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Sovereign Risk and Economic Growth: Unraveling the Interplay

Emilio Touma

Universidad San Francisco de Quinto USFQ, School of Economics

Faculty Advisor: Dr. Carlos Uribe

Abstract

In this paper, I analyze the economic costs of an increase in the probability of sovereign de- fault. I do so by applying a two-step procedure. First, a probit model estimates the probability of default. Second, I include this estimated probability in a local projections model that reduces the "forbidden comparisons" bias. I find evidence that an increase in sovereign risk has adverse effects on GDP and its components. An increase of 10 basis points reduces GDP and consumption by 2-3% during the first and second years after the shock. Also, investments and imports fall by 5%. Finally, the effect on exports and government expenditure is not statistically significant.

Keywords: Sovereign Risk, Default, Sovereign Debt, Local Projections

1. Introduction

Ecuador has experienced high levels of sovereign default risk during the last 20 years. As a result, this country tops the list of South American countries with higher country risk as measured by JP Morgan Chase & Co. The Emerging Markets Bonds Index (EMBI) is calculated by taking the difference in bond yields between Ecuador and the United States. Increments in this index are associated with a higher probability of default due to the risk premia.

Figure **??** depicts the evolution of Ecuador's EMBI from 2004 to 2024. As the graph shows, the index has maintained above 1,000 basis points, and in years like 2008 or 2020 has skyrocketed to more than 5,000 basis points. Consequently, what are the economic costs of an increase in the probability of default?

To answer this question, I use a novel econometric approach proposed by Dube et al. [2023] and combined with a probit model. The methodology involves two steps. In the first step, I calculate the probability of default using a probit model. In the second step, I include the estimated probability of default in a local projections model. For each equation, I limit the sample to reduce the bias induced by forbidden comparisons [de Chaisemartin and D'Haultfœuille, 2022]. To estimate the models I use the database of Kuvshinov and Zimmermann [2019] which has more than 150 countries, is available for the period 1970-2010, and has a rich set of fiscal, financial, and macroeoconomic variables.

The main result is that sovereign risk is costly for the economy. An increase of 10 basis points in the probability of default, contracts GDP and consumption by 2-3% during the first and second year after the shock. For investment and imports, the drop is 5%. Moreover, the effect has no statistical significance for government expenditure and exports. Additionally, using various robustness checks, I find a more persistent effect: an increase in the probability of default is costly after the 5th year.

My work contributes to the literature in two directions: First it uses a database that contains a heterogenous set of countries and a greater period, and second I use a state-of-the-art econometric approach. Other studies have calibrated a general equilibrium model with data from a particular event (e.g., the default of Argentina in 2001). In that way, Corsetti et al. [2013] uses a variant of the model of Cúrdia and Woodford [2010] to study how sovereign risk increases funding to the private sector. Also, Badarau et al. [2014] constructs and simulate a DSGE model of a country in a monetary union facing an increase in sovereign spreads.

Other authors use a narrative approach. For example, Bahaj [2020] constructs a high-frequency narrative dataset of the euro crisis to identify exogenous shocks to sovereign spreads. Then, the author implements external instruments to estimate a VAR model with Bayesian methods. His main conclusion is that sovereign spreads have a contractionary effect on output, and the channel of trans- mission is through the financial sector. Moreover, Hébert and Schreger [2017] use legal rulings of the case Republic of Argentina vs. NML Capital as external instruments to

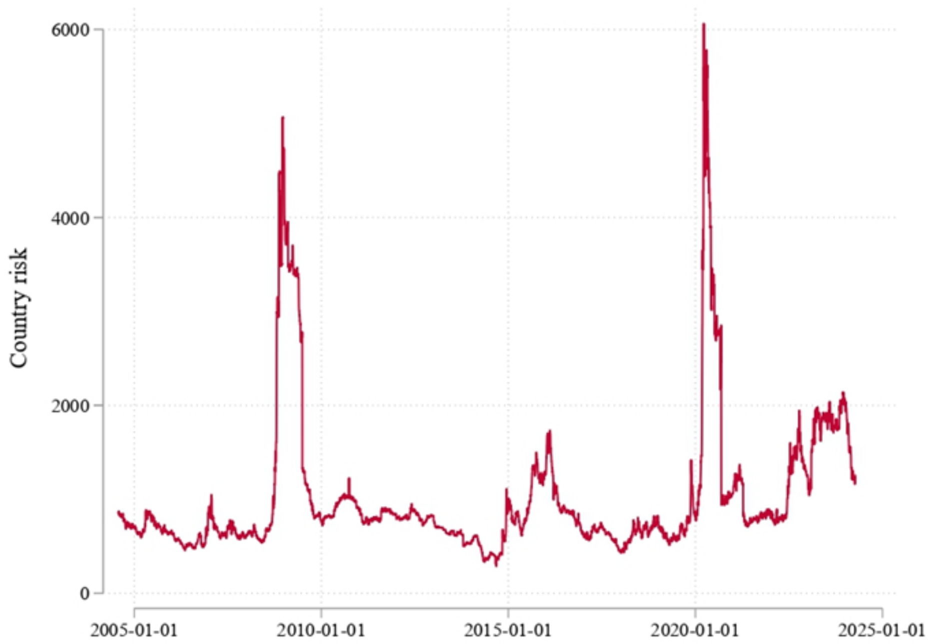


Figure 1: Country Risk of Ecuador, 2004-2024

Notes: The figure depicts the country risk of Ecuador, as measured by the Emerging Markets Bonds Index, from 2004 to 2024. *Source:* Central Bank of Ecuador.

study the effects of the probability of default on equity returns.

2. Why Countries Pay Their Debts?

Sovereign debt is challenging to enforce as opposed to private debt. The latter has mechanisms that protect investors from default; for instance, investors could seize a company's assets if it goes bankrupt. In that way, investors have safeguards to protect themselves from default. In the case of sovereign debt, it is harder to apply this legal device. For example, after substantial financial and political turbulence, Argentina defaulted on its debt in 2001 and 2002. NML CAPITAL, a hedge fund and one of Argentina's creditors, to recover some of the money lost, imposed legal actions to seize an Argentinian naval ship in Ghana. Despite NML Capital's legal actions, The Libertad returned to Argentina after the UN Tribunal for the Law of the Sea instructed Ghana to release the vessel, arguing that it possessed immunity as a military ship (BBC 2013).

As a result, what are the incentives for sovereigns to pay their debt? After all, legal reinforcement is hard to achieve, as the example above shows. In consequence, the costs of default help unravel this puzzling question. In this view, sovereigns may honor the payment of their bonds because the cost of defaulting is higher than its benefits. The literature points out two costs associated with default: reputational costs and direct retaliation [Hatchondo et al., 2007].

In the "reputational costs" framework, sovereigns pay their debt because capital markets allow them to smooth consumption [Rogoff and Bulow, 2015]. When they default, creditors restrict access to financial resources. To prove this hypothesis, researchers have studied the effects on credit ratings and bond spreads after a default episode (see Marchesi et al. [2023]). Moreover, the "direct retaliation" approach takes into account the fact that most sovereign debt is under New York or London law, so "creditors are thus afforded legal rights to interfere in the commercial dealings of the borrowers, e.g. by sanctioning trade outright, seizing shipments, or creating serious trade frictions by regulatory means" (Eberhardt [2018], p. 6). Therefore, default costs help us explain why investors are willing to lend to governments. However, what are the channels of transmission of default and sovereign risk?

3. Channels of Transmission

Researchers highlight two passthrough mechanisms that explain the links between sovereign risk and output loss. The first is an explanation based on banks' balance sheets, revealing how changes in sovereign risk could affect banks and their ability to lend. The second uses a game theory approach that emphasizes the importance of signaling.

To understand the first channel of transmission, it is crucial to explain how banks operate. These institutions use short-term liabilities (like deposits) to finance long-term assets (e.g., credit for an investment project of a company). In normal times, this process does not put at risk the financial health of the bank; nevertheless, when there is a liquidity shock (such as a bank run) this could undermine the financial soundness of the institution. That is one of the reasons why banks maintain liquid assets in their investment portfolio.

As a result, government securities could compose a part of a bank's investment portfolio because of the liquidity benefits derived from those assets or, in the case of Ecuador, due to regulatory obligations. This means that sovereign risk and default could affect the portfolio of a bank, and therefore its willingness to lend. For example, after the bailout of Greece in 2010, sovereign debt markets came under stress. The banks of Italy that were exposed to sovereign bonds, reduced credit and this, in turn, affected the investment and labor decisions of small firms. Bottero et al. [2020] estimates that a one-euro reduction in credit to small firms decreased investment by 38 cents during this period.

Given these recent episodes, some researchers argue that sovereign risk affects the economy through the banking sector. In the model of Arellano et al. [2017], there is heterogeneity between firms due to differences in productivity and borrowing needs to pay capital and labor. Banks borrow from households and use these funds to extend loans and invest in government bonds. When there is an increase in the probability of sovereign default, this lowers the price of bonds, thus affecting the bank's balance sheet and ability to finance firms and households. The interest rate of loans increases and the firms with more exposure to banking loans lower their output the most.

Also, Bocola [2016] builds a model in which the pass-through of sovereign risk is by two ways. First, when the probability of default rises, this hampers the balance sheet of the bank, so the banks lend less; this channel is similar to the mechanism described by Arellano et al. [2017]. Nevertheless, Bocola [2016] also adds a risk channel pass-through: The increase in sovereign risk means that lending to firms becomes riskier, so banks reduce their funding to the economy.

Other theories use a different framework to explain the link between the probability of default and output loss. Sandleris [2008] uses a game theory model to explain the link. In this framework, default reveals information about the state of the economy or the government. When default occurs, investors increase their expectations about a future default (i.e., the probability of default rises). The risk premium surges and this could decrease foreign investment or increase borrowing costs.

One interesting case study that illustrates this theory is Ecuador's default of 2008. During this period, president Rafael Correa campaigned that he would not pay part of the sovereign debt, arguing that it was illegitimate. Even though economic conditions did not justify the default, the government suspended payments of the 2012 and 2030 Global Bonds [Feibelman, 2010]. This had the effect of damaging the financial credibility of the government; Ecuador reentered the bond markets after 8 years and faced much higher interest rates.

To sum up, because the payment of public debt could be hard to enforce, sovereign default must be costly, so governments have an incentive to honor their debt. Apart from this, researchers assume that default is costly due to the need of restricting the levels of debt in the model or to match empirical facts in developing countries.

4. Default Models and the Cost of Default

During the '70s, developing countries increased their indebtedness to high and unmanageable levels. One decade later, international financial and economic conditions made it harder for these countries to pay their debts; rising interest rates, soaring world energy prices, and declining commodity prices caused the debt burden to become hard to fulfill [Effros, 1992]. Within this context, macroeconomists developed theoretical models to understand the debt crisis of the '80s.

In that way, the groundbreaking article of Eaton and Gersovitz [1981] established the foundations for future researchers on sovereign default. Their paper begins by recognizing that countries face nonexplicit sanctions for not paying their debts. The lack of enforcement mechanisms poses several theoretical challenges concerning why sovereigns pay the bonds issued. They undertake this challenge by adding an endogenous penalty cost to the model. This penalty takes the form of credit sanctions: they assume exclusion from the credit market when a country defaults. Therefore, when a sovereign does not honor its debt, international creditors refuse to extend any new loans afterward.

More recent models of default also assume that default is costly. Aguiar and Gopinath [2006] establish a parameter within their model that reflects the output cost due to financial autarky after default. This assumption is crucial in their model because it is necessary to limit the amount of debt contracted by the sovereign.

Also, Arellano [2008] assumes that the default episode is costly in two ways. First, when a sovereign defaults, there is an exclusion from financial markets, and the sovereign could borrow again after a stochastic number of periods. Second, default has direct output losses. In this model, households obtain a stochastic stream y of a tradable good. The government can buy one-period discount bonds B' at price $q(B', y)$. Also, the government transfers to households all the revenue from its capital markets operations. When the government does not default, the resource constraint of the household is

$$c = y - q(B', y)\, B' + B, \tag{1}$$

When the government defaults, debt is eliminated, but output is lower ($y^{\text{def}} \leq y$):

$$c = y^{\text{def}}. \tag{2}$$

How large are those costs and how do they evolve? To answer this, an appropriate econometric model should estimate the costs not only in one period but also in several periods after the shock. In the present paper, I tackle this by estimating impulse response functions using local projections.

5. Empirical Strategy

To estimate the costs of default risk on the economy, I combine the local projections methodology proposed by Dube et al. [2023] with a probit model of default. Consequently, the procedure involves two steps. First, I estimate the probability of default depicted by the following equation:

$$\text{ProbD}_{i,t} = \Phi\left(\sum_{k=0}^{2} \delta_k\, x_{i,t-k} + v_i\right), \tag{3}$$

where $\text{ProbD}_{i,t}$ is the probability of default, Φ is the standard normal cumulative distribution function, $x_{i,t-k}$ is a set of covariates lagged k periods, and v_i is the country-specific random effect. Moreover, Bandiera et al. [2010], Ghulam and Derber [2018], and Manasse et al. [2003] provide a set of candidates as independent variables. These include macroeconomic variables, like exports or inflation, and variables that capture fiscal distress such as the level of external public debt or interest payment (see Section X.II).

In the regression I include several economic variables due to the fact that empirical evidence shows a strong link between default and economic conditions. For example, Tomz and Wright [2007], using a database consisting of 160 default episodes since 1820, find that defaults start when economic activity is 1.6 percentage points below trend. Additionally, for countries whose exports are mainly commodities, declines in commodity prices are associated with default episodes. For example, Ecuador defaulted in 1999 after a sharp reduction in commodity prices. Also, Hatchondo et al. [2007] point out that the reduction in oil prices is one of the key triggers of Russia's default in 1998.

When is a country in default? The answer depends on the definition used by different authors and credit rating agencies. Rating agencies use a legal definition of sovereign default: a country defaults if it misses a payment or makes a restructuring that is disadvantageous to creditors [Balteanu and Erce, 2018].

Other authors take into account the amount of arrears to define whether a country is in default. For example, Detragiache [2001] defines a sovereign default as a situation in which (1) the arrears of principal or interest of external obligation are greater than 5% of the total debt, and/or (2) there is a debt restructuring with creditors of the GDF. Condition (1) is important because it eliminates small-scale arrears that can trigger a default under legal parameters. Moreover, this definition stresses the fact that default is not always around all debt, but rather specific segments. In that sense, partial default has gained more attention in theoretical models because it is a phenomenon widely observed in emerging markets [Arellano et al., 2023]; therefore, in this section, I use the definition of Detragiache [2001].

Once I estimate Equation 3, I use the estimated probability of default and incorporate it into the local projections equations. Consequently, the following set of regressions captures the dynamic effects of a rise in the probability of default:

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} = \beta^h\, \widehat{\text{ProbD}}_{i,t} + \sum_{k=0}^{2} \zeta_k^h\, Z_{i,t-k} \\ + \gamma_t^h + \varepsilon_{i,t}^h, \quad \text{for } h = \{-5, -4, \ldots, 10\}, \end{aligned} \tag{4}$$

limiting the sample to:

$$\begin{cases} \text{Countries in default: } D_{i,t} = 1;\ D_{i,t-j} = 0 \text{ for } 1 \leq j \leq 2, \\ \text{Clean controls: } D_{i,t-j} = 0 \text{ for } 0 \leq j \leq 2. \end{cases} \tag{5}$$

Here, the difference $y_{i,t+h} - y_{i,t-1}$ depicts the change in the outcome variable h periods forward with respect to the period before the shock. Additionally, $Z_{i,t-k}$ is a set of covariates (for details, see Section X.I), $\widehat{\text{ProbD}}_{i,t}$ is the probability estimated in Equation 3, and $D_{i,t}$ is a dummy variable of default.

What is the role of Equation 5? There exists a vast literature [see de Chaisemartin and D'Haultfœuille, 2022, for a survey] that points out the problem of "forbidden comparisons" in fixed-effects estimators:

> With staggered rollout, regression-based estimation leverages comparisons between groups that got treated over a period of time and ref-

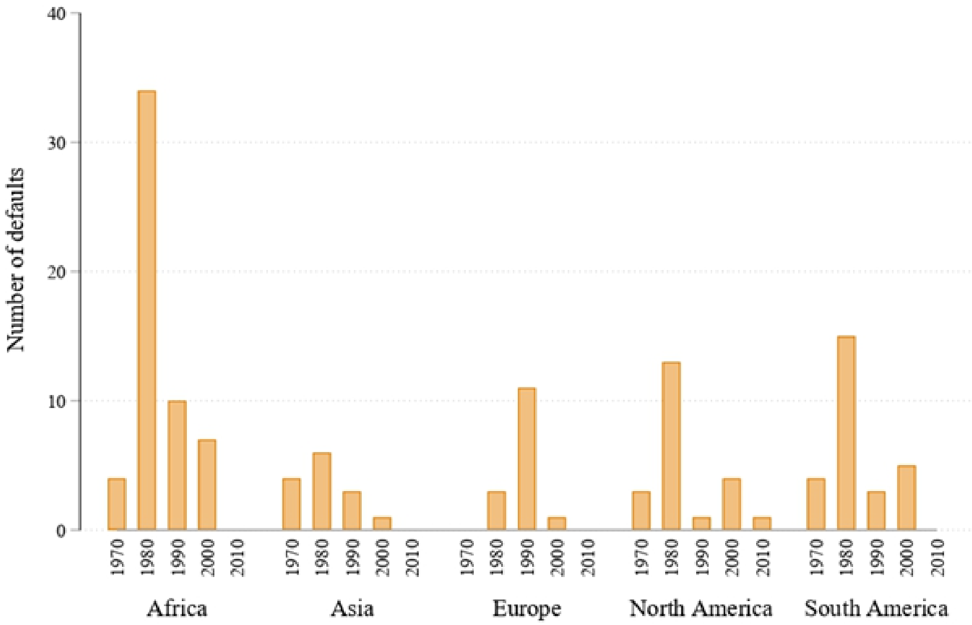


Figure 2: Number of Defaults by Continent, 1970-2010

Notes: Using the definition of S&P, this graph shows the number of defaults (vertical axis) by decades and continents. One standout fact is evident: the significant increase in defaults during the 1980s (especially in Africa).

> erence groups which had been treated earlier. We label such cases "forbidden comparisons." Indeed, these comparisons are only valid when the homogeneity assumption is true; when it is violated, they can substantially distort the weights the estimator places on treatment effects, or even make them negative. [Borusyak et al., 2024, p. 5]

Therefore, the solution of Dube et al. [2023] to the "forbidden comparisons" problem is to limit the estimation sample so that the control group is composed of observations that are not influenced by a change in treatment status. In that way, Equation 5 eliminates the influence that past defaults could have over recent defaults.

6. Data

In the present study, I use the database of Kuvshinov and Zimmermann [2019]. This database covers the period from 1970 to 2010 and more than 150 countries. It has a rich set of variables like fiscal indicators, sovereign debt levels, financial and political stability measures, and additional economic information. Also (and most importantly for this study), it contains dummy variables indicating if the country is in default.

There is heterogeneity in terms of the number of defaults between countries and periods. Figure ?? displays the number of defaults, as defined by S&P, for different countries and decades ranging from 1970 to 2010. An outstanding fact of the graph is the increase in the number of defaults during the 80s. While all continents experienced severe debt crises, Africa´s situation stands out: in the 80´s total defaults increased by a factor of more than nine.

Additionally, real per-capita GDP decreases in periods when a country experiences default. Table 1 summarizes the mean of real per-capita GDP within countries of a specific continent. The first column takes into account observations with countries in default, and the second column non-default episodes. When countries are in default, on average, the contraction in GDP ranges from -0.41% to -7.30%.

This stylized fact serves as a starting point to study the effects of default (and its probability) on output. Also, this comprehensive database contains a wide range of variables that are crucial for model estimation. Thus, I proceed to explain the results obtained to unravel the effects of sovereign risk on the economy.

7. Results

In this section, I present the estimation of the costs of a 10 basis point increase in the probability of default for several variables. These variables include real GDP, consumption, government expenditure, investment, exports, and imports. Also, I show the

Table 1: GDP Growth in Periods of Default vs. Non-Default (1970–2010)

	Average (%) Δ GDP per capita	
Continent	Default	Non-Default
Africa	−2.65	1.24
Asia	−0.63	2.78
Europe	−7.30	2.32
North America	−0.41	2.15
South America	−1.53	1.82

Notes: The table portrays the average real GDP per-capita growth divided by default vs. non-default episodes within continents.

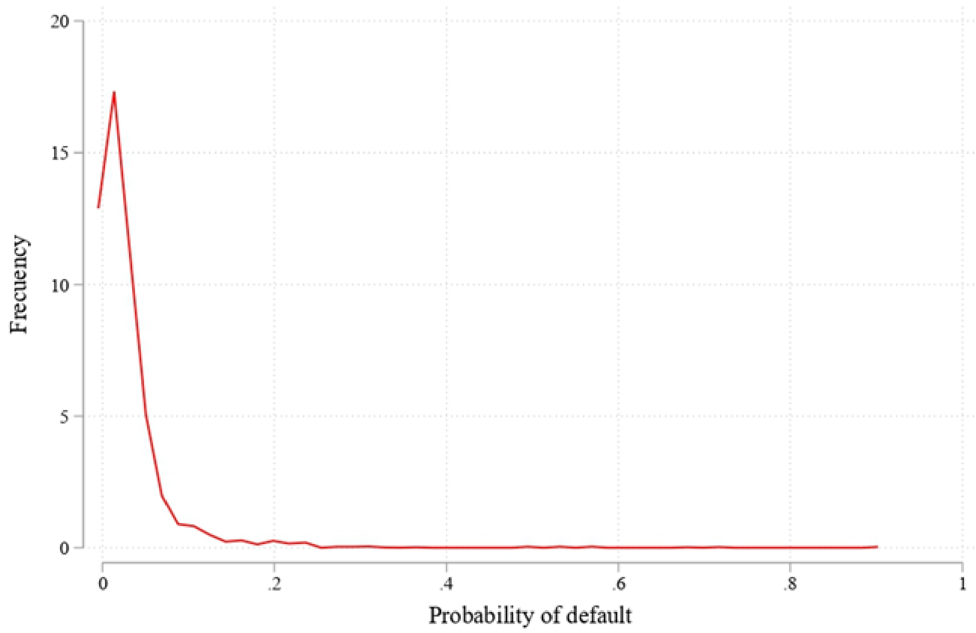


Figure 3: Probit Model of Default

Notes: This figure displays the frequency of the estimated probability of the probit model of Equation 3. It shows that the probit model assigns a low probability most of the time. Nevertheless, this probability increases in years of default.

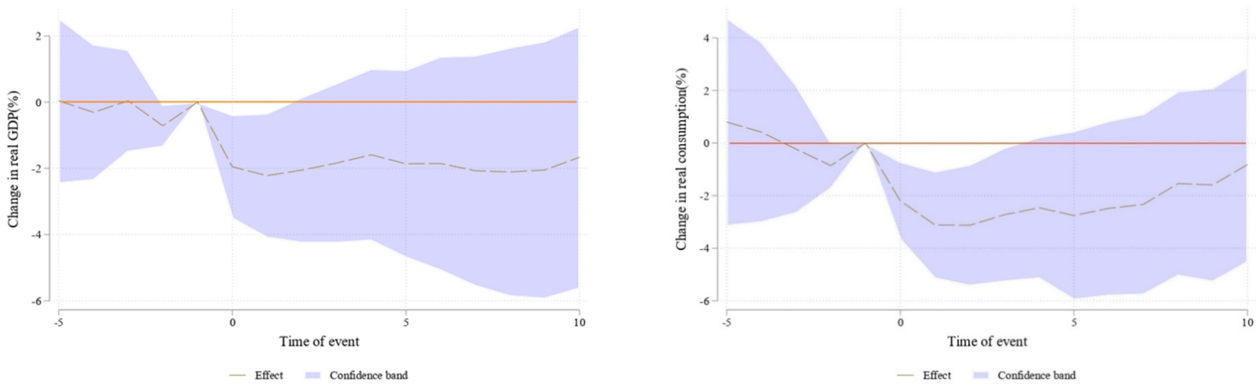
estimation of the first stage.

The estimation of Equation 3 assigns a low probability of default for most of the observations. Figure ?? illustrates these results. The vertical axis shows the frequency and the horizontal axis indicates the estimated probability. The graph exhibits left skewness, indicating that probabilities of default greater than 10% are observed only for a limited number of episodes.

The rationale behind these results is that the model estimates a low probability unless the country experiences a default. For example, in the case of Ecuador, the mean probability of default is 3.17% for the period 1986-2011. Nevertheless, in years of default the probability spikes: in 1999 the probability of default is 32%.

Moreover, Figure 4 displays the local projection functions. The horizontal axis of each panel is the time of the event, where time 0 is the date at which the default probability rises 10 basis points. The vertical axis shows the percentage change of the outcome variable at the time of the event with respect to one period before the shock. Also, the dashed line depicts the growth rate path and the shaded area is the 95% confidence band.

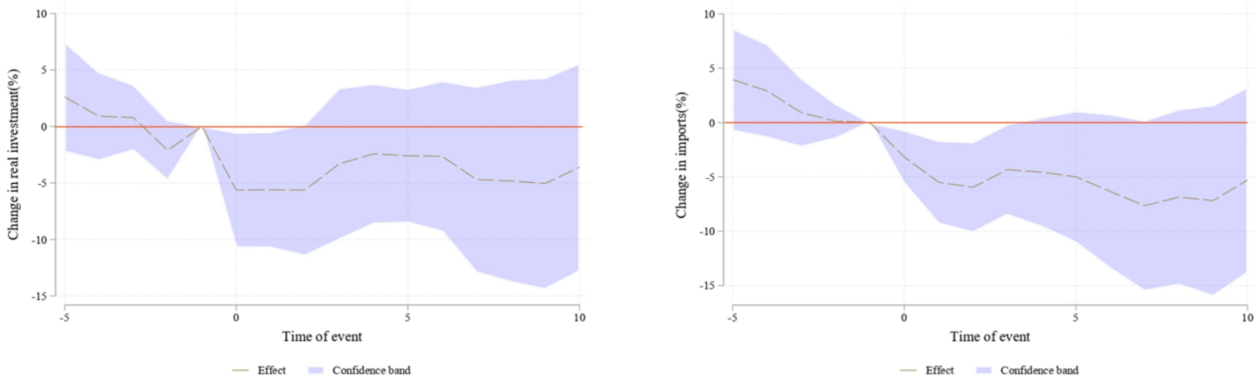
In that way, Panel 4a displays a 2% per year decrease in GDP between the first and second years after this shock; private consumption (Panel 4b) follows similar dynamics. There is a greater drop in investment (Panel 5a) and imports (Panel 5b); default risk costs to the economy as much as 5%. Additionally, the effect on exports (Panel 6a) and government expenditure (Panel 6b) is not significant.



(a) Real GDP (b) Consumption

Figure 4: The Effects on GDP and Consumption of a 10 Basis Point Increase in the Sovereign Risk

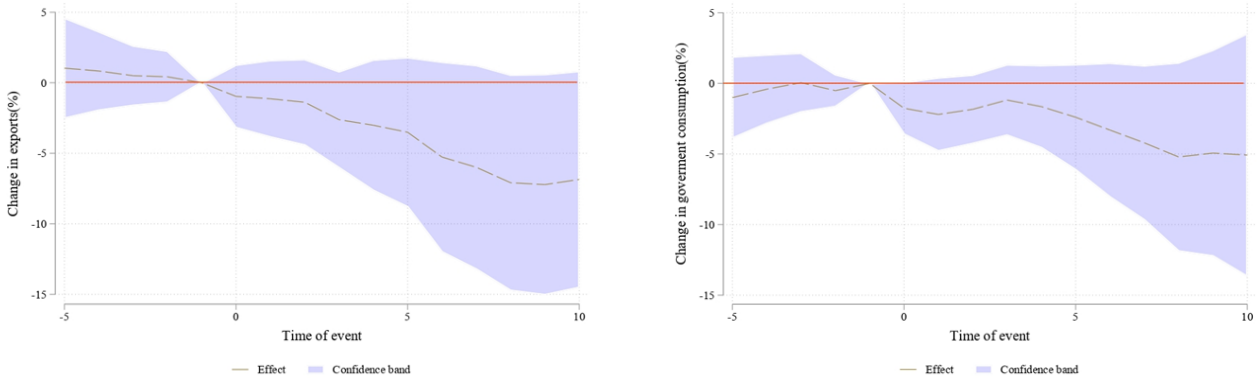
Notes: The figures show the local projection functions from Equation 4. Panel a illustrates a 2% annual decrease in GDP during the first and second years following the shock, with private consumption (Panel b) showing similar trends.



(a) Investments (b) Imports

Figure 5: The Effects on Investments and Imports of a 10 Basis Point Increase in the Sovereign Risk

Notes: The figures show the local projection functions from Equation 4. Notably, there is a more substantial decline in investment (Panel a) and imports (Panel b).



(a) Exports (b) Government Expenditure

Figure 6: The Effects on Exports and Government Expenditure of a 10 Basis Point Increase in the Sovereign Risk

Notes: The figures show the local projection functions from Equation 4. Furthermore, the impact on exports (Panel a) and government expenditure (Panel b) is statistically insignificant.

8. Robustness Checks

In this section, I provide some robustness checks for the local projections of GDP. First of all, the model in Equation 3 uses a probit model. Therefore, here I use a logit model. Figure 7 shows the frequency of the estimated probability. The results are very similar to the probit model: the estimated probability density is skewed to the left.

Additionally, the results from the local projection (Figure 8) are similar to Figure 4a because the estimated density distributions have no significant differences. When sovereign risk rises by 10 basis points, GDP decreases 2% after the first two years, while the effect is not statistically significant after the third year. As argued above, the effect of sovereign risk on GDP is short-lived.

Also, I use 4 different definitions, as documented by Kuvshinov and Zimmermann [2019], of default as an alternative robustness check. The definition of Standard & Poors considers that a country is in default if the government fails to pay or the restructuring is disadvantageous to creditors [Balteanu and Erce, 2018]. Reinhart and Rogoff use a similar legal definition as the rating agencies. Moreover, Beim and Calomiris only consider payment delays greater than 6 months as default. Finally, Laeven and Valencia define default as a severe debt crisis.

Using these alternative definitions, Figure 10 shows that the cost of sovereign risk is more per- sistent and costly than the baseline model. The definitions of Beim and Calomiris (Panel 9a) and Laeven and Valencia (Panel 9b) result in real GDP costs as high as 5% and statistical significance after the 5th year. Also, using the definition of S&P (Panel 10a) the cost of sovereign risk could scale to 8% after the 7th year. Finally, under the definition of Reinhart and Rogoff (Panel 10b), the cost is 2-3%, which is consistent with Figure 4a.

In summary, the robustness checks are consistent with the baseline model, in the sense that, sovereign risk is costly in terms of GDP for different specifications. Nevertheless, in this Section, I find evidence of persistence costs. One branch of the sovereign debt literature has found that the cost of default is short-lived. Nevertheless, the results obtained here follow more recent studies, like Marchesi, Masi, and Bomprezzi (2023), that find long-run effects of default.

9. Conclusion

In this thesis, I analyzed the costs that sovereign risk imposes on the economy. To explore this question, I used a novel econometric approach that combines two stages. In the first stage, I calculated the probability of sovereign default by using a probit model. In the second step, I included the estimated probability in a local projections model that deals with the forbidden comparison bias. Using this methodology and the rich dataset of Kuvshinov and Zimmermann [2019], I found that GDP and consumption contract by 2-3% during the first two years. Also, the reduction in investment and imports is 5% during the same period. Finally, the effects on exports and government expenditure are statistically insignificant.

These results highlight the fact that sovereign risk is not just a financial indicator, but rather something that could affect negatively the consumption, production, and investments of a country. Moreover, because sovereign risk is costly, governments should take this into account when implementing fiscal policies and debt management decisions. As the Latin American debt crisis or the case of Greece shows, the lack of prudent fiscal policy could undermined the financial stability and economic growth of a nation.

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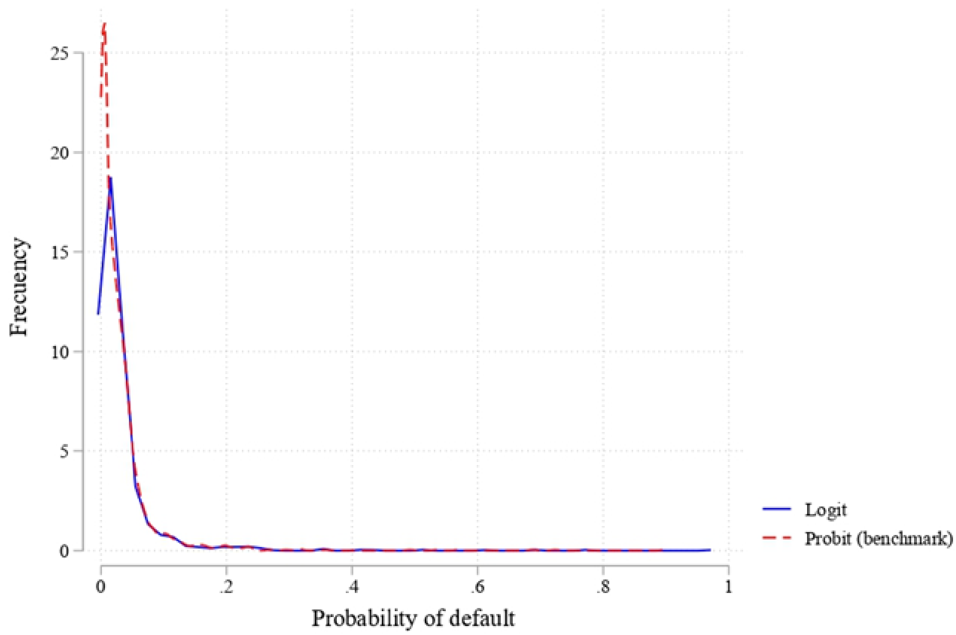


Figure 7: Logit Model of Default

Notes: This figure displays the frequency of the estimated probability of the logit model of Equation 3. It shows that the probit model assigns a low probability most of the time. Nevertheless, this probability increases in years of default.

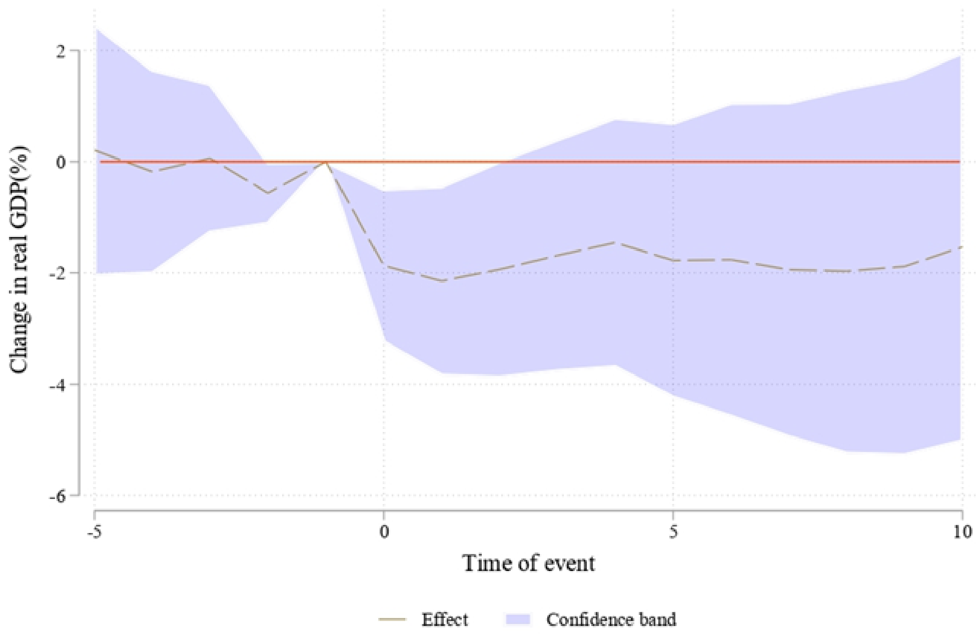
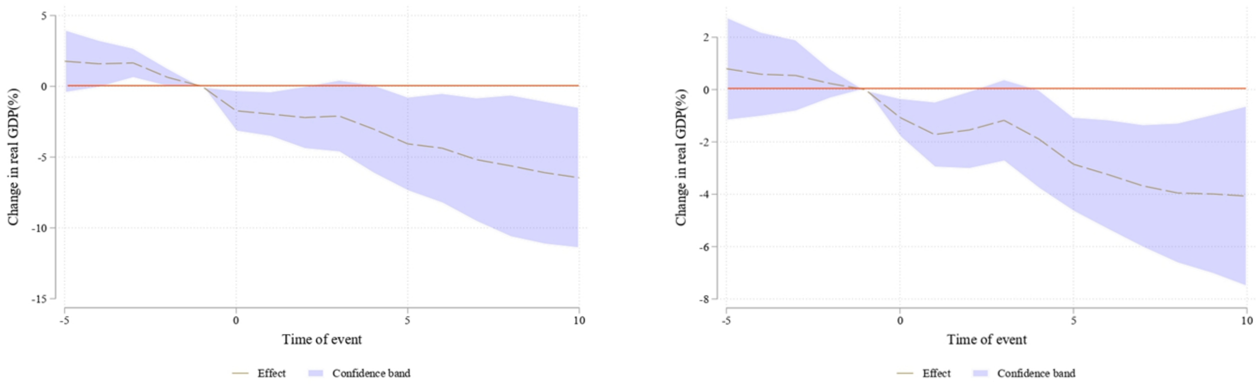


Figure 8: Results With Logit Specification

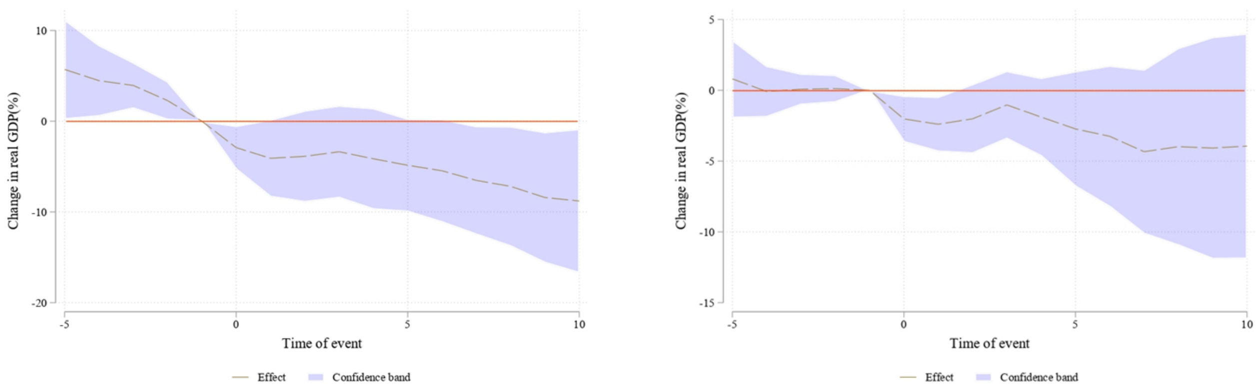
Notes: To plot this figure, I use a logit model to estimate the probability of default. When using this model in the first stage, the local projection shows a short-lived effect of an increase in sovereign risk.



(a) Beim and Calomiris (b) Laeven and Valencia

Figure 9: Robustness Check With Different Default Definitions

Notes: This figure illustrates the results of the local projections of Equation 4 for different definitions of default. The results are more persistent than in the baseline model.



(a) S&P (b) Reinhart and Rogoff

Figure 10: Robustness Check With Different Default Definitions (Continued)

Notes: This figure illustrates the results of the local projections of Equation 4 for different definitions of default. The results are more persistent than in the baseline model.

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