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Sovereign Debt Restructuring and Credit Recovery

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Abstract

This paper focuses on the significant growth of domestic credit once the debt is restructured and shows that is not correlated with the size of the haircut. Second, it performs an event study around Ecuador's sovereign default and restructuring of 2008-2009 to study changes in domestic bank lending behavior. After external debt restructuring, private lending increased the most for banks highly exposed to public debt. Finally, it provides a simple model were uncertainty about the return on government external debt during default has spillover effects on the domestic economy by creating dispersion in beliefs across domestic banks, which leads to a misallocation of credit. External debt restructuring eliminates domestic belief heterogeneity by making the return on bonds observable to everyone. This simple framing is not only consistent with the substantial growth in domestic credit upon debt restructuring but also with its independence from the haircut size observed in the data.

JEL Classifications: D8, E44, H63.

Keywords: Banks, Beliefs, Sovereign debt restructuring, uncertainty.

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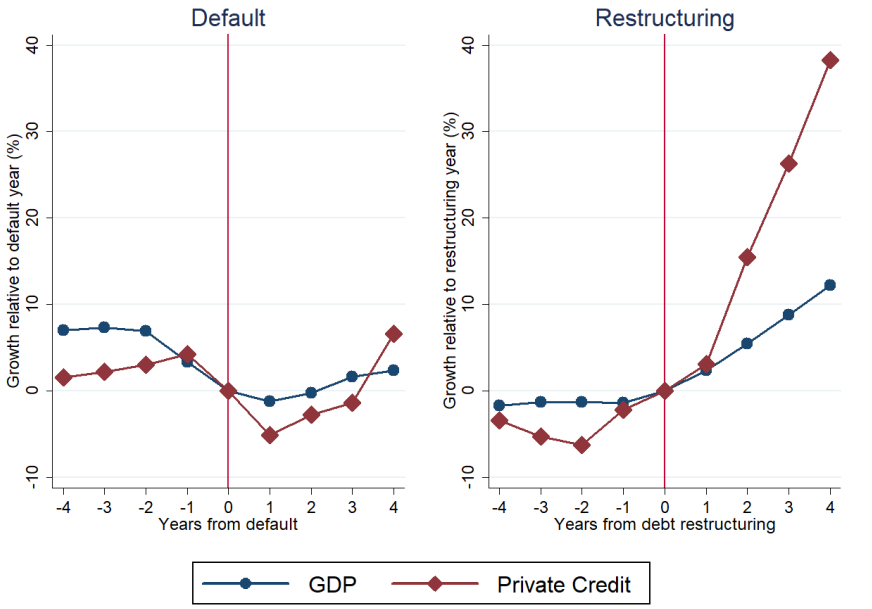
Figure 1: **GDP and Private Domestic Credit**



Note: The left (right) panel shows the cumulative growth with respect to the year of default (restructuring) for GDP and private domestic credit by banks. World Development Indicators annual data between 1980-2012 for 70 defaults and restructuring episodes from Benjamin and Wright (2009)

1 Introduction

Sovereign defaults are costly, with economic activity plunging at the time of default and then recovering at the end of the episode. These downturns are deeper when associated with a banking crisis where private credit falls substantially. This paper focuses on the significant growth in domestic credit once the debt is restructured. It first uses bank balance sheet data from Ecuador during its sovereign default and restructuring episode of 2008-2009 to study bank lending behavior. Then, this work proposes a simple model of belief dispersion to rationalize lending behavior and uses data on Ecuador to support key elements of the model

How does private lending respond to sovereign default and debt restructuring? The left panel of Figure 1 shows the well-known fact that upon default both GDP and private credit fall. The right panel draws attention to the rapid recovery of private credit once the debt is restructured. Countries only re-access international markets, on average, five years post restructuring (Cruces and Trebesch (2013)), thus borrowing from abroad cannot account for

this rapid growth. In addition, the growth in domestic credit is independent of the haircut size (see section 2).

Furthermore, the main finding of this paper is that after external debt restructuring, private lending increased the most for domestic banks that were highly exposed to public debt. To study bank lending behavior, this paper conducts and event study around Ecuador's 2008-2009 default and debt restructuring episode. This event provides a clean environment to study bank lending behavior for several reasons. First, different from most cases, Ecuador was not in a recession at the time of default. Second, the country did not regain access for international borrowing until 2014. Third, the economy was dollarized, so it was immune to fluctuations in exchange rates.

In the event study around debt restructuring the essential observable is bank exposure to government debt. To study the impact of debt restructuring on changes in bank lending behavior banks are first sorted according to their government debt holdings. The key empirical finding is that, after restructuring, private lending increased the most for banks that before default were highly exposed to sovereign debt. This sheds some light on the idea that restructuring provides a new environment that allows exposed banks to adjust their portfolio, improve their asset allocation and thus increase their lending.

Next, banks are sorted according to the purpose of their debt holdings. Banks hold government debt since they have lower credit risk and are more liquid than other assets in banks balance sheet. Public debt holdings are usually categorized into two groups: debt that is classified as *held-to-maturity* is usually held because of its safe asset characteristic, while assets classified as *available-for-sale* with the intention to be traded in the short term and valued for their their cash-like characteristic. This paper finds that, after external debt restructuring, banks that initially had large amounts of public debt held *for trading* motives increased their lending by more than those that did not have such amounts. This can be reconciled with the narrative that that banks holding government debt for trading purposes before default were interested in the cash-like characteristic of government debt which was lost during the default episode (due to lower market liquidity).[1] With debt restructuring, public domestic debt recovers

[1]Figure A.6 shows that bid-ask spreads (a measure of market illiquidity) spike during default but narrow after restructuring.

its liquidity allowing banks to reallocate their portfolio and increase private lending.

To rationalize the main empirical findings, this paper then proposes a new channel by which dispersion in the degree of optimism about public debt payoffs across domestic banks affects their lending behavior. External debt restructuring helps to reduce uncertainty on the value of domestic public debt by setting a haircut on external debt. This information reduces belief dispersion across domestic debt holders restoring the liquidity and cash like-characteristic of public debt. Thus, this allows for improvement in the allocation of credit. In addition, as long as beliefs become homogeneous, the allocation of resources is independent of the realization of the haircut.

Now, let's elaborate on the mechanism. In the model, domestic banks have to allocate resources to public and private lending. During default, there is uncertainty about the payoff of external debt which translates into uncertainty about the returns to domestic public debt. Domestic banks receive an exogenous shock which determines their lending productivity. Banks use their productivity shock as a private signal about the state of the economy. As a result of their information about the economy and belief updating, banks with higher productivity shock end up assigning a higher probability to states were the economy is doing better. Thus, more productive banks believe it is more likely for returns to government debt to be high, generating belief dispersion among domestic debt holders regards public debt returns. When allocating resources, banks equate the marginal returns to lending to the public and private sectors. Differences in expected bond payoffs across banks translate into dispersion in their marginal productivities, just as idiosyncratic distortions work in the misallocation literature (Hsieh and Klenow (2009),Restuccia and Rogerson (2013)). In addition, the positive correlation between banks' productivity and expected bond payoffs magnifies these distortions: high productive banks move away from financing large scale projects into public debt holdings instead. After debt restructuring, banks can observe the return to public debt, which eliminates beliefs dispersion. Hence, there is reallocation of resources, increasing private lending. Finally, I use data from Ecuador during the sovereign default of 2008-2009 to support the key elements of the stylised model: uncertainty and dispersion in beliefs.

1.1 Related Literature

Sovereign defaults are costly. They are associated with at least a 2% drop in output that can reach up to almost 9% when associated with a banking crisis (De Paoli et al., 2009; Trebesch and Zabel, 2017; Sandleris, 2016; Kuvshinov and Zimmermann, 2019). As regards debt restructuring, Forni et al. (2020) and Das et al. (2012) conclude that countries after a final debt restructuring have a substantial growth in economic activity. The fall in private credit during a debt crisis has been documented by Gennaioli et al. (2018), Acharya et al. (2018), Bofondi et al. (2017) and Popov and Van Horen (2015) among others. The contribution to this strand of the literature is to document and analyze the substantial growth in domestic private lending after debt restructuring and its independence from the haircut size.

Also, there are papers studying debt restructuring and their relationship with economic costs through different channels such as trade and bank intermediation (Asonuma et al. (2016), Asonuma et al. (2017)). In the latter, authors find that financial intermediation plays a prominent role even when a sovereign restructures private external debt, which is typically not held by domestic banks. By using a particular case of external debt restructuring, this paper complements with Asonuma et al. (2017) showing changes in domestic bank lending behavior during the restructuring episode. While restructuring debt prior to default might be desirable (Asonuma and Trebesch (2016)) many times this does not happen, and post default restructuring becomes a lengthy process. This paper focuses on debt restructuring post default showing the domestic incentives to restructure promptly, since highly exposed banks to public debt increase their lending the most.[2] From a theoretical perspective, in the debt restructuring literature the benefit from exiting default is mainly driven by access to trade credit, foreign lending, and foreign direct investments. However, the fact that being in default is costly is taken as given and this literature builds upon understanding what causes the delay in reaching an agreement as in Pitchford and Wright (2007) and Benjamin and Wright (2009). This paper takes restructuring as exogenous and shows how it would allow for a better allocation of domestic resources.

Quantitative models in the sovereign default literature that include strategic default in the spirit of Eaton and Gersovitz (1981) (EG), such as Arellano (2008), Aguiar and Gopinath (2006),

[2]Focusing on default, and not restructuring episode, Gennaioli et al. (2018) have shows that within a country and during a default year, bank's holdings of sovereign bonds correlate negatively with subsequent lending.

Hatchondo and Martinez (2009) and Yue (2010) among many others, need to include an output cost at the time of default besides international market exclusion in order to match certain moments such as spreads and default frequencies. This approach has lead to a new branch of the literature that nests the endogenous cost of default motives in the standard EG framework. For example, Mendoza and Yue (2012) explain the domestic cost with a misallocation of labor across sectors given imperfect substitution between domestic and foreign inputs. Others such as Sosa-Padilla (2018), Gennaioli et al. (2014), D'Erasmo and Mendoza (2016), and Perez (2015) associate this cost with disruption of the banking system that is transmitted to the real economy. In particular, Bocola (2016) argues that an increase in the probability of defaults reduces banks' funding ability in addition to demanding higher returns from firms due to higher risk. Engler and Steffen (2016) suggest that government bonds are used as a collateral, therefore a default reduces banks' borrowing and thus lending resources. Common across these papers is that the main mechanism by which government default affects the banking system is by reducing the net worth of banks holding these assets. Although this mechanism seems very appealing to explain output cost of the default, it is not yet clear how ending the default period would stir up domestic lending or resolve banks' reduced net worth—besides offering benefits from new sovereign and private borrowing from abroad. In addition, the mechanism generates correlation between the haircut size and the fall in private lending. This paper provides a different channel for reconciling the growth in credit after debt restructuring and it has no correlation with haircut size. In particular, banks' heterogeneous beliefs about bonds payoffs result in lower credit during default.

Some papers have dug deeper into the separation between domestic and external defaults such as Erce and Mallucci (2018), Bocola et al. (2019) and Paczos and Shakhnov (2018) optimizing debt issuance and default decisions. Differently, this paper leaves aside optimization and provides an alternative mechanism to understand how a default on external debt can have domestic implications.

As regards the relationship between liquidity and default, Passadore and Xu (2022) introduce liquidity risk into the pricing of government bonds in an EG framework, which contributes to better matching the data from default episodes. Perez (2015) proposes that default can affect the government's ability to provide liquidity and studies how this affects sovereign default

decisions. Although this paper does not model strategic default decisions as Perez (2015), both papers have in common that default induces a worse allocation of resources since low-productivity banks move away from public debt holdings into their own projects. In Perez (2015), upon restructuring, the government recovers its ability to provide liquidity domestically by issuing new public debt. Differently in my setting, access to new public debt is not necessary to improve the allocation of resources. Debt restructuring provides public information, which eliminates dispersion in beliefs. This triggers trading of government bonds, which allows banks to adjust their portfolios, improving the allocation of resources and thus increase total lending.

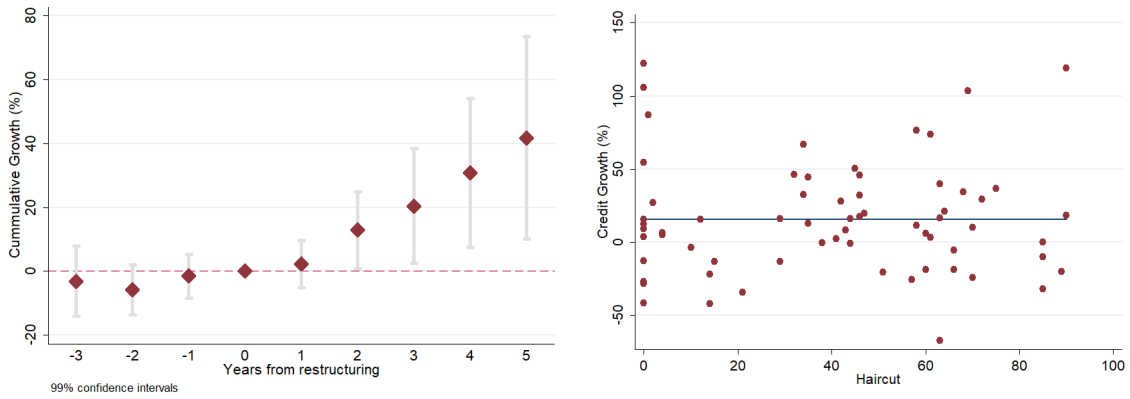
Finally, this paper is also related to sovereign debt and information. News shocks affect equilibrium outcomes because they contain information about the future ability of the government to repay its debt Durdu et al. (2013). In these lines, Dvorkin et al. (2020) show how credit risk dynamics depends on the information precision and maturity structure of sovereign debt. Dovis (2019) shows that government private information about the realizations of a productivity parameter can rationalize periods of exclusion after default, Bai and Zhang (2012), Asonuma and Joo (2020), and Asonuma and Joo (2019) study the role of information in the renegotiation process. In this literature information differences arise between the sovereign and lenders (either domestic or foreign). This paper leaves aside the borrower-lender debate to focus heterogeneity in beliefs *within domestic lenders* and its effect on domestic investment.

The paper is organized as follows. Section 2 provides cross-country evidence of domestic credit growth after debt restructuring. Section 3 focuses on Ecuador 2008-2009 default and restructuring to study bank lending behavior upon debt restructuring, showing that banks exposed to public debt see their lending increase the most. Section 4 presents a mechanism that could rationalize findings from the previous sections. Next, using data from Ecuador, section 4.6 provides empirical evidence to support the model. Finally the paper concludes with with section 5.

2 Cross-Country Evidence

Using cross-country data for 70 countries that defaulted and restructured their debt between 1980 and 2012, this section documents significant growth in domestic credit post restructuring

Figure 2: **Domestic Private Credit Growth**



Note: Default and debt restructuring events from Benjamin and Wright (2009) between 1980 and 2012. Bank domestic credit to the private sector from World Development Indicators. Growth rates are relative to the debt restructuring year. Confidence intervals at 99%.

and that this growth is not correlated with the size of the haircut.

To start with, the left panel of Figure 2 shows that domestic credit grows significantly post restructuring: two years after a country exits the default episode, private credit is on average 15% larger. Importantly, this growth is positive and significantly different from zero at the 99% confidence interval.[3]

Secondly, the substantial increase in domestic credit seems not to be related to the size of the haircut as shown on the right panel of Figure 2. The measure for the haircut is taken from Cruces and Trebesch (2013). Table 1, using two different measures of haircut—one from Cruces and Trebesch (2013) and the other from Benjamin and Wright (2009)—shows that effectively there is no correlation between domestic credit growth post restructuring and haircut size.[4] This finding is also robust to looking at the credit to GDP ratio or using other measures for domestic credit (see Table 1 in the Appendix). This paper provides a simple theory that is consistent with this evidence. In particular, the elimination of belief dispersion across domestic agents upon debt restructuring allows for an improvement in the allocation of resources.

[3]Figure A.1 in the appendix shows that this increase is also robust when looking at domestic credit to GDP ratio or a different measure for domestic private credit.

[4]Benjamin and Wright (2009) combine World Bank estimates of the reduction in the face value of the debt with estimates of the forgiveness of arrears on interest and principle. The Cruces and Trebesch (2013) database uses the Sturzenegger and Zettelmeyer (2008) haircut measure (SZ haircut), which is 1 minus the present-value of new debt over the present value of old debt, both discounted at the same rate. The main difference is that in the second measure old debt instruments are not taken at face value but computed in present value terms and discounted at the same rate as the new debt instruments.

Table 1: Haircut and credit growth

	Credit Growth		**Credit/GDP Growth**	
$Haircut_{BW}$	0.0001		0.0001	
	[0.980]		[0.959]	
$Haircut_{SZ}$		-0.1038		-0.0466
		[0.601]		[0.784]
Constant	0.1555	0.1913	0.0895	0.1067
	[0.113]	[0.158]	[0.282]	[0.353]

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

3 Ecuador 2008-2009

This section studies bank lending behavior during the default and debt restructuring episode in Ecuador in 2008-2009. I first describe the economic context and the data. Second, I perform an event study around debt restructuring to study bank lending behavior according to their holdings of public debt (Section 3.1.1) as well as the purpose of these holdings (Section 3.1.2). The main takeaway is that, after restructuring, private lending increased the most for banks that before default were highly exposed to sovereign debt. Furthermore, after restructuring, banks that initially had large amounts of public debt held *for trading* motives increased their lending by more than those that did not have such amounts. Both findings motivate the idea that debt restructuring provides a new environment that allows exposed banks to adjust their portfolio, improve their asset allocation and thus increase their lending.

In December 2008, Ecuador defaulted on two external government bonds: Global 2012 and Global 2030 (Gulati and Buchheit (2009)). Interestingly, different from most cases of default, Ecuador was not in a recession. The main reason for the default was that these bonds were considered illegitimate since they were said to be issued under completely unfavorable terms for Ecuador but favorable terms for particular political groups at the time of issuance.[5] In June 2009 Ecuador restructured two of the three external bonds (making no changes to Global

[5]When elected in 2006, President Correa created a special committee to analyze the legitimacy of all the debt issued in the previous period. Two bonds where proved to be illegitimate by this committee.

2015). The government bought a large amount of the defaulted external debt at 35% of its face value. What is also interesting about this episode is that Ecuador remained excluded from international markets and could not issue new debt until 2014.

Ecuador was not in a recession at the time of default. First, this is important since it allows me to step away from the feedback loop between default and business cycle. Second, the fact that the country was excluded from international borrowing until 2014 provides a setting where a change in domestic private lending after the debt was restructured cannot be addressed by changes in borrowing from abroad. Last but not least, Ecuador's economy was dollarized since March 2000 with the objective of stabilizing the country's currency after a large devaluation of almost 60% during the 1999 crisis. This allows me to abstain from considering changes in bank balance sheets due to changes in the currency they are denominated in. Overall, this particular case provides a relatively clean environment to study the changes in banks balance sheets during the default and debt restructuring episode.

As shown in the right panel of Figure A.6, private lending provided by the banking sector fell substantially with the default episode. However, it immediately increased once the country exited default.

Data: I use monthly disaggregated bank balance sheet data for all private banks (28 banks) in Ecuador for 2006-2012, provided by *Superintendencia de Bancos de Ecuador*.[6] They represent 80% of all financial sector in Ecuador and account for most of the public debt held by domestic agents.

3.1 Event Study: Ecuador Debt Restructuring in June 2009

3.1.1 Lending and Exposure to Government Debt

I perform a monthly event study around the restructuring episode in June 2009. I separate the sample into two groups: banks which in the first half of 2008 (before the default) held government debt to assets above the median (5%) and those that held such below the median. I look at the growth in loans with respect to the restructuring month, June 2009. The reason for this grouping is that banks with high holdings of government debt were more exposed to payoff

[6]The panel is incomplete and for some analysis I do not have information for a few small banks

uncertainty. While the default was on external debt, differentiated behavior among banks highly (and minimally) exposed to public debt suggests spillover effects from external debt restructuring into domestic financial intermediation. This finding is consistent with Asonuma et al. (2017) results, were domestic financial intermediation plays a prominent role even when a sovereign restructures private external debt. This section conveys that first, banks highly exposed to government debt increased their lending relative to the control group. And second, that the mechanism behind this result is a reduction in their holdings of government debt.

First, these two groups evolved similarly before the default episode. Figure A.7 shows the evolution of deposits, net worth, assets, and loans before the default episode for these two groups. I cannot statistically reject that these two groups behaved similarly prior to the default.

Second, Figure A.8 shows that once the debt was restructured, private lending increased more for banks highly exposed to government debt relative to banks unexposed. This figure plots the difference in loan growth for these two groups (highly exposed minus unexposed banks). The gap in loan growth is statistically different from zero a few months after the restructuring of the debt. Growth differences for other variables such as deposits, assets, and or net worth are not statistically different between the two groups.

To further test for the increase in private lending for highly exposed banks, I estimate the following regression:

$$\Delta\text{Loans}_{i,t} = \beta_1 \mathbb{I}\left\{B_0 \geq \bar{B}\right\} + \beta_2 \mathbb{I}\left\{t \geq t_{\text{R}}\right\} + \beta_3 \left(\mathbb{I}\left\{B_0 \geq \bar{B}\right\} \times \mathbb{I}\left\{t \geq t_{\text{R}}\right\}\right) + \alpha \mathbf{X}_{i,t} + \gamma_t + \epsilon_{i,t}$$

where the dependent variable is the cumulative growth in loans for bank i at time t with respect to the time of the debt restructuring, $\Delta\text{Loans}_{i,t}$. The explanatory variables are a dummy that takes the value of 1 if the public debt to assets ratio is above the median $\mathbb{I}\left\{B_0 \geq \bar{B}\right\}$, a dummy that takes the value of 1 after the debt has been restructured and 0 otherwise $\mathbb{I}\left\{t \geq t_{\text{R}}\right\}$, the interaction term between these two dummies, and a vector of controls $X_{i,t}$ (assets, deposit to asset ratio, and loans to asset ratio) as well as time fixed effects γ_t.

The main variable of interest is the interaction term between the dummy for restructuring and the dummy for the highly exposed banks, β_3. A positive value implies that banks with large amounts of government bonds before default increased lending more after restructuring

Table 2: **Lending Behavior of Banks Highly vs Non Exposed to Government Debt**

	ΔLoans			
$\mathbb{I}\left\{B_0 \geq \bar{B}\right\}$	0.0012	-0.0033	-0.0167	-0.0186
	[0.963]	[0.441]	[0.643]	[0.256]
$\mathbb{I}\left\{t \geq t_{\mathrm{R}}\right\}$	0.0326	0.0292	-0.0728	0.0363
	[0.456]	[0.514]	[0.159]	[0.413]
$\mathbb{I}\left\{B_0 \geq \bar{B}\right\} \times \mathbb{I}\left\{t \geq t_{\mathrm{R}}\right\}$	0.0531***	0.0531***	0.0704**	0.0553***
	[0.000]	[0.006]	[0.034]	[0.001]
ROE7	-0.0012		-0.0006	0.0002
	[0.737]		[0.887]	[0.865]
Δ assets			-0.3676	
			[0.671]	
Δ deposits			0.7316	
			[0.310]	
Δ cash			-0.0565	
			[0.446]	
Δ govt bonds			-0.0068**	
			[0.042]	
capital to assets		0.0869		0.3593*
		[0.731]		[0.060]
deposits to assets				0.2156**
				[0.039]
cash to assets				-0.4009***
				[0.005]
Observations	437	475	387	437
R-squared	0.117	0.126	0.278	0.243

Time FE, Robust pval in brackets, *** p<0.01, ** p<0.05, * p<0.1

Note: Difference in lending behavior across banks holding high versus low government debt to assets in the first half of 2008. Δ X is the growth in X with respect to the time of the debt restructuring, $\mathbb{I}\left\{B_0 \geq \bar{B}\right\}$ *is a dummy variable equal to 1 if the public securities to assets ratio is above the median (highly exposed banks) and zero otherwise (non-exposed banks), and* $\mathbb{I}\left\{t \geq t_R\right\}$ *is a dummy variable that takes the value of 1 after the debt has been restructured and 0 otherwise.*

relative to the control group. The third row of Table 2 shows that β_3 is positive and significant, supporting the main empirical hypothesis. This result is robust to several specifications. The first two columns control for profitability and the capital to assets ratio, to take into account the productivity as well as the leverage of banks. To have an exogenous measure of profitability to the default and restructuring period, I use the average return on equity for each bank in 2007, $ROE7$, which is prior to the period analysed.

The third column controls for changes in assets, deposits, cash, and government debt held by banks. This specification controls for possible change in loans due to changes in other variables. For example, this captures changes in deposits after the debt was restructured due to higher consumer confidence or a possible increase in cash holdings due to higher liquidity needs. The last specification controls for bank characteristics such as leverage, the deposit to assets ratio, and the liquidity ratio. The coefficient on changes in government bonds is negative and significant. This implies that banks that reduced their government debt holdings increased their loan growth. This suggests that highly exposed banks increased their private lending by selling government bonds. Figure A.9 provides further evidence to support the mechanism behind changes in lending.

It is worth mentioning that the current data set does not allow for a distinction between domestic and external public debt held by domestic banks. Still, domestic public debt represented 23% of all Ecuador's debt (prior to default),and restructured debt represented 23% of Ecuador's total public debt.[7] Overall, these findings suggest that external debt restructuring has implications for domestic banks. Either directly—in the case of domestic banks banks holding external debt—or indirectly—through possibly the change in expected value of domestic public debt. [8] In particular, debt restructuring provides a new environment that allows highly public debt exposed banks to adjust their portfolio and increase their private lending.

[7]In January 2008 Ecuador's government debt was composed by: domestic debt (3,183 millions USD), debt with international organizations (4,560 million USD), debt with foreign governments (1,691 million UDS), external debt through banks and bonds (4,132 million). Out of these 3,210 million USD correspond to GLOBAL 2012 and GLOBAL 2030. (See https://www.finanzas.gob.ec/deuda-publica/ for a detailed inventory.)

[8]Also, given the selective decision of which bonds to default upon, it would be hard to believe that Ecuador's government would decide to default on external bonds primarily held by domestic banks.

3.1.2 Lending and Purpose of Public Debt Holdings

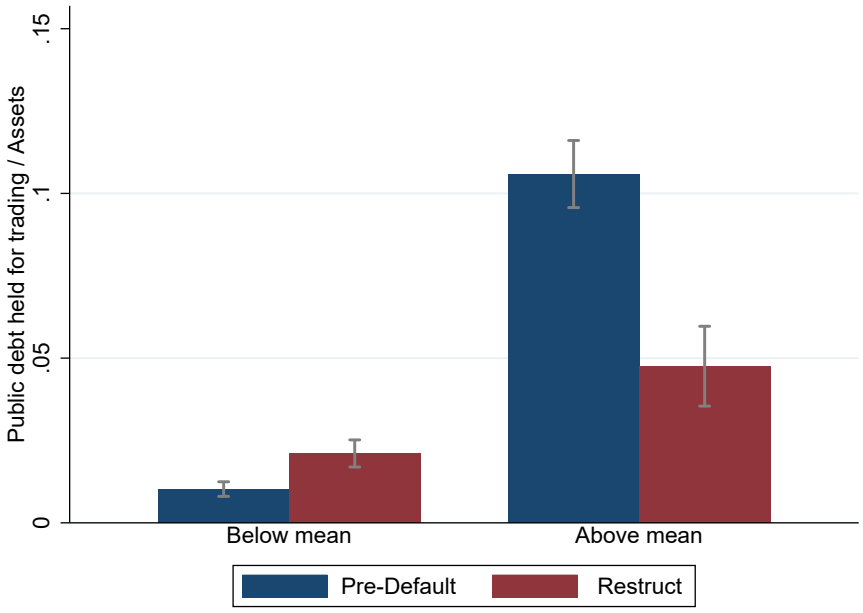
In this section, banks are sorted according to the purpose of their debt holdings. In normal times, banks hold government debt since they have lower credit risk and are more liquid than other assets in banks balance sheet. Public securities in bank balance sheet data appear separated into two categories: *available-for-sale* and *held-to-maturity*. Assets are classified at the time they are acquired and are assigned into either of these two categories according to the intention to be sold or to be held until they mature. This classification is to be made on the date of purchase of the security, and it is irreversible in principle (Huizinga and Laeven (2012)). Similar to standard bank valuation and accounting of securities, Ecuador's Superintendencia de Bancos determines that the best fair value of assets classified as *available-for-sale* is given by market value excluding transaction costs. On the other hand, *held-to-maturity* securities should be incorporated at fair value including transaction costs of acquisition and be carried at amortized cost.

This section finds that, after restructuring, banks that initially had large amounts of public debt *available-for-sale* increased their lending by more than those that did not have such amounts. A possible explanation for this finding could be that banks holding government debt for trading purposes before default were interested in its cash-like characteristic. Government bonds held for trading were meant to be sold in the short term. However, right after the default, banks were not able to trade these assets due to low market liquidity. As soon as these assets recovered their liquidity banks were able to easily adjust their portfolios by selling some of these securities and increasing private lending.[9]

Public securities *available-for-sale* involve securities that are held for an undetermined amount of time or for trading motives. These assets are usually classified in this way because banks are interested in their cash-like characteristic. Public debt *held-to-maturity* involves assets that are intended to be kept until they mature. These are usually held because of assets' safety of low-risk-characteristic. Assets held-to-maturity, in principle, are not be traded and are kept in banks' balance sheet until they mature, while assets intended to be sold at some point

[9]While data on domestic debt liquidity is unavailable up to my knowledge, left panel of Figure A.6 shows that external debt liquidity fell for all GLOBAL bonds (defaulted and not defaulted) and that their liquidity returned to prior levels after debt was restructured.

Figure 3: **Government debt held for trading to total assets**



Note: Evolution of government debt held for trading to total assets. Separated by high and low holdings previous to the default episode.

are not to be classified as held until maturity. Figure 3 shows that banks with initially large possessions of bonds for trading purposes reduced their holdings after restructuring, while those with low possession increased their holdings. Second, Figure A.10 (in the appendix) shows the difference in loan growth after restructuring across the two groups. Banks with large possession of government debt for trading purposes increased their lending by more than those in the control group. The difference in behavior between these two groups is statistically significant.

I perform a regression analysis to formally test the lending behavior of banks with different holdings of bonds for trading purposes:

$$\Delta \text{Loans}_{i,t} = \beta_1 \mathbb{I}\left\{T_0 \geq \bar{T}\right\} + \beta_2 \mathbb{I}\left\{t \geq t_{\text{R}}\right\} + \beta_3 \left(\mathbb{I}\left\{T_0 \geq \bar{T}\right\} \times \mathbb{I}\left\{t \geq t_{\text{R}}\right\}\right) + \alpha \mathbf{X}_{i,t} + \gamma_t + \epsilon_{i,t}$$

where $\mathbb{I}\left\{T_0 \geq \bar{T}\right\}$ is a dummy variable that takes the value of 1 if the ratio of public debt held for trading to total securities is above the mean (15%). For consistency, I control for the same variables as before and for time fixed effects. Once again the main variable of interest is the interaction term, β_3.

Table 3: **Lending Behavior of Banks with High vs Low Holdings of Public Debt for Trading**

	ΔLoans			
$\mathbb{I}\left\{T_0 \geq \bar{T}\right\}$	0.0479	0.0019	0.0210	0.0192
	[0.347]	[0.887]	[0.283]	[0.298]
$\mathbb{I}\left\{t \geq t_{\mathrm{R}}\right\}$	0.0420	0.0299	-0.0382	0.0444
	[0.498]	[0.611]	[0.195]	[0.464]
$\mathbb{I}\left\{T_0 \geq \bar{T}\right\} \times \mathbb{I}\left\{t \geq t_{\mathrm{R}}\right\}$	0.0349***	0.0575**	0.0333*	0.0403**
	[0.000]	[0.016]	[0.091]	[0.020]
ROE7	-0.0020		-0.0007	-0.0008
	[0.614]		[0.347]	[0.666]
Δ assets			-0.4207	
			[0.579]	
Δ deposits			0.5642	
			[0.414]	
Δ cash			-0.0653	
			[0.250]	
Capital to assets		0.0588	0.1171	0.3154
		[0.618]	[0.483]	[0.156]
Deposits to assets				0.2246
				[0.209]
Cash to assets				-0.3950
				[0.115]
Observations	437	475	437	437
R-squared	0.151	0.132	0.245	0.249

Time FE, Robust pval in brackets, *** p<0.01, ** p<0.05, * p<0.1

Note: Difference in lending behavior across banks holding high versus low ratios government debt for trading to total securities in the first half of 2008. Δ X is the growth in X with respect to the time of the debt restructuring, $\mathbb{I}\left\{T_0 \geq \bar{T}\right\}$ is a dummy variable equal to 1 if the public securities held for trading to total securities ratio is above the mean (high) and zero otherwise (low), and $\mathbb{I}\left\{t \geq t_R\right\}$ is a dummy variable thar takes the value of 1 if is after the debt has been restructured and 0 otherwise.

The third row of Table 3 shows that β_3 is a positive and significant coefficient. This implies that loan growth was higher post restructuring for banks that prior to default had large possession of government debt available-for-sale relative to possessions of the control group, providing further support for the second hypothesis. The intuition behind this results is that banks with public debt held for trading motives, post restructuring, were able to easily adjust their portfolio and increase their lending. These banks were interested in the liquidity, or cash-like, characteristic of these assets. On the other hand, banks with low levels of debt for trading motives were less affected by the reduced liquidity of public debt since they would have not traded these assets anyways. Once external debt was restructured and the uncertainty resolved, government assets recovered their liquidity and thus banks with public securities for trading purpose were able to easily adjust their portfolios and consequently increase their lending by more than those in the control group.

To sum up, this empirical section provides evidence supporting the narrative that external debt restructuring has spillover effects on domestic private lending. First, once external debt is restructured, banks highly exposed to government debt increase their lending by more than unexposed banks. To achieve this, they reduced their relative holdings of government debt. Second, banks in possession of public debt for trading motives also significantly increased their lending compared to those that intended to hold public assets until maturity. This evidence, speaks to government debt being (among other reasons) held for its cash-like characteristic. An external default episode has spillover effects on domestic public debt. Domestic public assets become more risky and lose their function of providing liquidity to banks. Upon debt restructuring, public debt recovers its cash like characteristic, allowing highly exposed banks to adjust their portfolios easily and increase lending to the private sector.

Similarly to Perez (2015), this paper proposes that default reduces the liquidity provision of public debt. Additionally, both papers have in common that default induces a worse allocation of resources since low productive banks move away from public debt holdings into their own projects. The key difference is that while in Perez (2015) upon restructuring the government recovers its ability to provide liquidity domestically by issuing public debt. Differently in my setting, access to credit is not necessary to improve the allocation of resources. Debt restructuring provides public information which eliminates dispersion in beliefs. Thus government bonds

trading resumes, allowing banks to adjust their portfolios and increase lending.

4 Model

To rationalize the main empirical findings, this paper proposes a new channel by which external sovereign's debt uncertainty creates dispersion in the degree of optimism about domestic public debt payoff across domestic banks. These beliefs affect banks' lending behavior. In this simple model, external debt restructuring reduces the uncertainty on the value of domestic public debt and thus belief dispersion. This restores the liquidity and cash like-characteristic of public bonds and allows for improvement in the allocation of credit. In addition, as long as beliefs become homogeneous, the allocation of resources is independent of the realization of the payoff. Sections 4.1 and 4.2 set the framework. Sections 4.3 and 4.4 provide equilibrium solution and results, followed by 4.5 which explains impact of the resolution of the uncertainty through debt restructuring. Finally section 4.6 provides some empirical support for key elements of the model.

4.1 Environment

Domestic banks are the main economic agents in this economy. Each bank is risk neutral and has the same amount of wealth at the beginning of the period: capital k_0 and public debt b_0. The model has two periods, and banks choose lending to the private sector and government in order to maximize their end-of-period expected net-worth. The government has already defaulted on its external debt, and banks hold public domestic debt for which there is uncertainty about the value of these assets. There exists fear that the government could impose a haircut on domestic debt, or that a haircut on external debt could reduce the value of domestic debt. Thus, the return on domestic debt once external bonds are restructured, R, is exogenous and stochastic. We can interpret R as the resale value of these domestic assets in the next period, which can either be high R^H or low R^L, depending on the size of the external haircut or restructuring outcome.

Domestic banks can also lend to the domestic private sector by choosing k. Banks have

an idiosyncratic productivity A, so the return to private lending is $f(A,k) = Ak^{\alpha}$.[10] Banks cannot borrow from one another but can exchange their government debt for capital at price $1/q$, which is endogenous.

Banks maximize their end-of-period expected networth $E[Ak_1^{\alpha} + Rb_1]$ by choosing to lend to the private and public sectors, k_1, b_1, respectively. In addition, banks cannot issue public bonds. The banks problem is

$$\max_{b_1,k_1} Ak_1^{\alpha} + E\left(R\right) b_1$$

$$\left(k_1 - k_0\right) + \left(b_1 - b_0\right) q = 0$$

$$b_1 \geq 0$$

The aggregate state of the economy is given by $x \sim N(\bar{A}, \sigma_x^2)$, which is related to aggregate productivity, and $z \sim N(0, \sigma_z^2)$, which is related to noise on public information (described later). The payoff on domestic public debt can be either high or low. This captures, for example, spillovers to domestic debt value from a small or a large haircut after debt restructuring respectively. The probability that the payoff is high increases with the productivity of the economy x. This assumption captures the idea that if the economy is doing well, the government's investments are more profitable and thus, more likely that the government can pay back higher returns on its domestic and external debt. Another interpretation is that if the economy is doing better, the government can collect higher taxes and therefore be more capable of paying a higher return on its obligations. In particular, let $\pi_x = Pr(R = R^H|x) = F(x)$, with $F(x) \in [0,1]$ increasing. Thus, the expected payoff of government debt is $E_x(R) = \pi_x R^H + (1-\pi_x)R^L$, which is increasing in x.

[10]Some banks are more productive than others in their private lending activities, either because of their loan portfolio allocation, relationship with borrowers, market share, industry they lend to, location of the branches, risk management, among others. When looking into bank balance sheet, total loans include not only the money initially lent (k) but also, interest rates, maturity, expected losses, etc. In this paper I am not modeling the portfolio allocation of credit to the private sector. I take as given that the production of credit given k for a bank ends up being Ak_1^{α}. In other words, lending interest rates, maturity, risk and losses, all are part of Ak_1^{α}

4.2 Information

Each bank receives an idiosyncratic productivity shock a which determines the bank's productivity given by $A = G(a) \in [0, B]$—bounded and increasing. Banks cannot observe the aggregate state of the economy, however they do observe s with $s = x + z$, and $z \sim N(0, \sigma_z^2)$ which is a common signal about the aggregate state. The signal s summarizes all the information that banks could obtain from observables such as media, government speeches and prices. This signal is a way of aggregating all public information available to banks. In addition, banks use their productivity shock as a private signal about the aggregate state. In particular $a = x + \epsilon_a$, with $\epsilon_a \sim N(0, \sigma_a^2)$. Banks use their private and public signals to learn about the true state of the economy.

I model the public signal s as a reduced form to allow some information about the economy to be commonly observed by all agents. However, I assume that banks cannot extract additional information from observing prices or other observables since that information is already contained in s.[11] During default episodes, high uncertainty can lead to price volatility and, thus making it hard for agents to extract information.[12] Also, there are several reasons to believe that traders can also misinterpret the information that prices convey. First, there are theoretical models showing that if agents are not fully rational or fully myopic (a cursed equilibrium), the information in prices may not be fully appreciated or misinterpreted (Mondria et al. (2022); Eyster et al. (2019)).[13] Second, there are lab experiments showing the existence of cursed beliefs (Biais et al. (2005); Corgnet et al. (2015)). Third, there is empirical evidence using real market data showing that individual investors neglect that prices contain information (Chague et al. (2018)). Moreover, during default episodes, uncertainty spikes and it is very hard to extract information from prices. Thus, I do not take a particular stance on what exactly drives this misperception of market price. Instead, I model a public signal as a reduced form to incorporate that some information about the economy can be commonly observed by

[11] This assumption is similar to adding noisy traders as in Grossman and Stiglitz (1980) and allow banks to filter information from prices. Please refer to appendix A.2 for an outline of the framework. During default period, there is a lot of uncertainty and thus market price precision would be low.

[12] For price dispersion please see Table 5 in the empirical section.

[13] Prices could also confer noisy information about fundamentals if traders overestimate their signal (Daniel et al. (1998); Odean (1999) or underestimate the precision of others signals Odean (1999); Banerjee et al. (2009); Banerjee (2011); Banerjee and Kremer (2010) or if traders believe that others signals are correlated.

all agents. The empirical section shows that during default there is a lot of uncertainty and price volatility (Table 5). Thus, it is hard to extract any information about fundamentals from prices. The larger σ_z^2 is, the less informative the public signal is.

After observing a and s, the conditional distribution of x is also normal $x|a,s \sim N(\mu_{x|a,s}, \sigma^2_{x|a,s})$, with

$$\sigma^2_{x|a,s} = \left[\frac{1}{\sigma_x^2} + \frac{1}{\sigma_a^2} + \frac{1}{\sigma_z^2}\right]^{-1}$$
$$\mu_{x|a,s} = \left[\frac{\bar{A}}{\sigma_x^2} + \frac{a}{\sigma_a^2} + \frac{s}{\sigma_z^2}\right]\sigma^2_{x|a,s}$$

Thus, the conditional mean of x is increasing in a.

Banks are not interested in knowing the true state x but in knowing the return on bonds. Banks use their private and public signals to update their beliefs on the probability of the return on bonds being high (π_x). Define the updated probability that the return on bonds is high given private (a) and public (s) signals as

$$\pi(a,s) \equiv E\left[\pi_x|a,s\right]$$
$$\pi(a,s) = \int F(u)\phi_{x|a,s}(u)du$$

Lemma 1: $\pi(a,s)$ is increasing in a. (Proof in the Appendix)

Banks with higher productivity are optimistic about the aggregate state and thus expect a high return on government bonds as well. Therefore, there is a positive correlation between banks' idiosyncratic productivity and beliefs about the expected bond payoff. In other words, $E(R|a,s) = \pi(a,s)R^H + (1-\pi(a,s))R^L$ is increasing in a.

4.3 Equilibrium

An equilibrium in this setting is a price $q(x,z)$ for each state of the world x,z such that given this price the following occur:

- Banks maximize their end-of-period networth given their lending productivity $G(a)$, private and public signals $\{a, s\}$, and endowment of capital and bonds:

$$k^*(a,s) = \left[\frac{\alpha G(a) q}{E(R|a,s) + \lambda}\right]^{(1/(1-\alpha))} \tag{1}$$

$$b^*(a,s) = b_0 + \frac{k_0 - k^*(a,s)}{q} \tag{2}$$

  where λ is the Lagrange multiplier on $b_1 \geq 0$.

- The bond market clears:

$$\int (b_1(a) - b_0(a))\, dF(a) = 0$$

4.4 Results

This section shows that belief dispersion is costly, that this cost is increasing in the level of uncertainty about the public debt payoff, measured as the difference between R^H and R^L, and explains the key mechanism behind this.[14]

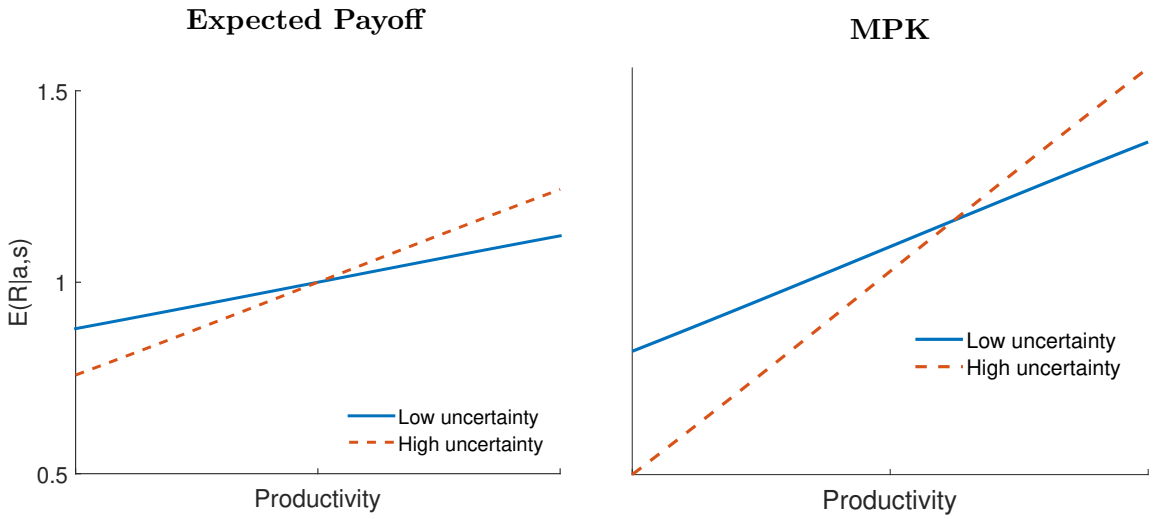
Let $R^L = R^d - \frac{u}{2}$ and $R^H = R^d + \frac{u}{2}$. I will consider changes in the level of uncertainty given by $u = R^H - R^L$. We can rewrite the expected government debt payoff in the following way:

$$E(R|a,s) = R^d + u\left(E\left[\pi_x|a,s\right] - \frac{1}{2}\right) \tag{3}$$

In an economy with *full information*—when x is observed—$E\left[\pi_x|a,s\right] = \pi_x$, the expected bond payoff is the same for all banks. However, under an economy with *learning*—where banks use their available information to learn about the aggregate state—the expected bond payoff is increasing with productivity $G(a)$, since $\pi(a,s)$ is increasing in a. In addition, the higher the level of uncertainty u, the larger the differences in expected payoffs across banks—this follows from observing (3). The left panel of Figure 4 illustrates the positive correlation between banks' productivity and the expected bond payoffs for two levels of uncertainty. A high level

[14] Equilibrium price q will change with the state of the economy and uncertainty level. For low aggregate productivity states q will be high but fall with uncertainty, while the opposite is true in high aggregate productivity states. (See Figure A.11).

Figure 4: Expected Payoff and Marginal Productivities in a Learning Economy



Note: Left panel plots the expected payoff relative to banks' productivity and right panel plots marginal productivity of capital relative to banks' productivity for two different levels of uncertainty (High and Low). Both figures illustrate interior solution results from a learning economy given an aggregate state $\{x, z\}$.

of uncertainty u makes the differences across expected payoffs more pronounced.

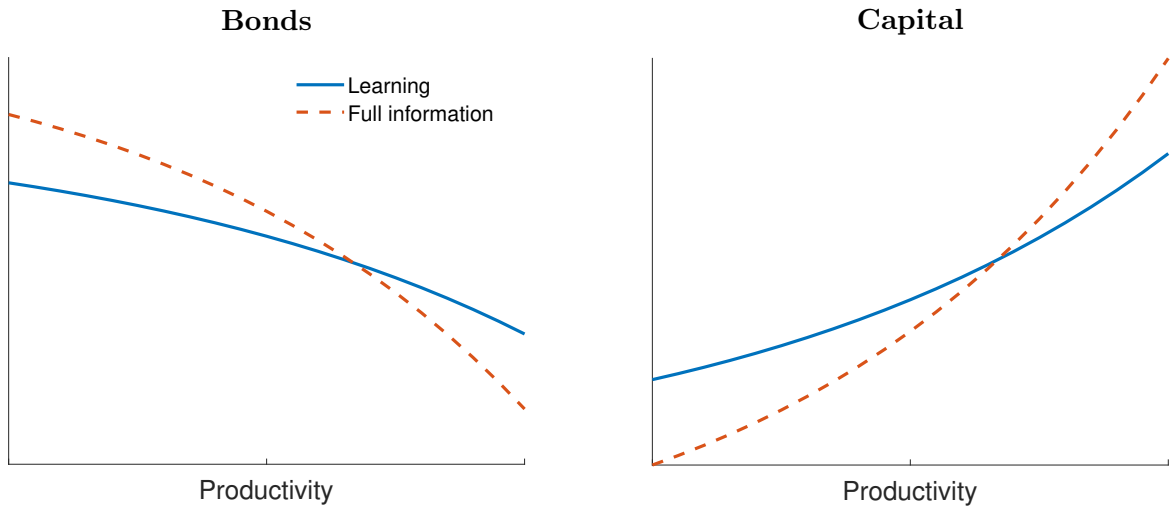
At an interior solution (i.e., where the constraint on bond holdings is not binding), the marginal return on lending to the private sector and the return on one extra unit of bonds must equalize

$$\alpha G(a) k_1(a,s)^{\alpha-1} = \frac{E(R|a,s)}{q} \tag{4}$$

In an economy with full information (x is observable), the expected bond payoff is the same for all banks, and thus marginal productivities (MPKs) are equalized across banks. However, under the learning economy, dispersion in the degree of optimism across banks translates in dispersion of MPKs. Higher levels of uncertainty $u = R^h - R^L$ deepen the dispersion in MPKs, as illustrated in the right panel of figure 4.

The fact that banks use their private productivity as a signal about the true state of the economy results in a positive correlation between expected government bond returns and productivity, which is the main driver of the results in this paper. Following directly from the positive correlation between expected payoffs and productivity, the MPKs are increasing in

Figure 5: **Full information vs Learning**



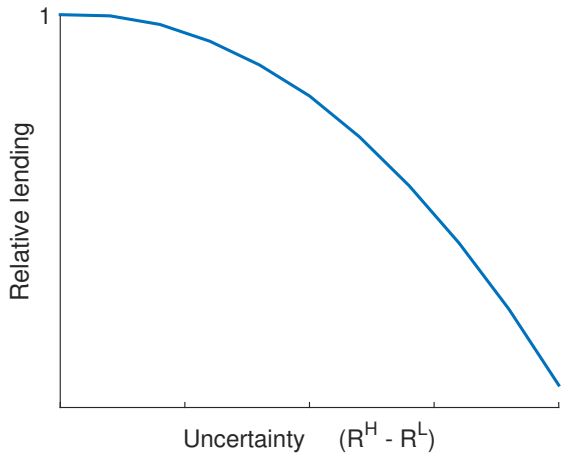
Note: Allocation of bonds and capital. "Full information" when all agents observe the true state $\{x, z\}$. "Learning" where agents update their beliefs given their private and public signals.

$G(a)$ as well. This positive correlation magnifies distortions generated by dispersion in beliefs. The correspondence induces high-productivity banks to hold excessive government debt and lend to the private sector at a lower scale. On the other hand, low-productivity banks are pessimistic about bond returns and are less willing to buy them. This dispersion in beliefs reduces the amount of bonds traded relative to that traded in a full-information economy, generating a worse allocation of resources. This correlation becomes stronger as the level of uncertainty deepens the distortions.

Belief dispersion leads to a worse allocation of resources. Figure 5 plots banks' holdings of government bonds and capital under the two economies: one where everyone can observe the true state x *full information* (dotted line) and one in which there are *heterogeneous beliefs* about the return on government debt (solid line). The key difference between these two economies is that under heterogeneous beliefs, high-productivity banks hold on to their government bonds relatively longer than they would under full information since they expect the return on these bonds to be higher than the price they can obtain in the market. Holding on to government debt instead of selling it induces high-productivity banks to lend at a lower scale than they would otherwise.

The mechanism of this model can be summarized in three steps: uncertainty, the trading trade off, and distortion in resource allocation. Intuitively, *uncertainty* about government bond

Figure 6: **Relative Aggregate Lending**



Note: Total credit ($\int_a (Ak_1^\alpha) dF(a)$) with heterogeneous beliefs relative to knowledge of the true state $\{x, z\}$, for different levels of uncertainty $u = R^H - R^L$ and a given realization of z.

payoff creates a wedge between market value and each bank's own expected value of bonds.

This wedge induces banks to face a *trade off*. They can either keep their bonds until the next period and receive $E(R|a, s)$ or trade these bonds and get $1/q$ units of capital that can be lent to the private sector. Given this trade off, we observe a worse allocation of credit across banks. On the one hand, low-productivity banks lend at higher rates than they would have otherwise since they would rather lend than purchase low-return bonds. On the other hand, high-productivity banks lend at a lower scale than they would have otherwise. This is because these banks believe that the return on bonds is higher than the market value and thus hold on to the bonds. Thus there is less trading of government bonds relative to what there would be with full information, which leads to a worse allocation of resources, with less credit to the private sector.

Beliefs dispersion is costly. The left panel of Figure 6 compares lending in the economy with heterogeneous beliefs relative to that in the economy with full information. Regardless of the economy being in a good or a bad state, total lending is always lower in an economy with heterogeneous beliefs. In addition, this cost increases as the difference between R^H and R^L widens.

Intuitively the higher the level of uncertainty—the difference between R^H and R^L—the wider the differences among expected bond returns across banks. This induces high-productivity

banks to hold more government bonds than they would in the full-information scenario, thus they lend to the private sector at a smaller scale. At the same time, this reduces the amount of government bonds traded in equilibrium.

Adding uncertainty about debt repayment amplifies the standard balance sheet effect analyzed in the literature. In these models, everyone knows what the haircut/repayment will be. Restructuring the debt sooner or later will not affect the allocation of bonds across domestic bondholders, since they have perfect foresight and would adjust their behavior immediately. When there are heterogeneous beliefs about the expected returns on bonds, which is correlated with banks' productivity, uncertainty reduces the amount of bonds traded in equilibrium, leading to a worse allocation of resources.

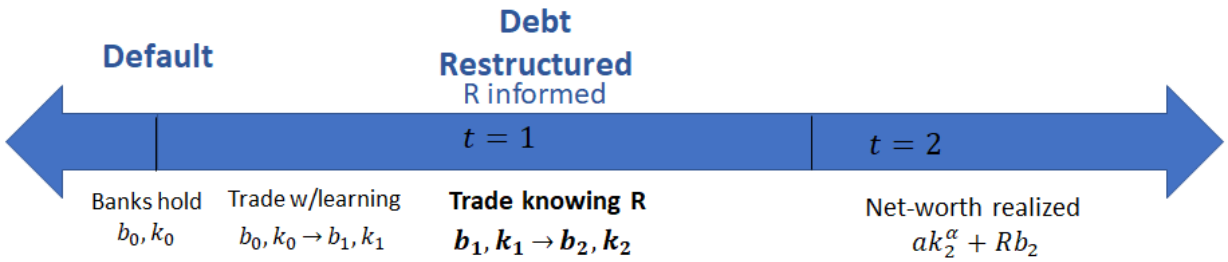
4.5 Debt Restructuring

Are there any domestic gains from restructuring external sovereign debt? Given that banks have already allocated their assets—under the heterogeneous-beliefs scenario—what are the effects of revealing the true return on bonds? In other words, what are the domestic effect on reducing external debt uncertainty? The main result of this section is that restructuring external debt allows for an increase in domestic private lending due to a improvement in the allocation of resources. In particular, external debt restructuring has a spillover effects on domestic debt uncertainty and belief dispersion. Improvement in the allocation of resources holds even when the realization implies a low return to domestic public debt holders $R = R^L$.

In this context I model spillovers of external debt restructuring on domestic economy by eliminating uncertainty on domestic debt return R. Once debt is restructured, everyone can learn from external restructuring what is the resulting domestic R. In other words, domestic banks can observe either $R = R^H$ or $R = R^L$.

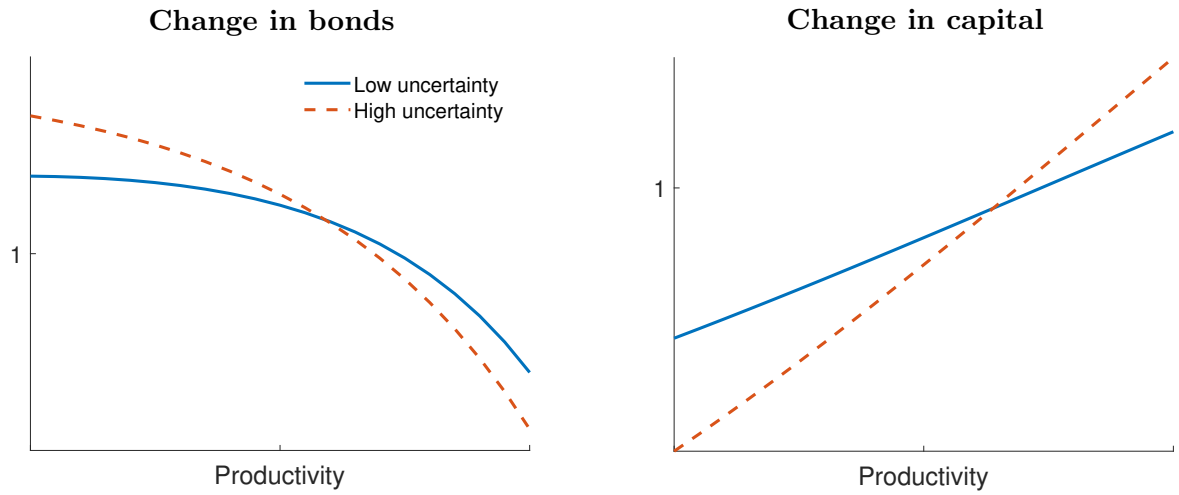
The timing of the exercise, illustrated in Figure 7, is the following. Initially, banks hold b_0, k_0, once the government defaults on external debt banks allocate their assets under the learning economy environment. However, unexpectedly, before the realization of the return on their assets, government restructures the external debt, thus more information is revealed to domestic banks, in particular R is revealed and banks have the opportunity of reallocating their assets, from b_1, k_1 to b_2, k_2. Then, in period 2 the net worth is realized. This section addresses

Figure 7: **Eliminating uncertainty timing**



Note: Banks observe the return on bonds during t=1 and are able to trade again. Return on assets only realized in t=2.

Figure 8: **Debt restructuring: does allocation depend on R?**



Note: This figure shows the change in bond (left) and capital (right) allocation with the new information, relative to the learning economy once debt is restructured.

two main questions: First, does this new information allow for a better allocation of resources? Second, does better allocation depend on the resulting R?

Figure 8 illustrates the changes in the allocations of bonds and capital, relative to the learning economy, once the debt is restructured. That is, once new information on R arrives, it is observable to everyone. When banks observe R, high-productivity banks sell government bonds and then use these resources to lend on a larger scale, while low-productivity banks reduce their lending. This pattern is even stronger with higher levels of uncertainty (dashed line).

So far I have not mentioned whether the results were under $R = R^H$ or $R = R^L$. The reason

is that with an interior solution, the allocation of resources is the same regardless of what the realization of R is. Once R is observed by everyone, the belief heterogeneity vanishes and thus it is possible to attain the full-information allocation, even if banks do not observe x.

Lemma 2: At an interior solution, the allocation of resources after debt restructuring is identical to a full-information allocation (observable x).

Corollary: Allocation of resources is independent of the observed haircut.

(Proof in the appendix.)

The main takeaway is that with external debt restructuring, total domestic private credit increases (relative to the learning economy) regardless of what R is, reaching the full-information allocation. The key element is that once R is known, the MPKs can be equalized across banks (at an interior solution) and thus improve the allocation of resources. The market price q will adjust so that this happens. Restructuring the debt increases total private credit, and this improvement is stronger for higher levels of uncertainty.[15]

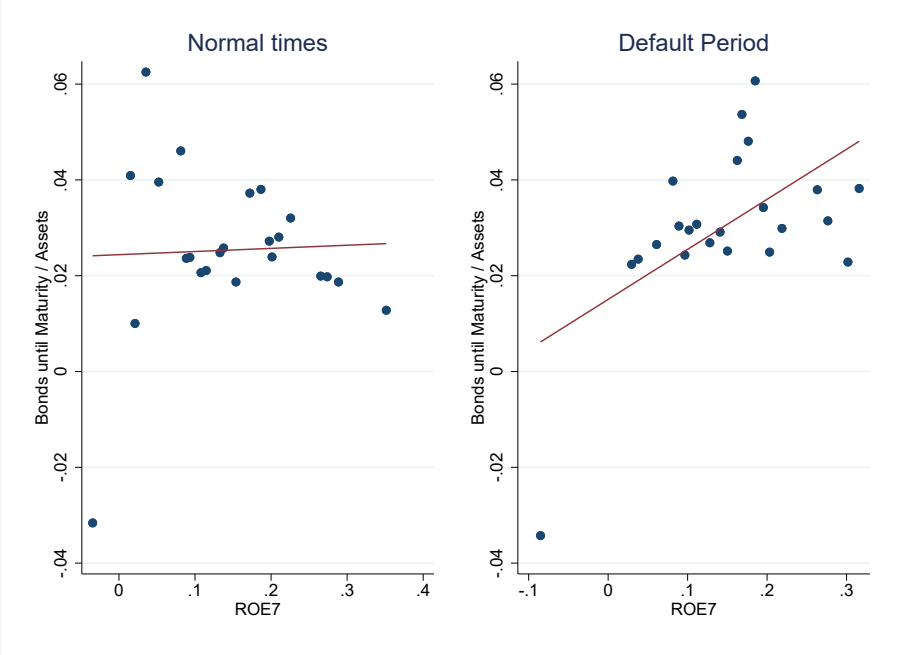
4.6 Evidence supporting key elements of the model

This section uses bank balance sheet data from Ecuador to support the main features of the model. First, I provide evidence that is consistent with the model's heterogeneous degree of optimism with respect to bond returns among domestic banks. In particular, I provide evidence that is consistent with the positive correlation between beliefs and productivity (Figure 9). Second, Figure 10 suggests that less profitable banks hold on average more public debt than more productive banks and that in periods of high uncertainty (default) low productive banks decrease their public debt holdings while high productive banks increase their holdings, leading to a less efficient allocation of resources. Fourth, Table 5 supports that there was a high level of uncertainty during the default episode. And lastly, I show that bond liquidity plunged during default (Figure A.6).

Banks hold public securities since they have lower credit risk and are more liquid than other assets in banks balance sheet. Public securities in bank balance sheet appear separated into

[15]However, if the resulting R^L is sufficiently low, high-productivity banks would not be able to attain their unconstrained level of lending, thus MPKs will not equalize across banks. This implies that although restructuring improves relative to the belief-heterogeneity environment, banks are at their constraint and cannot attain full information. (See Figure A.5 in the appendix.)

Figure 9: **Government debt held until maturity to profitability**



Note: Government debt held until maturity to profitability. Y-axis: government debt held until maturity to total assets ratio. X-axis: return on equity. This figure supports the upward sloping of the expected returns curve under heterogeneous beliefs during default.

two categories: *held-to-maturity*—assets intended to be held until they mature—and *available-for-sell*—held with the intention to trade them. I use these variation in classification to support the model.

Figure 9 shows that in normal times more-profitable not necessarily hold relatively more government debt *until maturity* than do less-profitable banks—coefficient is positive but not significant. Given that productivity is not observable, I consider higher *profitable* banks to be associated with higher *productivity*. The figure plots the ratio of government debt held until maturity to total assets against profitability.[16] In normal times, more-profitable banks do not hold relatively more government debt until maturity than less-profitable banks. However, during default, more profitable banks tend to hold more public assets until maturity that less profitable banks—coefficient is positive and significant. In both figures I control for government debt to total assets, since banks holding relatively more government bonds to assets are more likely to hold more of both: until maturity and for trading.

[16] Assets held until maturity are not intended to be traded.

One possible explanation for this evidence is that more-profitable banks believe that the return on government debt is higher than do less- profitable banks during periods of stress. This evidence is consistent with the positive correlation between the expected return on bonds and productivity in the model. Another interpretation of the data is that high-profitability banks have better information about the risk and return on these bonds or that they have more power to enforce the repayment on these assets. Either interpretation supports the positive correlation between expected returns of public debt and productivity, which is the key characteristic of the mechanism in the model. Thus, beliefs dispersion is one way to capture the positive correlation between productivity and expected returns.

Next, I test the correlation between productivity and government debt holdings more formally by running the following regression:

$$maturity/assets_{i,t} = \beta_0 + \beta_1 * ROE7_i + \beta_2 * Default_t + \beta_3 * (ROE7 * Default)_{i,t} + \beta_4 * X_{i,t}$$

where $maturity/assets_{i,t}$ is the ratio of government debt held until maturity to total assets, for bank i at time t; $ROE7_i$ is the average return on equity for bank i in 2007, used as a measure of profitability that is exogenous to the default period; $Default_t$ is a dummy that takes the value of 1 during the default episode (December 2008-June 2009) and zero otherwise; and $X_{i,t}$ is a vector of control variables: the government debt to assets ratio and cash to assets ratio. The first one is to control for the fact that banks might be holding more government debt until maturity to assets because their overall holdings of government debt relative to assets has increased. I include the variable cash to assets to control for other liquid assets the bank may have. This is important since I am interested in studying the liquidity provision that government debt provides. The main variable of interest is the interaction between productivity ($ROE7$) and $Default$. A positive and significant coefficient implies that during the default episode, more-profitable banks held significantly more government debt until maturity than did less-profitable ones.

Table 4 shows the results of these regressions. First, government debt held until maturity is not increasing in banks' profitability during normal times however the coefficient becomes positive and significant during default episode (first two columns). This is robust using either

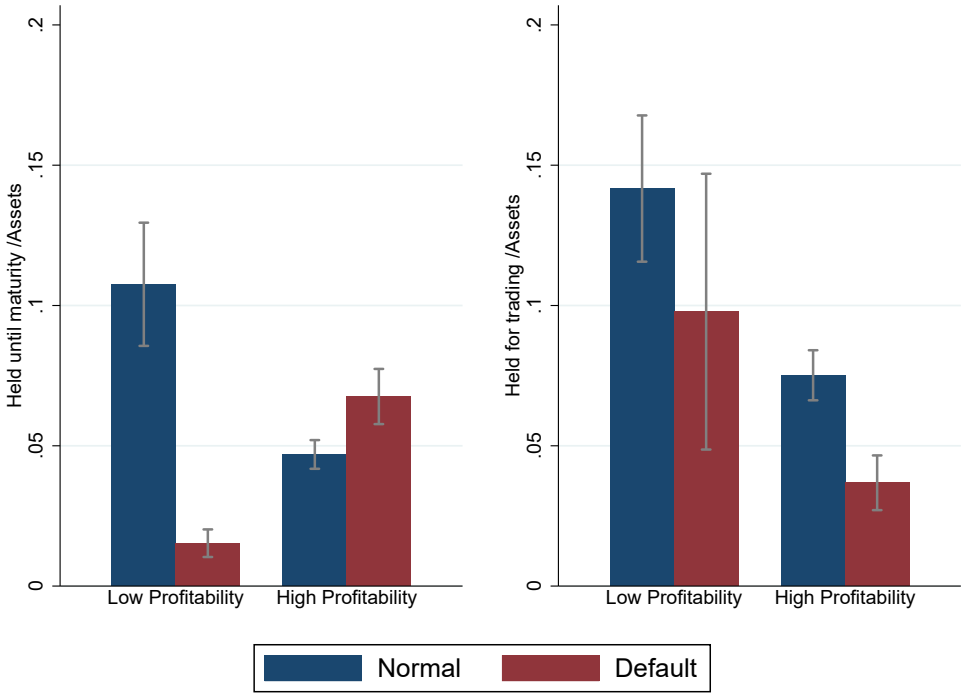
Table 4: **Government debt held until maturity and profitability**

	Government bonds held until maturity / Total assets			
ROE7	0.044	0.161***	-0.0116	
	[0.071]	[0.0432]	[0.097]	
Default			-0.0187*	-0.0148
			[0.011]	[0.010]
ROE7*Default			0.0994**	
			[0.046]	
Govt bonds to assets			0.3609**	0.3684**
			[0.165]	[0.164]
Cash to assets			0.0328	0.0403
			[0.027]	[0.033]
ROA7				-0.3182
				[0.828]
ROA7*Default				0.7392*
				[0.426]
Period	Normal	Default	All	All
Observations	787	136	923	923
R-squared	0.018	0.005	0.456	0.456

Time FE, Robust standard errors in brackets clustered at the bank level
*** p<0.01, ** p<0.05, * p<0.1

Note: Relation between government debt held until maturity/total assets and profitability. Measure of profitability is return on equity during 2007 ($ROE7$) or return on assets in 2007 ($ROA7$). Sample goes from 2006 to June 2009. Default goes from December 2008 to June 2009.

Figure 10: **Government debt to total assets**



Note: Government debt to total assets held by banks for exposed banks. Separated by high- and low-profitability banks and before and after the default episode. This figure supports that 1. low profitable banks hold on average more government debt to assets. 2. High profitable banks increased their debt holdings to maturity during default

measure of profitability: return on assets ($ROA7$) or return on equity ($ROE7$), both for 2007. In addition, during the default episode holdings of government debt held until maturity increased for more profitable banks. Columns three and four show that the interaction term between the default episode and either measure of profitability are positive and significant as well. Thus, the difference in government debt held until maturity across banks profitability type is larger during default relative to normal times.

The key implication of the positive correlation between productivity and expected bond payoff in the model is that in periods of stress, more-profitable banks hold on to government debt, that is, they do not sell their government bonds as much as they would otherwise. Figure 10 shows that this implication is consistent with banks' behavior. This figure shows the distribution of government debt to total assets split into held until maturity and held for trading. I also separate banks according to their profitability into two groups, high and low, during normal times and the default period. First, low profitable banks hold, on average more government debt. Second, high-profitable banks hold, on average, more government debt until maturity during periods of stress. More importantly, high-profitable banks increase their level of bonds held until maturity more than low-profitable banks do. This evidence supports the idea that during periods of stress, more-productive banks are more likely to hold on to their public debt leading to less efficient allocation of resources.

During 2008 and early 2009 there was a high level of uncertainty about the value and possible haircut of Ecuador's government bonds. This is not only true for the bonds on which Ecuador defaulted—Global 2012 and Global 2030—but also for others because there was spillover to other public bonds (such as Global 2015 which did not default). After the debt was restructured in June 2009, the uncertainty in the market fell substantially, for defaulted bonds as well as non-defaulted bonds. Table 5 shows that the standard deviation of bonds prices quintupled during default and then returned to its initial levels after restructuring. This evidence supports the existence of uncertainty and return dispersion about public debt held during this episode. Furthermore, substantial price dispersion is consistent with an environment were prices are not very informative about assets fundamentals making it difficult for agents to extract much about the economy by observing prices.

Ideally one would have data on belief dispersion. The relationship between price volatility

Table 5: **Standard deviations of bond prices**

	Pre-Default	**Default**	**Restructuring**
Global 2012	5.08	27.23	4.97
Global 2015	5.93	23.48	5.02
Global 2030	6.00	21.83	5.7

and belief dispersion has been empirically (Ajinkya and Gift (1985), Lobo and Tung (2000)) and theoretically (Shalen (1993), Atmaz and Basak (2018), Banerjee (2011)) documented. Additionally, price volatility may be related to the lack of consensus on the fundamental value or return of an asset but also it could be positively correlated with several different measures of financial and macroeconomic uncertainty (Baker et al. (2020), Bloom (2009)). Furthermore, substantial price dispersion is consistent with an environment where prices are not very informative about assets fundamentals making it difficult for agents to extract much about the economy by observing prices Andrei et al. (2023).

In addition, default episodes are associated with lower market liquidity. The left panel of Figure A.6 shows bid-ask spreads for three sovereign bonds—Global 2012, 2015, and 2030. Bid-ask spreads spiked for all bonds during the default episode and fell substantially once the debt was restructured. Higher bid-ask spreads are related to lower levels of liquidity and higher uncertainty. The spike and collapse of bid-ask spreads supports the evolution of market liquidity. During default, liquidity was low, reducing trading of government debt. Once debt was restructured, liquidity resumed—thus government bonds recovered their cash-like characteristic—allowing banks to trade bonds and improve their portfolio asset allocation.

To sum up, this section provided simple model were uncertainty about the return on government bonds during default creates dispersion in beliefs across domestic banks, which leads to a misallocation of credit. Debt restructuring eliminates belief heterogeneity by making the return on bonds observable to everyone. Furthermore, it provided some evidence to support the key elements of the model using data for Ecuador. This plain sailing theory is not only consistent with the substantial growth in domestic credit upon debt restructuring but also with its independence from the haircut size observed in the data.

5 Conclusions

This paper shows that default on external debt can have negative effects on domestic economy and provides domestic incentives to restructure external debt quickly. In particular, this work provides a simple framework were uncertainty about the value of external government debt has spillovers on the value and liquidity of public debt held by domestic banks. External debt restructuring contributes to resolving the uncertainty, allowing domestic banks to reallocate resources and increase private lending.

First, this paper conducts an event study around Ecuador's 2008-2009 debt restructuring and finds that lending increases the most for banks that were highly exposed to government debt. This sheds some light on the idea that restructuring provides a new environment that allows exposed banks to adjust their portfolio, improve their asset allocation and thus increase their lending. In addition, banks which held public debt for trading purposes were more likely to increase their lending. This suggests that there is something about debt restructuring related to the liquidity provision of public debt that allows banks to reallocate their portfolios and increase private lending. It is worth mentioning that the current data set does not allow for a distinction between domestic and external debt held by domestic banks. Nevertheless, these findings suggest that external debt restructuring has implications for domestic banks: directly in the case of domestic banks banks holding external debt; or indirectly: through the change in expected value of banks public debt holdings.

Ecuador provides a clean environment to analyze changes in banks balance sheets for several reasons. First, differently from most cases, Ecuador was not in a recession at the time of default. Second, the country did not regain access to international borrowing until 2014. Third, the economy was dollarized, so it was immune to fluctuations in exchange rates.

Then, this paper suggests a simple model to rationalize the increase in domestic private lending post restructuring regardless of international borrowing. In normal times, government bonds have lower credit risk and are more liquid than other assets in banks balance sheets. However, in turbulent times, public bonds lose their cash-like characteristic and speculation on their return becomes an issue for banks creating belief dispersion across banks. During default, positive correlation between banks' lending productivity and expected bonds returns restrains

some banks from selling and others from buying bonds. Debt restructuring resolves uncertainty by setting a haircut that banks can observe, which eliminates the beliefs dispersion. As a result, there is an increase in bond trading, which allows for a better allocation of resources and an increase in private lending. Finally, key elements of the model are supported using Ecuador's data.

This paper is silent about how dispersion in beliefs can alter default decisions and its differentiated (or not) impact on domestic and external debt holders. Future work should incorporate the information costs in a strategic default environment to address changes in government behavior. In addition, this paper focuses on the supply of private credit during default and debt restructuring.

Additionally, the results in this paper should be interpreted as the gains from reallocating domestic resources regardless of the realized return on bonds. Hence, this paper provides a domestic incentive to restructure debt promptly that is *complementary* with regaining access to international markets. These domestic gains could be incorporated when studying debt restructuring since they could affect the timing or size of a haircut.

While the model is simple and there are many areas of improvement, it provides a different framework that was has been used in the literature so far to ratioanlize the increase in private credit upon restructuring and its lack of correlation with haircut. Up to my knowledge, there is no other work that addresses both of these matters simultaneously.

Finally, Ecuador preemptive debt restructuring of 2020 was in the context of the COVID -19 pandemic and the collapse of oil prices in 2020 putting under severe stress the Ecuadorian economy given pre-existent vulnerabilities. Preemptive negotiations are shorter, the country is not exclude from external borrowing nor trade, and output loses (due to the banking sector and trade sector) end up being milder than post default restructurings Asonuma and Trebesch (2016). However, many times this does not happen, and post default restructuring becomes a lengthy process. This paper aims to draw the attention to the domestic incentives of debt restructuring and hopes to bring further research on this direction.

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A Appendix

A.1 Lemmas

Lemma 1: $\pi(a,s)$ is increasing in a. Proof:

If $a' < a$, then $\mu_{x|a',s} < \mu_{x|a,s}$. This implies that $\Phi_{x|a's}(v) >_{FOSD} \Phi_{x|a,s}(v)$ (first order stochastic dominates) which implies that $\forall u; \Phi_{x|a's}(u)$ accumulates faster than $\Phi_{x|a,s}(u)$
So

$$\begin{aligned}
\int f(v)\,\Phi_{x|a',s}(v)\,dv &> {}_{FOSD}\int f(v)\Phi_{x|a,s}(v)dv \\
1-\int f(v)\Phi_{x|a',s}(v)dv &< 1-\int f(v)\Phi_{x|a,s}(v)dv \\
\int F(v)\phi_{x|a',s}(v)dv &< \int F(v)\phi_{x|a,s}(v)dv \\
E(\pi_x|a',s) &< E(\pi_x|a,s)
\end{aligned}$$

which then implies that $E(\pi_x|a,s) = \pi(a,s)$ is increasing in a.

Lemma 2: At an interior solution, the allocation of resources after debt restructuring is identical to a full-information allocation (observable x).

Proof

From the market-clearing condition,

$$\int k_2^*(a,s)\,dF(a) = \int k_1(a,s)\,dF(a)$$

where $k^* = \left(\frac{\alpha A q}{E(R|a,s)}\right)^{\frac{1}{1-\alpha}}$

If $R = R^H$

$$\frac{R^H}{q^H} = \frac{1}{\alpha}\left(\frac{K_0}{E(A^{\frac{1}{1-\alpha}})}\right)^{\frac{1}{1-\alpha}}$$

Similarly, if $R = R^L$

$$\frac{R^L}{q^L} = \frac{1}{\alpha}\left(\frac{K_0}{E(A^{\frac{1}{1-\alpha}})}\right)^{\frac{1}{1-\alpha}}$$

Actually, for any R,

$$\frac{R}{q} = \omega$$

The market price adjusts such that the returns on bonds are equalized across states.

Corollary Allocation of resources is independent on the observed haircut.

$$MPK(a) = \frac{R^H}{q^H} = \frac{R^L}{q^L}$$

for all productivities $G(a)$, where $q^i, i \in \{L, H\}$ is the resulting equilibrium price under a high or low bond payoff respectively and could be different for different aggregate states x.

A.2 Learning from Prices and Noisy Traders

In the main text, I include a reduced form to analytically solve the model and do not allow banks to learn from prices. If banks were to filter information from prices, I need to include some noise such that the price is not be fully informative. I make some small modifications to the model to be able to incorporate this more easily. Here you can find an outline of the model and solution.

The Aggregate State and Return on Bonds

- The aggregate state of productivity is $x \sim N(0, \sigma_x^2)$.
- The return on bonds $R \sim N(R^d, \sigma_r^2)$.
- x, R are positively correlated with $\rho > 0$

$$\begin{pmatrix} x \\ R \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ R^d \end{pmatrix}, \begin{pmatrix} \sigma_x^2 & \rho\sigma_r\sigma_x \\ \rho\sigma_r\sigma_x & \sigma_r^2 \end{pmatrix}\right)$$

Learning about Aggregate state

Idiosyncratic noisy signal about aggregate state given by a :

- A bank observes $a = x + \varepsilon$ and $\varepsilon \sim N(0, \sigma_\varepsilon^2)$.
- Banks productivity is given by $G(a) \in [0, B]$.

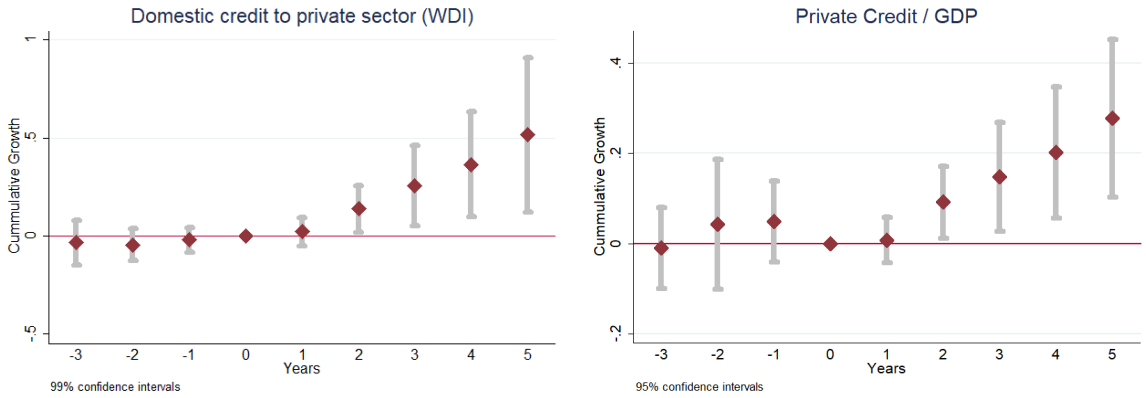
- International bond holders add noise to bond markets: $Z \sim N(0, \sigma_z^2)$.

The market clearing condition implies that: $\int b_1^*(a,q)\,dF(a) + z = \int b_0(a)\,dF(a)$, Replacing the expression for b_1^* in the market clearing equation, this can be solved through a by making some adjustments like taking logs to obtain a linear function of q in terms of the noise z and the aggregate state x.

Thus after observing a and q : $R|a,q \sim N(\mu_{R|a,q}, \sigma^2_{R|a,q})$ with $\sigma^2_{R|a,q} = (1-\rho^2)\left[\frac{1}{\sigma_r^2} + \frac{1}{\sigma_\varepsilon^2} + \frac{1}{\Lambda\sigma_z^2}\right]^{-1}$ and $\mu_{R|a,q} = \sigma^2_{R|a,q}\rho\left[\frac{R^d}{\sigma_r^2} + \frac{a}{\sigma_\varepsilon^2} + \frac{L(q_x)}{\Lambda\sigma_z^2}\right]$, where $L(q)$ is a linear function of q, and Λ a constant.

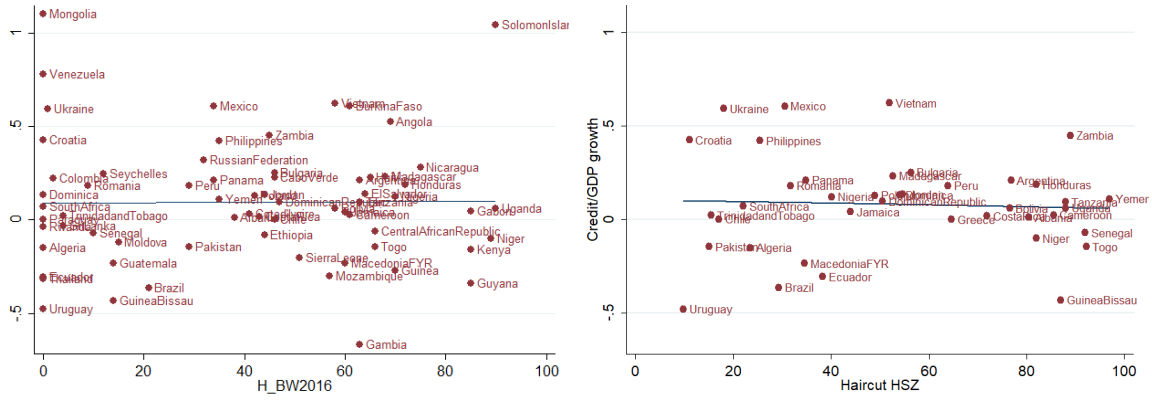
A.3 Figures

Figure A.1: Robustness: Domestic Credit Growth



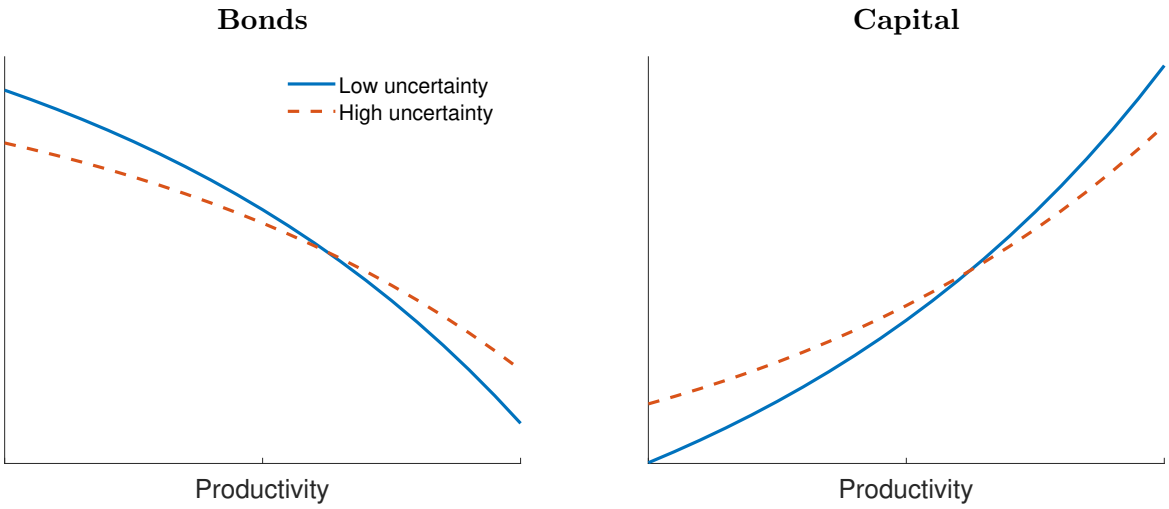
Note:(Left) Domestic credit to private sector (WDI) refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. (Right) Private Credit / GDP : Domestic credit to private sector by banks refers to financial resources provided to the private sector by other depository corporations (deposit-taking corporations except central banks).

Figure A.2: Haircut and Credit Growth Correlation



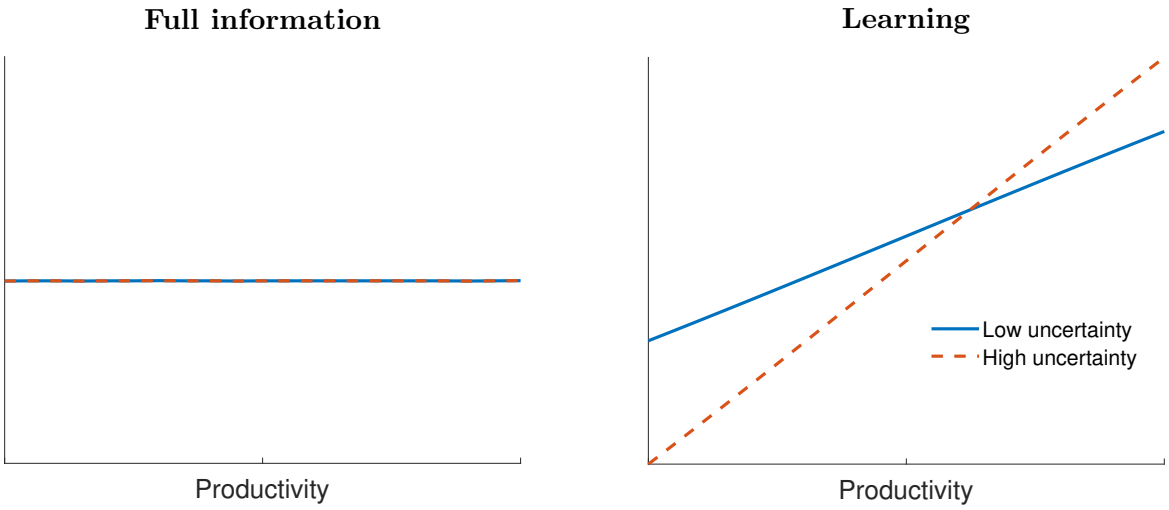
Note: H BW2016 corresponds to the haircut proposed by Benjamin and Wright (2009) which combines World Bank estimates of the reduction in the face value of the debt with estimates of the forgiveness of arrears on interest and principle. Haircut HSZ corresponds to Sturzenegger and Zettelmeyer (2008) haircut measure, which is 1 minus the present-value of new debt over the present value of old debt, both discounted at the same rate. Results are robust to either haircut measure.

Figure A.3: **Effect of uncertainty**



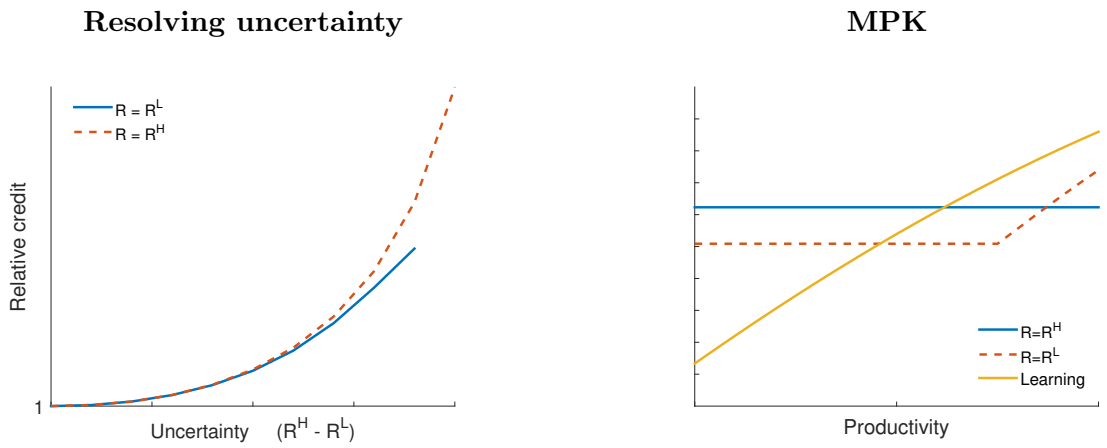
Note: Allocation of bonds and capital under heterogeneous beliefs for different levels of uncertainty $u = R^H - R^L$. *Given an aggregate state* $\{x, z\}$

Figure A.4: **Dispersion in MPK**



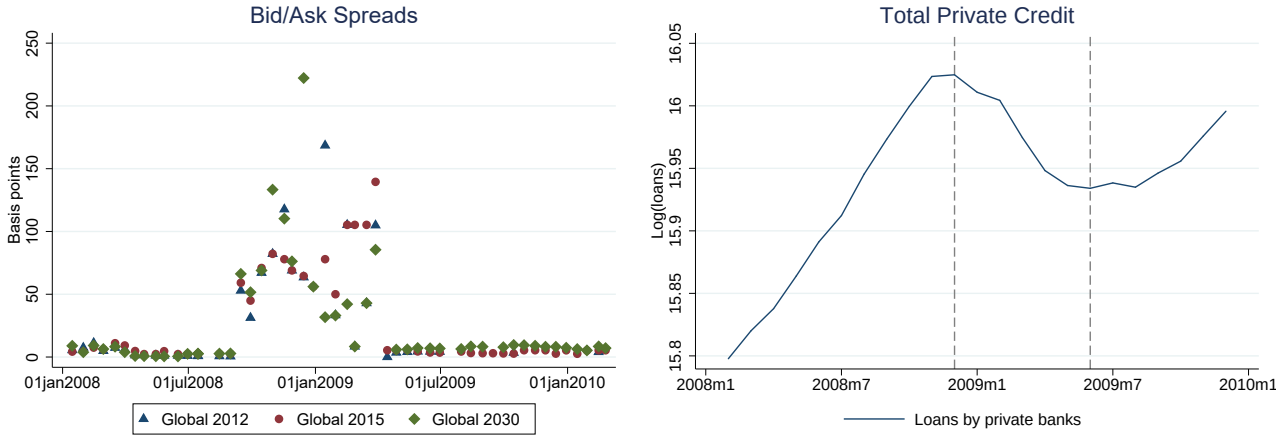
Note: Dispersion in marginal productivity of capital, full information vs economy with learning. Interior solution given an aggregate state $\{x, z\}$.

Figure A.5: **Debt restructuring: changes in allocation**



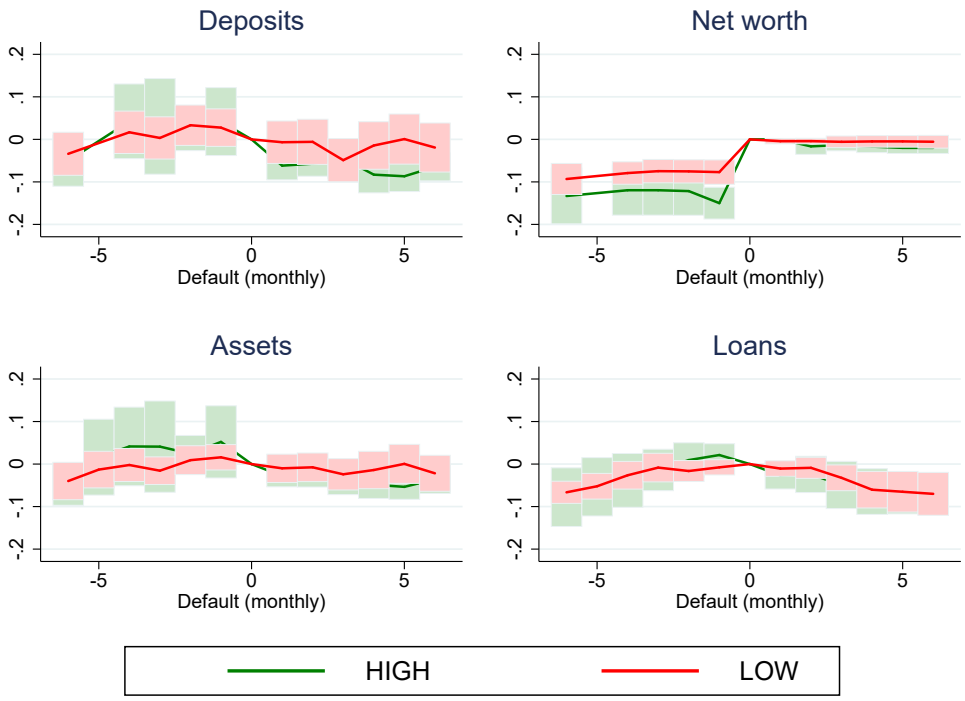
Note: Debt restructuring comparison under high or low realization of R. (Left) Production with restructuring relative to production under the learning economy. (Right) Marginal productivity of capital.

Figure A.6: **Ecuador's Global Bonds Bid Ask Spreads**



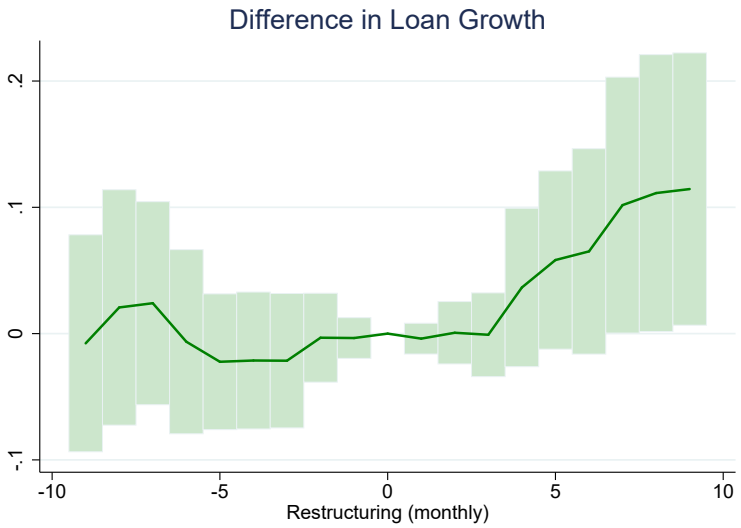
Note: Dotted lines in the right panel show default and debt restructuring dates. Source: Bloomberg, BCE, Superintendencia de Bancos de Ecuador

Figure A.7: **Similar behavior before default**



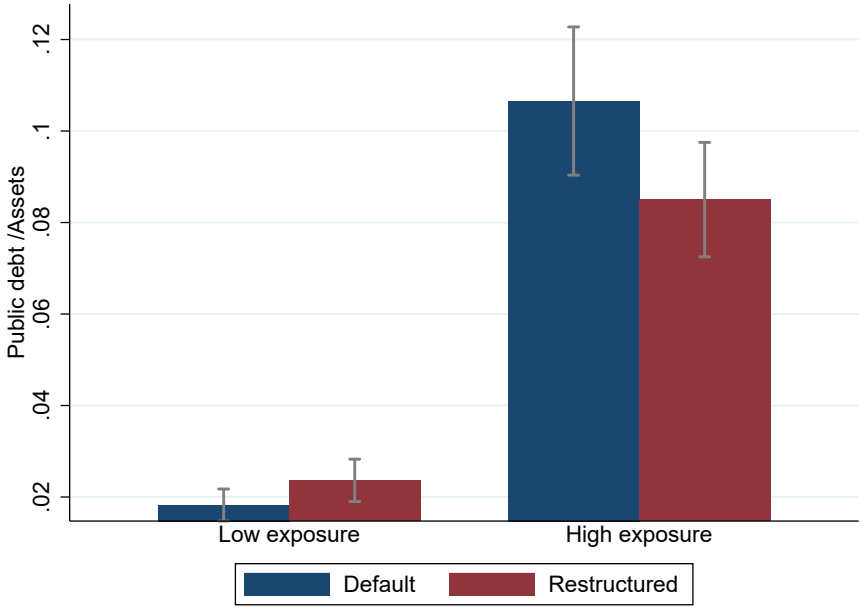
Note: Months before and after default event. Evolution of deposits, net worth, assets, loans with respect to default date. There is no statistical significant difference between the evolution of these variables across groups before the default.

Figure A.8: **Loan growth Highly vs Non exposed to Government debt**



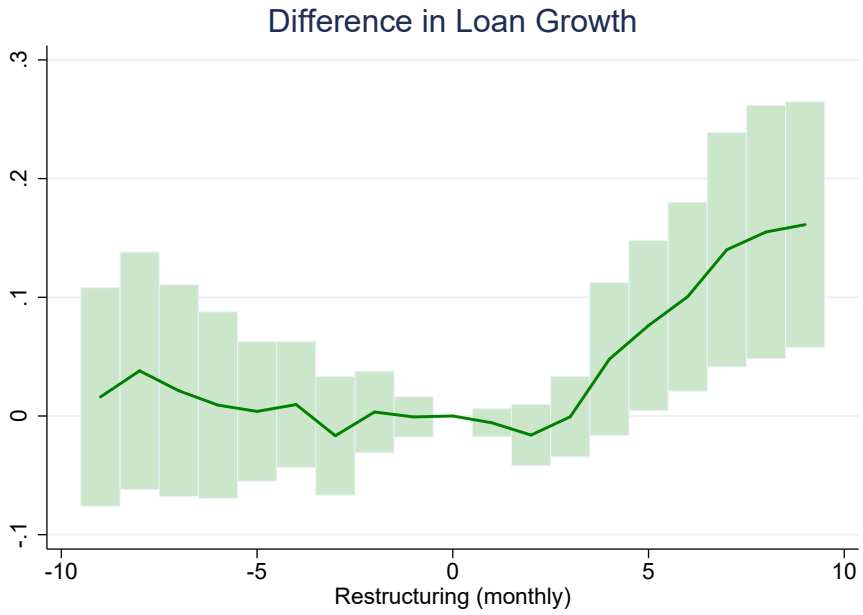
Note: Cumulative growth (with respect to restructuring month) of loans for banks with high holdings of government debt in 2008 vs those with low holdings. Banks with high government debt increase lending by more than banks with low debt holdings. Figure shows the difference between the high and the low groups.

Figure A.9: **Government debt to total assets**



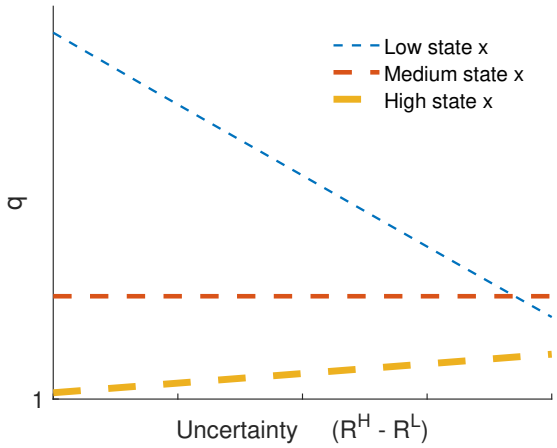
Note: Evolution of government debt to total assets held by banks. Separated by high and low exposure before default.

Figure A.10: **Loan growth High vs Low holdings of public debt until maturity**



Note: Cumulative growth (with respect to restructuring month) of loans for banks with a high level of trading to securities vs those with a low level. Banks with government debt held for trading increase lending by more than banks that held government debt for other purposes. Right figure shows the difference between the high and the low groups.

Figure A.11: **Equilibrium price q**



Note: Price q changes with state of economy. For states of high average productivity of lending to the private sector q is low. That is, you need a large amount of public bonds to get one unit or k. On the other hand, when the state of the economy is low, the opposite is true. The dynamics of price q also changes with the level of uncertainty. Mainly, as uncertainty increases the dispersion between price in low states and high states decreases.

A.4 Tables

Table 1: Robustness: Haircut and Credit Growth Correlation

	Domestic credit to private sector (WDI)		**Domestic credit provided financial sector (IMF)**	
$Haircut_{BW}$	-0.0010		-0.0016	
	[0.579]		[0.263]	
$Haircut_{SZ}$		-0.1154		0.0439
		[0.572]		[0.873]
Constant	0.1963**	0.1922	0.1462**	0.0689
	[0.049]	[0.159]	[0.050]	[0.654]

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1