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ABSTRACT

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Though currency and debt crises quite often occur simultaneously, the links between these two types of crises are not well understood. We review how currency and debt crises could be related due to (1) common causes, (2) internal contagion effects from one crisis to the other, and (3) complementary budget financing aspects. The relationship between currency and debt crises is illustrated with a small theoretical model. Using panel data for 80 countries over the period 1975-2000, we analyze the relationship between currency and debt crises empirically in two steps. First, we investigate the determinants of each crisis separately. Second, we estimate links between both crises employing instrumental variables techniques. We find that, while there is a negative lagged influence of currency crises on debt crises, the occurrence of a currency crisis significantly increases the risk of a contemporaneous debt crisis and vice versa. Both types of crises are significantly more likely if the debt burden is higher.

Keywords: debt crises, currency crises, contagion

JEL: F34, F41, E61

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1. Introduction

Empirically, the simultaneous occurrence of currency and sovereign debt crises is a rather frequent phenomenon.[1] Nevertheless the literature on currency crises and sovereign defaults usually neglects the question of how the two types of crises might be related and typically treats currency and debt crises as independent events.

This may be a severe shortcoming especially on the empirical side. The external debt level of countries for example is a significant determinant of currency crises in many studies. However, an important but open question is through which channels a high level of debt may lead to depreciation. Does a higher debt level increase the risk of a currency crisis directly? Or does it in a first step increase the probability of a debt crisis and it is actually the occurrence of the debt crisis which subsequently increases the risk of a currency crisis? If currency and debt crises are in fact interrelated due to common causes and / or direct contagion effects from one crisis type to the other, an explicit consideration of these interrelations may enhance the results of empirical research and maybe the quality of early warning systems also.

As our main contribution to the literature, we empirically analyze the time structure of those crises and investigate whether both types of crises are usually jointly determined by common causes or budget financing, or whether aspects of internal contagion makes one crisis appear as consequence of the other. What we find is, basically, that both types of crises are significantly more likely with higher debt burdens. While there is a negative lagged influence of currency crises on debt crises, the occurrence of a currency crisis significantly increases the risk of a contemporaneous debt crisis and vice versa, giving rise to an "internal contagion" hypothesis.

The remainder of this paper is organized as follows. In section 2 we shortly review the theoretical approaches on the determinants of currency and debt crises and present an in depth discussion of the potential relationship between both types of crises. We thereby differentiate between common causes, internal contagion effects from currency to debt crises and vice versa, and complementary budget financing aspects. We also discuss recent approaches to model the interrelations of currency and debt crises in an escape clause framework and present a small illustrative model. In

[1] Reinhart (2002) finds that 84 percent of the defaults in her emerging markets sample are linked with currency crises while almost half of the currency crises in the sample are associated with defaults. For a review of various approaches to empirically identify episodes and the causes of currency crises see Jacobs, Kuper and Lestano (2004).

section 3 we analyze the empirical relationship between currency and debt crises in two steps. We first investigate the determinants of each of the two types of crises separately. Then, after testing for Granger causality, we analyze both crises employing instrumental variables techniques.

2 Theoretical links between currency and debt crises: A review of the literature

The currency crisis literature can be separated into two groups. So-called first generation models focus on the causes and the timing of speculative attacks, which force a government to abandon a fixed exchange rate. In these models the breakdown of an exchange rate peg is explained as the inevitable result of an excessive monetary policy, which is inconsistent with the exchange rate regime (e.g. Krugman 1979 and Flood and Garber 1984). In contrast, the basic question in the so-called escape clause (or second generation) literature on currency crises is not whether a government is technically *able* but whether it is *willing* to keep an exchange rate peg. The exit from a peg is seen as a deliberate and strategic policy choice of a government that maximizes public welfare by weighing the costs and benefits of the fixed exchange rate. Shifts in private expectations play a crucial role in these models since they enter the government's welfare function or its budget constraint in various ways, e.g. via an expectations augmented Phillips curve or via interest rate premiums. The government's decision is endogenous in so far as it depends on private expectations. This feature typically allows for multiple equilibria with self-fulfilling devaluation expectations (see e.g. Obstfeld 1996, Ozkan and Sutherland 1998, and Jeanne 2000).

In an analogous way the debt crisis literature analyzes two different aspects of debt repudiation, the *inability* and the *unwillingness* of debtors to meet their debt service obligations.[2] A large part of the ability-to-pay literature is engaged in the question of how to deal with excessively indebted poor countries, which are de facto insolvent.[3] The basic question of the willingness-to-pay literature is to ask why

[2] Unlike in the currency crisis literature, however, in the debt crisis literature both aspects evolved at the same time.

[3] Many authors discuss multilateral and bilateral creditors' approaches to bring down these countries' external debt to a sustainable level. Recent research particularly focuses on the HIPIC initiative (see e.g. Gunter 2003, IMF 2002 and 2003a, and Bhattacharya 2003) and proposals to apply basic principles of the private insolvency law to sovereign debtors. The IMF for instance has already developed concrete proposals for a statutory sovereign debt restructuring mechanism (SDRM, see e.g. IMF

governments repay their debt at all, as creditors can apply only very few legal institutions or sanctions to enforce their claims. Just like in the escape clause approach to currency crises, the answer is that welfare-maximizing governments base their decision whether or not to honor their debt on a cost-benefit-calculus. They are willing to service their debt only if the costs of a default, e.g. negative output effects[4] or reputation losses, exceed the benefits of a default, i.e. avoided debt service (see e.g. Eaton and Gersovitz 1981, Grossman and van Huyck 1988, Cole, Dow and English 1995). Many of these models also give rise to multiple equilibria and extensive research has focused on the question whether sovereign liquidity crises, which are not due to solvency reasons, are mainly driven by economic fundamentals or by sudden shifts in private creditors' default expectations (see e.g. Calvo 1988, Alesina, Prati and Tabellini 1990, Detragiache 1996, and Cole and Kehoe 1998).[5]

The links between currency and debt crises have rarely been analyzed.[6] However, the literature on monetary and fiscal policy as well as the literature on financial crises discussed above incorporates several useful insights on possible interrelations. In this section we review the previous literature and investigate these linkages, thereby differentiating between common causes, internal contagion effects from currency to debt crises and vice versa, and complementary budget financing aspects.

2.1. Why currency and debt crises could be positively related I: common causes

The simultaneous occurrence of problems in the balance-of-payments and the government's budget could be due to the fact that they are caused by the same factors.

First, negative shocks on aggregate demand might lead to a breakdown in real economic activity and impose market pressure on the local currency to devalue. A government that has committed itself to keep a fixed exchange rate peg is forced to sell international reserves and / or to raise the interest rate in order to defend the peg, thereby worsening the recession. However, according to the second-generation

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2003b). However, in April 2003 the Fund's International Financial and Monetary Committee finally decided against the establishment of such a mechanism.

[4] See e.g. Dooley 2000, Rose 2002, and Rose and Spiegel 2002.

[5] Signalling their willingness to service their debt and to use new loans for investment rather than for consumption is thus important for governments to avoid liquidity crises. Marchesi and Thomas (1999) and Marchesi (2003) argue, that the adoption of an IMF programme can work as such a signal of "good intend" and is often rewarded by a subsequent debt rescheduling with private creditors.

[6] Among those are Herz and Tong (2003), Bauer, Herz and Karb (2003), and Jahjah and Montiel (2003), which will be discussed subsequently.

currency crises models, output and employment losses imply that the authorities have strong incentives to exit the peg and fight the recession by monetary expansion. Rational speculators recognize the government's incentives. They anticipate devaluation and withdraw their capital, thereby increasing devaluation pressure on the domestic currency and the costs of defending the peg. It finally gives in to the devaluation pressure, thereby validating speculators' expectations. In addition, output and employment losses also have a negative impact on the government's primary budget balance, as public expenditures (e.g. social transfers) tend to rise while taxable income shrinks. This increases the probability of sovereign default, particularly if the government has no further access to credits from the international capital market or can issue new debt only at prohibitively high interest rates.

A second important factor that may trigger both a currency and a debt crisis is a rise in the level of the international (real) interest rate. Under capital mobility domestic debtors have to increase their interest payments if they want to rollover maturing debt or raise additional funds. If such an adjustment does not take place, substantial outflows of portfolio capital put pressure on the currency. However, if the adjustment does occur, increased interest rates may cause investment and consumption to decline and lead to a recession with all the negative consequences for the balance-of-payments and the government's budget that have already been discussed. In addition, higher interest rates also directly augment the government's (and other borrowers') incentive to default on its (their) debt, as debt rollovers become more expensive and debt service increases.

Finally, currency and debt crises can be caused by political, institutional and structural problems that may well have existed for an extended period or have been deteriorating over time but that have so far been unobserved or unregarded by international investors. Any sunspot event could trigger speculators to gather new relevant information and / or to reassess their information, so that they refuse to rollover maturing debt, withdraw their capital, or at least demand very high interest rates. By doing so they impose high pressure on the currency to devalue and aggravate (sovereign) borrowers' financial problems at the same time.

2.2. Why currency and debt crises could be positively related II: internal contagion from debt to currency crisis

Based on the view that sovereign debt crises cause losses in trade, output, and employment,[7] a default may simply be seen as the source of a recession that affects the exchange rate through the channels described above. Furthermore, in the event of an imminent sovereign default rational investors do not lend additional funds to the sovereign debtor but try to retrieve their capital. If, in addition, speculators (correctly) interpret the sovereign fiscal crisis as a sign that the economy enters recession and crisis, they do not only claim back and refuse to roll-over the maturing debt of the government, but additionally remove a large part of their portfolio investments from the afflicted economy, thereby increasing devaluation pressure.

2.3. Why currency and debt crises could be positively related III: internal contagion from currency to debt crisis

In response to speculative pressure on their currency peg, policymakers face a delicate trade-off. Both policy options, i.e. exiting and defending the peg, may lead to high welfare costs. Taking into account various factors such as the economy's initial fundamental situation, the structure of the financial markets, and the balance sheets of banks, firms, and its own budget, the government weighs the costs and benefits of each option and chooses the least costly one.

Defending the peg implies rising interest rates, as monetary authorities increase short-term interest rates in order to stop portfolio capital outflows and stimulate capital inflows.[8] If foreign investors withdraw their investments in panic, the interest rate must rise to a notably higher level for as long as the threat of (repeated) speculative pressures persists.

However, these higher interest rates increase the risk of a sovereign debt default through two channels. First, rising interest rates make the debt rollover and the future debt service more expensive and thus increase the government's incentive to default. Second, high interest rates may lead into a recession as they cause aggregate demand to decline, especially if the interest rates have to be permanently maintained at rather

[7] See e.g. Dooley 2000, Rose 2002, and Rose and Spiegel 2002.

[8] Defending the peg through foreign exchange market interventions also leads to rising interest rates as selling hard currency reserves in exchange for domestic currency effectively reduces money supply. Velasco (1999) comprehensively discusses the case for and against tight monetary policy and high interest rates in the face of speculative pressure on the local currency. Corsetti and Mackowiak (2001) discuss the government's willingness to tolerate high interest rates in defending an exchange rate peg.

high levels to avoid ongoing speculative pressure. The number of bankruptcies and private debt defaults rises, tax revenues decrease, and the fiscal deficit and thus the risk of sovereign debt default both increase (see e.g. Flood and Jeanne 2000, Lahiri and Vegh 2002, 2003).

If the government does not defend but exits the peg, it risks loosing reputation and output. In addition, fiscal policy also may be negatively affected so that the risk of a sovereign debt default increases: After devaluation it might be difficult for a country to access the international capital market. Especially emerging markets' currency crises are often followed by downgrades of the credit rating (see e.g. Calvo and Reinhart 2000a, 2000b, and Reinhart 2002). Devaluation can thus be interpreted as a wake-up call for international investors to re-evaluate their information about the economy and to reassess the country's default risk. "devaluation can trigger financial panic, expectations of new depreciations, and hence monstrous interest rates" (Velasco 1999, p.16). Investors withdraw their funds unless the government is prepared to offer higher (default) risk premiums. For the government this again makes borrowing and rolling over its maturing debt more expensive, so that a sovereign debt default becomes more likely, which would confirm the investors' default expectations to be self-fulfilling.

Another important channel for a contagion effect from a currency to a debt crisis results from the so-called "original sin" phenomenon (see e.g. Eichengreen, Hausmann and Panizza 2002, Jeanne 2003). In contrast to industrialized countries, emerging markets and developing countries are usually not able to borrow from the international capital markets in their own currencies. As developing countries typically accumulate net external debt positions and as their few financial assets are usually at least partly denominated in local currency, there is a precarious currency mismatch in most countries' balance sheets.

Under original sin high debt is a double burden for sovereign borrowers. A government which aims to roll-over maturing debt or wants to issue new debt has to convince its international creditors not only that it will be able to raise enough taxes to honor its debt service obligations but also that it will be able to convert these revenues into foreign exchange, as debt service is due in foreign currency.[9] If prices are rigid so that purchasing power parity does not hold at least in the short run, a nominal

[9] See Mussa (2002, p. 16) for the problem of external debt in the case of Argentina's crisis of 2000-01.

devaluation drastically increases costs of carrying the debt and may cause a sovereign debt crisis, as the government can not immediately compensate the higher real debt level by higher tax revenues. On the contrary, as a large part of private corporations in emerging markets are also indebted in foreign currency, a nominal devaluation has the same devastating effects on their balance sheets and can cause substantial firm and bank bankruptcies, thereby lowering the tax base and aggravating the fiscal crisis even further (see e.g. Mishkin 1996).

2.4. Why currency and debt crises could be negatively related: budget financing

So far we have focused on hypotheses of why currency and debt crises could be positively connected. However, the two types of crises may also be negatively connected via the government's budget constraint. There are alternative ways for the government to finance its regular expenditures and to balance the budget. If the budgetary position is strained, the government may reduce expenditures, increase taxes, try to roll-over maturing debt and to issue new debt, generate seigniorage, i.e. impose an inflation tax through monetary expansion, and / or refuse debt service payments coming due (debt default).

The government has to choose among these five options in every period. If it cannot or does not want to reduce expenditures and increase taxes e.g. due to political pressure, and if furthermore the government may not resort to further borrowing from the international capital markets, then a monetary expansion, which induces inflation and devaluation pressure, and a sovereign debt default are the only alternatives to balance the budget. To the extent that the government chooses to finance its budget by printing money, the need of financing through a debt default declines and vice versa. Thus, as far as the question of budget financing is concerned, the occurrence of a currency crisis should make the occurrence of a simultaneous debt crisis less likely and vice versa.[10]

2.5. Integrated approaches based on the escape clause literature

Several authors had referred to the mechanism of budget financing through inflation as a major source of currency crises in the so-called first generation of

[10] Early work on this linkage was done by Cline (1983) and Edwards (1984), who, however, did not formalize their hypothesis in a theoretical model and did not find empirical evidence to support it either.

currency crisis models. But only recently, a number of authors introduced several of the possible linkages presented above into a common currency and debt crisis framework and by doing so started to analyze their combined effects and interrelations.

Based on the escape clause approach, this literature assumes that the government does not make its decisions whether to keep or exit an exchange rate peg and whether to honor its debt separately. It rather considers that its debt policy affects its exchange rate policy and vice versa. The decision to abandon the peg may well be a decisive factor in the government's debt policy considerations as it may change the welfare costs and benefits of a default, while the decision to default on its debt in turn can be crucial for the government's exchange rate policy as it may affect the costs and benefits of devaluation. Models of this kind typically embody the following ingredients: First, there is a welfare function, which the government maximizes. Second, the two policy parameters, i.e. the decision whether or not to exit the peg and whether or not to default on its maturing debt, affect variables in the welfare function either in the same or the opposite direction via the linkages presented above. Third, in maximizing public welfare the government is bound by its budget constraint, which implies that inflation / devaluation and debt default are alternative means of financing a budget deficit.[11]

Herz and Tong (2003) assume the government being unable or not willing to raise additional taxes and analyze the government's budget financing trade-off. If tax revenues are not sufficient to finance the sum of expenditures and debt service due, the government chooses among the alternatives of defaulting on (a fraction of) its maturing debt or / and expanding money supply, which would cause inflation and, due to the assumption of purchasing power parity, a devaluation. The joint incentives of the government and the behavior of investors may lead to situations of multiple equilibria. If investors expect a high default rate, they demand a high interest rate. This increases sovereign debt service obligations, so that the government in fact chooses a high default rate, thereby validating investors' expectations. If, however, investors expect a low default rate and thus demand a low interest rate, the

[11] Obstfeld (1994) was the first to model inflation (and the subsequent exit from a fixed exchange rate peg) explicitly as one among several alternative instruments of budget financing, which a government consciously and strategically chooses from to maximize public welfare. By doing so, he already established the grounds for this new escape-clause twin currency and debt crisis literature, even though he actually did not consider the possibility of a debt default but analyzed the trade-off between inflation and taxes as alternative means of budget financing only.

government chooses the small default rate, thereby again validating the investors' expectations. As via higher interest rates higher default expectations imply a higher absolute level of the government's need of budget financing and as the government simultaneously uses both the default and the monetary instrument to finance its budget, the high-interest-high-default-rate equilibrium furthermore implies a higher inflation and devaluation rate than the low-interest-low-default-rate equilibrium as well and thus leads to a much higher overall welfare loss. The government would therefore prefer the low default solution. Nevertheless, the high default situation is the only rational outcome if the bond market settles at the high interest rate. Herz and Tong (2003) also illustrate that with improving economic fundamentals the bad equilibrium disappears. In this respect their results are thus consistent with the traditional escape clause literature.

Bauer, Herz and Karb (2003) also analyze the optimal debt and exchange rate policy depending on the default expectations of private investors. They assume that the exit from a fixed exchange rate peg causes investors to reassess their information about both the country's economic state and the sovereign's creditworthiness. Investors demand higher interest risk premiums and the government's debt rollover thus becomes more expensive in the course of devaluation. These rising credit costs are only relevant for the government's devaluation decision, however, if the government plans to service its debt. In the case of a default, the government looses access to the capital market so that it no longer needs to consider devaluation-caused credit costs in its exchange rate policy. Bauer, Herz, and Karb (2003) find that the way and the extent to which the government's default decision affects its devaluation decision and vice versa depends on both the absolute level of debt and the fundamental situation of the economy. Generally, just like in most pure debt crisis models, the government's incentive to default rises with a higher level of debt. Furthermore, just like in most pure currency crisis models, the government's incentive to exit the fixed exchange rate peg rises with deteriorating fundamentals. However, in some situations a low debt level can substitute good fundamentals in preventing a currency crisis while good fundamentals can substitute a low debt in preventing a default. Intermediate debt levels and intermediate fundamentals give rise to multiple equilibria, in which private investors' default expectations are self-fulfilling. In certain constellations of debt levels and fundamentals private default expectations do not only trigger a self-fulfilling sovereign debt crisis but make a devaluation advantageous as

well, so that a crisis in the sovereign debt market spreads to the currency market and causes a currency crisis, too.

Jahjah and Montiel (2003) analyze a welfare-maximizing government's budget-financing trade-off between debt repudiation and taxation. They assume the local price level to be rigid so that purchasing power parity does not hold. Any change in the nominal exchange rate therefore implies a change in the real exchange rate in the same amount. Consequently, in the face of devaluation the "original sin" hypothesis becomes relevant, i.e. in the course of devaluation the real value of government debt, which is assumed to be entirely denominated in foreign currency, increases. Together with its budget constraint the government's incentives imply that with a rising level of (real) debt the government finances its rising real debt service obligations by a higher rate of default rather than by increased taxation, i.e. devaluation leads to higher default ratios. When the rate of devaluation reaches a critical amount, the government chooses a default ratio of 100 percent (total default).

An important implication of Jahjah and Montiel's analysis is that a government's ability to borrow from the international capital markets in foreign currency increases if the government credibly commits itself to keep the exchange rate fixed under a hard peg. If, in contrast, investors have to worry about a potential devaluation, which would lead to a higher default ratio for any given nominal level of foreign debt, they rationally reduce their loans to the government.

2.6. A simple model

Disregarding market participants' expectations and the interaction of investors' behavior and the government's policy decisions, in the following we present a simple model which combines the welfare optimizing government's incentives and its budget constraints. We show that even in this very restricted framework the optimal fiscal and debt policy does not only depend on fiscal but also on monetary fundamentals. Analogously, the optimal exchange rate policy does not only depend on monetary but also on fiscal fundamentals. Put another way, already this simple framework implies an interrelation between the optimal debt policy and the optimal exchange rate policy. Taking into account further aspects such as investors' expectations and time consistency problems would generate further and more complex interrelations.

The model focuses on a government with foreign currency denominated debt. Prices are fixed in the short run, so that changes in the nominal exchange rate imply

changes in the real exchange rate of the same amount. Following Jahjah and Montiel (2003), output *Y* is determined as

$$\mathrm{Y} = \mathrm{Y}^{*} - \alpha\left(\frac{\mathrm{S}^{*} - \mathrm{S}}{\mathrm{S}^{*}}\right)^{2} \tag{1}$$

Y^* is potential output. The nominal exchange rate S is determined by the government's monetary policy. The term $\left((S^* - S)/S^*\right)^2$ measures the degree of exchange rate misalignment relative to its fundamentally justified level S^*, which is normalized to $S^* = 1$. Over- and undervaluation reduce output symmetrically.

Denoted in local currency, the government's budget constraint is

$$t \cdot Y = G + (1-\theta) \cdot D \cdot S, \tag{2}$$

where *G* is government consumption, t is the tax rate, and *D* is the government's foreign currency debt service. To explicitly exclude the effects of private bondholders' expectations on future interest rates, the possibility to issue new debt and / or to roll over the old debt is not considered. θ is the default rate on the debt service coming due. Combining (1) and (2) yields

$$\theta = 1 - \frac{\mathrm{t} \cdot \mathrm{Y}^{*} - \mathrm{t}\alpha \cdot \left((\mathrm{S}^{*} - \mathrm{S})/\mathrm{S}^{*}\right)^{2} - \mathrm{G}}{\mathrm{D} \cdot \mathrm{S}} \ . \tag{3}$$

With all other variables in (3) assumed to be exogenous, the default rate θ, which the government chooses to balance its budget, depends on its monetary policy which determines the exchange rate *S*.

The government maximizes public welfare *W*, which is given by

$$\mathrm{W} = (1-\mathrm{t}) \cdot \mathrm{Y} - \mathrm{b} \cdot \theta^{2}\mathrm{SD} - \mathrm{c} \cdot \left(\frac{\mathrm{S} - \mathrm{S}_0}{\mathrm{S}_0}\right)^{2}. \tag{4}$$

The term $(1-\mathrm{t})\mathrm{Y}$ gives disposable income. The term $\mathrm{b} \cdot \theta^{2}\mathrm{SD}$ captures the social costs of default, which increase with the amount of repudiated debt service. S_0 is the parity of a fixed exchange rate system, which the government has announced and kept so far. We assume that $S_0 < S^*$, i.e. initially the exchange rate is overvalued and output is lower than Y^* according to (1). The term $\mathrm{c} \cdot \left((\mathrm{S} - \mathrm{S}_0)/\mathrm{S}_0\right)^2$ reflects the costs

of a change in the exchange rate, e.g. the monetary authorities' loss in reputation resulting from a deviation of the actual exchange rate S from the announced level S_0. The parameters b and c measure the relative weight of the default costs and the devaluation costs with regard to the government's welfare considerations. Combining (1), (3), and (4) yields

$$W = (1-t)\cdot\left[Y^* - \alpha\left(\frac{S^*-S}{S^*}\right)^2\right] - \frac{b}{SD}\left[SD - t\cdot Y^* - t\alpha\left(\frac{S^*-S}{S^*}\right)^2 - G\right]^2 - c\cdot\left(\frac{S-S_0}{S_0}\right)^2 \tag{5}$$

Maximizing W subject to S determines the welfare optimizing exchange rate S_{opt}, which by (3) also determines the corresponding optimal sovereign default rate θ_{opt}. Figures 1 and 2 show how the costs of a default (parameter b) and the costs of a change in the exchange rate (parameter c) affect both the government's choice of the exchange rate S_{opt} and the default rate θ_{opt}.[12]

Not surprisingly, a higher weight of the costs of a default in the government's cost-benefit-analysis (i.e. a higher b) is associated with a lower default rate. More importantly, however, it is also connected with a higher optimal exchange rate (see figure 1). The reason for this is that for a given level of public consumption G a lower default rate forces the government to increase its tax revenues to balance its budget. If the government is not able or willing to raise the tax rate t, e.g. due to political pressures, the only way to do so is to stimulate output Y by choosing a higher amount of devaluation, thereby weighing the costs of a larger change in the exchange rate and the costs of a higher default rate.

A higher weight of the costs of a change in the exchange rate in the welfare function (i.e. a higher c) is related to a smaller exchange rate change and thus to a lower exchange rate level S_{opt}. At the same time, it is also associated with a higher default rate θ_{opt} (see figure 2). The intuition for this is that higher costs of a change in the exchange rate and the resulting lower exchange rate level lead to a lower real output Y and thus to lower sovereign tax revenues. To balance its budget, the government has to choose a higher rate of default.

[12] In figures 1 and 2 the variables and parameters are set to Y^*=1, G=0.3, B=0.2, t=0.45, S_0=0.7, S^*=1, and a=2.5. In figure 1 the exchange rate change cost parameter is set to c=5. In figure 2 the default cost parameter is set to b=10.

The next section tests whether and to what extent currency and debt crises are empirically related.

Figure 1

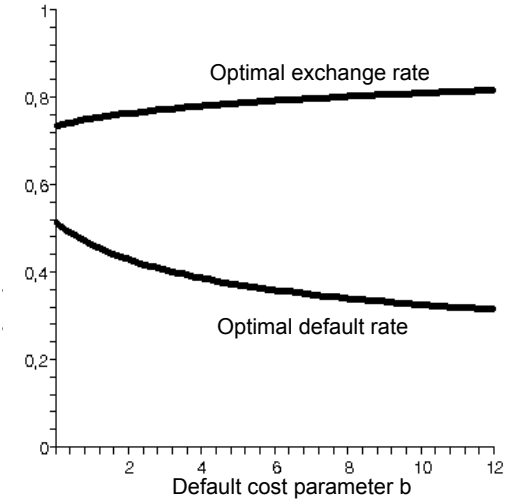
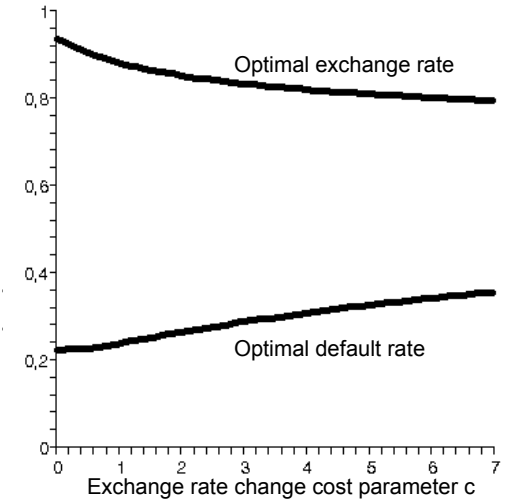


Figure 2



3. Empirical estimation of the relationship between debt crises and currency crises

In this section, the various hypotheses developed so far are confronted with actual data. The empirical literature on financial crises suggests two alternative ways of defining crises episodes, one that may be described as an event approach and one that may be characterized as an index method. The event approach focuses on market events to identify crises. Sharp nominal depreciations for instance could be used to identify currency crises (see e.g. Frankel and Rose 1996). In the same vein events such as Paris or London Club treatments could be used as indicators of debt crises. Though the event approach method may seem pretty attractive to use as the required qualitative data are generally rather easy to collect and due to its simplicity and feasibility, it is subject to a number of conceptual shortcomings. Both the identification of crisis episodes and the determination of the timing of crises are likely to be arbitrary, e.g. the choice of the threshold to distinguish between "normal" and "sharp" depreciations or the interpretation of successfully defended fixed exchange rates as currency crises.[13]

We therefore apply the second way of identifying crisis episodes and define an index of various variables, which jointly indicate whether a crisis is existent. We use this index method for the definition of both currency and debt crises. As not all crises are equally severe, we do not simply construct dummies for the occurrence of a crisis. Instead we use the index as a continuous variable, which allows us to measure and account for the severity of individual crisis episodes.

Ideally, a country should be defined as being in a (sovereign) debt crisis if

a) the government is in arrears on interest or principal and/or,
b) the government cannot borrow private capital at reasonable interest rates.

Unfortunately, we do not have data on interest rate spreads for a sufficiently large number of countries. Our index therefore consists of the sum of arrears of principal and interest relative to the sum of debt service due. Section 3.4. provides an alternative index using average interest rates on private and official credits instead of

[13] Ho and von Hagen (2003) extensively discuss the problems of the event method in the context of banking crises.

interest rate spreads on government bonds. As this analysis shows, most of our results are rather robust to the exclusion of interest rates from the index.

Our definition of currency crises follows Kaminsky and Reinhart (1999) and Reinhart (2002). The resulting index is an average of the rate of change of the exchange rate and of international reserves, weighed by their standard deviations. Ideally, one would also like to include interest rates that monetary authorities can use to defend parities. However, this leaves us with a drastically reduced sample, so, following Reinhart (2002), we do not include interest rates.

To assess the relationship between debt crises and currency crises empirically, we use a panel of 80 non-industrialized countries. Our data cover the years 1975-2000. Some of the data are not available for all countries or every year. Therefore, our panel data are unbalanced and the number of observations depends on the choice of explanatory variables. All variables, their precise definitions and data sources as well as the exact formula used to derive the index for currency crises are listed in the Appendix.

The following analysis focuses on the risk of running into crisis instead of fixing a certain (arbitrary) threshold where countries are defined as experiencing crises. Nevertheless it is instructive to see how often our indices exceed values that could indicate such crises. Table 1 contains the number of crisis events, where a country is defined as experiencing a currency crisis when its index is one standard deviation greater than the index mean and a debt crisis when more than 75 percent of a country's debt service due is not settled. According to this definition, there have been 280 debt and 179 currency crises during our sample period. In 34 cases, countries experienced both currency and debt crisis at the same time.

As possible determinants of both debt and currency crises, a huge number of variables has been suggested in the literature. From sources commonly used in cross-country time-series estimation, we could obtain data for 51 of those variables belonging to the groups just defined.[14] Since many of them are highly collinear, we

[14] The following variables are included in the data set as potential explanatory variables: the years the party of the chief executive has been in office; the years left in the current term; a dummy indicating that the chief executive's party controls all relevant houses; the herfindahl index of legislature concentration; a dummy for election years; indices measuring fractionalization of government, opposition or total legislature; shortest and longest tenure of a veto player; a measure for polarization between the executive party and the four principle parties of the legislature; a dummy for special interest government parties or chief executives; dummies indicating that the chief executive or his party belong to the military or are special interest; a dummy for left government parties (all Beck et al. 2001); an index measuring competitiveness of nominating process for political office (Banks 2002); an

should not include all of them in a single estimation. As proposed by Boockmann and Dreher (2003), our strategy was thus to form groups of variables, and select the variables with the most robust impact on currency or debt crises by iteratively replacing these variables with each other inside each of the groups. Our first step was to factor analyze the independent variables to recover the dimensionality of the data. It turned out that there are four important dimensions. The first can be interpreted as measuring checks and balances in the political system, the second contains variables relating to economic policy and outcomes, the third concerns amount and structure of debt and political stability, and the fourth relates to trade.

In the iterative replacement procedure, we started with a static specification with two variables from each of the groups, replacing them with other covariates from the groups and retaining those which had the highest number of statistically significant coefficients. We dropped variables, which did not have a coefficient significant at the five per cent level in more than a third of the regressions run. As the results will show, with the exception of the debt burden, this procedure leads to the selection of fairly different causes of currency and debt crises, giving rise to the conclusion that it is not common causes that are (directly) responsible for such crises.

We continue by first focusing on the determinants of currency crises. Second, we analyze which variables influence debt crises. After testing for Granger causality, we estimate both crises employing instrumental variables techniques.

3.1. Determinants of Currency Crises

Table 2 regresses the index of currency crises on the index of debt crises (and various lags of this variable). Estimation is by OLS. To account for time-invariant unobservable heterogeneity potentially correlated with the regressor, we use a fixed

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index for democracy (Marshall and Jaggers 2000); GDP per capita; current account balance; overall budget balance; value added in industry and agriculture; savings; (total, official and private) transfers; money; net domestic credit; gross fixed capital formation (all relative to GDP); GDP growth; bank liquid reserves to assets ratio; monetary growth; inflation; the black market premium for a country's currency; (all World Bank 2003); an index for restrictions of the capital account (Dreher and Siemers 2003); an index measuring overvaluation of a currency (Herz and Tong 2003); public and public guaranteed debt; private, total and short-term debt; total debt service; total trade; exports; imports (all relative to GDP); population; the shares of concessional and multilateral debt in total debt; interest payments relative to exports; terms of trade adjustment (all World Bank 2001) and an index for political instability (Dreher 2002).

effects specification. Therefore, we could not include variables that do not change over time.[15] All standard errors are estimated robustly.

The procedure outlined above shows that six variables are significant predictors of currency crises in more than a third of the regressions run:

- the overall budget balance relative to GDP,
- the black market premium for a country's currency,
- public and public guaranteed long-term commercial debt relative to GDP,
- total (external) debt service relative to exports,
- a dummy indicating that the chief government executive is a military and
- a dummy for election years.

These variables (with their lagged values) are included in all regressions. In addition, column 1 includes the contemporaneous index of debt crises, column 2 adds its first lag, column 3 its second lag and column 4 its third lag. Currency crises are (at least at the ten percent level of significance) more likely, with a lower budget balance, with lower debt service paid and with higher public commercial debt. The finding for debt service supports the view that currency and debt crises are alternative means of budget finance: With a higher debt service it is preferable for the government to finance its budget via default and not via inflation or devaluation. At the ten percent level of significance, currency crises are less likely in post-election years. This is probably because after an election the government tries to stabilize the economy (or markets expect them to). Also at the ten percent level, military chief executives lead to a lower risk of currency crises in all but the final specifications while the black market premium does not influence crises. The results also show that currency crises are significantly more likely the higher the contemporaneous probability of debt crises. This relationship is significant at the five percent level in column 1 and stays significant at the ten percent level in all other specifications. Although lagged values of our debt crises indicator do not individually contribute explaining currency crises, they are jointly significant at least at the ten percent level until the inclusion of two lags.

The final equation explains 24 percent of the variance of currency crises. However, a test for serial correlation in the idiosyncratic errors of our models (as

[15] Our decision to include fixed country effects is based on the results of a hausman test, showing that fixed effects cannot be omitted. While they help in overcoming omitted variables bias, we can thus not use between-country variation to estimate the coefficients.

suggested by Wooldridge 2002) revealed that there is some evidence of autocorrelation. We therefore replicated all specifications modeling the disturbance term as autoregressive process (Baltagi and Wu 1999). According to the estimations (not shown in the Table), our results are rather robust to this modification. The only variable loosing significance is the dummy for military chief executives. All other results, including the significantly positive influence of contemporaneous debt crises remain.

3.2. Determinants of Debt Crises

Table 3 uses the index of debt crises as dependent variable. Again, our focus is on the relation between debt and currency crises. Again, we tested for fixed country effects and found them to be significant. As in the previous section, standard errors are estimated robustly.

Our procedure of identifying relevant determinants of debt crises leads to the following (lagged) covariates:

- the share of multilateral debt in total debt,
- total external debt relative to GDP,
- exports relative to GDP,
- an index of restrictions on the capital account,
- the number of years the party of the chief executive has been in office,
- an index measuring polarization between the executive party and the four principle parties of the legislature and
- a country's degree of democracy.

Again, we start by including the contemporaneous index for currency crises and than including up to three lags in the following columns. Our covariates are significant at least at the ten percent level in all specifications, the only exception being the number of years the party of the chief executive has been in office, and the index of capital account restrictions in the final model. As the results show, debt crises are more likely, the higher the multilateral share in debt, the higher total debt, the lower exports, and the higher is legislature fractionalization. Capital account restrictions and degree of democracy are associated with a greater risk of debt crises. The coefficients are easy to explain: Countries usually borrow larger amounts from multilateral lenders if their access to private capital is restricted. This could be because they already experience a crisis (and our result is due to reversed causality) or

because countries with certain characteristics, e.g. corruption and inefficient bureaucracy, are more frequent clients of multilaterals. Multilateral lending could even cause moral hazard with the borrower (Dreher and Vaubel 2004, Dreher 2004) and thus increase the risk of debt crises. The higher debt relative to GDP, the more likely this debt becomes unsustainable and the more likely are debt crises to occur; the higher exports, the easier it is for a government to get international reserves it needs for debt payments. Countries that are governed by one party for a long time are likely to become cumbersome and reforms are likely to be prevented. Reforms are also less likely with higher legislature polarization. Capital account restrictions usually limit foreign direct investment flows and therefore make a country more vulnerable to short-term reversals of capital inflows. In more democratic countries, planning horizons might be shorter, which leads to the accumulation of higher short-term debt. Crises become thus more likely.

Notice that there is only limited support for the hypothesis of common causes for both debt and currency crises. The only variable significantly influencing either crisis is public debt (although in the debt-crises regressions total debt has been found to be the most robust debt-related variable, while it is public and public guaranteed commercial debt in the currency crises regressions). A one percentage point increase in debt increases the risk of currency crises by about half a standard deviation and the risk of debt crises by almost one percentage point.

Debt crises are also significantly more likely with contemporaneous currency crises ("contagion"). The results for further lags are less straightforward. Currency crises significantly increase the risk of debt crises in the next year according to all specifications and those in two years according to the final regression. Notice, however, that debt crises are significantly less likely if there has been a currency crisis three years before. This may simply be a hint that a contagion effect from currency to debt, if one appears at all, takes place rather quickly, i.e. within at most two years. This makes sense as the channels of such a contagion can work fast: The wake-up call effect of a devaluation that leads investors to reassess their information of the economy and their estimation of the default risk is a very rapid effect. Investors withdraw their funds either as soon as possible after they get the information of an unexpected devaluation or not at all. They do not wait several years.

Also, the devaluation-caused rise in the real value of the external debt (see original sin) is likely to be a short-term phenomenon. In the course of a currency crisis

the rate of nominal devaluation usually is higher than the inflation rate only in the short run, i.e. the real depreciation, which affects the real value of debt, is a short-term phenomenon. In the long run, however, it is reasonable to assume purchasing power parity to hold, i.e. the devaluation rate corresponds to the inflation rate. This means that tax revenues also rise in line with the price level and with the local currency value of the external debt. Thus the real burden of debt does not increase anymore in the long run. This implies that if the government decides to default on its debt due to a rise in the real value of debt, it will reach this decision either rather soon after the devaluation or not all. It will, however, not wait several years. The fact that the government found it preferable not to default on its debt within the two years directly after a currency crisis thus implies that it is rather sensible to assume that it won't default in the third year either.

Altogether, the lagged negative impact supports the view that in the middle and the long run the aspect of currency and debt crises as alternative means of budget financing is decisive, while the contemporaneous positive relation indicates that contagion effects dominate in the short run.

Currency crises are jointly significant at the one percent level in all regressions. 75 percent of the variation in the dependent variable is explained by the final regression. As in the previous section we also estimated regressions modeling the disturbance as first order autoregressive process. The number of years the chief executives' party stayed in office is then no longer significant. The other results remain.

3.3. Joint Determination of Debt and Currency Crises

As the analysis of the previous section has shown, currency crises significantly affect debt crises while, in turn, currency crises are significantly influenced by debt crises. If there is, however, a mutual relationship, the ordinary least squares technique applied above yields inconsistent estimates of the parameters and our equations have to be estimated using instrumental variables techniques. To determine the time structure in the relationship among currency and debt crises we use a dynamic model. Causality is defined in the sense of Granger (1969). That means that a variable x is causing a variable y if past values of x help to explain y once the past influence of y has been accounted for.

If we have N cross-sectional units observed over T time periods, the model is:

$$y_{i,t} = \sum_{j=1}^{m} a_j y_{i,t-j} + \sum_{j=1}^{m} \beta_j x_{i,t-j} + \alpha_i + u_{i,t}\,, \qquad (1)$$

where i=1,..., N and t=1,..., T. The parameters are denoted a_j and $ß_j$, the maximal lag length is m, α_i represents unobserved individual effects and u_{it} is an independently and identically distributed stochastic error.

Since the regressions include lagged dependent variables and individual effects, estimation with OLS generates biased coefficients. Moreover, the within groups estimator is inconsistent in the presence of endogenous variables (Nickell, 1981). We therefore apply the GMM estimator of Arellano and Bond (1991). This estimator consists in first-differencing the estimating equation and using lags of the dependent variable from at least two periods earlier as well as lags of the right-hand side variables as instruments. Since there are more instruments than right-hand side variables, the equations are over-identified and instruments must be weighted in an appropriate way. We only present results from the Arellano-Bond one-step GMM estimator, which uses the identity matrix as a weighting matrix. The two-step GMM estimator weighs the instruments asymptotically efficiently using the GMM1 estimates. However, in small samples like the one used here, standard errors tend to be under-estimated by the two-step estimator (Arellano and Bond, 1991: 291).

Table 4 presents the results. The null hypothesis that debt crises have no effect on currency crises can be rejected at the one percent level until lag length five. As can be seen, currency crises also Granger cause debt crises.

Since OLS assumes the right hand side variables to be exogenous, this casts doubt on our previous results. We therefore replicate our OLS regressions employing the GMM estimator just explained.

We also estimate two-stage least squares regressions (2SLS), which allows for the inclusion of endogenous regressors that are dependent variables from other equations in the system. This estimator is a limited information procedure and neglects information contained in the second equation. Therefore, this technique is less efficient than three-stage least squares (3SLS), but nevertheless consistent. As is well known, there will always be a trade-off between the robustness of the 2SLS estimator and the efficiency of 3SLS.

Our final method of estimation is thus 3SLS. In the first stage, 3SLS uses instruments for all endogenous variables. These instruments are the predicted values resulting from a regression of each endogenous variable on all exogenous variables

included in the system. The second stage consistently estimates the covariance matrix of the equation errors using the residuals from the 2SLS estimation of each equation. In the third stage, GLS estimation employing the covariance matrix estimated in the second stage and the instruments in place of the endogenous variables is performed.

Table 5 shows the results. According to almost all specifications, debt crises significantly increase the risk of running a currency crisis, while debt crises become significantly more likely with contemporaneous currency crises. The magnitude of the coefficients estimated for the index of debt crises do, however, vary widely. The smallest coefficient implies that an increase in the risk of debt crises by ten percentage points increases the risk of currency crises by about 2 standard deviations. According to the highest coefficient, such a change would lead to an increase in risk that is 20 standard deviations higher. The coefficient for currency crises is more stable across our models, ranging from 0.0001 to 0.005. The results also show that currency crises are significantly influenced by total debt service, while total debt (relative to GDP), exports (relative to GDP), and legislature polarization increase the risk of running a debt crisis.

On the basis of the homoscedastic Arellano-Bond estimator, a Sargan test on the validity of the instruments can be conducted. As can be seen in the Table, the Sargan test rejects the over-identifying restrictions. While this could be due to the presence of heteroscedasticity, it could also signal that there are problems with the instruments used. The test is not defined for the robust estimator used in the regressions. The Arellano-Bond test of second order autocorrelation (based on robust standard errors), which must not be present in the data in order for the estimator to be consistent, accepts the specifications at the ten percent level of significance.[16]

Only a small share of the variance in the dependent variable is explained by the explanatory variables in most specifications. The exception is the debt crises model with the lagged dependent variable included. The coefficient of the lagged endogenous variable in the final specification indicates that 39 percent of the adjustment takes place within the first year.

In summary, our results indicate that debt crises are significant predictors of currency crises, while currency crises significantly increase the risk of debt crises. We do not find evidence for the hypothesis that both crises are caused by the same

[16] The same is true if the explanatory variables are treated as predetermined instead of strictly exogenous.

exogenous variables. The next paragraph discusses a possible extension of the index for debt crises by an interest rate component.

3.4. Discussion of an alternative indicator

This section proposes an alternative indicator for measuring debt crises. It adds an interest rate component to the index of debt crises and tests whether the results of the previous sections are robust to this change.

In principle, the difference between the interest rate a government has to pay for private loans and the market interest rate is a measure of crisis. As one problem, however, countries might not borrow in private capital markets at all and the interest rate is therefore equal to zero. This could either be because there is no crisis, and a country does not want to borrow in foreign currency or, alternatively, because a country gets no private credit although it would like to. In the latter case, the country borrows from official creditors. Those official loans are probably more highly subsidized when a country is in crisis. This is because the share of (higher interest) export credits in official loans usually declines at those times. The majority of those countries for which there are zero interest rates on private loans in the sample are eligible to the IMF's low interest facility. Since the share of IMF credits in official loans rises during crises, the average official interest rate declines.

We thus add a second part to our index, consisting of the amount the interest rate for new private loans exceeds the average interest rate for all countries and, if the interest rate on private loans is zero, the interest subsidy obtained from official creditors, i.e., the difference between the average interest rate for private capital and the interest rate paid for new official loans. This part of the index is zero if the country can borrow on lower than average interest – and we omit the eight cases where a country received neither private nor official loans in a year. The two parts of the index enter the overall index with positive sign and are weighed with their country specific standard deviations. The exact formula used in calculating the index is shown in the Appendix.

Table 7 reproduces the frequency of crises using the revised index where a country is defined to be in a crisis, if its respective index is by one standard deviation greater than the mean. The results do not change substantially. As can be seen, there are now 45 joint debt and currency crises during 1975-2000.

Our final step was to replicate all regressions with this index (not reported in tables). Again, there are no substantial changes. In the static regressions (of Table 2 and 3), the coefficient of debt crises becomes insignificant when lagged values are included, whereas currency crises remain robust determinants of debt crises. Similarly, the results for debt crises are weaker in the instrumental variables regressions, with insignificant coefficients in the dynamic specifications. The influence of currency crises on debt crises, to the contrary, becomes even stronger.

In summary, there is no evidence that the omission of an interest rate component to the index of debt crises changes results significantly.

4. Summary

Theoretically, currency and debt crises can be related in various ways, both negatively and positively. Empirically, we find only weak evidence in favor of the hypothesis that common causes lead to simultaneous currency and debt crisis. Public debt is the only variable that was significantly associated with both types of crises. In OLS-estimations currency crises are significantly more likely with a high probability of a contemporaneous debt crisis, while debt crises are significantly more likely with contemporaneous currency crises. However, debt crises are significantly less likely if a currency crisis took place three years before. These findings may indicate that a contagion effect from currency to debt crises and vice versa, if it exists at all, takes place rather quickly. As the possible channels of internal contagion should work rather fast, this view is consistent with our theoretical considerations. The lagged negative relation indicates that the hypothesis of currency and debt crises as alternative means of budget financing dominates in the middle and the long run. The budget-financing hypothesis is supported by the finding that currency crises are more likely with a lower budget balance and lower debt service paid. The positive short-term relation between currency and debt crisis remains valid if we apply instrumental variables techniques.

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Appendix A: Tables

Table 1: Frequency of Debt and Currency Crises

		Currency Crises: yes	Currency Crises: no
Debt Crises	yes	34	246
	no	145	1357

Notes: A country is defined as being in a currency crisis if its index is one standard deviation above the mean. A country is in a debt crises, if its arrears on principal and interest exceed 75% of debt service due.

Table 2: Determinants of Currency Crises (panel data, 76 countries, 1975-2000)

Explanatory variables	(1)	(2)	(3)	(4)
Debt crises, index	15.96	15.71	16.05	16.44
	(2.53**)	(1.77^{o})	(1.76^{o})	(1.79^{o})
Debt crises, index (t-1)		0.39	0.13	0.30
		(0.06)	(0.03)	(0.06)
Debt crises, index (t-2)			0.01	-9.49
			(0.00)	(0.97)
Debt crises, index (t-3)				12.12
				(1.71^{o})
Overall budget balance	-0.28	-0.28	-0.29	-0.30
(relative to GDP, t-1)	(2.08**)	(2.01**)	(1.86^{o})	(1.84^{o})
Black market premium	0.002	0.002	0.002	0.002
(t-1)	(0.95)	(0.95)	(0.90)	(0.89)
Public and public guaranteed	24.27	24.14	24.21	24.61
debt (relative to GDP, t-1)	(3.58*)	(3.30*)	(3.18*)	(3.17*)
Total (external) debt service	-0.27	-0.27	-0.28	-0.30
(relative to exports, t-1)	(2.85*)	(2.92*)	(2.91*)	(2.91*)
Military chief executive,	-4.76	-4.75	-4.83	-4.84
Dummy (t-1)	(1.72^{o})	(1.69^{o})	(1.66^{o})	(1.63)
Election years, dummy (t-1)	-2.04	-2.02	-2.07	-2.21
	(1.80^{o})	(1.81^{o})	(1.81^{o})	(1.85^{o})
R squared (within)	0.23	0.23	0.23	0.24
Joint significance of debt variables (p-value)		0.03	0.07	0.11
Number of countries	83	83	83	81
Number of observations	1005	1003	981	948

Notes:

The coefficients of the country dummies are not reported.

Robust (White) t-statistics are shown in parentheses:

*: significant at the 1 percent level

**: significant at the 5 percent level

^{o}: significant at the 10 percent level.

Table 3: Determinants of Debt Crises (panel data, 76 countries, 1975-2000)

Explanatory Variables	(1)	(2)	(3)	(4)
Currency crises	0.0003 (3.51*)	0.001 (6.31*)	0.001 (6.18*)	0.001 (6.17*)
Currency crises (t-1)		0.0002 (2.49**)	0.001 (4.96*)	0.001 (4.14*)
Currency crises (t-2)			-0.0001 (1.19)	0.001 (6.43*)
Currency crises (t-3)				-0.0004 (3.45*)
Multilateral debt (relative to total debt, t-1)	0.004 (5.35*)	0.004 (5.49*)	0.005 (5.24*)	0.01 (5.66*)
Total debt (relative to GDP, t-1)	0.17 (4.75*)	0.16 (4.74*)	0.17 (4.09*)	0.22 (6.73*)
Exports (relative to GDP, t-1)	-0.35 (3.79*)	-0.37 (3.98*)	-0.39 (4.17*)	-0.46 (4.69*)
Index for capital account restrictions (t-1)	0.10 (3.47*)	0.08 (2.26**)	0.07 (1.92^{o})	0.05 (1.45)
Chief executives' party years in office (t-1)	0.001 (1.04)	0.001 (0.67)	0.003 (0.28)	-0.002 (0.21)
Legislature polarization (t-1)	0.05 (3.45*)	0.05 (3.63*)	0.05 (3.86*)	0.04 (3.25*)
Degree of democracy	0.01 (3.02*)	0.01 (2.57**)	0.01 (2.06**)	0.01 (1.77^{o})
R squared (within)	0.74	0.74	0.75	0.76
Joint significance of debt variables (p-value)		0.000	0.000	0.000
Number of countries	77	77	77	77
Number of observations	1128	1103	1072	1033

Notes:

The coefficients of the country dummies are not reported.

Robust (White) t-statistics are shown in parentheses:

*: significant at the 1 percent level

**: significant at the 5 percent level

^{o}: significant at the 10 percent level.

Table 4: Causality tests on Currency and Debt Crises (panel data, 76 countries, 1975-2000)

	Currency Crises					Debt Crises				
Debt Crises (t-1)	33.56	24.18	29.20	30.15	31.13	0.73	0.79	0.75	0.76	0.80
Debt Crises (t-2)		7.02	3.51	5.85	6.30		-0.04	-0.04	-0.05	-0.07
Debt Crises (t-3)			1.90	-5.13	-5.17			-0.02	0.004	0.001
Debt Crises (t-4)				12.17	14.05				-0.05	-0.04
Debt Crises (t-5)					-5.57					-0.01
Currency Crises (t-1)	0.02	0.10	0.10	0.09	0.09	-0.00	0.00	0.00	0.00	0.00
Currency Crises (t-2)		0.01	-0.11	-0.10	-0.11		-0.00	0.00	0.00	0.00
Currency Crises (t-3)			0.01	-0.11	-0.10			-0.00	0.00	0.00
Currency Crises (t-4)				-0.00	-0.04				-0.00	0.00
Currency Crises (t-5)					-0.00					-0.00
p-value for (joint) significance of currency crises	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.003	0.000	0.004
p-value for (joint) significance of debt crises	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5: Determinants of Currency and Debt Crises (panel data, 1975-2000)

Currency Crises						Debt Crises					
explanatory variables	GMM	2SLS		3SLS		explanatory variables	GMM	2SLS		3SLS	
Currency crises, (t-1)	0.02		0.01		0.02	Debt crises, (t-1)	0.55		0.63		0.90
	(1.70°)		(0.61)		(2.42**)		(10.49*)		(11.04*)		(42.74*)
Debt crises, index	20.31	148.42	43.88	96.52	12.65	Currency crises, index	0.0001	0.005	0.001	0.002	-0.001
	(2.47**)	(3.14*)	(5.23*)	(3.32*)	(4.28*)		(0.65)	(5.03*)	(3.58*)	(3.53*)	(0.84)
Overall budget balance	-0.29	-2.78	-0.18	-0.27	0.14	Multilateral debt (t-1)	-0.001	0.01	0.003	0.001	0.0001
(relative to GDP, t-1)	(0.87)	(2.63*)	(0.90)	(0.49)	(1.12)	(relative to total debt)	(0.23)	(2.27**)	(2.66*)	(1.37)	(0.57)
Black market premium	-0.001	0.02	-0.02	0.12	-0.01	Total debt (t-1)	0.10	0.22	0.08	0.15	0.04
(t-1)	(0.71)	(0.35)	(1.95°)	(3.19*)	(1.01)	(relative to GDP)	(2.53**)	(4.58*)	(3.96*)	(6.26*)	(4.39*)
Public and p. guaranteed	67.38	-91.26	29.76	55.32	26.43	Exports (t-1)	-0.29	0.50	0.07	-0.18	-0.02
debt (rel. to GDP, t-1)	(1.02)	(1.51)	(2.49**)	(1.55)	(3.25*)	(relative to GDP)	(2.12**)	(1.47)	(0.57)	(2.46**)	(0.47)
Total (external) debt service	-0.60	-0.67	-0.30	-0.84	-0.05	Capital account	-0.004	0.01	0.05	0.06	0.04
(relative to exports, t-1)	(2.97*)	(1.28)	(3.07*)	(2.76*)	(0.87)	Restrictions (t-1)	(0.05)	(0.09)	(1.23)	(1.74°)	(2.48**)
Military chief executive,	0.09	29.02	-1.60	1.60	-3.13	Chief executives' party	-0.0002	-0.003	-0.001	-0.002	0.0001
Dummy (t-1)	(0.20)	(1.54)	(0.47)	(0.20)	(1.82°)	years in office (t-1)	(0.52)	(0.65)	(0.30)	(2.28**)	(0.20)
Election years, dummy	0.82	-3.37	2.84	2.65	3.65	Legislature	0.01	0.08	0.04	0.04	0.01
(t-1)	(0.80)	(0.34)	(1.57)	(0.36)	(2.08**)	Polarization (t-1)	(0.89)	(1.65°)	(2.19**)	(2.43**)	(1.05)
						Degree of democracy	-0.001	0.007	0.004	-0.01	-0.003
							(1.57)	(0.53)	(0.73)	(4.11*)	(1.72°)
R squared		0.04	0.03	0.14	0.26			0.06	0.73	0.15	0.79
Number of countries	79	69	69	69	69		76	69	69	69	69
Number of observations	853	743	726	743	726		1112	743	743	743	726
Sargan test (p-value)	0.00						0.00				
Arellano-B. test (p-value)	0.15						0.06				

Notes:

The coefficients of the country dummies are not reported.

t-statistics in parentheses:

*: significant at the 1 percent level

**: significant at the 5 percent level

°: significant at the 10 percent level.

Table 7: Frequency of Debt and Currency Crises (including interest component)

		Currency Crises: yes	Currency Crises: No
Debt Crises	yes	45	216
	No	112	1228

Notes: A country is defined as being in a crisis if its respective index is one standard deviation above the mean.

Appendix B: Index of currency crises

$$cc = (\frac{1}{\sigma_{ex}}) * (\frac{\Delta_{ex}}{ex_{t-1}}) - (\frac{1}{\sigma_{res}}) * (\frac{\Delta_{res}}{res_{t-1}})$$

σ_{ex} : Standard deviation of the exchange rate

Δ_{ex} : Change of the exchange rate with respect to the previous year

ex_{t-1} : Exchange rate in the previous year

σ_{res} : Standard deviation of stock of international reserves

Δ_{res} : Change in stock of international reserves with respect to the previous year

res_{t-1} : Stock of international reserves in the previous year

Index of debt crises for the robustness analysis (Section 3.4.):

$$dc = \text{int} + (\frac{\sigma_{\text{int}}}{\sigma_{ar}}) * ar$$

$$\text{int} = \begin{array}{ll} \text{int}_{pr} - \text{int}_{av} & \textit{if} \quad \text{int}_{pr} > \text{int}_{av}, \\ \text{int}_{av} - \text{int}_{of} & \textit{if} \quad \text{int}_{pr} = 0. \end{array}$$

int_{pr} : Yearly average of interest rates on new public loans from private creditors

int_{av} : Yearly average of interest rates on new public loans from private creditors (average for all countries)

int_{of} : Yearly average of interest rates on new public loans from official creditors

σ_{int} : Standard deviation of int

σ_{ar} : Standard deviation of debt in arrears and debt rescheduled (relative to total debt service due)

ar : Principal and interest in arrears (relative to total debt service due)

Appendix C: Definitions and data sources

Variable	Source	Definition
Overall budget balance (relative to GDP)	World Bank (2003)	Current and capital revenue and official grants received, less total expenditure and lending minus repayments for central government.
Black market premium	Global Development Network Growth Database	((Parallel Exchange rate/official Exchange rate) – 1)*100
Public and public guaranteed debt (relative to GDP)	World Bank (2001)	Public and publicly guaranteed long-term commercial loans from private banks and other private financial institutions.
Total debt service (relative to exports)	World Bank (2001)	Total (external) debt service to exports of goods and services (including workers' remittances)
Military chief executive, Dummy	Beck et al. (2001)	Takes a value of one if the chief executive is a military officer and zero otherwise.
Election years, dummy	Beck et al. (2001)	Takes a value of one for years with national legislative elections.
Multilateral debt (relative to total debt)	World Bank (2001)	Multilateral debt relative to total external debt.
Total debt (relative to GDP)	World Bank (2001)	Consists of public and publicly guaranteed long-term debt, private nonguaranteed long-term debt, the use of IMF credit, and estimated short-term debt.
Exports (relative to GDP)	World Bank (2001)	Exports of goods and services are the total value of goods and services exported as well as income and worker remittances received.
Index for capital account restrictions	Dreher and Siemers (2003)	Range 0 (no restrictions) to 4 (fully restricted). Consists of dummies for the existence of payments restrictions, multiple exchange rates, surrender requirements and restrictions on current transactions.
Chief executives' party years in office	Beck et al. (2001)	Number of years the chief executive's party has been continuously in office.
Legislature polarization	Beck et al. (2001)	Total fractionalization of the legislature.
Degree of Democracy	Marshal and Jaggers (2000)	Measures the general openness of political institutions (0 = low, 10 = high democracy score).

Appendix C: Descriptive Statistics

Variable	Mean	Std. Dev. (overall)
Currency Crises Indicator	3.310	72.30
Debt Crises Indicator	0.271	0.341
Overall budget balance (relative to GDP)	-3.85	5.492
Black market premium	223.1	3742.1
Public and public guaranteed debt (relative to GDP)	0.070	0.110
Total debt service (relative to exports)	20.31	15.01
Military chief executive, Dummy	0.301	0.458
Election years, dummy	0.190	0.392
Multilateral debt (relative to total debt)	22.91	18.29
Total debt (relative to GDP)	0.662	0.728
Exports (relative to GDP)	0.331	0.207
Capital account restrictions	0.641	0.28
Chief executives' party years in office	12.63	13.34
Legislature polarization	0.201	0.566
Degree of Democracy	3.41	3.81

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No.	Title	Authors
1	IMF and Economic Growth: The Effects of Programs, Loans, and Compliance with Conditionality	Axel Dreher
2	Do gasoline prices converge in a unified Europe with non-harmonized tax rates?	Axel Dreher, Tim Krieger

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