Cryptocurrencies in Emerging Markets: A Stablecoin Solution?

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Abstract

We rationalize cryptocurrency adoption in a small open economy model. We show that digital dollarization, where stablecoins pegged to the USD are used for transactions, can improve social welfare. In contrast, the adoption of volatile cryptocurrencies, such as El Salvador's 2021 decision to make Bitcoin legal tender, results in welfare losses. This outcome aligns with the observed low take-up of Bitcoin as legal tender. The welfare benefits of digital dollarization increase with the magnitude of macroeconomic shocks, providing motivation for the growing use of stablecoins in emerging markets as a safeguard against high inflation and macroeconomic instability.

Keywords: stablecoins, digital dollarization, bitcoin, cryptocurrency, monetary policy

JEL Classifications: F31, G14, G15, G18, G23

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1 Introduction

Emerging market economies (EMEs) are increasingly turning to cryptocurrencies as a hedge against macroeconomic instability. Several countries, including Turkey and Argentina, have adopted stablecoins—blockchain-based currencies typically pegged to the USD—as an alternative store of value. The use of stablecoins, a form of digital dollarization, is often driven by high inflation and domestic policy uncertainty.[1] Recent survey data from Mastercard indicate that up to a third of households in Latin America have used stablecoins for retail payments.[2]

In addition to digital dollarization, El Salvador became the first country to adopt Bitcoin as legal tender in September 2021. The policy aimed to promote financial inclusion, lower remittance costs, and attract foreign direct investment. However, survey data suggest that adoption has been limited, with Bitcoin usage remaining low for everyday transactions (Alvarez, Argente, and Van Patten 2023).

In this paper, we examine cryptocurrency adoption within a standard small open economy (SOE) New Keynesian dynamic stochastic general equilibrium (DSGE) model. Our framework investigates how cryptocurrencies can provide macroeconomic benefits by facilitating consumption smoothing for the unbanked population. We address key questions about cryptocurrency adoption in emerging markets, including its welfare effects and whether digital currencies mitigate or amplify foreign financial shocks. In particular, we can rationalize why countries may choose to pursue digital dollarization in response to macroeconomic instability, and why risky cryptocurrency adoption leads to welfare losses, explaining the limited take-up of Bitcoin in El Salvador. We generalize our findings to SOEs with both floating and fixed exchange rates.

Our baseline SOE model features two types of households: banked households, which have access to banking services and hold deposits alongside domestic currency and cryptocurrencies, and unbanked households, which hold only domestic currency and cryptocurrencies.[3] The model includes a banking sector that intermediates funds

1. In January 2022, Turkish residents exchanged Lira for the Tether stablecoin. See: https://www.ft.com/content/02194361-a5b9-4bf0-9147-f36ba7759cf1. Similarly, concerns over the potential devaluation of the Argentine Peso following a government resignation led to a surge in stablecoin demand: https://www.coindesk.com/business/2022/07/04/argentines-take-refuge-in-stablecoins-after-economy-minister-resignation/.

2. See: https://www.prnewswire.com/news-releases/latin-america-s-crypto-conquest-is-driven-by-consumers-needs-819718066.html. For additional evidence, refer to Appendix A.

3. Our baseline assumes an independent central bank but can be extended to fixed exchange rate

between households and firms, with banks also borrowing from global interbank markets. A spread between foreign and domestic interest rates drives cross-border borrowing as investors seek higher yields.[4] Within this framework, we introduce a simple mechanism for the adjustment of cryptocurrency deposits based on valuation effects. Households must convert cryptocurrency into domestic currency at the time of consumption, implying that fluctuations in cryptocurrency prices directly impact their purchasing power. These valuation effects impact household consumption, labor supply, and bank lending. Based on the impulse response functions (IRFs), a negative 1 percent shock to cryptocurrency prices results in a peak decline in unbanked household consumption of approximately 0.1% and banked household consumption of approximately 0.015% (1.5 basis points).

We then examine the welfare implications of cryptocurrency adoption by comparing the relative welfare of an economy with cryptocurrency deposits to one without, which we refer to as a "cryptocurrency autarky." When cryptocurrency price volatility is sufficiently high, such as the volatility of risky cryptocurrencies like Bitcoin, the resulting general equilibrium effects increase the volatility of bank lending, firm wages, consumption, and labor. These amplified macroeconomic fluctuations impose welfare costs, leading to a decline in welfare for both banked and unbanked households relative to the cryptocurrency autarky economy.

Alternatively, we consider a "digital dollarization" regime, in which a cryptocurrency is pegged to a foreign currency within our small open economy framework. This captures stablecoins, blockchain-based currencies pegged to fiat currencies, typically the U.S. dollar (USD). Our welfare analysis highlights the potential benefits of digital dollarization: when cryptocurrency price volatility remains low, welfare improves relative to autarky. This suggests that digital dollarization can serve as an effective mechanism for consumption smoothing.

Next, we assess the welfare effects of digital dollarization in response to a foreign monetary policy shock. Our findings indicate that cryptocurrency adoption enhances welfare for both banked and unbanked households, with benefits increasing as macroeconomic volatility rises. In an economy with cryptocurrency deposits, unbanked households can more effectively hedge against external shocks by utilizing cryptocurrency

regimes like El Salvador, where the domestic currency is the USD.

4. The foreign interest rate can be proxied by the US Federal Funds Rate.

for consumption smoothing, rather than relying solely on real money balances.

While both banked and unbanked households benefit from cryptocurrency's role in consumption smoothing, our results indicate that welfare gains are larger for banked households in the presence of significant external shocks. This asymmetry arises due to the financial channel: banked households, whose income is closely tied to bank equity, are more exposed to foreign interest rate shocks, which increase the foreign debt burden and reduce bank net worth. However, access to cryptocurrency enables these households to diversify risk, thereby attenuating the financial channel's impact on bank capital and mitigating the adverse effects of foreign monetary shocks.

Our simulations demonstrate that in an economy with cryptocurrency deposits, banks experience improvements in net worth, deposits, and capital stock, while foreign currency borrowing, as a share of total assets, declines. This dynamic helps cushion the effects of foreign monetary shocks on banked households' consumption.

In summary, our results suggest that digital dollarization can serve as a hedge against sovereign and macroeconomic risk. These findings support the argument that countries may pursue digital dollarization as a policy tool to mitigate external vulnerabilities and sovereign risk, helping to rationalize the increasing use of stablecoins in high-inflation economies such as Turkey and Argentina.

Related Literature. We contribute to the literature on the macroeconomic costs and benefits of dollarization (Schmitt-Grohé and Uribe 2001; Chang and Velasco 2002; Mendoza 2001). The costs of dollarization, as examined by Schmitt-Grohé and Uribe (2001), include the loss of monetary policy autonomy and a reduced ability to stabilize prices in response to asymmetric shocks. These costs are weighed against benefits such as a lower likelihood of a "peso shock" and a reduced risk of large currency devaluations. Their welfare analysis estimates that the net welfare costs of dollarization range from 0.1% to 0.3% relative to alternative policy regimes. Chang and Velasco (2002) highlight that the welfare effects of dollarization depend on government credibility, while Mendoza (2001) show that dollarization can enhance welfare by reducing policy uncertainty and easing credit constraints, with estimated benefits ranging from 4% to 9%.

Relative to the existing literature on dollarization, we make three key contributions. First, we examine digital dollarization when the cryptocurrency itself is subject to price fluctuations, introducing an additional cost compared to traditional dollarization. This is because cryptocurrency prices are subject to devaluation risk, which—if sufficiently high—can lead to welfare losses. Second, similar to traditional dollarization studies, we show that digital dollarization can serve as a hedge against external macroeconomic shocks and, under reasonable assumptions about cryptocurrency price volatility, can generate net welfare gains. Finally, we analyze the differential effects of digital dollarization on banked and unbanked households. While unbanked households are generally more sensitive to cryptocurrency price shocks, both groups can experience welfare gains from access to a stable digital currency. Interestingly, during periods of large external shocks—such as foreign risk premium shocks—banked households may gain more from cryptocurrency deposits due to their role in mitigating financial volatility.

Our work also relates to an emerging literature on the macroeconomic implications of global stablecoins and Central Bank Digital Currencies (CBDCs) (Baughman and Flemming 2020; Benigno, Schilling, and Uhlig 2022; Benigno 2022; Ferrari Minesso, Mehl, and Stracca 2022; George, Xie, and Alba 2020; Skeie 2019; Ikeda 2020; Kumhof et al. 2021; Cong and Mayer 2021).

In the literature on CBDCs, Ferrari Minesso, Mehl, and Stracca (2022) introduce a two-country model in which the home country issues a CBDC, amplifying productivity spillovers and reducing the effectiveness of foreign monetary policy.

Turning to research on global stablecoins and digital dollarization, Benigno, Schilling, and Uhlig (2022) develop a two-country framework where a global stablecoin circulates freely between both economies. They show that, in equilibrium, interest rates synchronize across the two countries, making users indifferent between holding the global cryptocurrency and the domestic currency. Baughman and Flemming (2020) analyze basket-based stablecoins composed of a weighted portfolio of sovereign currencies, finding that demand for the global stablecoin is low in equilibrium and that its welfare effects are modest—approximately 2% relative to full dollarization. Ikeda (2020) model a two-country setting in which goods are priced in foreign currency, weakening domestic monetary policy transmission through the expenditure-switching channel, as described in the dominant currency pricing framework of Gopinath et al. (2020).

We contribute to this literature by examining the costs and benefits of digital dollarization and providing a theoretical rationale for why emerging markets may benefit from stablecoins. Our work complements empirical findings on cryptocurrency adoption in emerging markets. For instance, Ahmed, Karolyi, and Pour Rostami (2024) find that cryptocurrency adoption responds to sovereign default risk, as higher CDS spreads lead to increased app downloads and usage. Moreover, cryptocurrencies are increasingly used for cross-border payments and remittances in Latin America (Von Luckner, Reinhart, and Rogoff 2023), supporting their role as an alternative financial instrument when macroeconomic risks are elevated. However, Oefele, Baur, and Smales (2025) show that stablecoin trading against the Turkish Lira is primarily driven by growth in global cryptocurrency markets, and only weakly influenced by macroeconomic indicators such as changes in Turkish sovereign bond yields, suggesting that the role of digital dollarization through crypto assets remains limited in emerging markets.

Turning to studies on risky cryptocurrency adoption, such as El Salvador's adoption of Bitcoin as legal tender, Alvarez, Argente, and Van Patten (2023) document survey evidence on the Bitcoin Chivo wallet and analyze the determinants of Bitcoin adoption, finding that the unbanked population lacks sufficient incentives to adopt the payment system. Goldbach and Nitsch (2024) show that El Salvador's policies had negative effects on capital flows, and Subacci (2021) argues that while Bitcoin enables value transfers without intermediation, its price volatility creates uncertainty for migrants and their families, who cannot be sure of the exact amount transferred.[5]

Economists at the International Monetary Fund (IMF) (Adrian and Weeks-Brown 2021) have strongly opposed El Salvador's Bitcoin law, citing significant risks to macro-financial stability, financial integrity, consumer protection, and environmental sustainability. They argue that monetary policy becomes ineffective, as central banks cannot set interest rates on a cryptocurrency, potentially leading to high domestic price volatility. In February 2025, the IMF approved a 40-month Extended Fund Facility (EFF) arrangement, which includes measures to address risks associated with El Salvador's Bitcoin project by making Bitcoin acceptance voluntary, restricting public sector engagement in Bitcoin transactions, and strengthening oversight of digital assets in line with evolving international standards.[6]

Our model framework shows that risky cryptocurrency adoption brings welfare

5. See, for example, https://www.project-syndicate.org/commentary/risks-of-el-salvador-adopting-Bitcoin-by-paola-subacchi-2021-06.

6. See IMF Press Release No. 25/043: https://www.imf.org/en/News/Articles/2025/02/26/pr25043-el-salvador-imf-approves-new-40-month-us1-bn-eff-arr.

costs by increasing households' exposure to fluctuating income, leading to more volatile wages, consumption, and labor, thereby supporting the IMF proposal to reduce adoption.

The remainder of the paper is structured as follows. Section 2 introduces the model and defines the equilibrium conditions. In Section 3, we examine the impact of a cryptocurrency price shock in our baseline specification and conduct a welfare analysis. Finally, Section 4 concludes.

2 Model

Our model framework builds on small open economy (SOE) models with financial frictions and exogenous terms of trade shocks.[7] Financial frictions arise from an incentive compatibility constraint, where banks must maintain sufficient value to prevent them from absconding with a fraction of foreign deposits, following Gertler and Kiyotaki (2010) and Gertler and Karadi (2011). This friction is central to generating deviations from the uncovered interest parity (UIP) condition.

We extend the framework of Aoki, Benigno, and Kiyotaki (2016) (henceforth ABK) by introducing unbanked households that lack access to domestic or international banking channels. These households rely exclusively on money and cryptocurrencies for transactions and savings. In our model, cryptocurrency prices are subject to exogenous shocks, analogous to the terms of trade and commodity price shocks studied by Kulish and Rees (2017) and Drechsel and Tenreyro (2018). However, unlike commodity price shocks, which primarily affect firm-level resource allocation, cryptocurrency price shocks affect the saving and consumption behavior of unbanked households.

Our baseline model follows a New Keynesian DSGE framework (Galí 2015), incorporating a banking sector and cross-border interbank borrowing as a funding source for domestic banks. The model integrates SOE features from Galí and Monacelli (2005), ABK, and Akinci and Queralto (2023), while allowing banks to hold cryptocurrency balances and raise funds from both domestic households and international banks. A key feature of this framework is that international borrowing exposes domestic banks to foreign exchange risk and funding costs. For instance, an increase in foreign interest

7. For related SOE models with financial frictions, see Aoki, Benigno, and Kiyotaki (2016), Akinci and Queralto (2023), Gourinchas (2018), and Ahmed, Akinci, and Queralto (2021).

rates raises the cost of cross-border interbank borrowing, tightening domestic banks' funding conditions and constraining their lending behavior.

2.1 Households and Workers

The representative household consists of a continuum of individuals, categorized into three types: bankers ($i = b$), banked households (BHH, $i = h$), and unbanked households (UHH, $i = u$). Bankers and banked households share a perfect insurance scheme, ensuring equal consumption levels. However, unbanked households are excluded from this scheme, leading to differences in their consumption and savings behavior.

Banked Household Problem. Banked households maximize the present value of expected utility by choosing consumption C_t^h, labor supply L_t^h, equity holdings in firms K_t^h, bank deposits D_t (which earn a nominal return R_t),[8] real money balances M_t^h, and cryptocurrency deposits B_t^h,[9] subject to the following optimization problem:

$$\max_{\{C_t^h, L_t^h, K_t^h, M_t^h, B_t^h, D_t\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[u(C_t^h, L_t^h) + \Upsilon(M_t^h, B_t^h) \right],$$

subject to the period budget constraint:

$$\begin{aligned} &C_t^h + Q_t K_t^h + \chi_t^h + M_t^h + \chi_{M,t}^h + B_t^h + \chi_{DC,t}^h + D_t \\ &\quad = w_t^h L_t^h + R_t^k Q_{t-1} K_{t-1}^h + \frac{M_{t-1}^h + R_{t-1}^c B_{t-1}^h + R_{t-1} D_{t-1}}{\pi_t} + \Pi_t^P. \end{aligned} \tag{1}$$

Here, Q_t represents the equity price in final goods terms, Π_t^P denotes real profits from production and banking, and w_t^h is the real wage of the banked household. The gross return on capital is given by $R_t^k = (z_t^k + \lambda) Q_t / Q_{t-1}$, where z_t^k is the rental rate of capital

8. Technically, the household chooses nominal deposits, D_t^n, which are deflated by the domestic consumer price index, P_t:

$$D_t = \frac{D_t^n}{P_t}.$$

9. Specifically, we define

$$B_t = P_t^c B_t^N,$$

where P_t^c is the real price level of cryptocurrencies and B_t^N represents cryptocurrency deposits denominated in units of the cryptocurrency token (e.g., Bitcoin).

and λ accounts for depreciation. The nominal return on cryptocurrency deposits is:

$$R_t^c = \frac{P_t^c}{P_{t-1}^c}. \tag{2}$$

Unbanked Household Problem. The unbanked household problem differs from that of banked households in terms of access to deposits. Specifically, they supply labor to firms, receive wages, and hold savings in real money balances M_t^u and cryptocurrency deposits B_t^u. Their optimization problem is:

$$\max_{\{C_t^u, L_t^u, M_t, B_t^u\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[u(C_t^u, L_t^u) + \Upsilon(M_t^u, B_t^u) \right],$$

subject to the period budget constraint:

$$C_t^u + B_t^u + \chi_{M,t}^u + \chi_{DC,t}^h + M_t = w_t^u L_t^u + \frac{R_{t-1}^c B_{t-1}^u + M_{t-1}^u}{\pi_t}. \tag{3}$$

For details on first-order conditions (FOCs), please refer to Appendix B.1.

Household Preferences and Money Utility. The utility functions for each type of household follow a Greenwood-Hercowitz-Huffman (GHH) form:

$$u(C_t^i, L_t^i) = \ln \left(C_t^i - \frac{\zeta_0}{1+\zeta} (L_t^i)^{1+\zeta} \right),$$

where the parameters β, ζ_0, and ζ represent the household's discount factor, the relative disutility from labor supply, and the inverse Frisch elasticity of labor supply, respectively. GHH preferences eliminate income effects and induce pro-cyclical labor supply.

The sub-utility function for holding money and cryptocurrency balances is given by:

$$\Upsilon(M_t^i, B_t^i) = \nu_{0,i}^M \frac{(M_t^i)^{1-\nu_i^M} - 1}{1 - \nu_i^M} + \nu_{0,i}^{DC} \frac{(B_t^i)^{1-\nu_i^{DC}} - 1}{1 - \nu_i^{DC}}.$$

The terms $\nu_{0,i}^M$, ν_i^M, $\nu_{0,i}^{DC}$, and ν_i^{DC} capture the relative utility and the intertemporal elasticity of substitution for holding real money and cryptocurrency balances.

Household Adjustment Costs. Households incur quadratic adjustment costs when adjusting their holdings of real money balances and cryptocurrency:

$$\chi^i_{M,t} = \frac{\kappa_M}{2}\left(M^i_t - \bar{M}^i\right)^2,$$
$$\chi^i_{DC,t} = \frac{\kappa_{DC}}{2}\left(B^i_t - \bar{B}^i\right)^2.$$

To maintain consistency in terminology, we refer to $\chi^i_{M,t}$ and $\chi^i_{DC,t}$ as currency adjustment costs, distinguishing them from other frictions in the model. In addition to these adjustment costs, banked households incur management costs when purchasing equity:

$$\chi^h_t = \frac{\varkappa_h}{2}\left(\frac{K^h_t}{K_t}\right)^2 K_t, \tag{4}$$

where $\varkappa_h$ represents the intensity of the management cost, K^h_t denotes the equity holdings of the banked household, and K_t is the aggregate equity stock. These costs restrict the ability of banked households to scale their equity purchases, in contrast to banks, which do not face similar constraints when holding domestic equity.

Stochastic Discount Factor. For notational convenience, let λ^i_t denote the marginal utility of consumption for household i. The stochastic discount factor (SDF) for type i households is given by:

$$\Lambda^i_{t,t+1} = \beta\mathbb{E}_t\frac{\lambda^i_{t+1}}{\lambda^i_t}. \tag{5}$$

2.2 Banks

The interaction between workers and bankers within the representative household follows a dynamic transition process. To maintain a stable population, we normalize the combined density of workers and bankers to unity. Let σ denote the probability that a banker remains employed in the next period, implying a retirement probability of $1-\sigma$ each period. Retiring bankers are replaced by workers transitioning into banking, ensuring a steady composition over time. When a banker retires, she transfers her franchise value—equivalent to her remaining net worth—as a dividend to the household. New bankers, in turn, receive an initial capital injection from the household,

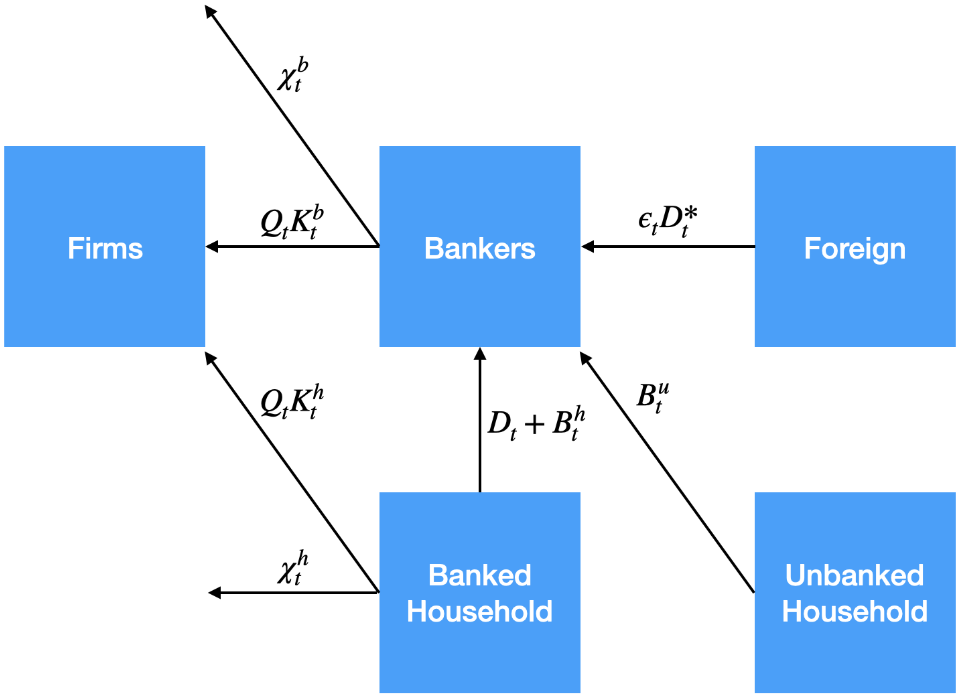


Figure 1: Graphical illustration of the model

amounting to a fraction γ of total assets.

Banked households cannot directly access foreign savings, nor can foreign households directly hold domestic capital. Instead, all interactions between domestic equity markets and foreign households are intermediated through the domestic banking sector, exposing domestic banks to foreign exchange rate risk. Figure 1 provides an overview of the agents and financial flows in the model.

A banker finances her capital investments, valued at $Q_t k_t^b$, by accepting deposits from banked households in domestic currency (d_t), cryptocurrency deposits (b_t), and foreign deposits denominated in foreign currency, which are converted into domestic currency units ($\epsilon_t d_t^*$). The banker faces exchange rate risk, where the real exchange rate ϵ_t is given by:

$$\epsilon_t = \frac{E_t P_t^*}{P_t}, \tag{6}$$

where E_t is the nominal exchange rate, defined as the number of domestic currency units per unit of foreign currency.[10]

While bankers can invest in domestic firms without incurring additional costs, unlike workers, they face foreign funding costs when raising deposits from foreign house-

10. An increase (decrease) in ϵ_t and E_t corresponds to a depreciation (appreciation) of the domestic currency.

holds. This cost is given by:

$$\chi_t^b = \frac{\varkappa^b}{2} x_t^2 Q_t K_t^b, \tag{7}$$

The parameter $\varkappa^b > 0$ governs foreign borrowing costs, capturing the severity of these costs, which create frictions in accessing foreign funding and limit the bank's ability to expand its balance sheet through external borrowing. The variable x_t represents the bank's foreign leverage ratio, defined as:

$$x_t = \frac{\epsilon_t d_t^*}{Q_t K_t^b}, \tag{8}$$

where Q_t is the price of equity, K_t^b is the capital stock held by banks, and $Q_t K_t^b$ represents the banker's total asset holdings. These quadratic adjustment costs are important for closing the model, as explained in Schmitt-Grohé and Uribe (2003).

Additionally, since bankers provide cryptocurrency wallet services to households,[11] we define x_t^c as the banker's cryptocurrency deposit leverage ratio:

$$x_t^c = \frac{b_t}{Q_t k_t^b}. \tag{9}$$

Bankers aim to accumulate net worth, or franchise value, n_t, over time until retirement. Upon retirement, a banker returns her net worth to the household in the form of a dividend.[12] Consequently, a banker seeks to maximize her bank's franchise value, $\mathbb{V}_t^b$, defined as the expected present discounted value of future dividends:

$$\mathbb{V}_t^b = \mathbb{E}_t \sum_{s=1}^{\infty} \Lambda_{t,t+s}^h \sigma^{s-1} (1-\sigma) n_{t+s}, \tag{10}$$

where n_{t+s} represents the bank's net worth at the time of the banker's retirement in period $t+s$, which occurs with probability $\sigma^{s-1}(1-\sigma)$. Thus, a banker chooses quantities k_t^b, d_t, and d_t^* to maximize equation (10).[13]

11. For example, the central bank of El Salvador has published draft regulations on banks handling Bitcoin deposits.

12. Following Gertler and Kiyotaki (2010) and Gertler and Karadi (2011), this assumption prevents banks from indefinitely accumulating retained earnings, which would allow them to bypass financing constraints and obligations to creditors.

13. For simplicity, we assume that each individual banker exogenously accepts cryptocurrency deposits, b_t, in proportion to the population of bankers and total cryptocurrency deposits. In aggregate,

To limit a banker's ability to raise funds, we introduce a financial friction in line with Gertler and Kiyotaki (2010), wherein bankers face a moral hazard problem: they can either abscond with the funds obtained from domestic and foreign depositors or operate honestly and fulfill their financial obligations. However, absconding is costly, as the banker can only divert a fraction, Θ, of the assets she has accumulated:

$$\Theta(x_t, x_t^c) = \frac{\theta_0}{\exp(\theta x_t + \theta^c x_t^c)}, \tag{11}$$

where $\{\theta_0, \theta, \theta^c\} > 0$. Following Gertler and Kiyotaki (2010), we assume that as a banker raises a greater share of funds from international financial markets and cryptocurrency deposits, the proportion of assets she can divert decreases.

Additionally, absconding requires time—it takes a full period for the banker to flee with the diverted funds. As a result, a banker must decide whether to abscond in period t before realizing the next period's rental rate of capital. If a banker chooses to abscond in period t, creditors will force the bank to shut down in period $t+1$, reducing the bank's franchise value to zero.

Therefore, a banker will only abscond if the return to absconding exceeds the franchise value of the bank at the end of period t, $\mathbb{V}_t^b$. Since depositors act rationally, they will not supply funds to a bank if they anticipate the banker has an incentive to abscond. This results in the following incentive compatibility constraint:

$$\mathbb{V}_t^b \geq \Theta(x_t, x_t^c) Q_t k_t^b, \tag{12}$$

where we assume that the banker will not abscond when the constraint holds with equality.

Bankers are subject to the following balance sheet constraint:

$$\left(1 + \frac{\varkappa^b}{2} x_t^2\right) Q_t k_t^b = d_t + \epsilon_t d_t^* + n_t + b_t. \tag{13}$$

the sum of individual cryptocurrency deposits across all banks, $b_t(j)$, equals total cryptocurrency deposits, B_t:

$$\sum_{j=1}^{\infty} b_t(j) = B_t.$$

Additionally, the flow of funds constraint for a banker is given by:

$$n_t = R_t^k Q_{t-1} k_{t-1}^b - \frac{R_{t-1}}{\pi_t} d_{t-1} - \frac{R_{t-1}^*}{\pi_t^*} \epsilon_t d_{t-1}^* - \frac{R_{t-1}^c}{\pi_t} b_{t-1}, \tag{14}$$

where, for a newly entering banker, net worth consists of the startup capital provided by the household, which is a fraction γ of the household's total assets.

2.2.1 Banker's Problem and Financial Market Wedges

Since the franchise value of the bank, $\mathbb{V}_t^b$, can be interpreted as its "market value," we define the bank's Tobin's Q ratio, ψ_t, as the ratio of franchise value to net worth:

$$\psi_t \equiv \frac{\mathbb{V}_t^b}{n_t}. \tag{15}$$

Additionally, let ϕ_t denote the bank's leverage ratio:

$$\phi_t = \frac{Q_t k_t^b}{n_t}. \tag{16}$$

The banker's objective is to maximize franchise value, which can be expressed as:

$$\psi_t = \max_{\phi_t, x_t} \left\{ \mu_t \phi_t + \left(1 - \frac{\varkappa^b}{2} x_t^2 \phi_t\right) \upsilon_t + \mu_t^* x_t \phi_t + \mu_t^c x_t^c \phi_t \right\}, \tag{17}$$

subject to the incentive compatibility constraint:

$$\psi_t = \Theta(x_t, x_t^c) \phi_t. \tag{18}$$

In this formulation, μ_t represents the excess return on capital over home deposits, while μ_t^c captures the cost advantage of cryptocurrency deposits relative to home deposits. Similarly, μ_t^* denotes the cost advantage of foreign currency debt over home deposits, effectively measuring the deviation from UIP. The term υ_t corresponds to the marginal cost of deposits. These expressions are given by:

$$\mu_t = \mathbb{E}_t \Omega_{t,t+1} \left(R_{t+1}^k - \frac{R_t}{\pi_{t+1}} \right), \tag{19}$$

$$\mu_t^c = \mathbb{E}_t\Omega_{t,t+1}\left(\frac{R_t}{\pi_{t+1}} - \frac{R_t^c}{\pi_{t+1}}\right), \tag{20}$$

$$\mu_t^* = \mathbb{E}_t\Omega_{t,t+1}\left(\frac{R_t}{\pi_{t+1}} - \frac{\epsilon_{t+1}}{\epsilon_t}\frac{R_t^*}{\pi_{t+1}^*}\right), \tag{21}$$

$$\upsilon_t = \mathbb{E}_t\Omega_{t,t+1}\frac{R_t}{\pi_{t+1}}, \tag{22}$$

$$\Omega_{t,t+1} = \Lambda_{t,t+1}^h(1-\sigma+\sigma\psi_{t+1}). \tag{23}$$

Solving the banker's optimization problem yields the optimal leverage ratio and the share of foreign deposits:

$$\phi_t = \frac{\upsilon_t}{\Theta(x_t, x_t^c) - \mu_t - \mu_t^* x_t - \mu_t^c x_t^c + \frac{\varkappa^b}{2}x_t^2\upsilon_t}, \tag{24}$$

$$x_t = \frac{\theta\mu_t^* - \varkappa^b\upsilon_t}{\theta\varkappa^b\upsilon_t} + \sqrt{\left(\frac{\mu_t^*}{\varkappa^b\upsilon_t}\right)^2 + 2\frac{\mu_t^c}{\varkappa^b\upsilon_t}x_t^c + \left(\frac{1}{\theta}\right)^2 + 2\frac{\mu_t}{\varkappa^b\upsilon_t}}. \tag{25}$$

For a detailed derivation of the banker's problem, refer to Appendix B.2.

2.3 Firms

2.3.1 Final Good Firms

The production structure follows a standard New Keynesian Dixit-Stiglitz framework. Final goods are produced by perfectly competitive firms that aggregate differentiated intermediate goods according to:

$$Y_t = \left(\int_0^1 Y_t(i)^{\frac{\eta-1}{\eta}} di\right)^{\frac{\eta}{\eta-1}},$$

where $Y_t(i)$ denotes the quantity of intermediate good $i \in [0,1]$, and $\eta > 0$ represents the elasticity of demand.

2.3.2 Intermediate Good Producers

Each intermediate good is produced using a constant returns to scale production function:

$$Y_t(i) = A_t\left(\frac{K_{t-1}(i)}{\alpha_K}\right)^{\alpha_K}\left(\frac{IM_t(i)}{\alpha_M}\right)^{\alpha_M}\left(\frac{L_t^h(i)}{\alpha_h}\right)^{\alpha_h}\left(\frac{L_t^u(i)}{\alpha_u}\right)^{\alpha_u},$$

where $K_t(i)$, $IM_t(i)$, $L_t^h(i)$, and $L_t^u(i)$ denote capital, imported inputs, labor supplied by banked households, and labor supplied by unbanked households, respectively. Aggregate total factor productivity (TFP), A_t, follows a stationary AR(1) process. The input shares, α_K, α_M, α_h, and α_u, lie in the interval (0,1) and sum to unity, ensuring constant returns to scale.

From the firm's cost minimization problem, real marginal cost is given by:[14]

$$mc_t = \frac{1}{A_t}(z_t^k)^{\alpha_K}\epsilon_t^{\alpha_M}(w_t^h)^{\alpha_h}(w_t^u)^{\alpha_u}. \tag{29}$$

In a symmetric equilibrium, aggregate production satisfies:

$$Y_t = A_t\left(\frac{K_{t-1}}{\alpha_K}\right)^{\alpha_K}\left(\frac{IM_t}{\alpha_M}\right)^{\alpha_M}\left(\frac{L_t^h}{\alpha_h}\right)^{\alpha_h}\left(\frac{L_t^u}{\alpha_u}\right)^{\alpha_u}. \tag{30}$$

where K_{t-1}, IM_t, L_t^h, and L_t^u denote aggregate capital, imports, and the labor of banked and unbanked households, respectively.

In addition to selecting input quantities to minimize costs, each intermediate firm i sets a price $P_t(i)$. Under Rotemberg pricing, and assuming symmetry across firms, the evolution of inflation follows:[15]

$$(\pi_t - 1)\pi_t = \frac{1}{\kappa}(\eta mc_t + 1 - \eta) + \mathbb{E}_t\Lambda_{t,t+1}^h\frac{Y_{t+1}}{Y_t}(\pi_{t+1} - 1)\pi_{t+1}. \tag{31}$$

2.3.3 Investment Good Firms

Investment goods are produced by perfectly competitive firms, and the aggregate capital stock evolves according to:

$$K_t = \lambda K_{t-1} + I_t, \tag{32}$$

14. From the first-order conditions, we also obtain the following expenditure share ratios:

$$\frac{\epsilon_t IM_t}{z_t^k K_{t-1}} = \frac{\alpha_M}{\alpha_K}, \tag{26}$$

$$\frac{w_t^h L_t^h}{z_t^k K_{t-1}} = \frac{\alpha_h}{\alpha_K}, \tag{27}$$

$$\frac{w_t^u L_t^u}{z_t^k K_{t-1}} = \frac{\alpha_u}{\alpha_K}. \tag{28}$$

15. A standard New Keynesian Phillips Curve (NKPC) can be derived by log-linearizing equation (31) around the non-inflationary steady state.

where $\lambda = 1 - \delta$ and $\delta \in (0, 1)$ represents the depreciation rate. The total cost of investment is given by:

$$I_t \left[1 + \Phi\left(\frac{I_t}{\bar{I}}\right) \right].$$

Each investment firm maximizes its profit function:

$$\max_{I_t} \left\{ Q_t I_t - I_t - \Phi\left(\frac{I_t}{\bar{I}}\right) I_t \right\}.$$

Differentiating with respect to I_t yields the first-order condition:

$$Q_t = 1 + \Phi\left(\frac{I_t}{\bar{I}}\right) + \left(\frac{I_t}{\bar{I}}\right) \Phi'\left(\frac{I_t}{\bar{I}}\right). \tag{33}$$

Investment adjustment costs, $\Phi(\cdot)$, follow Christiano, Eichenbaum, and Evans (2005),[16] and are specified as:

$$\Phi\left(\frac{I_t}{\bar{I}}\right) = \frac{\kappa_I}{2} \left(\frac{I_t}{\bar{I}} - 1\right)^2.$$

This function satisfies $\Phi(1) = \Phi'(1) = 0$ and $\Phi''(\cdot) > 0$. The parameter $\kappa_I = \Phi''(1)$ is chosen to match the investment elasticity estimates from instrumental variable regressions in Eberly (1997).

2.4 Foreign Exchange

This section describes the role of foreign output and inflation in the model. Throughout, starred variables denote their foreign counterparts.

Our model follows a standard producer pricing framework, where exports depend on foreign output and are given by:

$$EX_t = \left(\frac{P_t}{E_t P_t^*}\right)^{-\varphi} Y_t^* = \epsilon_t^{\varphi} Y_t^*, \tag{34}$$

where φ represents the price elasticity of foreign demand. While an alternative specification would allow firms to set export prices in foreign currency to maximize revenues, we simplify by assuming exports are exogenously determined, following ABK.[17]

16. Unlike Christiano, Eichenbaum, and Evans (2005), where adjustment costs depend on the ratio I_t/I_{t-1}, we assume they depend on $I_t/\bar{I}$.

17. For a model in which domestic firms set export prices in foreign currency, see Cesa-Bianchi, Ferrero, and Li (2024). Although exogenously setting exports simplifies the analysis, a global pricing framework

To express the relationship between the nominal and real exchange rate, we take the logarithm of the real exchange rate definition and compute its first difference:

$$\ln \epsilon_t - \ln \epsilon_{t-1} = \ln E_t - \ln E_{t-1} + \ln P_t^* - \ln P_{t-1}^* - (\ln P_t - \ln P_{t-1}).$$

Rearranging yields:

$$\Delta \ln \epsilon_t = \Delta \ln E_t + \hat{\pi}_t^* - \hat{\pi}_t. \tag{35}$$

The nominal exchange rate is determined by the purchasing power parity condition in (35) and the exchange rate regime described in Section 2.5.

2.5 Exchange Rate Regime and Monetary Policy

In the baseline specification, the domestic central bank follows an inertial Taylor Rule:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R} \left[\left(\frac{\pi_t}{\bar{\pi}}\right)^{\frac{1-\omega_E}{\omega_E}} \left(\frac{E_t}{\bar{E}}\right)^{\frac{\omega_E}{1-\omega_E}}\right]^{1-\rho_R} \exp(\varepsilon_t^R), \tag{36}$$

where the central bank responds to deviations of inflation and the nominal exchange rate from their steady-state targets, $\bar{\pi}$ and $\bar{E}$, respectively. The term ε_t^R represents a monetary policy shock. This formulation follows Galí and Monacelli (2016) and Akinci and Queralto (2023), where $\omega_E \in [0, 1]$ governs the central bank's sensitivity to exchange rate fluctuations relative to inflation.

The assumption of an independent central bank aligns with the monetary policies of many emerging markets, where authorities target inflation while using foreign exchange interventions to mitigate excessive exchange rate volatility. For instance, Brazil follows an inflation-targeting framework while conducting interventions to stabilize the exchange rate and provide liquidity during periods of financial stress (Sandri 2023).

The Taylor Rule nests different exchange rate regimes through the parameter ω_E. When $\omega_E \to 0$, the central bank prioritizes inflation stabilization, effectively implementing a strict inflation-targeting regime by assigning a high weight to inflation and a near-zero weight to exchange rate fluctuations. Conversely, as $\omega_E \to 1$, monetary pol-

would reduce the role of the expenditure-switching channel, as exports would be priced in foreign currency. Instead, our model emphasizes the financial channel of exchange rates, focusing on how exchange rate movements affect foreign currency liabilities on bank balance sheets, net worth, lending, and asset prices, as in ABK.

icy focuses entirely on stabilizing the exchange rate, approximating a fixed exchange rate regime where the nominal exchange rate remains stable despite moderate monetary shocks. Intermediate values of $\omega_E \in (0,1)$ correspond to hybrid managed exchange rate regimes, balancing inflation and exchange rate stabilization.[18]

2.6 Cryptocurrency Price Process

Stablecoin and Digital Dollarization. We model the adoption of stablecoins in emerging markets, assuming that their price follows a stationary AR(1) process. Since stablecoins are typically pegged to the USD, their real price in the model tracks the real exchange rate, ϵ_t.[19] We allow for deviations from the peg due to a cryptocurrency price shock, $\varepsilon_t^{P^c}$, and assume a symmetric distribution of these deviations, consistent with empirical evidence showing that stablecoin prices fluctuate on both sides of the peg.[20]

$$\ln\left(\frac{P_t^c}{\epsilon_t}\right) = \rho_c \ln\left(\frac{P_{t-1}^c}{\epsilon_t}\right) + \varepsilon_t^{P^c}. \tag{37}$$

Risky Cryptocurrency. We also consider the case of a risky cryptocurrency, as in El Salvador's adoption of Bitcoin as legal tender. The price process follows a stationary AR(1) process similar to stablecoins, but in this case, $\bar{P}^c$ is exogenously determined and does not depend on the nominal exchange rate. This reflects the empirical observation that Bitcoin and other volatile cryptocurrencies are largely disconnected from macroeconomic fundamentals (Benigno and Rosa 2023).

$$\ln\left(\frac{P_t^c}{\bar{P}^c}\right) = \rho_c \ln\left(\frac{P_{t-1}^c}{\bar{P}^c}\right) + \varepsilon_t^{P^c}. \tag{38}$$

While our baseline empirical specification focuses on the stablecoin-based digital dollarization regime, our key results extend to an environment where a risky cryptocurrency is adopted.

18. To model fully dollarized economies like El Salvador, which lack an independent central bank, we replace the Taylor Rule with a fixed exchange rate condition, $E_t = 1$. This setup yields welfare and steady-state outcomes equivalent to the limiting case where $\omega_E \to 1$.

19. In practice, stablecoins track the nominal exchange rate. However, since P_t^c represents the real cryptocurrency price in domestic goods, its fluctuations align with movements in the real exchange rate.

20. Appendix A.1 presents the empirical distribution of stablecoin prices for USDT and USDC.

2.7 Macroeconomic Shocks

In addition to domestic interest rate and cryptocurrency price shocks, we incorporate foreign interest rate, foreign output, foreign inflation, and domestic productivity shocks. Each follows a stationary AR(1) process:

$$\ln\left(\frac{R_t^*}{\bar{R}^*}\right) = \rho_{R^*} \ln\left(\frac{R_{t-1}^*}{\bar{R}^*}\right) + \varepsilon_t^{R^*}, \tag{39}$$

$$\ln\left(\frac{Y_t^*}{\bar{Y}^*}\right) = \rho_{Y^*} \ln\left(\frac{Y_{t-1}^*}{\bar{Y}^*}\right) + \varepsilon_t^{Y^*}, \tag{40}$$

$$\ln\left(\frac{\pi_t^*}{\bar{\pi}^*}\right) = \rho_{\pi^*} \ln\left(\frac{\pi_{t-1}^*}{\bar{\pi}^*}\right) + \varepsilon_t^{\pi^*}, \tag{41}$$

$$\ln\left(\frac{A_t}{\bar{A}}\right) = \rho_A \ln\left(\frac{A_{t-1}}{\bar{A}}\right) + \varepsilon_t^{A}. \tag{42}$$

2.8 Market Equilibrium

Aggregate capital consists of equity held by banked households and bankers:

$$K_t = K_t^h + K_t^b. \tag{43}$$

Aggregate consumption is given by:

$$C_t = C_t^h + C_t^u \tag{44}$$

The domestic resource constraint is:

$$Y_t = C_t + \left[1 + \Phi\left(\frac{I_t}{\bar{I}}\right)\right] I_t + EX_t + \frac{\kappa}{2}(\pi_t - 1)^2 Y_t + \chi_t^h + \chi_t^b + \chi_{M,t}^h + \chi_{DC,t}^h + \chi_{M,t}^u + \chi_{DC,t}^u, \tag{45}$$

where output is allocated to consumption, investment, exports, and adjustment costs.[21]

The law of motion for aggregate net foreign debt is:

$$D_t^* = \frac{R_{t-1}^*}{\pi_t^*} D_{t-1}^* + IM_t - \frac{1}{\epsilon_t} EX_t. \tag{46}$$

21. GDP is defined as:

$$Y_t^{GDP} = Y_t - \epsilon_t IM_t.$$

This equation expresses the evolution of foreign debt, D_t^*, accounting for interest accrual and the trade balance (imports minus exports). Under balance of payments equilibrium, the current account deficit equals the capital account surplus, reflecting net foreign capital inflows.

The aggregate net worth of the banking sector evolves as:

$$N_t = \sigma \left(R_t^k Q_{t-1} K_{t-1}^b - \frac{R_{t-1}}{\pi_t} D_{t-1} - \epsilon_t \frac{R_{t-1}^*}{\pi_t^*} D_{t-1}^* - \frac{R_{t-1}^c}{\pi_t} B_{t-1} \right) + \gamma R_t^k Q_{t-1} K_{t-1}. \tag{47}$$

The aggregate balance sheet of the banking sector is:

$$Q_t K_t^b \left(1 + \frac{\varkappa^b}{2} x_t^2\right) = \left(1 + \frac{\varkappa^b}{2} x_t^2\right) \phi_t N_t, \tag{48}$$

$$Q_t K_t^b \left(1 + \frac{\varkappa^b}{2} x_t^2\right) = N_t + D_t + \epsilon_t D_t^* + B_t, \tag{49}$$

$$x_t = \frac{\epsilon_t D_t^*}{Q_t K_t^b}, \tag{50}$$

$$x_t^c = \frac{B_t}{Q_t K_t^b}. \tag{51}$$

Equation (48) follows from the definition of leverage in (16), while (49) aggregates individual bank balance sheets. Since all banks are identical, (50) and (51) follow directly from their microeconomic counterparts.

The total cryptocurrency deposits held in the banking system are:

$$B_t = B_t^u + B_t^h. \tag{52}$$

A competitive equilibrium is a set of prices $\{E_t, mc_t, Q_t, R_t, R_t^c, w_t^h, w_t^u, z_t^k, \epsilon_t, \pi_t\}$; quantity variables $\{B_t, B_t^h, B_t^u, C_t, C_t^h, C_t^u, D_t, D_t^*, EX_t, I_t, K_t, K_t^b, K_t^h, L_t^h, L_t^u, M_t^h, M_t^u, N_t, Y_t\}$; banking variables $\{x_t, x_t^c, \psi_t, \phi_t, v_t, \mu_t, \mu_t^c, \mu_t^*\}$; foreign variables $\{R_t^*, Y_t^*, \pi_t^*\}$; and exogenous variables $\{A_t, P_t^c\}$, which satisfy 42 equilibrium conditions. These conditions include household and banker optimality conditions, firm first-order conditions, bank balance sheet and foreign borrowing constraints, the cryptocurrency deposit market clearing condition, goods and labor market clearing conditions, capital market equilibrium, the aggregate resource constraint, exchange rate dynamics, the monetary policy rule, and the evolution of macroeconomic shocks.

2.9 Calibration

We calibrate the parameters in our model using standard values from the New Keynesian macroeconomics literature. We select El Salvador as a representative small open economy for parameter calibration. The model operates at a quarterly frequency. The baseline calibration of the domestic household block, banking sector, and firm sector follows ABK (see Table 1, where banked and unbanked households are abbreviated as (BHH) and (UHH), respectively)

Money and Cryptocurrency Balances. The preference parameter $\nu^M_{0,i}$ in an economy without cryptocurrency (referred to as the "autarky" case) is calibrated to target a real money balance-to-GDP ratio of 10%, based on cash-to-GDP estimates from Abad, Nuno, and Thomas (2025). Similar figures are reported for emerging markets by Shirai and Sugandi (2019).[22]

In transitioning to an economy with cryptocurrency, we assume that the share of physical cash remains at 10% of GDP, ensuring comparability between the two economies:

$$\frac{M_{\text{autarky}}}{GDP} = \frac{M_{\text{dc}}}{GDP},$$

where M_{autarky} and M_{dc} denote the aggregate real money balances in the cryptocurrency autarky and the economy with digital currency, respectively.

The coefficient of relative risk aversion (CRRA) for both money and cryptocurrency, ν^M_i and ν^{DC}_i, is set to 2, consistent with lower-bound CRRA estimates in the finance literature (**elminejad2022relative**). Since there is no precise counterfactual for cryptocurrency balances, we calibrate $\nu^{DC}_{0,i}$ such that the share of cryptocurrency balances matches the share of real money balances in the cryptocurrency economy. As cryptocurrency adoption increases, these parameters can be re-calibrated using observed data.

Interest Rates. Domestic interest rates are calibrated at an annualized 5%, based on IMF data for El Salvador from 2000 to 2020. The foreign interest rate is set at 2% annually, reflecting historical US interest rates.

22. Broad money-to-GDP ratios are typically much higher. For instance, the World Bank reports a 60% broad money-to-GDP ratio, but this includes interest-bearing term deposits. Our baseline calibration relies on cash-in-circulation, aligning with the model's definition of money balances.

Table 1: Baseline calibration

Parameter	Value	Description
β	0.9876	Household discount factor
ζ	1/3	Inverse-Frisch elasticity of labor supply
ζ_0	7.883	Labor supply capacity
$\nu_{0,h}^{M}$	0.002	Scale term of real money balances (BHH)
ν_{h}^{M}	2	CRRA of real money balances (BHH)
$\nu_{0,u}^{M}$	0.005	Scale term of real money balances (UHH)
ν_{u}^{M}	2	CRRA of real money balances (UHH)
$\nu_{0,h}^{DC}$	0.002	Scale term of cryptocurrency balances (BHH)
ν_{h}^{DC}	2	CRRA of cryptocurrency balances (BHH)
$\nu_{0,u}^{DC}$	0.005	Scale term of cryptocurrency balances (UHH)
ν_{u}^{DC}	2	CRRA of cryptocurrency balances (UHH)
κ_M	2	Money adjustment cost parameter
κ_{DC}	2	Cryptocurrency adjustment cost parameter
$\varkappa^h$	0.0197	BHH direct finance cost
θ	0.1	Elasticity of foreign-financed leverage
θ^c	0.1	Elasticity of cryptocurrency-financed leverage
θ_0	0.401	Bank moral hazard severity
σ	0.94	Banker survival probability
γ	0.0045	Fraction of total assets allocated to new banks
$\varkappa^b$	0.0197	Bank management cost of foreign borrowing
α_K	0.3	Capital share in production
α_M	0.18	Import share in production
α_h	0.1734	Labor share of BHH
α_u	0.3466	Labor share of UHH
λ	0.98	One minus the depreciation rate ($\delta = 0.02$)
κ_I	0.66	Investment adjustment cost parameter
ω_E	$[0, 1]$	Monetary policy exchange rate sensitivity parameter
ρ_A	0.85	TFP AR(1) coefficient
ρ_R	0.8	Monetary policy inertia
ρ_{R^*}	0.85	Foreign interest rate AR(1) coefficient
ρ_{Y^*}	0.85	Foreign output AR(1) coefficient
ρ_{Π^*}	0.85	Foreign inflation AR(1) coefficient
ρ_c	0.7	Stablecoin price AR(1) coefficient

Bank Parameters. The banking parameters θ_0, $\varkappa^b$, and γ are calibrated to yield a steady-state bank leverage multiple, ϕ, of approximately 4, with a 2% spread between bank asset returns and deposit rates. The banker's continuation probability, σ, is set to ensure an annualized dividend payout equal to $4(1-\sigma) = 24\%$ of net worth.

We assume bankers treat cryptocurrency and foreign deposits symmetrically with respect to the fraction of funds they can abscond with. Consequently, the elasticity of cryptocurrency-financed leverage, θ^c, is set to 0.1, the same as for foreign deposits. The moral hazard severity parameter is also assumed to be symmetric, $\theta_0 = \theta_0^c = 0.401$.

Firms and Production. Capital and import shares are calibrated to standard values in the literature, with $\alpha_K = 0.3$ and $\alpha_M = 0.18$. Two-thirds of El Salvador's population are unbanked.[23] The labor share of unbanked households, α_u, is determined based on El Salvador's labor market composition. Given that the total labor share is $\alpha_h + \alpha_u = 0.52$ and two-thirds of the workforce is unbanked, we set $\alpha_u = \frac{2}{3} \times 0.52 = 0.3466$, and $\alpha_h = 0.1734$.

Exchange Rate Regime. For monetary policy, we set $\omega_E = 0.5$, representing a managed float regime, which balances between a strict peg ($\omega_E \to 1$) and full inflation targeting ($\omega_E \to 0$).

Macroeconomic Shocks. Productivity and foreign output shocks are assigned quarterly standard deviations of 1.3% and 2%, respectively. Innovations to foreign inflation and interest rates have a standard deviation of 0.25%. Cryptocurrency price shocks are calibrated to a quarterly standard deviation of 1%—higher than stablecoins like USDC and Tether (0.1–0.2%) but significantly lower than Bitcoin (70%).[24] We assume cryptocurrency price shocks are uncorrelated with macroeconomic fundamentals, consistent with findings in Benigno and Rosa (2023).

23. https://datatopics.worldbank.org/g20fidata/country/el-salvador.
24. Calculations are based on data from CryptoCompare (2017–2021).

3 Results

3.1 Cryptocurrency Price Shock IRFs

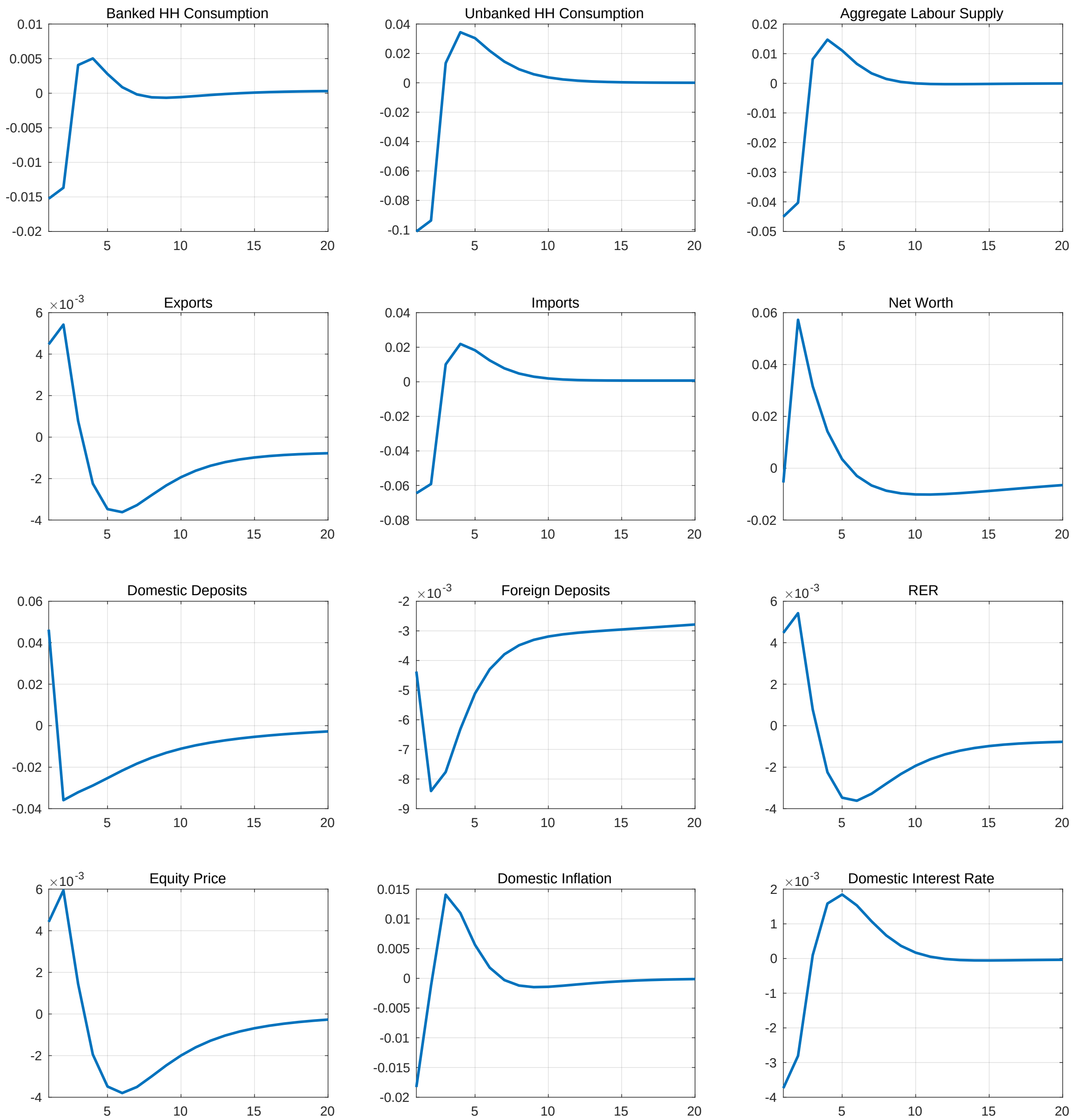
Figure 2 presents the IRFs following a negative 1 percent decline in cryptocurrency prices over a 20-quarter horizon. The shock affects the economy through three key channels: household savings and consumption, banking sector balance sheets, and monetary policy adjustments.

The decline in cryptocurrency prices reduces the value of unbanked households' savings, leading to a reduction in consumption. Given their GHH preferences, lower consumption leads to a contraction in labor supply, which in turn reduces real wages. The overall price level falls, with unbanked household consumption declining by a peak of approximately 0.1%. Banked households also experience a decline in consumption, but to a lesser extent—around 0.015% (1.5 basis points). Unlike unbanked households, banked households hold deposits, which provide a buffer against the wealth effects of the cryptocurrency shock. However, they are still affected by lower wages, reduced labor supply, and weaker household income.

The banking sector is affected through balance sheet adjustments. As cryptocurrency prices decline, the value of banks' cryptocurrency liabilities falls, leading to a rise in banker net worth. Banks respond by reallocating their portfolios, shifting toward greater reliance on domestic and foreign deposits. While this increase in net worth supports higher asset prices and investment, the stimulus is insufficient to fully counteract the decline in household consumption, wages, and output.

Monetary policy responds by lowering interest rates as the central bank reacts to falling inflation and weaker output. The reduction in the policy rate depreciates the nominal and real exchange rate, leading to an increase in net exports. While this exchange rate depreciation partially offsets the negative effects on output, the overall economy still experiences a contraction in aggregate demand due to weaker household consumption and labor income.

Figure 2: Cryptocurrency price shock



Note: The figure plots impulse responses of model variables to a 1% (quarterly) negative shock to cryptocurrency prices. Time is measured in quarters, and responses are expressed as percentage deviations from the steady state. Domestic inflation and the domestic interest rate are annualized.

3.2 Welfare Analysis

3.2.1 Welfare Comparison: Digital Dollarization vs. Cryptocurrency Autarky

In this section, we analyze how welfare gains depend on cryptocurrency price volatility. To assess the costs and benefits of cryptocurrency adoption, we compare household welfare in the stochastic steady state across two regimes: one where cryptocurrency is available and another where it is not (crypto-autarky). In each case, the economy remains subject to macroeconomic shocks, following the calibration strategy outlined in Section 2.9, which includes shocks to domestic interest rates, productivity, and foreign interest rates and inflation.

In addition to macroeconomic shocks, cryptocurrency is subject to price volatility. For our baseline welfare estimates, we assume σ_c is 0.15% (quarterly), based on estimates derived from available stablecoin price data for Tether and USDC, as described in Appendix A. Therefore, the cryptocurrency regime captures digital dollarization, in which cryptocurrency is pegged to the foreign currency but with small fluctuations.

The comparison incorporates the sub-utility functions for holdings of money and cryptocurrency balances. Specifically, in the cryptocurrency economy, the sub-utility function includes both real money balances and cryptocurrency deposits, $\Upsilon(M_t^i, B_t^i)$, whereas in the no-cryptocurrency economy, preferences include only real money balances, $\Upsilon(M_t^i)$.[25]

The welfare gains of digital dollarization are given by:

$$\begin{aligned}
\text{BHH: } & \ln\left(C^h - \zeta_{0,h}\frac{(L^h)^{1+\zeta_h}}{1+\zeta_h}\right)\Big|_{\text{crypto}} - \ln\left(C^h - \zeta_{0,h}\frac{(L^h)^{1+\zeta_h}}{1+\zeta_h}\right)\Big|_{\text{no crypto}} \\
& + \Upsilon(M_t^h, B_t^h)\big|_{\text{crypto}} - \Upsilon(M_t^h)\big|_{\text{no crypto}} \\
& = 1.01\%, \\
\text{UHH: } & \ln\left(C^u - \zeta_0^u\frac{(L^u)^{1+\zeta^u}}{1+\zeta^u}\right)\Big|_{\text{crypto}} - \ln\left(C^u - \zeta_0^u\frac{(L^u)^{1+\zeta^u}}{1+\zeta^u}\right)\Big|_{\text{no crypto}} \\
& + \Upsilon(M_t^u, B_t^u)\big|_{\text{crypto}} - \Upsilon(M_t^u)\big|_{\text{no crypto}} \\
& = 1.33\%.
\end{aligned}$$

Both household types experience welfare gains in the cryptocurrency economy, though the unbanked benefit more than the banked under the baseline specification.

Next, we extend the analysis through Figure 3, which plots the welfare gains for banked and unbanked households relative to the no-cryptocurrency economy for different parameterizations of cryptocurrency volatility. In addition to reporting the wel-

25. This is because, under the current calibration of $\nu_i^{DC} = 2 > 1$, the utility function for cryptocurrency balances is undefined when $B_t^i = 0$.

fare outcomes for both household types, we compute an aggregate welfare measure that accounts for their relative shares in the economy. Specifically, the aggregate welfare measure assigns a weight of two-thirds to the unbanked and one-third to the banked, reflecting their respective labor shares, as outlined in Section 2.9.

Welfare for both sets of households declines as cryptocurrency price volatility increases. At higher volatility levels, the welfare losses for unbanked households outweigh the moderate welfare losses for banked households. For unbanked households, we numerically determine a volatility threshold σ_c of approximately 24.65% (quarterly), above which they experience net welfare losses compared to the no-cryptocurrency economy. Similarly, banked households begin experiencing net welfare losses when volatility exceeds 26.75% (quarterly). These results suggest that, when cryptocurrency price volatility is low, holding a fraction of income in cryptocurrency provides a useful savings mechanism that helps stabilize consumption in response to adverse shocks.

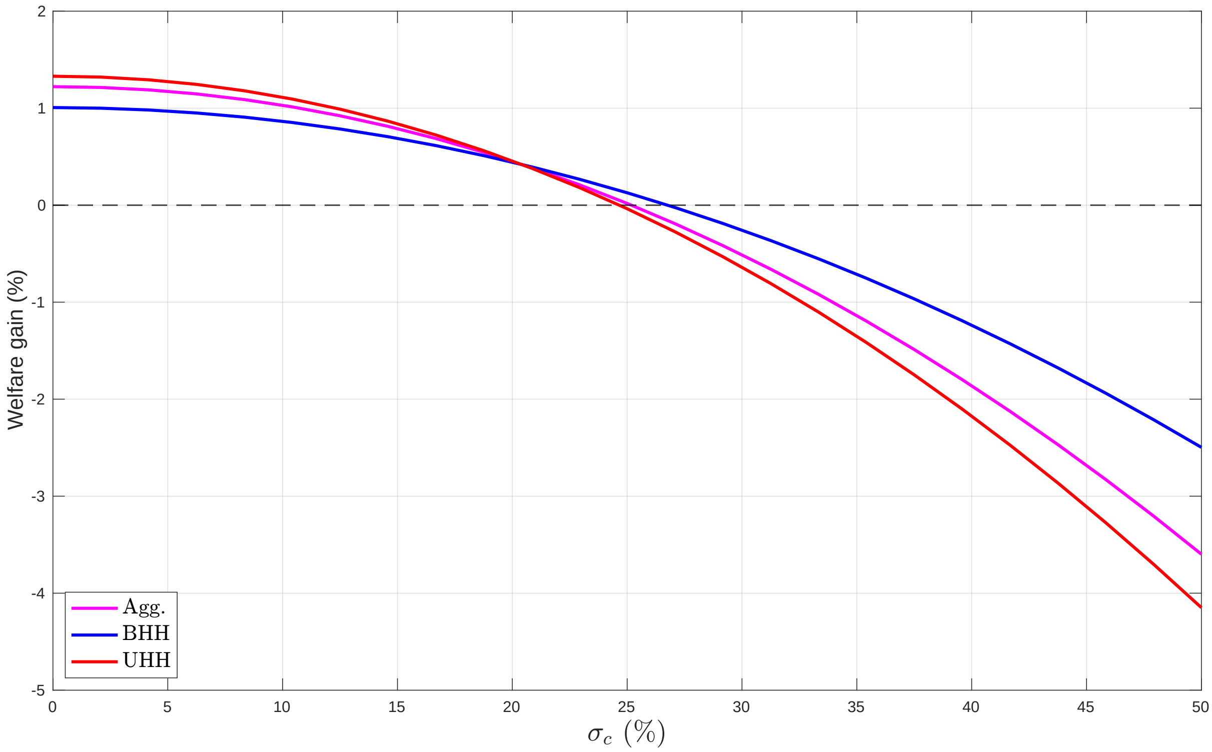
At high volatility levels—such as Bitcoin's average quarterly volatility of 70% between January 2017 and September 2021—net welfare losses emerge for both household types, as the instability of cryptocurrency as a store of value outweighs the benefits of financial inclusion and consumption smoothing. Therefore, our findings provide an explanation for the limited adoption of Bitcoin as legal tender in El Salvador (Alvarez, Argente, and Van Patten 2023).

Robustness Tests. A key robustness test examines whether our results are sensitive to differences in preferences over cryptocurrency and real money balances across the two economies. We find that our welfare results remain consistent even when excluding the sub-utility function for holdings of money and cryptocurrency balances. These results are detailed in Appendix C.

A second robustness test addresses the choice of CRRA parameters for money and cryptocurrency, where we assume $\nu_i^M = \nu_i^{DC} = 2 > 1$ for both $i \in \{h, u\}$. In this case, the sub-utility function for money and cryptocurrency deposits can take negative values. However, since it satisfies the key properties of utility functions—namely, positive and diminishing marginal utility ($\Upsilon'(\cdot) > 0$ and $\Upsilon''(\cdot) < 0$) — it remains well-defined for deriving the optimal allocation of cryptocurrency and real money balances.

To confirm that our findings are not driven by this parameter choice, we conduct

Figure 3: Welfare gains and cryptocurrency price volatility



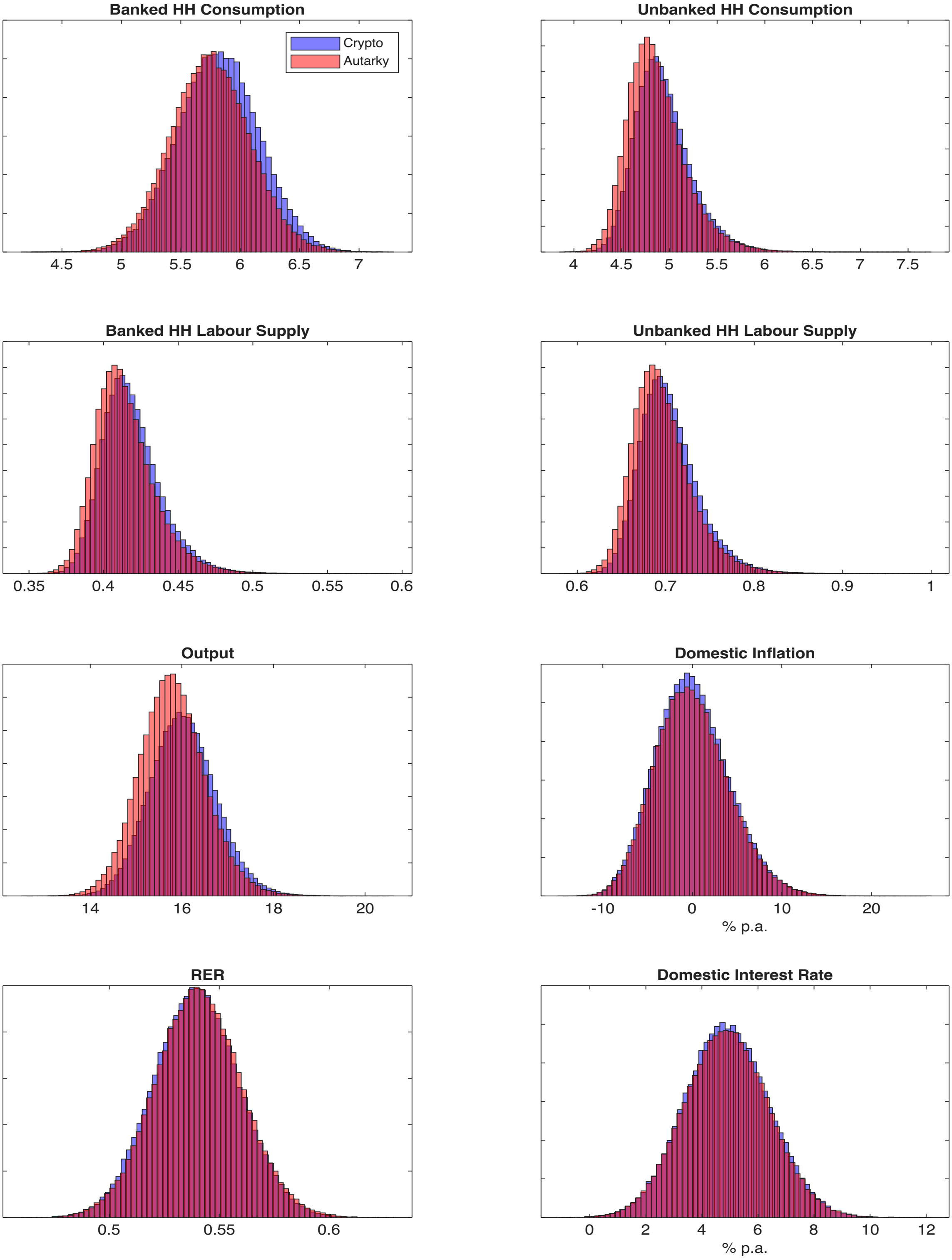
Note: The figure plots welfare gains for unbanked (UHH) and banked (BHH) households, as well as a representative aggregate household. Welfare gains are computed for varying levels of cryptocurrency price volatility, relative to an economy without cryptocurrency deposits. Both economies are subject to macroeconomic shocks, as outlined in Section 2.9. The first moment of welfare is calculated using a second-order log-linear approximation to the steady state.

an additional sensitivity analysis in Appendix C. Specifically, we consider an alternative calibration where $\nu_i = 0.9 < 1$, ensuring that the sub-utility function remains strictly positive, and re-evaluate our welfare results. The comparison of welfare estimates under $\nu_i = 2$ and $\nu_i = 0.9$ confirms that our findings are robust to different CRRA parameterizations.

3.2.2 Simulations

To further explore the mechanisms driving the welfare effects for banked and unbanked households, we conduct simulations of both the baseline cryptocurrency and crypto-autarky economies. Figure 4 presents the distributions of key macroeconomic variables under both regimes.

Figure 4: Simulations of key macroeconomic variables: cryptocurrency vs. autarky



Note: The figure plots simulations over 100,000 periods for banked and unbanked consumption, banked and unbanked labor, aggregate output, inflation (net annualised), the real exchange rate, and the domestic nominal interest rate (net annualised). Simulations incorporate all macroeconomic shocks in the baseline calibration outlined in Section 2.9, with cryptocurrency price volatility set at 0.15% (quarterly).

The simulations indicate a rightward shift in the consumption distributions for both household types in the cryptocurrency economy, reflecting higher average consumption. Output and labor supply increase for both banked and unbanked households under cryptocurrency adoption. Meanwhile, the distributions of the domestic interest rate and real exchange rate remain largely unchanged, while inflation volatility declines in the cryptocurrency economy.

One key mechanism driving these results is the additional financial asset provided by cryptocurrency, which facilitates consumption smoothing. In response to negative income or demand shocks—such as those induced by monetary policy—households can more effectively draw down their savings. When money balances alone are insufficient for smoothing consumption, cryptocurrency provides an additional buffer.

For banked households, cryptocurrency adoption also helps mitigate adverse shocks. While they already have access to traditional deposit accounts, their consumption-smoothing benefits are smaller compared to unbanked households. However, banked households can still benefit from cryptocurrency as an additional tool for absorbing financial volatility and reducing the impact of foreign shocks on bank balance sheets.

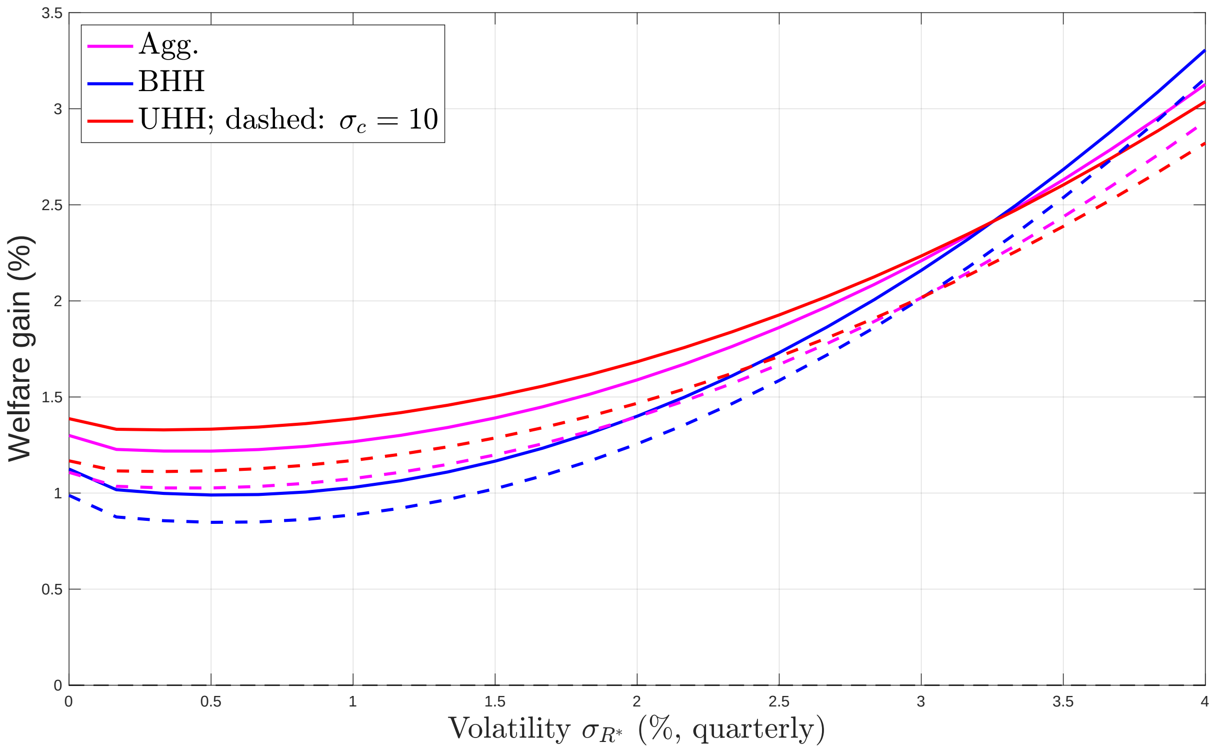
Thus, a final channel through which digital dollarization can enhance welfare is by providing a hedge against macroeconomic volatility, which we explore in the following section.

3.3 Welfare Effects of Monetary Policy and Risk Premia

One motivation for cryptocurrency adoption is its potential to hedge against macroeconomic fluctuations. Empirical evidence supports this idea, highlighting the observed disconnect between cryptocurrency returns and macroeconomic fundamentals (Benigno and Rosa 2023; Umar et al. 2021; Pyo and Lee 2020; Marmora 2022). This literature finds that Bitcoin returns remain largely unaffected by Federal Open Market Committee (FOMC) announcements and other macroeconomic events, reinforcing the role of cryptocurrencies as a hedge against macroeconomic risk, particularly in emerging markets.

To test this assertion within our model framework, Figure 5 presents welfare levels for different household types in the cryptocurrency economy relative to the autarky level under varying levels of foreign risk premia. Solid lines indicate a cryptocurrency volatility of zero percent, while dotted lines indicate a volatility of 10 percent (quarterly). The relative welfare of both household types increases with the variance of macroeconomic shocks, highlighting the role of cryptocurrency as a hedge against external macroeconomic shocks.

Figure 5: Welfare gains of cryptocurrency adoption with respect to foreign risk premia shocks



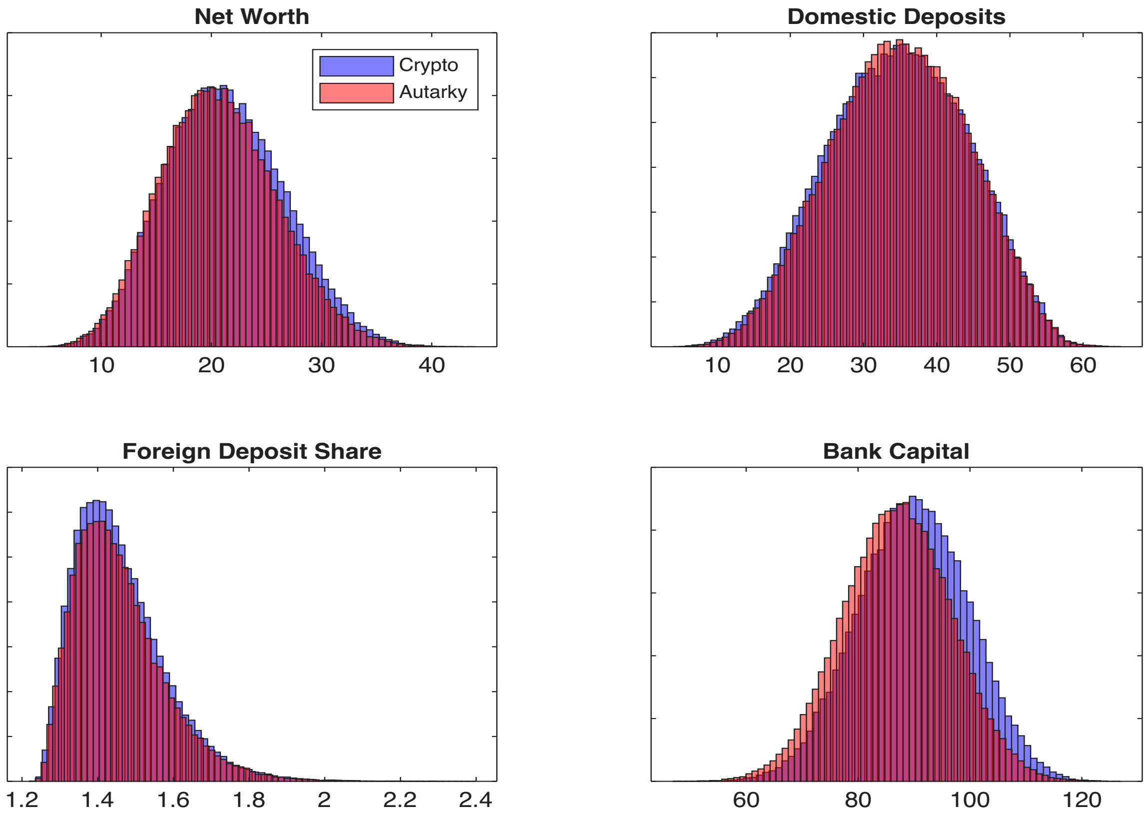
Note: The figure plots welfare gains for three household types: unbanked (UHH), banked (BHH), and a representative aggregate household that combines the consumption of both groups. Welfare gains are computed for different levels of foreign risk premia, relative to an economy without cryptocurrency deposits. Solid lines indicate welfare gains under zero cryptocurrency price volatility, while dashed lines represent welfare gains when cryptocurrency price volatility is $\sigma_c = 10\%$ (quarterly). Both economies are subject to macroeconomic shocks, as outlined in Section 2.9. The first moment of welfare is calculated using a second-order log-linear approximation to the steady state.

While consumption smoothing explains part of the welfare gains in the cryptocurrency economy, an important finding is that banked households can experience greater welfare gains than unbanked households when foreign interest rate shocks are large. To understand this effect, we examine the financial channel through which foreign interest rate shocks propagate, as discussed in ABK.

A key mechanism driving this result is the financial channel, which primarily affects banked households. Since these households derive income through bank equity, shocks to the banking sector directly impact their welfare. When a foreign interest rate shock occurs, the cost advantage of banks borrowing in foreign currency diminishes. To compensate, uncovered interest parity requires the domestic currency to depreciate, increasing the burden of foreign debt and reducing bank net worth.

However, access to cryptocurrency helps banked households diversify risks associated with foreign monetary policy shocks. To further analyze this, we present simulations of key banking variables—such as net worth, domestic and foreign currency deposits, and bank capital—in Figure 6.

Figure 6: Simulations of banking variables: baseline (cryptocurrency) and autarky regimes



Note: The figure plots simulations over 100,000 periods for bank net worth, domestic currency deposits, foreign deposit share and bank capital. Simulations incorporate all macroeconomic shocks in the baseline calibration outlined in Section 2.9, with cryptocurrency price volatility set at 0.15% (quarterly).

In the cryptocurrency economy, there is a rightward shift in the distribution of net worth and capital stock held by banks. While the domestic deposit base is similar across both economies, there is a leftward shift in the proportion of foreign deposits relative to total assets. This pattern is intuitive, as contractionary foreign monetary shocks typically increase reliance on foreign currency borrowing through the financial channel. However, in a cryptocurrency economy, the impact of these shocks on foreign currency deposits and net worth is reduced. Consequently, the financial channel's effect on bank capital is weakened, mitigating the adverse effects of foreign interest rate fluctuations on the welfare of banked households.

In summary, our findings suggest that cryptocurrency adoption provides a hedge against macroeconomic risk. This aligns with empirical evidence from Ahmed, Karolyi, and Pour Rostami (2024), which shows that cryptocurrency adoption responds to sovereign default risk in emerging markets.

4 Conclusion

This paper examines the macroeconomic costs and benefits of cryptocurrency adoption in a small open economy framework with heterogeneous households. Our model captures key empirical patterns observed in emerging markets: the increasing use of stablecoins in economies with high inflation and macroeconomic risk, such as Turkey and Argentina, and the limited adoption of Bitcoin as legal tender in El Salvador.

We introduce a framework where households can hold cryptocurrency deposits alongside domestic currency, with unbanked households relying more on cryptocurrency due to limited access to traditional banking. In this setup, we analyze the welfare implications of digital dollarization—where stablecoins are used as a stable store of value—compared to an economy without cryptocurrency, which we refer to as cryptocurrency autarky. Our findings suggest that stablecoin adoption improves welfare by providing unbanked households with a more efficient savings vehicle, enabling smoother consumption. In contrast, risky cryptocurrencies such as Bitcoin impose welfare costs due to their price volatility, which amplifies fluctuations in household consumption, bank lending, and firm labor demand.

We also analyze how cryptocurrency adoption interacts with external macroeconomic shocks, specifically foreign interest rate shocks. Our results indicate that as macroeconomic volatility increases, both banked and unbanked households experience greater welfare gains from cryptocurrency adoption. Additionally, banked households benefit from cryptocurrency's role in mitigating the impact of foreign monetary policy shocks on bank capital and borrowing costs. By weakening the financial channel through which foreign policies affect bank funding costs, net worth, and leverage, cryptocurrency helps dampen the macroeconomic effects of external shocks.

These findings have important policy implications. First, they provide a theoretical rationale for why emerging markets increasingly turn to stablecoins as a hedge against macroeconomic instability, as seen in Turkey and Argentina. Second, they help explain why Bitcoin adoption has been limited in El Salvador, as its high price volatility introduces additional welfare costs. In summary, our results suggest that while digital dollarization can improve the welfare of households in emerging markets, its benefits depend critically on the stability of the adopted cryptocurrency.

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Appendix

A Digital Dollarization and El Salvador

A.1 Stablecoins

Stablecoins are a class of blockchain-based cryptocurrencies, typically pegged to the USD. As of September 2021, Tether and USDC, the largest stablecoins by market capitalization, accounted for approximately 90 percent of the stablecoin market, with prices typically displaying a two-sided distribution around 1 USD (Figure 7). Stablecoins have faced scrutiny from regulators due to concerns over potential run risk and speculative attacks. This risk arises in part from stablecoins being backed by illiquid assets, which can make it difficult for issuers to meet mass redemptions.

Estimates of volatility based on quarterly returns of Tether/USD and USDC/USD from January 2020 to September 2021 are 0.18 percent and 0.12 percent, respectively. To maintain financial stability, stablecoins must be appropriately regulated to ensure full collateralization at all times.[26]

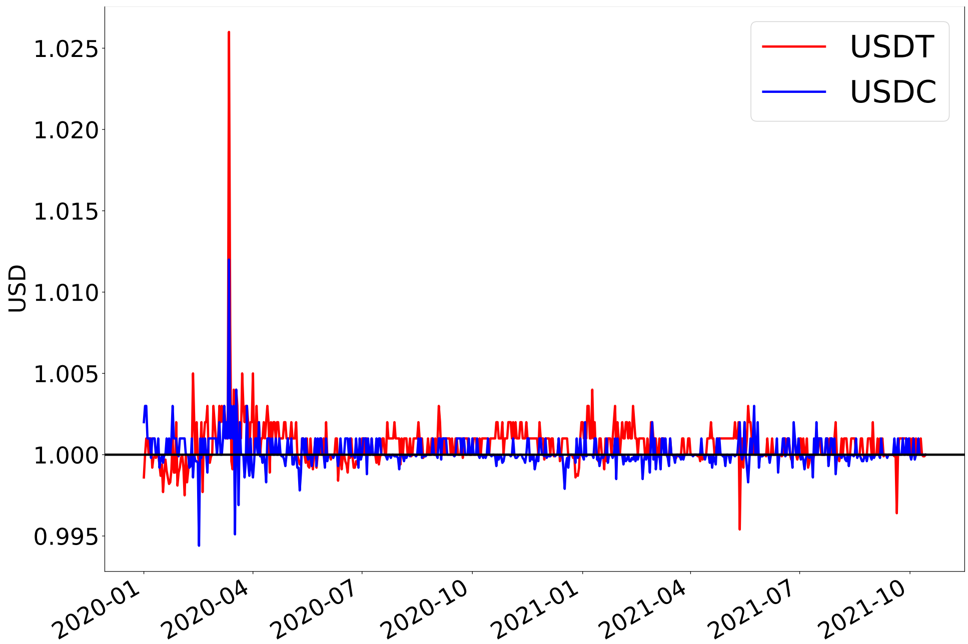
Regulations may require stablecoin issuers to meet strict capital requirements to ensure full collateralization. Policies such as deposit insurance, central bank liquidity support, and redemption fees in response to peg discounts—as discussed in Routledge and Zetlin-Jones (2021)—can help ensure peg stability.

A.2 Stablecoin adoption in emerging market currencies

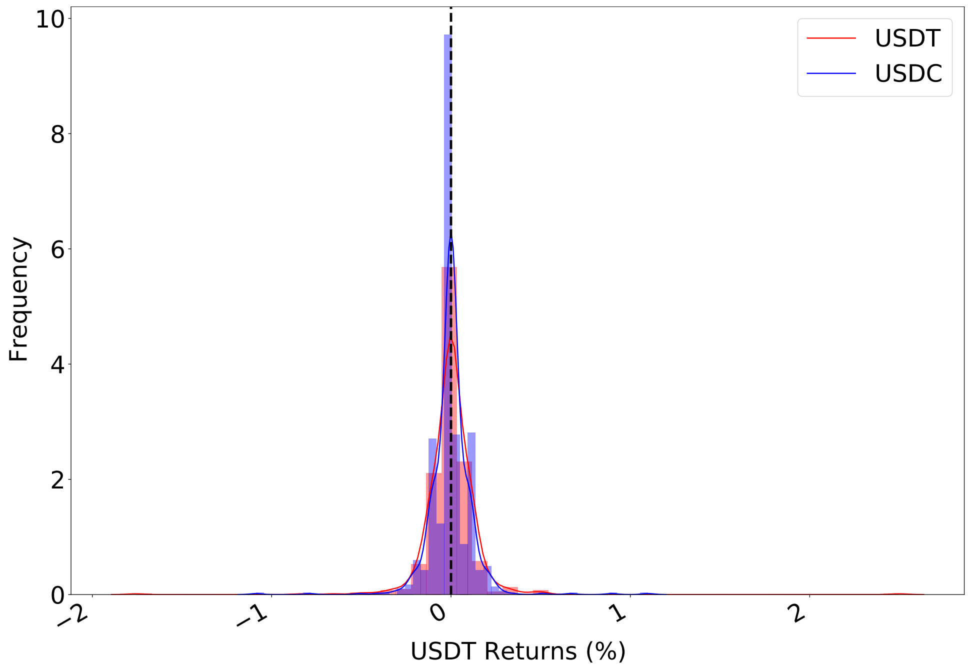
To motivate our link to digital dollarization, we find high inflation countries like Turkey and Argentina have a large amount of stablecoin/USD trading during periods of macroeconomic instability and trend exchange rate devaluation. In particular, both countries face macroeconomic instability and high (annualized) inflation rates of over 50 per cent for Turkey and over 200 per cent for Argentina, as of writing in 2024. In Figure 8 we plot trading volume for the Turkish Lira and Argentine Peso against stablecoin Tether

26. For example, statements provided by Tether indicate that the stablecoin is backed at most by 75.6 percent liquid assets, including commercial paper, fiduciary deposits, Treasury bills, and cash reserves. This breakdown of reserves was published in a quarterly statement issued by Tether Ltd. on May 13, 2021, and shared on Tether's Twitter account. Available at https://twitter.com/Tether_to/status/1392811872810934276.

Figure 7: Stablecoin prices and returns



Panel A: Stablecoins Tether, USDC, and DAI prices from January 2020 to September 2021.



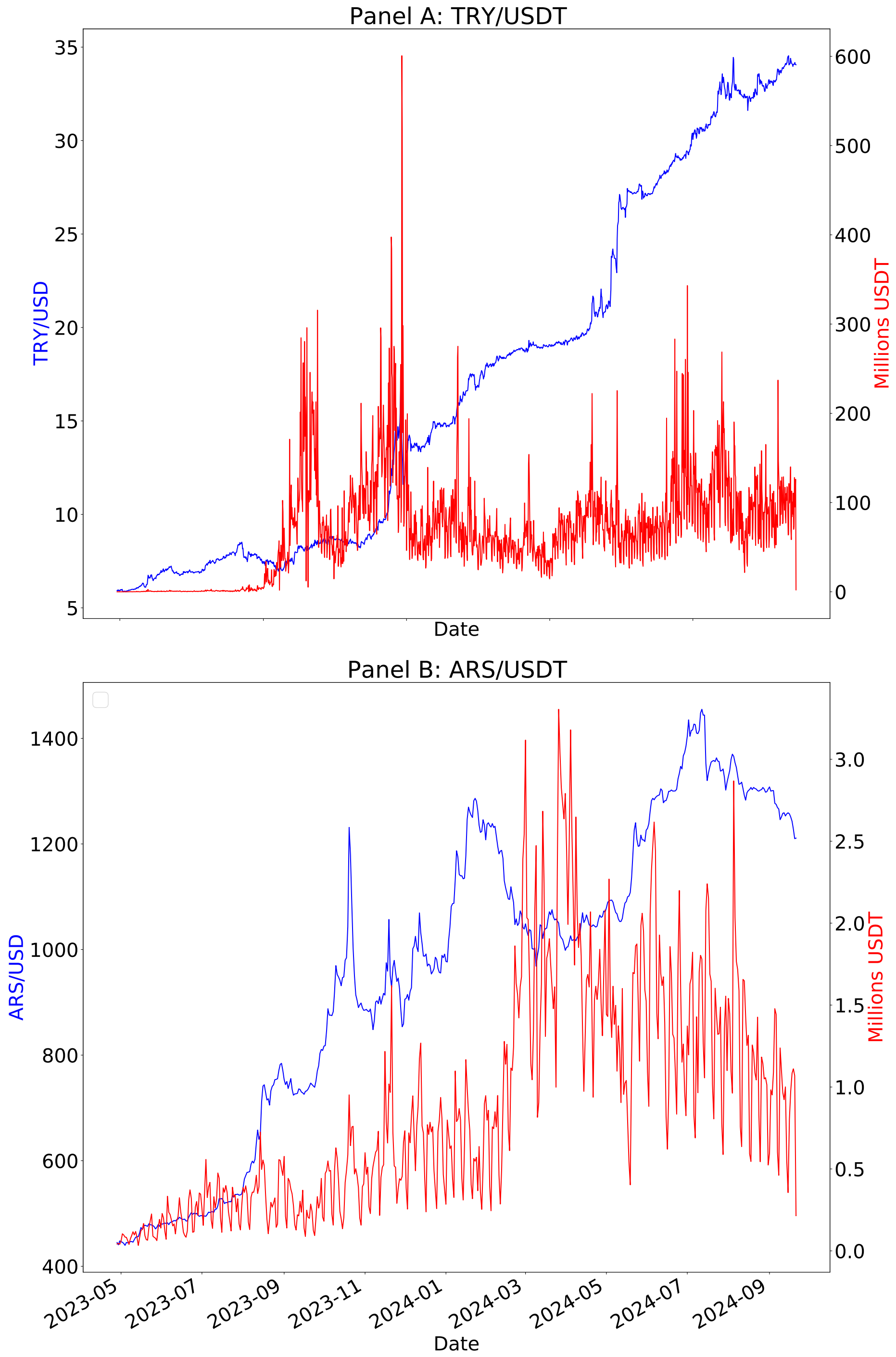
Panel B: Histogram of daily returns.

Note: Source: Cryptocompare.

on Binance, the largest and most liquid cryptocurrency exchange. For example, trading in Binance in the TRY/USDT pair peaked at over 600 Million USDT.[27]

27. For the TRY/USDT pair Binance is the largest trading venue. For ARS/USDT trading, there are other cryptocurrency exchanges like Bitso which have similar levels of trading to Binance.

Figure 8: Panel A: Stablecoin Trading Volume — Panel B: Histogram of Daily Returns



Note: Stablecoin trading in TRY/USDT and ARS/USDT markets on Binance cryptocurrency exchange. Source: Coinapi.

A.3 Risky Cryptocurrency Adoption: El Salvador

El Salvador's law making Bitcoin legal tender took effect on September 7, 2021.[28] Each individual is eligible for a government-sponsored Chivo digital wallet, which provides $30 USD in Bitcoin. El Salvador has also installed several Bitcoin ATMs, allowing citizens to convert the cryptocurrency into U.S. dollars. On the first day of the Bitcoin law's implementation, Bitcoin fell by approximately 10 percent, from $52,000 USD to $47,000 USD by the end of the day. Moody's downgraded El Salvador's government debt due to concerns over poor governance and the risks associated with the Bitcoin law.[29]

Proponents of the policy cite several potential benefits, including financial inclusion,[30] reduced remittance costs,[31] and increased foreign direct investment (FDI) inflows.[32]

However, Hanke, Hanlon, Chakravarthi, et al. (2021) quantify the costs of using Bitcoin for remittances relative to conventional banking methods. Their estimates suggest that remittance fees for banking services are approximately 4 percent, while Bitcoin remittance fees are at least 5 percent, with additional costs related to network fees and payment security.

For consumers, firms, and banks, the choice of legal tender depends on the network characteristics of the currency and whether it fulfills the core properties of money: an effective store of value, a medium of exchange, and a unit of account. The main drawback of adopting Bitcoin as legal tender is its failure to function as a reliable store of value, given that its volatility exceeds fiat exchange rate fluctuations by an order of magnitude. From January 2017 to September 2021, Bitcoin exhibited a maximum daily return of 19.4 percent and a peak negative daily return of -38.4 percent. The volatility of

28. https://www.npr.org/2021/09/07/1034838909/bitcoin-el-salvador-legal-tender-official-currency-cryptocurrency?t=1634944255426

29. https://www.coindesk.com/markets/2021/07/31/moodys-lowers-el-salvador-rating-maintains-negative-outlook-partly-due-to-Bitcoin-law/.

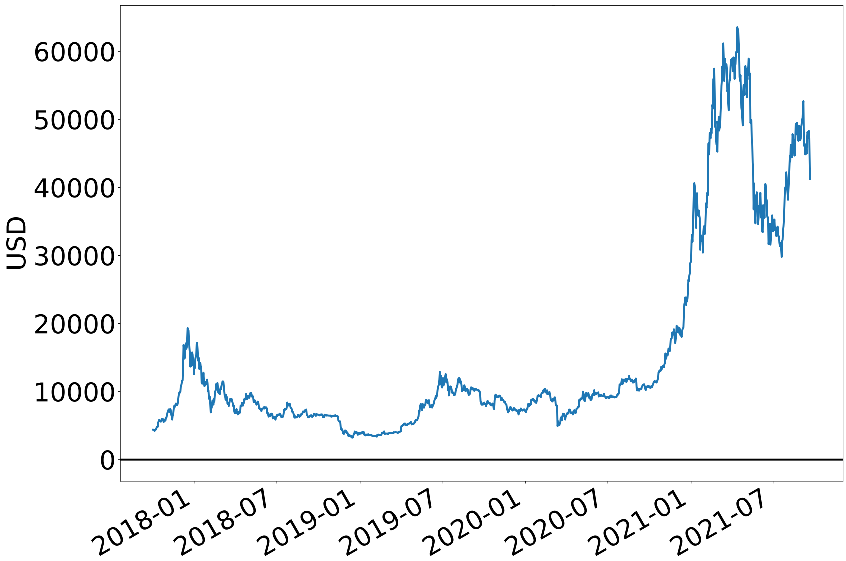
30. Estimates from the World Bank suggest that up to two-thirds of El Salvador's population lacks a bank account. https://datatopics.worldbank.org/g20fidata/country/el-salvador.

31. El Salvador is one of the most remittance-dependent countries, with remittances accounting for 25 percent of GDP. https://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS?locations=SV.

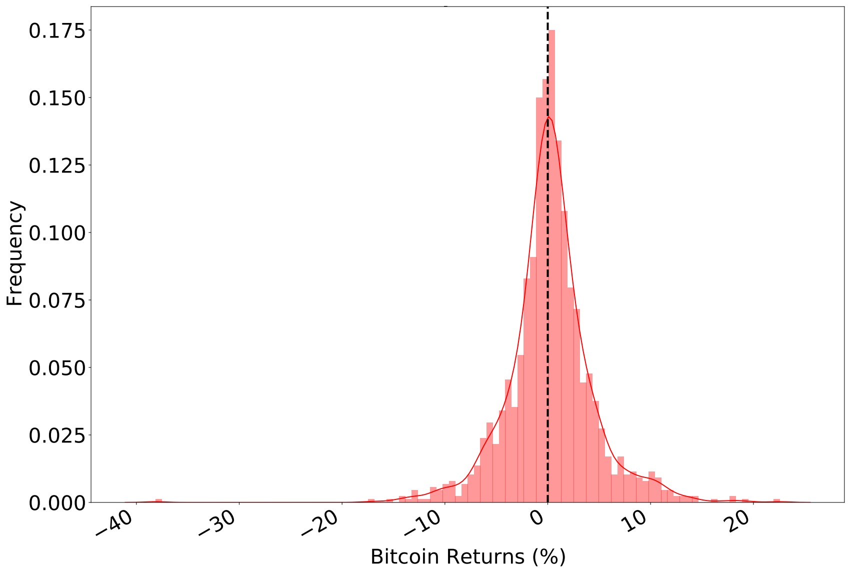
32. In 2019, the coastal town of El Zonte adopted Bitcoin as a local currency. The project provided $50 USD in Bitcoin to each local family, encouraging cryptocurrency adoption by local vendors. Bitcoin was subsequently used to pay for utility bills, health care, food, and other services. https://www.reuters.com/technology/bitcoin-beach-tourists-residents-hail-el-salvadors-adoption-cryptocurrency-2021-09-07/

quarterly returns for the Bitcoin/U.S. dollar (BTC/USD) exchange rate over the same period is estimated at 70 percent (Figure 9.[33]

Figure 9: Bitcoin prices and returns



Panel A: Bitcoin prices from January 2018 to September 2019.



Panel B: Histogram of daily returns.

Note: Source: Cryptocompare.

33. A poll conducted by the Central American University found that approximately 67 percent of Salvadoran respondents did not believe Bitcoin should be legal tender, and more than 70 percent believed the law should be repealed. Public skepticism regarding the Bitcoin law is justified given Bitcoin's extreme volatility.

B Model extended solutions

B.1 Household optimization problem

The first-order conditions (FOCs) for labor, savings in equity, deposits, and cryptocurrency balances which emerge from the banked household's problem are:

$$w_t^h = \zeta_0^h (L_t^h)^{\zeta_h}, \tag{53}$$

$$1 = \mathbb{E}_t \Lambda_{t,t+1}^h R_{t+1}^k, \tag{54}$$

$$1 = \mathbb{E}_t \Lambda_{t,t+1}^h \frac{R_t}{\pi_{t+1}}, \tag{55}$$

$$\mathbb{E}_t \frac{\Lambda_{t,t+1}^h}{\pi_{t+1}} = 1 + \kappa_M (M_t^h - \bar{M}^h) - \nu_{0,h}^M \frac{C_t^h - \frac{\zeta_0}{1+\zeta}(L_t^h)^{1+\zeta}}{(M_t^h)^{\nu_h^M}}, \tag{56}$$

$$\mathbb{E}_t \Lambda_{t,t+1}^h \frac{R_t^c}{\pi_{t+1}} = 1 + \kappa_{DC} (B_t^h - \bar{B}^h) - \nu_{0,h}^{DC} \frac{C_t^h + \frac{\zeta_0}{1+\zeta}(L_t^h)^{1+\zeta}}{(B_t^h)^{\nu_h^{DC}}}. \tag{57}$$

The FOCs for labor supply, real money balances, and cryptocurrency balances for the unbanked household are:

$$w_t^u = \zeta_0^u (L_t^u)^{\zeta^u}, \tag{58}$$

$$\mathbb{E}_t \frac{\Lambda_{t,t+1}^u}{\pi_{t+1}} = 1 + \kappa_M (M_t^u - \bar{M}^u) - \nu_{0,u}^M \frac{C_t^u + \frac{\zeta_0}{1+\zeta}(L_t^u)^{1+\zeta}}{(M_t^u)^{\nu_u^M}}, \tag{59}$$

$$\mathbb{E}_t \Lambda_{t,t+1}^u \frac{R_t^c}{\pi_{t+1}} = 1 + \kappa_{DC} (B_t^u - \bar{B}^u) - \nu_{0,u}^{DC} \frac{C_t^u + \frac{\zeta_0}{1+\zeta}(L_t^u)^{1+\zeta}}{(B_t^u)^{\nu_u^{DC}}}. \tag{60}$$

B.2 Rewriting and solving the banker's problem

With the constraints of the banker established in Section 2.2, we can proceed to write the banker's problem as:

$$\max_{k_t^b, d_t, d_t^*} \mathbb{V}_t^b = \mathbb{E}_t \left[\Lambda_{t,t+1}^h \left\{ (1-\sigma) n_{t+1} + \sigma \mathbb{V}_{t+1}^b \right\} \right],$$

subject to the incentive compatibility constraint (12) and the balance sheet constraint (13).

As discussed in Section 2.2.1, dividing $\mathbb{V}_t^b$ by n_t yields a Tobin Q expression of the form:

$$\psi_t \equiv \frac{\mathbb{V}_t^b}{n_t} = \mathbb{E}_t \left[\Lambda_{t,t+1}^h (1 - \sigma + \sigma\psi_{t+1}) \frac{n_{t+1}}{n_t} \right],$$

where the evolution of net worth, n_{t+1}/n_t, is attained by simply iterating the banker's flow of funds constraint (14) forward by one period, and then dividing through by n_t:

$$\begin{aligned}
\frac{n_{t+1}}{n_t} &= \left(z_{t+1}^k + \lambda Q_{t+1}\right) \frac{k_t^b}{n_t} - \frac{R_t}{\pi_{t+1}} \frac{d_t}{n_t} - \frac{R_t^*}{\pi_{t+1}^*} \frac{\epsilon_{t+1} d_t^*}{n_t} - \frac{R_t^c}{\pi_{t+1}} \frac{b_t}{n_t} \\
&= \frac{\left(z_{t+1}^k + \lambda Q_{t+1}\right)}{Q_t} \phi_t - \frac{R_t}{\pi_{t+1}} \frac{d_t}{n_t} - \frac{R_t^*}{\pi_{t+1}^*} \frac{\epsilon_{t+1}}{\epsilon_t} \frac{\epsilon_t d_t^*}{n_t} - \frac{R_t^c}{\pi_{t+1}} \frac{b_t}{n_t}.
\end{aligned}$$

Rearrange the balance sheet constraint (13) and use the fact that $\epsilon_t d_t^*/n_t = x_t \phi_t$ and $b_t/n_t = x_t^c \phi_t$, to yield the following:

$$\frac{d_t}{n_t} = \left(1 + \frac{\varkappa^b}{2} x_t^2\right) \phi_t - x_t \phi_t - x_t^c \phi_t - 1.$$

Substitute this value for d_t/n_t into the expression for n_{t+1}/n_t, and we get:

$$\frac{n_{t+1}}{n_t} = \left(R_{t+1}^k - \frac{R_t}{\pi_{t+1}}\right) \phi_t + \left(1 - \frac{\varkappa^b}{2} x_t^2 \phi_t\right) \frac{R_t}{\pi_{t+1}} + \left(\frac{R_t}{\pi_{t+1}} - \frac{R_t^*}{\pi_{t+1}^*} \frac{\epsilon_{t+1}}{\epsilon_t}\right) x_t \phi_t + \left(\frac{R_t}{\pi_{t+1}} - \frac{R_t^c}{\pi_{t+1}}\right) x_t^c \phi_t.$$

Substituting this expression into (15), yields the following:

$$\begin{aligned}
\psi_t &= \mathbb{E}_t \Lambda_{t,t+1}^h (1 - \sigma + \sigma\psi_{t+1}) \left\{ \begin{array}{c} \left(R_{t+1}^k - \frac{R_t}{\pi_{t+1}}\right) \phi_t \\ + \left(1 - \frac{\varkappa^b}{2} x_t^2 \phi_t\right) \frac{R_t}{\pi_{t+1}} \\ + \left[\frac{R_t}{\pi_{t+1}} - \frac{R_t^*}{\pi_{t+1}^*} \frac{\epsilon_{t+1}}{\epsilon_t}\right] x_t \phi_t \\ + \left[\frac{R_t}{\pi_{t+1}} - \frac{R_t^c}{\pi_{t+1}}\right] x_t^c \phi_t \end{array} \right\} \\
&= \mu_t \phi_t + \left(1 - \frac{\varkappa^b}{2} x_t^2 \phi_t\right) \upsilon_t + \mu_t^* x_t \phi_t + \mu_t^c x_t^c \phi_t,
\end{aligned}$$

with μ_t, μ_t^*, μ_t^c, υ_t, and $\Omega_{t,t+1}$ as defined in Section 2.2.1.

With $\mu_t, \mu_t^*, \mu_t^c > 0$, the banker's incentive compatibility constraint binds with equality, and so we can write the Lagrangian as:

$$\mathcal{L} = \psi_t + \lambda_t (\psi_t - \Theta(x_t, x_t^c)\phi_t),$$

where λ_t is the Lagrangian multiplier. The FOCs are:

$$(1+\lambda_t)\left[\mu_t + \mu_t^* x_t + \mu_t^c x_t^c - \frac{\varkappa^b}{2} x_t^2 \upsilon_t\right] = \lambda_t \Theta(x_t, x_t^c), \tag{61}$$

$$(1+\lambda_t)\left[\varkappa^b x_t \upsilon_t - \mu_t^*\right] = \theta \lambda_t \Theta(x_t, x_t^c), \tag{62}$$

$$\psi_t = \phi_t \Theta(x_t, x_t^c). \tag{63}$$

Use (63) and substitute into the banker's objective function to yield:

$$\phi_t = \frac{\upsilon_t}{\Theta(x_t, x_t^c) - \mu_t - \mu_t^* x_t - \mu_t^c x_t^c + \frac{\varkappa^b}{2} x_t^2 \upsilon_t}. \tag{64}$$

Then, combine (61) and (62) to write

$$F\left(x_t, \frac{\mu_t}{\upsilon_t}, \frac{\mu_t^*}{\upsilon_t}, \frac{\mu_t^c}{\upsilon_t}\right) = -\frac{\theta \varkappa^b}{2} x_t^2 + \left(\theta \frac{\mu_t^*}{\upsilon_t} - \varkappa^b\right) x_t + \theta\left(\frac{\mu_t}{\upsilon_t} + \frac{\mu_t^c}{\upsilon_t} x_t^c\right) + \frac{\mu_t^*}{\upsilon_t}.$$

Note that $\mu_t, \mu_t^*, \mu_t^c, \upsilon_t > 0$, and so $F(x_t = 0, \dots) > 0$, and thus we can write

$$x_t = \frac{\theta \mu_t^* - \varkappa^b \upsilon_t}{\theta \varkappa^b \upsilon_t} + \sqrt{\left(\frac{\mu_t^*}{\varkappa^b \upsilon_t}\right)^2 + 2\frac{\mu_t^c}{\varkappa^b \upsilon_t} x_t^c + \left(\frac{1}{\theta}\right)^2 + 2\frac{\mu_t}{\varkappa^b \upsilon_t}}. \tag{65}$$

These expressions are (24) and (25) in the main body of the text. This concludes the problem and optimal choices of the banker.

B.3 Firms and production

Final good firms maximize their profits by selecting how much of each intermediate good to purchase, and so their problem is:

$$\max_{Y_t(i)} P_t Y_t - \int_0^1 P_t Y_t(i) di.$$

Thus, as in Blanchard and Kiyotaki (1987), following the FOC of the final good firm problem, intermediate good producers face a downward sloping demand curve for their products:

$$Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\eta} Y_t,$$

where $P_t(i)$ is the price for good i, and P_t is the price index for the aggregate economy and is defined as:

$$P_t = \left(\int_0^1 P_t(i)^{1-\eta} di \right)^{\frac{1}{1-\eta}}.$$

The cost minimization problem for each intermediate good producer is:

$$\min_{K_{t-1}(i), IM_t(i), L_t^h(i), L_t^u(i)} z_t^k K_{t-1}(i) + \epsilon_t IM_t(i) + w_t^h L_t^h(i) + w_t^u L_t^u(i),$$

subject to:

$$A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u} \geq Y_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\eta} Y_t.$$

The Lagrangian for intermediate firm i's problem is:

$$\mathcal{L} = z_t^k K_{t-1}(i) + \epsilon_t IM_t(i) + w_t^h L_t^h(i) + w_t^u L_t^u(i) - mc_t(i) \left\{ \begin{array}{c} A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u} \\ - \left(\frac{P_t(i)}{P_t} \right)^{-\eta} Y_t \end{array} \right\},$$

where mc_t is the minimized unit cost of production or the real marginal cost. The FOCs to this problem are:

$$z_t^k = mc_t(i) A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K - 1} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u},$$

$$\epsilon_t = mc_t(i) A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M - 1} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u},$$

$$w_t^h = mc_t(i) A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h - 1} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u},$$

$$w_t^u = mc_t(i) A_t \left(\frac{K_{t-1}(i)}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t(i)}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h(i)}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u(i)}{\alpha_u} \right)^{\alpha_u - 1},$$

Under Rotemberg (1982) pricing, firm i maximizes the net present value of profits,

$$\mathbb{V}_t(i) = \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} \Lambda^h_{t,t+s} \left[\left(\frac{P_{t+s}(i)}{P_{t+s}} - mc_{t+s} \right) Y_{t+s}(i) - \frac{\kappa}{2} \left(\frac{P_{t+s}(i)}{P_{t-1+s}(i)} - 1 \right)^2 Y_{t+s} \right] \right\},$$

by optimally choosing $P_t(i)$. Differentiating $\mathbb{V}_t(i)$ with respect to $P_t(i)$ yields the following FOC:

$$\kappa \left(\frac{P_t(i)}{P_{t-1}(i)} - 1 \right) \frac{Y_t}{P_{t-1}(i)} = \frac{1}{P_t} \left(\frac{P_t(i)}{P_t} \right)^{-\eta} Y_t - \eta \left(\frac{P_t(i)}{P_t} - mc_t \right) \left(\frac{P_t(i)}{P_t} \right)^{-\eta-1} \frac{Y_t}{P_t}$$
$$+ \kappa \mathbb{E}_t \left[\Lambda^h_{t,t+1} \left(\frac{P_{t+1}(i)}{P_t(i)} - 1 \right) Y_{t+1} \frac{P_{t+1}(i)}{P_t(i)^2} \right].$$

B.4 Equilibrium conditions

Households.

$$w^h_t = \zeta_0 (L^h_t)^\zeta \tag{66}$$

$$1 = \mathbb{E}_t \Lambda^h_{t,t+1} R^k_{t+1} \tag{67}$$

$$1 = \mathbb{E}_t \Lambda^h_{t,t+1} \frac{R_t}{\pi_{t+1}} \tag{68}$$

$$1 + \kappa_{DC}(B^h_t - \bar{B}^h) = \mathbb{E}_t \Lambda^h_{t,t+1} \frac{R^c_t}{\pi_{t+1}} + \nu^{DC}_{0,h} \frac{C^h_t + \frac{\zeta_0}{1+\zeta}(L^h_t)^{1+\zeta}}{(B^h_t)^{\nu^{DC}_h}} \tag{69}$$

$$1 + \kappa_M(M^h_t - \bar{M}^h) = \mathbb{E}_t \frac{\Lambda^h_{t,t+1}}{\pi_{t+1}} + \nu^M_{0,h} \frac{C^h_t + \frac{\zeta_0}{1+\zeta}(L^h_t)^{1+\zeta}}{(M^h_t)^{\nu^M_h}} \tag{70}$$

$$C^u_t + B^u_t + \chi^u_{DC,t} + M_t + \chi^u_{M,t} = w^u_t L^u_t + \frac{R^c_{t-1}}{\pi_t} B^u_{t-1} + \frac{1}{\pi_t} M_{t-1} \tag{71}$$

$$w^u_t = \zeta_0 (L^u_t)^\zeta \tag{72}$$

$$1 + \kappa_{DC}(B^u_t - \bar{B}^u) = \mathbb{E}_t \Lambda^u_{t,t+1} \frac{R^c_t}{\pi_{t+1}} + \nu^{DC}_{0,u} \frac{C^u_t + \frac{\zeta_0}{1+\zeta}(L^u_t)^{1+\zeta}}{(B^u_t)^{\nu^{DC}_u}} \tag{73}$$

$$1 + \kappa_M(M^u_t - \bar{M}^u) = \mathbb{E}_t \frac{\Lambda^u_{t,t+1}}{\pi_{t+1}} + \nu^M_{0,u} \frac{C^u_t + \frac{\zeta_0}{1+\zeta}(L^u_t)^{1+\zeta}}{(M^u_t)^{\nu^M_u}} \tag{74}$$

Banks.

$$\mu_t = \mathbb{E}_t \Omega_{t,t+1} \left(R^k_{t+1} - \frac{R_t}{\pi_{t+1}} \right) \tag{75}$$

$$\mu_t^c = \mathbb{E}_t \Omega_{t,t+1} \left(\frac{R_t}{\pi_{t+1}} - \frac{R_t^c}{\pi_{t+1}} \right) \tag{76}$$

$$\mu_t^* = \mathbb{E}_t \Omega_{t,t+1} \left(\frac{R_t}{\pi_{t+1}} - \frac{\epsilon_{t+1}}{\epsilon_t} \frac{R_t^*}{\pi_{t+1}^*} \right) \tag{77}$$

$$v_t = \mathbb{E}_t \Omega_{t,t+1} \frac{R_t}{\pi_{t+1}} \tag{78}$$

$$\psi_t = \phi_t \Theta(x_t, x_t^c) \tag{79}$$

$$\phi_t = \frac{v_t}{\Theta(x_t, x_t^c) - \mu_t - \mu_t^* x_t - \mu_t^c x_t^c + \frac{\varkappa^b}{2} x_t^2 v_t} \tag{80}$$

$$x_t = \frac{\theta \mu_t^* - \varkappa^b v_t}{\theta \varkappa^b v_t} + \sqrt{\left(\frac{\mu_t^*}{\varkappa^b v_t} \right)^2 + 2 \frac{\mu_t^c}{\varkappa^b v_t} x_t^c + \left(\frac{1}{\theta} \right)^2 + 2 \frac{\mu_t}{\varkappa^b v_t}} \tag{81}$$

Firms.

$$mc_t = \frac{1}{A_t} (z_t^k)^{\alpha_K} \epsilon_t^{\alpha_M} (w_t^h)^{\alpha_h} (w_t^u)^{\alpha_u} \tag{82}$$

$$Y_t = A_t \left(\frac{K_{t-1}}{\alpha_K} \right)^{\alpha_K} \left(\frac{IM_t}{\alpha_M} \right)^{\alpha_M} \left(\frac{L_t^h}{\alpha_h} \right)^{\alpha_h} \left(\frac{L_t^u}{\alpha_u} \right)^{\alpha_u} \tag{83}$$

$$\frac{\epsilon_t M_t}{z_t^k K_{t-1}} = \frac{\alpha_M}{\alpha_K} \tag{84}$$

$$\frac{w_t^h L_t^h}{z_t^k K_{t-1}} = \frac{\alpha_h}{\alpha_K} \tag{85}$$

$$\frac{w_t^u L_t^u}{z_t^k K_{t-1}} = \frac{\alpha_u}{\alpha_K} \tag{86}$$

$$(\pi_t - 1)\pi_t = \frac{1}{\kappa} (\eta mc_t + 1 - \eta) + \mathbb{E}_t \Lambda_{t,t+1}^h \frac{Y_{t+1}}{Y_t} (\pi_{t+1} - 1)\pi_{t+1} \tag{87}$$

$$K_t = \lambda K_{t-1} + I_t \tag{88}$$

$$Q_t = 1 + \Phi \left(\frac{I_t}{\bar{I}} \right) + \left(\frac{I_t}{\bar{I}} \right) \Phi' \left(\frac{I_t}{\bar{I}} \right) \tag{89}$$

Foreign Exchange.

$$\epsilon_t = \frac{E_t P_t^*}{P_t} \tag{90}$$

$$EX_t = \epsilon_t^{\varphi} Y_t^* \tag{91}$$

$$\Delta \ln \epsilon_t = \Delta \ln E_t + \hat{\pi}_t^* - \hat{\pi}_t \tag{92}$$

$$\ln \left(\frac{R_t^*}{\bar{R}^*} \right) = \rho_{R^*} \ln \left(\frac{R_{t-1}^*}{\bar{R}^*} \right) + \varepsilon_t^{R^*} \tag{93}$$

$$\ln\left(\frac{Y_t^*}{\bar{Y}^*}\right) = \rho_{Y^*}\ln\left(\frac{Y_{t-1}}{\bar{Y}^*}\right) + \varepsilon_t^{Y^*} \tag{94}$$

$$\ln\left(\frac{\pi_t^*}{\bar{\pi}^*}\right) = \rho_{\pi^*}\ln\left(\frac{\pi_{t-1}^*}{\bar{\pi}^*}\right) + \varepsilon_t^{\pi^*} \tag{95}$$

Central Bank.

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R}\left[\left(\frac{\pi_t}{\bar{\pi}}\right)^{\frac{1-\omega_E}{\omega_E}}\left(\frac{E_t}{\bar{E}}\right)^{\frac{\omega_E}{1-\omega_E}}\right]^{1-\rho_R}\exp(\varepsilon_t^R) \tag{96}$$

Market Equilibrium.

$$K_t = K_t^h + K_t^b \tag{97}$$

$$C_t = C_t^h + C_t^u \tag{98}$$

$$\begin{aligned} Y_t &= C_t + \left[1 + \Phi\left(\frac{I_t}{\bar{I}}\right)\right] I_t + EX_t + \frac{\kappa}{2}(\pi_t - 1)^2 Y_t + \chi_t^h + \chi_t^b \\ &\quad + \chi_{M,t}^h + \chi_{DC,t}^h + \chi_{M,t}^u + \chi_{DC,t}^u \end{aligned} \tag{99}$$

$$D_t^* = \frac{R_{t-1}^*}{\pi_t^*} D_{t-1}^* + IM_t - \frac{1}{\epsilon_t} EX_t \tag{100}$$

$$\begin{aligned} N_t &= \sigma\left[R_t^k Q_{t-1} K_{t-1}^b - \frac{R_{t-1}}{\pi_t} D_{t-1} - \epsilon_t \frac{R_{t-1}^*}{\pi_t^*} D_{t-1}^* - \frac{R_{t-1}^c}{\pi_t} B_{t-1}\right] \\ &\quad + \gamma R_{t-1}^k Q_{t-1} K_{t-1} \end{aligned} \tag{101}$$

$$Q_t K_t^b\left(1 + \frac{\varkappa^b}{2} x_t^2\right) = \left(1 + \frac{\varkappa^b}{2} x_t^2\right)\phi_t N_t \tag{102}$$

$$Q_t K_t^b\left(1 + \frac{\varkappa^b}{2} x_t^2\right) = N_t + D_t + \epsilon_t D_t^* + B_t, \tag{103}$$

$$x_t = \frac{\epsilon_t D_t^*}{Q_t K_t^b} \tag{104}$$

$$x_t^c = \frac{B_t}{Q_t K_t^b} \tag{105}$$

$$B_t = B_t^h + B_t^u \tag{106}$$

$$R_t^c = \frac{P_t^c}{P_{t-1}^c} \tag{107}$$

Exogenous Processes.

$$\ln\left(\frac{A_t}{\bar{A}}\right) = \rho_A \ln\left(\frac{A_{t-1}}{\bar{A}}\right) + \varepsilon_t^A \tag{108}$$

$$\ln\left(\frac{P_t^c}{\epsilon}\right) = \rho_{P^c} \ln\left(\frac{P_{t-1}^c}{\epsilon}\right) + \varepsilon_t^{P^c} \tag{109}$$

C Welfare Analysis: Sensitivity Tests

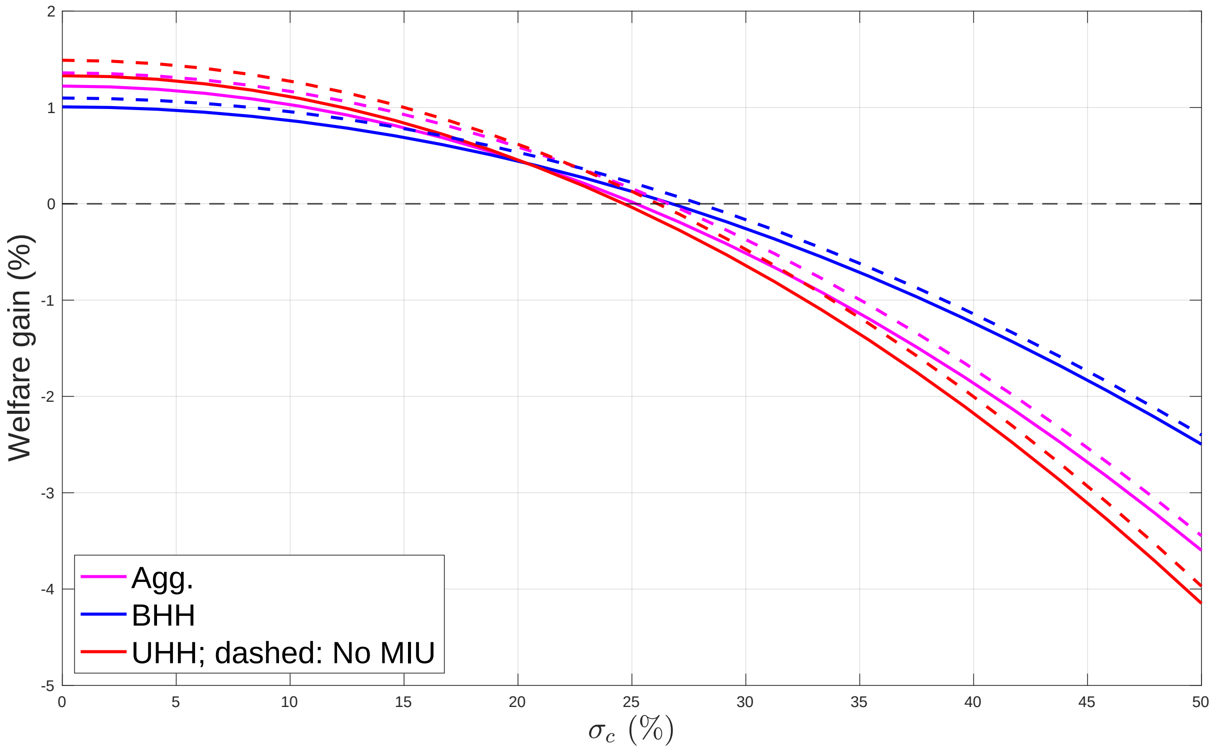
C.1 Welfare Calculations Without Preferences for Cryptocurrency and Money Balances

In this section, we reassess our welfare calculations by excluding preferences for cryptocurrency and real money balances. This adjustment addresses concerns that our results may be influenced by inconsistent sub-utility functions across the two economies: one with cryptocurrency balances and one without. Below, we present our welfare calculations without incorporating preferences for money and cryptocurrency balances:

$$\begin{aligned}
\text{BHH:}\ & \ln\left(C^h - \zeta_{0,h}\frac{(L^h)^{1+\zeta_h}}{1+\zeta_h}\right)\Bigg|_{\text{crypto}} - \ln\left(C^h - \zeta_{0,h}\frac{(L^h)^{1+\zeta_h}}{1+\zeta_h}\right)\Bigg|_{\text{no crypto}} \\
& = 1.10\%, \\
\text{UHH:}\ & \ln\left(C^u - \zeta_0^u\frac{(L^u)^{1+\zeta^u}}{1+\zeta^u}\right)\Bigg|_{\text{crypto}} - \ln\left(C^u - \zeta_0^u\frac{(L^u)^{1+\zeta^u}}{1+\zeta^u}\right)\Bigg|_{\text{no crypto}} \\
& = 1.49\%.
\end{aligned}$$

Figure 10 presents the welfare results under different levels of cryptocurrency volatility when sub-utility functions for money and cryptocurrency balances are omitted from the welfare calculations. We find that the welfare effects remain broadly consistent with the baseline specification.

Figure 10: Welfare Gains and Cryptocurrency Price Volatility



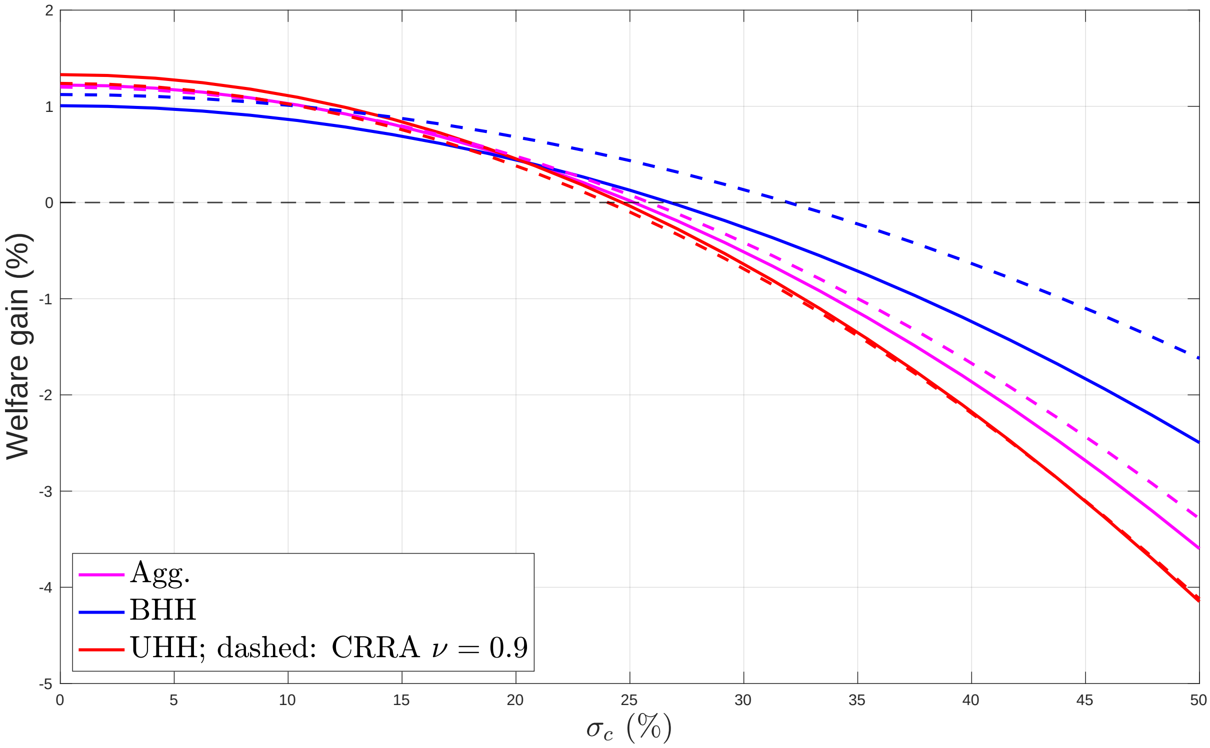
Note: The figure plots welfare gains for unbanked (UHH) and banked (BHH) households, as well as a representative aggregate household. Welfare gains are computed for varying levels of cryptocurrency price volatility, relative to an economy without cryptocurrency deposits. Both economies are subject to macroeconomic shocks, as outlined in Section 2.9. The first moment of welfare is calculated using a second-order log-linear approximation to the steady state. The dashed line represents the case where money-in-utility (MIU) preferences for cryptocurrency and money balances are omitted from welfare calculations.

C.2 Sensitivity Analysis: CRRA Coefficient

In this section, we examine the sensitivity of our results to the parameterization of the CRRA. In the baseline specification, the CRRA coefficient is set to 2, which implies that the sub-utility function for holding cryptocurrency and real money balances yields negative values. This raises concerns about the potential impact on our welfare results.

To assess robustness, we recalibrate the model with an alternative CRRA coefficient of 0.9, ensuring that the sub-utility function remains strictly positive. Figure 11 compares the welfare estimates under both parameterizations and shows that our main findings remain unchanged.

Figure 11: Welfare Gains and Cryptocurrency Price Volatility



Note: The figure plots welfare gains for unbanked (UHH) and banked (BHH) households, as well as a representative aggregate household. Welfare gains are computed for varying levels of cryptocurrency price volatility, relative to an economy without cryptocurrency deposits. Both economies are subject to macroeconomic shocks, as outlined in Section 2.9. The first moment of welfare is calculated using a second-order log-linear approximation to the steady state. The dashed line represents the case where the coefficient of relative risk aversion (CRRA) is set to 0.9 instead of the baseline value of 2.