Dollarization and Default Risk

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Abstract

The welfare costs of dollarization trade off the benefit of lower inflation against the cost of the loss of seignorage, the cost of the initial open market operation to purchase the money supply, and the increased probability of default induced by the first two. We evaluate the welfare costs of dollarization in a small open economy model of defaultable debt with money and international reserves calibrated to Ecuador which dollarized in 2000. The welfare cost of dollarization in an economy with 90% of debt-to-GDP can be as high as 1.75% of permanent consumption. This cost can be expressed in terms of a break-even permanent level of inflation that increases non-linearly between 40% and 150% with the stock of initial debt. We also compute conditional default probabilities between a dollarized and a local currency economy and find that dollarization can lead to increased default incentives, particularly in the short run highlighting that the initial stocks of debt, reserves and money matter.

JEL codes: E21, E42, E43, E58, F33, F34, H63.

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1 Introduction

- What we do, how and why
  - Dollarization = unilateral adoption of a foreign currency as the official currency of a country. Recent examples: Ecuador, El Salvador fechas
  - This paper studies the welfare cost of dollarization in a model of sovereign debt stemming from default risk.Arellano (2008); Bianchi et al. (2018) We find that . . . , en terminos de consumo y break-even inflation.
- the case of Ecuador
  - explicar breve historia
  - grafico de monetary base para ilustrar que com,prarpon xx% de gfp, que cuesta tanto seignorage y eleva net foregn debt
- this paper's value added relative to the literature
  - The analysis of the cost and benefit of dollarization is typically embedded in the analysis of optimal currency areas: Mundell (1961), Friedman (1953), Neumeyer (1998).
  - Dollarization is more than the adoption of a fixed XR because od seignorga (Fischer (1982))
  - This paper adds the welfare effect of dollarization stemming from default risk, which goes further and above Caravello et al. (2023); Fischer (1982)
    - agregar al grafico que separa fisher un aree con Caravello et al. (2023)

Emerging countries that cannot commit to a low-inflation regime consider adopting a low-inflation foreign currency instead of their own as way of putting an end to chronic inflation. Dollarization is the adoption of the United States dollar as a national currency in a country other than the United States. Ecuador and El Salvador are two emerging economies that became fully dollarized in the early 2000s. The literature on dollarization stresses the loss of seignorage as one of the costs of this shortcut to monetary stability (Fischer (1982)). However, dollarization requires a large open market operation by which the government buys back the whole stock of national currency using its international reserves or issuing foreign debt. If foreign debt is issued, dollarization causes a large initial increase in the stock of foreign debt of the small open economy. Moreover, money demand is now a demand of US dollars that the economy cannot costlessly supply, and thus, the economy's budget constraint requires real money demand growth to be financed through trade surpluses or foreign debt. Thus, dollarization and foreign debt dynamics appear to be intertwined.

In this paper, we perform a welfare analysis of dollarization as well as a study of the effect of dollarization on default incentives. We develop a small-open economy model with limited enforceability of foreign debt contracts in the spirit of Eaton and Gersovitz (1981) and Arellano (2008). The economy is allowed to dollarize or maintain the national currency. We find that dollarization increases default incentives only in the short run and when the economy is forced to issue to debt to finance the initial open market operation to buy back the stock of national currency. However, in the long run, the unfavorable cost of borrowing leads to incentives to delever and the dollarized economy does not default more often than the national currency economy.

We introduce a pair of conditional probabilities to measure the effect of dollarization on default incentives. Default incentives in both the dollarized and local currency economies can be thought of in terms of default sets which specify the levels of output for which each economy defaults. From these default sets, we define two conditional probabilities which measure the extent to which dollarization increases and decreases default incentives with respect to the benchmark economy. The former is the probability that the dollarized economy defaults given that the national currency economy does not default. The latter, on the other hand, is the probability that the dollarized economy does not default given that the national currency economy defaults. We will show that when output is low and debt is high, these probabilities point to dollarization increasing default incentives. On the other hand, as output increases default becomes costly and dollarization lowers default incentives.

Finally, we perform a welfare analysis of dollarization. To this end we compute the welfare cost in terms of permanent consumption as well as the break-even permanent inflation rate that would be necessary for dollarization to be welfare-enhancing. We find that the welfare cost of dollarization in an economy with an initial debt of 20% of GDP is 1.75% of permanent consumption.

The Ecuadorian experience. This paper was motivated by the Ecuadorian dollarization that occurred in 2000. During 1998 and 1999, Ecuador suffered a profound economic crisis. A banking crisis in 1998 was followed by a default and restructuring of Ecuador's external debt in 1999 and 2000. The Ecuadorian sucre to US dollar exchange rate increased from 4,438 sucres per dollar to 18,287 sucres per dollar between December 1997 and December 1999. In January 2000, the Ecuadorian government announced that the dollar would replace the Ecuadorian sucre as the official currency. The dollar became legal tender in March 2000 and sucres remained exchangeable for dollars until March 2001 at a fixed exchange rate of 25,000 sucres per dollar.

The dollarization process requires the central bank to be able to exchange the circulating local currency and bank reserves, that is, the monetary base, for US dollars. However, one should also consider highly liquid assets that the central bank would need to exchange to dollars upon liquidation. In this sense, in 1999 the Central Bank of Ecuador had US$356.1 million outstanding in bonds to private entities. The monetary base alone amounted to US$770.2 million in 1999 while all highly liquid liabilities of the central bank were US$1254.5 million. However, international reserves amounted to US$872.7 million.

Hence, dollarization requires an initial open market operation in which the central bank exchanges the stock of local currency for US dollars. This is usually accompanied by a devaluation of the local currency to facilitate this trade with the available international reserves. However, it might be too costly for the central bank to use up all of its international reserves or to devalue the currency. In this case, the remaining stock of local currency can be exchanged for dollars financed by the issuance of foreign debt.

To see this, consider the aggregate budget constraint of a dollarized economy. In real terms, it is given by

$$m_{t+1} - \frac{m_t}{\pi_t} = y_t - c_t + b_t - q_t b_{t+1} + f_t - q_f f_{t+1}$$

where m denotes end-of-period dollar holdings, y denotes output, c denotes consumption, b denotes a discount bond (negative if debt), f denotes international reserves, and q, q_f are the discount prices. Hence, increases in real dollar balances must be financed by trade surplus, debt issuance, or depletion of international reserves.

Figure 1 presents each component of the balance of payments for Ecuador between 1999 and 2019 and the stock of US dollars (monetary base) in terms of GDP. By the end of 1999, the stock of sucres was 4% of GDP. Following dollarization, the stock of dollars increased to 9% of GDP which remained stable until 2007. From then on, it increased until it reached 22% in 2016.

In the years 1999 and 2000, Ecuador defaulted and restructured its foreign public debt with a haircut close to 40%, which led to a large reduction in government debt.

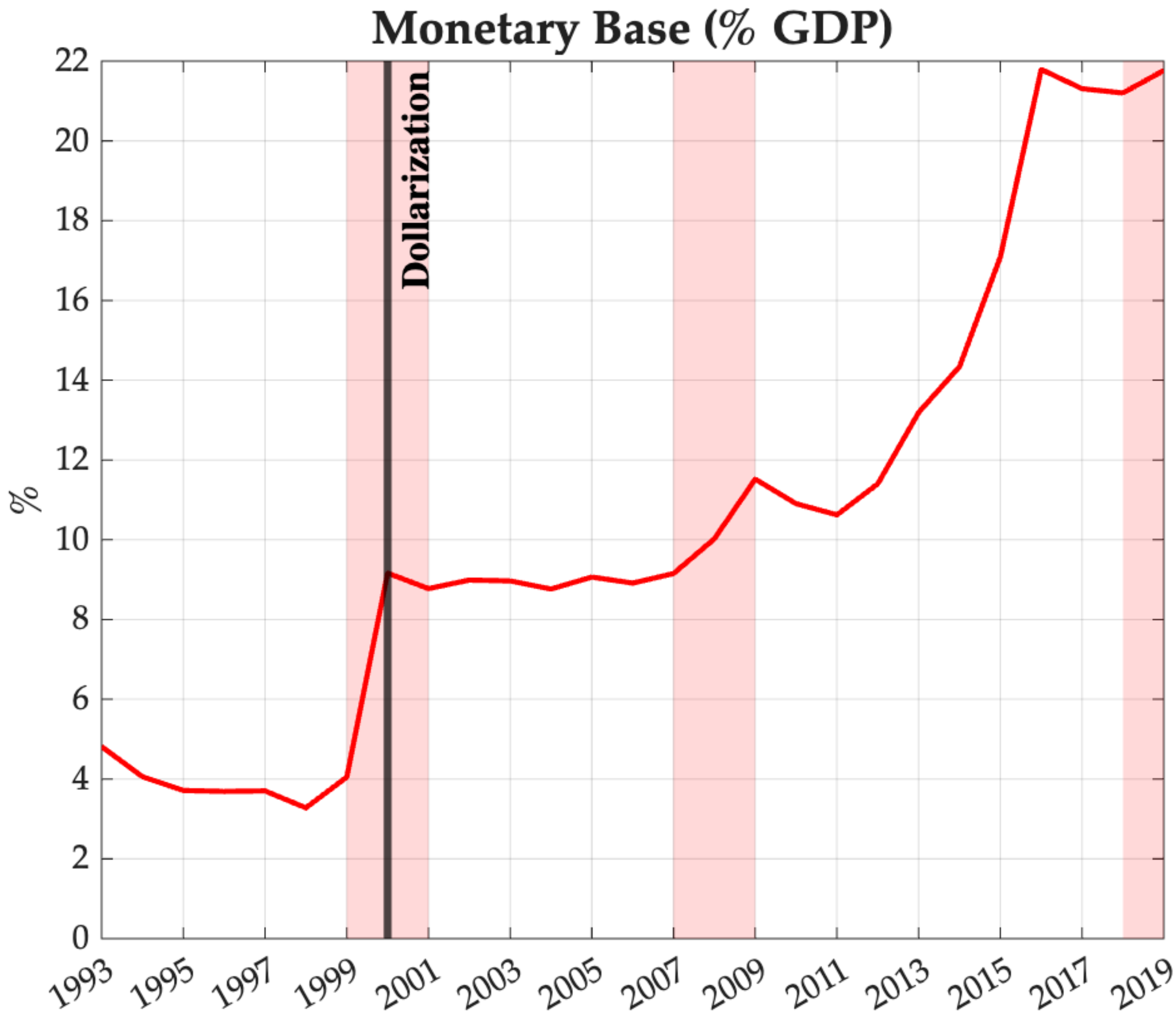


Figure 1: Monetary base in Ecuador between 1999 and 2019. Monetary base is expressed in terms of GDP. Source: Central Bank of Ecuador.
nota explicando como hacen la cuenta de la BM, en particular billetes en circulacion

Literature review. The literature on dollarization has addressed both its costs and benefits in terms of loss of seignorage, price stability, stabilization policy, transaction costs and financial integration. Borensztein and Berg (2000) identify advantages of dollarizing in that it lowers borrowing costs and deepens financial markets and disadvantages in that seignorage is transfered to the United States. Alesina and Barro (2002) argue that dollarization implies losing a stabilization device but gains credibility and reduces inflation but Fischer (1982) warns against the loss of seignorage that dollarization implies. Calvo (2002) states that dollarization could be preferable in emerging economies where despite fixed exchange rate regimes, domestic interest rates remain high in fear of devaluation.

Arellano and Heathcote (2010) argue that dollarization increases incentives to repay debts and increases access to financial markets in a context of low interest rates. More recently, Caravello et al. (2023) show that the effects of dollarization when the economy has a low stock of dollar holdings are similar to those of a sudden stop. However, the interaction of sovereign debt default and dollarization is not yet explored.

The paper is organized as follows: Section 2 presents the models and characterizes the equilibria, Section 3 presents the calibrations and evaluates the quantitative implications of the model, Section 4 presents the welfare analysis and Section 5 concludes.

2 The Model

We develop a small open economy model of sovereign default with money and international reserves. The model embeds two monetary regimes within an otherwise standard Eaton and Gersovitz (1981) framework. The setting is designed to capture three forces relevant for the welfare analysis of dollarization: the loss of seignorage emphasized by Fischer (1982); the budgetary cost of the open market operation required to retire the local-currency monetary base; and the equilibrium response of sovereign default risk to both.

2.1 Environment

Setting. Time is discrete and infinite denoted by $t \in \{0, 1, 2, \ldots\}$. We model a small, open economy with a representative household that receives a stochastic stream of a single tradable good. Households use real balances to purchase the consumption good, which we capture through a money-in-the-utility specification. A benevolent government with limited commitment borrows and saves through two types of assets: a defaultable long-term bond (foreign debt) and a risk-free one-period bond (international reserves). Deep-pocketed, risk-neutral foreign financiers are the counterparty of these trades. Every period, the government chooses to repay or default on its foreign debt. Then, it chooses consumption, real money holdings, foreign debt, and international reserves to maximize the expected lifetime utility of a representative household.

We compare two permanent monetary regimes. Under a local-currency regime, the central bank supplies local currency to target a constant inflation rate and rebates the seignorage revenue to the household as a lump-sum transfer. Under a dollarized regime, the economy adopts the United States dollar as currency, and by the law of one price, domestic inflation equals the US inflation rate. In a dollarized regime, no seignorage accrues to the domestic government. In both regimes, the government may default on its external debt, which entails a temporary output loss and exclusion from international debt markets.

Preferences. The economy is populated by an infinitely-lived representative household with preferences

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t, m_t), \tag{1}$$

where $\beta \in (0,1)$ is the discount factor, c_t denotes consumption of the tradable good, and m_t denotes real money balances chosen in period t and carried into $t+1$. The period utility function u features a constant elasticity of substitution between consumption and real balances

$$u(c_t, m_t) = \frac{\left[\kappa c_t^{1-\psi} + (1-\kappa) {m_t}^{1-\psi}\right]^{\frac{1-\sigma}{1-\psi}}}{1-\sigma}, \tag{2}$$

where $\sigma > 0$ is the inverse of the elasticity of intertemporal substitution, $\psi > 0$ is the inverse of the elasticity of substitution between consumption and real balances, and $\kappa \in (0,1)$ is the consumption weight.

Endowment. In every period t, the household receives a stochastic stream of a tradable good y_t. This endowment follows a first-order stationary Markov process in logarithms

$$\log y_{t+1} = \rho \log y_t + \varepsilon_{t+1}, \tag{3}$$

where the persistence parameter is $\rho \in (0,1)$ and the innovation is independent and identically-distributed over time $\varepsilon_{t+1} \sim \mathcal{N}(0, \sigma_\varepsilon^2)$.

Financial Assets. There are three financial assets: money, a risk free bond, and a defaultable bond with an exponentially decaying coupon.

The household chooses real money holdings $m_t \equiv M_t/P_t$ in period t, where M_t are nominal money holdings and P_t is the price level in the small open economy.

The government issues long-term debt with geometrically-decaying coupons, as in Hatchondo and Martinez (2009). A bond issued in period t has a payoff of $\delta(1-\delta)^{j-1}$ units of the tradable good at $t+j$ for $j \geq 1$, where $\delta \in (0,1]$ governs the duration equal to $1/\delta$. This can be interpreted as a bond in which a fraction δ matures and pays principal every period, while the remaining $1-\delta$ survives into the next period. The case $\delta = 1$ corresponds to a one-period bond. Let $b_t \in [0, \bar{b}\,]$ denote the face value of outstanding debt entering period t, where $\bar{b}$ is a sufficiently large upper bound that rules out Ponzi schemes. New issuance equals $b_{t+1} - (1-\delta)b_t$ and is sold at the endogenous price q_t.

The government can accumulate risk-free reserves $f_{t+1} \geq 0$ at constant price $q^f = R^{-1}$, where R is the gross international risk-free rate which we assume to be constant. These reserves mature in one period and pay a unit of consumption good.

Default. In every period, the government chooses to default on its outstanding debt stock b_t if the value of default exceeds the value of repayment. The values of default and repayment are determined endogenously but are subject to exogenous independent Gumbel shocks ϵ_t^d and ϵ_t^r, respectively. These shocks are independent over time with mean zero and scale parameter ς. We use a default indicator $d_t \in \{0,1\}$ to denote the default decision in period t. A default entails a complete repudiation of outstanding debt, and we assume that defaulted debt has no recovery value for the lender, which implies that upon reentry to debt markets, outstanding debt is zero. However, in doing so, the economy faces two penalties. First, it is excluded from debt markets for one period and reentry occurs with exogenous probability $\theta \in (0,1)$. Second, the economy suffers an exogenous endowment loss captured by a continuous, non-decreasing, and convex function of the endowment $\ell_D(y) \equiv \max\{0, \alpha_0 y + \alpha_1 y^2\}$, with $\alpha_0 \in \mathbb{R}$ and $\alpha_1 > 0$.

Foreign Financiers. The international credit market is populated by a continuum of deep-pocketed competitive foreign financiers. They observe the full state of the economy at every period and price defaultable debt to break even in expectation. The value of purchasing one unit of the tradable good in sovereign debt is

$$\mathcal{V}_t = \mathbb{E}_t \left[\sum_{j=1}^{\infty} \Lambda_{t,t+j} \left(\prod_{k=1}^{j} \widetilde{p}_{t+k} \right) \delta(1-\delta)^{j-1} \right], \tag{4}$$

where $\Lambda_{t,t+j}$ is an exogenous stochastic discount factor (SDF) between periods t and $t+j$, and $\widetilde{p}_{t+j}$ is the financiers' perceived conditional probability that the sovereign repays in period $t+k$, conditional on no previous default. This value satisfies a recursive representation given by

$$\mathcal{V}_t = \mathbb{E}_t \left\{ \Lambda_{t,t+1} \widetilde{p}_{t+1} \left[\delta + (1-\delta)\mathcal{V}_{t+1} \right] \right\}, \tag{5}$$

where we assumed that the SDF has the property $\Lambda_{t,t+j} = \prod_{k=0}^{j-1} \Lambda_{t+k,t+k+1}$ for $j \geq 1$.

We assume that lenders are subject to exogenous shocks to risk aversion, captured by the following SDF

$$\Lambda_{t,t+1} = R^{-1} \exp\Big(- \xi_t \, \varepsilon_{t+1} \; - \; \tfrac{1}{2} \, \xi_t^2 \, \sigma_\varepsilon^2 \Big) \,, \tag{6}$$

as in Bianchi et al. (2018). The random variable ξ_t follows a two-state Markov chain with states $\{\xi_L, \xi_H\}$ and transition probabilities π_{LH} and π_{HL}. We set $\xi_L = 0$, so that in low-risk states, lenders price debt in a risk-neutral fashion. The SDF (6) loads on ε_{t+1}, the innovation to the endowment. When $\xi_t > 0$, $\Lambda_{t,t+1}$ decreases in ε_{t+1} as lenders price the repayments received in low-income states more heavily, which is when default is most likely, generating an equilibrium spread above the risk-free rate. The Jensen correction term $-\frac{1}{2}\xi_t^2\sigma_\varepsilon^2$ ensures $\mathbb{E}_t[\Lambda_{t,t+1}] = R^{-1}$ for any ξ_t, so that ξ_t shifts the price of income risk without altering the risk-free rate, and the model nests risk-neutral pricing at $\xi_t = 0$. The choice of loading the SDF directly on ε_{t+1}, rather than on a separate global factor, is a parsimonious reduced form for a stand-in international lender whose risk-bearing capacity covaries with the fundamentals of emerging markets.

Monetary Regime. We denote the currency regime by $\mathcal{R} \in \{LC, D\}$, where LC stands for local currency and D for dollarized. We assume that under a local-currency regime, the central bank targets a constant inflation rate π across time. The market-clearing condition that determines the price level is $P_t = \overline{M}_t / m_t$, where $\overline{M}_t$ is the money supply controlled by the central bank. For inflation to be constant, we assume that the rate of growth of the nominal money supply is proportional by a constant π to the rate of growth of the real money demand, i.e., $\overline{M}_{t+1}/\overline{M}_t = \pi \, m_{t+1}/m_t$. By our assumption of free-trade and small open economy, this monetary regime also determines the nominal exchange rate $\mathcal{E}_t$ through the law of one price $P_t = \mathcal{E}_t P_t^*$, where P_t^* is the price level in the United States. Hence, this monetary policy rule is equivalent to a crawling peg regime in the exchange rate that devalues the local currency at the rate π/π^*, where π^* is the gross inflation rate in the US, which we assume to be constant. Under a dollarized regime, the economy adopts the U.S. dollar as currency so that $\mathcal{E}_t = 1$ for all t. Through the law of one price, this implies that $P_t = P_t^*$ and inflation is constant and equal to US inflation.

Budget Constraints. We describe the budget constraints for households, the government, and the aggregate one for the country.

Let T_t denote a real lump-sum tax (or transfer if negative) from the government to the household. The household's flow budget constraint in real terms is

$$c_t + m_t - m_{t-1} + \frac{\pi - 1}{\pi} m_{t-1} \;=\; y_t - T_t, \tag{7}$$

Equation (7) shows that real after-tax income is spent on consumption, accumulation of real balances, and the inflation tax.

The consolidated government services foreign debt, accumulates reserves, and, under the local-currency regime only, collects seignorage. The government's consolidated flow budget constraint in real terms is

$$\delta b_t \left(1 - d_t\right) + q_f\, f_{t+1} \;=\; T_t + f_t + q_t \left(1 - d_t\right) \left[b_{t+1} - \left(1 - \delta\right) b_t\right] + \left(m_t - \frac{m_{t-1}}{\pi}\right) \left(1 - \mathbf{1}_t^D\right). \tag{8}$$

Equation (8) lists the consolidated government's outflows on the left-hand side and its inflows on the right-hand side. The government pays a coupon δb_t on its outstanding debt if it decides to repay (i.e. $d_t = 0$), and saves $q_f f_{t+1}$ in a one-period risk-free bond (international reserves). The government finances these outflows through lump-sum taxes T_t, maturing risk-free bonds f_t, new long-term debt issuance $b_{t+1} - (1-\delta)b_t$ if it decides to repay its outstanding debt (i.e. $d_t = 0$), and seignorage revenue $m_t - m_{t-1}/\pi$ if it issues the local currency (i.e. $\mathbf{1}_t^D = 0$).

Combining (7) and (8) yields the economy's current account balance:

$$\delta b_t(1 - d_t) + \left(q_f\, f_{t+1} - f_t\right) + \left(m_t - \frac{m_{t-1}}{\pi}\right) \mathbf{1}_t^D \;=\; y_t - c_t + q_t(1 - d_t)\left[b_{t+1} - (1-\delta)b_t\right]. \tag{9}$$

Under the local-currency regime and without default, trade surplus and debt issuance finance servicing the debt and reserve accumulation. In this regime, money demand growth is financed domestically and does not enter the balance of payments. By contrast, in a dollarized regime, increases in real money demand must be financed externally, through trade surpluses, debt issuance, or reserve depletion.

We can write the balance of payments identity (9) in terms of an economy-wide risk-free asset a_t. That is, we define $a_t \equiv f_t + m_{t-1}/\pi$, which is the sum of the stock of risk-free bonds held by the government and the real money stock brought into period t by the household. We can then rewrite (9) as

$$\delta b_t(1 - d_t) + \left(q_f\, a_{t+1} - a_t\right) + \frac{i - 1}{i} m_t \;=\; y_t - c_t + q_t(1 - d_t)\left[b_{t+1} - (1-\delta)b_t\right] + \tau_t, \tag{10}$$

where $i \equiv R\pi$ is the ex-post risk-free nominal gross interest rate and $\tau_t \equiv \left(m_t - m_{t-1}/\pi\right)(1 - \mathbf{1}_t^D)$ is the seignorage rebate from the government to the household. The left-hand side lists the use of funds: debt service, reserve accumulation, and real money balances. The right-hand side lists the source of funds: trade surplus, debt issuance, and seignorage transfer to the household. When the economy is dollarized, the seignorage transfer is zero ($\tau_t = 0$) and the economy loses a source of funding.

2.2 Optimization Problems

We describe the timing assumptions and then set up the benevolent government's problem in recursive form and the foreign financiers' static problem.

Timing. The economy is in a currency regime $\mathcal{R}$. Given an outstanding stock of government debt b, a stock of economy-wide risk-free assets a, and after observing the exogenous states $(\xi, y, \epsilon^r, \epsilon^d)$, the economy chooses to default ($d = 1$) or repay ($d = 0$). If it defaults, the government chooses consumption c, real balances m', and risk-free assets a' subject to its balance of payments in default. If it repays, the government chooses consumption c, real balances m', risk-free assets a', and debt holdings b' subject to the balance of payments. The price of defaultable debt q adjusts so that the debt market clears.

Government. In every period, a benevolent government under a monetary regime $\mathcal{R}$ with outstanding debt b, risk-free assets a, and an exogenous state for lenders' risk aversion and endowment $s \equiv (\xi, y)$, has the option to default or repay with value

$$\hat{v}(b, a, s, \varepsilon^r, \varepsilon^d; \mathcal{R}) = \max\left\{v^r(b, a, s; \mathcal{R}) + \varepsilon^r, v^d(a, s; \mathcal{R}) + \varepsilon^d\right\}, \tag{11}$$

where $v^r(b, a, s; \mathcal{R})$ is the value of repayment and $v^d(a, s; \mathcal{R})$ is the value of default. Both values are subject to additive shocks $(\varepsilon^r, \varepsilon^d)$ that are independent and follow a Gumbel distribution with mean zero and a common scale parameter ς. We denote the expectation of the option value function $\hat{v}$ over the Gumbel shocks by $v(b, a, s; \mathcal{R}) \equiv \mathbb{E}_{\varepsilon^r, \varepsilon^d}[\hat{v}(b, a, s, \varepsilon^r, \varepsilon^d; \mathcal{R})]$. The associated probability of repayment is given by $p(b, a, s; \mathcal{R}) \equiv \mathbb{P}_{\varepsilon^r, \varepsilon^d}[\varepsilon^d - \varepsilon^r \leq v^r(b, a, s; \mathcal{R}) - v^d(a, s; \mathcal{R})]$, where $\varepsilon^d - \varepsilon^r$ follows a Logistic distribution with mean zero and scale parameter ς. These shocks are useful for computational purposes since they smooth value and policy functions, as well as the bond pricing functions. However, we do not assign any economic meaning to these shocks, and we set the scale parameter small enough to not have any economic implications. Under these assumptions, following McFadden (1973), the value function $v(b, a, s; \mathcal{R})$ and the repayment probability $p(b, a, s)$ have the closed forms below

$$v(b,a,s;\mathcal{R}) = \varsigma \ln \left[\exp(v^r(b,a,s;\mathcal{R})/\varsigma) + \exp\left(v^d(a,s;\mathcal{R})/\varsigma\right)\right], \tag{12}$$

$$p(b,a,s;\mathcal{R}) = \frac{\exp(v^r(b,a,s;\mathcal{R})/\varsigma)}{\exp\left(v^d(a,s;\mathcal{R})/\varsigma\right) + \exp(v^r(b,a,s;\mathcal{R})/\varsigma)}. \tag{13}$$

We now define the value functions of repayment and default. The value of repayment is given by

$$v^r(b,a,s;\mathcal{R}) = \max_{c,m',b',a'} u(c,m') + \beta \mathbb{E}_{s'}[v(b',a',s';\mathcal{R})|s], \tag{14}$$

subject to

$$c = y + a + \tau(\mathcal{R}) - \delta b + q(b',a',s;\mathcal{R})[b' - (1-\delta)b] - q_f a' - \frac{i-1}{i} m', \tag{15}$$

$$a' \geq m'/\pi. \tag{16}$$

The seignorage rebate in the balance of payments equation (15) is given by $\tau(\mathcal{R}) = (m' - m/\pi)(1 - \mathbf{1}^D(\mathcal{R}))$, where $\mathbf{1}^D(\mathcal{R})$ is an indicator function of the currency regime such that $\mathbf{1}^D(\mathcal{R}) = 1$ if $\mathcal{R} = D$ and 0 if otherwise. As we show below, the price of debt is, in equilibrium, a function of newly issued debt, newly accumulated reserves, and the future realisation of the exogenous shocks. We assume that the government internalises the effect of debt issuance and reserve accumulation on the price of debt q. The constraint in equation (16) is the non-negativity constraint in international reserves and follows from the definition of risk-free assets a.

In default, the economy does not service the debt but faces temporary exclusion from debt markets and an endowment loss. However, when it re-enters credit markets, it does so with zero debt outstanding. The value of default is then given by

$$v^d(a,s;\mathcal{R}) = \max_{c,m',a'} u(c,m') + \beta \mathbb{E}_{s'}\left[\theta v(0,a',s';\mathcal{R}) + (1-\theta) v^d(a',s';\mathcal{R}) \middle| s\right], \tag{17}$$

subject to

$$c = y - \ell_D(y) + a + \tau(\mathcal{R}) - q_f a' - \frac{i-1}{i} m' \tag{18}$$

$$a' \geq m'/\pi \tag{19}$$

For a given monetary regime $\mathcal{R}$, the solution to the government's recursive problem yields decision rules for bond holdings $\widehat{b}^r_{\mathcal{R}}(b,a,s)$, consumption under repayment and default $\{\widehat{c}^r_{\mathcal{R}}(b,a,s), \widehat{c}^d_{\mathcal{R}}(a,s)\}$, real balances under repayment and default $\{\widehat{m}^r_{\mathcal{R}}(b,a,s), \widehat{m}^d_{\mathcal{R}}(a,s)\}$, and economy-wide risk-free assets under repayment and default $\{\widehat{a}^r_{\mathcal{R}}(b,a,s), \widehat{a}^d_{\mathcal{R}}(a,s)\}$.

Foreign Financiers. Foreign financiers are risk averse and price sovereign debt using their stochastic discount factor. A financier who purchases B units of sovereign debt, takes the price q as given and maximises their risk-adjusted payoff every period

$$\max_{B\geq 0} \left(\mathcal{V}(\widetilde{p},s;\mathcal{R}) - q\right) B, \tag{20}$$

where $\mathcal{V}(\widetilde{p},s;\mathcal{R}) = \mathbb{E}_{s'}\left\{\Lambda(s,s')\widetilde{p}\left[\delta + (1-\delta)\mathcal{V}(\widetilde{p}\,',s';\mathcal{R})\right] \middle| s\right\}$. The perceived probability of repayment $\widetilde{p}$ evolves according to some function $\widetilde{p}\,' \sim \mathcal{P}(b,a,s;\mathcal{R})$ of the state. An equilibrium with positive and finite debt levels requires that bond prices satisfy the following recursion

$$q(\widetilde{p},s;\mathcal{R}) = \mathbb{E}_{s'}\left\{\Lambda(s,s')\widetilde{p}\left[\delta + (1-\delta)q(\widetilde{p}\,',s';\mathcal{R})\right] \middle| s\right\}. \tag{21}$$

We define the spread on defaultable debt as the difference between the required promised return on a buy-and-hold strategy and the risk-free rate, i.e. $\omega(\widetilde{p},s;\mathcal{R}) \equiv I(\widetilde{p},s;\mathcal{R}) - R$ where the required promised return is defined implicitly by

$$q(\widetilde{p},s;\mathcal{R}) = \sum_{j=1}^{\infty} \frac{\delta(1-\delta)^{j-1}}{(I(\widetilde{p},s;\mathcal{R}))^j}, \tag{22}$$

which after manipulation can be written as $I(\widetilde{p},s;\mathcal{R}) = 1-\delta+\delta/q(\widetilde{p},s;\mathcal{R})$. The promised return of a buy-and-hold strategy is equal to the capital gain value of the remaining unmatured bond plus the maturing coupon payment, divided by today's price.

3 Equilibrium

In this section, we define and characterise the equilibrium of the model outlined above. We then derive our main result that links dollarization and default risk.

We start by defining an equilibrium in this model as follows:

Definition 1. *For a given monetary regime $\mathcal{R}$, a Markov-perfect competitive equilibrium is a set of*

1. *government value functions* $\{\widehat{v}_{\mathcal{R}}, \widehat{v}^r_{\mathcal{R}}, \widehat{v}^d_{\mathcal{R}}\}$,

2. *policy functions for debt* $\{\widehat{b'}_{\mathcal{R}}\}$*, consumption* $\{\widehat{c}^r_{\mathcal{R}}, \widehat{c}^d_{\mathcal{R}}\}$*, real balances* $\{\widehat{m'}^r_{\mathcal{R}}, \widehat{m'}^d_{\mathcal{R}}\}$*, and national risk-free assets* $\{\widehat{a'}^r_{\mathcal{R}}, \widehat{a'}^d_{\mathcal{R}}\}$ *under repayment* (r) *and default* (d)*,*

3. *perceived and actual probabilities of repayment* $\{\widetilde{p}, \widehat{p}_{\mathcal{R}}\}$ *and*

4. *a bond pricing function* $\widehat{q}_{\mathcal{R}}$*,*

such that

1. *the value functions solve the government's recursive problems* (14) - (19)*,*

2. *the policy functions are the optimal choices to the government's recursive problems* (14) - (19)*,*

3. *the bond pricing function is consistent with the financiers' problem and satisfies* (21)*, and*

4. *the financiers' perceived repayment probability are consistent with actual repayment probabilities determined by* (13)*.*

In equilibrium, the debt pricing equation (21) together with actual repayment probabilities (13) imply that the equilibrium price of debt is

$$q(b', a', s; \mathcal{R}) = \mathbb{E}_{s'|s} \left\{ \Lambda(s, s') p(b', a', s'; \mathcal{R}) \left[\delta + (1-\delta) q(b'', a'', s'; \mathcal{R}) \right] \right\} \tag{23}$$

where $b'' \equiv \widehat{b'}_{\mathcal{R}}(b', a', s')$ and $a'' \equiv \widehat{a'}^r_{\mathcal{R}}(b', a', s')$. Lenders internalise that the probability of repayment depends on the level of debt, the level of national risk-free assets, the level of output, and the risk aversion state.

3.1 Dollarization and Default Risk

We now study the interaction between dollarization and default risk. We first describe how default risk distorts the equilibrium relative to the full-commitment benchmark. Then, we show that dollarization can induce a one-time large decrease in net-foreign assets that increases default risk.

For a currency regime $\mathcal{R}$, the optimality conditions that discipline consumption, demand for real balances, national risk-free assets, and debt are given by

$$\frac{{m'}_{\mathcal{R}}^{r}}{c_{\mathcal{R}}^{r}} \leq \left(\frac{1-\kappa}{\kappa}\right)^{1/\psi} \left(\frac{i-1}{i}\right)^{-1/\psi}, \tag{24}$$

$$\frac{{m'}_{\mathcal{R}}^{d}}{c_{\mathcal{R}}^{d}} \leq \left(\frac{1-\kappa}{\kappa}\right)^{1/\psi} \left(\frac{i-1}{i}\right)^{-1/\psi}, \tag{25}$$

$$q_f \geq \beta \mathbb{E}_{s'} \left[p'_{\mathcal{R}} \frac{u_c({c'}_{\mathcal{R}}^{r}, {m''}_{\mathcal{R}}^{r})}{u_c(c_{\mathcal{R}}^{r}, {m'}_{\mathcal{R}}^{r})} + (1-p'_{\mathcal{R}}) \frac{u_c({c'}_{\mathcal{R}}^{d}, {m''}_{\mathcal{R}}^{d})}{u_c(c_{\mathcal{R}}^{r}, {m'}_{\mathcal{R}}^{r})} \bigg| s \right] + q_{a\mathcal{R}}[b'_{\mathcal{R}} - (1-\delta)b], \tag{26}$$

$$q_f \geq \beta \mathbb{E}_{s'} \left\{ \theta \left[p'_{\mathcal{R}} \frac{u_c({c'}_{\mathcal{R}}^{r}, {m''}_{\mathcal{R}}^{r})}{u_c(c_{\mathcal{R}}^{d}, {m'}_{\mathcal{R}}^{d})} + (1-p'_{\mathcal{R}}) \frac{u_c({c'}_{\mathcal{R}}^{d}, {m''}_{\mathcal{R}}^{d})}{u_c(c_{\mathcal{R}}^{d}, {m'}_{\mathcal{R}}^{d})} \right] + (1-\theta) \frac{u_c({c'}^{d}, {m''}^{d})}{u_c(c^{d}, {m'}^{d})} \bigg| s \right\}$$
$$+ q_{a\mathcal{R}}[b'_{\mathcal{R}} - (1-\delta)b], \tag{27}$$

$$q_{\mathcal{R}} + q_{b\mathcal{R}}[b'_{\mathcal{R}} - (1-\delta)b] = \beta \mathbb{E}_{s'} \left\{ p'_{\mathcal{R}} \frac{u_c({c'}_{\mathcal{R}}^{r}, {m''}_{\mathcal{R}}^{r})}{u_c(c_{\mathcal{R}}^{r}, {m'}_{\mathcal{R}}^{r})} [\delta + (1-\delta) q'_{\mathcal{R}}] \bigg| s \right\}, \tag{28}$$

where $x_{\mathcal{R}}^{o} = \hat{x}^{o}(b, a, s; \mathcal{R})$ for any variable x, $o \in \{r, d\}$, $u_c(c, m')$ is the partial derivative of u with respect to c, $q_{x\mathcal{R}}$ is the partial derivative of $q(b', a', s; \mathcal{R})$ in equation (23) with respect to x', and $p'_{\mathcal{R}} = p(b', a', s'; \mathcal{R})$ given by equation (13). The inequalities are strict when the non-negativity constraints on reserves (16) and (19) bind. The budget constraints (15) and (18), the bond price equation in (23), and equations (24)-(28) form a system of 8 equations in 8 unknowns $\{b'_{\mathcal{R}}, c_{\mathcal{R}}^{r}, c_{\mathcal{R}}^{d}, {m'}_{\mathcal{R}}^{r}, {m'}_{\mathcal{R}}^{d}, {a'}_{\mathcal{R}}^{r}, {a'}_{\mathcal{R}}^{d}, q_{\mathcal{R}}\}$ which completely characterise the equilibrium.

To understand the impact of dollarization on default risk, we must first understand how default distorts the equilibrium relative to the full-commitment benchmark. The intertemporal conditions in equations (26)-(28) determine the evolution of risk-free national assets and debt. In them, next-period marginal utilities are weighed by the probability of repayment $p'_{\mathcal{R}}$. A lower probability of repayment makes risk-free assets more valuable in future default states, since the government cannot smooth consumption through debt markets. This increases incentives to accumulate reserves in states where the probability of default is high. Similarly, a lower probability of repayment lowers the marginal cost of issuing debt, since it is more likely that the government will default on its debt. In this case, through equation (23), the price of the bond q will adjust downward for foreign financiers to be willing to lend.

We now turn to describe how dollarization can affect default risk. We introduce dollarization through the economy's budget constraint. The economy needs to use present and pledge future trade surpluses to finance the initial open market operation to retire the local currency, and the financing of the demand for real balances. Hence, the economy incurs two fiscal costs: the loss of seignorage revenue and the initial open market operation to retire the local currency. The former has been studied by a large literature since Fischer (1982), while the latter has received relatively less attention, and, in particular, its interactions with sovereign debt default are unexplored.

Consider an economy which decides to dollarise in a period $t = T$ and assume that the dollarization is not anticipated by any agent. The central bank must retire the local currency in circulation and replace it with U.S. dollars, which requires converting M_T units of local currency into U.S. dollars at an exchange rate $\mathcal{E}_T$. The central bank can use international reserves, with local-currency value of $f_T \mathcal{E}_T$, to finance this operation. If $M_T \leq f_T \mathcal{E}_T$, the central bank has enough international reserves to carry out the trade. We focus on the case in which $M_T > f_T \mathcal{E}_T$, i.e. there is a shortage of reserves to carry out the trade at the prevailing exchange rate. The central bank could announce a one-time devaluation of the local currency so that $\mathcal{E}_T \geq M_T / f_T$. Since the required devaluation decreases with the amount of international reserves, a devaluation might prove unfeasible if international reserves are too low relative to nominal local-currency balances. In this scenario, the only viable option to finance the currency trade is to tap into debt credit markets. The government can issue debt for an amount $M_T / \mathcal{E}_T - f_T$ to cover the financing gap. Then, the economy enters the next period with additional debt equal to the financing gap. To understand the impact on default incentives, we see from equation (13) that the effect of higher initial debt on the probability of repayment is negative and equal to

$$\frac{\partial p(b,a,s;\mathcal{R})}{\partial b} = -\frac{1}{\varsigma} p(b,a,s;\mathcal{R})[1 - p(b,a,s;\mathcal{R})] u_c(b,a,s;\mathcal{R})[\delta + (1-\delta) q(b',a',s;\mathcal{R})] < 0, \tag{29}$$

where $u_c(b,a,s;\mathcal{R})$ is the partial derivative of u with respect to consumption, evaluated at the optimum. An increase in outstanding debt reduces the value of repayment $v^r(b,a,s;\mathcal{R})$, while keeping the value of default $v^d(a,s;\mathcal{R})$, constant.

Then, an economy that dollarizes and finances the initial open market operation with debt faces a higher initial default probability than if it had not dollarized. Moreover, dollarized economies face initially higher costs of borrowing: the higher probability of default decreases the expected payoff to foreign financiers, which in turn require a higher return to hold the debt.

Financing the demand for real balances. We now isolate the financing channel through which dollarization affects default incentives. In a local-currency regime, the central bank supplies real balances by issuing domestic nominal liabilities and rebates seignorage to the household. By contrast, in a dollarized regime, real balances are foreign currency. Hence, changes in the demand for real balances must be financed with tradable resources.

The dollarized economy's budget constraint in repayment states, after imposing money demand optimality (24), reads

$$\mu c = (y - c + a - \delta b) + q[b' - (1-\delta)b] - q_f f', \tag{30}$$

where $\mu \equiv \left(\frac{1-\kappa}{\kappa}\right)^{1/\psi}\left(\frac{i-1}{i}\right)^{-1/\psi}$ is the constant of proportionality between real balances and consumption. The transactional demand for real balances can be satisfied through three sources. The first term in equation (30) is equal to the current account, which is the sum of the trade balance and the interest payments on net foreign assets. The second term is the issuance of new long-term debt, while the third term is the variation in the risk-free asset.

We study how dollarization affects default risk. To this end, consider a fixed level of international reserves $f' = \bar{f} \geq 0$. Then, a government that optimally chooses consumption and debt in a dollarized regime solves the following problem

$$\max_{c,b'} u\left(c, \mu c\right) + \beta \mathbb{E}\left[v(b', \mu c/\pi, s)|s\right] \tag{31}$$

subject to (30) with $f' = \bar{f}$. The solution to this problem gives the following optimality condition linking debt issuance with financing the demand for real balances

$$\frac{u_c(c, \mu c) + \mu u_m(c, \mu c) + \beta \mu r(s)/\pi}{1 + \mu - \mu q_a[b' - (1-\delta)b]/\pi} = \frac{\beta \mathbb{E}\left\{p' u_c(c'^r, m''^r)\left[\delta + (1-\delta)q'\right]|s\right\}}{q + q_b[b' - (1-\delta)b]}, \tag{32}$$

where $r(s) \equiv \mathbb{E}[p' u_c(c'^r, m''^r) + (1-p')u_c(c'^d, m''^d)|s]$. The left-hand side of (32) measures the effective marginal benefit of acquiring a unit of tradable good for consumption. The first term shows that in a dollarized economy, acquiring a unit of consumption good has an effective price of $1 + \mu - \mu q_a[b' - (1-\delta)b]\mu$, which is the amount of debt that the economy needs to issue. The term μ captures the additional resources that a dollarized economy needs to spend on acquiring real balances to finance consumption expenditure. The term $q_a[b' - (1-\delta)b]\mu$ captures the effect on the price of debt of accumulating real balances. Since real balances constitute a share of the economy's net foreign assets, they affect the probability of repayment, and hence the price at which the economy can issue debt. The probability of repayment can increase or decrease with respect to a, and the sign is determined by the difference between the marginal utilities of consumption in repayment and default in each state. These two terms are absent in an economy with a local currency regime, since the local central bank provides the required real balances for consumption expenditure. The right-hand side of (32) captures the cost of acquiring a unit of the consumption good. When issuing debt, a share δ is due in the next period, while a share $1 - \delta$ is rolled over into the future at the next period price q', which occurs with a probability of repayment p'. Note that debt-financed dollarization features an amplification mechanism: the more debt the government issues to finance real dollar balances, the lower the price at which it can issue, and the larger the required increase in face-value debt.

4 Quantitative Analysis

4.1 Solution Method

We solve the model globally by iterating on the value and bond price functions until convergence. We first solve a finite-horizon version of the model for a sufficiently large horizon and feed the time-0 value and bond pricing functions as the initial guess for the infinite-horizon algorithm, which we iterate to convergence. The state variables lie on finite discrete grids: 60 points for debt, 40 for national risk-free assets, and 35 for the endowment process, and the stochastic discount factor follows a two-state Markov chain. Expectations over the endowment are computed using Gauss-Hermite quadrature. We then refine the discrete solution to a continuous-choice equilibrium, treating next-period debt and assets as continuous variables. Appendix A describes the algorithm in detail and reports Euler-equation errors.

4.2 Calibration

We calibrate the model on a yearly frequency using data from Ecuador between 2000 and 2019. We first set some parameters externally and then calibrate others to match a set of moments. Table 1 presents the parameter values. We set the risk-free real interest rate at 4% per annum which is standard in the sovereign default literature (Aguiar and Gopinath, 2006), and the US inflation rate at 2% which is the inflation target of the US Federal Reserve.

We estimate a money demand function to compute the inverse interest rate elasticity (ψ) using data on M1, the Central Bank's reference nominal interest rate, and household consumption expenditures. We use M1 since it is the most liquid measure of non-interest-bearing money, and hence the closest counterpart to money in our model.[2] We fit these

[2] M1 is the sum of currency in circulation, fractional currency issued by the Central Bank of Ecuador and fully backed by US dollars, digital money, and demand deposits.

data to the money demand function (24) and estimate $\psi = 2.73$, which implies an interest rate elasticity of approximately 0.37, well within the range estimated by Benati et al. (2021). We calibrate the endowment process using the time series of real GDP for Ecuador. We fit an AR(1) model after removing a linear trend and taking natural logarithm, and obtain an estimate of $\rho = 0.79$ and $\sigma_\varepsilon = 0.03$. We discretize the process following Tauchen (1986).

We now turn to calibrating parameters that govern debt and spread dynamics. The coupon rate δ is set to match an approximate debt duration of 6 years, which we compute using outstanding US-dollar-denominated bonds in 2019.[3] The probability of re-entry after default is set to reflect an average exclusion of 6.3 years, which we take from the estimates in Cruces and Trebesch (2013). The transition probabilities of the risk aversion shock in the financiers' SDF are computed using the JPMorgan Emerging Bond Market Index (EMBI) spread for Ecuador. We define a high-spread episode as a year in which the spread is higher than the median spread over the sample plus one standard deviation. We identified 3 high-spread episodes between 2000 and 2019, giving a transition probability from a low to a high risk aversion state of $\pi_{LH} = 0.15$. The average duration of each episode is 1.33 years, giving a transition probability from a high risk to a low risk aversion state of $\pi_{HL} = 0.75$. Finally, the scale parameter of the Gumbel preference shocks, ς, is set to 0.01. We do not assign any economic meaning to these shocks, since they only help to smooth the value and policy functions, and the bond price function. We choose a scale parameter value small enough to speed up convergence, but that does not distort economic decisions. In particular, this value implies a standard deviation of the shock that is approximately 0.12% of the lifetime utility if consumption were constant and equal to the expected value of the endowment.

We calibrate the remaining six parameters using the simulated method of moments to match the short-run moments in Table 2, which we compute in the first 20 years after dollarization. Our goal is to understand how dollarization affects default incentives, and so our calibration is focused on capturing the dynamics observed since Ecuador dollarized. Since Ecuador dollarized in 2000, we do not yet have a sample long enough to perform a long-run calibration exercise. For this reason, we performed a short-run calibration matching some business cycle moments in the 20 years following dollarization, feeding into the simulations the initial conditions when Ecuador dollarized. In 2000, output was 1.76% below trend, US dollar-denominated debt was 71.1% of GDP, international reserves held by the Central Bank were 6.6% of GDP and real balances (measured by M1)

[3] The geometrically-decaying coupon structure of debt implies that the Macaulay duration is $\sum_{t=1}^{\infty} t\delta(1-\delta)^{t-1} = 1/\delta$.

were 5.5% of GDP. The JPMorgan EMBI spread of Ecuador averaged 28.66 percentage points (p.p.) in 2000, which we classify as a high risk aversion episode since it is above the threshold of 14.10 p.p. (median plus one standard deviation).

The simulated method of moments pins down six parameters: the discount factor β, the inverse elasticity of intertemporal substitution σ, the relative consumption weight κ, the high value of foreign financiers' risk-aversion shock ξ_H, and the linear and quadratic loadings on the default output cost, α_0 and α_1. The model determines all six jointly, but each parameter speaks mainly to one moment. The discount factor $\beta = 0.84$ governs the average ratio of debt to GDP, and the inverse elasticity $\sigma = 2.53$ the volatility of consumption relative to output. The consumption weight $\kappa = 0.9991$ controls the average ratio of M1 to output, while the risk-aversion shock $\xi_H = 104$ shapes the cyclicality of spreads. Finally, the two default-cost loadings discipline the spread distribution with $\alpha_0 = -0.87$ targetting its average level and $\alpha_1 = 0.99$ its volatility.

Table 1: Parameter Values

Parameter	Description	Value	Source or target
	Parameters set externally		
R	Risk-free gross real interest rate	1.04	Aguiar and Gopinath (2006)
π^*	US gross inflation rate	1.02	US Fed inflation target
ψ	Inverse elasticity of money demand	2.73	Ecuador's money demand
ρ	Persistence of endowment process	0.79	Ecuador's GDP
σ_ε	Standard deviation of endowment shock	0.03	Ecuador's GDP
δ	Debt coupon rate	0.16	Ecuador's external debt duration
θ	Probability of re-entry	0.19	Cruces and Trebesch (2013)
π_{LH}	Probability of transiting to high risk premium	0.15	Ecuador's JPMorgan EMBI
π_{HL}	Probability of transiting to low risk premium	0.75	Ecuador's JPMorgan EMBI
ς	Gumbel shocks scale parameter	0.01	Small, computational advantage
	Parameters set by simulation		
β	Discount factor	0.84	Relative volatility of consumption
σ	Inverse elasticity of intertemporal substitution	2.53	Average debt to GDP
κ	Money demand intercept	0.9991	Average M1 to GDP
ξ_H	High risk aversion shock	104	Cyclicality of spreads
α_0	Linear loading on default output cost	-0.87	Average spreads
α_1	Quadratic loading on default output cost	0.99	Volatility of spreads

Table 2 reports business cycle statistics from simulations of the dollarized economy. The first two columns compare the short-run model moments with their data counterparts over the twenty years following dollarization, while the last column reports the model's long-run moments. The targeted short-run moments, which we target for calibration, align closely with the data. In particular, the model performs well in matching the spread distribution and the level of real balances, which is relevant since we are assessing the impact the dollarization on sovereign risk. The untargeted short-run moments are also informative: the model reproduces the strong positive comovement of spreads and debt (a correlation of 0.51 versus 0.49 in the data) and the procyclicality of consumption, although it overstates the latter, while net exports are roughly acyclical, against the mildly countercyclical pattern in the data. The model generates a lower default frequency and lower reserves than the data. The long-run column shows that the ergodic economy is more indebted and carries higher, more volatile spreads than the transition (debt of 38.4% versus 24.9% and an average spread of 12.3 versus 10.2 p.p.), indicating that the short-run sample has not yet reached the model's stationary distribution; net exports also become countercyclical in the long run, in line with the data.

Table 2: Business Cycle Statistics: Model and Data.

		Short Run		Long Run
		Model	Data	Model
Targeted moments				
Relative volatility of consumption	$\sigma(c)/\sigma(y)$	1.13	1.14	1.21
Average debt to output	$\overline{b/y}$	24.9%	25.1%	38.4%
Average real balances to output	$\overline{m/y}$	14.8%	15.0%	15.1%
Cyclicality of spread	$\rho(\omega, y)$	-0.34	-0.26	-0.42
Average spread	$\overline{\omega}$	10.2 p.p.	10.4 p.p.	12.3 p.p.
Volatility of spread	$\sigma(\omega)$	6.0 p.p.	5.9 p.p.	8.1 p.p.
Untargeted moments				
Cyclicality of consumption	$\rho(c, y)$	0.86	0.56	0.89
Average international reserves	$\overline{f/y}$	0.4%	4.0%	0.0%
Default frequency	$\overline{(\text{\# new defaults})/20}$	1.2%	5.0%	–
Cyclicality of net exports	$\rho\left((y-c)/y, y\right)$	0.03	-0.09	-0.18
Correlation between spread and debt	$\rho\left(\omega, b/y\right)$	0.51	0.49	0.18

Notes: Short-run model moments are mean values computed across 400 draws of 20 years each. Long-run model moments are mean values computed across 1,000 draws of 300 years each, and taking the last 35 observations of samples in which the last default was observed at least 25 years before the beginning of the sample. Data moments are computed between 2000 and 2019. Initial conditions in the model are set to match Ecuador's initial conditions in 2000. $\bar{x}$ denotes the average value of x, $\sigma(x)$ denotes the standard deviation of x, and $\rho(x, z)$ denotes the correlation between x and z. (# new defaults) is the number of new defaults occurring over a 20-year period.

4.3 Dollarization and Default Risk

The open market operation to retire the local currency can increase default incentives when debt is issued to finance this operation. We attempt to provide a measure of the increase in default incentives caused by dollarization. To this end, we define two conditional probabilities that measure the excess default and repayment probabilities in a dollarized regime relative to a local currency regime. We define the excess default probability of dollarization as the conditional probability that the dollarized economy defaults on its debt, given that the local currency economy repays its debt. We also define an analogous excess repayment probability. We denote these probabilities by $p_d(x^D, x^{LC})$ and $p_r(x^D, x^{LC})$, where $x^{\mathcal{R}} \equiv (b^{\mathcal{R}}, a^{\mathcal{R}}, s^{\mathcal{R}}; \mathcal{R})$ is the state vector of the economy in a regime $\mathcal{R}$. Formally, these probabilities are defined as follows:

$$p_d\left(x^D, x^{LC}\right) \equiv \mathbb{P}_{\epsilon^r,\epsilon^d}\left[\epsilon^d - \epsilon^r > v^r(x^D) - v^d(x^D) \middle| \epsilon^d - \epsilon^r \leq v^r(x^{LC}) - v^d(x^{LC})\right], \quad (33)$$

$$p_r\left(x^D, x^{LC}\right) \equiv \mathbb{P}_{\epsilon^r,\epsilon^d}\left[\epsilon^d - \epsilon^r \leq v^r(x^D) - v^d(x^D) \middle| \epsilon^d - \epsilon^r > v^r(x^{LC}) - v^d(x^{LC})\right]. \quad (34)$$

Given our assumptions, we can express these probabilities in terms of the unconditional repayment probability defined by equation (13):

$$p_d\left(x^D, x^{LC}\right) = 1 - \frac{p(x^D)}{p(x^{LC})} \qquad \text{for} \quad p(x^D) \leq p(x^{LC}), \quad (35)$$

$$p_r\left(x^D, x^{LC}\right) = \frac{p(x^D) - p(x^{LC})}{1 - p(x^{LC})} \qquad \text{for} \quad p(x^D) \geq p(x^{LC}). \quad (36)$$

Figure 2 traces the transition following dollarization, starting from Ecuador's conditions in early 2000 and holding initial debt equal across regimes. The cost of dollarization is concentrated at the switch: in the first year, the dollarized economy defaults in states where the local-currency counterfactual repays with probability close to one half, and this excess default probability decays to under 5 percent within a decade (panel (a)). The source of the early risk is the remonetization itself. Deprived of seignorage, the dollarized economy must purchase its money stock, and it does so by borrowing: external debt rises endogenously by roughly 2 percent of output relative to the local-currency counterfactual within five years (panel (b)). Lenders price this accumulation—the spread differential peaks at about 330 basis points at the initial issuance before settling at a permanent premium of roughly 45 basis points (panel (c)). Panel (d) shows what the debt buys and what it costs: real balances rise from about a quarter of their stationary level to that level within six years, while consumption falls 6 % below the local-currency counterfactual on impact, recovering to a permanent shortfall of about half a percent—the carrying cost of the additional debt. To remove survivorship bias from the two regimes exiting the market at different rates, the debt and spread differentials in panels (b) and (c) are averaged over paths in which neither economy has defaulted.

5 The Welfare Cost of Dollarization

In this section, we study the welfare implications of dollarization. We have shown that dollarization worsens the economy's borrowing terms: to satisfy the demand for real balances, now U.S. dollars, the economy must issue additional debt, which raises default incentives. The initial open market operation, in which the government finances the currency trade, and the permanent loss of seignorage revenue thereafter must be weighed against the benefit that dollarization delivers permanently lower inflation.

5.1 Consumption-equivalent welfare cost and threshold inflation

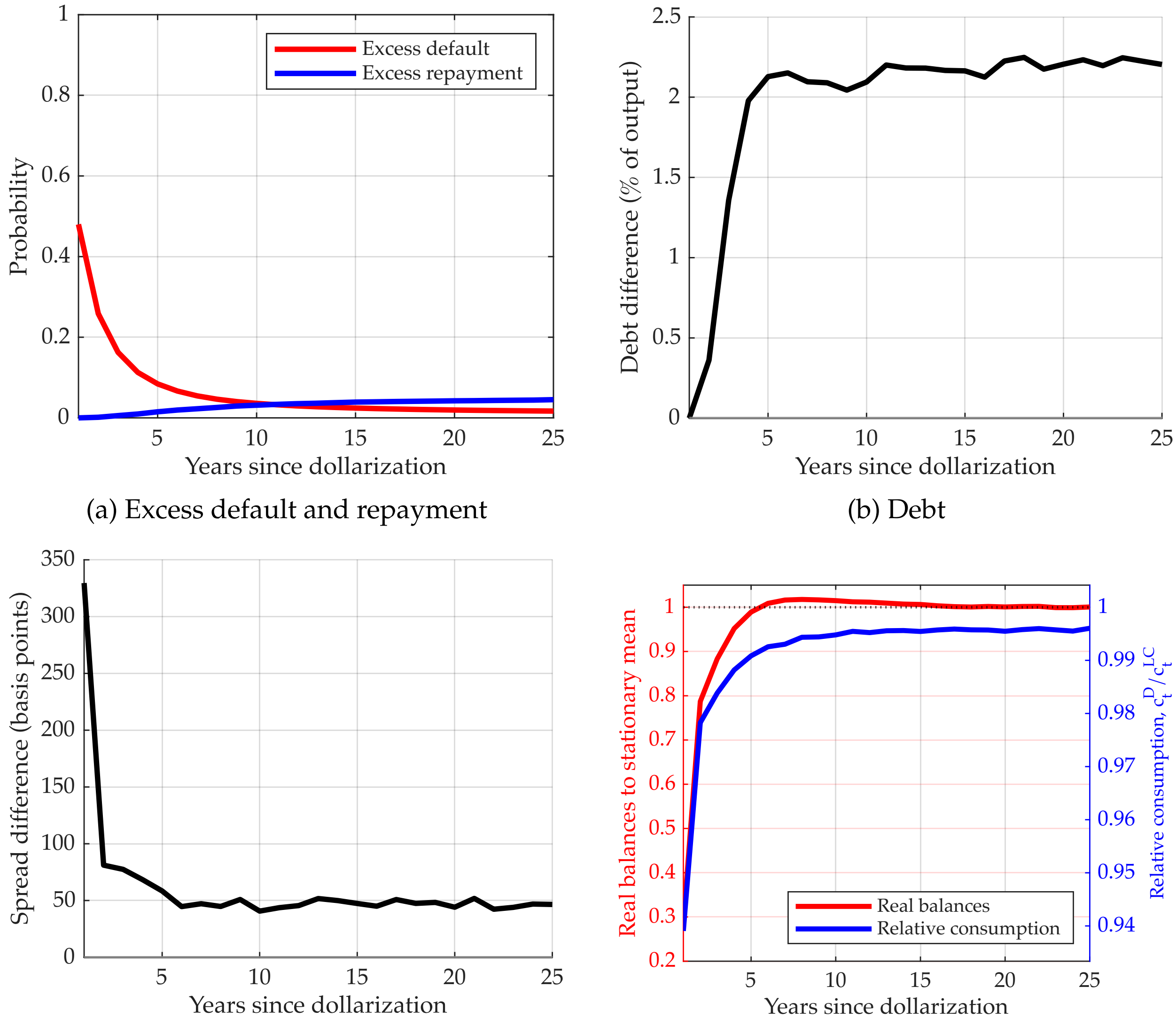
We compute the welfare cost of dollarization in terms of consumption and inflation measures. Consider a local-currency regime with a permanent inflation level π and initial state x_0^{LC}, and let x_0^D denote the state at which the economy would dollarize. We define the permanent consumption-equivalent loss $\gamma\left(\pi; x_0^{LC}, x_0^D\right)$ as the constant fraction of the local-currency consumption allocation that makes the household indifferent between the two regimes:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \, u(c_t[1-\gamma]\,,\, m_t) = v\left(x_0^D\right), \tag{37}$$

where the expectation is taken over the local-currency equilibrium allocation at inflation π. If $\gamma(\pi; x_0^{LC}, x_0^D) > 0$, the household under the local-currency regime would be willing to give up a permanent fraction γ of its consumption to avoid dollarization. Conversely, if $\gamma(\pi; x_0^{LC}, x_0^D) < 0$, the household would need to be compensated to remain in the local-currency regime, i.e., dollarization increases welfare. For a pair of initial states $\left(x_0^{LC}, x_0^D\right)$, we can then define a threshold inflation level $\pi^\star\left(x_0^{LC}, x_0^D\right)$ above which dollarization is welfare-improving, given by

$$\pi^\star\left(x_0^{LC}, x_0^D\right) = \inf\left\{\pi : \; \gamma\left(\pi; x_0^{LC}, x_0^D\right) \leq 0\right\}. \tag{38}$$

We evaluate the welfare cost at the initial states that match the levels of debt, reserves, real balances, output, and spreads of Ecuador in early 2000. Both regimes start from the



(a) Excess default and repayment

(b) Debt

(c) Spread

(d) Real balances and consumption

Figure 2: Dollarization transition: default risk, debt, spreads, real balances and consumption.

Notes: Starting from Ecuador's initial conditions in early 2000, with the same initial debt in both regimes, we simulate the dollarized (D) and local-currency (LC) economies under common shocks and average across simulations at each year t since dollarization. Panel (a) reports the excess default probability p_d and the excess repayment probability p_r from (35)–(36), pooled over periods up to t. Panels (b) and (c) report the differences in external debt, $b_t^D - b_t^{LC}$ (present value, % of output), and in spreads, $\omega_t^D - \omega_t^{LC}$ (basis points), averaged over paths in which neither economy has defaulted up to year t, which removes the survivorship bias from the two regimes exiting the market at different rates. Panel (d) shows the dollarized economy's real balances m_t/y_t relative to their stationary mean (left axis, computed from the same simulations after a 100-period burn-in) and the consumption ratio c_t^D/c_t^{LC} (right axis).

same pre-dollarization states, and we allow the model to endogenously determine the remonetization that follows after dollarization.

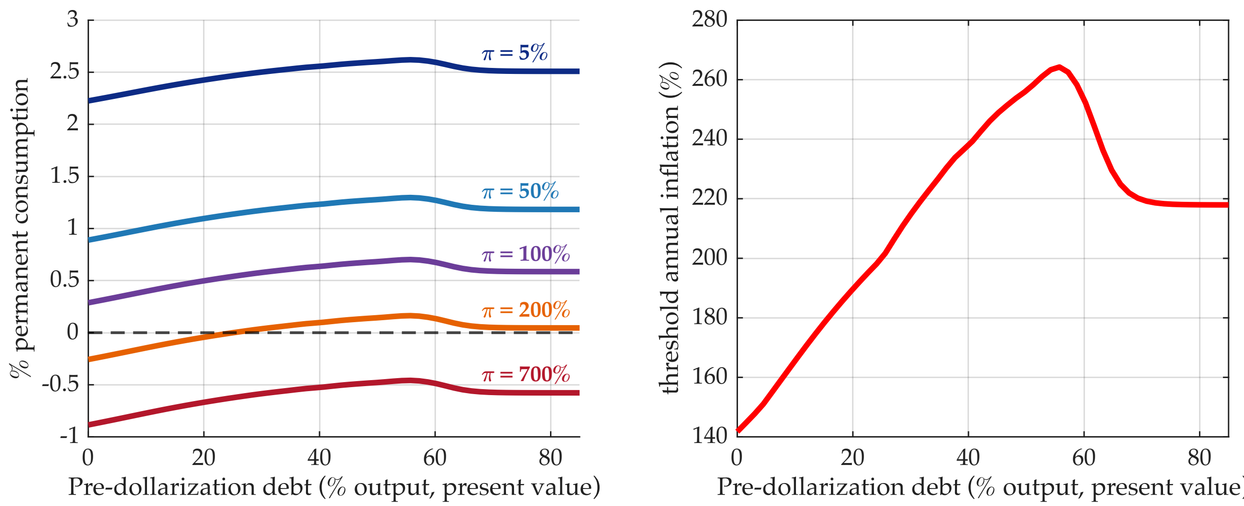
Figure 3 reports the results. Panel (a) plots the welfare cost of dollarization as a function of pre-dollarization debt for several inflation rates. The cost declines with inflation at every debt level: the higher the inflation the local-currency regime delivers, the less valuable it is to maintain the local-currency regime. At 5% annual permanent inflation and a 40% debt-to-output ratio, the household would give up around 2.5% of permanent consumption to avoid dollarization, while at 200% annual permanent inflation dollarization raises welfare for levels of debt below 20% of output.

The welfare cost is non-monotone in debt. Note that the welfare cost rises with indebtedness up to a peak at roughly 55% of output: in this region, a marginal unit of debt weighs more heavily on the dollarized economy, which faces worse borrowing terms and must borrow to accumulate its dollar balances, than on the local-currency economy. The decline and subsequent flattening beyond the peak reflect default risk rather than any benefit of issuing debt. Past roughly debt levels 55% of output, default becomes nearly certain for the dollarized economy, so its value ceases to vary with debt, while the local-currency value continues to fall. This explains the decreasing region in the welfare cost. Beyond debt levels 65% of output, default is nearly certain in both regimes, both values are insensitive to the debt burden, and the welfare cost settles at the comparison of the two financial-autarky continuation values, which we analyze further below.

Panel (b) translates the same information into the threshold inflation $\pi^{\star}$, which inherits the shape of the welfare cost: it rises from 140% for an economy with no debt to a peak of 265% at a debt-to-output ratio of 55%, and settles at 218% once default is nearly certain in both regimes, which is the financial-autarky threshold. The levels are high: at Ecuador's debt in 2000, 63% of GDP, the threshold of roughly 235% exceeds the 96% inflation Ecuador experienced in that year. Through the lens of the model, realized inflation alone did not justify dollarization; the case for Ecuador's decision rests on the inflation that would have prevailed absent dollarization (the economy was on a path of accelerating money growth in 1999) and on the fact that Ecuador was already in default, so that the relevant comparison is the financial-autarky threshold we compute next.

5.2 Dollarizing outside credit markets

We have argued that the transition to dollarization relies on market access when the remonetization is financed with debt. Yet economies contemplating dollarization are often in default or otherwise excluded from international credit markets. To study this case, we evaluate both regimes at their financial-autarky values, where debt has been wiped and re-entry occurs with probability θ. Without market access, the currency trade cannot be financed with debt, so the remonetization is paid for out of reserves; reserves below the



(a) Welfare cost of dollarization

(b) Threshold inflation

Figure 3: Welfare cost of dollarization and threshold inflation, by pre-dollarization debt.

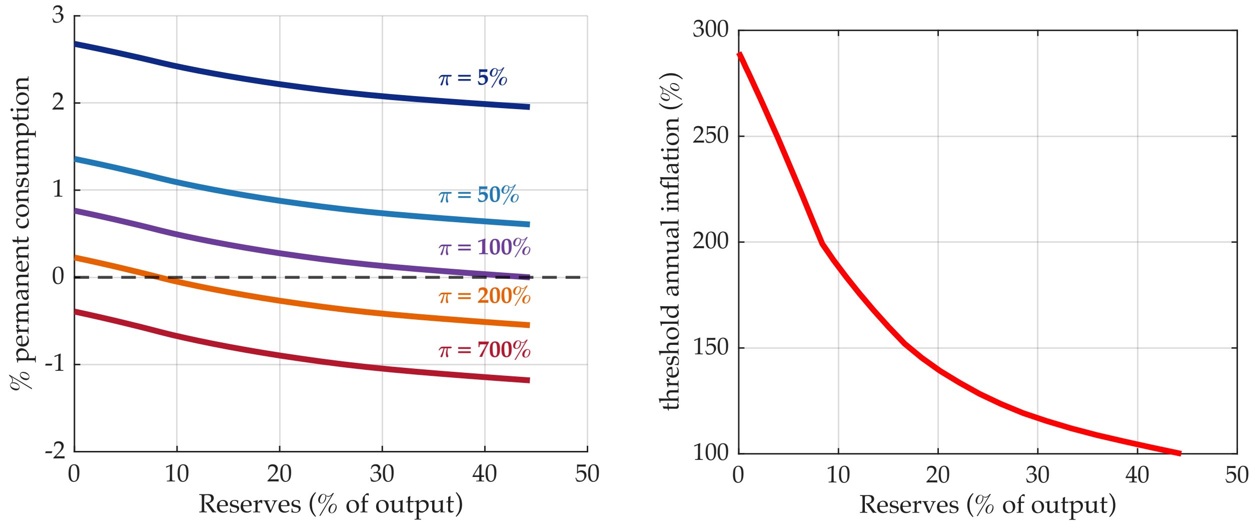
Notes: Panel (a) plots the permanent consumption-equivalent welfare cost of dollarization γ, by pre-dollarization debt (% of output, present value), for several permanent inflation rates of the local-currency alternative; $\gamma > 0$ means avoiding dollarization is valuable, $\gamma < 0$ that dollarization raises welfare. Panel (b) plots the threshold inflation $\pi^{\star}$ above which dollarization is welfare-improving. Both regimes start from the Ecuador 2000 transition states: reserves of 6.7% of output and a money stock of 4% of output.

cost of the money stock make dollarization infeasible without sacrificing consumption.

Figure 4 plots the welfare cost and the threshold inflation as functions of reserves. The welfare cost of dollarization as well as the inflation threshold decrease with the level of initial reserves. With larger initial reserves, richer economies in autarky find dollarization cheaper because the reserve drain to finance the remonetization is a smaller share of their buffer stock of assets. For a country with neither reserves nor market access, dollarization requires cutting consumption to finance the increase in real balances. At this point, the welfare cost of dollarization is maximal: for the initial conditions of Ecuador in early 2000, dollarization improves welfare only at permanent inflation levels of around 280% or higher.

5.3 Default Risk and Welfare

The literature that evaluates dollarization under full commitment (Caravello et al., 2023; Fischer, 1982), where sovereign debt is repaid with certainty and the only cost of surrendering the currency is the loss of seignorage, can underestimate the welfare costs of dollarization. Our framework nests this full-commitment world, but also considers the impact of dollarization on sovereign bond pricing. We now compute the contribution of default risk to this welfare cost, and show it is quantitatively relevant. We solve the model



(a) Welfare cost of dollarization

(b) Threshold inflation

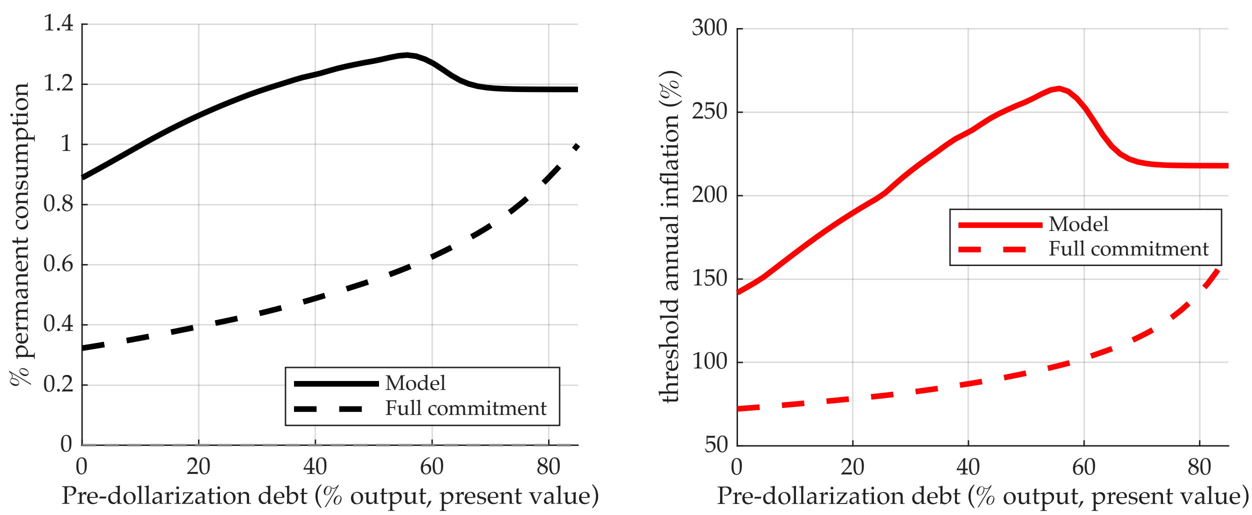
Figure 4: Welfare cost of dollarization and threshold inflation outside credit markets, by reserves.

Notes: Panel (a) plots the welfare cost of dollarization and panel (b) the threshold inflation for an economy excluded from credit markets, by reserves (% of output). Both regimes are evaluated at their financial-autarky values: debt has been wiped, re-entry occurs with probability θ, and the accumulation of dollar balances cannot be debt-financed, so it comes out of consumption while the economy is excluded. The pre-existing money stock of 4% of output is converted one-for-one. Both the welfare cost and the threshold decline with reserves: the reserve drain of dollarizing is a smaller share of a larger buffer stock. At the lowest feasible reserve level the threshold is 290%; at Ecuador's reserves of 6.4% of output it is 222%.

for both currency regimes shutting down the default option, so that sovereign bonds are priced risk-free and the welfare cost captures only the seignorage and initial currency trade channels.

The total contribution of default risk to the welfare cost of dollarization is $\mathfrak{d} \equiv \gamma - \gamma_{cc}$, where γ_{cc} denotes the welfare cost when neither regime can default. Between our baseline, in which both regimes retain the default option and whose welfare cost we denote by γ, and this full-commitment world lie two mixed configurations in which exactly one regime can commit to repay. We compute both: γ_{cb} is the welfare cost of dollarizing when the dollarized economy can commit but the local-currency alternative cannot, and γ_{bc} the cost in the reverse configuration. Each configuration answers a question from the policy debate. Advocates of dollarization have long argued that surrendering the currency itself disciplines the sovereign and lowers its risk premium (e.g., Alesina and Barro, 2002; Arellano and Heathcote, 2010; Borensztein and Berg, 2000); γ_{cb} prices this claim, that is, what dollarization would cost if it delivered repayment credibility. The opposite concern, raised by Sims (1999), is that giving up the currency removes a fiscal margin and worsens default risk rather than reducing it; γ_{bc} prices this worst case, dollarizing without credibility when the local-currency regime is run by a government that can commit.

Figure 5 compares the baseline with the full-commitment world. At 50% inflation and close to zero debt, the welfare cost of dollarization is 0.90% of permanent consumption in the baseline against 0.38% under full commitment: default risk accounts for more than half of the total. The two curves differ in shape as well as in level. Under full commitment, the cost of dollarizing rises steadily with debt, as the dollarized economy must service both its inherited debt and the additional borrowing that sustains its dollar balances. In the baseline, the cost instead peaks near 55% of output and then falls toward its financial-autarky level: once default is nearly certain, additional debt no longer burdens the dollarized economy, which will not repay it. The two curves approach each other at high debt but never meet. This occurs because even after default wipes the debt, the baseline economy re-enters credit markets with probability θ, borrows, and carries default risk on that borrowing forever after, while the commitment economy does not. Correspondingly, the threshold inflation under full commitment is much lower: roughly 70% against 140% for an economy without debt, and 100% against 235% at Ecuador's pre-dollarization debt.



(a) Welfare cost of dollarization

(b) Threshold inflation

Figure 5: The welfare cost of dollarization: baseline versus full commitment.

Notes: Panel (a) plots the welfare cost of dollarization and panel (b) the threshold inflation, in the baseline and under full commitment, by pre-dollarization debt (% of output, present value), at the Ecuador 2000 initial states.

Table 3 reports the welfare cost of dollarization in all four configurations across permanent inflation rates, evaluated at the stationary mean of the baseline local-currency economy. Two results stand out. First, the welfare stakes lie in credibility, not in the currency: granting either regime commitment moves the welfare cost of dollarization by

Table 3: The welfare cost of dollarization across commitment configurations

	Default option		Local-currency inflation π				
	D	LC	5%	50%	100%	200%	700%
Baseline (γ)	✓	✓	2.61	1.28	0.69	0.15	-0.47
Full commitment (γ_{cc})	✗	✗	1.82	0.47	-0.14	-0.69	-1.33
Committed dollarization (γ_{cb})	✗	✓	-5.02	-6.64	-7.38	-8.05	-8.82
Committed local currency (γ_{bc})	✓	✗	8.94	7.84	7.34	6.90	6.39
Default-risk contribution ($\mathfrak{d} = \gamma - \gamma_{cc}$)			0.78	0.81	0.83	0.84	0.85

Notes: The table reports the permanent consumption-equivalent cost (in %) of dollarizing, by the permanent inflation rate of the local-currency alternative, evaluated at the stationary mean of the baseline local-currency economy: debt of 33% of output in present value, reserves of 0% of output, and mean output. A ✓ indicates that the dollarized (D) or local-currency (LC) regime retains the option to default; ✗ that it commits to repay. Negative entries mean dollarization raises welfare.

5–9% of permanent consumption, an order of magnitude more than the seignorage and currency-trade costs that the full-commitment comparison isolates. If dollarization delivered credibility, it would improve welfare at every inflation rate we solve, even against a local currency that delivers 5% inflation, since γ_{cb} ranges from -5.02 to -8.82%. Dollarizing without credibility against a credible peso would cost between 6.39 and 8.94% of permanent consumption, as reflected by γ_{bc}. Second, in our model, dollarization does not deliver credibility: the dollarized economy defaults more, not less. The net contribution of default risk is accordingly modest relative to these gross stakes, $\mathfrak{d} = 0.78$ to 0.85% of permanent consumption, but positive at every debt and inflation level we compute: because the dollarized economy relies more heavily on the debt market, default risk on net always argues against dollarization. Relative to the welfare costs measured by the full-commitment literature, however, $\mathfrak{d}$ is large: it amounts to 30% of the baseline cost of dollarizing at 5% inflation and to two thirds at 50%. At 100% inflation it flips the sign of the comparison: an analyst who evaluates dollarization under full commitment would conclude that dollarizing raises welfare ($\gamma_{cc} = -0.14$%), when in fact it lowers it ($\gamma = 0.69$%).[4]

6 Conclusion

[4]An additive attribution of $\mathfrak{d}$ to the two regimes' commitment technologies is not well defined. The contribution of each channel depends on the order in which commitment is granted, and the interaction term $(\gamma - \gamma_{cb}) - (\gamma_{bc} - \gamma_{cc})$, between 0.5% and 0.6% of permanent consumption across the columns of Table 3, is of the same order as $\mathfrak{d}$ itself. Relative to the gross credibility stakes of 5–9%, however, the ordering is immaterial. We therefore report the configurations directly rather than an additive split.

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Appendices

A Computational Details

A.1 Solution Method

We solve the model globally by value-function iteration on the household value functions and the long-term bond price schedule. To obtain an accurate starting point, we first solve a finite-horizon version of the economy by backward induction from a terminal period in which no debt can be issued, using a horizon long enough that the time-0 functions are invariant to its length; the resulting time-0 value and bond price functions serve as the initial guess for the infinite-horizon problem. We then iterate until the value and bond price functions converge in the sup norm.

We discretize the state vector on finite grids: 60 points for long-term debt b, 40 points for the national asset position a (international reserves plus real money balances), and 35 points for the detrended endowment y; the stochastic discount factor follows a two-state Markov chain. The endowment follows an $\mathrm{AR}(1)$ in logs, and we evaluate the conditional expectation over next-period output with Gauss–Hermite quadrature, interpolating continuation values off the grid; expectations over the discount-factor state use its transition matrix. The asset grid is spaced more densely near zero to resolve the small reserve and money holdings chosen in equilibrium.

Each infinite-horizon iteration has three steps. First, given the current value and price functions, we form the continuation values and solve the repayment and default problems. The default decision is subject to an additive Gumbel taste shock, so the repayment probability takes a smooth logit form and the option value is the corresponding log-sum-expectation; this regularizes the default region and the implied price schedule. We exploit the monotonicity of the optimal debt policy in incoming debt through the divide-and-conquer (binary-monotonicity) algorithm of Gordon and Qiu (2018), and search over the asset choice on its grid; money demand satisfies an intratemporal optimality condition and is solved in closed form given consumption. Second, we accelerate convergence with Howard policy-evaluation steps that iterate the value functions holding policies and the price fixed. Third, we update the bond price. Because debt is long-term (Hatchondo and Martinez, 2009), prices and values feed back on one another through dilution; we therefore apply a single damped price update per iteration rather than solving the pricing fixed point at transient policies, which stabilizes the algorithm.

To remove the discretization error in the choice variables, we refine the converged grid solution to a fully continuous-choice equilibrium. Using the grid solution as a warm start, we re-solve treating next-period debt and assets as continuous: at each state we bracket the optimum with the grid maximizer and polish it by golden-section search, with value and price functions interpolated by shape-preserving (monotone cubic) splines, and we re-price the continuous policies and iterate to a fixed point. The value functions, policy functions, and bond prices we report are these continuous-choice objects.

We assess accuracy by computing Euler-equation errors for the household's debt and reserve first-order conditions, reported as $\log_{10}$ relative residuals both over the grid and weighted by the model's ergodic distribution.