Did the 1980s in Latin America Need to Be a Lost Decade?

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Abstract

In 1979, the Federal Reserve Board, led by Chairman Paul Volcker, drastically raised the federal funds rate as part of their efforts for taming inflation. As a consequence of this increase, borrowing costs for Mexico rose substantially. Eventually the country suspended its debt payments in 1982, which was followed by an economic crisis and seven years of little to no access to foreign credit. In this paper we use a standard sovereign default model to explore the extent to which the rise in U.S. interest rates caused the default in Mexico. We find that, even if interest rates had remained low, Mexico would still have defaulted. We then extend the model to allow for endogenous re-entry to financial markets via debt restructuring. Within this framework we analyze whether the crisis could have been shorter and less severe had interest rates remained low.

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1 Introduction

During the 1970s there was an increase in the supply of credit to emerging economies. Mexico, among other Latin American countries, substantially increased its external borrowing during this 1970s petrodollar recycling surge. The 1982 oil price collapse deteriorated the Mexican economy and tightened the government's budget. Finally, the then Federal Reserve Chairman Paul Volcker decided to raise the federal funds rate in order to tame the rising US inflation. This is a widespread narrative for why Mexico defaulted in 1982 (see for example Eichengreen and Mody (1998); Boughton (2001); Schaeffer (2003)). This paper addresses this narrative by evaluating the impact of the Volcker shock on the default decision and the duration of the crisis using a quantitative sovereign default model à la Eaton and Gersovitz (1981) with risk-free interest rate regime switching, long-term debt, and endogenous re-entry to international financial markets via voluntary debt restructuring.

The narrative continues and points the 1982 Mexican default as the trigger for what came to be called the Latin American lost decade. As documented by Trebesch (2008, 2011), Mexico spent the rest of the decade restructuring its debt until the Brady Plan announcement in 1989. This paper continues evaluating the debt crisis by quantifying the extent to which the Volcker shock prolonged the restructuring and, hence, prolonged the exclusion of Mexico from international financial markets.

Dooley (1994), for example, understands the 1982 international debt crisis as a prolonged negotiation between commercial banks and their own governments over who would bear the economic losses generated by loans made to developing countries instead of simply a conflict between debtor countries and their creditors. Our approach can elucidate these conflicting views by finding evidence on whether Mexico had incentives to prolong default and if it was only due to the high risk-free interest rates regime.

We first present results from a standard sovereign default model, following Arellano (2008), with regime switching for risk-free interest rates. Under this framework, we question the first part of the narrative since, in the model, interest rate shocks do not change default decisions most of the times. We find that Mexico would have defaulted in 1982, regardless of the level of the risk-free interest rate. Nevertheless, even though the model accurately predicts Mexico should not have defaulted in 1981 but should have in 1982, just as it occurred, it is not appropriate to analyze the counterfactual scenario in which the Volcker shock does not hit Mexican economy. The reason is that, unless lender's risk neutrality is eliminated and a risk averse pricing kernel is assumed, price scheduling of bonds are not much sensitive to regime switching in the model. Furthermore, since the model assumes the government re-enters financial markets with an exogenous probability, thus remaining in financial autarky for a stochastic period of time, then it can not evaluate if the government could have renegotiated and hence returned back from financial autarky before the Brady's plan if the Volcker shock had not happened.

We then propose a new small open economy model, still with stochastic endowment stream and risk-free interest rate regime switching. The government's objective is to maximize the expected utility of their households by making decision about long-term debt accumulation, default and renegotiation. The default cost is captured by a direct output cost and exclusion from international financial markets until risk neutral foreign lenders and the government agree upon some renegotiation. Differently than most previous studies, the government does not return from financial autarky with zero debt. Here, debt is frozen and post-renegotiation debt level might be even greater than prior to default. This is consistent with Cruces and Trebesch (2013), who identify nine episodes of debt restructurings with negative haircuts. Thus, the benefit of default in our model is to postpone coupon payments until debt is renegotiated and to postpone renegotiation until better terms for the government arise.

2 Related literature

Renegotiation models have been studied from many different perspectives. Arellano and Bai (2014), for example, analyze two countries with a common foreign lender and their joint default and renegotiation decisions. In terms of approach, our paper is mostly related to Hatchondo, Martinez and Sosa-Padilla (2014). Interested in restructuring episodes characterized by absence of missed debt payments, they model debt restructurings that are beneficial for both parties: government and foreign lenders. Restructurings occur when reductions in government's debt burden increases the market value for holders of the restructured debt for reducing the government's default probability. Our approach is similar to theirs in the sense that it also does not have debt overhang as the motive for renegotiation, but it differs specially with respect to the timing of renegotiation: theirs allow for renegotiation before a country declares default (as long as an exogenous renegotiation cost shock allows) while ours restricts it to happen only after the government declares default.

The 1982 Mexican crisis was also studied by Tourre (2017). He uses a continuous time model, with a government that issues long-term debt, regime switching risk-free interest rates and an implicit (not modeled) renegotiation in which default does not eliminate the country's stock of debt. Tourre (2017) evaluates the potential impact of the Volcker shock on the Mexican government's default decision taking into account that Latin American countries had used floating rate debt during the 1970s and 1980s. The channel he focuses on is, therefore, the exchange rate's impact caused by the Volcker shock on Mexican debt service. Furthermore, this work does not elaborate on the consequences of the Volcker shock on the subsequent years of default declaration.

3 Model

In this section we layout the model we will use for our main analysis. This model nests the environment in Arellano (2008), which we use in Section 4 to assess whether the interest rate shock caused the crisis.

3.1 Environment

Time is discrete and indexed by $t \in \{0, 1, 2, \ldots\}$. There is a small open economy populated by identical households and a benevolent government[1]. The government has access to international financial markets and can issue non-contingent debt. There is a large number of risk neutral foreign lenders that have access to a risk-free asset and to the government's

[1] The benevolent government is a common interpretation that we can use. Naturally, we could have just assumed the government has preferences potentially different than that of their households, but can implement any feasible consumption sequence as a competitive equilibrium via their many available policy instruments (Aguiar, Chatterjee, Cole, and Stangebye (2016)).

bonds. The economy receives a stochastic endowment of a tradable good Y_t every period. We assume it follows a log-normal AR(1) process $\log(Y_t) = \rho \log(Y_{t-1}) + \epsilon_t$,with $|\rho| < 1$ and $\epsilon_t \sim N(0, \sigma_\epsilon^2)$.

Each period, the risk-free interest rates can take one of two values $r \in \{r_L, r_H\}$, with $r_L < r_H$. Given the current state r, the probability of high risk-free interest rate during next period is denoted by $\lambda(r)$. The probability of switching from low to high risk-free interest rate is denoted by $\lambda(r_L)$ while the probability of remaining under a high risk-free interest rate is denoted by $\lambda(r_H)$.

Households are impatient and risk averse, with preferences given by

$$E_t \left[\sum_{j=t}^{\infty} \beta^{j-t} \frac{c_j^{1-\eta}}{1-\eta} \right]$$

where $\beta \in (0,1)$ is the subjective discount factor, η is the constant coefficient of relative risk aversion, and c is consumption.

Government can issue non-contingent long-term debt to competitive foreign lenders. As in Bianchi, Hatchondo and Martinez (2012), Arellano and Ramanarayanan (2012), and Hatchondo and Martinez (2009), a bond consists of a perpetuity with geometrically declining coupon payments: a bond issued in period t promises to pay $\gamma(1-\gamma)^{j-1}$ units of the tradable good in period $t+j$, $\forall j \geq 1$, and the law of motion for bonds is given by

$$b_{t+1} = (1-\gamma) b_t + i_t$$

where b_t and i_t denote the number of bonds due at the beginning of period t and the bond issue in period t, respectively.

The government cannot commit to repay its debt and can choose to default in every period. Default is characterized by coupon payment suspension, but not by debt forgiveness. Once in default, the government is excluded from credit markets and faces direct output costs $\phi(Y) = \max\{0, d_0 Y + d_1 Y^2\}$, $d_0 < 0 < d_1$, until debt is renegotiated with foreign lenders[2].

[2]Output cost $\phi(Y) = \max\{0, d_0 Y + d_1 Y^2\}$, $d_0 < 0 < d_1$ makes output loss be zero for $0 \leq Y \leq \frac{d_0}{d_1}$ and be more than proportionally increasing for $Y > \frac{d_0}{d_1}$. This direct ouput cost and the long-term debt allow our model to match the spread dynamics observed in the data (see Chatterjee and Eyigungor (2012) and

After renegotiation the government regains access to financial markets.

In the spirit of Hatchondo, Martinez and Sosa-Padilla (2014), we allow for debt renegotiation in which the post-renegotiation debt level is endogenously determined in a Nash bargaining game. In our model, debt renegotiation is only available after the government misses a coupon payment and remains available until the government and lenders reach an agreement.

3.2 Recursive formulation

At the beginning of each period the government observes its endowment realization Y and the risk-free interest rate r and decides whether to suspend the payment of debt obligations or not. The value of the government is thus:

$$V\left(B,Y,r,\theta\right)=\max\left\{V^{P}\left(B^{P}\left(\theta\right),Y,r\right),V^{D}\left(B,Y,r\right)\right\} \tag{1}$$

Where $\theta=0$ indicates that the government missed a coupon payment the previous period and $\theta=1$ means the government paid. V^D is the value of default and V^P is the value of repaying and are defined as:

$$V^{P}\left(B,Y,r\right)=\max_{C,B'}\left\{u(C)+\beta\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}\left[V\left(B',Y',r',1\right)\right]\right\} \tag{2}$$
$$s.t.\quad C+\gamma B\leq Y+q\left(B',Y,r,1\right)\left[B'-\left(1-\gamma\right)B\right]$$

$$V^{D}\left(B,Y,r\right)=u(h\left(Y\right))+\beta\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}\left[V\left(B,Y',r',0\right)\right] \tag{3}$$

where $h\left(Y\right)=\max\left\{Y-\phi\left(Y\right),\epsilon_{Y}\right\}$, $\epsilon_Y>0$, is the consumption under default and q is the price of issuing bonds so that at the beginning of the next period the level of outstanding debt is B'. If the government repaid the previous period then its value of repaying in the current period is evaluated at the current debt level $B^P\left(1\right)=B$. If the government missed a payment the previous period then its value of repayment will be evaluated at the renegotiated

Hatchondo, Martinez and Sosa-Padilla (2014)) debt level (defined below) $B^P(0) = B^R(B, Y, r)$. Also, note that if the government defaults the current debt level is carried to the following period.

The solution to the government's problem gives decision rules for consumption, debt issuance and default decision, $\hat{C}(B, Y, r)$, $\hat{B}(B, Y, r)$ and $\hat{D}(B, Y, r, \theta)$, respectively. $\hat{D}(B, Y, r, \theta) = 0$ means default, while $\hat{D}(B, Y, r, \theta) = 1$ has two different meanings depending on θ: it means repay if $\theta = 1$ and renegotiate if $\theta = 0$.

Notice that, once the new debt level B^R is agreed upon, government regains access to financial markets and there is no longer an output cost. Moreover, observe how debt is simply frozen when in default, independently of how many periods the government chooses to remain in default, it always carries the debt level to the subsequent period. Indeed, depending on which risk-free interest rate and endowment shocks are realized, renegotiation might lead to different debt levels, potentially including even increases in debt levels.

The post-renegotiation debt level, B^R, is defined as the solution to the following Nash bargaining game

$$\begin{aligned} B^R(B, Y, r) &= \arg\max_{\tilde{B}} \left[S^{LEN}\left(\tilde{B}, B, Y, r\right)\right]^{\alpha} \left[S^{GOV}\left(\tilde{B}, B, Y, r\right)\right]^{1-\alpha} \\ s.t.:\quad & S^{LEN}\left(\tilde{B}, B, Y, r\right),\ S^{GOV}\left(\tilde{B}, B, Y, r\right) \geq 0 \end{aligned} \tag{4}$$

where S^{LEN} and S^{GOV} denote, respectively, the lenders' and the government's surplus from renegotiating:

$$\begin{aligned} S^{LEN}\left(\tilde{B}, B, Y, r\right) &= \gamma\tilde{B} + \frac{1-\gamma}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}\left[MV\left(\hat{B}\left(\tilde{B}, Y, r\right), Y', r', 1\right)\right] \\ &\quad - 0 - \frac{1}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}\left[MV\left(B, Y', r', 0\right)\right] \end{aligned}$$

$$S^{GOV}\left(\tilde{B}, B, Y, r\right) = V^P\left(\tilde{B}, Y, r\right) - V^D(B, Y, r)$$

Note that if renegotiation is successful, the lender receives the coupon $\gamma\tilde{B}$ in the current period. Define the market value of bonds B as $q(B, Y, r, \theta) \cdot B = \frac{1}{1+r}\mathbb{E}\left[MV\left(B, Y', r', \theta\right)\right]$.

We choose this formulation to highlight the fact that the outside option of the lenders in this renegotiation game is not zero, since debt is never forgiven and lenders take into account potential future renegotiation. This highlights a key feature of this model: defaulted bonds have positive value. Finally, $MV(B,Y,r,1)$ and $MV(B,Y,r,0)$ are:

$$
\begin{aligned}
MV(B,Y,r,1) = {} & [1 - D(B,Y,r,1)]\left\{\gamma B + \frac{1-\gamma}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}MV\left(B'(B,Y,r),Y',r',1\right)\right\} \\
& + D(B,Y,r,1)\left\{0 + \frac{1}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}MV\left(B,Y',r',0\right)\right\}
\end{aligned} \tag{5}
$$

$$
\begin{aligned}
MV(B,Y,r,0) = {} & [1 - D(B,Y,r,0)]\left\{\gamma B^R(B,Y,r)\right. \\
& \left. + \frac{1-\gamma}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}MV\left(B'\left(B^R(B,Y,r),Y,r\right),Y',r',1\right)\right\} \\
& + D(B,Y,r,0)\left\{0 + \frac{1}{1+r}\mathbb{E}_{r'}\mathbb{E}_{Y'|Y}MV\left(B,Y',r',0\right)\right\}
\end{aligned} \tag{6}
$$

which provide a recursive definition for bonds prices. The market value at current state (B,Y,r,θ) takes as given all of the government's decision rules.

3.3 Recursive equilibrium

A Markov perfect equilibrium is characterized as

1. a set of value functions V, V^P, and V^D
2. rules for default $\hat{D}$, consumption $\hat{C}$, and borrowing $\hat{B}$
3. a bond price function $q(B',Y,r,1)$
4. and a renegotiation rule $B^R(B,Y,r)$

such that

1. Given the bond price and the renegotiation rule, the value functions and the policy functions solve the government's problem in (1) to (3)
2. Given the solution to the government's problem and the renegotiation rule, the bond price function solves the Bellman's equations (5) and (6)

3. Given the price and the solution to the government's problem, the renegotiation rule solves the Nash Bargaining game in (4)

4 One period bonds, no renegotiation and debt forgiveness

The framework we presented before allows for enough flexibility to nest an environment similar to that in Arellano (2008) augmented with risk-free interest rate regime switching. Below we calibrate this simplified version of our model to show that the interest rate shock by itself is unlikely to have caused the default in Mexico in 1982.

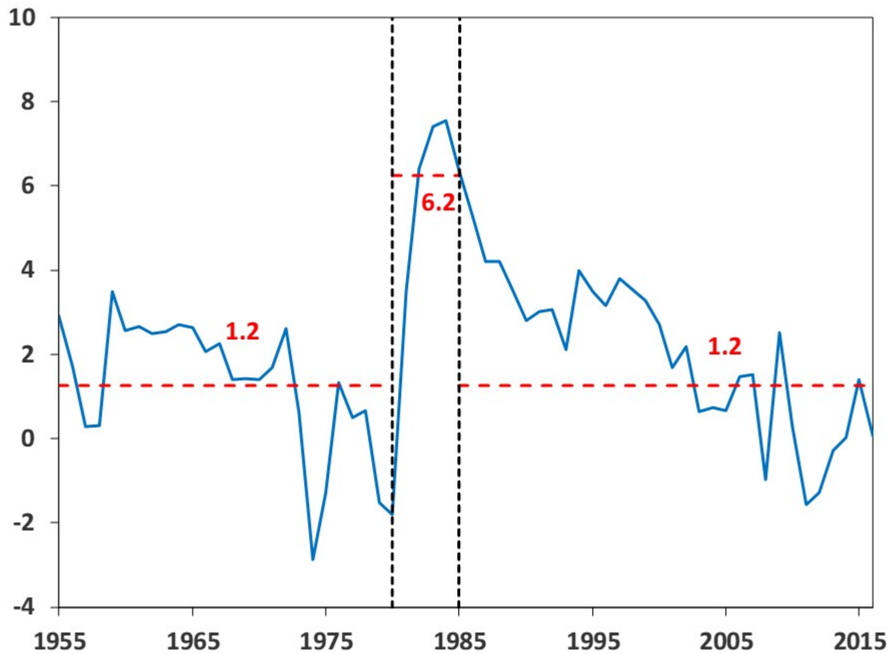
Table 1 presents all parameter values that can be directly calibrated from the data. Each period in the model corresponds to 1 year. Here, we set the coupon rate $\gamma = 1$ so that there are only one-period bonds. Risk aversion is set to a standard value, $\eta = 2$, as in Arellano (2008) and Hatchondo, Martinez, and Sosa-Padilla (2014). Instead of having the debt renegotiation game, we just assume that, after default, debt is forgiven and the government is in financial autarky, with probability θ of regaining access to international financial markets. The AR(1) income process is estimated using HP-filtered logged Mexican GDP data from 1921 to 1983. This yields an auto-correlation parameter $\rho = 0.705$ and a standard deviation of innovation parameter $\sigma = 0.040$.

Table 1: Parameters

Parameters		Values	Details
Pr(high to low r)	$1-\lambda\left(r_H\right)$	0.20	Duration of 5 years
Pr(low to high r)	$\lambda\left(r_L\right)$	0.01	Duration of 100 years
Low risk-free interest rate	r_L	1.2%	1955 - 1980
High risk-free interest rate	r_H	6.2%	1981 - 1985
Coupon rate	γ	1	One period bonds
Risk aversion	η	2	Standard
Lender's bargaining power	α	1	Hatchondo, Martinez, and Sosa-Padilla (2014)
Income process	ρ	0.705	AR(1):
	σ_ϵ	0.040	

The probability of switching from the high risk-free interest rate regime to the low one is set to $1-\lambda\left(r_H\right) = 20\%$ so that it generates an expected duration for the high regime of 5 years. This is the time the Volcker shock lasted in the US economy, as can be seen in Figure 1. Hence, implicitly in our analysis is the assumption the Mexican government had the correct expectation for the duration of high interest rates. We set the probability of switching from the low risk-free interest rate regime to the high one to $\lambda(r_L) = 1\%$ so that shocks like the one we are studying are very infrequent events. Figure 1 also displays the average interest rate during the Volcker shock (1980-1985) and the average interest rate before that (1955-1980)[3]. Therefore, the risk-free interest rate is set to $r_L = 1.2\%$ in the low regime and $r_H = 6.2\%$ in the high regime.

Figure 1: Annual real interest rate of 5-Year Treasury Constant Maturity Rate



Finally, we simplify the output cost for default to be the same as in Arellano (2008):

$$h(y) = \begin{cases} \hat{y} & if\ y > \hat{y} \\ y & if\ y \leq \hat{y} \end{cases}$$

To calibrate the discount factor, β, the probability of reentry, θ, and the parameter for output cost, $\hat{y}$, we follow Arellano (2008) and set these parameters to match three moments

[3]For simplicity we assume for now only two possible states for the risk-free interest rate. An extension to a more complex behavior of the interest rate over time could be included, however our main focus is, for now, comparing unlikely short periods with high interest rates and very likely longer periods with low rates.

of the Mexican economy: a default probability of 3 percent, an average debt service-to-GDP ratio of 6.14 percent, and a standard deviation of the current account (as a fraction of GDP) of 1.31. Table 2 summarizes the calibration of these parameters[4]:

Table 2: Estimated parameters and targeted moments

Parameter	Value	Moment	Target	Model
β	0.882	Probability of default	3	3.14
θ	0.422	Current account / GDP (volatility)	1.31	1.75
$\hat{y}$	0.924	Debt service / GDP (mean)	6.14	6.06

Figure 2 shows the spreads generated by the model for different states (B, Y) in which the government has not defaulted $(\theta = 1)$ and different interest rate regimes. We show (B, Y) corresponding to the state of Mexico right before and at the moment of default (1981 and 1982). We define spreads as $\frac{1}{q(B,Y,r,1)} - 1 - r$ and, in general, they do not seem to be very sensitive to the regime, regardless of the state of income or outstanding debt.

Figure 2: Interest rate spreads for different risk-free regimes

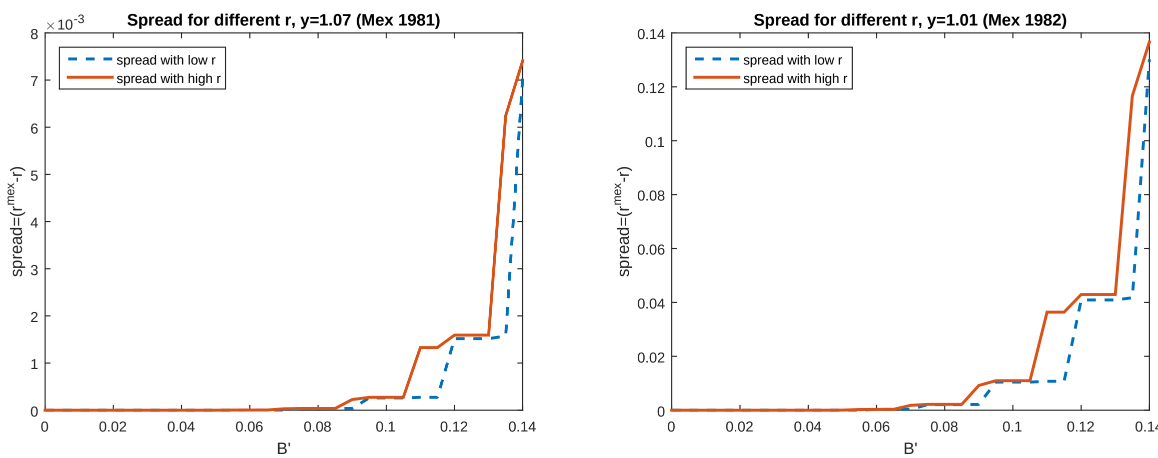
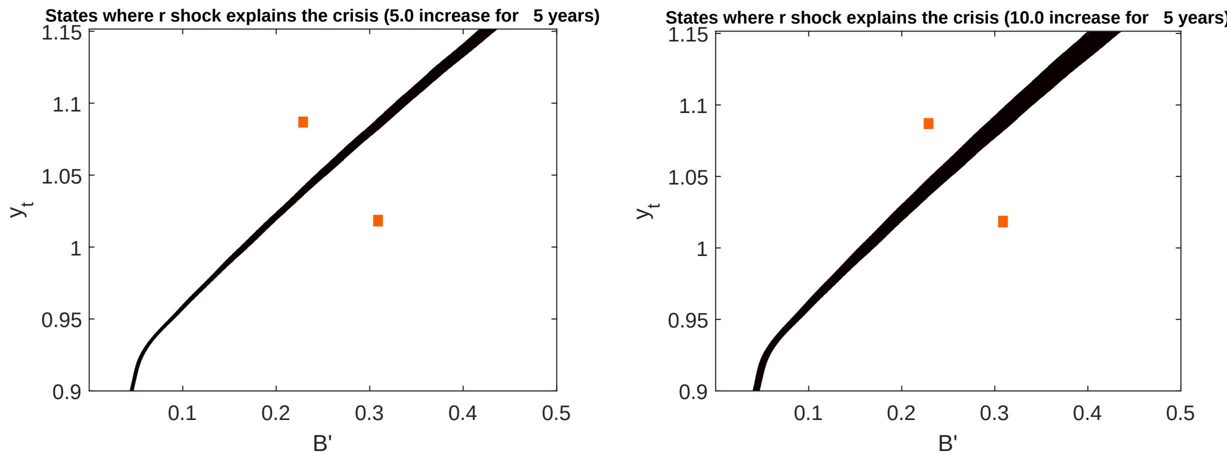


Figure 3 shows the states (B, Y) in which the government defaults independently of the regime, the states in which it repays independently of the regime, and the states in which

[4]In the 100 years prior to and including 1982 the Mexican government defaulted on its debt three times: 1914, 1928 and 1982. In 1899 there was a debt restructuring, however we don't consider this a default episode in the sense of this version of the model since there was no suspension of payments. Moreover, the restructuring in that period was in part promoted by lenders themselves, as Lill (1919) points out: "Due to the increasing prosperity of the nation and the good results which we are beginning to obtain in the finances of the Federal Government, the value of the securities of the public debt has gradually risen, and the question has presented itself in financial circles and those interested in Mexican securities as to the possibility of reducing the annual charge against the nation for debt service."

the government repays only in the low risk-free interest rate regime (the black area). The orange dot to the left and above the black region corresponds to the state of Mexico in 1981, outside the default region, regardless of the interest rate level. The orange dot to the right and below the black region corresponds to Mexico in 1982. The model predicts that, regardless of the Volcker shock, Mexico would have defaulted in 1982.

Figure 3: States in which the Volcker shock explains the crisis



As can be seen, the weak reaction spreads have to changes in risk-free interest rates makes the area in which the Volcker shock explains default events to be small. Indeed, as it can be seen in the second panel of Figure 3, even if the Volcker shock was much higher - with $r_H = 11.2\%$ instead of 6.2% - the Volcker shock would still not explain the crisis in many states, including the actual 1982 Mexican state. We obtain a similar result if we instead increase the expected duration of the Volcker shock from 5 to 10 years: the measure of states for which the shock explains the default just marginally increases (as in the second panel in Figure 3).

5 Long-term bonds

We should be cautious when interpreting the results from Section 4. Figure 2 shows that spreads do not move much once a regime switching occurs and, consequently, the measure of states in which the Mexican default could be attributed to the Volcker shock is small. Therefore, this version of our model is suitable for predicting default decisions, as it does correctly for 1981 and 1982, but not for reproducing spreads dynamics, which are crucial to carry on counterfactual cases.

This is the reason why we introduce long-term debt to the model. Coupled with a quadratic specification for the direct output cost of default, long-term debt allows to match the spread dynamics observed in the data (see Chatterjee and Eyigungor (2012) and Hatchondo, Martinez and Sosa-Padilla (2014)). Thus, changes in risk-free interest rates have a greater impact on government's borrowing cost and can potentially change their default decision. We set $0 < \gamma < 1$ in order to match the average duration of new issuances of Mexican debt. We specify the direct output cost of default to be a quadratic function so that $\phi(Y) = \max\{0, d_0 Y + d_1 Y^2\}$, $d_0 < 0 < d_1$ makes output loss be zero for $0 \leq Y \leq \frac{d_0}{d_1}$ and be more than proportionally increasing for $Y > \frac{d_0}{d_1}$.

6 Renegotiation

Another issue with the simplified version of our model is its mechanical limitation to analyze the duration of the government being in autarky. Having an exogenous probability of regaining access to international financial markets means the model can, at best, mimic the observed expected duration of financial autarky. In order to analyze a counterfactual duration of the crisis we introduce the possibility to renegotiate outstanding debt while in default, which allows regaining access to financial markets to be endogenous.

We say the government is in the default state ($\theta = 0$) if it missed a coupon payment in the previous period. In this version of the model, the level of outstanding debt remains frozen and, in each period while the government is in default, the renegotiation option for both government and lenders is available. We characterize renegotiation with the Nash bargaining game described above, so it only occurs when it is mutually beneficial.

The value for lenders of holding debt from a government in default is, in general, not zero; this is because they take into account the possibility of future renegotiation. This gives the lenders incentives to wait if renegotiation terms are bad. From the point of view of the government it is crucial that debt is not forgiven after default. The government takes into account the fact that accumulating too much debt makes coming back from financial autarky harder after default.

With this extension we validate the model by evaluating its ability to predict both the default decision of Mexico in 1981/1982 (repay and default, respectively) and the decisions between 1983-1989 (remain in default until the last year and, finally, renegotiate). We can then proceed to evaluate the counterfactual case without the Volcker shock and compare the duration that the model predicts with the observed seven years.

7 Conclusion

This is a work in progress aimed to study what were the causes of the debt crisis in Latin America in the 1980s and its duration. We document how it is very unlikely that the increase in U.S. interest rates was the main driver of the default in Mexico and, subsequently, in other Latin American countries. We developed an environment that can be useful to analyze not only if the Volcker shock was the trigger of the debt crisis, but also if the shock prolonged it.

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