Macro-Financial Impacts of Foreign Digital Money*

Anh H. Le   Alexander Copestake   Brandon Tan

Evan Papageorgiou   S. Jay Peiris   Umang Rawat

July 2025

Abstract

We develop a two-country New Keynesian model with endogenous currency substitution and financial frictions to examine the impact on a small developing economy of a stablecoin issued in a large foreign economy. The stablecoin provides households in the domestic economy with liquidity services and an additional hedge against domestic inflation. Its introduction amplifies currency substitution, reducing bank intermediation and weakening monetary policy transmission, which exacerbates the impacts of recessionary shocks and increases banking sector stress.

Keywords: Stablecoins, Open Economy, Financial Frictions, Optimal Policy.
JEL Codes: E50, F30, F31, G15, G18, G23.

*Le (corresponding author) is at IMFS, Goethe University Frankfurt; email le@imfs-frankfurt.de. Copestake, Tan, Papageorgiou, Peiris and Rawat are at the International Monetary Fund. We thank Itai Agur, Michael Binder, Damien Capelle, Yan Carrière-Swallow, Andrés Fernández Martin, Clemens Graf von Luckner, Annamaria Kokenyne Ivanics, Michael Kumhof, Tommaso Mancini-Griffoli, Soledad Martinez Peria, Alexander Meyer-Gohde, Valerio Nipsi Landi, Marco Reuter, Alasdair Scott, Ken Teoh, Toni Whited, Volker Wieland, and various seminar participants at the IMF for helpful comments and suggestions. The views expressed herein are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

1 Introduction

Developments in the international monetary system frequently raise concerns about spillover effects on developing countries (see, for instance, Eichengreen, 2012; Rey, 2013), and the emergence of new forms of digital money is no exception. Recent growth in the use of USD stablecoins has elevated concerns of 'digital dollarization' (Brunnermeier et al., 2021) or 'cryptoization' (IMF, 2021) where households choose to use them over their domestic currency. By reducing bank intermediation, this could in turn weaken monetary policy transmission and exacerbate the impact of recessionary shocks on developing countries.

However, recent work on the international spillovers of new forms of digital money has focused on the implications for large, rich countries. For instance, Cova et al. (2022) and Kumhof et al. (2023) consider spillovers from stablecoins or CBDCs in a foreign country to equally sized economies, while Minesso et al. (2020, 2022) use US-Europe and US-Germany ratios in their calibrations.[1] This leaves open the question of the implications for those countries most exposed to harmful spillovers, namely small emerging markets and developing economies (IMF, 2021).

In this paper, we therefore construct a two-country New Keynesian model to assess the risks from a foreign stablecoin for a small developing country whose currency faces substitution. Our model features a small domestic economy, with financial frictions and a banking sector, that is connected through trade and financial flows to a large foreign economy in which a payments firm issues a stablecoin backed by foreign cash. This stablecoin is useful to domestic households as both a means of payment and a non-domestic-currency store of value, following Henriksen and Kydland (2010), and we allow for endogenous currency substitution as in Özbilgin (2012).

Faced with an inflationary shock, the domestic household faces a trade-off between diverting more assets out of the domestic currency (preserving their purchasing power) and being able to meet the liquidity demands of its desired consumption transactions. Our main result is that the addition of the foreign stablecoin to the menu of payment assets relaxes this

[1] Ikeda et al. (2020) considers a small:large economy ratio of 1:99, but focuses only on the implications of digital money as a unit of account for pricing and does not include a financial sector. Moro and Nispi Landi (2023) also consider the implications of foreign CBDC for a small open economy, but do not allow for endogenous currency substitution.

trade-off, allowing households to shift more purchasing power away from domestic currency assets after the shock. As a result, currency substitution and capital outflows are amplified in response to negative shocks, which in turn magnifies domestic output losses.

A wide literature models the macroeconomic impact of digital money in closed economies.[2] Models addressing open-economy considerations include Barrdear and Kumhof (2016), George et al. (2021), Uhlig and Xie (2021) and Benigno et al. (2022). Our paper is most closely related to Cova et al. (2022), Ikeda et al. (2020), Kumhof et al. (2023), Minesso et al. (2022) and Moro and Nispi Landi (2023). We contribute by constructing a model that features all three of (i) asymmetric countries, (ii) endogenous currency substitution, and (iii) a financial sector, providing a rich environment to assess the macro-financial impacts of foreign digital money in small developing economies with bank-based financial systems.[3]

2 Model

The core framework is an NK-DSGE model with financial frictions and foreign funding in the financial sector, following Aoki et al. (2016), along with a stablecoin in the household payment basket. Figure 1 provides an overview of the model. Our two main innovations are to introduce (i) endogenous currency substitution in domestic households' portfolio decision and (ii) a stablecoin issuer in the foreign economy. This section describes these features; remaining model details are provided in Appendix A.

[2]See, for instance: Agur et al. (2022); Andolfatto (2021); Asimakopoulos et al. (2019); Banet and Lebeau (2022); Barrdear and Kumhof (2016); Burlon et al. (2022); Chang et al. (2023); Chiu et al. (2019); Fernández-Villaverde and Sanches (2019); Jiang and Zhu (2021); Keister and Sanches (2022); Sockin and Xiong (2018); Tan (2023b).

[3]Contemporaneous work by Murakami and Viswanath-Natraj (2025) also includes elements of each of these dimensions, but they model their cryptoasset as a form of deposit at domestic banks, whereas in our model the stablecoin gives households direct access to a foreign asset, in line with widespread concerns that new digital assets could reduce bank intermediation (see, for example, Agur et al., 2022).

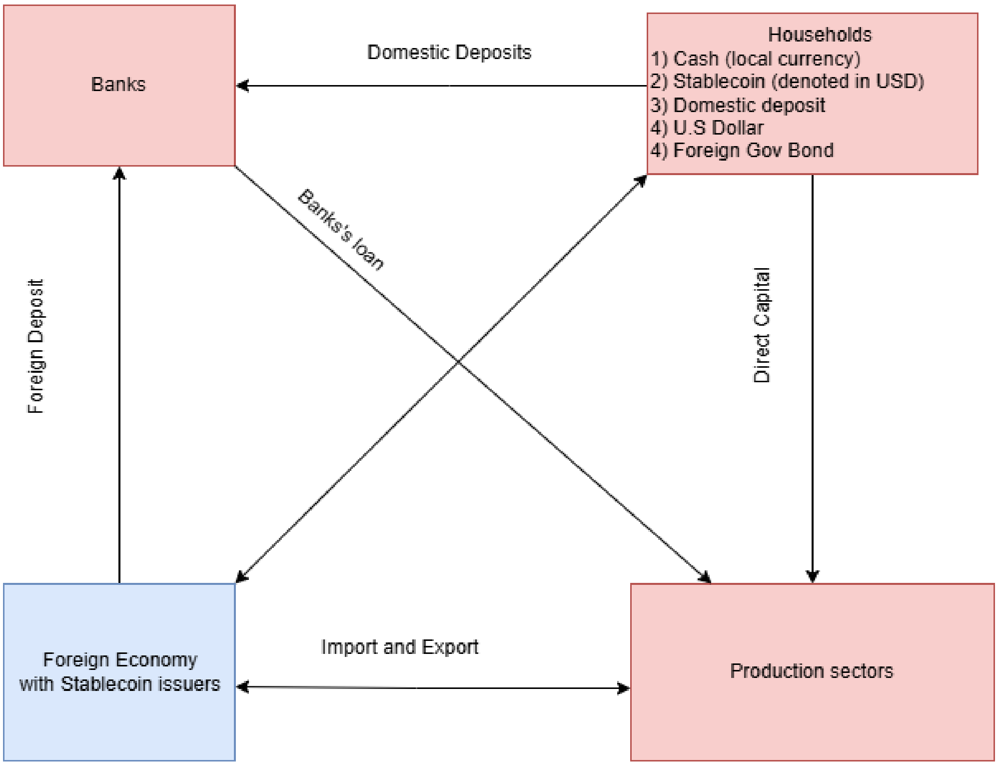

Figure 1: A bird eye view of the model.

2.1 Currency Substitution

We introduce currency substitution in payment instruments, extending the framework of Özbilgin (2012) to incorporate stablecoins, SC_t. The household values the consumption of a continuum of goods $C_t(j)$ indexed by $j \in [0, 1]$, with Leontief-type instantaneous utility from each equal to:

$$U_t = U\left(\min\left\{\frac{C_t(j)}{(1-\omega)j^{-\omega}}\right\}, L_t\right), \quad \omega \in \mathbb{R}_- \tag{1}$$

This implies that the consumption of each good satisfies:

$$\frac{C_t(j)}{(1-\omega)j^{-\omega}} = C_t, \quad j \in [0, 1] \tag{2}$$

i.e., j indexes goods by quality—the household consumes more of low-j goods.[4] A share $\bar{j}_t$ of these goods is purchased using domestic cash, and the remainder is purchased using other liquid assets—specifically deposits, foreign cash, and stablecoins, if available.[5] The

[4]Integrating from $j = 0$ to 1 will verify that total consumption in period t is C_t.

[5]Following Henriksen and Kydland (2010) and Özbilgin (2012), we assume the foreign bond and capital are illiquid and cannot be used for purchases.

composite liquidity provided by these other liquid assets is:

$$\Omega(D_t, s_t M^*_{H,t}, s_t P^{sc}_t SC_t) = \left((1-\mu^{SC}-\mu^D)\left(s_t M^*_{H,t}\right)^\rho + \mu^{SC}\left(s_t P^{sc}_t SC_t\right)^\rho + \mu^D (D_t)^\rho\right)^{1/\rho} \tag{3}$$

where μ^{SC} and μ^D govern the share of stablecoins, foreign cash and deposits. ρ reflects the substitutability between the those assets. s_t is the real exchange rate. Intuitively, stablecoins provide a differentiated source of foreign-currency liquidity—reflecting, for instance, that their digital form provides greater convenience relative to foreign cash, or that their pseudonymity and decentralization preclude any withdrawal limits or other regulatory constraints that may inhibit use of foreign currency held in traditional accounts.[6]

Following Freeman and Kydland (2000), the household chooses its distribution of asset holdings at the beginning of each period and maintains it until the beginning of the next. Keeping the proportions constant requires visiting the asset market n_t times at a small cost of κ units of time in each case. Households therefore base their payment decisions on a forward-looking consideration of inflation, exchange rates, interest rates, the price of stablecoins, and the cost of visiting the asset market. They will choose to use liquid assets if, as in Özbilgin (2012):

$$v^d_t R^D_t + v^{sc}_t \frac{P^{sc}_t}{P^{sc}_{t-1}} s_t + (1 - v^d_t - v^{sc}_t) De_t - \frac{n_t \tau \bar{r}^k_t}{C_t(j)} - \Delta_t \geq \frac{1}{\pi_t} \tag{4}$$

where v^i_t is the weight of each asset in the portfolio, De_t is the depreciation of the nominal exchange rate, $\bar{r}^k_t$ is the net return of capital adjusted for adjustment cost and Δ_t corrects for transformation between assets in the non-cash bundle and is independent of the amount of consumption goods purchased using it.

Intuitively, a higher rate of domestic inflation—holding constant the return on deposits, the price of the stablecoin, depreciation and transactions costs—encourages the household to shift away from domestic cash and toward other liquid assets that provide a better store of

[6] In general, while stablecoins and US dollars both function as stores of value and means of payment, they differ on important dimensions that can lead households to hold a mix of both, such as privacy, security, programmability, transaction costs, and interoperability across platforms or borders (e.g., Agur et al., 2022, 2025; Caramichael and Liao, 2022; Jin et al., 2023; Lee, 2021).

value.[7] Notably, the larger the purchase size $C_t(j)$—i.e., the higher the value of the good j—the more thinly spread across units of consumption is the fixed transactions cost of paying using liquid assets (reflected in the penultimate term on the left-hand side of Equation 4), and hence the greater the substitution away from domestic cash. This framework therefore matches empirical observations, noted in Özbilgin (2012), that in a context of rising inflation, currency substitution begins with foreign currency being adopted as a store of value, then becoming a means of exchange for big-ticket items, and finally being used for progressively smaller and more frequent transactions.

We can therefore define $\bar{j}_t$ as the threshold good, for which Equation 4 holds with equality and the household is indifferent between payment options. The household's total demands for cash and liquid assets in period t are then:

$$\int_0^{\bar{j}_t} c_t(j)\, dj = n_t \frac{M_t}{P_t} \tag{5}$$

$$\int_{\bar{j}_t}^1 c_t(j)\, dj = n_t \frac{\Omega(D_t, e_t M^*_{H,t}, e_t P^{sc}_t SC_t)}{P_t} \tag{6}$$

Finally, we normalise the time endowment of the household to one unit, which they spend on labor, leisure and trips to the asset market:

$$L_t + H_t + \kappa n_t = 1 \tag{7}$$

2.2 The Foreign Stablecoin Issuer

Building on Cova et al. (2022), the stablecoin issuer sells stablecoins that it produces from foreign cash according to the technology constraint:

$$SC^s_t = M^*_{SC,t} \tag{8}$$

[7] Note that foreign inflation is only relevant to the extent that it impacts the exchange rate since the household is concerned with the domestic purchasing power of the foreign currency.

where $M^*_{SC,t}$ is its holdings of USD.[8] The issuer is owned by the foreign household, who maximizes discounted profit in the form:

$$\max E_t \left(\sum_{j=0}^{\infty} \beta^j \frac{\Lambda^*_{t+j}}{\Lambda^*_t} \Omega^{SC}_{t+j} \right) \tag{9}$$

where

$$\Omega^{SC^s}_t = (P^{SC}_t SC^s_t - P^{SC}_t SC^s_{t-1}) - (M^*_{SC,t} - M^*_{SC,t-1}). \tag{10}$$

2.3 Calibration

Here we describe the calibration of the novel elements of our model. Further details on calibration are provided in Appendix B.

Stablecoin. The hypothetical nature of our exercise—exploring the potential macro-financial implications of the as-yet-nonexistent broad adoption of a new asset—precludes estimating the key parameters empirically. Instead, we set the main parameters such that the stablecoin comprises 35% of the non-cash payment portfolio in the steady state. This is less than for deposits but more than for foreign cash.[9] Intuitively, we consider our results to reflect a severe but plausible downside scenario in which foreign stablecoins are widely adopted and play a substantial role in domestic currency payments.

Relative sizes. We consider a small developing economy that is both smaller and poorer than the foreign economy. Specifically, we calibrate total domestic GDP to be approximately one fiftieth of the foreign economy, and the domestic population to be roughly one fifth the size.

[8]Unlike Cova et al. (2022), we do not include domestic bonds among the backing assets, reflecting that the domestic economy is a small developing country whose assets are not widely included in global reserves.

[9]I.e., we have $\mu^{M*} < \mu^{SC} < \mu^D$ where $\mu^{M*} = 1 - \mu^D - \mu^{SC}$ is the weight of foreign cash in the liquidity bundle. We consider this reasonable and in line with other work modeling a liquidity premium for digital money over cash based on convenience, potential programmability (Lee, 2021), or other opportunities for improvement as adoption and innovation reinforce each other (Cong and Mayer, 2022; Tan, 2023a). Nonetheless, we show in Appendix D that our results also hold under the alternative calibration $\mu^{M*} = \mu^{SC}$.

3 Results

This section presents the dynamic responses of the economy to two shocks—a domestic productivity shock and a foreign monetary policy shock—and compares the outcomes in scenarios with and without the foreign stablecoin. Appendix C assesses the welfare implications of these shocks, finding that in both cases welfare declines by more after the shock in the world with the stablecoin.

3.1 Domestic TFP Shock

First, we assess the impact on the domestic economy of a 1% negative shock to domestic total factor productivity (TFP). The black line in Figure 2 presents the results under our baseline model without the stablecoin, which are relatively conventional and in line with existing models in the literature. Output falls as a result of the standard negative supply shock, as do both consumption and investment. Inflation rises due to the lower productivity of goods-producing firms. The central bank responds to inflation by raising the policy rate, which causes a recession in the real economy that lowers investment and asset prices.[10] In the banking sector, the negative TFP shock diminishes net worth (a measure of current and future profits) as it pushes down asset prices and increases the credit spread. As the cost of capital rises due to the risk premium, capital demand in the production sector decreases, exacerbating the decline in investment and asset prices. Additionally, demand for both domestic and foreign deposits falls, reducing domestic and foreign financing channels for the banking sector.

The red line plots outcomes when the stablecoin is available. As highlighted by Cova et al. (2022), households look forward, taking into account the expected stablecoin price for the next period. As a result, households tend to reallocate toward the stablecoin when they expect the price to rise and reallocate away from it when they expect the price to fall (relative to other sources of liquidity). While the price of the stablecoin in US dollars deviates very little, its price in domestic currency deviates substantially as the exchange rate changes, and this anticipation in turn drives households' decisions.

The availability of stablecoins exacerbates the impact of the negative TFP shock. In

[10] Lower output and income also reduce imports, improving the trade balance.

addition to a somewhat larger slump in output, consumption, and investment, there is a more pronounced decline in domestic cash usage and an increase in stablecoin holdings. This incremental currency substitution is also accompanied by a larger drop in domestic deposits, indicating bank disintermediation that worsens banking sector stress.

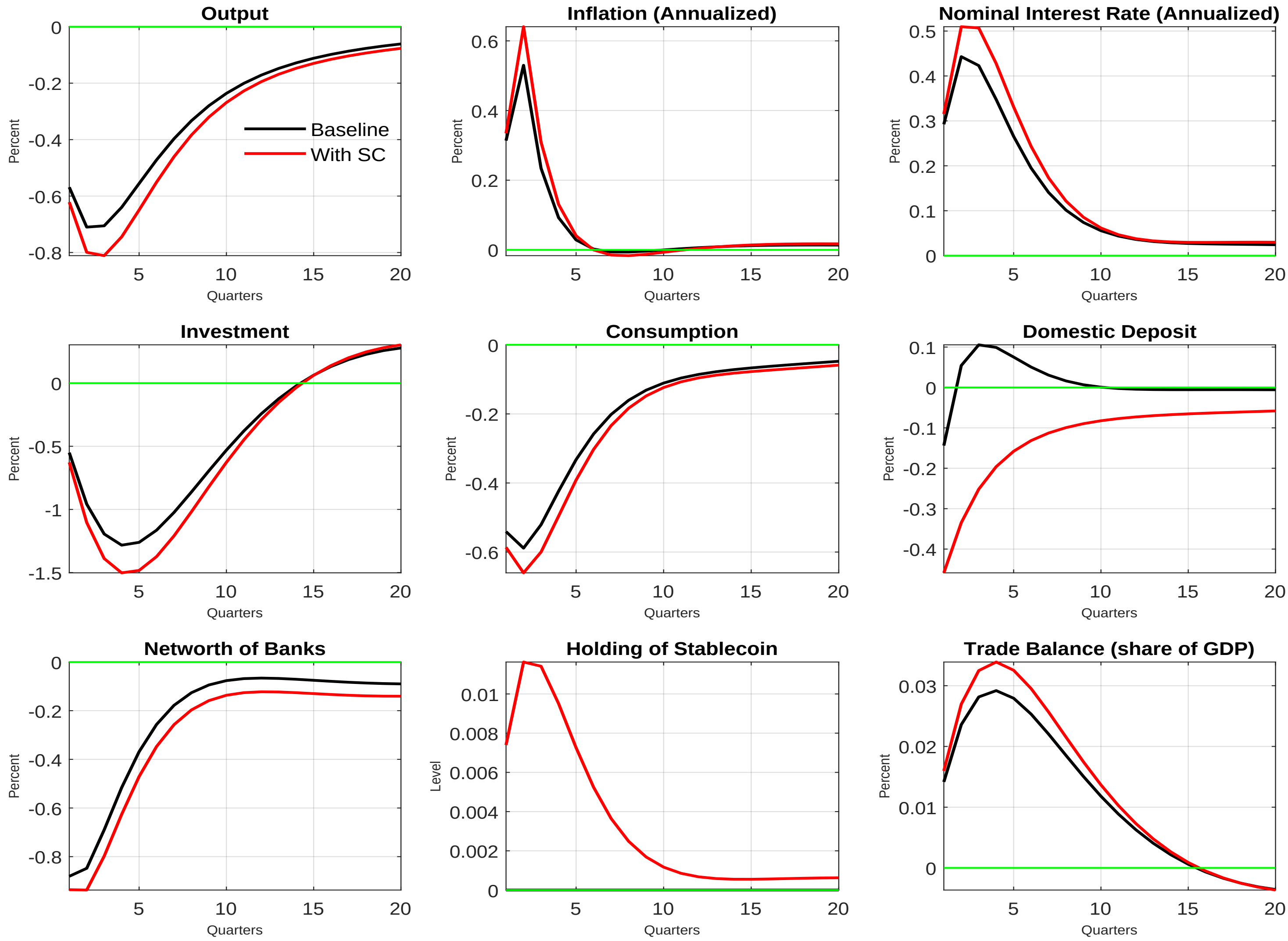

Figure 2: Responses of selected variables in the domestic economy to a negative 1% TFP shock. Time is in quarters. The black line depicts the model without the stablecoin, and the red line depicts the model with the stablecoin.

3.2 Foreign Monetary Shock

We now turn to a shock originating from outside the domestic economy. Given the small size of our domestic economy and the trade and financial linkages between countries, fluctuations in the larger economy take on particular significance, in line with the wide literature on the global financial cycle (e.g., Miranda-Agrippino and Rey, 2020; Rey, 2013).

Figure 3 shows the responses to a contractionary shock in the foreign interest rate. The shock triggers a decline in domestic output. As the appeal of the domestic currency declines, the real exchange rate depreciates, bolstering exports through an expenditure-switching effect and supporting aggregate demand. However, the depreciation of the exchange rate also prompts an increase in the inflation rate by elevating the prices of imported goods. The central bank responds to these inflationary pressures by raising interest rates, which, in turn, boosts savings and reduces consumption. Although higher inflation helps alleviate the real burden of debt denominated in the home currency, the resulting deterioration in bank balance sheets and the decline in investment and asset prices (Tobin's Q) echo the findings of Kiyotaki and Moore (1997) and Gertler and Karadi (2015).

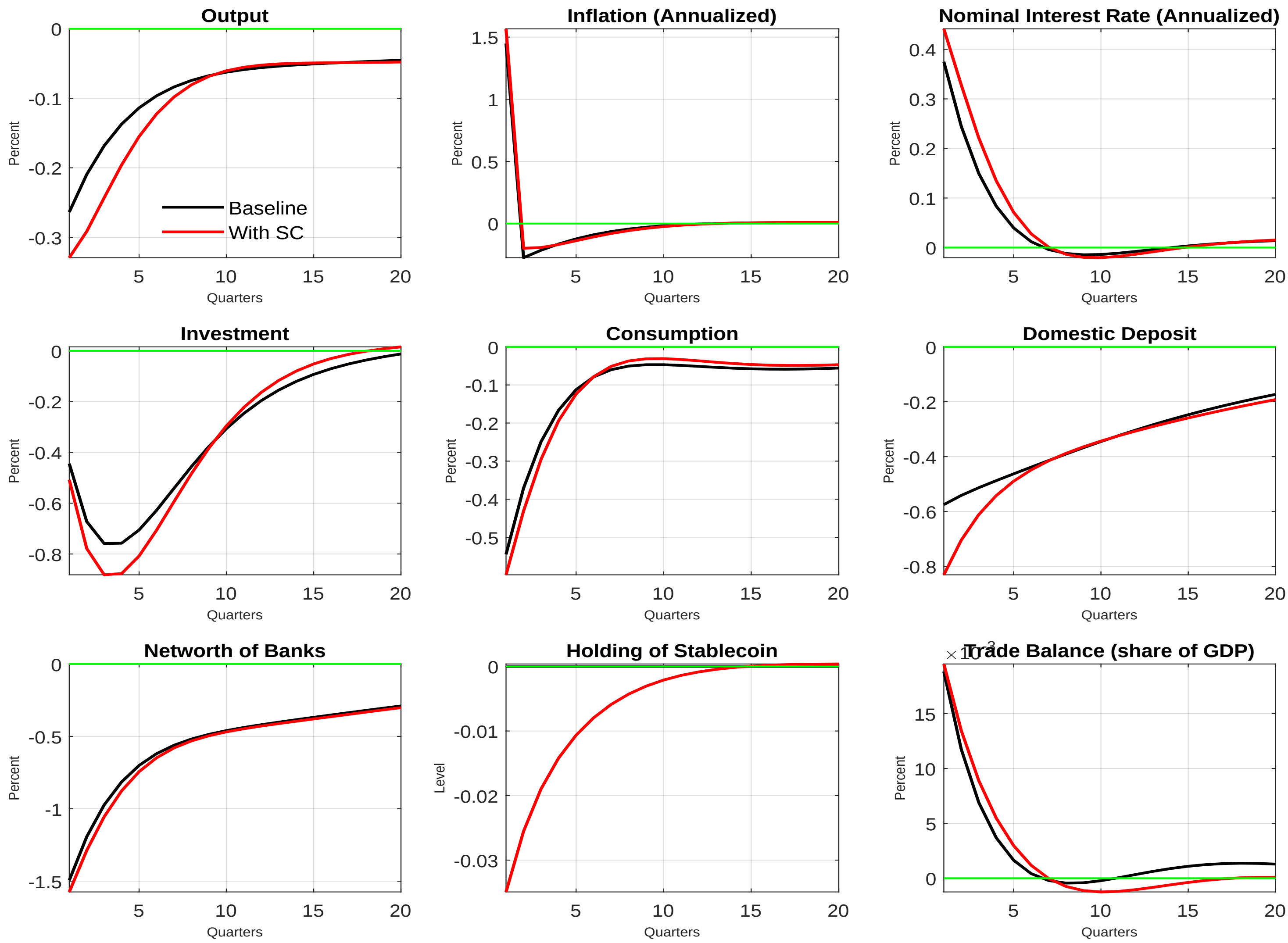

Figure 3: Responses of selected variables in the domestic economy to a contractionary foreign monetary policy shock. Time is in quarters. The black line depicts the model without the stablecoin, the red line depicts the model with the stablecoin.

We observe a substantially larger spillover effect to the domestic economy when the stablecoin is available. Since it can be traded among three agents—domestic households, foreign households, and issuers—its availability strengthens the connection between the two economies. Importantly, the first order condition for the household's stablecoin holdings also involves the exchange rate, creating an additional cross-border transmission channel. The responses of output, consumption, and investment become more pronounced compared to the scenario without stablecoins. As highlighted by Minesso et al. (2022) for foreign central bank digital currencies (CBDCs), introducing this new digital asset adds a novel arbitrage condition that intertwines the domestic interest rate, the exchange rate, and the trajectory of stablecoin prices. This effect is reflected mainly in the first-order conditions on the household side. Deposits decline more in response to the foreign shock, and the domestic banking sector undergoes a period of stress, as evidenced by lower net worth. Meanwhile, holdings of the stablecoin decrease, indicating that the drop in consumption outweighs the substitution effect among payment tools.

4 Conclusion

We develop a large two-country DSGE model to examine the macro-financial implications of a foreign stablecoin for a small developing economy. We find that the presence of the stablecoin can amplify currency substitution by providing an additional asset through which domestic households can diversify away from the domestic currency. Bank intermediation declines and monetary policy transmission weakens further, exacerbating the impacts of recessionary shocks and increasing stress in the banking sector. For a shock originating abroad, we find that the presence of the stablecoin can intensify spillover effects from the foreign economy onto the domestic economy by creating an additional transmission channel, in a magnified form of the findings of Minesso et al. (2022) for a foreign central bank digital currency with near-symmetric economies.

References

Adrian, T., C. J. Erceg, M. Kolasa, J. Lindé, and P. Zabczyk (2021): *A Quantitative Microfounded Model for the Integrated Policy Framework*, International Monetary Fund.

Agur, I., A. Ari, and G. Dell'Ariccia (2022): "Designing central bank digital currencies," *Journal of Monetary Economics*, 125, 62–79.

Agur, I., G. Villegas-Bauer, T. Mancini-Griffoli, M. S. M. Martinez Peria, and B. Tan (2025): "Tokenization and Financial Market Inefficiencies," Fintech Note 2025/001, International Monetary Fund, Washington, D.C.

Andolfatto, D. (2021): "Assessing the impact of central bank digital currency on private banks," *The Economic Journal*, 131, 525–540.

Aoki, K., G. Benigno, and N. Kiyotaki (2016): "Monetary and financial policies in emerging markets," *Unpublished paper, London School of Economics.[652].*

Asimakopoulos, S., M. Lorusso, and F. Ravazzolo (2019): "A new economic framework: a DSGE model with cryptocurrency," .

Banet, J. and L. Lebeau (2022): "Central Bank Digital Currency: Financial Inclusion vs. Disintermediation," Working Papers 2218, Federal Reserve Bank of Dallas.

Barrdear, J. and M. Kumhof (2016): "The macroeconomics of central bank issued digital currencies," .

Benigno, P., L. M. Schilling, and H. Uhlig (2022): "Cryptocurrencies, currency competition, and the impossible trinity," *Journal of international economics*, 136, 103601.

Brunnermeier, M., H. James, and J.-P. Landau (2021): "The digitalisation of money," *BIS Working Papers.*

Burlon, L., C. Montes-Galdon, M. Muñoz, and F. Smets (2022): "The optimal quantity of CBDC in a bank-based economy," .

Caramichael, J. and G. Y. Liao (2022): "Stablecoins: Growth Potential and Impact on Banking," *International Finance Discussion Papers*, number: 1334 Publisher: Board of Governors of the Federal Reserve System (U.S.).

Chang, H., L. Gornicka, F. Grinberg, M. Miccoli, and B. Tan (2023): "CBDC and banking disintermediation in a portfolio choice model," *Forthcoming IMF Working Paper.*

Chiu, J., S. M. Davoodalhosseini, J. Hua Jiang, and Y. Zhu (2019): "Bank market power and central bank digital currency: Theory and quantitative assessment," *Available at SSRN 3331135.*

Christiano, L. J., M. Eichenbaum, and C. L. Evans (2005): "Nominal rigidities and the dynamic effects of a shock to monetary policy," *Journal of political Economy*, 113, 1–45.

Cong, L. W. and S. Mayer (2022): "The coming battle of digital currencies," *The SC Johnson College of Business Applied Economics and Policy Working Paper Series.*

Cova, P., A. Notarpietro, P. Pagano, and M. Pisani (2022): "Monetary policy in the open economy with digital currencies," *Bank of Italy Temi di Discussione (Working Paper) No*, 1366.

Davis, J. S. and I. Presno (2017): "Capital controls and monetary policy autonomy in a small open economy," *Journal of Monetary Economics*, 85, 114–130.

Eichengreen, B. (2012): *Exorbitant Privilege: The Rise and Fall of the Dollar and the Future of the International Monetary System*, Oxford ; New York: Oxford University Press, reprint edition ed.

Fernández-Villaverde, J. and D. Sanches (2019): "Can currency competition work?" *Journal of Monetary Economics*, 106, 1–15.

Freeman, S. and F. E. Kydland (2000): "Monetary Aggregates and Output," *The American Economic Review*, 90, 1125–1135.

George, A., T. Xie, and J. D. Alba (2021): "Central bank digital currency with adjustable interest rate in small open economies," *Available at SSRN 3605918*.

Gertler, M. and P. Karadi (2015): "Monetary policy surprises, credit costs, and economic activity," *American Economic Journal: Macroeconomics*, 7, 44–76.

Gopinath, G., E. Boz, C. Casas, F. J. Díez, P.-O. Gourinchas, and M. Plagborg-Møller (2020): "Dominant currency paradigm," *American Economic Review*, 110, 677–719.

Henriksen, E. and F. E. Kydland (2010): "Endogenous money, inflation, and welfare," *Review of Economic Dynamics*, 13, 470–486.

Ikeda, D. et al. (2020): "Digital money as a unit of account and monetary policy in open economies," Tech. rep., Institute for Monetary and Economic Studies, Bank of Japan.

IMF (2021): "Global financial stability report: Covid-19, crypto and climate," *International Monetary Fund, Washington*.

Jiang, J. H. and Y. Zhu (2021): "Monetary Policy Pass-Through with Central Bank Digital Currency," Staff Working Papers 21-10, Bank of Canada.

Jin, F., J. Li, and Y. Xue (2023): "Preferring stablecoin over dollar: Evidence from a survey of Ethereum platform traders," *Journal of International Money and Finance*, 131, publisher: Elsevier.

Keister, T. and D. Sanches (2022): "Should Central Banks Issue Digital Currency?" *The Review of Economic Studies*, 90, 404–431.

Kiyotaki, N. and J. Moore (1997): "Credit cycles," *Journal of political economy*, 105, 211–248.

Kumhof, M., M. Pinchetti, P. Rungcharoenkitkul, and A. Sokol (2023): "CBDC Policies in Open Economies," SSRN Scholarly Paper 4388834, Social Science Research Network, Rochester, NY.

Lee, A. (2021): "What is Programmable Money?" *FEDS Notes*, number: 2021-06-23-1 Publisher: Board of Governors of the Federal Reserve System (U.S.).

Lindé, J. and M. Trabandt (2018): "Should we use linearized models to calculate fiscal multipliers?" *Journal of Applied Econometrics*, 33, 937–965.

Minesso, M. F., A. Mehl, and L. Stracca (2020): "Central bank digital currency in an open economy," Working Paper Series 2488, European Central Bank.

——— (2022): "Central bank digital currency in an open economy," *Journal of Monetary Economics*, 127, 54–68.

Miranda-Agrippino, S. and H. Rey (2020): "US monetary policy and the global financial cycle," *The Review of Economic Studies*, 87, 2754–2776.

Moro, A. and V. Nispi Landi (2023): "The External Financial Spillovers of CBDCs," *Available at SSRN 4347004*.

Murakami, D. and G. Viswanath-Natraj (2025): "Cryptocurrencies in Emerging Markets: A Stablecoin Solution?" *Journal of International Money and Finance*, 156.

Özbilgin, H. M. (2012): "Currency substitution, inflation, and welfare," *Journal of development Economics*, 99, 358–369.

Rey, H. (2013): "Dilemma not trilemma: the global cycle and monetary policy independence," *Proceedings - Economic Policy Symposium - Jackson Hole*.

Rotemberg, J. J. (1982): "Sticky prices in the United States," *Journal of political economy*, 90, 1187–1211.

Schmitt-Grohé, S. and M. Uribe (2007): "Optimal simple and implementable monetary and fiscal rules," *Journal of Monetary Economics*, 54, 1702–1725.

Sockin, M. and W. Xiong (2018): "A model of cryptocurrencies. Princeton University," *Unpublished manuscript.[Google Scholar]*.

Tan, B. (2023a): "Central Bank Digital Currency Adoption: A Two-Sided Model," *IMF Working Paper 23/127*.

——— (2023b): "Central Bank Digital Currency and Financial Inclusion," *IMF Working Paper 23/69*.

Uhlig, H. and T. Xie (2021): "Parallel digital currencies and sticky prices," Tech. rep., National Bureau of Economic Research.

Woodford, M. (2003): "Interest and prices," .

Online Appendix

A Model Structure

A.1 Domestic Household

The representative household maximizes her expected utility

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t \left[ln(C_t) - \Psi \frac{(1-L_t)^{1+\varphi}}{1+\varphi} \right]$$

subject to the budget constraint

$$\begin{aligned} & C_t + Q_t K_t^h + \frac{D_t}{P_t} + e_t \frac{B_{F,t}}{P_t} + \frac{M_t}{P_t} + \frac{e_t M_{H,t}^*}{P_t} + P_t^{sc} e_t \frac{SC_t}{P_t} + \chi^h(K_t^h, K_t) + \tau(1-j_t) \\ & = w_t H_t + (Z_t + \lambda Q_t) K_{t-1}^h + \frac{R_{t-1}^D}{P_t} D_{t-1} + \epsilon^m \frac{M_{t-1}}{P_t} + e_t \frac{M_{H,t-1}^*}{P_t} + P_t^{sc} e_t \frac{SC_{t-1}}{P_t} + e_t R_{z,t-1}^* \frac{B_{F,t-1}}{P_t} + \Pi_t \end{aligned} \tag{A.1}$$

where C_t denotes total consumption, K_{t-1}^h denotes physical capital from household investment, w_t denotes the real wage and H_t is total labor, D_t is the deposits, M_t denotes domestic cash, $M_{H,t}^*$ denotes foreign cash, SC_t is the stablecoin, $\chi^h(K_t^h, K_t)$ is the capital cost, and $\tau(1-j_t)$ stands for the total transaction cost. R_{t-1}^D is the risk-free nominal interest rate for deposits calculated using available information at time t, and Π_t is total profit transfers from firms. P_t^{sc} is the nominal price of the stablecoin. ϵ^m is a storage cost for holding cash. Z_t and Q_t denote the productivity and price of household capital respectively. In addition, B_{Ft} denotes one-period U.S. bonds denominated in the foreign currency (which we label USD for convenience), paying a nominal interest rate of $R_{z,t} = R_t^* - \phi e^{B_{F,t} - B_{F,t-1}}$ similar to Gopinath et al. (2020) and Davis and Presno (2017), which is adjusted to account for the risk of borrowing in USD. Lastly, e_t is the nominal exchange rate. The household solves the following first-order conditions:

F.O.C. with regard to consumption:

$$\lambda_t = \frac{1}{C_t} \tag{A.2}$$

F.O.C. with regard to deposits:

$$\lambda_t = \beta E_t \left(\lambda_{t+1} \frac{R_t^D}{\pi_{t+1}} \right) + \lambda_t^{\Omega} n_t \mu^D D_t^{\rho-1} \left((1 - \mu^{SC} - \mu^D) \left(s_t M_{H,t}^* \right)^{\rho} + \mu^{SC} \left(s_t P_t^{sc} SC_t \right)^{\rho} + \mu^D (D_t)^{\rho} \right)^{\frac{1-\rho}{\rho}} \tag{A.3}$$

F.O.C. with regard to stablecoins:

$$\lambda_t P_t^{SC} s_t = E_t s_{t+1} \beta \lambda_{t+1} \frac{P_{t+1}^{SC}}{\pi_{t+1}} + \lambda_t^{\Omega} n_t \mu^{SC} SC_t^{\rho-1} \left((1 - \mu^{SC} - \mu^D) \left(s_t M_{H,t}^* \right)^{\rho} + \mu^{SC} \left(s_t P_t^{sc} SC_t \right)^{\rho} + \mu^D (D_t)^{\rho} \right)^{\frac{1-\rho}{\rho}} \tag{A.4}$$

F.O.C. with regard to foreign cash:

$$\lambda_t s_t = E_t s_{t+1} \beta \frac{\lambda_{t+1}}{\pi_{t+1}} + \lambda_t^{\Omega} n_t (1 - \mu^{SC} - \mu^D) {M_{H,t}^*}^{\rho-1} \left((1 - \mu^{SC} - \mu^D) \left(s_t M_{H,t}^* \right)^{\rho} + \mu^{SC} \left(s_t P_t^{sc} SC_t \right)^{\rho} + \mu^D (D_t)^{\rho} \right)^{\frac{1-\rho}{\rho}} \tag{A.5}$$

F.O.C. with regard to domestic cash:

$$\lambda_t = E_t \beta \frac{\lambda_{t+1}}{\pi_{t+1}} + \lambda_t^m n_t \tag{A.6}$$

F.O.C. with regard to household supply of capital:

$$\lambda_t = \beta E_t \left(\lambda_{t+1} \frac{(Z_t + \lambda Q_t)}{Q_t + \chi^h (K_t^h, K_t)} \right) \tag{A.7}$$

F.O.C. with regard to labor:

$$w_t = \Psi \frac{(1 - L_t)^{\varphi}}{\lambda_t} \tag{A.8}$$

F.O.C. with regard to foreign bonds:

$$\lambda_t = \beta E_t \left(\lambda_{t+1} \frac{R^*_{z,t}}{\pi^*_{t+1}} \frac{s_{t+1}}{s_t} \right) \tag{A.9}$$

F.O.C. with regard to investment from capital producers:

$$1 = Q_t \left[1 - \frac{\Omega_k}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 - \Omega_k \frac{I_t}{I_{t-1}} \left(\frac{I_t}{I_{t-1}} - 1 \right) \right] + \beta E_t \left[Q_{t+1} \frac{\lambda_{t+1}}{\lambda_t} \Omega_k \left(\frac{I_{t+1}}{I_t} \right)^2 \left(\frac{I_{t+1}}{I_t} - 1 \right) \right] \tag{A.10}$$

A.2 Domestic Financial Intermediaries

Domestic bankers have three sources of funding that they use to make their capital loans to producers: their own net worth N_t, domestic deposits D_t and foreign deposits D^*_t. x_t is the fraction of assets financed by foreign borrowing. Foreign deposits are converted into domestic currency at the prevailing exchange rate s_t and are more expensive—we assume that domestic banks in the emerging market must pay a risk premium $\left(1 + \frac{\varkappa_b}{2}\right)^2$ to accumulate foreign debt. The flow of funds constraint for a representative bank is therefore:

$$\left(1 + \frac{\varkappa_b}{2} x_t^2\right)^2 Q_t K^b_t = N_t + D_t + s_t D^*_t \tag{A.11}$$

As mentioned briefly above, businesses may receive two sources of capital. The first is from the household directly[11]. The second is from the financial sector, K^b_t. Then the net worth is as follows:

$$N_t = (Z_t + Q_t\, \lambda)\; K^b_{t-1} - \frac{D_{t-1}\, R_{t-1}}{\pi_t} - \frac{s_t D^*_{t-1} R^*_{t-1}}{\pi^*_t} \tag{A.12}$$

At the beginning of each period t, bankers raise funds and purchase assets from non-financial firms. During this period, the banker decides whether to keep working as a banker (operating honestly) or to divert assets. Deciding to keep being a banker means carrying capital until the returns are given and the banker fulfils the responsibilities to depositors. Otherwise, bankers can choose to exit and keep a fraction θ of the total assets for themselves.

[11]This reflects that the household can participate in the financial market.

We define V_t as the bank's value function, which can be considered the 'market value' of bankers. Depositors will only trust the bank with their funds if bankers are incentivized not to divert assets, i.e. if

$$V_t(N_t) \geq \Theta(x_t) Q_t K_t^b \tag{A.13}$$

Under a perfect financial market, the incentive constraint always holds with equality to prevent limitless asset expansion. However, in our model, banks are also subject to a terminal wealth maximization problem. Banks maximize expected terminal wealth, which can be expressed recursively as:

$$V_t(N_t) = E_t \Lambda_{t;t+1}[(1-\sigma)N_{t+1} + \sigma V_{t+1}] \tag{A.14}$$

We can also express this in terms of Tobin's Q maximization, where $\psi_t = \frac{V_t}{N_t}$ is Tobin's Q, and $lev_t = \frac{Q_t K_t^b}{N_t}$ is the leverage ratio:

$$\psi_t = \max_{lev_t, x_t} \left(\mu_t lev_t + \left(1 - \frac{\varkappa_b}{2} lev_t^2 x_t\right) v_t + \mu_t^* lev_t x_t \right) \tag{A.15}$$

subject to

$$\psi_t \geq \Theta(x_t) lev_t \tag{A.16}$$

$$\mu_t = E_t \left[\Lambda_{t;t+1} \left(\frac{Z_{t+1} + \lambda Q_{t+1}}{Q_t} - R_{t+1} \right) \right] \tag{A.17}$$

$$\mu_t^* = E_t \left[\Lambda_{t;t+1} \left(R_{t+1} - \frac{s_{t+1}}{s_t} R_{t+1}^* \right) \right] \tag{A.18}$$

$$v_t = E_t \left[\Lambda_{t;t+1} R_{t+1} \right] \tag{A.19}$$

$$\Omega_{t+1} = \Lambda_{t;t+1}(1 - \sigma + \sigma \psi_{t+1}) \tag{A.20}$$

where $\Omega_{t;t+1}$ is the stochastic discount factor of the banker, μ_t is the excess return on capital over home deposits, μ_t^* is the cost advantage of foreign currency debt over home deposits or the deviation from real uncovered interest parity (UIP), and v_t is the marginal cost of deposits.

A.3 Foreign Household

Similar to the domestic household, the foreign household maximizes

$$U_t^* = E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{*1-\sigma^*}}{1-\sigma^*} - \kappa_L \frac{H_t^{*1+\varphi^*}}{1+\varphi^*} + \mu^{\$} \frac{M_t^{*1-\sigma^{\$}}}{1-\sigma^{\$}} + \mu^{SC^*} \frac{SC_t^{*1-\sigma_{SC}^*}}{1-\sigma_{SC}^*} \right] \tag{A.21}$$

subject to

$$\begin{aligned} C_t^* + I_t^* + \frac{B_{F,t}^*}{P_t^*} + \frac{D_t^*}{P_t^*} + \frac{M_t^*}{P_t^*} + P_t^{sc} \frac{SC_t^*}{P_t^*} =& w_t^* H_t^* + R_t^{k*} K_{t-1}^* + \\ & \frac{R_{t-1}^*}{P_t^*} D_{t-1}^* + \frac{R_{t-1}^*}{P_t^*} B_{F,t-1}^* + P_t^{sc} \frac{SC_{t-1}^*}{P_t^*} + \frac{R_{t-1}^*}{P_t^*} bF_{t-1}^* + \Gamma_t^* \end{aligned} \tag{A.22}$$

$$K_t^* = (1-\delta^*) K_{t-1}^* + \left[1 - \frac{\Omega_k^*}{2} \left(\frac{I_{t+1}^*}{I_t^*} - 1 \right)^2 \right] I_t^* \tag{A.23}$$

where C_t^* and I_t^* are foreign consumption and investment, respectively. B_{Ft}^* and D_t^* are foreign bonds and deposits in the domestic economy, which are perfect substitutes from the household's perspective. R_t^* is the foreign risk-free rate. M_t^* and SC_t^* are foreign holdings of foreign cash and the stablecoin, respectively. R_t^{k*} and K_t^* is the foreign return of capital and capital. w_t^* and H_t^* are foreign wages and labor. The household receives utility from holding liquid assets, following Woodford (2003), and we assume that cash is the most liquid asset such that $\mu^{*M^*} > \mu^{SC^*}$. Lastly, P_t^* is the foreign price level. Different from the domestic household, we let the foreign household be the capital producer, where δ^* is the foreign rate of depreciation. Ω_k^* governs investment adjustment cost.

F.O.C. with regard to consumption:

$$\lambda_t^* = C_t^{*-\sigma^*} \tag{A.24}$$

F.O.C. with regard to deposits and internationally traded bonds:

$$\lambda_t^* = \beta E_t (\lambda_{t+1}^* \frac{R_t^*}{\pi_{t+1}^*}) \tag{A.25}$$

F.O.C. with regard to cash

$$\mu^{\$} M_t^{*-\sigma^{\$}} = \lambda_t^* - \beta E_t \lambda_{t+1}^* \tag{A.26}$$

F.O.C. with regard to stablecoins

$$\mu^{SC^*} SC_t^{*-\sigma_{SC^*}} = \lambda_t^* P_t^{sc} - \beta E_t \lambda_{t+1}^* P_{t+1}^{sc} \tag{A.27}$$

F.O.C. with regard to labor:

$$w_t^* = \kappa_L \frac{H_t^{*\varphi^*}}{\lambda_t^*} \tag{A.28}$$

F.O.C. with regard to capital

$$1 = \beta E_t \left\{ \frac{\lambda_{t+1}^*}{\lambda_t^*} \frac{R_{t+1}^{k*} + (1-\delta^*) q_{t+1}^*}{q_t^*} \right\} \tag{A.29}$$

F.O.C. with regard to investment:

$$1 = q_t^* \left[1 - \frac{\Omega_k^*}{2} \left(\frac{I_t^*}{I_{t-1}^*} - 1 \right)^2 - \Omega_k^* \frac{I_t^*}{I_{t-1}^*} \left(\frac{I_t^*}{I_{t-1}^*} - 1 \right) \right] + \beta E_t \left[q_{t+1}^* \frac{\lambda_{t+1}^*}{\lambda_t^*} \Omega_k^* \left(\frac{I_{t+1}^*}{I_t^*} \right)^2 \left(\frac{I_{t+1}^*}{I_t^*} - 1 \right) \right] \tag{A.30}$$

A.4 Production Sectors

As in the domestic economy, foreign production is a CES aggregate of differentiated intermediate inputs i

$$Y_t^* = \left[\int_0^1 Y_t^*(i)^{\frac{\epsilon^*-1}{\epsilon^*}} di \right]^{\frac{\epsilon^*}{\epsilon^*-1}}$$

which again implies that demand from the representative final-good firm for each input is

$$Y_t^*(i) = \left(\frac{P_t^*(i)}{P_t^*} \right)^{-\epsilon^*} Y_t^* \tag{A.31}$$

The production function of each foreign intermediate goods producer is

$$Y_t^*(i) = A_t^* \left(K_{t-1}^*\right)^{\alpha^*} H_t^{*1-\alpha^*} \tag{A.32}$$

where A_t^* is firm productivity which follows an AR(1) process with technology shock parameter $\epsilon_t^a \sim N(0, \sigma_a^2)$:

$$log(A_t^*) = \rho_a log(A_{t-1}^*) + \epsilon_t^a$$

Firms then maximize profits in line with Rotemberg (1982)

$$E_t \sum_{i=0}^{\infty} \beta^t \frac{\lambda_t^*}{\lambda_0^*} \left[\frac{P_{F,t}^*(i)}{P_t^*} Y_{F,t}^*(i) - w_t^* H_t(i)^* - r_t^{k*} K_{t-1}^*(i) - \frac{AC_t(i)}{P_t^*} \right] \tag{A.33}$$

where the adjustment cost, AC_t, is defined by

$$AC_t^*(i) = \frac{\kappa_P}{2} \left(\frac{P_{F,t}^*(i)}{P_{F,t-1}^*(i)} - \pi^* \right)^2 P_{F,t}^* Y_t^* \tag{A.34}$$

Only foreign prices need to be considered, since all sales by foreign firms—including exports—are priced in dollars.

A.5 Foreign Central Bank and Market Clearing

Market clearing requires that the total supply of dollars M_t^{s*} is equal to the total holdings of dollars by the stablecoin issuer, foreign households and domestic households:

$$M_t^{s*} = M_{SC,t}^* + M_t^* + \frac{n}{1-n} M_{H,t}^* \tag{A.35}$$

where n and $1-n$ are the sizes of the domestic and foreign economies, respectively.

Likewise, for the US bond market, we require:

$$B_t^{s*} = B_{F,t}^* + \frac{n}{1-n} B_{F,t} \tag{A.36}$$

The foreign government constraint follows Lindé and Trabandt (2018):

$$B_t^{s*} - \frac{R_t^*}{\pi_{t+1}^*} B_{t-1}^{s*} + M_t^{s*} - M_{t-1}^{s*} = G_t^* - TR_t \tag{A.37}$$

$$\frac{TR_t}{TR} = \left(\frac{B_{t-1}^{s*}}{B^{s*}} \right)^{\phi} \tag{A.38}$$

The foreign central bank is also assumed to follow a Taylor-type rule:

$$\ln\left(\frac{R_t^*}{R^*}\right) = \rho_r^* ln \left(\frac{R_{t-1}^*}{R^*}\right) + (1-\rho_r^*) \left(\rho_\pi^* ln \left(\frac{\pi_t^*}{\pi_{ss}}\right) + \rho_y^* ln \left(\frac{Y_t^*}{Y_{t-1}^*}\right)\right) \tag{A.39}$$

Lastly, foreign goods market clearing requires:

$$Y_t^* = (1-\gamma^*)(p_{F,t}^*)^{-\eta}(C_t^* + I_t^*) + G_t^* + \frac{n}{1-n}\gamma^*(p_{F,t})^{-\eta}(C_t + I_t) + \frac{\kappa_P}{2}(\pi_{F,t}^* - \bar{\pi}^*)^2 Y_t^* \tag{A.40}$$

A.6 Foreign Stablecoin Issuer

The stablecoin issuer's optimization problem is shown in the main text. It generates the following first-order conditions, where all variables are expressed relative to price level for convenience and λ_t^{sc} is the Lagrangian multiplier.

F.O.C. with regard to SC_t^s:

$$P_t^{SC} = \lambda_t^{sc} - \beta \frac{\Lambda_{t+1}^*}{\Lambda_t^*} P_{t+1}^{SC}; \tag{A.41}$$

F.O.C. with regard to $M_{SC,t}^*$:

$$\lambda_t^{sc} = 1 - \beta \frac{\Lambda_{t+1}^*}{\Lambda_t^*}; \tag{A.42}$$

The market clears when total global stablecoin supply SC_t^s is equal to total demand from the domestic and foreign economies

$$SC_t^s = \frac{n}{1-n} SC_t + SC_t^*. \tag{A.43}$$

B Calibration

We draw most of our parameter values from the literature, particularly Aoki et al. (2016) and Adrian et al. (2021), and their values are relatively standard. Table B.1 shows the main parameters and resulting steady-state ratios.

Table B.1: Selected Calibrated Parameter Values

Parameter	Value	Description
β	0.995	Discount rate of household (IPF)
θ	0.399	Elasticity of leverage with regard to foreign borrowing
σ	0.94	Survival probability
ξ	0.0045	Fraction of total assets brought by new banks
$\varkappa^b$	0.0219	Management cost for foreign borrowing
ζ	1	Inverse of Frisch elasticity of labor supply
ζ_0	18.527	Labor disutility (labor in steady state around 1/3)
$\varkappa_h$	0.0219	Cost parameter of direct finance (ABK)
α_K	0.30	Cost-share of capital (IPF)
δ	0.025	Depreciation rate
η_d	8	Elasticity of demand
ω_c	0.5	Calvo parameter of price stickiness
κ_I	2.48	Investment adjustment cost (Christiano et al., 2005)
ϵ^m	1	Storage cost
μ^{M*}	0.15	Weight of USD
μ^D	0.5	Weight of deposits
μ^{SC}	0.35	Weight of stablecoins
ρ	0.55	Elasticity of of payment substitution
$\bar{A}$	1.000	Steady state productivity
ρ_i	0.82	Taylor rule persistence (IPF)
ϕ_π	1.5	Taylor rule response to CPI inflation
ϕ_{π_D}	0.5	Taylor rule response to domestic inflation
ϕ_Y	0.09	Taylor rule response to output
γ	0.297	Home bias
ς	0.15	Relative size of the population of the home economy
n	55	Relative size of the foreign economy to domestic economy
η	0.8	Elasticity of substitution (IPF)
ω	-1.25	Leontief utility parameter
C/Y	0.67	Steady state ratio of consumption to GDP
K/Y	7.5	Steady state ratio of consumption to GDP
I/Y	0.19	Steady state ratio of investment to GDP
J	0.71	Share of cash payment
Π	4%	Steady state rate of annualized inflation

Notes: This table shows the main parameters used in the model and their sources. ABK refers to Aoki et al. (2016); IPF refers to Adrian et al. (2021).

C Welfare Implications

In this section, we consider how the presence of the stablecoin influences the welfare response to the recessionary shocks examined above. We define this welfare response as the stochastic mean of the percentage deviation of utility from its own steady state:

$$U_t^i = \left[ln(C_t) - \Psi \frac{(1-L_t)^{1+\varphi}}{1+\varphi} \right] \tag{C.1}$$

$$\mathcal{W}_t^i = U_t^i + \beta E_t \left(\mathcal{W}_{t+1}^i \right) \tag{C.2}$$

$$\Delta W_t^i = ln \left(\frac{\mathcal{W}_t^i}{\bar{\mathcal{W}}_t^i} \right) \tag{C.3}$$

where $\bar{\mathcal{W}}_t^i$ denotes welfare in the steady state and $i \in \{B, SC\}$ denotes the baseline or stablecoin economy respectively. Following Schmitt-Grohé and Uribe (2007), we take a second order approximation of the stochastic mean of ΔW_t^i after the shock. Table C.1 shows the estimated difference in the welfare response between the two scenarios, for each of the shocks individually and for both together. Welfare declines by more after the shock in the world with the stablecoin, and this relative decline is particularly large in response to the TFP shock.

Table C.1: Differential welfare response when stablecoin available

Shocks	$\Delta W_t^{SC} - \Delta W_t^B$
TFP	-0.1089
Foreign rate	-0.0185
Both	-0.1274

D Robustness

In this section, we repeat our main simulations for an alternative calibration in which foreign cash and the stablecoin have the same weight in the non-domestic-cash liquidity bundle (equation 3). Specifically, we set $\mu^{SC} = 0.25 = \mu^{M*}$, instead of $\mu^{SC} = 0.35 > 0.15 = \mu^{M*}$ as in the baseline calibration. The results are shown in Figures D.1 and D.2 below. The macroeconomic implications of the stablecoin are very similar. Thus, our results are not sensitive to the particular liquidity weight assigned to the stablecoin, instead being driven primarily by the availability of an alternative and differentiated non-domestic-currency means of payment and store of value.

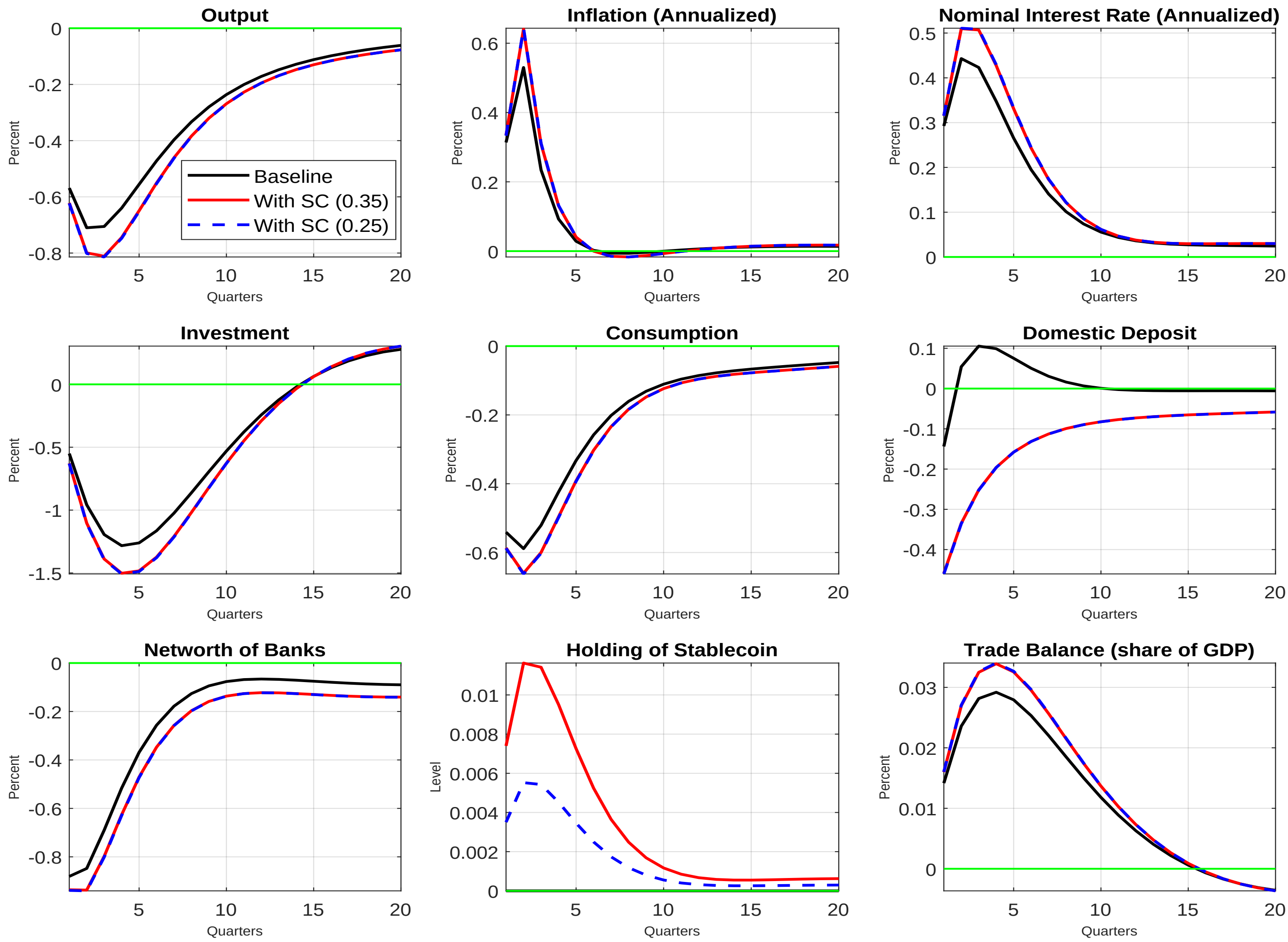

Figure D.1: Responses of selected variables in the domestic economy to a negative 1% TFP shock. Time is in quarters. The black line depicts the model without the stablecoin, the red line depicts the model with the stablecoin in the baseline calibration, and the blue line depicts the model with the stablecoin in the alternative calibration.

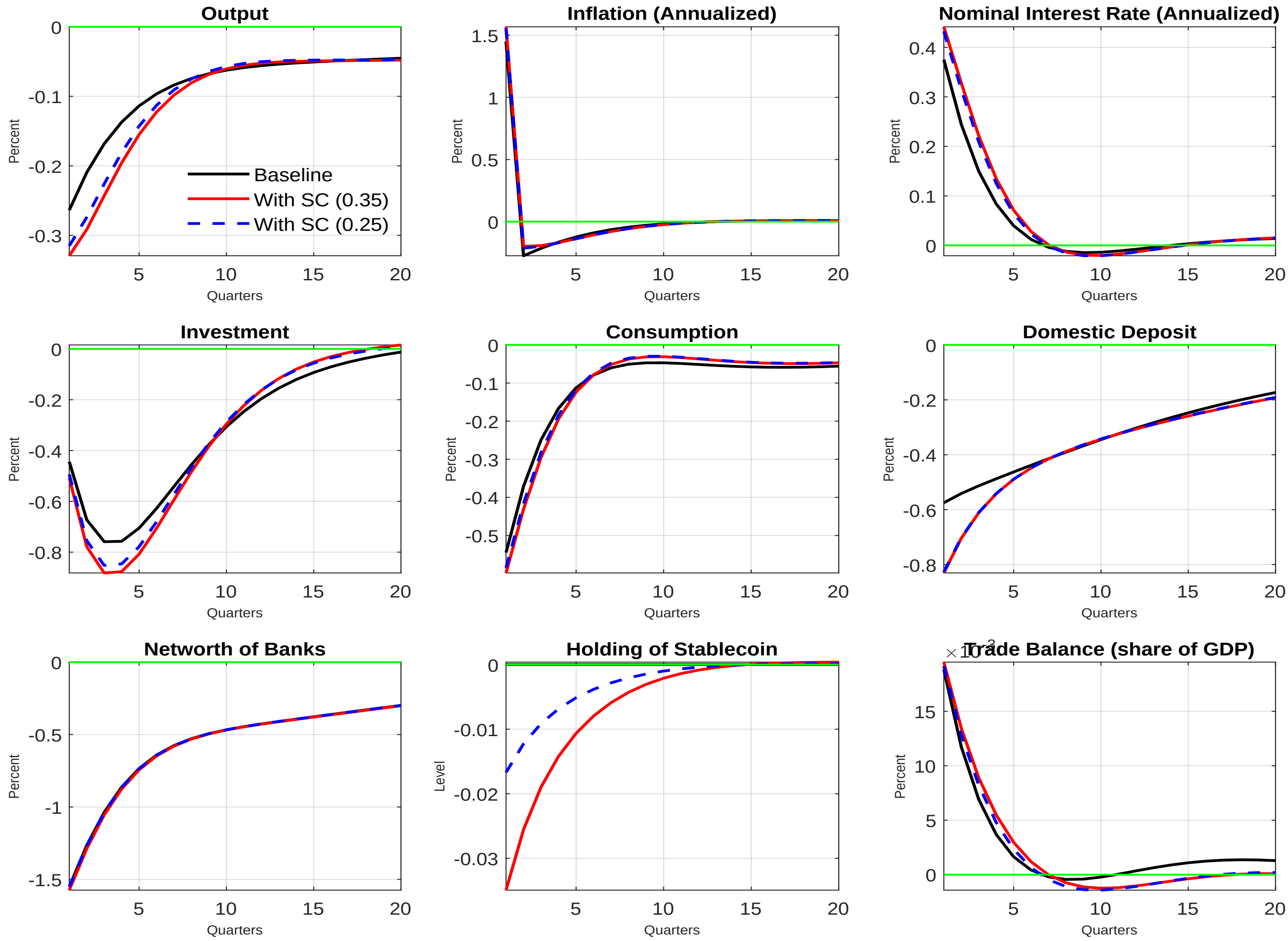

Figure D.2: Responses of selected variables in the domestic economy to a contractionary foreign monetary policy shock. Time is in quarters. The black line depicts the model without the stablecoin, the red line depicts the model with the stablecoin in the baseline calibration, and the blue line depicts the model with the stablecoin in the alternative calibration.