Sovereign Defaults, Credit to the Private Sector and Domestic Credit Market Institutions

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Abstract

Sovereign defaults are associated with declines in foreign and domestic credit to the domestic private sector. This paper analyzes theoretically whether sovereign defaults can lead to this decline, even if domestic agents do not hold sovereign debt. It also studies whether the quality of domestic financial institutions affect the magnitude of this effect. In order to address these issues the paper embeds the traditional sovereign borrower/foreign creditors relationship of the sovereign debt literature in a macro model where widespread individual financial constraints limit a country’s ability to reallocate resources. The paper finds that sovereign defaults can indeed generate a decline in foreign and domestic credit even if domestic agents do not hold sovereign debt, and that stronger domestic financial institutions can amplify this effect. These findings constitute a new step towards understanding the costs of sovereign defaults.

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1 INTRODUCTION

Top Argentine government officials in the years 1999 and 2000 rejected the idea of a sovereign default, partly out of concern about its effect on the private sector. In particular, they were worried about the potential impact that a default could have on credit to the private sector. This concern had some empirical underpinning. A stylized feature of recent sovereign debt crises in Russia, Ukraine, Pakistan, Ecuador and Argentina was that in all of them, the defaults were accompanied by strong declines in credit to the private sector even after controlling for macroeconomic conditions. This association, which has been documented in the sovereign debt literature, might just be the result of a common shock without any causal relationship. However, it is natural to wonder whether sovereign defaults may be causing, at least in part, the decline in credit to the private sector.

The canonical works in the sovereign debt literature were not well-suited to study the effects of defaults on credit to the private sector. The reason is that they usually modeled the relation between a sovereign government and foreign creditors without including the domestic private sector in their models. More recently, a number of papers have analyzed some costs of default related to their effect on the domestic private sector. A common feature of all these papers is that the effect of the default on the domestic private sector arises because domestic agents are holding some of the defaulted instruments and the government cannot discriminate between foreign and domestic creditors when it defaults. In many of these papers, the domestic banks are the ones holding sovereign debt and, as a result, a default affects the banks’ balance sheet limiting their ability to lend.

This paper addresses two questions. First, it studies whether sovereign defaults can affect foreign and domestic credit to the private sector even if domestic agents do not hold sovereign debt. Second, it analyzes how the quality of domestic financial institutions, such as better legal enforcement of private sector contracts or improved corporate governance, can influence this effect.

In response to the first question, the paper shows that even if domestic agents do not hold government bonds, a sovereign default can create a credit

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1Arteta and Hale (2008) find systematic evidence of a decline in foreign credit to the private sector in the aftermath of sovereign debt crises. Even after controlling for macroeconomic conditions, they find that sovereign debt crises are associated with an additional decline in credit to the private sector of over 20% below the country-specific average, which persists for more than two years after the restructuring agreement is reached. Trebesch (2009) also finds that debt restructurings affect foreign credit to the private sector. Sturzenegger and Zetelmeyer (2008) also find evidence of contractions in domestic credit.


3See for example Broner and Ventura (2008), Guembel and Sussman (2009), Alessandro (2009), Gennaioli et al. (2009), Basu (2009).
crunch in domestic credit markets and a contraction in foreign lending to the private sector. This finding constitutes a new step towards understanding the costs of sovereign defaults, and, therefore, in explaining why we do observe so much lending to sovereigns in spite of the weak legal framework under which sovereign borrowing takes place.

Regarding the quality of institutions, the paper shows that stronger domestic financial institutions could amplify the effect of sovereign defaults on credit to the private sector. So, stronger domestic financial institutions can reduce governments’ incentives to default, which, in turn, facilitates public borrowing.

In order to answer these questions this paper embeds the traditional sovereign borrower/foreign creditors relationship of the sovereign default literature in a three periods macro model where widespread individual financial constraints limit a country’s ability to reallocate resources. This framework can be thought of as the sovereign debt literature meets the collateral constraints literature a la Holmstrom and Tirole (1998) or Caballero and Krishnamurthy (2001).

The intuition behind the effects of sovereign defaults on credit to the private sector is the following. Domestic firms have an investment opportunity and in order to finance it they need to borrow. Their ability to borrow is limited by the presence of individual domestic and international collateral constraints. Both the productivity of investment and the value of the collateral depend on some of the fundamentals of the economy. These fundamentals can be for example, the ability or willingness of the government to undertake structural reforms. Agents do not know these fundamentals when they have to borrow, lend and invest, but the government does.² Domestic and foreign agents form expectations about the productivity of investment and the value of the collateral after observing the government repayment/default decision.

In the model, the government faces a trade-off when it has to decide whether to repay or default on foreign creditors. On the one hand, repaying implies giving up resources that could be used for consumption. On the other, repaying could allow the government to signal to the private sector that fundamentals are good. If the private sector perceives that fundamentals are good, desired investment would go up (investment channel) and the collateral will be worth more, which would lead to more foreign and domestic credit to the private sector (credit channel). As when fundamentals are good, capital is more productive, the gain from repaying and conveying the positive signal will be larger. This implies that for some debt levels the government will choose to repay only when fundamentals are good. So, as in Sandleris (2008), in equilibrium, a default will signal that fundamentals are bad, decreasing desired investment and making the collateral constraints more stringent. Through this mechanism a sovereign default can generate a decline in foreign and domestic credit and investment. Stronger financial institutions will amplify the effect of sovereign defaults on credit.

²This story is analogous to one where the private information is about the government type or the state of the economy. Note also that for the results of the model to go through, the government does not need to know more than the private sector, what is needed is different information sets for the government and the private sector.
A natural question is why the government cannot just "tell" the private sector what the fundamentals are. The government could do it. The problem is that it will not be believed. The reason is that in the model the government has an incentive to lie and inform the agents that fundamentals are good as this will relax the collateral constraints and place the economy closer to the unconstrained optimum. So, as in Spence signaling model, the government will have to undertake a costly action to signal that fundamentals are good namely, repaying the debt. In fact, using this action as a signal is going to be efficient.

In order to gain some additional insight into idea of repayment being a signal, it is interesting to briefly analyze Brazil President, Luis Inacio "Lula" Da Silva, decision not to default soon after being sworn to office in 2003. The months prior to Lula’s election were characterized by a tremendous amount of uncertainty and concerns for investors and entrepreneurs (both Brazilian and from abroad).\footnote{The Brazilian stock market, the exchange rate, and government debt reflected these concerns. From the beginning of 2002 until the elections in October, the Brazilian stock market index lost a third of its value, the nominal exchange rate depreciated more than 60%, and Brazil’s sovereign risk soared to break the 2000 bps mark.} In particular, there were worries about Lula’s government’s attitudes towards issues such as property rights, privatizations and the business environment in general. Once elected, Lula tried to dissipate these concerns, and debt repayment was an important component of the strategy. Although not the only feasible explanation, it can be argued, as this model does, that repaying foreign creditors was one of the costly signals that Lula’s government had to undertake in order to improve investors’ and entrepreneurs’ expectations. Had he chosen to default, the negative effect on expectations and the economy would have been substantial.

This paper constitutes a new step towards understanding the costs of sovereign defaults. It presents a new channel through which sovereign defaults generate output costs, namely its effect on credit to the private sector (even if domestic agents do not hold sovereign debt). By providing a detailed analysis of this mechanism this paper complements recent works in the sovereign debt literature that have assumed this to happen.\footnote{See for example Mendoza and Yue (2010)} A number of papers have shown theoretically and empirically that better financial institutions enhance the ability of domestic financial systems to attract foreign funds and use them efficiently (see for example Caballero and Krishnamurthy (2001) and Alfaro et al. (2008)). This paper shows that they could also attract funds to finance the government. Reinhard et al (2003) argued that countries tend to default at different debt to GDP ratios, they called this the "debt intolerance" of a country. This paper points out to a variable that can help explained this and that has not been taken into account so far, the quality of domestic financial institutions.

The paper is organized as follows. Section 2 presents the set up of the model, Section 3 presents and discusses the main results, and Section 4 concludes.
2 THE MODEL

2.1 Environment

The model has three periods, \( t=0,1,2 \). There are three type of agents: the government, a continuum of foreign creditors and a continuum of domestic agents. There is one consumption/capital good in the economy produced by the domestic agents and a public good produced by the government. All agents have linear preferences on time 2 consumption. A fraction \( \alpha \) of the domestic agents are entrepreneurs and a fraction \( (1 - \alpha) \) are financial intermediaries. All domestic agents receive an endowment at time 0 consisting in a project that will generate output at time 2. In addition, entrepreneurs receive at time 1 an investment opportunity. Private sector output at time 2 will be given by:

\[
\begin{align*}
y_e^2 &= y(\theta) + A(\theta)f(k) \\
y_i^2 &= y(\theta)
\end{align*}
\]

where \( y_e^2 \) is the output generated by each entrepreneur and \( y_i^2 \) is the income generated by each financial intermediary; \( y(\theta) \) is the output generated by the endowed project, which is increasing in \( \theta \), that captures the fundamentals of the economy. \( A(\theta)f(k) \) is the output generated by the time 1 investment opportunity where \( f'(k) > 0 \) and \( f''(k) < 0 \). \( A(\theta) \), which is increasing in \( \theta \), captures the effects of the fundamentals on the productivity of investment.

As there are no goods in the economy, entrepreneurs will need to borrow to finance their time 1 investment project. They will be able to do so pledging a fraction of their endowment as collateral.

In order to motivate sovereign borrowing, I will assume that the only way in which the government can finance the production of a public good is by borrowing from abroad through one period non-contingent debt contracts. These contracts are not collateralized. These assumptions are consistent with real world sovereign debt contracts. Repaying is costly for the government as it involves transferring resources to foreign creditors whose welfare does not enter into the government welfare function.

The government borrows from foreign creditors at time 0, and at time 1 gets to know the fundamentals, \( \theta \), while other agents in the economy only know the probability distribution of the fundamentals: good \( (\bar{\theta}) \) with probability \( p \) and bad \( (\bar{\theta}) \) with probability \( 1 - p \). This assumption tries to capture the fact that governments, particularly in developing countries, might have some private information that affect private sector actions. This information could be

\[\text{Note that, at the cost of some additional notation, both the government and the investors could have received noisy signals about the fundamentals. The relevant assumption for the results of the model to carry over would be that the government’s information is different and relevant for investors.}\]
related, for example, to their own ability or willingness to deal with corruption or implement structural reforms that may enhance some fundamental institutions of a country such as the respect of property rights or the rule of law.

After observing its private information about the fundamentals, the government chooses whether to repay its debt with foreign creditors \((x = 1)\) or to default \((x = 0)\). It is assumed that creditors cannot impose sanctions on the government following a sovereign default. However, the government makes the repayment/default decision being aware that economic agents might update their beliefs on fundamentals being good from \(p\) to \(p'\) based on the government action. Posterior beliefs, \(p'\), matter as they will affect domestic entrepreneurs’ credit constraints.

Finally, at time 2 output is produced and consumption takes place. The following table summarizes the timing of events in the model:\(^9\)

### 2.2 Credit chain and domestic credit markets

As entrepreneurs are not endowed with goods, but with a project that matures at time 2, they need to borrow to finance their time 1 investment. Foreign creditors require collateral to back their lending. A fraction, \(\gamma_f\) of the output that their endowment will generate at time 2 can be pledged as collateral to borrow from abroad. The production that the investment itself will generate is assumed to be neither observable nor verifiable so it can not be used as collateral. The securities that entrepreneurs issue to borrow from abroad promise to pay \(\gamma_f y(\theta)\) if fundamentals end up being good. In case that fundamentals were bad,\(^9\)

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\(^9\)The fact that private sector actions take place after the government repayment/default decision is not a strong assumption as there are a myriad of decisions that are influenced by fundamentals that are made almost all the time in the real world. So, for example there will always be some investment decisions made after the government repayment/default decision.
entrepreneurs would default and the collateral, \( \gamma_f y(\theta) \), seized. Foreign creditors, which have large endowments relative to the size of the domestic economy, are risk neutral and compete in international credit markets, require a return equal to the world interest rate, \( R_w \), to lend to the entrepreneurs. We will assume for simplicity that \( R_w = 1 \). The collateral constraint faced by entrepreneurs is then given by:

\[
\beta_f \leq \gamma_f E_1 [y(\theta) | x]
\]  

where \( \beta_f \) is the amount of foreign borrowing that entrepreneurs undertake at time 1 and \( E_1 \) are the time 1 expectations.

One possible interpretation of \( \gamma_f \) is that it captures the quality of institutions in a country. The better the institutions the larger the fraction of time 2 output that foreign creditors could recover if the debtor were to choose not to repay.\(^{10}\) Alternatively, one could interpret this parameter as the value of the time 2 output for foreign creditors (which would be less than for the original owner if there are costs of reselling it or if preferences differ).

In addition to their international collateral, domestic entrepreneurs can pledge as domestic collateral a fraction, \( \gamma_d \), of the output that their endowment will generate. The fraction that they can pledge as collateral for domestic borrowing is larger than the one they can pledge for foreign borrowing (i.e.: \( \gamma_d > \gamma_f \)). The collateral that they pledge for foreign borrowing reduces the available collateral for domestic borrowing.\(^{11}\) This implies that the time 1 domestic borrowing constraint for entrepreneurs is given by:

\[
\beta_d \leq \gamma_d E_1 [y(\theta) | x] - \frac{\beta_f}{R_d}
\]  

where \( \beta_d \) denotes the amount borrowed domestically at time 1 and \( R_d \) denotes the domestic interest rate.

As before, \( \gamma_d \) can be interpreted as the quality of institutions that determine the fraction of the output that can be seized as collateral. While the assumption that only a fraction of the future output is pledgeable as collateral is standard in the credit constraints literature, the asymmetry in the borrowing constraints for domestic and foreign borrowing is more unusual. Caballero and Krishnamurthy (2001) introduce a similar distinction and there is empirical evidence supporting this “home bias” in investments and bargaining advantages for domestic investors.\(^{12}\)

Domestic financial intermediaries will be the ones providing credit in domestic credit markets. This will happen through a credit chain. Domestic financial intermediaries do not have any goods at time 1 to lend, but they have their endowed project that will generate output at time 2. As the entrepreneurs,

\(^{10}\) The assumption that only a fraction of future output is pledgeable as collateral is standard in the literature on credit constraints. It tries to capture capital market imperfections such as the existence of moral hazard, or the presence of limited liability.

\(^{11}\) This implies that foreign creditors have more seniority than domestic ones.

\(^{12}\) See Choe et al. 2001.
they can pledge a fraction $\gamma_f$ of the output that their endowment will generate to borrow from foreign creditors at time 1, and then they can lend to the domestic entrepreneurs.

The different valuation of collateral between domestic and foreigners can create a wedge between the domestic gross interest rate $R_d$ and the world interest rate $R_w$. This difference provides an incentive to domestic financial intermediaries to borrow from abroad and lend domestically. However, they will only do so as long as $R_d \geq R_w$. This implies that for the entrepreneurs borrowing domestically will be at least as expensive as borrowing from abroad. So, they will usually borrow as much as possible from abroad, and only after they exhaust their international collateral will they turn to domestic credit markets (for simplicity we will assume that this will be the case even if $R_d = R_w$).

The collateral constraints are a fraction of the expected value of the endowment of the economy. So, entrepreneurs and financial intermediaries’ ability to borrow both domestically and from abroad will depend on creditors’ time 1 expectations of the time 2 output. Given the information structure of the model, creditors will update their expectations at time 1 after they observe the government default/repayment decision, decision that the government makes after observing the fundamentals.

### 2.3 Sovereign borrowing

The assumptions of the model determine the timing of government borrowing and the maturity structure of the sovereign debt in this model. As the world ends at time 2, there are no reputation considerations in terms of future market access to take into account at that time. Furthermore, as there are no agents making decisions at that time the government does not need to worry about affecting agents’ expectations through a default, and as there are no sanctions either, the government will never have an incentive to make a payment at time 2. As a result, foreign creditors will never offer the government debt contracts that mature at time 2. This implies that foreign creditors will never lend to the government at time 1, regardless of whether the government has defaulted or repaid its time 0 debts (if any) at time 1. So, the government will only be able to borrow at most once, at time 0 and the debt contracts will mature at time 1, exactly as described above.

As in Sandleris (2008) even in the absence of sanctions or repeated interactions (as the government can borrow only once), sovereign borrowing could arise as a result of the information structure of the model. The government faces a tradeoff when making its repayment/default decision. Repaying implies giving resources to foreigners whose welfare does not enter into the government welfare function; defaulting may negatively affect agents’ expectations.

If foreign creditors were to lend to the government $b$ units of the good at time 0, they would obtain $xRb$ when the contract expires at time 1, where $R$ is the gross interest rate on sovereign debt promised in the contract ($R = 1$ if it were a zero coupon bond bond) and $x$ is an indicator variable that captures
the government default decision (i.e.: \( x \in \{0, 1\} \), \( x = 0 \) if the government defaults and \( x = 1 \) if the government repays). That is, if the government defaults it will not repay anything.\(^{13}\) Perfect competition between creditors will make the expected return on sovereign lending equal to the world interest rate in equilibrium. In other words, the zero expected profit condition for foreign creditors is given by:

\[
b = E(xRb) \tag{4}
\]

If the government were always to default, trivially, the only amount of lending consistent with the zero expected profit condition will be zero lending. If the government were to default in some states of the world and repay in others, for the zero expected profit condition to hold, it has to be the case that the interest rate of the debt contract, \( R \), is larger than the world interest rate. So, the interest rate that the government will have to pay when borrowing from foreign creditors will be equal or larger than the world interest rate as a result of the default risk.

### 2.4 Optimization and equilibrium

The model can be solved by backward induction. Entrepreneurs have to choose the optimal amount of investment and their external and domestic borrowing subject to the international and domestic collateral constraints. The time \( t \) optimization problem of the entrepreneurs is given by:

\[
W^e = \max_{b_f^e, b_d^e, k} \ E_1[(y(\theta) + A(\theta)f(k)) \mid x] - b_f^e - R_d b_d^e + z(G) + Tr \tag{5}
\]

subject to

\[
\begin{align*}
 b_f^e & \leq \gamma_f E_1[y(\theta) \mid x] \\
 b_d^e & \leq \gamma_d E_1[y(\theta) \mid x] - b_f^e \\
 k &= b_f^e + b_d^e \\
 k, b_f^e, b_d^e & \geq 0
\end{align*}
\]

where \( Tr \) are government transfers, \( z(G) \) is the effect of the public goods on welfare and all other variables are defined as before. The first constraint is the international collateral constraint that limits the amount of funds that entrepreneurs can raise abroad, the second one is the domestic collateral constraint that does the same for domestic borrowing. The last constraint states that all borrowing will be used for investment, and that borrowing is the only way in which entrepreneurs can obtain the capital good. In addition, we have the usual non-negativity constraints \( k, b_f^e, b_d^e \geq 0 \).

\(^{13}\)This assumption is extreme as it excludes any possible renegotiation that could generate a positive repayment to foreign creditors upon default, which is what we usually observe in reality. The extension of the model to the case where the government could choose any \( x \in [0, 1] \) is straightforward.
Financial intermediaries have some international pledgeable collateral that they can use to borrow from abroad and relend domestically to entrepreneurs in need of capital. So, at time 1 their problem is to choose the optimal amount of relending they are going to undertake:

\[
W^i = \max_{b^i_d} \mathbb{E}_1[y(\theta) \mid x] + (R_d - 1)b^i_d + z(G) + Tr
\]

subject to

\[
0 \leq b^i_d \leq \gamma_1E_1[y(\theta) \mid x]
\]

where \(b^i_d\) is the amount that the financial intermediaries will borrow from abroad and relend domestically.

I assume that the government is benevolent and maximizes domestic agents’ welfare.\(^{14}\) The government faces two decisions in the model. At time 0 it has to decide how much to borrow and spend in the production of the public, and at time 1, once it has received its private information, it has to decide whether to repay or default on the debt "inherited" from time 0. The time 0 problem is given by:

\[
\max_{b, G} \mathbb{E}[W] = \mathbb{E}[\alpha W^r + (1 - \alpha)W^i]
\]

subject to

\[
b \leq \bar{b} \\
G = b \\
Tr = T - xRb \\
G \geq 0
\]

where \(T\) are exogenous government resources, and \(\bar{b}\) is the maximum amount that foreign creditors are willing to lend and is the maximum amount of lending that satisfy their zero expected profit condition.

In the absence of any commitment problem the government would just equate the expected marginal return of investing in production of the public good with the marginal cost of borrowing, but its borrowing will be constrained by its inability to commit to repay.\(^{15}\)

The time 1 repayment/default decision can be characterized as follows:

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\(^{14}\)With a little additional notation it is easy to analyze cases in which the government is not completely benevolent.

\(^{15}\)The government resource contraint could also limit the ability of the government to borrow. However, in order to focus on the government incentives to repay, it is assumed that \(T\) is large enough.
\[
\max_{x \in \{0,1\}} W = \alpha W^e + (1 - \alpha)W^i \quad (8)
\]

subject to
\[Tr = T - xRb\]
\[Tr \geq 0\]

For simplicity, we impose a bit more structure in the model by assuming that
\[W(\theta, p'(1), G^c, Tr(1)) < W(\theta, p'(0), G^c, Tr(0)) \quad \forall \theta,\]
where \(G^c\) is the optimal level of public spending under full commitment. This assumption guarantees that the government credit constraint binds.

Note that at time 1 the government knows the true value of the fundamentals, but it has to take into account that entrepreneurs will maximize their welfare based on expectations about them that can be conditional on the government actions.

An equilibrium for this economy can be defined as follows:

**Definition 1** A Perfect Bayesian equilibrium of this economy is a set of time 0 and time 1 borrowing, lending and investment decisions, prices and beliefs:
\[
\{(b^*_f, G^c), (x, k^*, b^*_f, b^*_d, b^*_d), (R^*, R^*_d), p'(x)\}
\]
such that:

i. \((b^*_f, G^c)\) are solutions to equation (7); \(x\) is a solution to (8); \(k^*, b^*_f, b^*_d\) are a solution to (5); \(b^*_d\) is a solution to (6) given prices

ii. Markets clear: \(\alpha h^*_d = (1 - \alpha)b^*_d\) and \(E(xR) = 1\)

iii. Beliefs, \(p'(x)\) are consistent with Bayes’ rule

This model is a game that can be solved by backward induction. The strategy for each of the players (government, foreign creditors, entrepreneurs, domestic financial intermediaries) is a mapping from their information sets that include all observed actions played by other players that move before them to each player action set. As foreign creditors, entrepreneurs and domestic financial intermediaries make their time 1 decisions without observing the value of the fundamentals, they should update their beliefs about them and base their actions on the posterior beliefs, \(p_t\), that condition on the government choices after observing the fundamentals.

### 3 SOVEREIGN DEFAULTS, INSTITUTIONS AND CREDIT TO THE PRIVATE SECTOR

This section analyzes the interrelation between sovereign defaults, credit to the public sector and domestic credit market institutions. It highlights the effects that sovereign defaults may have on foreign and domestic credit markets through some novel transmission mechanisms. Sovereign defaults can affect the economy collateral constraints. They can make the aggregate financial constraint of the
private sector more stringent and also they can constrain the ability of the economy to reallocate resources domestically. These effects can create a credit crunch in domestic credit markets. All these effects can arise even if domestic agents do not hold sovereign debt. This section also shows that better domestic credit market institutions can amplify this effects, making sovereign defaults more costly and, as a result, allowing for more sovereign lending.

I begin by further characterizing the domestic credit market equilibrium in the presence of domestic and international borrowing constraints. Then I show that sovereign borrowing can arise in equilibrium and analyze the effects that defaults could have on the credit markets. Finally, I analyze the role of the quality of domestic financial institutions in amplifying the effects of default.

3.1 Domestic credit market equilibrium with domestic and international borrowing constraints

As explained above, financial intermediaries will only use their international collateral to borrow from abroad and relend domestically if $R_d > R_w$. In particular, if $R_d > R_w$ financial intermediaries will want to borrow up to the point when their international collateral becomes exhausted. On the other hand, if $R_d = R_w$, they will be indifferent between borrowing and relending or not:

$$ b_d^* = [0, \gamma f E_1[y(\theta) | x]] $$

This implies that borrowing from abroad will always be at least as cheap as borrowing domestically. Thus, entrepreneurs will turn to domestic credit markets only after exhausting their ability to borrow from abroad.\(^{16}\) As a result, if their international collateral constraint does not bind, then domestic credit markets will not arise.

Let’s focus on the more interesting cases, the ones where the international collateral constraint binds for the entrepreneurs. When this happens an entrepreneur can be in one of two possible situations at time 1:

- The international collateral constraint binds, but the domestic one is slack, so the expected marginal product of capital is equal to the domestic interest rate ($MPK = R_d$).

- Both the international and the domestic collateral constraints bind, so the expected marginal product of capital is larger than the domestic interest rate ($MPK > R_d$).

Financial intermediaries will also face two possible situations:

\(^{16}\)For simplicity I am assuming that if indifferent entrepreneurs will always borrow first from abroad.
The international collateral constraint binds, which would happen only if the domestic interest rate is larger than the world interest rate ($R_d > R_w$).

The international collateral constraint is slack because financial intermediaries are indifferent between borrowing and relending and not doing it, which would happen only if the domestic interest rate is equal to the world interest rate ($R_d = R_w$).

I summarize in Proposition 1 the main results up to here:

**Proposition 1 (Proposition 1)** The economy can be in one of four regions at date 1, depending on which collateral constraints bind.

- **Region I:** the only binding constraint is the international collateral constraint of the entrepreneurs. As a result, the expected marginal product of capital will be equal to the domestic interest rate and to the world interest rate ($MPK = R_d = R_w$).

- **Region II:** the international collateral constraint binds for both the entrepreneurs and the financial intermediaries while the domestic collateral constraint of the entrepreneurs is slack. There is a positive spread between the domestic interest rate and the world interest rate ($R_d > R_w$), but the expected marginal product of capital is equal to the domestic interest rate ($MPK = R_d$).

- **Region III:** both the international and the domestic collateral constraints bind for the entrepreneurs, but the international collateral constraint of the financial intermediaries is slack. The domestic interest rate is equal to the world interest rate ($R_d = R_w$), but the expected marginal product of capital is higher than the domestic interest rate ($MPK > R_d$).

- **Region IV:** both the international and domestic collateral constraints of the entrepreneurs, and the international collateral constraint of the financial intermediaries bind (i.e., all constraints bind). There is a positive spread between the domestic interest rate and the world interest rate ($R_d > R_w$), and the expected marginal product of capital is higher than the domestic interest rate ($MPK > R_d$).

The following Figures illustrates these regions. The supply curve in each figure is the supply of international collateral in the economy. It is horizontal at the level of the world interest rate, $R_w = 1$, up to the point where the economy exhaust its international collateral and the constraint binds. Initially entrepreneurs use their own international collateral, once exhausted, financial intermediaries begin borrowing from abroad and relending domestically. The unconstrained demand curve traces the marginal product of capital for entrepreneurs. The domestic borrowing constraint is downward sloping as higher domestic interest rates makes the constraint tighter.
While in Region I the economy achieves the unconstrained level of investment, in the other three regions the constraints distort the allocation of resources in the economy leading to less investment, output and welfare.

In Region II the economy manages to aggregate all of its international collateral, but this is insufficient to achieve the undistorted level of investment. The economy as a whole suffers from the lack of sufficient international collateral. As a result, there exists a positive spread between the domestic interest rate and the world interest. Domestic credit markets are deep enough (relatively to the availability of international collateral), so the domestic collateral constraint does not bind. This makes the marginal product of capital equal to the domestic interest rate.

In Region III domestic credit markets are too shallow relatively to the available international collateral. The lack of sufficient domestic collateral depresses the demand for funds and the economy fails to aggregate all of its international collateral due to domestic credit markets imperfections. In this Region, domestic and world interest rates are equal, but smaller than the marginal product of capital. There are profitable investment opportunities that can not be pursued. However, providing more international collateral to such an economy would have no effect on the outcome, only more domestic collateral could have an effect.

Finally, an economy situated in Region IV suffers from weak domestic credit institutions and insufficient international collateral. The economy is able to aggregate all of its international collateral, but this is insufficient to finance the demand for funds. This happens even if this demand is depressed by the lack of sufficient domestic collateral. There exists a positive spread between the domestic and the world interest rate, and the marginal product of capital is higher than the domestic interest rate. Again there are profitable investment opportunities than cannot be pursued.

3.2 Sovereign defaults and credit to the private sector

Regardless of the region in which an economy is, the information structure of the model is such that the repayment/default decision of the government
can reveal information to entrepreneurs, financial intermediaries and foreign creditros about the fundamentals of the economy. This happens because at time 1, the government already knows the fundamentals but other agents do not.

For given levels of $\theta, G, b, R$ and $T$, the government will only repay if:

$$W(\theta, p'(1), b^*, T - Rb) \geq W(\theta, p'(0), b^*, T)$$

This expression makes clear the costs and benefits of repaying. The cost of repaying is given by the last argument of the function, namely a smaller amount of resources can be used for transfers to the domestic agents, and the benefit of doing so by the second one, the impact of repaying on expectations. Better expectations will lead to higher desired investment and more relaxed credit constraints for the private sector.

It follows that, in this model, the only reason why a government would repay is to affect expectations. If repaying does not reveal any information (for example, in a full information world), it will not affect beliefs (i.e.: $p'(1) = p'(0)$), then the government will always be better off by defaulting on any outstanding amount of debt.

In the presence of private information, the government may have incentives to repay. Repayment may affect expectations, which in turn affect collateral constraints (credit channel) and desired investment (investment channel). It is straight forward to show how this can happen. Assume that beliefs are such that following a default $p'(0) = 0$ and following a repayment $p'(1) = 1$. As investments are more productive when fundamentals are good, the gain from repaying (more relaxed credit constraints and more investment) in terms of output and welfare will be larger when fundamentals are good than when they are bad. At the same time, the linearity of the preferences guarantees that the cost of repaying is the same if fundamentals are bad than if they are good. This creates a "single crossing property", for some debt levels the government will only repay when fundamentals are good and default when they are bad, making the assumed beliefs consistent. The following proposition formalizes these results:

**Proposition 2 (Proposition 2)** There exists an equilibrium with positive sovereign borrowing where the government defaults when fundamentals are bad, and repays otherwise. In this equilibrium:

$$p'(0) = 0 \text{ and } p'(1) = 1$$

$$R^* = \frac{1}{p}$$

$$b^* > 0 \text{ and, in particular it will be the one that makes: } W(\bar{\theta}, p'(1), b^*, T - \frac{1}{p} b^*) - W(\bar{\theta}, p'(0), b^*, T) = 0$$

17In general, there would be two effects to take into account when analyzing how better fundamentals affect the effect of higher investment on welfare. The first effect can be thought of as a substitution effect -it is more convenient to have more investment when fundamentals are good as you are more productive-. The second effect, that appears with concavity, is a wealth effect -when fundamentals are good there is more output, so the welfare gain of having additional goods is smaller-. Both effects work in opposite directions. The absence of concavity in the model guarantees that the first effect dominates.
Proof. See Appendix ■

The previous proposition shows that, as in Sandleris (2008) there exists an equilibrium for this model with positive sovereign borrowing in which the government will default when fundamentals are bad, and repay when they are good. The government repays to communicate information about the fundamentals to other agents in the economy, and in this way influences their expectations. In other words, the government repays out of concern of the effect of a default on expectations.

This separating equilibrium is not the only possible equilibrium of this economy. Another trivial equilibrium is one in which there is no lending to the government. Another set of equilibria for this model is one in which there is a positive amount of sovereign debt and the government never defaults (pooling equilibria).

Proposition 3 (Proposition 3) For any set of posterior beliefs \( p'(1) = p \) and \( p'(0) < p \), there exist an equilibrium with positive sovereign borrowing in which the government always repays. In such equilibrium:

\[
R^* = 1 \\
\frac{b^*}{1} > 0 \text{ and, in particular it will be the one that makes: } W(\theta, p'(1), b^*, T - b^*) - W(\theta, p'(0), b^*, T) = 0
\]

Proof. See Appendix ■

The mechanism through which a sovereign default can create a credit crunch in domestic credit markets, reduce the ability of the private sector to borrow from abroad, and cause a decline in investment and output is not related to the domestic private sector holding government debt. It is the result of the information content of defaults. In the model, a default endogenously becomes a signal of bad fundamentals and affect expectations. Thus, as in Sandleris (2008), the government may have incentives to repay at least for some realizations of the fundamentals even in the absence of sanctions or repeated interactions.

The key contribution of this paper is to show the effect of sovereign defaults on credit to the private sector, both domestic and from abroad. It is interesting to analyze in more detail these effects. Assume that the government has privately observed that fundamentals are good and it has to decide whether to repay or default. In Region III the international collateral constraint binds for both the high and low output entrepreneurs and the domestic collateral constraint is slack. The binding aggregate constraint means that the economy has insufficient resources to finance all investment needs. A default would negatively affect the desired level of investment at time 1 (investment channel), and in addition it will decrease the value of the international collateral (credit channel), making the constraints even more stringent. The economy as a whole would be able to borrow less from abroad and as a result the amount of time 1 investment will decrease. The domestic interest rate may go up or down depending on the demand and supply elasticities.

An alternative channel behind a real contraction following a default is a shortage of domestic collateral. This would happen in Region II where the
economy is failing to aggregate all of its international collateral. Even when the private sector has sufficient resources in the aggregate, entrepreneurs in need of funds have insufficient domestic collateral, so they will not be able to access these resources. A default would make the collateral constraints more stringent. In these two regions, repaying following a good or a bad shock would relax the collateral constraints and allow an investment level closer to the unconstrained optimum. However, while the increase in welfare that this would generate outweighs the cost of repaying when the shock is good, it does not when the shock is bad. The reason is that investment is more productive when the shock is good than when it is bad, as a result relaxing the collateral constraints is more valuable when the economy has better investment opportunities.

Finally, in Region IV where all collateral constraints bind, a default would generate again a decrease in the desired level of time 1 investment (investment channel) and make all collateral constraints more stringent (credit channel). The economy as a whole would be able to borrow less from abroad, and in addition domestic entrepreneurs will be able to borrow less domestically. It is the concern about these potential costs the reason why the government will repay foreign creditors in the model. The following graph shows the effects of a default for an economy in this region.

Repaying would relax the collateral constraints and allow an investment level closer to the unconstrained optimum. However, in this separating equilibrium, while the increase in welfare that this would generate outweighs the cost of repaying when fundamentals are good, it does not when fundamentals are bad. The reason is that investment is more productive when fundamentals are good than when it is bad, as a result relaxing the collateral constraints is more valuable when the economy has better investment opportunities.

So far, the analysis has focused on cases where the sovereign default leaves the economy in the same region in which it was. However, there is no reason to believe that this will necessarily be the case. A sovereign default may transform
a slack constraint into a binding one. Moving the economy, for example, from Region II or III to Region IV when all constraints bind.

3.3 Domestic financial market institutions and sovereign borrowing

An interesting result of the model is that the degree of development of domestic financial institutions will affect the ability of a sovereign government to borrow from abroad. The mechanism is simple. More developed financial institutions, higher $\gamma$s, imply, for economies in Region II, III and IV, where the constraints bind, that a default would have a larger effect on credit to the private sector. So, the benefits of repaying become larger and as a result the amount of sovereign debt that can be supported in equilibrium are higher. The following proposition formalizes this.

**Proposition 4 (Proposition 4)** For all other things equal, countries in Region II, III and IV with more developed financial institutions, higher $\gamma$s, will be able to engage in more sovereign borrowing

**Proof.** See Appendix

This result allows us to understand the relation between domestic financial institutions that determine in the model the leverage that entrepreneurs can achieve and sovereign borrowing.

This result could be relevant for example to understand the issue of debt intolerance highlighted by Reinhart et al, that tries to understand why countries default at different ratios of debt to GDP. According to this model, part of the explanation would lie in different degrees of development in domestic financial institutions.

Note also that if we interpret $\gamma$ as the degree of leverage that the private sector can achieve we will have, for $\gamma > 1$ an amplifying effect of the financial systems on the cost of defaults.

4 CONCLUSIONS

This paper addresses two questions. First, it studies whether in an economy in which domestic agents do not hold sovereign bonds, a sovereign default can affect credit to the private sector. Second, it analyses whether the presence of stronger domestic financial institutions, such as better legal enforcement of private sector contracts or improved corporate governance, influence the magnitude of the effect of sovereign defaults on credit to the private sector.

In a simple macroeconomic model the paper identifies two channels through which a sovereign default, through its effect on expectations about fundamentals, may have a widespread effect on the domestic economy, generating potentially important costs in terms of output and welfare. A default can decrease
domestic desired investment (investment channel), and it can negatively affect firms’ net worth, which will make firms’ collateral constraints more stringent triggering a contraction in foreign lending to domestic firms (even without sanctions) and a credit crunch in domestic credit markets (credit channel). These effects become larger when domestic financial institutions are more developed.

This latter finding highlights an often overlooked benefit from reforming domestic financial institutions. Better financial institutions can reduce the incentives of a government to default and with it relax the government foreign borrowing constraint.

These novel mechanisms through which sovereign defaults affect domestic private sector constitutes a new step towards understanding the costs of default.
References


5 APPENDIX

5.1 Proofs

Proposition 2. The proof of this proposition involves 4 steps.

i. There exists a solution to agents individual problems

As all agents are maximizing continuous functions over compact sets, from Weierstrass theorem there exists a maximum.

ii. There are updating rules of private sector beliefs for which the government will repay a positive amount of debt

\[ W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) > W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) \]

if \( p'(1) > p'(0) \). Note that if \( bR = 0 \) then \( W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) \)

if \( p'(1) > p'(0) \). Given the assumption that \( p'(1) > p'(0) \), so by continuity \( \exists bR > 0 \) for which \( W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) > bR \). This implies that even under bad fundamentals the government will be willing to make some repayments as long as the amount of debt is low enough though still positive. Pick any positive level of debt \( b \) and interest rate \( R \) such that

\[ W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) \geq bR > W(\theta, p'(1), G, T - Rb) - W(\theta, p'(0), G, T) \]

It is clear that for any such level of debt and interest rate the government will only find optimal to repay when fundamentals are good and that \( bR > 0 \).

iii. The updating of beliefs is consistent

In the previous step I have assumed that \( p'(1) > p'(0) \). In particular, let \( p'(1) = 1 \) and \( p'(0) = 0 \). That is, after a default beliefs are that fundamentals are bad, and after a repayment beliefs are that fundamentals are good. Given this updating rule, from (ii) there exist strictly positive levels of debt for which the government will repay only when fundamentals are good and default when they are bad. As a result the updated beliefs will be correct on equilibrium.

iv. In this equilibrium: \( R^* = \frac{1}{p} \) and \( b^* \) will be such that

\[ W(\theta, p'(1), b^*, T - \frac{1}{p} b^*) - W(\theta, p'(0), b^*, T) = 0 \]

Perfect competition in international credit markets implies that foreign creditors will lend to the government any amount that satisfies their zero expected profit condition. The maximum amount that the government can commit to repay (i.e.: the incentive compatibility constraint) when fundamentals are good is the one that would make the government indifferent between repaying and defaulting when fundamentals are good, which is given by:

\[ W(\theta, p'(1), b^*, T - \frac{1}{p} b^*) - W(\theta, p'(0), b^*, T) = 0 \]

From A5 the borrowing constraint will bind, so the government will borrow as much as possible, which implies that \( b^* = b \).

In addition, for the zero expected profit condition to hold:

\[ b^* = E[x R^* b^*] \]

As the government will only repay when fundamentals are good and this happens with probability \( p \):

\[ E[x R b] = p R^* b^* \]
So, from the two previous expressions: \( R = \frac{1}{p} \)

**Proposition 3.** From the previous proof, there exists a solution to agents’ problems.

Assume that posterior beliefs are:

\( p'(1) = p \) and \( p'(0) < p \)

Then, \( W(\bar{\theta}, p'(1), b, T - Rb) - W(\bar{\theta}, p'(0), b, T) > W(\bar{\theta}, p'(1), b, T - Rb) - W(\bar{\theta}, p'(0), b, T) \)

and there exists \( Rb > 0 \) such that:

\( W(\bar{\theta}, p'(1), b, T - Rb) - W(\bar{\theta}, p'(0), b, T) > 0 \)

Then for those \( Rb \) that satisfy this, the government will find optimal to repay both when fundamentals are good and when they are bad. This in turn implies that beliefs are correct on equilibrium (there is no information revealed by a repayment), and a default will be an off-equilibrium event. So, the posterior beliefs conditional on default are not pinned down.

For those \( Rb \) where the government will never default, perfect competition in international credit markets guarantees that \( R^* = R_w = 1 \). As a result the maximum amount the government will be able to borrow, \( \bar{b} \), will be given by:

\( W(\bar{\theta}, p'(1), b, T - Rb) - W(\bar{\theta}, p'(0), b, T) = 0 \)

And as in Proposition 2: \( b^* = \bar{b} \)

**Proposition 4.** For a country in Regions II and IV total credit to the private sector, and, therefore, investment is given by:

\( b^*_f = \gamma_f E_1[y(\theta) \mid x] \).

In the separating equilibrium we would then have:

\( b^*_f(x = 1) = \gamma_f y(\bar{\theta}) \) and \( b^*_f(x = 0) = \gamma_f y(\bar{\theta}) \)

Recall that \( W = \alpha W^c + (1 - \alpha)W^\varphi \), and \( W^c = \max_{\varphi, \gamma, k} E_1[\pi^e \mid x] = E_1[(y(\theta) + A(\theta)f(k)) \mid x] - b^*_\gamma - Rb^*_\delta + z(G) + Tr \)

So, \( W(\bar{\theta}, p'(1), b^*, T - \frac{1}{p}b^*) - W(\bar{\theta}, p'(0), b^*, T) \) is increasing in \( \gamma_f \). A similar argument can be made for a country in Region III.