Persistent Gaps and Default Traps

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This version: March 15, 2007

Abstract

We show how virtuous and vicious circles in countries' credit histories arise in a model where output persistence is coupled with asymmetric information between borrowers and lenders about the nature of output shocks. In such an environment, a default creates a pessimistic outlook about the borrower's output path. This translates into higher debt to expected output ratios, pushing up interest spreads and hence debt servicing costs; by raising the cost of future repayments, this creates "default traps". We provide empirical support for the model by building a long and broad cross-country dataset spanning over a century. This data is used to highlight main stylized facts about defaults and to provide econometric evidence that the effects of persistence on sovereign creditworthiness are significant after controlling for other determinants of sovereign risk.

JEL Classification: F34, G15, H63, N20.

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[§]Preliminary version, comments welcome. The views expressed in this paper do not necessarily reflect those of the IMF.

1 Introduction

Two main stylized facts permeate the history of sovereign borrowing. The first is serial default. Lindert and Morton (1989) find that countries that defaulted over the 1820-1929 period were, on average, 69 percent more likely to default in the 1930s, and that those that incurred arrears and concessionary schedulings during 1940-79 were 70 percent more likely to default in the 1980s – clearly suggestive of substantial persistence in creditworthiness patterns. While these probability estimates are not conditioned on countries' fundamentals, evidence provided in Rogoff, Reinhart, and Savastano (2003) indicates that serial default is only loosely related to countries' indebtedness levels and other fundamentals. They show that such serial defaulters have lower credit ratings and face higher spreads at relatively low indebtedness levels – a phenomenon they call "debt intolerance". The experience of such debt-intolerant countries – which embark upon a vicious circle of borrowing, defaulting and being penalized with higher interest rates – stands in sharp contrast with that of countries that manage to undergo a "virtuous circle" of borrowing and repayment with declining sovereign spreads. In short, the historical evidence to date overwhelmingly points to substantial persistence in creditworthiness patterns and the possibility of "default traps".

A second main empirical regularity about the sovereign borrowing is that default rarely entails complete exclusion from international capital markets. This regularity is at odds with the classical incentive mechanism for debt repayment underlying Eaton and Gersovitz's (1981) seminal model, in which the threat of permanent exclusion from capital markets tends to deter default if domestic income is sufficiently volatile.[1] In practice, default is often "punished" not through outright denial of credit but through a worsening of the terms on which the country can borrow – absolute exclusion representing only the limiting case in which the country spread is prohibitively large for

[1]Since then, the sovereign debt literature has evolved out of this benchmark by allowing for coordination problems among multiple lenders that render exclusion problematic (Kletzer, 1984), in addition to the fact that if borrowers retain the ability to invest in international assets, default-free lending may not be sustainable without other penalties (Bulow and Rogoff, 1989). But see Kletzer and Wright (2000) for qualified reinstatement of the original Eaton and Gersovitz result based on the "cheater of the cheater" game-theoretical argument.

any positive borrowing to take place. Even then, absolute exclusions spanning several years are not only rare, but also temporary loss of market access has not been strikingly long on average: recent estimates using micro data on international loans and bond issuance put it at 2 1/2 years for the post-1980 period (Gelos et al., 2004).

In this paper, we argue that two structural features which are typically found in emerging markets (EMs) help explain both stylized facts. These are that output shocks are not only typically large, thus producing high cyclical variability about trend growth, but also that such shocks tend to be highly persistent. That output volatility is generally high among emerging markets is a well-documented phenomenon (see, e.g., Kose, et. al., 2006). Recent work has related it to a number of long-lasting structural features, ranging from domestic institutions and commodity specialization to imperfections in international capital markets which make it difficult for these countries to issue domestic-currency denominated sovereign debt, thus rendering them more vulnerable to currency fluctuations (Acemoglu et. al, 2004; Blattman et al, 2006; Eichengreen et al. 2003). Previous work (Catão and Kapur, 2006), has shown that the net effect of high historical volatility in output and terms of trade is both to increase default risk and to reduce average borrowing, even after controlling for a host of other macroeconomic fundamentals as well as for borrowers' credit histories. This helps explain what that paper called the paradox of "debt intolerance" – that is, more volatile countries which need to borrow the most to smooth consumption, are precisely the ones that are constrained from doing so at lower debt levels due to the riskiness that volatility engenders.

What has received little attention in the sovereign debt literature, however, is the fact that such output volatility is often coupled with considerable persistence of output shocks. On a theoretical level, there are well established channels which help explain why shock persistence can be expected to be typically high in EMs. One is simply associated with supply-side inelasticities over the short-run which make primary commodity price shocks highly persistent; to the extent that primary commodities remain key export items for many EMs, this helps drive much of the aggregate terms of trade and output persistence in these countries.[2] The other is associated with various frictions

[2]See Cashin et al. (2000) and references therein for empirical evidence on the persistence of commodity price shocks. Mendoza (1995) finds that terms of trade variations

(political as well as economic) that make fiscal policy much more procyclical in some countries relative to others. Gavin and Perrotti (1997) and Kaminsky, Reinhart and Vegh (2004) provide empirical evidence that fiscal procylicality is typically higher in emerging markets than in advanced countries – and the more so among countries that are shown below to have serially defaulted. To the extent that a contractionary fiscal stance tends to exacerbate the severity of recessions and delay recoveries, then such fiscal procyclicality clearly increases output persistence.[3] A third mechanism which adds to the persistence of output shocks pertains to financial/institutional frictions that exacerbate the sensitivity of domestic credit to loan collateral values. To the extent that the latter is cyclically sensitive to a variety of demand and interest rate shocks (e.g. real state), and both domestic output and investment are subject to binding credit constraints related to such collateral values, as for instance in Kiyotaki and Moore (1997), the credit transmission mechanism can then generate prolonged spirals of output contraction or expansion, including painful episodes of debt deflation. Insofar as such frictions are more prominent in EMs and often coupled with protracted balance-sheet adjustments stemming from currency-denomination mismatches (see, e.g., Calvo, 1998; Mendoza, 2005), they also help explain higher shock persistence in those economies.

These theoretical considerations raise the question as to whether output has indeed been typically more volatile and persistent in emerging markets than in advanced countries and, particularly so among serial default-

typically account for up to one-half of business cycle fluctuations in developing countries, so also helping explaining output persistence through this channel. Acemoglu et al. (2005) discuss institutional reasons as to why commodity specialization can be highly persistent historically.

[3]Talvi and Vegh (2005) theoretically examine the role of domestic political frictions in accounting for such procylicality, whereas Eichengreen, Hausmann and Panizza (2005) explain greater fiscal procyclicality in developing countries in terms of the incompleteness of international financial markets. As this incompleteness limits long-term external borrowing in these countries" own currency, when bad shocks hit (which typically entail a currency depreciation or devaluation), the cost of public borrowing rise accordingly; this in turn forces these countries to undergo contractionary fiscal adjustment or at least limits the scope for counter-cyclical fiscal policies. Since the same mechanism is deemed to operate in reverse during good shocks, the overall persistence of such shocks is magnified through the fiscal channel. Guidotti et al. (2005) provide empirical evidence consistent with this theoretical story, in that more "dollarized" countries tend to display slower recoveries following capital account shocks ("sudden stops").

ers. Tables 1 and 2 provide suggestive evidence.[4] Using data spanning the century-and-quarter period from dawn of international bond financing in the 1870s through 2004, the Tables report the standard deviation as well as the first autoregressive coefficient of HP-filter de-trended output for each country over the three main sub-periods delimited by the World Wars.[5] As is immediately apparent from group medians at the bottom of the two tables, defaulting countries typically display higher volatility and persistence than non-defaulting countries on average. Further, these cross-countries differences appear to be typically even higher between serial defaulters and non-defaulters, and are consistently observed for certain countries over the entire 1870-2004 period. Tables 1 and 2 also suggest that the postulated relationship appears to be robust to potential reverse causality emanating from the effects of defaults on the volatility and persistence of output shocks: when we eliminate from the sample all default events and their immediate aftermaths (see the Appendix for details), defaulters continue to display greater output volatility and shock persistence relative to their more virtuous peers.

Against this background, this paper lays out a bare-bones model to examine the effects of stochastic output shocks and their persistence on sovereign risk. We deliberately abstract from the ultimate sources of persistent shocks - which have been studied elsewhere - choosing to focus instead on their potential effects on repayment decisions and sovereign spreads over consecutive periods. The key ingredient of our model is the combination of shocks that persist and asymmetric information between borrowers and lenders about the extent of such persistence. Three main theoretical results are derived in this context.

First, if macroeconomic shocks are persistent, higher spreads following default should not necessarily be seen as a punitive act by colluded lenders: if default is triggered by negative shocks and if shocks are persistent, a bor-

[4] The shorter cross-sectional dimension of the pre-World War II sample is entirely determined by the availability of output data. The post-WWII sample includes countries that tapped from international capital markets during the period and excludes those where lending has been mostly concessionary (including direct official lending and lending through multilateral institutions). Since output data for these lower-income developing countries also tend to be less reliable, their exclusion from the sample can be justified on these grounds as well.

[5] We provide evidence in Section 4 that the related inferences are robust to the choice of detrending method.

rower in default is more likely to default again. If so, country-specific risk premia must rise even when lending is competitive and investors' only aim is to break even. No less importantly, however, we show that this "pure" persistence effect can be greatly amplified if there is asymmetric information between lenders and borrowers about how large the persistent component of the shock is. Insofar as such a deterioration in the terms of market access and heightened country risk perception by investors lower the cost of future default all else constant, this mechanism generates "default traps". If so, it may well take a sovereign borrower some considerable dose of good luck, such as a long string of favorable shocks, in addition to some genuine improvement in macroeconomic fundamentals, to get unshackled from such a default trap.

Second, we show that the likelihood of getting trapped in such a vicious circle of default and higher spreads increases on the persistence of the gap between actual and expected or trend output. In fact, we show that sovereign spreads tend to increase on output persistence even for countries with a clean credit history, and that those that have defaulted in the past will thus witness an extra default premium. That is, higher persistence increases country risk both before and after default relative to baseline. This theoretical result has clear testable implications on a cross-country as well as time-series dimmension which are examined below.

The third set of theoretical findings that we derive pertains to the effects of volatility on default risk. On the one hand, we find that higher conditional volatility of the temporary as well as of the persistent component of the output shock generally increases default risk. This result is akin to that other recent studies (Aguiar and Gopinath, 2005; Arellano, 2006; Catão and Kapur, 2006) and contrasts with that of Eaton and Gersovitz (1981), wherein an increase in volatility typically lowers the probability of default, since repayment preserves access to capital markets which is more valuable for more volatile economies. On the other hand, and unlike these previous studies, we show that a rise in permanent component volatility tends to dampen the"default premium" - i.e. the difference in borrowing rates between default and non-default states after the realization of a given shock, all else constant. This is because, under asymmetric information, higher volatility countries are more prone to "excusable" defaults in the sense of Van Huyck and Grossman (1988). The intuition is that default by a country with endemically more volatile output generates a less pessimistic outlook for its future output path relative to a less volatile economy that also defaults; so, the default premium does not rise as much in the former case.

These theoretical findings relate to those of previous studies. Closest in spirit to our emphasis on the role of shock persistence in magnifying country risk is the work of Aguiar and Gopinath (2006). Based on numerical simulations of an infinite-horizon consumption smoothing model with exogenous probability of market re-entry after default, they show that sole reliance on transient shocks to trigger defaults generates much lower probability of default than those observed in the actual data as well as in models where shocks to trend output are persistent. The intuition is that if default is penalized by exclusion from financial markets (albeit temporary), the deterrent effect will depend on the difference between the long term values of financial autarky relative to continued access to financial markets; by their very nature, transient shock will have little effect on these long-term values. In this paper, we show that the presence of information asymmetries amplifies such a role of persistence, thus potentially helping accounting for the substantial gap between the default rates generated by their model and those featuring in real world data.[6] Conversely, our emphasis on the role of asymmetric information in generating persistence in country risk and default traps shares some similarities with two other recent studies. In Alfaro and Kanczuk (2005) and Fostel (2005), asymmetry of information implies that the borrower's decision to repay or default is revealing of its type rather than its output process. As

[6]Other main differences include the fact that, while the average duration of the exclusion is exogenously determined and numerically calibrated to generate default frequencies more closely aligned with real world data, the main deterrent to default in our model is default spread premium: the case of complete exclusion can be interpreted as the extreme outcome of prohibitive spreads. Lastly, the finite horizon structure of our set-up does require us to have to take a stand on the thorny time series issue of distinguishing shocks to the trend from those to cyclical component of output. As discussed in Comin and Gertler (2006), it may well be that what appears as trend-related volatility from a narrow high-frequency view of the business cycle may simply be a manifestation of long lags in shock propagation which are better characterized within a medium-term business cycle framework; if so, the fundamental time series properties of the data are then better described as a combination of short- and medium-term cycles along a smooth (upward) trend, rather than in terms of volatile trend variations. Here, instead of taking a theoretical stand on these distinct views, we simply examine empirically below the extent to which our results about the effects of shock persistence on sovereign risk are sensitive on whether the source of such persistence originates in the cyclical or the trend component of output.

the sovereign's type is also a persistent characteristic in these studies, there is a formal similarity with our model: default decisions are indicative of "bad" type of borrower, so that default is thus followed by lower bond prices. A major difference with Fostel (2006) is that bond prices and quantities are determined endogenously in her model, both being driven by adverse exogenous shocks (in her model to US High Yield sector), and feedback from endogenous margins requirements. While informational asymmetry and type persistence are key features that these studies share with our model, our characterization of persistence as an underlying feature of the output generation process is not only more easily amenable to empirical measurement but also arguably more appealing from a theoretical standpoint. For one thing, it is often unclear what is behind a "bad" type vs. a "good" type beyond the characterization that one defaults whilst the other repays - both actions may well just be rational response to distinct fundamentals such as different degrees of underlying output volatility and shock persistence. Further, the implicit rationalization of higher interest rates following a default as essentially punitive in response to the realization of "bad type" (see also Cole and Kehoe, 1998) is not sustainable in a competitive equilibria with heterogeneous agents: with lenders that seek to break even each period, a lender that tries to recoup losses from a previous default by raising rates may be short-cut by other peers. Last but not least, by punitively raising interest rates in response to a default implying that the country is of a "bad" type, lenders are in fact lowering the cost of default in the subsequent period for a given shock. This interest rate effect gives an extra kick to the role of output persistence in default in our model, and this constitutes an important distinction between this paper and previous studies.

The other main contribution of this paper relative to previous studies is to provide empirical evidence in support of the theoretical results that we derive. We do so using an unprecedentally long and broad cross-country database spanning the first globalization era in the 1870s - when international financial integration and sovereign bond financing began to climb to unprecedented historical levels (see Obsfeld and Taylor 2005 for detailed evidence on this) - to date. We use this database both to highlight a number of stylized facts on sovereign defaults that are consistent with our model, as well as to provide econometric evidence on the effects of conditional volatility and persistence of output shocks on sovereign risk. The results indicate that countries with more volatile and persistent output shocks are likely to face higher ex-ante interest spreads and thus more likely to be caught into default traps. Consistent with our theoretical findings, we also find that, condition upon actual default, default interest premium of countries with historically higher output volatility tend to be lower than less volatile countries, all else constant. We show that these empirical results are robust to a host of other controls on the determinants of sovereign risk.

The plan of the paper is as follows. Section 2 presents the model and the theoretical results. Section 3 discusses extensions. Section 4 presents key stylized facts about sovereign defaults which are consistent with the model as well as the main econometric results. Section 5 concludes. Appendix 1 presents the proofs to the theoretical propositions while Appendix 2 provides details and sources of our historical data.

2 The Model

A sovereign borrower issues bonds in international capital markets to finance investment in long-term projects. We can think of these as physical infrastructure and/or human capital development (e.g. education and health). We develop our argument in the simplest setting, which involves three periods, $t = 0, 1$, and 2. The project's investment requirements, I_0 in period 0 and I_1 in period 1, are exogenously given. To finance this requirement, the sovereign issues one-period bonds in $t = 0$ and $t = 1$. In periods 1 and 2, the sovereign decide whether or not to redeem bonds issued in the previous period.Bonds are held by competitive-risk neutral lenders and the issue price of bonds is determined endogenously in each period, based on the perceived likelihood of sovereign default.

In our model, the likelihood of default depends on the sovereign's indebtedness relative to its stochastic output. There are two sources of output uncertainty, one involves a persistent shock and the other a transient shock. Specifically, output in $t = 1, 2$ is given by:

$$\tilde{Y_1} = \bar{Y_1} + \tilde{\epsilon_1} + \tilde{\omega_1} \tag{1}$$

$$\tilde{Y_2} = \bar{Y_2} + \rho\tilde{\epsilon_1} + \tilde{\omega_2} \tag{2}$$

where $\bar{Y}_t$, the path of expected output, allows for secular growth. ω_t denotes transient or temporary shocks: these are i.i.d., with mean 0 and standard deviation σ_ω. Random variable ϵ_1 is a persistent shock, with mean 0 and standard deviation σ_ϵ. The parameter $\rho \in (0, 1)$ measures the persistence of the shock from period 1 to period 2. Let $\Phi(\epsilon)$ denote the distribution of persistent shocks and $\phi(\epsilon)$ the associated density function.

Our model builds on an informational asymmetry between the sovereign borrower and lenders. We assume that, while $\bar{Y}_1, \bar{Y}_2$, ρ and the distribution of shocks are common knowledge, only the sovereign observes the magnitude of its period-1 shock directly. Bondholders do not,[7] but make an inference about its distribution by observing the sovereign's repayment decision in period 1. This updated beliefs are used to calculate future probability of default. Specifically, in the equilibrium we describe below, default in period 1 signals an adverse output shock and, given persistence, creates a more pessimistic outlook for future output. Repayment, on the other hand, generates a more favorable outlook for the future. Thus default has informational content for bondholders.[8]

The timing of the model is as follows. At time $t = 0$, the sovereign issues one-period bonds to meet its initial investment requirement I_0. The issue price of these bonds is determined endogenously: it reflects expected future default risk. At time $t = 1$, the sovereign observes its output and chooses between default, d, or repayment, r. On observing the sovereign's repayment choice in period 1, bond holders update their beliefs about the sovereign's future output using Bayes' rule. The sovereign then issues new bonds in period 1 to finance its period-1 investment requirement I_1. Once again, the

[7] Informational asymmetry is common in many models of debt. In the present context, it could be argued that publicly-available information on a country's output and/or the sovereign income is subject to statistical inaccuracies, and in the short run at least, vulnerable to deliberate obfuscation. Other forms of informational asymmetry in sovereign markets have been studied by Kletzer (1984), Atkeson (1991), Calvo and Mendoza (2000), Alfaro and Kanczuk (2005), and Fostel (2005).

[8] A more realistic structure could allow bondholders to also learn from other publicly-available signals of output shocks. However as long as these signals are noisy (i.e., not perfectly informative), observed default will have some informational value. Incorporating additional information channels complicates the exposition without altering our qualitative results. Our assumption that bondholders learn only through observing the repayment choice maximizes the informational value of any observed default.

issue price reflects perceived future default risk. In the final period, the sovereign chooses whether or not to repay its debt.

The bond market is competitive, with risk-neutral lenders who are willing to subscribe to bonds at any price that, given their beliefs, allows them to break-even. For modeling simplicity we treat the mass of lenders as a single lender who choose a price that, given the perceived default risk, just allows it to break even. As the risk of default depends on future output and indebtedness, so does the price of bonds.

Let p_0 be the market-clearing price in period 0 of a bond with unit face value in period 1. To meet the investment requirement I_0, the sovereign must issue D_1 bonds where:

$$p_0 D_1 = I_1. \tag{3}$$

The implied yield on these bonds is $i_1 = (D_1/I_0) - 1$.

We assume that in the event of default, bondholders can enforce partial recovery cD_1; here $c < 1$ is the recovery rate and hence $1 - c$ is the "haircut" inflicted on bondholders. If the sovereign is expected to default in $t = 1$ with probability π_1, the expected return to bond holders is $[\pi_1 c + (1 - \pi_1)]D_1$. For a risk-neutral lender to break even in expected term, we require

$$[\pi_1 c + (1 - \pi_1)]D_1 = R_f I_0, \tag{4}$$

where R_f is the exogenously-given gross risk-free interest rate. Combining the last two equations the market-clearing price of bonds is:

$$p_0 = \frac{1 - \pi_1(1 - c)}{R_f} \tag{5}$$

which indicates that the issue price of bonds is decreasing in the anticipated probability of default. Note that $p_0 \in [c/R_f, 1/R_f]$ so the bond price is positive as long as $c > 0$.

Likewise, bonds issued in period 1 must meet investment requirement $p_1 D_2 = I_1$. The price of bonds issued in period 1 depends on the anticipated probability of default in period 2, so that:

$$p_1 = \frac{1 - \pi_2(1-c)}{R_f} \quad (6)$$

In any finite-horizon framework, partial capture provides insufficient deterrence against default in the final period. In the absence of other penalties, in period 2 the borrower will default with probability one. To avoid the trivialities associated with this case, we assume that default in the final period is also punished with sanctions that cause the sovereign to lose a fraction s of its current output $\tilde{Y}_2$.[9] If so, repayment will be rational in the final period if and only if the cost of sanctions exceeds any direct gain from reneging on repayments.

We model the interaction between the borrower and lenders as a game. A strategy for the sovereign borrower involves the following elements: bond issuance D_1 in period 0, repayment choice $h(\epsilon_1)$ in period 1 (which is a function of the observed shock realization), history-contingent bond issuance D_2^h in period 1 and repayment choice in period 2.[10] For simplicity, we assume that the sovereign's utility function is linear in payoffs. Let $\tilde{y}_t$ denote its output net of (voluntary or enforced) repayments. When making its period 1 choice, the sovereign maximizes $E(\tilde{y}_1 + \beta\tilde{y}_2)$ where $\beta \leq 1$ is a discount factor. With this linear specification, the sovereign cares only about expected future payoffs. If so, the decision to default or repay in period 1 does not depend on the transient component of the shock, ω_1, as this does not affect expected future payoff, $E(\tilde{y}_2)$.

A strategy for the lender involves prices (p_0, p_1^r, p_1^d) that allow it to break even in each period for every history. We can represent these prices in terms of the bond yields (i_0, i_1^r, i_1^d) that capture the risk spreads needed to break even. Finally, since lenders do not perfectly observe the shock realization, they will have beliefs, based on the prior shock distribution and of the observed borrower's actions. The timing of the game is presented in Figure 1.

[9] As in Sachs and Cohen (1985) and Obstfeld and Rogoff (1996) we assume that sanctions result in deadweight losses: that is, bondholders cannot appropriate any benefit from these. Cohen (1991) discusses a bargaining approach in which these losses can be shared and the resulting equilibrium becomes "negotiation proof". For a related setting in which deadweight losses are partial and proportional to the size of the default, see Catão and Kapur (2006).

[10] Of course, D_1 and D_2^h are trivially determined by equations (3)-(6).

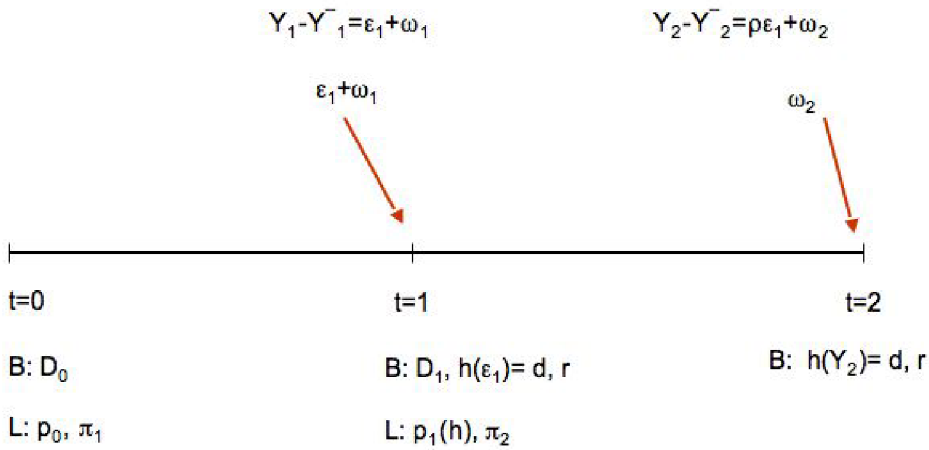

Figure 1: Timing structure of Model.

Proposition 1: Default Premium Equilibrium.

There exists an e_1^* such that the following is a PBE of the game:

1. *The borrower's strategy in $t = 1$ is given by*

$$h(\epsilon_1) = \begin{cases} r & \epsilon_1 \geq e_1^* \\ d & \epsilon_1 < e_1^* \end{cases}$$

and at $t = 2$ it repays if and only if $\tilde{Y}_2 \geq [(1 - c)/s] D_2^h$.

2. *The lender's strategy is given by* $(p_0, p_1^h; h = r, d)$ *at which it breaks even in each period given its beliefs. Moreover,* $p_1^r - p_1^d > 0$*, i.e, the default premium in equilibrium is positive.*

3. *The lender's beliefs in period 0 are given by the prior distribution. In period 1, after observing default, lender's beliefs are given by*

$$\gamma(\epsilon_1|e_1^*, d) = \begin{cases} \frac{\phi(\epsilon_1)}{\Phi(e_1^*)} & \epsilon_1 < e_1^* \\ 0 & \epsilon_1 \geq e_1^* \end{cases}$$

If instead, lenders observe repayment

$$\gamma(\epsilon_1|e_1^*, r) = \begin{cases} \frac{\phi(\epsilon_1)}{1-\Phi(e_1^*)} & \epsilon_1 \geq e_1^* \\ 0 & \epsilon_1 < e_1^* \end{cases}$$

Proof: See Appendix.

The sovereign has a "cut-off" strategy for repayment. For all shocks above a threshold it will repay, for those below it will default. In the second period, the "cut-off" strategy takes into consideration the level of debt as a proportion of output. Of course, this value will be history dependent. The lender, on the other hand, will charge an interest rate (price) such that the expected return equals the return from a riskless investment. The expectation is calculated using beliefs which are formed after the borrower's action is observed. In equilibrium, there is an *ex-ante endogenous* deterrence mechanism given by a positive default premium. Given the borrower's strategy, default in period 1 creates a more pessimistic outlook for future output, translating into lower prices for further bond issues.

This in turn implies that the continuation payoff for the borrower following default, V_2^d, is lower than the continuation payoff following repayment, V_2^r. The difference between these value functions measures the anticipated future gain from repayment, in terms of the lower cost of financing future investment requirements. The possibility of such gain encourages repayment.We show that this function is decreasing in the borrower's repayment threshold e_1^*. For very low values of e_1^*, bondholders consider default in period 1 very unlikely. But if this very unlikely event actually occurs, bondholder's expectations about future output levels face a large downward correction (given persistence), translating into a wide divergence between $V_2^r$and V_2^d. For very high values of e_1^*, the ex-ante probability of default is very high, and hence actual default in period one will not trigger big ex-post corrections. On the other hand, the immediate gain from default in period 1 is given by $(1-c)D_1 = (1-c)(I_1/p_0)$. Since $p_0$is a decreasing function of the probability of default, and hence of e_1^*, it follows that the gains from default are increasing in e_1^*. At the equilibrium repayment threshold e_1^*, the gain from repayment is just matched by the direct gain from default. Borrowers face a trade-off between preserving current consumption in the face of a negative income shock, and the higher future financing cost following the default decision. The equilibrium is depicted in Figure 2.

The underlying mechanism explains the possibility of debt traps. An adverse transient shock in period 1, if it triggers default, can make bond issuance more expensive, increasing the probability of future default.All things equal, a previous defaulter will need good luck in the period 2 shock (ω_2) not to default again, and thus be able to get out of the *default trap.*

Next, we consider how the equilibrium varies with key parameters: persistence and volatility of shocks.

Proposition 2: Persistence.

Greater persistence in output shocks increases the equilibrium probability of default as well as the default premium. This is, $\triangle\rho$ implies $\triangle\pi_t, t = 1,2$ and $\triangle(p_1^r - p_1^d)$.

Proof: See Appendix.

This result may seem counterintuitive since one would expect that a higher default premium would deter default. It is therefore important to explore the intuition behind this result.

Suppose we are in an equilibrium as described in Proposition 1 and there is an increase in persistence observable by *all* players. Given the borrower's strategy, e_1^*, higher ρ will translate into higher default premium. This is because greater persistence implies that future output shocks are more closely related to current shocks, so that the informational value of default is greater. Hence, the impact on future financing costs will more severe. At e_1^*, the gain from repayment is now higher than the gain from default. It follows that the borrower's strategy is not optimal anymore given the lenders' reaction. To restore the trade-off between the gain from repayment and default, the threshold needs to increase to a new higher value e_1^{**} as shown in Figure 2. Given this new threshold lenders update their beliefs increasing the probabilities of default at period 1 and 2.

In short, higher persistence exacerbates the mechanism described in Proposition 1, since it implies a greater deterrence against default, which in equilibrium can support debt transactions that carry greater risk of default.

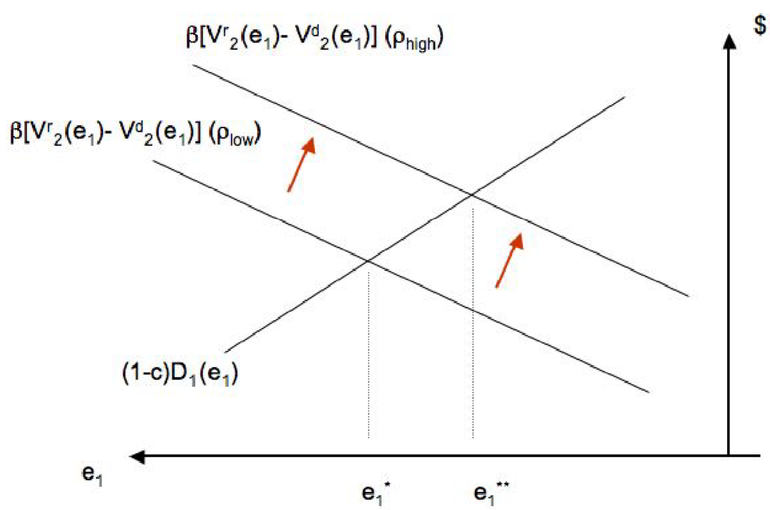

Figure 2: Equilibrium and Increase in Persistence.

Proposition 3: Volatility.

If both shocks are distributed uniformly, an increase in the transient shock' volatility results in a decrease in the issue price of bonds, i.e. if $\triangle\sigma_{\omega_t}$ *then* ∇p_{t-1}. *Moreover, an increase in the volatility of the persistent shock results in a decrease in default premium, i.e., if* $\triangle\sigma_{\epsilon_1}$ *then* $\nabla(p_1^r - p_1^d)$.

Proof: See Appendix.

The intuition behind this proposition is as follows. Given that the debt repayment function that lenders face is a step function (recall that lenders recover cD upon default, where $c < 1$), they lose more when output is low than what they gain when output is high.[11] Hence, an increase in the variance of temporary shocks will lower the price enough to account for this.[12] On the other hand, high volatility of the persistent shock will reduce the informational content of any action in period 1. This is because the more volatile output is, the higher the range of output realizations that make default optimal. Once lenders know this, default will not trigger as pessimistic expectations about the future as in the less volatile case. To use the jargon Grossman and Van Huyck (1998) there is more "excusability" in default. So, while p^r and p^d will both decrease, p^d will decrease less. That is, the default premium will decrease.

Summing up the results in this section, in a world with asymmetric information and persistent output shocks, there exist default traps. These traps are exacerbated with persistence and volatility of the transitory component. However, when the precision of persistent shock decreases, the mechanism is weaker.

[11] A similar result obtains under different repayment functions provided that they display some concavity. See, e.g. Catão and Kapur, 2006.

[12] This effect is obviously reinforced by risk aversion, as discussed below.

3 Model Extensions.

3.1 Risk Aversion and Capacity to Pay Considerations

For simplicity of exposition our model assumes that the borrower's utility function is linear. With a linear specification, the sovereign cares only about expected payoff, so all default is strategic. In particular, this ignores the possibility of "involuntary" default: for instance, a large negative shock, combined with low intertemporal elasticity of substitution, would imply high marginal utility of current consumption in times of crises, compelling the borrower to default. Alternatively, if there are limits to the borrower's capacity to repay in times of crises, negative shocks – even temporary ones – can trigger "involunatry default". Thus the borrower's repayment choice may depend not just on the persistent shock but also on temporary shock. This introduces the possibility that volatility in the *temporary* component of output shocks can trigger a vicious circle of credit events leading to serial default. Given asymmetry of information between borrowers and lenders, even when default is triggered by inability to pay in the face of adverse temporary shocks, this may be misconstrued as arising due to adverse persistent shocks. If so, this misperception will lead lenders to raise interest spreads in the subsequent period. Such higher spreads will then widen the range of output realizations in the subsequent period for which the borrower default. So, a combination of "bad luck" and asymmetric information can thus induce serial default over and above the volatility of the persistent component of output.[13]

3.2 Endogenous Output Shocks.

While the period-2 output is vulnerable to exogenous shocks, the model in section 2 overlooks does the possibility that default itself may cause endoge-

[13] Clearly in those circumstances, the borrower would have an obvious incentive to prove to the lender that the output shock was temporary rather than permanent. But as lenders internalize such incentives, they will likely require a third party or some form of objective monitoring of output realizations which will entail verification costs. Whether such monitoring scheme can be implemented and how costly it would be, will then determine the extent to which this mechanism is operative in practice.

nous loss of output.[14] If circumstances following default weakens access to trade credit or causes other disruption, we may well have the case that expected output in period 2, $\bar{Y}_2$, depend on the repayment decision in the previous period. Specifically, this introduces the possibility that $\bar{Y}_2^d < \bar{Y}_2^r$. In this scenario, the default premium is likely to be higher still. So, the *ex-ante* deterrence mechanism described in this paper will be amplified. By the same token, however, this mechanism will also have an adverse *ex-post* effect on creditworthiness: if, notwithstanding this deterrent effect, the sovereign does default following the shock realization in $t = 1$, this will in turn lower the cost of defaulting in the subsequent period, as the debt burden relative to output will be higher in the second period.

The combination of output persistence and a negative output elasticity to interest shocks can also be important in amplifying the role of a much-documented trigger of "sudden stops" in sovereign borrowing and business cycles in emerging markets – namely, fluctuations in the international (risk-free) interest rate (see, e.g., Calvo, Leiderman, and Reinhart, 1993; Catão, 2006 and Uribe and Yue, 2006). For any given I_0 , as the risk-free R_f rises in period 1, so will D_1 all else constant (see equation (6)). If $\bar{Y}_1$ is a negative function of R_f and $\bar{Y}_2 = (1 + g)\bar{Y}_1$, where g is the expected secular growth rate of output, then both the likelihood of default in period 1 as well as that serial default will increase along the lines discussed above. Empirical results reported below provide support for this external interest rate channel as a significant determinant of sovereign risk.

4 Empirical Evidence

In this section we empirically evaluate four main testable implications that follow from the above theoretical set-up, namely

1. *Hypothesis 1:* Countries that display higher underlying persistence of output shocks face higher sovereign spreads (or equivalently lower prices

[14]Cohen (1992) and Calvo (2000) suggest that this is the case in practice. Obsfeld and Rogoff (1996) provide a theoretical model in which lower-than-envisaged output growth is related to under-investment due to imperfect monitoring by lenders of the use of borrowed funds.

of their discount bonds), all else constant. This follows from propositions 1 and 2 above.

2. *Hypothesis 2:* Countries with higher conditional volatility of output gaps (i.e. those that are more prone to larger shocks) will tend to face higher spreads. This follows directly from the first part of proposition 3.

3. *Hypothesis 3:* Conditional upon previous default, we expect countries to face a positive "default premium". Further, their spreads will be higher (relative to those countries did not default at that same point in time) than other defaulting countries with lower degrees of shock persistence. This follows from propositions 1 and 2.

4. *Hypothesis 4:* To the extent that excessive volatility decreases the informational content of default the default premium should be negatively related to volatility. This follows from the second part of proposition 3.

As these hypotheses have both cross-sectional and time series implications, an important requirement for their assessment is the existence of relatively long data series on sovereign spreads on a broad cross-country basis, which also encompasses a number of default events. A long and cross-sectionally large dataset will allow for more robust inferences about the response of spreads and repayment decisions to the evolution of persistence and the variance of shocks over time. Historical data uncovered by economists and economic historians in recent years allows us to overcome the limitations of the short time-series data series on sovereign bond spreads available for the post-1990 period, and to incorporate also pre-war data to gauge such relationships.[15] Our sample starts from the early globalization years of the 1870s – when international bond markets began to witness unprecedented

[15]In the post-war period, a consistent series on emerging market sovereign bond indices (EMBIs) is only available from 1994 onwards and, even then, suffers from a sample selection bias in the first few years. This is because the countries issuing internationally traded bonds (Bradies) were the ones with tarnished recent history of sovereign default. It was not until later in the 1990s when a more diversified group of sovereign emerging markets began issuing widely traded bonds in international capital markets that comprise the currently available EMBI series. Unlike its pre-war counterpart used in this paper, this post-1990 series does not encompass the whole gamut of developing and developed countries.

expansion and integration – through the eve of World War II, covering 33 countries for this period. In light of the data limitations just described our post-1993 sample spans 60 countries. Details of the data, country coverage, and the various sources we have drawn on are provided in Appendix 3.

Our theoretical model suggests a parsimonious empirical specification for the determinants of default risk consisting of five variables: an external "risk-free" interest rate, the ratio of debt to GDP, an indicator of openness to capture the costs of defaults in terms of associated trade losses (consistent with Rose's (2002) empirical results), and measures of volatility and persistence of output shocks. Figures 2 and 3 provide evidence on the other centerpieces of our theoretical model by depicting the window centered on the year where default occurs (t=0). (See Appendix for a definition of these events). Each panel in the Figures depict the respective medians over the various default events (26 in total for the pre-WWI period) or debt crises events (56 for the post-1960 period);[16] the associated lower and upper quartiles are also plotted in dotted lines to provide a gauge of typical dispersions around the medians. Due to greater data availability for the post-WWII period, Figure 3 spans a larger number of variables featuring as additional controls in the post-WWII regressions.

The first panels of Figures 2 and 3 show that default events are typically preceded by hikes in the "risk-free" external real interest rate. Such a common external factor clearly appears to help explain some of the considerable synchronicity of default events in the pre-war sample (see, e.g., della Paolera and Taylor, 2006 for a description of the various events and further references). Consistent with lenders' break-even condition embodied in our model, rises in world interest rates should be followed by concomitant rises in interest spreads all else constant. The second panel in Figure 2, which plots the longer and cross-sectionally wider series on pre-WWII spreads, shows that

[16]We use "debt crises" rather than default as a metric for the post-1960 period so as to include in the sample events such as the 1995 Mexican crisis and some of the late 1990s emerging market crises which arguably could have resulted in outright default to government bondholds in the absence of multilateral intervention. Using a narrower definition of defaults which excludes these case does not, however, substantively alter the set of stylized facts characterized here. These results are readily available from the authors upon request. Throughout Figures 2 and 3, medians were used rather than means because of its lower sensitivity to outliers; however, very similar patterns emerge if one uses means and standard deviation bands instead.

this has been indeed the case. No less importantly – and in keeping with the theoretical predictions of our model – defaults are typically followed by some further widening in sovereign spreads. This response of spreads to default is not only reasonably persistent (spreads do not return to pre-default levels within 4 years after default), but also made all the more significant by the fact that spreads remain above pre-default levels while the risk-free world interest rate drops sharply over the same 4-year window. While this pattern appear less dramatic in the post-1990 spread series in Figure 3, the available historical data is overall suggestive of substantive interest costs for recalcitrant borrowers, in contrast with what is sometimes argued in the literature.[17]

Also consistent with our model, defaults are typically associated with "bad" rather than "good" states of nature: both real GDP and terms of trade (a gauge of the purchase power of domestic income and generally positively correlated with real GDP, as discussed below) are turning down when defaults occur relative to their respective (HP-filter) trends. This result is clearly robust to the use of the HP-filter detrending procedure, since we also observe a significant deceleration in real GDP growth and absolute drops in terms of trade in the run up to defaults (see Figure 3).[18] Further, real GDP shocks appear to be quite persistent: real GDP is not typically back to trend by the fourth year following default, over the various pre- and post-war events. Finally, indebtdness – scaled by either GDP or exports – increases in the run-up to defaults and over its immediate aftermath. This is consistent with our theoretical set-up in that, given fixed financing needs and falling bonds prices, indebtedeness should increase in the run-up to defaults and their immediate aftermaths as a result of both lower bond prices and further output drops. Finally, defaults are typically associated with shares of external debt to total

[17]Previous studies provide mixed evidence on whether recalcitrant borrowers tend to face higher spreads or worse conditions of market access. Jorgensen and Sachs (1989) argue that international capital markets have not properly discriminated "bad" from "good" borrowers during the interwar and early post– World War II years. In a similar vein, Eichengreen and Portes (1986) do not find clear-cut support for the hypothesis that debtors which honored their debt obligations during the 1930s depression benefitted from more favorable market access. In contrast, Ozler (1993) provides econometric evidence that past repayment record is statistically significant in explaining differences in sovereign spreads across her sample of 26 developing countries between 1968 and 1981.

[18]This evidence is consistent with Levy-Yeati and Panizza (2006) in that output losses commonly attributed to defaults actually preceed defaults. Our data - both for the pre- and the post-WWII period clear show, however, post-default recovery is typically not steep enough to have output returning to trend within four years after default

debt in excess of 60 percent in both the pre- and post-WWII periods. The only major difference between the two periods is that pre-WWII defaults tended to be followed by drops in the ratio of external debt to total debt, possibly reflecting sovereigns' greater access to domestic bond markets in the pre-war lower inflation environment.

We now turn to the issue of measuring volatility and the persistence of output shocks. At this point, one has to take a stand about the interpretation of the persistent component of output in the model (ϵ) as a cyclical component (which ultimately mean revertible) or as a stochastic shock to trend (which will therefore alter the level of output permanently). Our three-period set-up does not in principle require one to take a stand on the issue. On the one hand, if one interprets the last period as the present value of all future periods, then ϵ becomes a shock to trend as in Aguiar and Gopinath (2006). In this case where a negative shock entails a permanent reduction in future levels of trend output, then a default today will help explain a default many years into the future. This is because, following a negative shock today that is accompanied by default, investors will revise down their trend output predictions and see debt servicing costs rising relative to expected output many years down the line. As the sovereign is thus seeing more risky, sovereign spreads will have to rise so as to allow lenders to break-even ex-ante. As debt servicing costs rise, so will the cost of future repayments, leading to default traps.

On the other hand, if the cyclical component is broadly defined as sufficiently long (as often the case for some emerging markets - see Aiolfi et al. 2006), ϵ can be interpreted as a persistent but still cyclical, mean-reversible shock. If so, the question is then how a default today may explain a another default by the same sovereign ten or twenty years down the line? There are three possible interpretations. One is that, once investors seek to break even period by period, a country with higher persistence of cyclical shocks will always face a higher spread; when the same negative shock hit all countries with the same borrowing needs relative to output, those paying higher spreads and hence higher debt servicing costs will be more prone to default. So, differences in cyclical persistence help explain why certain countries are more prone to fall prey of default traps. This has clear cross-sectional testable implications which we examine below. A second interpretation combines the predictions of our model with a reputational-type view as Reinhart et al

(2003). That is, cyclically more persistent countries are more prone to default for the reasons noted above and, once they do default, this tarnishes their reputation on a long-lasting basis; as spreads will remain higher relative to their peers once this reputation remains, so will debt servicing costs; this will increase the cost of future repayments and hence will activate default traps. A third interpretation has to do with investors' gradual learning about the persistence properties of a country's output process. Assume that investors do not know ρ but learn it. In this case, an Argentine default in 1983, for instance, will indicate to investors that Argentina is a high persistence country and thus will have to face higher spreads on a permanent basis. If so, future debt servicing costs will rise notwithstanding the fact that output eventually returns to trend. This will activate default traps through the same mechanism just described.

These distinct interpretations of our theoretical set up clearly call for distinct estimation approaches for volatility and persistence parameters. Should we interpret ϵ as a trend shock, a natural trend-cycle decomposition approach is the classical method proposed by Beveridge and Nelson (1981). It consists of modelling output as an ARIMA (p,1,q), where p and q can be chosen by usual likelihood-based criteria. In this case, we can define the "trend gap" as:

$$\triangle z_t - \mu = [(1 + \theta_1 + \theta_2 + ... + \theta_q)/(1 - \phi_1 - \phi_2 - ... - \phi_p)] \cdot \epsilon_t,$$

where $\triangle z$ stands for overall trend growth, μ represents its deterministic component (drift), and ϵ is i.i.d. $(0, \sigma^2)$. Clearly, if $\sigma^2 = 0$", then the trend is purely deterministic (expanding at a constant rate μ),and the "trend gap" vanishes. In this case, default relays no information on the future output path; so the postulated mechanism in the model is no longer operative in such an environment with a deterministic trend and purely transient stationary shocks. The theoretically interesting and arguably more realistic case is thus that where $\sigma^2 \neq 0$", as will be seen below.

Alternatively, if the trend is deterministic (or nearly deterministic) but the cyclical component displays considerable persistence, a standard widely-used measure of stochastic persistence is the slope coefficient of a regression of detrended real GDP - the so-called "output gap", as obtained by say the standard HP-filter method - on its first-order lag.[19] In this case, stochastic volatility can then be gauged by the standard deviations of the respective regression residuals – a similar procedure used in previous studies on business cycle volatility. To allow for gradually evolving changes in volatility and persistence, we compute both measures recursively over a 10-year or 20-year rolling window, consistent with what is also typically done in the business cycle literature (Mendoza, 1995; Williamson et al., 2006; Aiolfi et al., 2006)).[20] Similar rolling window measures are employed for the real GDP instrument discussed below.

Starting with the pre-WWII evidence and the HP-filter measure of cyclical persistence, column (1) of Table 3 reports the pooled OLS results with t-ratios corrected for heterocedasticity (using the standard White estimator) and for country-specific first-order auto-correlation. All right-hand side variables enter the regression with a one-year lag so as to mitigate endogeneity biases.[21]As in Obstfeld and Taylor (2003), we drop from all regressions observations corresponding to spreads above 1,000 basis points so as to eliminate non-traded bonds and bonds of countries in default; as such, Table 1 regressions are mainly testing the empirical relevance of the comparative static mechanism described in Figure 2 and layed out in Hypothesis 1. As typical in country spread regressions, the R-square is relatively low reflecting the fact that spreads are known to be sensitive to news and uncorrelated shocks. Yet, all the estimated coefficients yield signs that are consistent with those of the theoretical model and are statistically significant at 5 percent, including the debt-to-GDP variable which was not found to be significant by Obstfeld and Taylor (2003) in their pre-WWI regressions.[22] The respective point estimates show that a 1 percentage point increase in conditional volatility ("std yga")

[19]As standard, we set the HP-filter smoothing factor to 100 with annual data. This yields considerable smoothness in trend growth in the long annual series for the various countries in our sample.

[20]To avoid throwing away information on pre-1890s defaults in our sample, we use a 10-year rolling volatility window in the pre-WWI sub-sample and then a 20-year window in the interwar and post-WWII sub-samples.

[21]The external interest rate could be thought of as exogenous for all but two countries in our sample – the US and the UK. So, one could plausible enter i* without lags but it turns out that lagging i* of one year dominates the specification with contemporaneous i*.

[22]Apparent reasons for this discrepancy are that in their regressions Obstfeld and Taylor (2003) do not control for the volatility and persistence effects considered here, plus the fact that our sample has wider country coverage and uses GDP indicators for four Latin

implies a 15.2 basis point increase in sovereign spreads, while a 10 percentage point increase in persistence (i.e., as "yins per" moves from, say, 0.5 to 0.6) raised spreads by 4 basis points, all else constant. These effects may appear small by today's standards, but were not so in the pre-WWI context when the cross-country dispersion of spreads was much tighter.[23]

In light of the potential criticism that our output shock volatility and persistence measures may be (weakly) endogenous to spreads, the second column of Table 3 replaces the output gap-based indicators with an instrument. The latter is constructed by regressing the output gap of each country on its terms of trade, the world interest rate, and an indicator of world output growth.[24] To the extent that all these three variables are exogenous to individual country spread, any remaining endogeneity bias is eliminated. The results of this instrumental variable regression clearly indicate the the previous results were robust: all coefficients retain a similar order of magnitude of the regressions in column and are statistically significant at 1%.

Columns (3) to (8) of Table 3 introduce various controls to the baseline model regression. We start with fixed effects associated with differences between developed countries and less developed ones (a "periphery" dummy, "Dper"), the same control featuring in Obtsfeld and Taylor (2003) spread regressions. The rationale is to capture a host of structural characteristics not ammemable to easy measurement, such as quality of institutions and degrees of financial development. To the extent that quality of institutions and financial maturity are also proxies for the degree of information asymmetries between borrower and lenders in our model, we should expect this catch-all variable to be positively related to spreads. As the dummy takes the value of 1 for "peripheral" countries and zero otherwise, the positive sign of the estimated coefficient in column (3) of Table 3 conforms to our theoretical

American countries (Argentina, Brazil, Chile, and Mexico) that are deemed to be more reliable than the Maddison figures used in their study. See the Appendix for details.

[23]Furthermore, cross-country spread dispersion declined dramatically during the period as capital markets became more internationally integrated. By the eve of WWI, the cross-country standard deviation of spreads was down to 91 basis points. See Flandreau and Zumer (2004, chapter I), for a discussion of these trends.

[24]These estimate of world output growth was constructed as a weighted average of real GDP in eight countries (Australia, Canada, France, Germany, Italy, UK and the US) in 1990 dollars, as provided in Maddison (2003). In these instrumental regression we allowed for up to one lag of each independent variable.

priors. Its main effect on the other estimated coefficients is to detract from the significance of export/GDP ratio in explaining spreads – which is hardly surprising given that the two variables bear considerable multicolinearity.[25] The other fixed effect control, also considered in Obstfeld and Taylor (2003), is whether the country formally belonged to the British empire – inter alia a catch-all proxy for assurances of greater investors' legal protection and arguably preferential access to British markets. In the context of our model, this dummy variable ("Demp")can thus be thought of as a potential increase in the recovery rate parameter c, which will tend to lower spreads. Accordingly, the results reported in columns (4) to (8) of Table indicate that this dummy takes on the expected negative sign and is highly significant statistically. Its main effect is to reduce the coefficients of the volatility and persistence variables, though without rendering them insignificant.

Exchange rate regimes are often perceived to be related to macroeconomic risk, so it seems important to examine whether our hypotheses regarding the roles of volatility and shock persistence on sovereign spreads stand up to such a control variable. In the pre-WWII era, the main dichotomy is that between countries that were on the gold standard and those that were not, so a dummy ("Gold") taking on the unity value (and zero otherwise) was introduced in the regressions. The results reported in column (5) are consistent with the findings of Bordo and Rockoff (1996) as well as Obstfeld and Taylor (2003): membership of the gold standard shaved off some 60 basis points in country spreads, consistent with the view of gold standard membership as a good housekeeping seal of approval. Interestingly, both the size and the statistical significance of the persistence variables shrink after the introduction of this exchange rate regime control, though remaining statistically significant at 10%. This is not surprising in light of well-known theoretical reasons to expect that fixed exchange rate regimes tend to exacerbate shock persistence by both fostering balance sheet mismatches and/or slowing the relative price adjustment process.

A final set of non-fixed effect controls include default history, the ratio of foreign currency-denominated external debt to total debt (a proxy for "original sin" considerations), and terms of trade shock which, if large enough, may

[25]This is because, in the context of the pre-WWI international division of labor, international trade was a main driving force of GDP growth in the peripheral economies which thus tend to display high openness coefficients.

prompt a country into default along the lines of capacity to pay arguments.[26] Neither of these variables undermine the statistical significance of our volatility and persistence proxies, although they do weight down on the estimated size of the persistence coefficient. This, again, is not surprising since currency mismatches are found to exacerbate the severity of debt and financial crises thus making shocks more persistent (IADB, 2006). Likewise, as persistence is a very slowly moving indicator and bound to be highly correlated with default history if our model is correct, one would expect considerable colinearity between default history and persistence. Overall, though, the results are very consistent with the model's theoretical priors and provide significant support for the hipotheses laid out above.

Table 4 reports a similar set of regressions using the Beveridge-Nelson (BN) measure of the "trend gap". While the fit improves considerably in these regressions relative to Table 3, this is mostly due to fewer observations.[27] But more importantly, the coefficients on both the volatility and persistence indicators have the correct sign and are significantly throughout. Regarding the magnitude of the effects, while the coefficient on the volatility variable is broadly similar using the HP output gap or the BN trend gap, persistence effects are often twice as large on HP gap measure. This suggests that cyclical persistence does a better job in explaining sovereign risk relative to the view that attributes much of the stochastic output variations to trend shocks.

Turning to the inter-war period, we follow Obstfeld and Taylor (2003) in focusing on the post-1924 years, thereby dropping from the sample the early post-WWI spell – when war dislocations, hyperinflations, and Britain's delay in re-joining gold had far-reaching effects on international bond issuance. As result, while the country coverage is essentially the same, the number of observations is less than half of the pre-WWI sample in Table 3. As before, we start by reporting regression estimates for the HP-gap measures in Table 5.

[26] This latter variable is computed as the residual of HP-detrended terms of trade on its first order lag.

[27] Because the computation of the Beveridge-Nelson decomposition is far more data intensive than HP-filter measures, we often had to broaden our estimation window beyond 20 years to ensure convergence, depending on the curvature of the likelihood function of the various country specific regression. As a result, the 1870-1913 sample becomes a lot smaller in these regressions. Results ot Table 3 regressions using this smaller sample are available from the authors upon request.

As is typically the case with inter-war regressions, the fit of the model is much poorer than its pre-WWI counterpart and the international risk free rate is no longer statistically significant at coventional levels, though it retains its expected theoretical sign. However, the volatility and persistence indicators remain both significant at 5% in the baseline model of column (1), with the significance of the volatility indicator dropping in some alternative specifications. Further, the effect of persistence on spreads is now much larger: an 10 percentage point increase in persistence leads to 20 basis point increase in spreads (as opposed to 4 bps in the pre-WWI sample). Instrumenting both variables out as in column (2) dampens the respective coefficients, but variables remain significant at close to 5%. This appears to be partly related to the fact that, as most economies in our sample became closer to international trade and financial linkages, our set of instruments (terms of trade, the world interest rate, and world GDP growth) bore a weaker correlation with GDP in each country; that is, we no longer have such good instruments as in the pre-WWI period. Columns (3) to (8) in Table 5 reports the results for the same set of controls as in the pre-WWI regressions (see Table 3). The main quantitative difference is that now the debt/GDP ratio regains statistical significance only after some controls are added, whereas our volatility variable looses it. Persistence remains significant thoughout at 5% . These inferences are broadly the same with the BN trend gap measures, as reported in Table 6. As with the pre-WWI period, the main difference is that the effect of persistence on sovereign spreads is stronger when HP gap measure is used relative to the BN measure.

Tables 7 and 8 report the results of a similar specification and controls for the 1994-2005 period. As noted above, despite the wider country coverage, the number of observations in these regressions is considerably lower than the various pre-WWII regressions due not only to a shorter time series dimmension but also due to the lack of spread data for many emerging markets until later in the 1990s/early 2000s. This means that the cross-sectional dimmension of these regressions dominate the time-series dimmensions. Partly reflecting that, the fit is higher overall and considerably so for the baseline model of column (1) in both tables, where the basic model accounts for about half of variations in country spreads. Once again, the volatility variable is economically and statistically significant in most regressions, whereas persistence is significant throughout except for the specification in column (1) of Table 8. Interestingly, neither exchange rate regimes, nor debt maturity or currency composition stand out as significant in explaining spread variations. Yet, and consistent with first-generation currency crisis models and related empirical evidence on twin crisis (Kaminsky and Reinhart, 1998), international reserve coverage (as a share of broad money, M2) and fiscal position do matter. Also interestingly, once volatility and persistence are included in the regressions, the Reinhart et al. (2003) default history variable is no longer statistically significant. This is consistent with the evidence amassed in Catão and Kapur (2006), which suggest that default history is often a catch all for slowly moving fundamentals associated with the underlying stochastic features of the output generation process; in our regressions these are captured by historical volatility and persistence indicators.

A final and important set of predictions in our model regarding both persistence and volatility pertains to their effects on the "default premium" – the difference in spreads between a country that defaults and others that do not (once differences in fundamentals between the defaulter and the non-defaulter are controlled for). Our model indicates that the default premium should rise on persistence, whereas a rise in volatility may temper some of this effect since higher volatility implies that default in t=1 is less informative on the country's future prospects. The various regression results reported in Tables 9 and 10 indicate that these predictions find broad support in the data. In both regressions, the dependent variable is now the difference between defaulters" and non-defaulters' spreads at any given year. Clearly, the default premium rises on persistence as the model predicts, while being negatively affected by volatility – consistent with the view that higher volatility makes the act of defaulting less informative about a country's future output. This result holds once the various controls exogenous to the model are contemplated. In particular, while past default history is significant as before (thus consistent with the Reinhart et.al. (2003) story), both our volatility and persistence indicators hold their own as sources of additional information purportedly by markets to price spreads of defaulting countries.

5 Conclusions

History tells us that sovereign creditworthiness displays persistence: countries that default once are more likely to do so again, face higher spreads as a result, which in turn tends to lower future default costs. This paper has sought to rationalize how countries may fall prey to such "default traps", highlighting three factors in this connection high conditional volatility of output shocks, persistent gaps between actual and expected output, and asymmetric information between borrowers and lenders about the extent of such persistence. While the first two factors alone can make default optimal for a range of output realizations, generating a positive country spread over the risk-free interest rate, we have shown that asymmetric information amplifies this spread mechanism: a default decision signals that the country was likely hit by a large negative output shock which will persist, thus raising future debt-to-output ratios above the expected baseline. As competitive lenders seek to break even, the spread premium will typically be higher than warranted if lenders could observe the shock; this, in turn, increases the borrower's debt burden, thereby making future default more likely, all else constant.

To the extent that both conditional output volatility and shock persistence display significant cross-country differences (due to institutions, commodity specialization, etc.), and as these differences are structural and hence slowly-evolving, they should translate into distinct credit histories. Using an unprecedentally comprehensive database spanning 135 years and up to 62 countries, we have shown that this is the case: countries which defaulted more often and faced higher spreads are typically the ones displaying higher conditional volatility and persistence of output gaps - such effects being statistically and economically significant over and above a variety of controls. These inferences are also robust to detrending methods: whether one measures persistence as shocks to trend (thus creating a Òtrend gapÓ) or shocks to cyclical output (thus creating an output gap which may persist for several years but is ultimately mean revertible), the postulated spread mechanism finds broad support in the data.

The empirical evidence provided also corroborates other predictions of our model. In particular, defaults typically occur in cyclical downturns and in the wake of increases in debt to output ratios and in the external risk-free interest rate; defaults are typically followed by higher spreads and further output losses, both of which are quite persistent; and while there is a positive spread premium between defaulters and non-defaulters which is increasing on historical measures of output persistence (after controlling for other differences between defaulters and non-defaulters), such a premium is decreasing on conditional volatility. As discussed above, this is consistent with the notion that the informational content of default is significant but decreasing on the noise of output realizations.

Our results add to the literature in three ways. First, by helping explain default traps and its converse (virtuous circles in borrowing and repayment) our model also helps rationalizes "debt intolerance" phenomenon documented in Reinhart et al. (2003): that is, how a sizeable group of countries face much higher spreads and more stringent borrowing constraints than others with far higher debt to income ratios. Rather than the standard causality running from higher debt ratios to higher credit risk along a steady upward sloping supply curve (see Sachs, 1984; Sachs and Cohen, 1985), our findings suggest that it is the perceived riskiness of some countries – as determined by intrisically high volatility and persistence of output shocks – which shifts the investors' supply curve inwards limiting the borrower from taking or "tolerating" as much debt. Thus, the combination of higher volatility and shock persistence helps account for both default traps and debt intolerance.

Second, our results reinforce the empirical evidence from previous studies showing that underlying output volatility tends to increase default risk and hence increase spreads. Unlike previous studies, however, we have shown that, conditional upon default, volatility tends to dampen the default premium. To the best of our knowledge, this subtle effect of conditional output volatility on country spreads has not been developed in the literature.

A third contribution of this paper to the empirical literature is to highlight the previously neglected role of historical output volatility and persistence indicators in country spread regressions. Clearly, the volatility and persistence indicators in our model and regressions are, in a deeper sense, catch-all variables that stem from underlying economic mechanisms which can be quite complex in practice. For analytical purposes of singling out the issue at hand, we chose in the paper to take them as exogenous. But insofar as both indicators are readily observed by agents, then there is also a case to study their effects as if they were indeed parameters actually taken into account by investors.

Finally, some practical implications follow from this paper's results. Plainly, they highlight the importance of reforming institutions and changing policy frameworks that have typically made many emerging markets more volatile and slower in recovering from shocks. At the same time, our findings also suggest that countries with higher underlying dispersion of temporary shocks are more vulnerable to sheer "bad luck": given that these are countries with a wider region of output realizations over which they cannot pay, and that a default may be misperceived by lenders as strategic and due to a highly persistent shock, default traps can be more easily activated. If so, unless an improvement in fundamentals dramatically narrows the variance of output shocks, it may take more than improvements in fundamentals to escape from a default trap: once investors are imperfectly informed about how persistent is the shock and the sovereign's borrowing needs remain high, good luck in output realizations may turn out to be just as important.

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7 Appendix 1

7.1 Proof of Proposition 1

1. Let's assume to start the borrower's strategy in $t = 1$ as stated in the proposition.

2. Borrower's strategy in t=2, contingent on history h
   In period 2, with repayment obligation D_2^h, the sovereign's net payoff to repayment is $\tilde{Y}_2 - D_2^h$, while sanctions and partial recovery of debt following default leave it with $(1-s)\tilde{Y}_2 - cD_2^h$. Repayment is rational in period 2 if and only if: $\tilde{Y}_2 \geq [(1-c)/s]D_2^h$.

3. Lender's beliefs.
At $t = 0$ lender's beliefs are given by the prior distribution. At $t = 1$, beliefs follow directly from the borrower's strategy given in 1, using Bayesian updating.

4. Lender's strategies.
Lender's strategies follow from 3. and the break-even condition assumed in the text. In $t = 0$ and $t = 1$ prices will be determined by equation (5) and (6) respectively, with the probabilities of default in each case calculated using the distributions in 3.

5. Existence of an e_1^* as in 1. consistent with 2., 3. and 4.
The continuation payoff following action h for realization ϵ_1 is $V_2^h(\epsilon_1, e_1^*) = \int max[\tilde{Y}_2 - D_2^h, (1-s)\tilde{Y}_2 - cD_2^h]dF(\tilde{Y}_2/\epsilon_1)$. Note that V_2 depends on e_1^*, as D_2^h depends on e_1^*, and ϵ_1. When choosing h in period 1, the borrower takes into account the immediate payoff and the discounted value of the continuation payoff, V_2. Redemption has payoff $V_1^r = (\tilde{Y}_1 - D_1) + \beta V_2^r(\epsilon_1, e_1^*)$, while default has payoff $V_1^d = (\tilde{Y}_1 - cD_1) + \beta V_2^d(\epsilon_1, e_1^*)$. The borrower is indifferent when these last two expressions are equal or $\beta[V_2^r(\epsilon_1, e_1^*) - V_2^d(\epsilon_1, e_1^*)] = (1-c)D_1(e_1^*)$. This is, the incentive to repay equals the incentive to default. Define $g(\epsilon_1, e_1^*)$ as the left hand side minus the right hand side of the equation. To prove that the borrower's strategy is optimal given the lender's reaction we need to show that there exists $\epsilon_1 = e_1^*$ such that i) $g(e_1^*, e_1^*) = 0$ and ii) g is an increasing function of ϵ_1 so that for all $\epsilon_1 > e_1^*, g > 0$ and $\epsilon_1 < e_1^*, g < 0$.

   - i) To prove this we will show that $\beta[V_2^r(\epsilon_1, e_1) - V_2^d(\epsilon_1, e_1)]$ is a decreasing function of e_1 (e_1 being the borrower's strategy) and that $(1-c)D_1(e_1)$ is an increasing function of e_1. Since both are continuous functions, then it follows the existence of e_1^* such that they are equal provided that β is not too low. That $(1-c)D_1(e_1)$ is an increasing function of e_1 follows from equations (3), (5) and lenders' beliefs in 3. To show that $\beta[V_2^r(\epsilon_1, e_1) - V_2^d(\epsilon_1, e_1)]$ is a decreasing function of e_1 note that this expression is an increasing function of the default premium. Also from equation (6) it follows that $p^r - p^d = (\pi^d - \pi^r).(1-c)/R_f$. Hence the default premium is an increasing function of $\pi^d - \pi^r$. So we are done if we prove that $\pi^d - \pi^r$ is a decreasing function of e_1. But given how beliefs are formed it is clear that π^r dominates in the first order stochastic sense π^d. So when e_1 decreases both probabilities of default increase, however π^d increases more and therefore the premium rises. The existence of e_1^* follows.

- ii) Note that $(1-c)D_1(e_1)$ does not depend on ϵ_1. So we need to show that $\beta[V_2^r(\epsilon_1, e_1) - V_2^d(\epsilon_1, e_1)]$ is increasing in ϵ_1. Let's consider the following partition of the support of ϵ_1: $E_L = \{\epsilon_1, \tilde{Y}_2 < [(1-c)/s]D_2^r\}$, the default for sure region, $E_H = \{\epsilon_1, \tilde{Y}_2 \geq [(1-c)/s]D_2^d\}$, the repayment for sure region, and $E_M = \{\epsilon_1, [(1-c)/s]D_2^r \leq \tilde{Y}_2 \leq [(1-c)/s]D_2^d\}$, the region in which prior repayment induces future repayment and prior default induces future default. Clearly $E = E_L \bigcup E_M \bigcup E_H$. Also $\bigcap_{i=L,M,H} E_i = \emptyset$ provided that the support of the shocks are bounded and chosen accordingly so that $\exists \epsilon_1^L, \epsilon_1^H$ such that $\rho\epsilon_1^L + w_2^{max} = (1-c)/s.D^r$ and $\rho\epsilon_1^H + w_2^{min} = (1-c)/s.D^d$. Now we will prove that $g/E_i, i = L, M, H$ is increasing. First note that $dF(\cdot/\epsilon_1)$ in increasing in ϵ_1. In E_L g becomes $\int c(D_2^d - D_2^r)dF - (1-c)D_1$. Since the default premium is positive, the integrand is positive so g/E_L is increasing. For an analogous argument it follows that g/E_H is also increasing since in this region g becomes $\int D_2^d - D_2^r dF - (1-c)D_1$. Finally, in E_M g is equal to $\int(s\tilde{Y}_2 + cD_2^d - D_2^r)dF - (1-c)D_1$. The integrand is positive since $\tilde{Y}_2 - D_2 > (1-s)Y_2 - cD_2^r$ and $D^d > D^r$. This concludes the prove that g in increasing in ϵ_1.

7.2 Proof of Proposition 2

For fixed e_1^*, higher ρ increases the informational value of default. To see why, note that with greater persistence, observed default in period 1 leads to greater pessimism about future returns to bondholders, so required D_2^d is increasing in ρ. On the other hand, observed repayment suggests a more optimistic outlook for future repayments, justifying a lower D_2^d. Thus, for fixed e_1^*, a higher value of ρ is associated with a greater default premium and hence a higher $\beta[V_2^r(\epsilon_1, e_1) - V_2^d(\epsilon_1, e_1)]$. So at e_1^* the gain from repayment is higher than the gain from default. Since the gain from default, given by (1-c)$D_1(e_1^*)$is increasing in e_1^*, to restore equilibrium, the equilibrium value of e_1^*must rise.

7.3 Proof of Proposition 3

First part of the proposition: Suppose that shocks have uniform distribution. Hence $\tilde{Y_2}$is uniform in $[-Y, Y]$. Without loss of generality suppose that $\bar{Y_2} = 0$ and $\epsilon_1 = 0$. Given the strategies in $t = 2$, the cut-off value is given by $Y^* = [(1-c)/s][I_1/p]$. Therefore, the bondholders payoff function is given by D_2 if $Y_2 \geq Y^*$ and cD_2 otherwise. This can be seen in figure 3. Now suppose the volatility of the ω_2 shock increases so that $\tilde{Y_2}$ is uniform $[-\alpha Y, \alpha Y], \alpha > 1$. By the lender's strategy we have that $\frac{Y-Y^*}{2Y}.D_2 + \frac{Y^*+Y}{2Y}.cD_2 = R_f$ and $\frac{\alpha Y-Y^*}{2\alpha Y}.kD_2 + \frac{Y^*+\alpha Y}{2\alpha Y}.ckD_2 = R_f$ have to hold in equilibrium. Doing some algebra we can get that $k = \frac{\alpha(A-B)}{\alpha A-B}$, where $A = (1 + c)Y$ and $B = Y^*(1 - c)$. The derivative $k'(\alpha) = \frac{(A-B)(\alpha A-B)-\alpha(A-B).A}{(\alpha A-B)^2}$. Hence the sign of the derivative is the sign of $-B(A - B)$ which is positive provided that $Y^* < 0$. Therefore with an increase in α there is a decrease in the price. Obviously, in equilibrium this will increase Y^* as it is shown in figure 3. By a similar argument can be shown that and increase in volatility in ω_1 decreases the price at $t = 0$. The proof of the second part is in two steps. First we prove

that an increase in volatility of the permanent shock will increase the e_1^*. We assume again uniform distribution and without loss of generality that $\bar{Y_1} = 0$ and $\omega_1 = 0$. Using the same break even condition we have that $\frac{\epsilon-\epsilon^*}{2\epsilon}.D_1 + \frac{\epsilon^*+\epsilon}{2\epsilon}.cD_1 = R_f$ and $\frac{\alpha\epsilon-\epsilon^*}{2\alpha\epsilon}.kD_1 + \frac{\epsilon^*+\alpha\epsilon}{2\alpha\epsilon}.ckD_1 = R_f$ have to hold in equilibrium. Doing some algebra we can get that $k = \frac{\alpha(A-B)}{\alpha A-B}$, where $A = (1 + c)\epsilon$ and $B = \epsilon^*(1 - c)$. Hence the sign of the derivative of k with respect to α will be positive provided that $\epsilon^* < 0$. This proves that an increase in α induces a decrease in the price. The second step is to prove that this induces a decrease in the premium as well. Note that from equation (6) an increase in α also induces an increase in the probability of default. This must mean therefore that in equilibrium there must be an increase of e^*. As was proved in proposition 1 this induces a decrease in the premium as wanted.

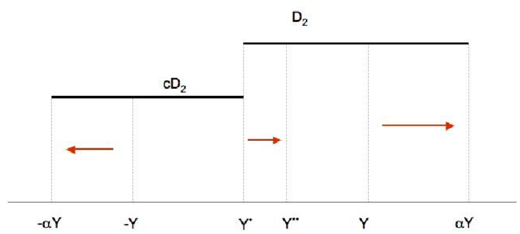


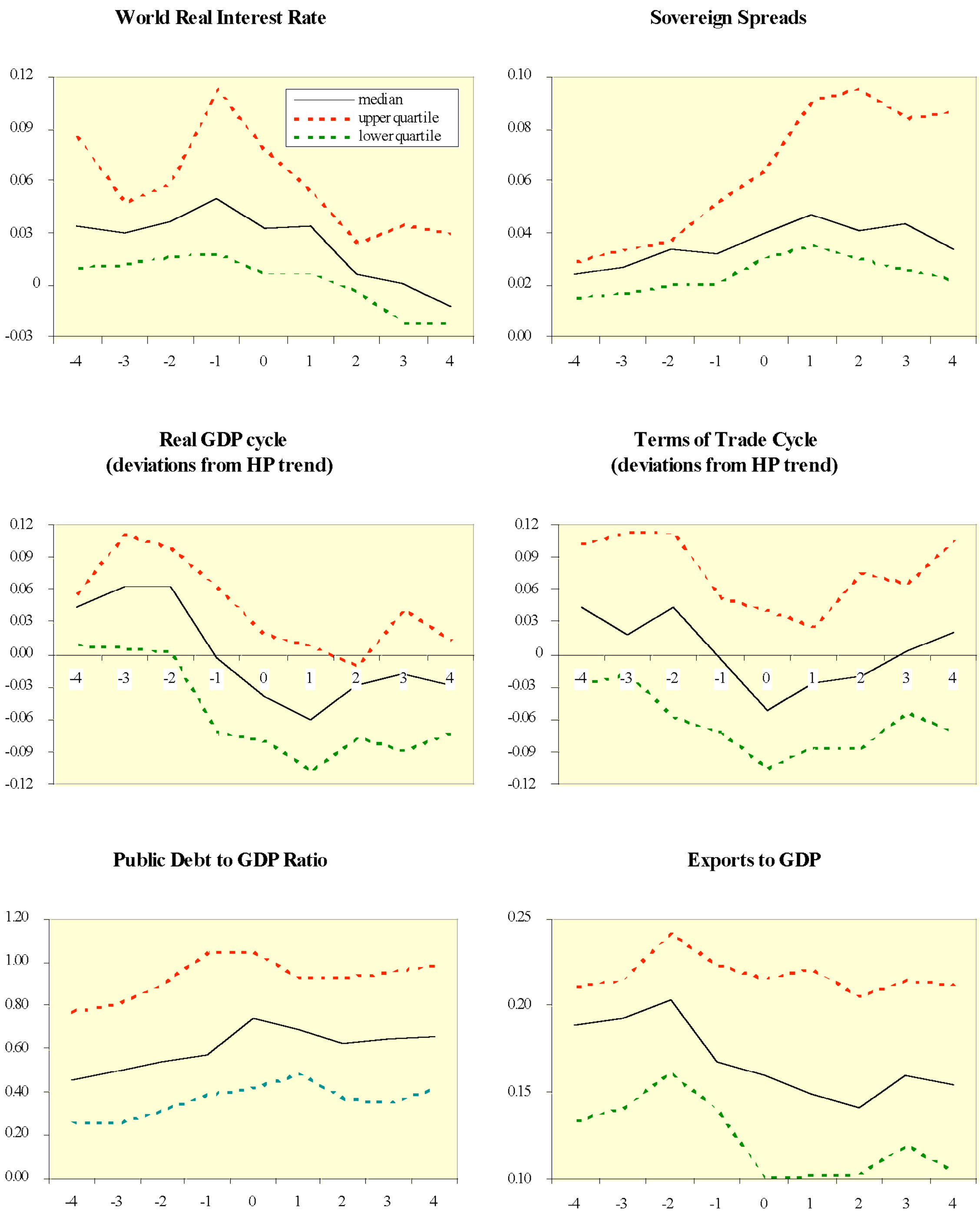
Fig. 3: Lender's payoff and output volatility.

8 Appendix 2

Table A.2: Default Events

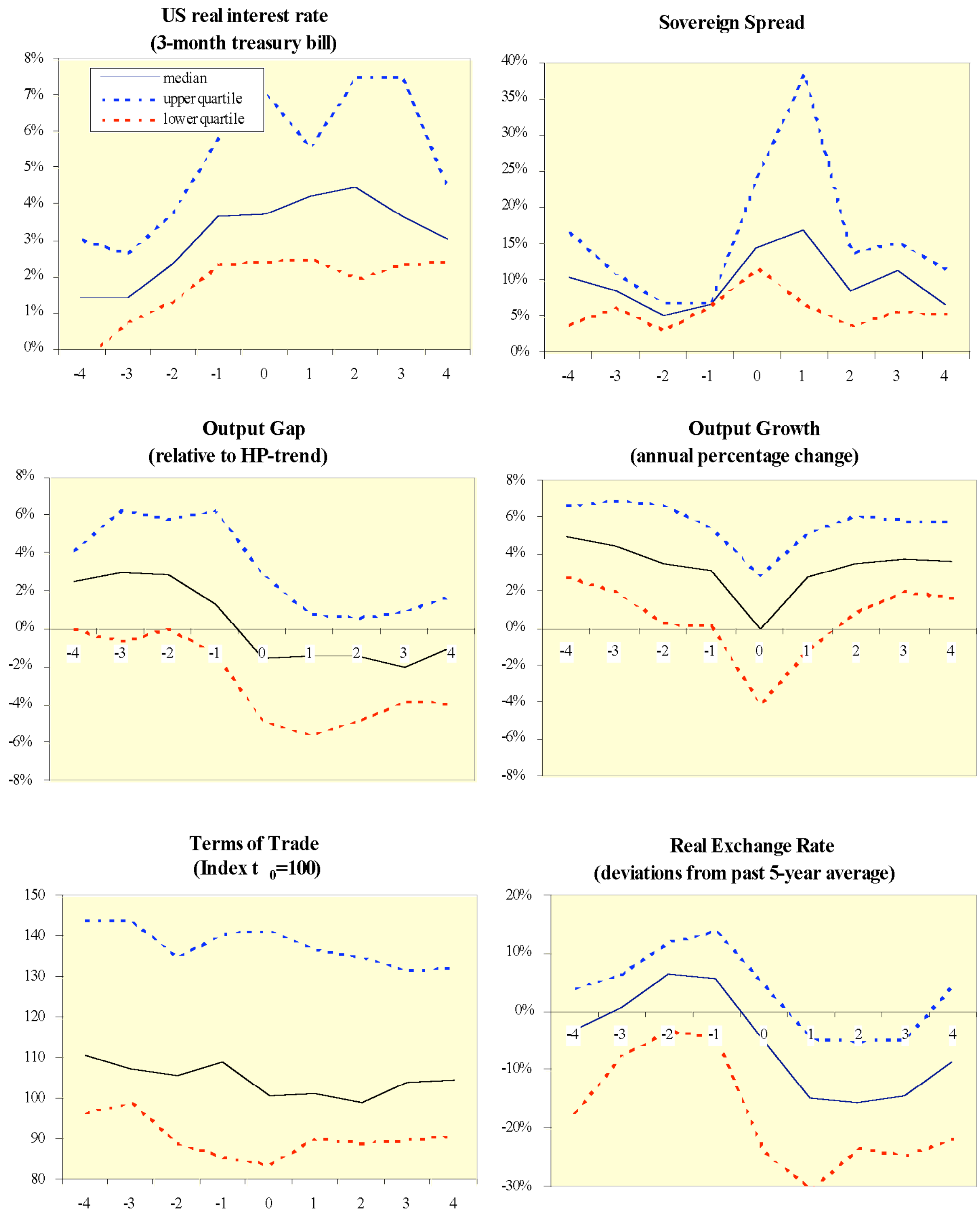
Country	Default	Debt Rescheduling	Debt Crisis/ IMF Rescue Package
Argentina	1890;1982 2001	1962;1965	1995
Bolivia	1981	1980	
Brazil	1898;1914 1931;1983	1961;1964	
Chile	1880;1931 1973;1983	1961;1963 1965;1972	
China	1914;1931		
Costa Rica	1983		
Dominican Republic	1982		
Ecuador	1983;1999		
Jamaica		1981	
Mexico	1914;1982		1995
Panama	1983		
Peru	1875;1931 1981	1968;1969 1980;1983	
Uruguay	1875;1932 1961;1983	1965	
Venezuela	1892;1898 1961;1983		
India		1969	
Indonesia		1966;1998	1997
Pakistan	1998		
Philipines	1983	1969	
Thailand			1997
Egypt	1876;1984		
Gabon	1986	1978	
Jordan	1989		
Morocco	1983		
South Africa	1985		
Turkey	1875;1914 1978		
Bulgaria	1990		
Hungary	1931		
Poland	1981		
Romania	1982		
Yugoslavia	1931		
Russia	1917;1991 1998		
Germany	1931		
Greece	1893;1932		
Portugal	1892		
Spain	1882		

Figure 2. Macroeconomic Developments around Sovereign Defaults, 1870-1939



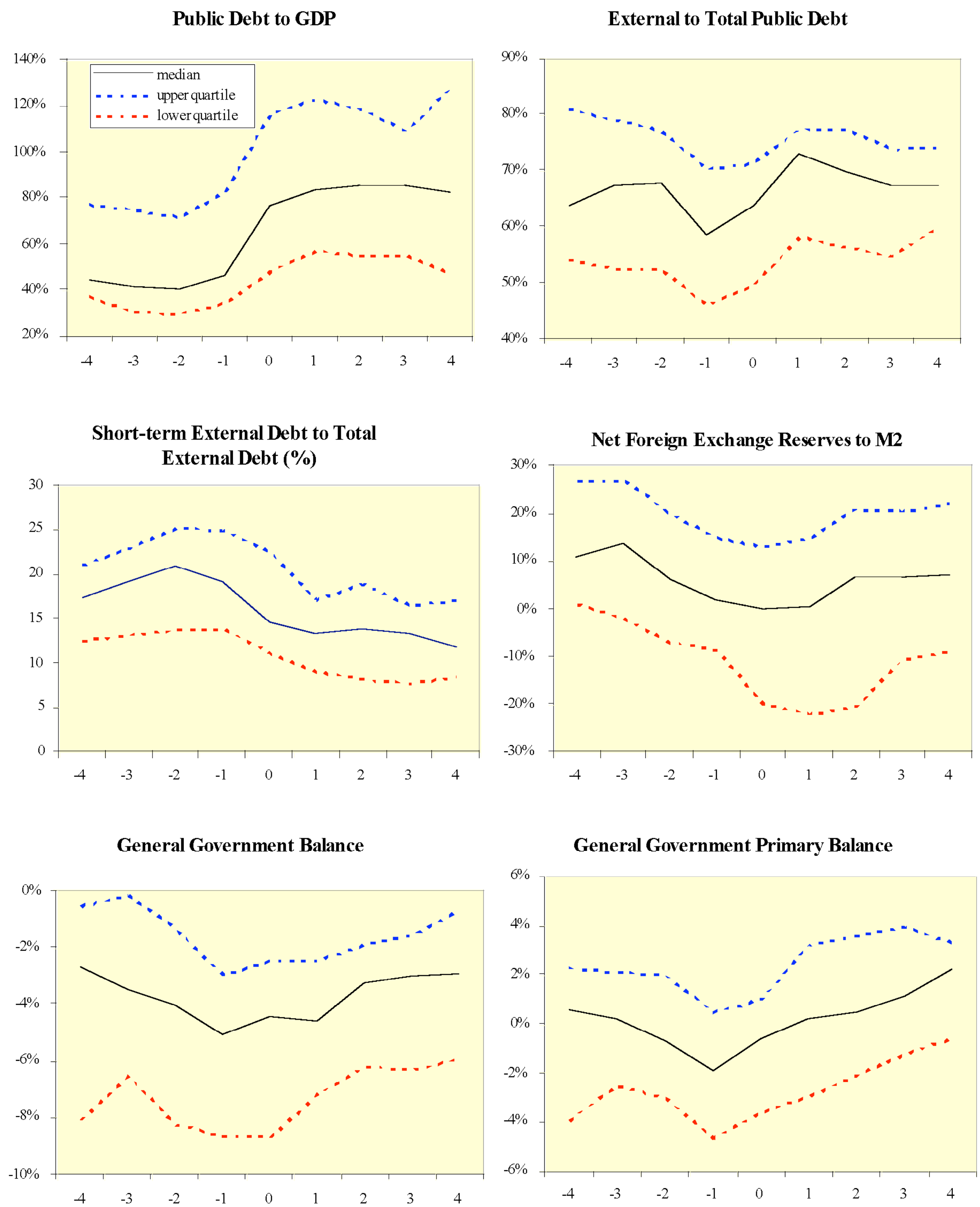
Source: See Appendix.

Figure 3. Macroeconomic Developments around Debt Crises, 1960-2004



Sources: See Appendix.

Figure 3 (cont.). Macroeconomic Developments around Debt Crises, 1960-2004



Source: See Appendix.

Table 1: Real GDP Volatility and Persistence and Countries' Repayment Records
(in deviations from HP trend)

	1870-1913			1919-1939		
	Std. Dev.	AR(1)	Def. Freq.	Std. Dev.	AR(1)	Def. Freq.
ARG	0.0640	0.0716	2	0.0387	0.5540	0
BRA	0.0437	0.7950	1	0.0423	0.5820	1
CHL	0.0491	0.6080	1	0.1270	0.6470	1
MEX*	0.0410	0.7910	2	0.0557	0.6520	0
PERU	.	.	1	0.1214	0.3270	1
URU	0.0812	0.3800	1	0.0914	0.4600	1
VEN	0.0914	0.2480	2	0.1316	0.7760	0
AUS	0.0466	0.3070	0	0.0618	0.7770	0
EGY	.	.	1	0.0280	0.5870	0
IND	0.0396	-0.0032	0	0.0237	-0.0420	0
JAP	0.0247	-0.1459	0	0.0522	0.4430	0
NZL	0.0410	0.2360	0	0.0672	0.5497	0
TUK	.	.	1	0.0753	0.3810	1
AHU	0.0193	0.2110	0	.	.	.
BEL	0.0200	.	0	0.0534	0.5226	0
DEN	0.0137	0.2350	0	0.0404	0.5080	0
FIN	0.0371	0.7470	0	0.0564	0.5205	0
FRA	0.3950	0.3720	0	0.0919	0.6734	0
GER	0.3460	0.9580	0	0.0969	0.5420	1
GRE	0.6760	0.2990	2	0.0847	1.0760	1
HUN	.	. .		0.0510		1
ITA	0.2680	0.0650	0	0.0569	0.4440	0
NET	0.0266	0.4240	0	0.0606	0.6298	0
NOR	0.0185	0.6560	0	0.0412	0.1830	0
PT	0.0240	0.5780	1	0.0497	0.1160	0
SPA	0.0369	0.3020	1	0.0780	0.6570	0
RUS	0.0645	0.3270	0	.		.
SWE	0.0271	0.4910	0	0.0424	0.6288	0
UK	0.0224	0.5490	0	0.0753	0.4940	0
CAN	0.0449	0.4820	0	0.1080	0.7581	0
US	0.0373	0.3094	0	0.0900	0.7692	0
LA median	**0.057**	**0.494**		**0.091**	**0.582**	
Asian median	**0.040**	**-0.003**		**0.052**	**0.550**	
Non-def Europe	**0.027**	**0.424**		**0.057**	**0.522**	
Def. Europe	**0.037**	**0.302**		**0.075**	**0.519**	
North America	**0.041**	**0.396**		**0.099**	**0.764**	
Defaulters	**0.049**	**0.380**		**0.080**	**0.542**	
Serial Defaulters	**0.064**	**0.380**		**0.088**	**0.615**	
Non-defaulters	**0.037**	**0.327**		**0.056**	**0.554**	

*Remained in default throughout 1919-1939.

Table 2 (cont.). Volatility and Persistence Measures of Real GDP and TOT

(deviations of HP trend)

	Real GDP		**TOT**		
	Std. Dev.	AR(1)	Std. Dev.	AR(1)	Def
us	0.019	0.531	0.032	0.471	0
uk	0.020	0.613	0.041	0.566	0
aus	0.017	0.472	0.067	0.408	0
ozt	0.016	0.533	0.020	0.289	0
bel	0.016	0.563	0.019	0.368	0
can	0.020	0.609	0.032	0.394	0
den	0.019	0.471	0.028	0.296	0
fin	0.033	0.720	0.063	0.460	0
fra	0.015	0.679	0.031	0.394	0
ger	0.025	0.615	0.039	0.501	0
grc	0.020	0.398	0.041	0.183	0
ice	0.039	0.628	0.057	0.374	0
ire	0.024	0.640	0.041	0.299	0
ita	0.019	0.464	0.043	0.608	0
jap	0.197	0.451	0.083	0.604	0
net	0.040	0.505	0.014	0.319	0
nzl	0.024	0.526	0.151	0.437	0
nor	0.017	0.605	0.081	0.535	0
pt	0.030	0.600	0.047	0.017	0
spa	0.024	0.724	0.066	0.635	0
swe	0.021	0.584	0.031	0.635	0
swi	0.025	0.666	0.030	0.292	0
Median	**0.034**	**0.607**	**0.067**	**0.371**	
LA def	**0.042**	**0.613**	**0.110**	**0.369**	
Asia non-def	**0.043**	**0.504**	**0.059**	**0.275**	
Asia def	**0.034**	**0.649**	**0.083**	**0.286**	
Africa def	**0.063**	**0.569**	**0.118**	**0.448**	
Africa non-def	**0.019**	**0.526**	**0.050**	**0.328**	
EEU def	**0.059**	**0.758**	**0.067**	**0.288**	
EEU non-def	**0.035**	**0.653**	**0.034**	**0.395**	
Defaulters	**0.044**	**0.613**	**0.090**	**0.333**	
Serial Defaulter	**0.042**	**0.623**	**0.090**	**0.349**	
Non-defaulters	**0.026**	**0.607**	**0.047**	**0.408**	

Table 3. Determinants of Sovereign Spreads: 1870-1913 1/

(HP-filter measures of the output gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ir*	0.013	0.011	0.013	0.014	0.013	0.014	0.014	0.013
	(2.41)**	(2.62)***	(2.42)**	(2.12)**	(2.18)**	(2.15)**	(2.11)**	(2.16)**
Debt/GDP	0.01	0.015	0.009	0.007	0.008	0.007	0.007	0.008
	(12.88)***	(22.17)***	(8.48)***	(7.19)***	(8.10)***	(8.32)***	(8.22)***	(10.36)***
X/GDP	-0.005	-0.011	0.002	-0.001	0.003	0.005	0.005	-0.003
	(-2.02)**	(-8.09)***	(0.66)	(-0.32)	(1.77)*	(2.69)***	(2.67)***	(-1.00)
std_HPygap	0.152		0.111	0.099	0.13	0.145	0.146	0.12
	(9.73)***		(7.40)***	(5.66)***	(8.13)***	(8.36)***	(8.42)***	(7.22)***
per_HPygap	0.004		0.004	0.002	0.001	0.002	0.002	0.003
	(5.66)***		(5.06)***	(2.91)***	(1.69)*	(2.07)**	(2.02)**	(2.97)***
std_yins		0.18						
		(5.57)***						
yins_per		0.004						
		(4.12)***						
Dper			0.02	0.025	0.022	0.019	0.019	0.014
			(11.15)***	(10.25)***	(11.42)***	(10.88)***	(10.85)***	(5.93)***
Demp				-0.023	-0.019	-0.015	-0.015	-0.017
				(-11.22)***	(-11.14)***	(-10.95)***	(-10.80)***	(-11.00)***
Gold					-0.006	-0.006	-0.006	-0.006
					(-9.69)***	(-11.2)***	(-11.12)***	(-10.66)***
Def. history						0.041	0.042	0.038
						(8.77)***	(8.64)***	(8.74)***
Ext. Debt/Total Debt								0.005
								(3.11)***
TOT shock							0.0	
							(0.27)	
Observations	619	598	619	619	619	619	619	588
R-squared	0.24	0.23	0.26	0.31	0.36	0.37	0.37	0.31

1/ Robust t-ratios in parentheses. Dependent variable is the respective country's interest rate on long-term bonds minus the UK consol interest rate. A constant is included in all regressions. All explanatory variables except for TOT shock enter the regression one period lagged, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Determinants of Sovereign Spreads: 1870-1913 1/
(Beveridge-Nelson measures of the trend gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ir*	0.004	0.004	0.004	0.002	0.003	0.002	0.002	
	(0.72)	(0.58)	(0.63)	(0.3)	(0.36)	(0.31)	(0.34)	
Debt/GDP	0.014	0.015	0.014	0.013	0.013	0.013	0.013	0.014
	(11.52)***	(11.62)***	(9.01)***	(9.95)***	(9.45)***	(9.41)***	(9.16)***	(9.04)***
X/GDP	-0.012	-0.018	-0.022	-0.016	-0.017	-0.017	-0.019	-0.02
	(-3.20)***	(-4.00)***	(-4.20)***	(-3.84)***	(-3.72)***	(-3.71)***	(-3.59)***	(-3.81)**
std_BNygap	0.159	0.117	0.106	0.119	0.132	0.13	0.128	0.127
	(6.20)***	(4.34)***	(4.08)***	(4.77)***	(5.44)***	(5.31)***	(4.95)***	(4.96)**
per_BNygap	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
	(5.58)***	(4.17)***	(2.96)***	(3.06)***	(2.52)**	(2.60)**	(2.98)***	(2.95)***
Dper		0.014	0.019	0.016	0.014	0.014	0.006	0.006
		(10.31)***	(9.82)***	(11.74)***	(11.89)***	(11.91)***	(3.12)***	(2.91)***
Demp			-0.02	-0.015	-0.014	-0.014	-0.018	-0.018
			(-11.02)***	(-12.49)***	(-12.51)**	(-12.29)**	(-11.10)***	(-10.45)***
Gold				-0.01	-0.008	-0.008	-0.009	-0.009
				(-9.61)***	(-9.01)**	(-9.00)**	(-9.46)***	(-9.21)***
Def. history					0.03	0.03	0.031	0.032
					(10.01)***	(10.05)***	(8.98)***	(8.41)***
Ext. Debt/Total Debt							0.01	0.011
							(4.06)***	(4.10)***
TOT shock						0.003		
						(1.39)		
Observations	424	424	424	424	424	424	413	413
R-squared	0.39	0.39	0.42	0.48	0.46	0.47	0.46	0.46

1/ Robust t-ratios in parentheses. Dependent variable is the respective country's interest rate on long-term bonds minus the UK consol interest rate. A constant is included in all regressions. All explanatory variables except for TOT shock enter the regression one period lagged, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Determinants of Sovereign Spreads: 1925-1939 1/
(HP-filter measures of the output gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ir*	0.005 (0.53)	0.005 (0.66)	0.005 (0.64)	0.005 (0.57)	0.006 (0.80)	0.008 (1.08)	0.01 (1.35)	
Debt/GDP	0.004 (1.54)	0.001 (0.23)	0.003 (0.68)	0.004 (1.18)	0.004 (1.24)	0.009 (5.64)***	0.009 (4.58)***	0.008 (5.67)***
X/GDP	-0.057 (4.61)***	-0.051 (-3.97)***	-0.052 (4.77)***	-0.045 (3.53)***	-0.042 (3.94)***	-0.028 (3.84)***	-0.026 (3.01)***	-0.03 (4.48)***
std_HPygap	0.333 (3.93)***		0.503 (4.47)***	0.329 (3.01)***	0.205 (2.25)**	0.083 (1.51)	0.119 (1.75)*	0.085 (1.55)
per_HPygap	0.02 (3.89)***		0.022 (4.09)***	0.018 (3.38)***	0.017 (3.51)***	0.01 (2.14)**	0.01 (2.29)**	0.009 (2.08)**
std_yins		0.168 (2.95)**						
yins_per		0.007 (1.81)*						
Dperiphery			0.018 (5.43)***	0.028 (5.57)***	0.029 (6.06)***	0.015 (3.04)***	0.015 (2.97)***	0.015 (3.09)**
Dempire				-0.027 (5.00)***	-0.025 (4.33)***	-0.017 (3.22)***	-0.016 (3.15)***	-0.017 (3.27)***
Gold					-0.007 (5.01)***	-0.007 (6.46)***	-0.007 (6.31)***	-0.007 (6.92)**
Def. history						0.08 (4.29)***	0.079 (4.59)***	0.079 (4.30)***
Ext. Debt/Total Debt								
TOT shock							0.001 (0.51)	
Observations	305	305	305	305	305	305	295	305
R-squared	0.12	0.11	0.19	0.23	0.33	0.52	0.53	0.52

1/ Robust t-ratio in parenthesis. Dependent variable is the respective country's interest rate on long-term bonds minus the UK consol interest rate. A constant is included in all regressions. All explanatory variables except for TOT shock enter the regression one period lagged, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. Determinants of Sovereign Spreads: 1925-1939 1/

(Beveridge-Nelson measures of the trend gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ir*	0.004	0.005	0.004	0.005	0.005	0.007	0.016	
	(0.45)	(0.53)	(0.43)	(0.71)	(0.88)	(1.15)	(1.95)*	
Debt/GDP	0.002	0.003	0.008	0.006	0.01	0.01	0.036	0.01
	(0.78)	(0.76)	(2.29)**	(2.40)**	(6.06)***	(5.09)***	(7.82)***	(6.10)***
X/GDP	-0.053	-0.05	-0.048	-0.043	-0.037	-0.038	-0.029	-0.038
	(-4.43)***	(-3.71)***	(-3.93)***	(-5.01)***	(-5.41)***	(-4.54)***	(-1.16)	(-5.82)***
std_BNygap	0.084	0.384	0.309	0.272	0.128	0.149	0.18	0.128
	(1.67)*	(3.78)***	(2.57)**	(2.99)***	(2.55)**	(2.37)**	(1.36)	(2.57)**
per_Bnygap	0.015	0.004	0.004	0.004	0.002	0.002	0.004	0.002
	(2.12)**	(3.03)**	(3.32)**	(2.98)**	(2.12)**	(2.01)**	(2.34)**	(2.06)**
Dperiphery		0.021	0.029	0.026	0.014	0.015	0.021	0.014
		(4.69)**	(5.24)**	(6.17)**	(3.13)**	(3.02)**	(1.26)	(3.13)***
Dempire			-0.031	-0.027	-0.02	-0.021	-0.007	-0.02
			(-4.72)***	(-4.97)***	(-3.92)***	(-3.84)***	(-0.81)	(-3.93)***
Gold				-0.008	-0.007	-0.007	-0.007	-0.007
				(-5.25)**	(-6.67)**	(-6.53)**	(-4.87)***	(-7.04)***
Def. history					0.079	0.077	0.104	0.079
					(4.24)***	(4.42)***	(9.85)***	(4.23)***
Ext. Debt/Total Debt							-0.019	
							(-1.67)*	
TOT shock						0.001		
						(0.49)		
Observations	302	302	302	302	302	292	100	302
R-squared	0.12	0.17	0.28	0.41	0.56	0.53	0.56	0.56

1/ Robust t-ratios in parentheses. Dependent variable is the respective country's interest rate on long-term bonds minus the UK consol interest rate. A constant is included in all regressions. All explanatory variables except for TOT shock enter the regression one period lagged, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Determinants of Sovereign Spreads, 1994-2005 1/
(HP-filter measures of the output gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ir*	0.217	0.195	0.201	0.205	0.181	0.197	0.2	0.188	0.173	0.161
	(1.57)	(1.38)	(1.44)	(1.44)	(1.33)	(1.36)	(1.38)	(1.36)	(1.30)	(1.27)
Debt/GDP	0.124	0.144	0.141	0.14	0.149	0.142	0.151	0.119	0.106	0.093
	(3.98)***	(5.20)***	(5.62)***	(3.97)***	(4.65)**	(5.05)**	(5.10)**	(4.06)**	(3.37)**	(3.42)**
X/GDP	-0.157	-0.148	-0.147	-0.142	-0.153	-0.159	-0.151	-0.13	-0.145	-0.153
	(4.85)***	(4.50)***	(4.42)***	(-4.77)***	(4.48)**	(4.43)**	(4.55)**	(3.88)**	(4.13)**	(4.31)**
std_ygap	1.118	1.61	1.75	0.505	1.49	1.749	1.623	1.919	1.952	1.55
	(1.61)	(1.90)*	(2.18)**	(1.07)	(1.83)*	(2.00)*	(1.92)*	(2.42)*	(2.40)*	(2.48)*
ygap_per	0.054	0.037	0.041	0.05	0.037	0.041	0.041	0.042	0.052	0.057
	(3.17)***	(2.73)***	(2.97)**	(2.99)***	(2.69)**	(2.45)*	(2.51)*	(2.78)**	(1.95)*	(3.45)**
Dla		0.044	0.041	0.032	0.043	0.043	0.045	0.044	0.03	
		(2.98)***	(2.61)**	(1.56)	(2.83)**	(2.67)**	(3.00)**	(2.59)**	(1.29)	
Das		0.035	0.039	0.026	0.041	0.036	0.029	0.023	0.025	
		(2.18)**	(2.53)**	(1.27)	(1.84)*	(2.15)*	(1.88)*	(1.39)	(1.19)	
FX regime			0.002							
			(0.48)							
Def. history				(0.006)						
				(0.12)						
TOT shock					-0.066					
					(-1.26)					
Ext. Debt/Total Debt						0.001				
						(0.02)				
% Short-term Debt							0			
							(0.15)			
Reserves/M2								-0.083	-0.072	-0.082
								(-3.12)**	(-2.47)*	(-3.13)**
Fiscal Balance/GDP									-0.148	-0.204
									(-1.46)	(-2.82)**
Observations	177	177	177	177	177	177	177	176	176	176
Number of countries	26	26	26	26	26	26	26	25	26	26
R-squared	0.45	0.53	0.51	0.44	0.49	0.5	0.53	0.5	0.53	0.52

1/ Robust t-statistics in parentheses. Dependent variable is the respective country's spread on long-term bonds relative to the US instrument the US instrument of similar maturity (JP Morgan's EMBI index). A constant is included in all regressions. All explanatory are lagged one-year with the exception of terms of trade shock, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8. Determinants of Sovereign Spreads, 1994-2005 1/

(Beveridge-Nelson measures of the trend gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ir*	0.223	0.197	0.226	0.19	0.193	0.221	0.199	0.178	0.185	
	(1.66)*	(1.43)	(1.68)*	(1.36)	(1.46)	(1.58)	(1.44)	(1.33)	(1.36)	
Debt/GDP	0.124	0.146	0.133	0.139	0.148	0.133	0.151	0.122	0.1	0.124
	(4.24)***	(4.69)***	(5.59)***	(3.88)***	(4.77)***	(5.12)***	(5.37)***	(3.65)***	(3.24)***	(3.59)***
X/GDP	-0.125	-0.14	-0.109	-0.148	-0.141	-0.121	-0.127	-0.129	-0.11	-0.133
	(-3.94)***	(-3.84)***	(-4.10)***	(-3.85)***	(-3.94)***	(-4.12)***	(-3.72)***	(-3.64)***	(-3.82)***	(3.64)***
std_ygap	1.028	1.013	1.359	1.003	0.965	1.242	1.223	1.206	1.368	1.251
	(1.79)*	(1.57)	(1.94)*	(1.58)	(1.57)	(1.93)*	(1.68)*	(1.70)*	(1.79)*	(1.76)*
ygap_per	0.005	0.011	0.011	0.013	0.011	0.012	0.013	0.011	0.01	0.011
	(1.05)	(1.83)*	(1.89)*	(2.02)**	(1.94)*	(1.91)*	(2.26)*	(1.84)*	(1.70)*	(1.88)*
Dla		0.039	0.041	0.038	0.038	0.046	0.044	0.044	0.04	0.042
		(2.56)**	(2.58)**	(1.54)	(2.37)**	(2.57)**	(2.77)**	(2.91)**	(2.09)**	(2.62)***
Das		0.054	0.045	0.056	0.055	0.042	0.035	0.045	0.038	0.042
		(2.12)**	(2.56)**	(2.24)**	(2.15)**	(2.25)**	(1.83)*	(1.96)**	(1.98)**	(1.81)*
FX regime			0.002							
			(0.44)							
Def. history				0.006						
				(0.09)						
TOT shock					-0.07					
					(-1.34)					
Ext. Debt/Total Debt						-0.013				
						(-0.46)				
% Short-term Debt							0.01			
							(0.72)			
Reserves/M2								-0.072	-0.066	-0.076
								(-2.62)***	(-2.22)*	(2.58)***
Fiscal Balance/GDP									-0.1	
									(-1.10)	
Observations	173	173	173	173	173	173	167	173	172	173
Number of countries	26	26	26	26	26	26	26	25	26	26
R-squared	0.47	0.53	0.52	0.47	0.51	0.53	0.55	0.48	0.48	0.49

1/ Robust t-statistics in parentheses. Dependent variable is the respective country's spread on long-term bonds relative to the US instrument of similar maturity (JP Morgan's EMBI index). A constant is included in all regressions. All explanatory are lagged one-year with the exception of terms of trade shock, as discussed in the main text.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 9. Determinants of the Default Premium, 1870-1939 1/

(HP-filter measures of the output gap)

	(1)	(2)	(3)	(4)	(5)	(6)
ir*	0.237	0.277	0.303	0.091	0.106	0.109
	(1.20)	(1.35)	(1.44)	(0.80)	(0.87)	(1.09)
Debt/GDP	-0.029	-0.014	0.006	0.079	0.102	0.091
	(1.11)	(0.59)	(0.32)	(3.53)***	(3.45)**	(3.60)**
X/GDP	-0.004	-0.003	-0.003	-0.009	-0.056	0.069
	(-0.86)	(-0.79)	(-0.76)	(-3.34)**	(-0.38)	(-0.44)
std_ygap	-1.046	-1.271	-1.483	-1.659	-1.654	-1.765
	(-1.71)*	(-1.89)*	(-1.98)**	(-2.27)**	(-2.25)**	(-2.27)**
ygap_per	0.125	0.163	0.262	0.171	0.169	0.083
	(1.66)*	(1.84)*	(2.36)**	(2.51)**	(2.52)**	(1.68)*
Dperiphery		-0.072	-0.112	-0.218	-0.244	-0.283
		(-2.30)**	(-2.76)**	(-3.14)***	(-3.03)***	(-2.79)***
Gold			0.104	-0.035	-0.034	-0.051
			(-1.98)**	(-0.84)	(-0.63)	(-1.54)
Def. history				0.402	0.447	0.395
				(2.56)**	(2.53)**	(2.67)***
TOT shock					-0.288	-0.258
					(-2.17)**	(-2.11)**
Ext. Debt/Total Debt						0.133
						(1.76)*
Observations	66	66	66	66	63	74
R-squared	0.15	0.17	0.19	0.35	0.40	0.41

1/ Robust t statistics in parentheses. In all regressions, the dependent variable is the difference between the spread of a country in default and the mean spread of all other countries not in default in that year.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 10. Determinants of the Default Premium, 1870-1939 1/

(Beveridge-Nelson measures of the trend gap)

	(1)	(2)	(3)	(4)	(5)	(6)
ir*	0.397	0.482	0.474	0.287	0.311	0.31
	(1.50)	(1.60)	(1.58)	(1.97)**	(2.13)**	(2.06)**
Debt/GDP	-0.058	-0.05	-0.04	0.06	0.078	0.078
	(-1.43)	(-1.40)	(-1.25)	(3.82)***	(4.24)***	(4.21)***
X/GDP	-0.328	-0.18	-0.341	0.831	0.802	0.806
	(-1.80)*	(-0.86)	(-1.11)	(-1.77)*	(-1.74)*	(-1.79)*
std_ygap	-0.989	-1.224	-1.23	-1.776	-1.772	-1.771
	(-1.75)*	(-1.79)*	(-1.79)*	(-2.53)**	(-2.55)**	(-2.53)**
ygap_per	0.105	0.144	0.166	0.146	0.15	0.15
	(1.68)*	(1.75)*	(1.74)*	(2.21)**	(2.26)**	(2.23)**
Dperiphery		-0.103	-0.133	-0.309	-0.335	-0.333
		(-1.69)*	(-1.67)*	(-2.64)***	(2.81)***	(2.52)***
Gold			0.08	-0.283	-0.269	-0.271
			(1.05)	(2.26)**	(2.16)**	(2.23)**
Def. history				0.678	0.694	0.697
				(2.60)***	(2.66)***	(2.77)***
TOT shock					-0.215	-0.215
					(-2.35)**	(-2.33)**
Ext. Debt/Total Debt						-0.005
						(-0.08)
Observations	64	64	64	64	64	64
R-squared	0.24	0.26	0.27	0.49	0.53	0.53

1/ Robust t statistics in parentheses. In all regressions, the dependent variable is the difference between the spread of a country in default and the mean spread of all other countries not in default in that year.

* significant at 10%; ** significant at 5%; *** significant at 1%