being forced to declare a suspension of payments on *asientos,* as well as on collateral *juros* still held by the bankers. The total outstanding amount was roughly 15 million ducats, or two years' worth of revenue. Five and a half million ducats were collateralized through standard *juros*, while 4.3 million were collateralized through *juros* guaranteed by the Casa de Contratación that had failed to perform as expected and were already trading at a heavy discount.[10]

Two years of negotiations with the bankers produced a comprehensive settlement, called a *medio general*, by which the king repaid on average 62 cents on the dollar.[11] The standard *juros* were recognized at face value, but their yield was lowered from 7.14% to 5%. 55% of the *juros* placed on the Casa de Contratación were recognized at face value; the remaining 45% of these *juros* were treated as uncollateralized debt. Two thirds of the uncollateralized debt was converted to 3.3% perpetuities guaranteed by the salt monopoly, and the rest to 2.3% perpetuities guaranteed by specific taxes on Crown villages. The bankers also agreed to immediately provide a new loan of five million ducats.

The *medio general* was a new device that was to prove very effective in reaching a relatively quick settlement and restart lending. The previous payment stop has been followed by nine years of protracted negotiations with individual bankers. While the talks progressed at a very slow pace, no fresh funds had been forthcoming. In 1575, the king negotiated with a consortium of

[9] A reconstruction of the negotiations between the king and the Cortes during the crisis is provided by Jago (1985).
[10] *Juros* guaranteed by the House of Trade, perhaps the most spectacular case of financial mismanagement during Philip's reign, were thoroughly studied by Ruíz Martín (1965).
[11] Our own calculations based on the present value of the promised repayment streams relative to the original commitments. *Asiento y Medio General de la Hacienda*. Archivo General de Simancas; Consejo y Juntas de Hacienda; Libro 42.

bankers that represented upwards of 70% of the outstanding debt; proposed settlements went back and forth at a fast pace, quickly converging to a final agreement. As a deal approached, more bankers joined the consortium, so that in the end, the settlement was all but comprehensive (a few separate deals with the most powerful bankers notwithstanding). Lending restarted as early as 1578.

The default was not without costs for the Crown. The stop in the transfers to the armies in Flanders caused unrest among the Spanish troops, progressively eroding their military position and culminating in the sack of Antwerp in November 1576. Recovering the lost ground was to prove extremely costly and, in the end, futile (Lovett 1980; Conklin 1998).

After 1577, expenditures grew at an even higher pace. The renewed financial demands of warfare in the Low Countries were compounded when Philip decided to undertake an invasion of England, equipping and sending out the Invincible Armada. The disaster of 1588 convinced the Cortes to grant a new tax, the *millones*, that increased royal revenues by 20%. It was promptly spent on rebuilding Spain's battered naval power. This ability to extract even higher taxes points could be seen as a sign that Castile's revenue potential had not yet been exhausted – or that "imperial overstretch" (Kennedy 1987) was beginning to set in.

III. Data

Despite the large bureaucracy of the Spanish Empire, Philip's obsession with record-keeping, and the richness of Spanish archives, aggregate data on public finances are hard to come by. Like all Early Modern fiscal regimes, the Castilian central administration was not geared towards timely assessments of revenues and expenditures. The most comprehensive overviews of the fiscal

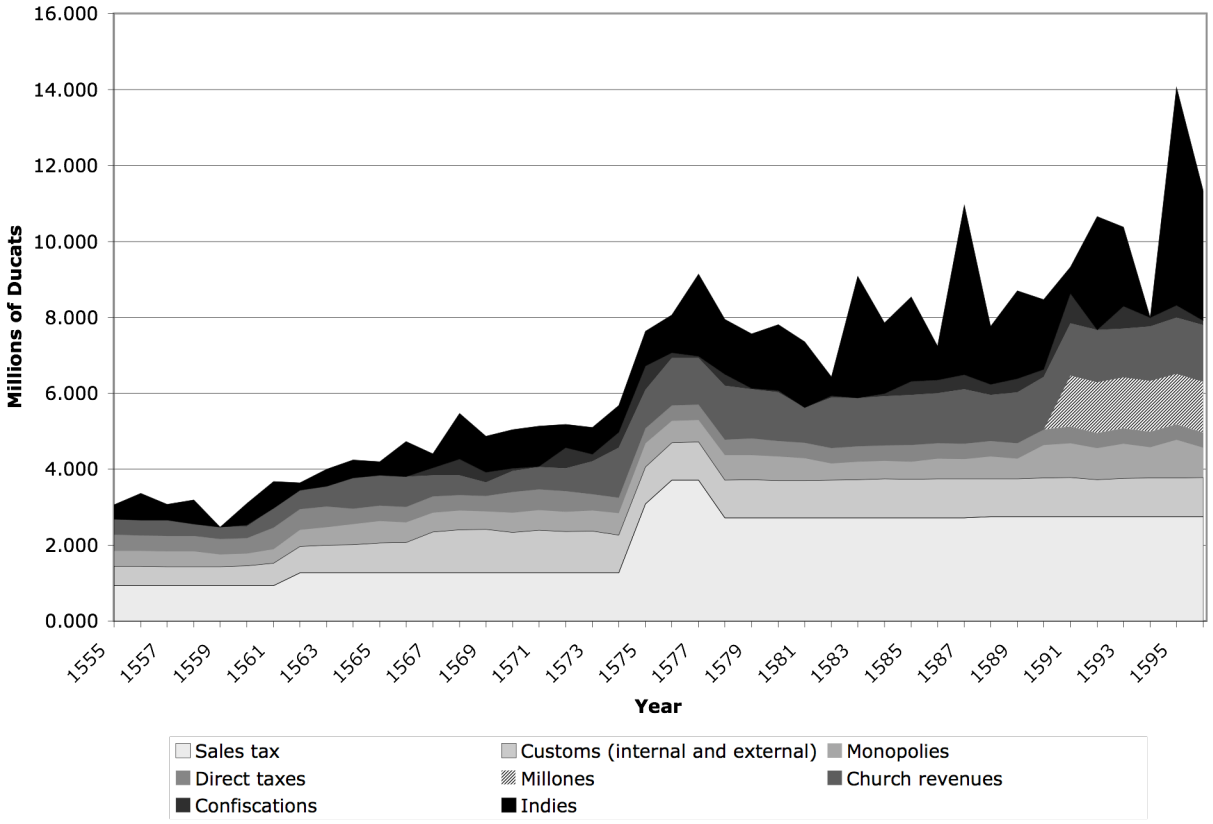
position were ordered after the payment stops themselves, as Crown officials sought to obtain a bird's eye view of obligations, resources, and their own bargaining position. Using these estimates and all available additional sources, we have compiled year-by-year estimates of revenues, *asientos* and interest payments on *juros*. These form the empirical basis for our subsequent analysis.

Figure 1 shows the evolution of Crown revenues by type between 1555 and 1596. While fragmentary data for individual tax streams are reported in Ulloa (1977), this is to our knowledge the first time that the different series have been aggregated to produce a comprehensive annual series of fiscal income for this period. For many revenue streams, data are incomplete. Ulloa only reported confirmed revenues and did not estimate the value of those income streams for which he could not obtain a definite amount. We have imputed missing observations by assuming that, in years for which there is no information, revenues were equal to the lowest of the two closest years for which data was available. We have also incorporated information on the frequency with which different taxes were collected when available. This procedure and Ulloa's methodology bias the series downwards, yielding a lower bound of actual tax revenue. Since most of the revenue streams do not change for long periods, the actual impact of missing data turns out to be limited. Data for Indies revenue, the most volatile series, are available for every year throughout the period. Table A1 in the appendix reports the data used in Figure 1.

With the exception of silver remittances (the topmost category in the chart), revenues were very stable as a result of being farmed out or contracted upon with the cities. Tax farmers or city councils agreed to fixed yearly payments and became the residual claimants. Almost the entire

volatility of the series is driven by the treasure revenues. Both the nature of mining operations and the logistics of transferring the silver from the Bolivian plateau to Seville caused wild fluctuations in remittances. The increases in the sales taxes in 1576-7 and the introduction of the *millones* in 1591 produced healthy increases in revenue.

Figure 1: Crown revenues, 1555-1596

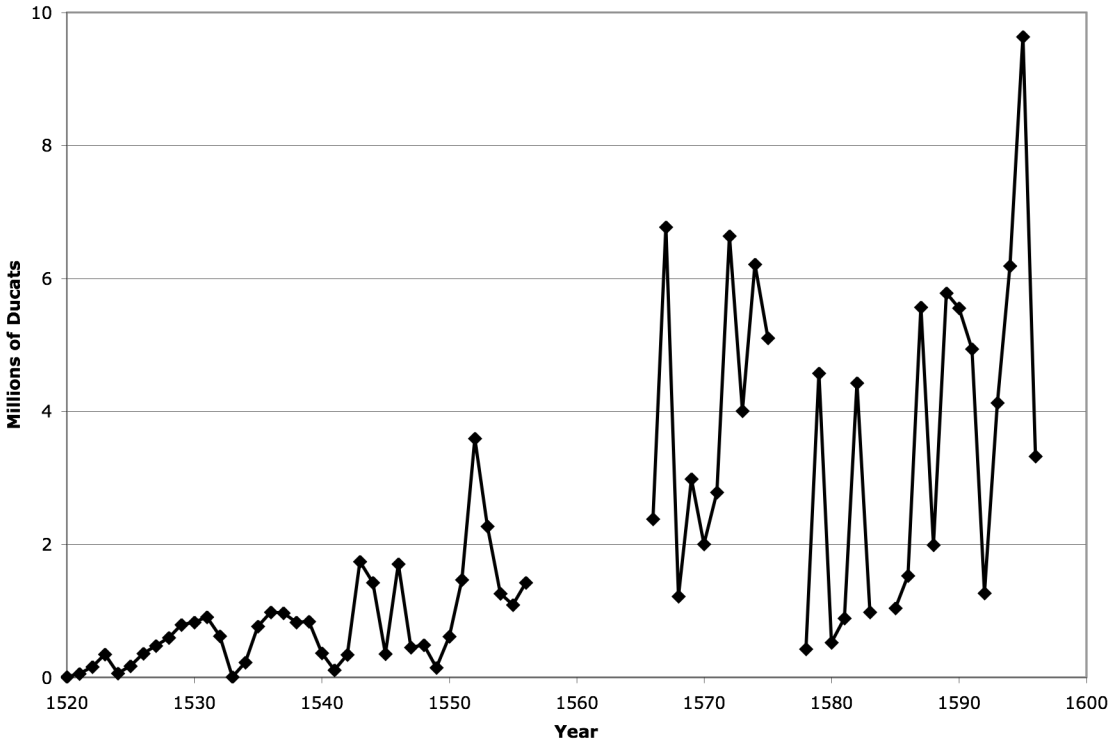


Source: Ulloa (1977), authors calculations.

Figure 2 shows the *asientos* contracted each year by the Crown as reported by Artola (1982), corrected with our own data from the Archivo General de Simancas.[12] The gaps in the series correspond to the hiatus in lending after each default and hence reflect exclusion from capital markets, not missing data. Table A2 in the data appendix reports the entire series.

[12] Archivo General de Simancas, Contadurías Generales, Legajos 84, 85, 86, 87, 89, 90, 91, 92.

Figure 2: Asientos



Source: Artola (1982, pp. 86-87), Archivo General de Simancas, Contadurías Generales, Legajos 84,85, 86, 87, 89, 90, 91, 92.

While the *asientos* of Charles V have receive the largest amount of scholarly attention, Philip's borrowing clearly dwarfs them. The series also shows that the second suspension of payments was much shorter than the first; while the 1557 default resulted in nine years of exclusion from capital markets, most of the debt suspended in 1575 was rescheduled through the *medio general* by late 1577. The quick resumption is consistent with our argument that defaults were an outcome that was already taken into account when bankers decided to lend. Once the eventuality became a certainty, it was quickly dealt with.

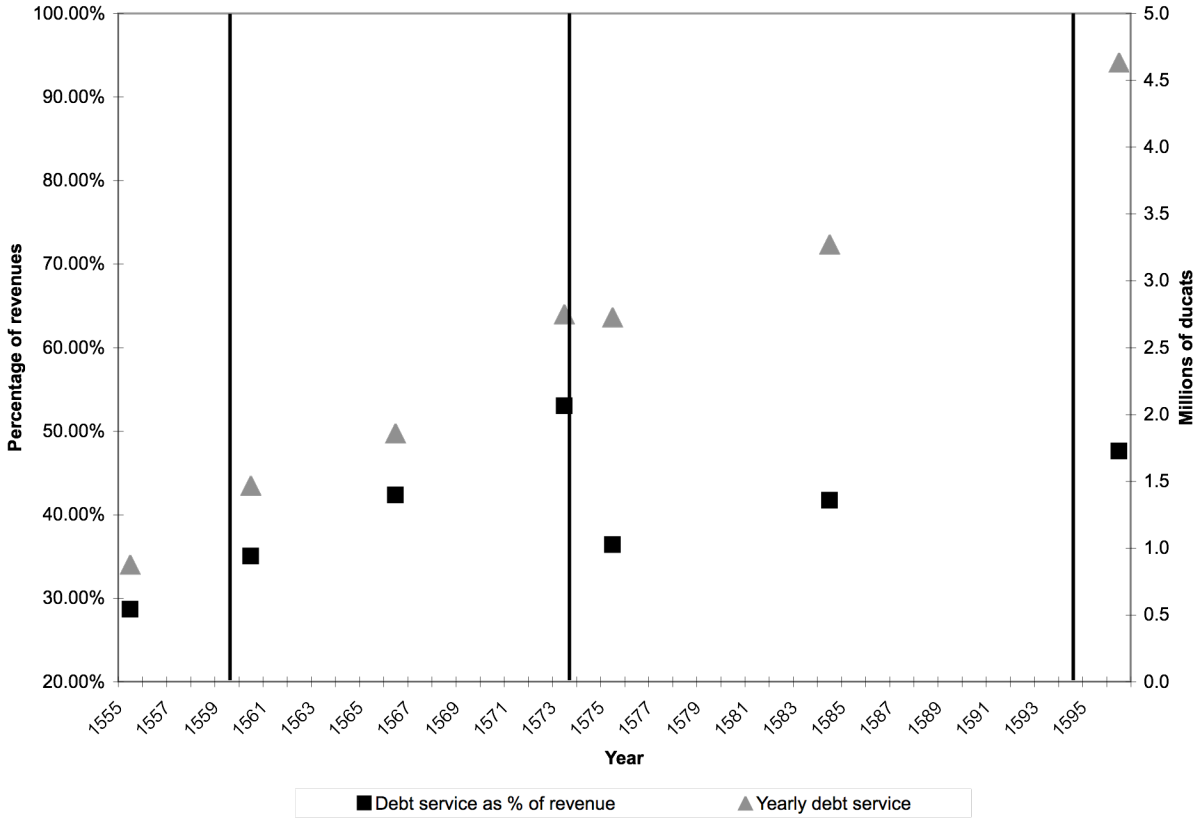
While much higher than that of the first half of the sixteenth century, the amounts borrowed through *asientos* during Philip's reign are largely without trend. *Asientos* were convenient as a short-term borrowing device; they allowed the Crown to obtain money quickly and transfer it to

virtually any point in its European dominions. *Asientos* were also expensive. It was not uncommon for the cost of an *asiento* to climb into the double digits, with some possibly yielding 30% per annum.[13] As soon as it could, the Crown sought to convert the outstanding amount into *juros*, which could be placed at interest rates around 7%. The series of *asientos* can be interpreted as reflecting the flow of new borrowing; to estimate outstanding debt, one needs to look at *juros*.

The triangles in Figure 3 (read on the right-hand scale) indicate the cost of servicing outstanding *juros* in absolute terms, while the squares (left-hand scale) plot its magnitude as a percentage of Crown revenues. The vertical lines indicate Crown defaults. To avoid distortions caused by years with abnormal treasure income, in the calculations for this chart the "Indies" category is smoothed with a three-year moving average (in our data analysis, we use yearly figures).

[13] Establishing the cost of borrowing is no trivial matter, as it involves estimates of the value of export licences, hidden interest rate charges for transfer services, and the like. We are currently enganged in a large-scale project that will produce detailed estimates of the cost of each asiento. As an example of their cost, in an *asiento* underwritten by Niccoló and Vincenzo Cattaneo on December 5 1567 for a disbursement of 75,000 ducats, the king agreed to repayments in cash and *juros*, as well as to *juro* swaps, that represented a total cost of financing of 40.77%. In another *asiento* underwritten by Juan Curiel de la Torre on December 15 1567 for a total of 200,000 *ecús* to be delivered in Anvers, the king agreed to exchange and interest charges and to the concession of lifetime *juros* that amounted to a total cost of financing of 29.44%. (Archivo General de Simancas, Contadurías Generales, Legajo 84). While in many cases the cost of financing was much lower, *juros* could be normally placed at around 7% and their capital was never due, representing a much more attractive option if revenues to guarantee them could be found.

Figure 3: Evolution of debt service.



Source: Ulloa (1977), Artola (1982), authors calculations.

The chart shows that the 1575 bankruptcy was effective in reducing the percentage of revenue allocated to debt service. This followed from 1) the lower yield on the outstanding debt negotiated with the bankers; 2) the increase in taxes negotiated with the Cortes; 3) the increase in American treasure shipments that occurred around the same date.

Data are even scarcer for the total value of outstanding *juros*; since *juros* carried different yields, which where in turn altered with each default, their aggregate face value cannot be backed out from interest payments. The very limited data compiled by Artola (1982) is the result of Crown inquiries, called *averiguaciones*, ordered in times of crisis. These inquiries yielded snapshots of royal finances, including the amount of outstanding debt. Artola also supplies a collection

estimates of revenue for the snapshot years, which we contrast with our estimates based on Ulloa's data.

Table 1: Revenue, outstanding debt and debt service in the snapshot years (in millions of ducats)

Year	Revenue (Artola)	Revenue (our estimate)	Juros	Juros Service
1560	4,192,237	3,102,002	19,000,000	1,468,000
1565	5,600,000	4,196,908	25,000,000	1,861,000
1577	8,700,000	9,142,759	36,000,000	2,730,000
1598	9,731,408	n/a	68,000,000	4,634,000

Source: Artola (1982), Ulloa (1977), author's calculations.

In 1577, our estimates and Artola's are fairly close. Our series does not reach as far as 1598, but our average estimates for the 1590s are also close to Artola's. In the early years, however, we are 20% below Artola's figures. His data for those years comes from Ruíz Martín (1965). The discrepancy arises because Ulloa only tabulated confirmed revenues, thus missing a number of income streams for which no data has survived; Ruíz Martín, on the other hand, worked with contracted revenues, which were almost always higher than what the Crown actually received. Ulloa's numbers are therefore a lower bound for the true revenue figures, while Ruiz Martín's are probably a high upper bound. We have no way of guessing what the true figures for 1560 and 1565 might be, and leave the sorting out of the discrepancy to more qualified historians of this period. For each empirical test, we will use the set of numbers that will bias the results against our argument.

IV. Debt sustainability

How irrational was it to lend to the Philip II? Was there a chance at all that, after all the military adventures had been financed and the Escorial built, some money could be found to service the

debt? And should the eventual reschedulings lead us to conclude that there was no ex ante possibility of Philip honoring his contracts? If the answer is no, we need not necessarily call the rationality of bankers into doubt – lending to the Spanish king may well have been a "rational bubble." Blanchard and Watson (1983) show that even if an asset's value declines to zero with probability one at an (uncertain) point of time in the future, it can rationally be bought and traded for a price markedly greater than zero. In this case, the rates of return for the duration of the "bubble" would have to compensate for the high ex-ante risk of very substantial capital losses.

A cursory glance at Philip's revenues and borrowing as provided by Table 1 shows that the situation was at times precarious. Between 1560 and 1598 revenues more than doubled, but debt service more than tripled. Despite the substantial haircuts imposed on lenders, Philip's borrowing certainly stretched the fiscal resources he could command.

This section will argue that, fiscal strictures notwithstanding, Philip's finances were fairly well-run throughout the period. While borrowing was heavy, the king always had a good chance of repaying all his creditors in full. We establish this fact by first looking at conventional measures of debt sustainability. We then examine the perspective bankers might have had of Spain's chances to repay with a simulation method analogous to the Value-at-Risk calculations employed by modern financial institutions. Finally, we apply the more recent policy rules approach to look at the fiscal response of Habsburg Spain to rising levels of debt.

Traditional debt sustainability

There is a burgeoning literature on how debt sustainability is best defined. Most approaches agree that for spending and borrowing to be sustainable, the long-run level of the debt to GDP

ratio has to be stable. Only if spending plus debt service do not grow faster than national income can an explosion of debt be avoided. Aizenman and Pinto (2005) show that this is equivalent to

$$\Delta d_t = (pd_t - ndfs_t) + \frac{(r_t - g_t)}{(1+g_t)} d_{t-1} = 0 \qquad (1)$$

where Δd is the change in the debt to GDP ratio, *pd* is the primary deficit, *ndfs* are non-debt financing sources, *r* is the (nominal) rate of interest, and *g* is the (nominal) growth rate of GDP. For our purposes, we need to adapt equation 1. GDP figures for sixteenth century Spain are simply not available. In any case, the main challenge of all early modern states was to claim a share of existing incomes as taxes. We replace GDP by Crown revenue, and reinterpret *g* as the growth rate of revenues. This approach could produce problems because one might erroneously conclude that debt was sustainable because of rapidly rising revenues, while in fact the latter were overwhelming the economy's resources. This concern is somewhat allayed by the fact that overall fiscal pressure in Spain was low, reaching an estimated 9% of GDP by 1600 (Yun Casalilla 2002, pp. 79-80).

Table 2: Primary surplus of the Spanish Crown, 1560-1598.

Period	Average Yearly Fiscal Deficit (□ debt)	Average Yearly Revenue	Average Yearly Debt Service	Average Yearly PS (Debt service - deficit)	Average Yearly Expenditure (revenue - ps)	Yearly Debt Growth Rate	Yearly Revenue Growth Rate
1560-1565	-1,200,000	4,896,119	1,664,500	464,500	4,431,619	5.64%	9.21%
1565-1577	-916,667	7,150,000	2,295,500	1,378,833	5,771,167	3.09%	3.74%
1577-1598	-1,523,810	9,215,704	3,682,000	2,158,190	7,057,514	3.07%	0.53%
1560-1598	-1,289,474	7,995,010	2,978,697	1,689,224	6,305,786	3.41%	2.24%

Table 2 shows our calculation of the primary surplus as implied by the imperfect data on debt stock, debt service and revenues supplied by Artola (1982).[14] Throughout the period the king is running a primary surplus, implying that his expenditures net of debt service are lower than his revenues. In this minimalist sense, the finances of Philip II were not hopelessly overstretched – he was not borrowing to just pay interest for his debtors in the aggregate. In the first two periods, between 1560 and 1577, we find that debt is also growing more slowly than revenue. This is reversed in the final period, when debt is increasing six times faster than taxes and extraordinary revenues.

What do the figures in Table 2 imply about debt sustainability? If we assume that *ndfs=0*, we can rewrite equation 1 as

$$ps \equiv -pd = \frac{(r-g)}{(1+g)}d \qquad (2)$$

(suppressing time subscripts for convenience).

To stabilize the debt to revenue ratio, the primary surplus has to be sufficiently high to check the rise in the value of debt that comes from interest rates that are higher than the growth rate of revenues. Table 3 examines if the Spanish Crown's finances pass this test.

[14] In the early years Artola's data show revenues 20% higher than our own calculations. By using his data, we will find a lower rate of growth of revenues than we would using ours. Using a lower rate of revenue growth will bias our results in the direction of finding that borrowing was unsustainable for the purposes of this test, and hence against our argument.

Table 3: Debt sustainability during Philip II's reign.

Period	Debt as % of Revenue at beginning of period (dt-1)	Annualized change in debt as % of Revenue (Ddt)	Revenue Growth Rate (g)	Implied interest rate (r)	Primary surplus needed to stabilize debt (ps*)	Actual Primary Surplus as % of Revenue (ps)
1560-1565	453.22%	-1.36%	9.21%	11.17%	8.13%	9.49%
1565-1577	446.43%	-2.72%	3.74%	7.59%	16.56%	19.28%
1577-1598	413.79%	13.57%	0.53%	9.52%	36.99%	23.42%
1560-1598	453.22%	6.46%	2.24%	8.46%	27.59%	21.13%

Throughout the period, interest rates (as implied by the debt dynamics in equation 2 and the values in Table 2) are indeed higher than the growth rate of revenue. We find that for the first two periods, Philip ran primary surpluses that were bigger than necessary to make debt sustainable. This is reversed in the final period, when the primary surplus would have had to reach a very high value – 37% of revenue. While for most of his reign, Philip's expenditure does not appear reckless, the same cannot necessarily be said for the final 22 years.

If we define $\delta \equiv (1+g)/(1+r)$, we can derive:[15]

$$d_t = \sum_{i=1}^{\infty} \delta^i ps_{t+i} \tag{3}$$

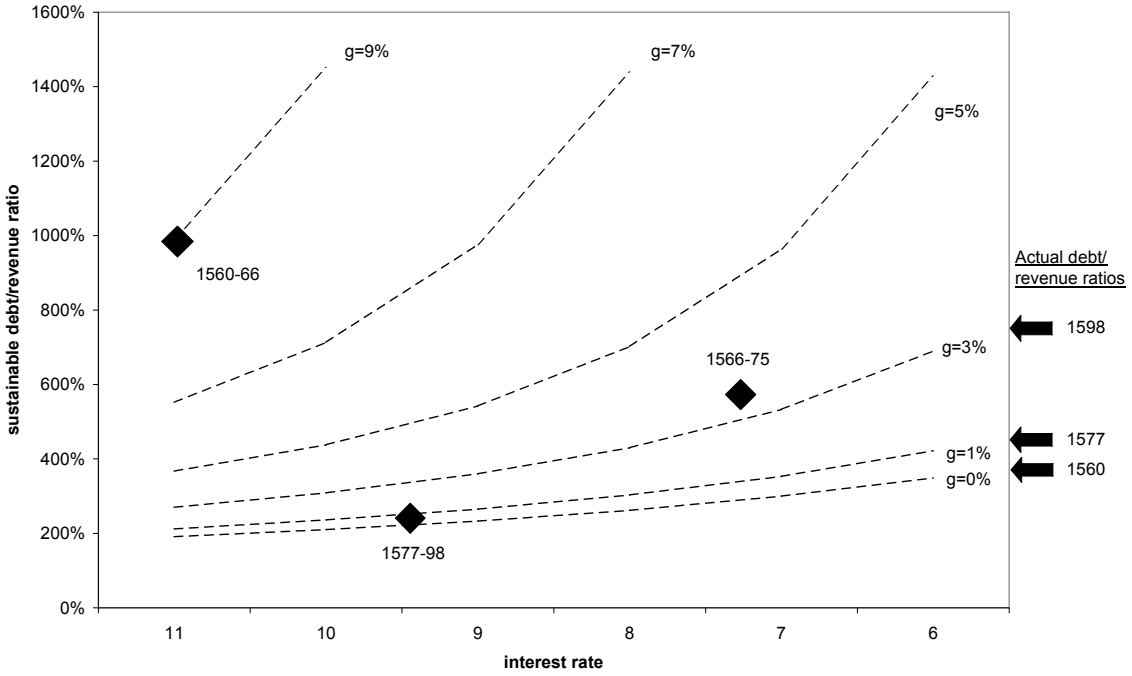
To be sustainable, primary deficits have to be eventually repaid by future primary surpluses, and debt today cannot be higher than the value of future discounted primary surpluses. Philip II never ran primary deficits during his reign, but the size of his primary surpluses sometimes fell short of the required rate to stabilize the debt to revenue ratio. Clearly, falling short of *ps** for a few years, or by a narrow margin, is not enough to conclude that the chance of repaying existing debts was zero. What can we say about the range of scenarios during which Philip's borrowing was still in a range when the sustainability condition 3 would have held?

[15] Aizenmann and Pinto (2005).

We know both *d* and the average size of *ps*. We already know that to make debt sustainable on average, Philip would have had to run surpluses of 28% of revenue on average during his reign, when the actual number was 21%. How different would a world have to look in which 21% would be a sustainable figure? We can derive the growth rate of revenue necessary to sustain the initial debt to revenue ratio of 453%, holding the interest rate *r* constant. It turns out that with growth of 3.7%, even the lower primary surplus could have been sufficient to stabilize the debt ratio. For most of the period, the king's revenue grew at least as fast, if not faster. The period between 1560 and 1577 saw revenues climb at this rate. Alternatively, a fall in interest rates to 6.97% would have rendered the existing debt ratio sustainable. To make debt at the 1598 level sustainable, given the surplus of 23%, revenues would have had to climb at a clip of 6.05% per year. Alternatively, a decline in interest rates to 3.7% would have made the debt burden manageable.

Figure 4 maps the actual rates of change in revenues and the implicit interest rates onto the grid of sustainable debt to revenue ratios. The dotted lines give combinations of interest rates and debt-revenue burdens that are sustainable, for a given a growth rate of revenues. The diamonds indicate the debt ratios that would have been sustainable during our three sub-periods, given the historical interest rates and revenue growth rates that derived earlier. The arrows on the right-hand side show how actual debt to revenue ratios compare. For the first two periods, actual debt-revenue ratios are actually below the "speed limit" derived from equation 3. However, as expenditure swelled and revenue growth faltered after 1577, the debt burden started to look too high relative to standard benchmarks.

Figure 4: Sustainable debt/revenue ratios in Spain, 1560-98



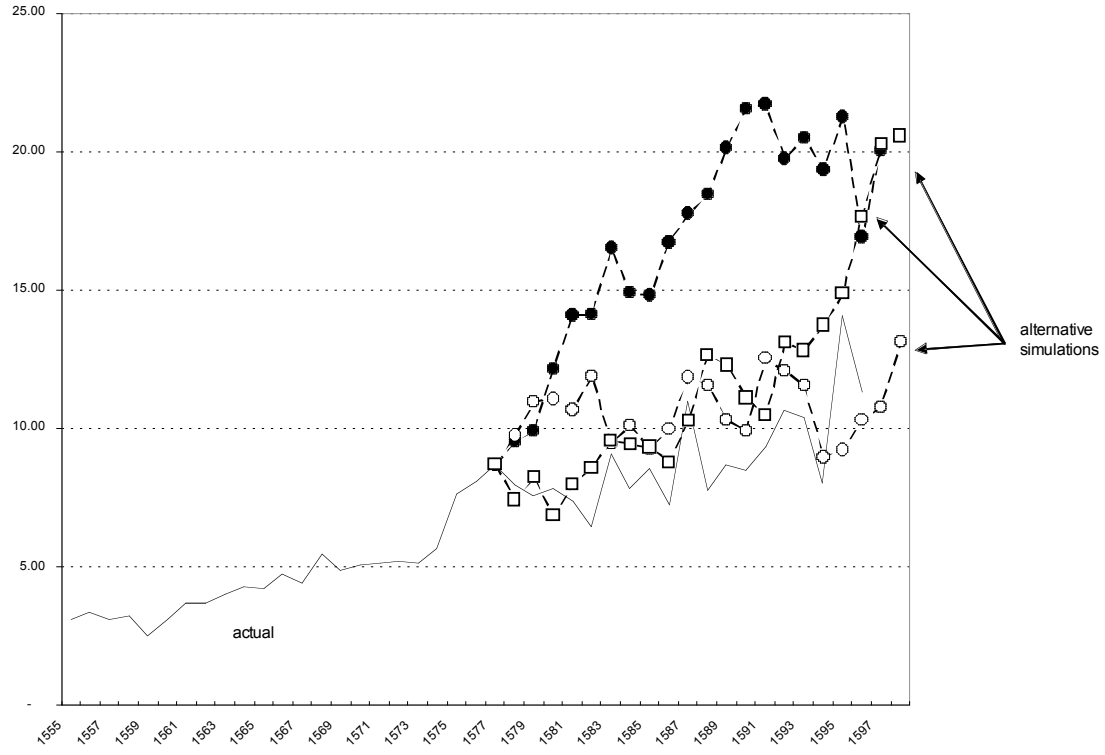
Our calculations so far suggest that until 1577 debt was probably sustainable. Thereafter this is a more questionable assumption. That debt in the end turned out to be high is interesting, but it should not conclude our examination. We are interested in the ex-ante rationality of lending behavior. The fact that ex post the king's debt turned out to be high does not prove that lenders who extended credit in, say, 1585 were irrationally exuberant. They may have simply been unlucky.

Static simulation

To examine this further, we use Monte Carlo simulations of possible future debt paths. Our methodology is analogous to the Value-at-Risk techniques employed by modern financial institutions to calculate the probable loss in their portfolios within a given confidence interval (Jorion 2006). We start from the average growth rate of revenues from 1560-1577 (4.9%), and the

observed standard deviation of revenue increases (12.4%). Assuming that debt growth is exogenous, we can calculate the range of likely final debt to revenue ratios. Figure 5 illustrates the kind of revenue paths that our model generates. We repeat the exercise 10,000 times, and then ask how often the debt to revenue ratio turns out to be below the 453% figure that would have been sustainable based on the primary surpluses of the year 1560-77. It turns out that for 7,203 of our simulated paths, revenue growth would have been sufficient to keep debt manageable. There is also a non-negligible range of outcomes (2,797 results) when revenue growth would have been too low.[16]

Figure 5: Simulations of revenue paths



[16] In this exercise a higher variance in the revenue series used to initialize the simulation leads to a higher number of unsustainable debt paths. We use our own data, rather than Artola's, to calibrate the exercise; since our revenue estimates exhibit higher variance, using them biases the results against finding a large number of sustainable paths.

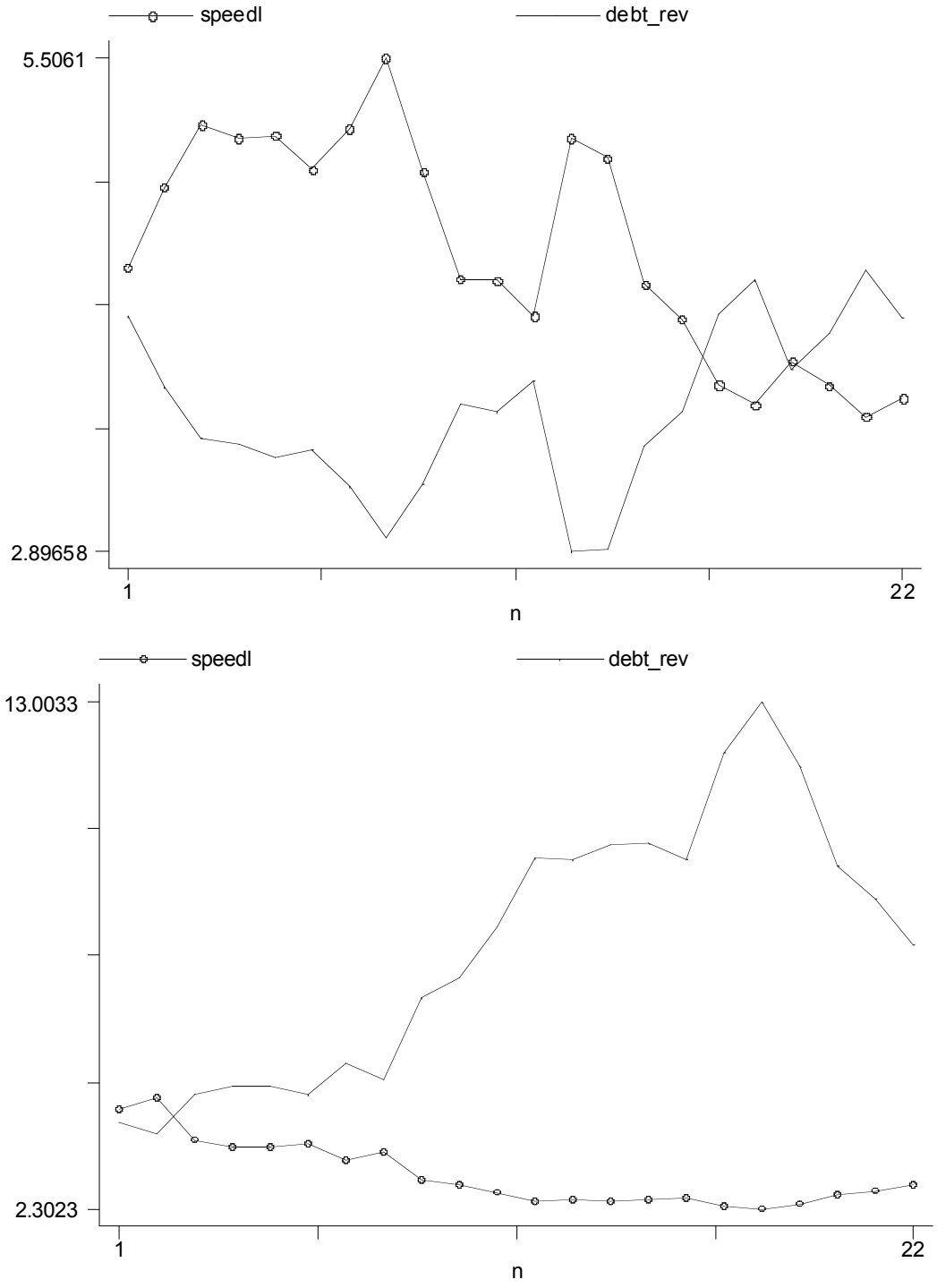
Dynamic simulation

The method in the previous sub-section involves a questionable shortcut. We implicitly assume that lenders do not update their beliefs about the likely future revenue paths as realizations of shocks after 1577 arrive. This is clearly unrealistic. The alternative is to calculate new "speed limits" for the debt-revenue ratio as new fiscal news emerges, and then compare this to the implied level of indebtedness. This approach has the advantage that, instead of mechanically applying the 453% debt-revenue ratio as a maximum (as before), we now allow this threshold to move as good or bad fiscal news materializes. The top panel of Figure 6 gives an example of how a potential revenue path, and the sustainability limits driven by it, can look. A sequence of benign surprises pushes up the "speed limit", and lowers the debt-revenue ratio. We keep the primary surplus constant at the average level for 1565-1577 (19.3%). For most of the 22 periods between 1577 and 1598, the debt to revenue ratio is sustainable. However, this is reversed later in the period as a result of random shocks. Eventually, debt becomes too high. In this case, 5 out of 22 years do not meet the sustainability criterion.

We again run the simulation 10,000 times, and reach unsustainable debt levels in 28.5% of all cases. This is an upward-biased estimate of the true value; presumably, bankers would have curtailed lending at some point as debt grew ever larger. Also, there are quite a few runs of the simulation when debt ratios appear unsustainable, and then drop to manageable levels. Given the stochastic properties of the revenue series, the lack of sustainability is not an irreversible death sentence; it is often enough a passing illness. The bottom panel of Figure 6 gives an example of a

debt path that, while possible in our simulation, would probably not have occurred in sixteenth century Spain.

Figure 6: Examples of dynamically simulated debt paths.



There are also numerous "near misses", where a small change in the primary surplus would readily yield much more favorable numbers. If we used the actual average primary surplus for the period 1577-98 (23.4%) in our dynamic simulations, we would conclude that 81% of all debt paths are sustainable. Table 4 reports the percentage of sustainable debt paths under varying assumptions for the size of the primary surplus.

Table 4: Debt sustainability under uncertainty: percentage of sustainable years, as a function of the primary surplus.

Historical Period	Primary Surplus	Percentage of years with a debt to revenue ratio above sustainability
Hypothetical	10.0	71.0
Average 1560-77	16.4	38.0
Average 1566-77	19.3	28.5
Average 1577-98	23.4	28.8
Hypothetical	26.0	15.0
Hypothetical	30.0	9.0
Hypothetical	35.0	6.0

Despite stacking the odds against such a finding, even lending during the period 1577-98 shows few of the signs of the kind of excess optimism that would be necessary for the rational bubble interpretation. The majority of debt paths was sustainable, even if we vastly exaggerate the extent to which the sovereign could have piled up debt independently of drops in revenue.

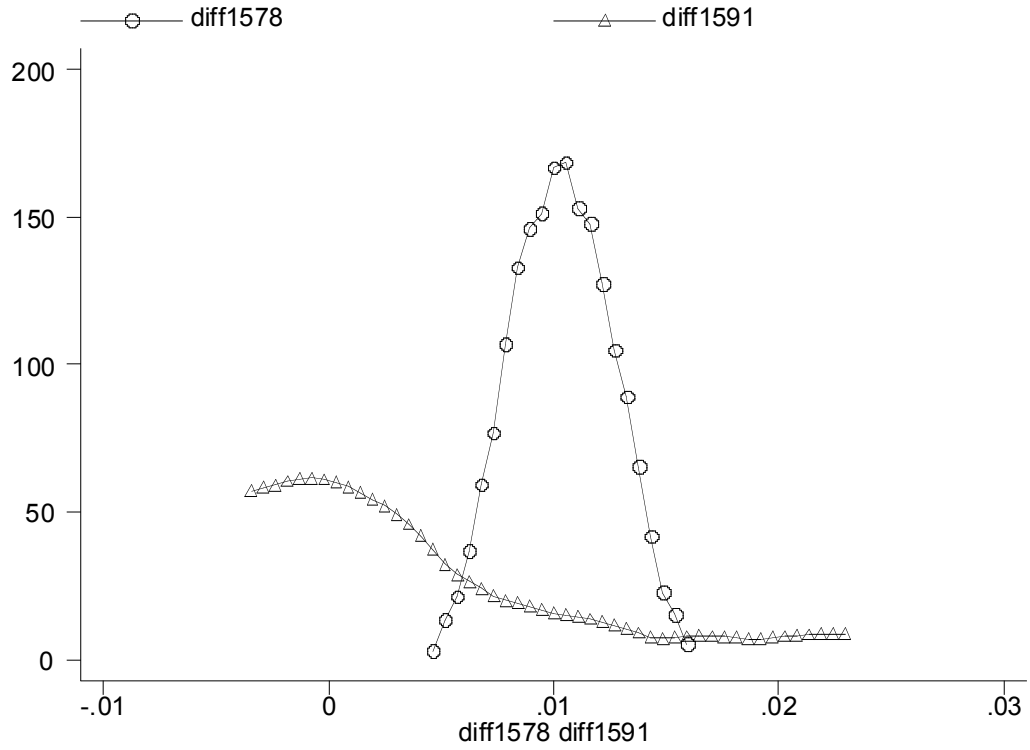
So far, we have used simulated revenues, combined with historical primary surpluses and debt accumulation to evaluate the sustainability of future debt paths. We effectively assumed that the debt accumulation process is independent of the realization of the revenue path. We also did not link the attainable primary surpluses in our simulations to the evolving level of indebtedness. To build a fully dynamic model, we simulate both revenue and debt paths, based on historically

observed average growth rates and their variability. For each year t after 1577, we simulate a 20-year path of revenues and debt. The primary surplus is calculated as the budget surplus net of interest rate costs, where expenditure overall is the sum of revenues and net debt growth. We then calculate, for each year in the simulation, the primary surplus necessary to stabilize the debt/revenue ratio, and compare it with the actual one. For the period of the entire simulation, we compare the average primary surplus (ps) and the necessary one to stabilize debt (ps*). If the ps>ps*, we count the hypothetical fiscal path as sustainable. The exercise is then repeated for each year between 1577 and 1598, with updated parameters of the growth rates of debt and revenues. Note that we employ a slightly different criterion here for sustainability – instead of counting every single year in which ps≤ps* as a unsustainable, we take, say, the average of ps for the (simulated) period 1583-1603, and compare it with average ps* for the same range of dates. We then repeat the process 1,000 times, yielding a total of 22,000 simulated yearly observations for which we calculate revenue/debt ratios, actual ps, and ps*.

To illustrate our results, Figure 7 plots the difference between required and simulated primary surpluses for two starting years in our simulation – 1578 and 1591. Here, positive values indicate sustainability. For the earlier period, all values are positive, indicating that the debt path would have been sustainable under all scenarios. In the later period, this is no longer true. While the bulk of simulations indicate a positive gap between ps and ps*, a small share is actually below the threshold. In all cases, the difference here is relative small – less than a one percent gap relative to revenue. Simulating 1,000 times, we find that the 318 fiscal paths are unsustainable over the 20 years following 1591. The same is true of only 71 paths after 1577. The difference between these two frequencies is an indicator of the deterioration in the fiscal situation of

Habsburg Spain. On average, where there was a negative gap between required and actual primary surplus, it amounted to 2.4 percent of revenue in 1591, and to 1.4 percent in 1578.

Figure 7: Difference between PS and PS*, 1578 and 1591



A crucial underlying assumption for our calculations is that all debt is captured by the figures in Table 1. In a simple accounting sense, we know this not to be true – the debt encompasses all *juros*, but none of the short-term *asientos*. However, since the benchmark years are the years of default, all short-term *asientos* have been converted into long-term debt. We have therefore determined the ex-ante sustainability of Spanish debt under the assumption that the defaults and conversions were anticipated, and that they could be repeated in the future – that they were part of a sustainable, repeated interaction between Crown and lenders.

Changing fiscal behavior

One standard test for sustainability examines if there is a unit root in the debt to GDP ratio. We do not have access to GDP figures on an annual basis, but we can test the time-series properties of our data. Table 5 presents the results. The results are inconclusive throughout. For debt, the ADF-test suggests that we cannot reject non-stationarity at the 5% level of confidence. The KPSS test marginally rejects stationarity at the five percent level. For the debt to revenue ratio, we fail to reject either non-stationarity or stationarity. These results for debt ratios are typical since the power of stationarity tests is often low, especially if series have a near-unit root. The only conclusion that the time-series tests in Table 5 permit is that perhaps the debt and the primary surplus in absolute terms may be non-stationary.

Table 5: Time-series properties of debt and primary surplus

Variable	Augmented Dickey-Fuller	KPSS
primary surplus	-0.3 (-2.4)	0.457 (0.46)
debt	0.98 (-2.4)	0.48 (0.46)
ps / revenue	-0.95 (-2.8)	0.27 (0.46)
debt / revenue	-0.66 (-2.5)	0.18 (0.46)

Note: The null for the DF-test is non-stationarity; for the KPSS, it is stationarity. Five-percent critical values are in parentheses. We use a DF-implementation based on GLS. The lag length was chose according to the Schwert criterion (8 lags in all cases). All estimation without trend.

Inspired by the statistical problem of testing for non-stationarity in debt series, Bohn (1998) develops an alternative method. He shows that if the primary budget surplus increases significantly with the level of debt, the fiscal situation is sustainable – increases in the debt to GDP ratio are reversed sooner or later by greater financial stringency or higher revenues. Bohn examines US borrowing over the twentieth century, a period for which it is possible to scale by

GDP. We do not have access to annual estimates of GDP. Since we are interested in a relatively short period of time, and since we know that GDP growth in the early modern period in general was relatively slow, we will use unscaled figures. As a robustness check, we will also experiment with scaling by revenues.

In order to estimate this relationship, we need yearly series of revenues and primary surpluses. Our revenue series is reported in Table A1. Primary surpluses are more complicated to derive. In the absence of expenditure data, we can only calculate them as the difference between the overall fiscal deficit and interest payments. Calculating the overall fiscal deficit requires knowing the stock of debt for every year, while our data for outstanding *juros* covers only four data points, 1560, 1565, 1577 and 1598. In order to estimate the remaining values, we use our series of *asientos* and the observed change in total debt between benchmark years. Table A4 in the appendix presents our estimates of outstanding *juros*, interest payments, fiscal deficits and primary surpluses; the accompanying note discusses our estimation technique in detail.

We estimate linear, log and quadratic forms of the basic policy function

$$s_t = \rho \bullet d_t + \varepsilon_t \qquad (4)$$

where d_t is the debt stock, and s_t is the primary surplus. In addition to using absolute values, we also employ primary surpluses and debt divided by revenue. Figure 8 illustrates the relationship for the log specification. We find that primary surplus during the reign of Philip II reacted strongly and positively to increasing debt levels – the estimated coefficient implies that for every doubling of the debt stock, the primary surplus increased by 174%. The coefficient is significantly different from zero, and an F-test confirms that it is higher than unity at the 90%

level of confidence.[17] Table 6 shows that we find statistically significant and economically meaningful effects of higher debt on the size of the primary surplus run by Philip and his Council of Finance. In each specification, from absolute values to logs and a quadratic one, we find the same mechanism at work. As loans accumulated, the king's finances were put on an ever stricter diet – debt accumulation was not a Ponzi scheme where fresh borrowing simply paid the interest on old loans. Only in the case of using the debt/revenue ratio do we find an insignificant coefficient. This is because revenue was increasing rapidly as debt grew – the correlation coefficient between the two series is 0.18 (insignificant even at the 34% level). Since we have to consider possible non-stationarity in our series, we also use cointegration analysis. A Johansen test – assuming no trend in the data generating process – confirms that there is precisely one cointegrating vector between our series. The estimated coefficient suggests an even greater positive effect of higher debt on the primary surplus than the OLS estimates.

If we accept that dividing by GDP would not alter our results markedly, we can compare the coefficients in Table 6 with those obtained by Bohn (1998). He found adjustment parameters in the policy reaction functions ranging from 0.028 to 0.054 for the US, 1916-95. His figures are below the ones we find for Habsburg Spain, which suggests that the fiscal policy under Philip was at least as "virtuous" (i.e. committed to sustainability) as that of the twentieth century US.

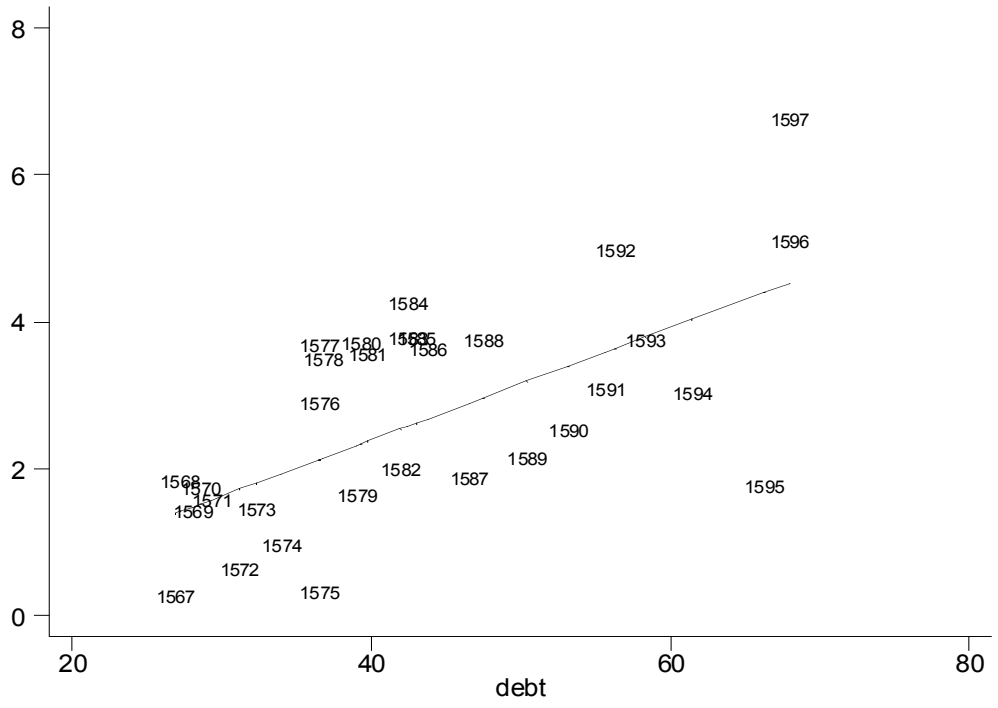
[17] We also experimented with estimating an AR(1) model of the primary surplus. The coefficient ρ in that case is 1.41, still above unity.

Table 6: Response of the primary surplus to debt accumulation

Model of d_t	Constant	d_t	$(d_t-d_a)^2$	R^2/Chi^2	N
Linear	-0.66 (0.76) [0.2]	0.076 (3.58) [3.3]		0.39	31
Log	-5.77 (3.2) [2.99]	1.744 (3.7) [3.47]		0.34	31
Quadratic	-0.84 (1.1) [0.5]	0.084 (5.1) [4.99]	-0.001 (0.7) [1.94]	0.41	31
Log, scaled by revenue	-1.6 (1.11) [1.1]	0.17 (0.2) [0.2]		0.001	31
Cointegrating Vector from VEC	-1.12	0.147 (13.2)		175.1	31

Note: t-statistics in brackets derived from heteroskedasticity-robust standard errors. T-statistics in square brackets derived from Newey-West estimation to correct for autocorrelation of errors with lag length (1) as in Bohn (1998). For the cointegrating vector, we report the z-statistic and Chi^2 instead of the t-statistic and the R^2.

Figure 8: Response of the primary surplus to debt (millions of ducats).



Conclusions

In the history of fiscal policy, Spain under Philip II occupies a special role. Few countries, according to the standard account, managed to borrow so much with such poor finances. In his hallmark account of the Mediterranean economy in the age of Philip II, Braudel describes how the Spanish state's "expenditure continued to rise above all reasonable limits while its income was declining, with a visible drop in fiscal revenues" (Braudel 1966, p. 511).

We resolve the apparent paradox by demonstrating that the Spanish king's finances remained sustainable throughout the period. While debt levels eventually became high, successful attempts to raise revenue combined with windfalls from the Indies produced a constant primary surplus, with the king borrowing less than he spent on interest and debt repayments. Far from presiding over declining tax revenues, Habsburg Spain proved highly successful in squeezing additional income from the territories it ruled (with the brunt of the fiscal pressure borne by the Castilian taxpayer). We provide a variety of tests that show that in response to the accumulating debt, decisive corrective action was taken. At least on some counts, Habsburg Spain did more to assure the long-term viability of its debt than the US in the 20th century. Far from being a sign of banker gullibility, the privileged access to credit enjoyed by Habsburg Spain indicated the strength of its fiscal position.

Our results suggest that future research should address two questions. First, relative fiscal health does not answer the more fundamental question why the Spanish king managed to borrow at all – why an Early Modern monarch as powerful as Philip II could credibly commit to repay. Second, we would like to know how much of a difference the so-called defaults really made to those

financiers who bankrolled the various Habsburg adventures. Traditional accounts suggest that each rescheduling left scores of them reeling. If our re-interpretation of the evidence is correct, we would predict that rates of turnover amongst bankers lending to the king was much lower than has previously been thought.

Data Appendix

Table A1: Revenues by Type, 1555-1596

Year	Sales tax	Customs (internal and external)	Monopolies	Direct taxes	Millones	Church revenues	Confiscation	Indies	Total
1555	0.933	0.513	0.399	0.432	0.000	0.411	0.000	0.372	3.061
1556	0.933	0.513	0.405	0.404	0.000	0.411	0.000	0.704	3.369
1557	0.939	0.500	0.404	0.404	0.000	0.411	0.000	0.425	3.083
1558	0.939	0.497	0.404	0.404	0.000	0.307	0.000	0.644	3.195
1559	0.939	0.490	0.330	0.404	0.000	0.307	0.000	0.000	2.470
1560	0.939	0.515	0.331	0.404	0.000	0.307	0.034	0.573	3.102
1561	0.939	0.585	0.375	0.565	0.000	0.506	0.000	0.704	3.674
1562	1.277	0.690	0.440	0.537	0.000	0.506	0.000	0.199	3.650
1563	1.277	0.720	0.483	0.537	0.000	0.533	0.000	0.455	4.005
1564	1.277	0.737	0.542	0.404	0.000	0.807	0.000	0.474	4.241
1565	1.277	0.781	0.575	0.404	0.000	0.807	0.000	0.352	4.197
1566	1.277	0.791	0.532	0.404	0.000	0.807	0.000	0.921	4.732
1567	1.277	1.076	0.501	0.432	0.000	0.554	0.202	0.368	4.411
1568	1.277	1.132	0.505	0.404	0.000	0.522	0.427	1.210	5.477
1569	1.277	1.136	0.484	0.404	0.000	0.360	0.260	0.949	4.870
1570	1.277	1.064	0.520	0.537	0.000	0.554	0.079	1.010	5.041
1571	1.277	1.115	0.537	0.537	0.000	0.597	0.008	1.068	5.139
1572	1.277	1.083	0.527	0.537	0.000	0.597	0.554	0.605	5.179
1573	1.277	1.090	0.549	0.432	0.000	0.867	0.181	0.708	5.103
1574	1.277	0.985	0.587	0.404	0.000	1.316	0.411	0.700	5.680
1575	3.091	0.975	0.616	0.404	0.000	1.018	0.619	0.917	7.639
1576	3.715	0.978	0.579	0.404	0.000	1.260	0.135	0.988	8.059
1577	3.715	1.000	0.583	0.404	0.000	1.233	0.040	2.168	9.143
1578	2.715	0.994	0.661	0.404	0.000	1.431	0.301	1.448	7.953
1579	2.715	1.006	0.652	0.444	0.000	1.290	0.025	1.437	7.568
1580	2.715	0.992	0.636	0.404	0.000	1.286	0.042	1.739	7.813
1581	2.715	0.983	0.592	0.404	0.000	0.933	0.000	1.737	7.364
1582	2.715	0.994	0.442	0.404	0.000	1.336	0.049	0.498	6.437
1583	2.715	1.014	0.472	0.404	0.000	1.274	0.000	3.200	9.078
1584	2.715	1.037	0.472	0.404	0.000	1.299	0.067	1.857	7.850
1585	2.715	1.018	0.472	0.439	0.000	1.310	0.359	2.226	8.539
1586	2.715	1.038	0.533	0.404	0.000	1.314	0.350	0.890	7.243
1587	2.715	1.028	0.524	0.404	0.000	1.432	0.382	4.472	10.957
1588	2.755	0.993	0.595	0.404	0.000	1.211	0.281	1.519	7.757
1589	2.755	0.999	0.529	0.404	0.000	1.338	0.356	2.322	8.703
1590	2.755	1.020	0.869	0.404	0.000	1.384	0.202	1.836	8.469
1591	2.755	1.033	0.896	0.444	1.338	1.378	0.788	0.697	9.329
1592	2.755	0.974	0.825	0.404	1.338	1.380	0.000	2.985	10.660
1593	2.755	1.008	0.912	0.404	1.338	1.283	0.592	2.089	10.381
1594	2.755	1.015	0.816	0.404	1.338	1.438	0.230	0.000	7.996
1595	2.755	1.017	1.010	0.404	1.333	1.476	0.325	5.738	14.058
1596	2.755	1.026	0.784	0.404	1.333	1.501	0.108	3.418	11.328

Table A2: Asientos

Year	Ducats	Year	Ducats
1520	4,454	1566	2,383,267
1521	55,834	1567	6,771,667
1522	156,502	1568	1,218,569
1523	348,103	1569	2,985,840
1524	60,858	1570	2,001,444
1525	172,415	1571	2,781,994
1526	358,224	1572	6,636,996
1527	472,917	1573	4,009,997
1528	599,668	1574	6,210,887
1529	794,567	1575	5,106,521
1530	830,467	1576	
1531	904,406	1577	
1532	620,638	1578	426,667
1533	5,225	1579	4,573,333
1534	222,473	1580	526,667
1535	764,733	1581	887,788
1536	981,600	1582	4,430,175
1537	970,004	1583	978,889
1538	830,655	1584	
1539	842,334	1585	1,043,456
1540	366,100	1586	1,531,004
1541	110,609	1587	5,564,531
1542	343,936	1588	1,992,285
1543	1,742,301	1589	5,778,554
1544	1,424,778	1590	5,554,480
1545	353,182	1591	4,939,000
1546	1,708,020	1592	1,265,724
1547	451,026	1593	4,127,957
1548	484,811	1594	6,189,055
1549	147,370	1595	9,635,737
1550	615,933	1596	3,324,565
1551	1,470,195		
1552	3,595,147		
1553	2,271,108		
1554	1,258,368		
1555	1,091,813		
1556	1,427,433		

Table A3: Debt service and tevenue for available years (in millions of ducats).

Year	Revenue	Juros service	Juros service / Revenue
1555	3.061	0.878	28.69%
1560	4.192	1.468	35.03%
1566	4.393	1.861	42.37%
1573	5.189	2.752	53.03%
1575	7.496	2.730	36.42%
1584	7.845	3.273	41.72%
1596	9.731	4.634	47.62%

Table A4: Yearly estimates of juros, fiscal deficit, interest payments and primary surplus

Year	Asientos	Outstanding Juros	Fiscal deficit	Interest rate	Interest payments	Primary Surplus
1566	2.383	25.000				
1567	6.772	26.862	1.862	7.59%	2.039	0.177
1568	1.219	27.197	0.335	7.59%	2.064	1.729
1569	2.986	28.018	0.821	7.59%	2.127	1.305
1570	2.001	28.569	0.550	7.59%	2.168	1.618
1571	2.782	29.334	0.765	7.59%	2.226	1.461
1572	6.637	31.159	1.825	7.59%	2.365	0.540
1573	4.010	32.262	1.103	7.59%	2.449	1.346
1574	6.211	33.970	1.708	7.59%	2.578	0.870
1575	5.107	36.523	2.553	7.59%	2.772	0.219
1576	0.000	36.523	0.000	7.59%	2.772	2.772
1577	0.000	36.523	0.000	9.52%	3.477	3.477
1578	0.427	36.736	0.213	9.52%	3.497	3.284
1579	4.573	39.023	2.287	9.52%	3.715	1.428
1580	0.527	39.286	0.263	9.52%	3.740	3.477
1581	0.888	39.730	0.444	9.52%	3.782	3.338
1582	4.430	41.945	2.215	9.52%	3.993	1.778
1583	0.979	42.435	0.489	9.52%	4.040	3.550
1584	0.000	42.435	0.000	9.52%	4.040	4.040
1585	1.043	42.957	0.522	9.52%	4.089	3.568
1586	1.531	43.722	0.766	9.52%	4.162	3.397
1587	5.565	46.504	2.782	9.52%	4.427	1.645
1588	1.992	47.500	0.996	9.52%	4.522	3.526
1589	5.779	50.390	2.889	9.52%	4.797	1.908
1590	5.554	53.167	2.777	9.52%	5.061	2.284
1591	4.939	55.636	2.470	9.52%	5.297	2.827
1592	1.266	56.269	0.633	9.52%	5.357	4.724
1593	4.128	58.333	2.064	9.52%	5.553	3.489
1594	6.189	61.428	3.095	9.52%	5.848	2.753
1595	9.636	66.246	4.818	9.52%	6.307	1.489
1596	3.325	67.908	1.662	9.52%	6.465	4.803
1597	0.000	67.908	0.000	9.52%	6.465	6.465
1598	0.000	68.000	0.092	9.52%	6.474	6.382

Notes on the estimation of the yearly outstanding juros, fiscal deficit, interest payments, and primary surplus: As discussed in section II, short-term loans were a very expensive source of financing for the king, who used them to cover specific financial needs but sought to converted them into *juros* as soon as he could. Each *asiento* was either repaid, converted into a *juro*, or a combination of the two. For each period between our benchmark dates, we add up total short-term borrowing and estimate the repayment ratio for the whole period by dividing the increase in long term debt by total short-term lending. We then assume that the repayment ratio was constant for the whole period, and multiply the series of *asientos* by the repayment ratio to estimate the amount added to the stock of *juros* each year. Next, we calculate interest payments on *juros* multiplying their stock by the implied interest rates derived in Table 2. Finally, we calculate the primary surplus by subtracting interest payments from the change in the stock of debt (fiscal deficit).

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