The Fiscal Implications of Parallel Currencies *

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Abstract

By controlling the scarcity of an offshore parallel currency, policymakers can manage capital flows and steer the exchange rate. This is an alternative policy to setting the rate of a Tobin tax. However, its fiscal implications are distinct, and this paper lays them out. Having a parallel currency creates both seigniorage and liquidity revenues. The two revenues have different sizes and different Laffer curves, both of which vary with the regime for the exchange rate, with liquidity policies, and with the size of the offshore market. Quantitatively, the fiscal footprint of offshore money management is small and the Laffer curve is flat, boosting the chances that it can be used independently of fiscal pressures.

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1 Introduction

The IMF (2021) has proposed a framework for countries to evaluate cross-border capital flows and choose a mix of policy tools. This *Integrated Policy Framework* (IPF) takes as given deviations from efficient financial markets so that some capital flows can inefficiently amplify shocks, and floating exchange rates may deviate from the levels that would efficiently allocate resources across borders (Bianchi and Lorenzoni, 2022). Many policy tools can attack these inefficiencies directly, manage the capital flows, and steer the equilibrium exchange rate. They all work by moving wedges in optimality conditions. In the formal model of the IPF (Basu et al., 2025), these policies are: financial transaction taxes across borders (sometimes called Tobin taxes), macro-prudential policies over the leverage and risk-taking of financial intermediaries, and occasional foreign exchange interventions.

In practice, all of these policies face obstacles. Accounting conventions make it hard to net out gross flows to apply financial transaction taxes, and they open many paths for tax evasion (for Brazil's experience with these, see Chamon and Garcia 2016). Macro-prudential policies spill over to distort the allocation of domestic credit and are hard to adjust at high frequencies (Reis, 2021). Foreign exchange intervention may have only short-lived effects (Fratzscher et al., 2019). As a result, economists still search for alternative policy tools to include in the IPF.

One recently studied alternative comes from the successful Chinese experience: the use of an offshore parallel currency. By forcing cross-border capital flows to go through exchanges in and out of that currency, and at the same time controlling the relative scarcity of that currency, authorities can affect the relevant wedges in the arbitrage conditions between investing domestically or abroad (Bahaj and Reis, 2024). A related alternative that shares the same theoretical underpinnings is to require that the conversion of foreign capital into domestic currency happens only through state banks at an official non-market exchange rate. The offshore-currency policy has at least three practical advantages over the IPF's current tools: (i) netting of gross flows happens automatically in currency exchanges, (ii) controlling the offshore money supply can be done at high frequencies, and (iii) central banks have liquidity tools to persistently affect the creation of money by banks.

An open question is what the fiscal implications of an offshore currency are. This matters for evaluating whether these tools are, on the one hand, feasible, by not requiring funds from always-stretched public budgets, and on the other hand, safe, since the best-intended policy can become a tool for financial repression if it can generate significant fiscal revenues (Reis, 2026). Transaction taxes and subsidies like the ones in the IPF have revenues and expenses that appear directly in the government's budget. In turn, macro-prudential constraints create rents without fiscal revenues.

An offshore currency shares fiscal features with both of these. Like transaction taxes, the creation of base money creates seigniorage revenues. Like macro-prudential policies, the expansion of liquidity through the money multiplier creates rents for banks that may be only partly captured by the public authorities.

At the same time, if the offshore currency becomes widely used internationally, then these fiscal implications can displace the IPF's intentions. The potential for a currency to grow as an international currency depends on its fiscal backing. In turn, one of the advantages of having an international currency is to collect seigniorage revenues.

The goal of this paper is to study these fiscal implications of offshore parallel currencies.

Section 2 presents a model where capital controls and an offshore market allow policy to manage capital flows and affect the exchange rate. The model builds on the two-period setup of Bahaj and Reis (2024), extending it to an infinite horizon and including liquidity benefits from the currency to both domestic and foreign holders.

Section 3 discusses the fiscal properties of the model. After isolating the fiscal revenues from having an offshore currency, it proves that they are approximately equal to the product of offshore deposits over GDP and a tax-like wedge created by the scarcity of offshore money. Reasonable calibrations point to fiscal revenues of 0.07–0.17% of GDP, while the estimate for the Chinese experience with the offshore yuan is 0.002% of GDP. Therefore, the fiscal backing required by the system is limited.

Section 4 studies the Laffer curve for fiscal revenue as a function of the size of the offshore money supply. The curve turns out to be flat at modest levels of revenue. This suggests that the temptation to use this tool for financial repression will be limited. This section further splits the total revenue into the part that comes from printing money (seigniorage) and the part that comes from operating lending facilities (liquidity), and plots their respective Laffer curves. It finds that this split varies with the money supply as banks change how many deposits they supply.

Section 5 considers alternative policies to manage the offshore currency. The first has the authorities sterilizing the expansion of the offshore money supply in order to keep the exchange rate fixed. The second uses liquidity policies that change banks' incentives to raise the broad money supply by creating inside money rather than by issuing narrow outside money. The third has the authorities promoting the offshore currency as an international means of payment, as seems to be the case for the offshore yuan. These have different implications for net foreign assets, money multipliers, and the sources of seigniorage, respectively. But the first two leave the size of fiscal revenues and the flatness of their Laffer curve unchanged, while under the third, fiscal revenues increase almost one-to-one with the size of the offshore currency.

Section 6 concludes. Offshore currencies leave a relatively modest fiscal footprint so that both their fiscal backing is limited and the temptation to use them for financial repression is weak. From the perspective of the integrated policy framework, these are advantages that make this policy tool promising.

Three papers are close to this one in their goals even if they study different instruments. First, Schmitt-Grohé and Uribe (2024) study the fiscal implications of having exchange controls so that private agents must incur a smuggling cost to circumvent them. This creates a gap between official and market exchange rates. As Bahaj and Reis (2024) discuss, there is a clear parallelism between that gap and the onshore-offshore exchange rate that we study. Second, Reis (2026) quantifies the fiscal implications of financial repression policies. These include policies and regulations that raise the demand for government liabilities while keeping their supply scarce, creating convenience yields. Parallel currencies are one specific type of these policies, and their fiscal revenues are tied to a convenience yield of offshore deposits. Third, Itskhoki and Mukhin (2026) study the fiscal implications of sanctions by tying them to their impact on exchange rates and net foreign assets, as we do in our analysis.

Beyond these three, our work fits into a much broader literature on fiscal-monetary interactions in a domestic or closed economy setting. Issues range from the consequences of fiscal policy for the price level (Cochrane, 2023) to the fiscal footprint of central bank policies (Reis, 2019) and the importance of seigniorage (Kehoe and Nicolini, 2022). This paper focuses on the narrower issue of the fiscal backing of an offshore currency.

2 A model of an offshore currency

There are four relevant agents in the economy: domestic households, foreign investors, offshore banks, and the government. The key assumption of the model is that there are capital controls and an offshore currency such that:

(i) domestic households cannot invest abroad directly, but they can hold bank deposits in the offshore currency;

(ii) foreign investors cannot invest domestically directly, but they can hold bank deposits in the offshore currency;

(iii) the government controls the supply of offshore narrow money (reserves), and offshore banks create offshore broad money (deposits) subject to regulations;

(iv) the government can invest domestically and abroad at will, while offshore banks only invest domestically.

By keeping the supply of offshore money scarce, the government creates two wedges. One is between what households can earn on their offshore deposits and the returns of investing abroad. The other is between what foreigners earn on their offshore deposits and what they could earn if allowed to invest domestically. It is in this sense that an offshore currency becomes a tool in the IPF.

We now present the problem of each agent in turn. Time is discrete and indexed by $t = 0, 1, \ldots$. We consider a deterministic economy with a perfect foresight equilibrium.[1]

2.1 Domestic households

A representative household discounts the future by the factor $\beta \in (0, 1)$ and gets utility from consuming non-tradable goods $c_{NT,t}$ and tradable goods $c_{T,t}$, as well as liquidity benefits from holding offshore deposits d_t^h. There are many ways to microfound the benefits of holding money; we follow the classical money-in-the-utility function formulation for simplicity. The household therefore maximizes:

$$\sum_{t=0}^{\infty} \beta^t \left[\ln(c_{NT,t}) + \iota \ln(c_{T,t}) + \mu_t \left(\frac{(d_t^h)^{1-1/\varepsilon_h} - 1}{1 - 1/\varepsilon_h} \right) \right]. \tag{1}$$

The fixed parameter $\iota > 0$ controls preferences over the two goods, while the time-varying parameter $\mu_t > 0$ shifts the household's demand for offshore deposits. This will be an important parameter in scaling the size of the offshore money market, and so in driving the fiscal implications. The parameter $\varepsilon_h > 0$ will turn out to be the return-elasticity of the demand for deposits.

[1]Adding shocks to the key exogenous variables would keep most equations unchanged, aside from expectations operators over future variables. Because we focus our analysis and conclusions on balanced growth paths, considering uncertainty would do little to our results, so we leave shocks to future work.

We let $E_t^\$$ be the exchange rate between the foreign currency in which tradable goods are priced in international markets and the domestic currency in which non-tradables are quoted. An increase in $E_t^\$$ will stand for a depreciation of the domestic onshore currency.

In turn, E_t is the exchange rate between the offshore currency and its onshore domestic counterpart. An increase in E is also a depreciation of the onshore currency, but now relative to the offshore currency.

Households can save domestically at date t in domestic bonds b_t^h that pay a return R_t in onshore units at date $t+1$. Or, they can save in offshore currency that pays a return R_t^d in offshore units. Given their endowments of the two goods $y_{T,t}$ and $y_{NT,t}$, their budget constraint (expressed in non-tradable units) is:

$$E_t^\$ c_{T,t} + c_{NT,t} + b_t^h + E_t d_t^h = E_t^\$ y_{T,t} + y_{NT,t} + R_{t-1} b_{t-1}^h + R_{t-1}^d E_t d_{t-1}^h + T_t\,. \tag{2}$$

The household receives a lump-sum transfer T_t from the government: it will be discussed at length in Section 2.5. Domestic nominal GDP is endogenous and given by:

$$Y_t = y_{NT,t} + E_t^\$ y_{T,t}\,. \tag{3}$$

The optimal intertemporal behavior of this household is characterized by an Euler equation for savings and an equation for offshore money demand. Imposing already the goods market clearing condition that $y_{NT,t} = c_{NT,t}$, and assuming that the preference for deposits scales with non-tradable output so that the preferences are compatible with balanced growth: $\mu_t = \mu y_{NT,t}^{1/\varepsilon_h - 1}$ for a fixed parameter μ, the two optimality conditions are:

$$R_t = \left(\frac{1}{\beta}\right)\left(\frac{y_{NT,t+1}}{y_{NT,t}}\right), \tag{4}$$

$$\mu\left(\frac{d_t^h}{y_{NT,t}}\right)^{-1/\varepsilon_h} = E_t - \frac{E_{t+1}R_t^d}{R_t}\,. \tag{5}$$

The first equation pins down domestic onshore returns to equal the exogenous growth rate in non-tradable output divided by the discount factor. The second equation shows that either a higher interest rate on offshore deposits, or a higher appreciation of the offshore currency, reduces the opportunity cost of holding offshore deposits, and raises the household's demand for this money.

Finally, intratemporal behavior in choosing between non-tradable and tradable consumption implies that:

$$c_{T,t} = \frac{\iota y_{NT,t}}{E_t^{\$}}\,. \tag{6}$$

A higher preference for the tradable good ι or a higher income from the non-tradable endowment raises consumption of tradables, while a higher $E_t^{\$}$ increases the price of tradable goods, and so lowers their consumption.

2.2 Foreign investors

A representative foreign investor has linear preferences over foreign consumption in foreign-currency units c_t^* and deep pockets. The investor maximizes:

$$\sum_{t=0}^{\infty}(R^{\$})^{-t}\left[c_t^* + \gamma_t^{1/\varepsilon_f}\left(\frac{(d_t^f)^{1-1/\varepsilon_f}-1}{1-1/\varepsilon_f}\right)\right], \tag{7}$$

where $1/R^{\$} \in (0,1)$ is a constant discount factor, $\gamma_t > 0$ is a time-varying preference for the services provided by offshore money that the investor holds, d_t^f, and $\varepsilon_f > 0$ is the foreigners' return-elasticity of the demand for deposits.

Since holding one unit of offshore deposits between t and $t+1$ gives the investors a gross payoff $R_t^d E_{t+1}/E_t$ in units of the domestic onshore currency, their optimal demand for offshore money is given by the optimality condition:

$$d_t^f = \gamma_t\left[\frac{R^{\$}E_{t+1}^{\$}}{E_t}\left(\frac{R^{\$}E_{t+1}^{\$}}{E_t^{\$}} - \frac{R_t^d E_{t+1}}{E_t}\right)^{-1}\right]^{\varepsilon_f}. \tag{8}$$

To understand this equation, note that in the limit $\gamma_t \to 0$, the foreign demand for offshore currency is perfectly elastic. This optimality condition becomes the uncovered interest parity (UIP) condition: $R_t^d = R^{\$}(E_{t+1}^{\$}/E_t^{\$})(E_t/E_{t+1})$ for an arbitrary level of deposits. Instead, because there is a finite elasticity of demand for offshore currency, there is a UIP wedge. This wedge pins down the finite level of offshore deposits held by foreigners.

2.3 Offshore banks

Competitive financial institutions offer offshore deposits d_t. They hold domestic bonds b_t^b. Therefore, they are a vehicle through which foreign investors can invest domestically.

Moreover, because they take both domestic and foreign deposits, swapping one extra unit of domestic deposits for one fewer of foreign ones is a vehicle through which the country invests abroad.

These banks can also hold offshore reserves at the central bank m_t, which earn a return R_t^m between t and $t+1$. Reserves reduce the liquidity cost that banks incur every time they issue a deposit. This is captured by the cost-per-deposit function $\Phi(m/d, M/D)$, which depends both on individual choices as well as on aggregate conditions.

Banks maximize profits:

$$\max_{b_t^b, m_t, d_t} \quad R_t b_t^b + E_{t+1}\left(R_t^m m_t - R_t^d d_t\right), \tag{9}$$

$$\text{s.t.} \quad b_t^b + E_t m_t + E_t \Phi(m_t/d_t, .) d_t = E_t d_t\,. \tag{10}$$

The two optimality conditions, together with a zero-profit condition from free entry, are:

$$R_t^m E_{t+1} = E_t R_t (1 + \Phi'(m_t/d_t, .)), \tag{11}$$

$$R_t^d E_{t+1} = E_t R_t \left(1 - \Phi(m_t/d_t, .) + (m_t/d_t)\Phi'(m_t/d_t, .)\right), \tag{12}$$

where $\Phi'(m_t/d_t, \cdot)$ is the partial derivative of the function with respect to its first argument.

The first condition equates the return from holding an additional reserve at the central bank to the return of alternatively lending it out. It takes into account that holding reserves has two benefits: they pay a return and lower liquidity costs. The second condition likewise equates the return paid on deposits to the return earned on investments, taking into account that deposits raise liquidity costs.

2.4 Liquidity costs

As in most models of money creation by banks, the liquidity cost function plays an important role. In its reduced-form version, the function $\Phi(.)$ captures two key principles: issuing a deposit gives out liquidity and so costs the bank; holding a reserve receives liquidity and so lowers this cost. We assume that total costs are homogeneous of degree one in reserves and deposits, so that velocity in terms of these two concepts of money (narrow and broad respectively) is stationary in a balanced growth path. The two principles translate into a single mathematical condition: $\Phi'(m_t/d_t, .) \leq 0$.

There are many possible microfoundations behind this function. Bahaj and Reis (2024) propose one in which banks' assets are illiquid, while deposits and reserves are liquid, in the sense that within a period a bank may face a withdrawal in excess of its reserves that it must satisfy by borrowing from other banks or from the central bank at a penalty rate. The cost then corresponds to the weighted average of two interest rates relative to the rate on reserves: the interbank rate at which the bank can borrow from other banks, and the rate charged on central bank loans.

In equilibrium, one bank's gain by lending to another bank is offset by the latter bank's loss in borrowing. All that is left are the penalty payments on the loans of last resort to banks. This implies that the liquidity costs to the banks are then fiscal revenues to the government. Liquidity costs are tied to the scarcity of money, as opposed to being an unavoidable physical resource cost. Since the goal of this paper is to study the fiscal implications of money, we take this extreme view that all liquidity costs accrue to the government. This biases our fiscal revenues upward, so the small numbers we report are an upper bound. Other microfoundations where the fiscal revenues would be only a share of the liquidity costs would reduce the revenues.

We let $x_t \equiv M_t/D_t$ be the money-deposit ratio in equilibrium, and denote by $\phi(x_t) \equiv \Phi(M_t/D_t, M_t/D_t)$ the equilibrium value of the per-deposit liquidity costs. The marginal liquidity benefit of holding an extra reserve in equilibrium then is: $-\phi'(x_t) \equiv -\Phi'(x_t, x_t)$, while the marginal cost of issuing a deposit in equilibrium is: $\psi(x_t) \equiv \phi(x_t) - x_t\phi'(x_t)$.[2]

The equilibrium liquidity cost function $\phi(x)$ has the following properties. First, it is non-negative, and it will reach zero when banks become narrow ($x \to 1$). Second, as more of the banks' deposits are backed by liquid reserves, the cost falls, so $\phi'(x) \leq 0$, and this marginal benefit approaches zero again as $x \to 1$ and the bank becomes satiated in its demand for liquidity. Third, there are diminishing marginal benefits to liquidity, so the marginal benefit of an extra reserve shrinks as reserves accumulate: $\phi''(x) \geq 0$.

2.5 The government

The government issues domestic bonds B_t^g in units of the domestic currency, and supplies offshore reserves M_t in units of the offshore currency. It invests in foreign bonds $B_t^\$$ in units of foreign currency. The government's period-t flow budget constraint in domestic currency units is:

$$E_t^\$ R^\$ B_{t-1}^\$ + B_t^g + E_t M_t + E_t \phi(x_t) D_t = E_t^\$ B_t^\$ + R_{t-1} B_{t-1}^g + E_t R_{t-1}^m M_{t-1} + T_t \,. \tag{13}$$

[2]Note that $\phi'(x)$ is not the total derivative of $\phi(x)$; Appendix E elaborates on the difference.

On the left-hand side are the sources of funds: returns on investing abroad plus borrowing plus money plus the liquidity costs. On the right-hand side are its uses: investment abroad, payment of interest on bonds and money, and lump-sum transfers.

Every period, the government chooses: the rate at which to remunerate offshore narrow money R_t^m, the quantity of that money M_t, the amount of foreign reserves $B_t^{\$}$, the domestic public debt B_t^g, and transfers T_t. We make two assumptions on these choices.

The first is on the fiscal rule through which the government stays solvent. We assume the government keeps public debt rising at a constant gross rate $g = B_t^g / B_{t-1}^g$. Since the economy satisfies the conditions for Ricardian equivalence, other rules would lead to identical outcomes. Because we will focus on balanced growth paths, this keeps the debt on such a path as well.

Equation (13) then implies that transfers are given by:

$$T_t = E_t \left(M_t - R_{t-1}^m M_{t-1} \right) + E_t \phi(x_t) D_t + E_t^{\$} \left(R^{\$} B_{t-1}^{\$} - B_t^{\$} \right) - \left(R_{t-1} - g \right) B_{t-1}^g . \tag{14}$$

The government transfers to the households: (i) the increase in the supply of offshore narrow money after interest paid, plus (ii) the liquidity costs collected from banks, plus (iii) the gains on its foreign reserves, minus (iv) the net interest paid on the growing public debt. These are the four terms on the right-hand side, respectively.

The second assumption concerns the offshore exchange rate. Consistent with this being a parallel currency, we assume that the government aims for a peg:

$$E_t = 1 , \tag{15}$$

at all dates. Since the physical separation of offshore and onshore is typically weak, any prolonged deviation from parity would invite attempts to circumvent the capital controls in the financial system. Eventually, if the deviation were too large, a version of Gresham's law would apply, with the overvalued money driving the undervalued one out of circulation. Instead of specifying an arbitrary upper and lower bound for the exchange rate, we simply set it to one.

The government achieves this peg by varying the interest paid on reserves. From the demand for reserves by banks in equation (11), this requires setting interest rates according to the following rule:

$$R_t^m = R_t (1 + \phi'(x_t)) , \tag{16}$$

for any observed path of R_t and x_t.

2.6 Market clearing

The market clearing conditions in the financial markets for money, deposits, and domestic bonds, respectively, are:

$$M_t = m_t \,, \tag{17}$$

$$D_t = d_t^h + d_t^f \,, \tag{18}$$

$$B_t^g = b_t^h + b_t^b \,. \tag{19}$$

For goods markets, we already noted that for the non-tradable good: $y_{NT,t} = c_{NT,t}$. For the tradable good, combining the household and government budget constraints, the household intra-temporal condition, the bond market clearing condition, and the peg policy $E_t = 1$—equations (2), (13), (6), and (19)—gives the balance of payments identity:

$$E_t^\$ y_{T,t} - \iota y_{NT,t} = E_t^\$ \left(B_t^\$ - R^\$ B_{t-1}^\$ \right) - \left(d_t^f - R_{t-1}^d d_{t-1}^f \right) \,. \tag{20}$$

On the left-hand side is the trade balance, which is the difference between the endowment of the tradable good and its consumption by the household. On the right-hand side is the change in the country's net foreign assets minus the net investment income. The latter includes the government's foreign reserves and the foreigners' offshore deposits.

The no-Ponzi condition on the public debt is automatically satisfied as long as g is not too large. The no-Ponzi condition on the households (or the nation) is:

$$\lim_{T \to \infty} \left(\prod_{s=0}^{T-1} \left(R_s^d \right)^{-1} \right) d_T^f = 0 \,, \tag{21}$$

since the foreign investors will not allow their claims on the banks to be rolled over forever.

2.7 Equilibrium

The exogenous endowments pin down the domestic interest rate R_t given the households' Euler equation (4). The policy for the interest rate on money R_t^m in equation (16) pins down $E_t = 1$ given the banks' demand for narrow money. The banks' optimality condition with respect to deposits in equation (12) then becomes $R_t^d = R_t(1 - \psi(x_t))$. Domestic deposits are $d_t^h / y_{NT,t} = (\mu / \psi(x_t))^{\varepsilon_h}$ from equation (5).

Combining the previous equations, an equilibrium for the sequences of the money-deposit ratio, foreign deposits, and the exchange rate $\{x_t, d_t^f, E_t^\$\}_{t\geq 0}$, as a function of the exogenous preference path for $\{\gamma_t\}_{t\geq 0}$, the path for $\{R_t\}_{t\geq 0}$ pinned down by the exogenous endowments $\{y_{NT,t}, y_{T,t}\}_{t\geq 0}$ according to equation (4), and the exogenous policy paths $\{M_t, B_t^\$\}_{t\geq 0}$ solves the system of four equations:

$$E_t^\$ y_{T,t} - \iota y_{NT,t} = E_t^\$ \left(B_t^\$ - R^\$ B_{t-1}^\$\right) - \left(d_t^f - R_{t-1}(1-\psi(x_{t-1}))d_{t-1}^f\right), \tag{22}$$

$$\frac{d_t^f}{Y_t} = \frac{\gamma_t}{Y_t}\left\{\frac{R^\$ E_{t+1}^\$}{R^\$(E_{t+1}^\$/E_t^\$) - R_t[1-\psi(x_t)]}\right\}^{\varepsilon_f}, \tag{23}$$

$$d_t^f = \frac{M_t}{x_t} - y_{NT,t}\left[\frac{\mu}{\psi(x_t)}\right]^{\varepsilon_h}, \tag{24}$$

$$Y_t = y_{NT,t} + E_t^\$ y_{T,t}\,. \tag{25}$$

There are three boundary conditions: the initial values for d_{-1}^f and $B_{-1}^\$$ and

$$R_{-1}(1-\psi(x_{-1}))d_{-1}^f = \sum_{t=0}^{\infty}\left(\prod_{s=0}^{t-1}[R_s(1-\psi(x_s))]^{-1}\right)\times \left[E_t^\$ y_{T,t} - \iota y_{NT,t} - E_t^\$\left(B_t^\$ - R^\$ B_{t-1}^\$\right)\right], \tag{26}$$

which comes from iterating forward the balance of payments condition and imposing the no-Ponzi condition.

Given a solution to this system, all the other variables in the model follow. Of particular importance to this paper, the fiscal transfers in equation (14) become:

$$T_t = \left(M_t - R_{t-1}(1+\phi'(x_{t-1}))M_{t-1}\right) + \frac{\phi(x_t)M_t}{x_t} + E_t^\$\left(R^\$ B_{t-1}^\$ - B_t^\$\right) - \left(R_{t-1} - g\right)B_{t-1}^g\,. \tag{27}$$

The four terms are: (i) seigniorage from printing base money, (ii) revenue extracted from banks by operating lending facilities at a penalty rate, (iii) net cash flow from net foreign assets, and (iv) interest expense for servicing the debt.

2.8 Balanced growth path

We restrict our analysis to a balanced growth path of the economy, where the exogenous paths for tradable output, non-tradable output, supply of money, foreign reserves, and public debt all grow at the same constant rate g. So that foreign deposits also grow at this rate, and stay constant as a ratio of GDP, we assume that the exogenous $\gamma_t = \gamma_0 g^t$. Appendix A proves the following result.

Proposition 1. *If the gross growth rates of $\{y_{NT,t}, y_{T,t}, \gamma_t, M_t, B_t^{\$}, B_t\}$ are all the same g, then they are equal to the growth rate of nominal GDP: $Y_{t+1}/Y_t = g$. Fiscal transfers, domestic deposits, and foreign deposits are all a constant fraction of GDP, while the money-deposit ratio x_t and $E_t^{\$}$ are constant as well.*

The solution of the model comes from solving the system of four equations:

$$1 - \frac{(1+\iota)y_{NT}}{Y} = \left(1 - \frac{R^{\$}}{g}\right)\frac{E^{\$}B^{\$}}{Y} + \left(\frac{1-\psi(x)}{\beta} - 1\right)\frac{d^f}{Y}, \tag{28}$$

$$\frac{d^f}{Y} = \frac{\gamma}{Y}\left[\frac{R^{\$}E^{\$}}{R^{\$} - \frac{g(1-\psi(x))}{\beta}}\right]^{\varepsilon_f}, \tag{29}$$

$$\frac{d^f}{Y} = \frac{M}{Yx} - \left(\frac{y_{NT}}{Y}\right)\left(\frac{\mu}{\psi(x)}\right)^{\varepsilon_h}, \tag{30}$$

$$1 = \frac{y_{NT}}{Y} + \frac{E^{\$}y_T}{Y}, \tag{31}$$

for the unknown values of $E^{\$}, x, d^f/Y, Y$, taking as given exogenous values of y_{NT}/Y, y_T/Y, γ/Y, $B^{\$}/Y$, M/Y, and μ, and subject to the conditions $\max\{0, 1-\beta R^{\$}/g\} < \psi(x) < 1-\beta$ *for there to be an interior solution with positive deposits.*

This set of equations reveals the key force that allows policy to control the level of the exchange rate in the model. When policymakers issue more offshore money (M rises), this leads banks to create more deposits. Some of them are held by foreigners. From the balance of payments condition, the domestic exchange rate must depreciate ($E^{\$}$ rises) to restore equilibrium, unless the policymaker sterilizes that increase in foreign deposits by raising its foreign reserves $B_t^{\$}$. Because deposits do not rise in proportion to the money supply, the money-deposit ratio x will change, and this brings second-round effects that amplify the initial shock.

As long as offshore deposits are scarce, they pay a return below both the domestic and the foreign returns. This creates a wedge in the arbitrage conditions that connect returns. Because the central bank controls the scarcity of narrow money (reserves), it can keep broad money (deposits) scarce, and so control this wedge. Mathematically, this wedge is not zero as long as the cost $\psi(.) > 0$ and the demand factors $\mu, \gamma > 0$. This wedge leads to liquidity premia appearing in the uncovered interest parity condition that determines the exchange rate. Since policy controls the amount of liquidity in the system, it can drive these premia and affect the exchange rate.

3 The size of fiscal revenues

This section characterizes the size of the fiscal revenues from an offshore currency before the next section discusses how they vary with the supply of offshore money.

3.1 The four components of transfers

The government budget constraint in the balanced growth path reduces to the following expression (see Appendix B):

Lemma 1. *Fiscal transfers over GDP in a balanced growth path equilibrium are:*

$$\frac{T}{Y} = \underbrace{-\left(\frac{\phi'(x)}{\beta}\right)\frac{M}{Y}}_{\textit{seigniorage}} + \underbrace{\phi(x)\frac{D}{Y}}_{\textit{liquidity}} + \underbrace{\left(\frac{R^{\$}}{g} - 1\right)\frac{E^{\$}B^{\$}}{Y}}_{\textit{investment income}} - \underbrace{\left(\frac{1}{\beta} - 1\right)\frac{B^{g} + M}{Y}}_{\textit{public debt}}. \tag{32}$$

The first term on the right-hand side is the flow seigniorage revenue from providing narrow offshore money M to the banks. This is a fiscal revenue arising from the monopoly power to issue narrow money.

The second term is the revenue from operating the lending facility to those banks. This equals the liquidity costs that the banks incur by issuing deposits. It is a revenue from providing liquidity, but in this case in the form of broad money.

The third term is the revenue that the country earns on its foreign investment. In this model, only the government can invest abroad, so all of the net investment income of the country appears as fiscal revenue. This term is positive when the foreign return exceeds the growth rate of reserves in foreign-currency units: $R^{\$} > g$.

The fourth and final term is the one usually associated with Ricardian equivalence. When the government increases the size of the total public liabilities—public debt B^{g} plus money M—this is offset by lower transfers T to agents. Private wealth is unchanged and so are agents' choices from this channel.

3.2 The fiscal offshore revenues

The size of the third term in Lemma 1 is pinned down by an assumption we made: zero private savings abroad. If we had made the more realistic assumption that there is a fixed quota of investment that private domestic agents can place abroad, the equilibrium would be unchanged. The efficacy of the offshore currency regime would be the same, but the fiscal revenues would net that amount from $B^{\$}$. Therefore, by changing the investment quota, one could make the fiscal revenues associated with investment income arbitrarily high or low.

A similar argument applies to the fourth term. In our model, government bonds are the only vehicle for onshore savings by households, whereas in reality there will be private stores of value and production opportunities. By changing the average stock of onshore public debt B^g, and how it may change when the offshore money supply M changes, we could raise or lower the size of this fourth term at will. And yet, by Ricardian equivalence, the size of the total public debt is irrelevant for equilibrium.

Moreover, these two fiscal revenues are not intrinsically related to the offshore currency regime or to the manipulation of the exchange rate. Even if the capital controls and offshore market were abolished, or if the demand for offshore narrow money by banks were fully satiated so that policy could no longer affect the exchange rate, these two terms would still be there.

From now on, we therefore focus on the *fiscal offshore revenues* associated with the offshore currency alone.

Definition 1. *The fiscal offshore revenues as a share of GDP that are associated with scarce offshore money are:*

$$F(M) \equiv -\left(\frac{\phi'(M/D)}{\beta}\right)\left(\frac{M}{Y}\right) + \phi(M/D)\left(\frac{D}{Y}\right), \tag{33}$$

which is the sum of seigniorage revenues and liquidity-provision revenues.

Note that banks pay both sources of revenue to the government, since banks both hold reserves and bear the liquidity costs. However, banks are competitive and earn zero profits. Therefore, they pass these costs on to their depositors through the rate they pay on deposits. We can split the incidence of these revenues between domestic and foreign agents by using the shares of deposits held by each, d^h/D and d^f/D, which sum to one.

3.3 Tobin taxes and fiscal revenues

Define the wedge τ as:

$$\tau \equiv 1 + \frac{\psi(x)}{1-\psi(x)}\,. \tag{34}$$

Bahaj and Reis (2024) started with a simpler model of an offshore currency. That paper only had two periods and it assumed an infinitely elastic demand for offshore currency by foreigners. It then replaced the capital controls and the offshore currency instead with a financial transaction (Tobin) tax: purchases of foreign bonds by households would have to pay tax at a gross rate τ. The paper showed that the equilibrium exchange rate of this economy under the tax was the same as under an offshore currency, as long as the tax rate was equal to the wedge defined above.

Intuitively, a Tobin tax introduces a wedge between investing in the domestic economy or abroad. Likewise, a scarce offshore currency introduces such a wedge, through two sub-wedges. The first arises because foreign investors can only earn the offshore deposit rate. The second comes from offshore banks incurring the liquidity cost $\psi(x)$ when they supply those deposits to invest domestically. Both the Tobin tax and the offshore-money wedges can be manipulated by policy to achieve a target exchange rate, in one case through fixing the tax rate, and in the other by controlling the supply of money.

Appendix C proves the following:

Lemma 2. *For a discount factor near one $\beta \approx 1$, and a net wedge near zero $\tau - 1 \approx 0$, the fiscal offshore revenues are:*

$$F(M) \approx (\tau - 1)\left(\frac{D}{Y}\right)\,. \tag{35}$$

Interpreting the net wedge as a tax rate and deposits as a tax base, the fiscal offshore revenues are simply the product of the two. The fiscal revenues will be zero if there is either no demand for broad offshore money ($D = 0$), or the marginal cost of supplying it is zero in equilibrium ($\psi(x) = 0$ so $\tau = 1$).

A Tobin tax typically applies to all financial transactions, whereas the implicit tax in the revenues from an offshore currency applies only to the stock of that offshore currency. The fiscal footprint of the offshore currency will therefore tend to be smaller.

3.4 Quantifying fiscal revenues

Lemma 2 provides a simple formula to calculate the size of those revenues.

The Bank for International Settlements (BIS) locational banking statistics have data on cross-border deposits (excluding those held within the financial system) for the EUR, the GBP, the JPY, and the CHF. We divide them by the output of the issuing country or currency area to get D/Y. They are 0.167 for the EUR, 0.130 for the GBP, 0.134 for the JPY, and 0.066 for the CHF. Total offshore yuan (CNH) deposits between 2017 and 2024 were on average 0.007 of GDP.

As for τ, in their study of the Chinese offshore-currency regime, Bahaj and Reis (2024) estimate that it led to a net wedge of about 0.3% on average in 2017–2024. Brazil adopted a 2% Tobin tax in 2009, raised to 6% in 2010, although the usual difficulties with implementing it, discussed in the introduction, meant that it raised revenue of only 0.05% of GDP (Reis, 2026).

Taking $\tau = 1.01$ and $D/Y = 15\%$ as a benchmark, an offshore currency will generate revenues approximately equal to 0.15% of GDP. Taking the range of cross-border deposits in the data, the range of revenues would be between 0.07% and 0.17% of GDP, while taking the upper bound of taxes Brazil tried to implement would push fiscal revenues at best to 0.9% of GDP. Focusing on the CNH case, the average offshore fiscal revenues have been 0.002% of GDP.

These are modest amounts. Running an offshore currency for the purposes of capital flow management would barely register in the consolidated government's fiscal budget.

4 The Laffer curve for fiscal offshore revenues

Seigniorage from issuing currency is also usually small, and yet countries often resort to expanding it sharply during fiscal emergencies (Reis, 2019, Kehoe and Nicolini, 2022), partly because it is so easy to print more money, even if hyperinflation ensues. This section discusses how the fiscal offshore revenues vary as the supply of money rises.

4.1 The Laffer curve in theory

Appendix D proves the following result:

Lemma 3. *The elasticity of fiscal offshore revenues with respect to the money supply is given by:*

$$\frac{d\log(F(M))}{d\log(M)} = \left[\eta(x) - \left(\frac{d^h}{D}\right)\varepsilon_h - \left(\frac{d^f}{D}\right)\varepsilon_f\right]\frac{d\log(\tau-1)}{\tau d\log M} + \left[\left(\frac{d^f}{D}\right)\varepsilon_f - \frac{E^\$ y_T}{Y}\right]\frac{d\log E^\$}{d\log M}, \tag{36}$$

where $\eta(x) = d(\log(\psi(x) + (1 - 1/\beta)x\phi'(x)))/d\log(\psi(x)) \approx 1$ *when* $\beta \approx 1$.

The impact of an increase in the money supply on fiscal revenues works through the wedge and the exchange rate, captured by the two terms on the right-hand side of equation (36). Starting with the first term, $d\log(\tau - 1)/d\log M$ measures the equilibrium response of the wedge to the policy instrument. Then, $\eta(x)$ is the elasticity of fiscal revenue per deposit with respect to the liquidity wedge, keeping the deposits fixed. It captures the mechanical increase in revenue collected from each unit of deposits when the wedge rises, and it is approximately one. However, as the wedge rises, deposits fall, and this is what the other terms inside the square brackets capture. The higher is the average elasticity of demand for deposits, the larger this effect, with each elasticity weighted by the relative size of deposits.

One special case is instructive. If the elasticity of money demand is one (agents have log preference for deposits), then the deposit-share-weighted demand elasticity is one, and this first term is approximately zero. Intuitively, with a unit elasticity, as the tax-like wedge rises, the base to which this tax applies shrinks proportionately, and the two effects exactly offset.

The Laffer curve is not completely flat in this case because of the second term on the right-hand side of equation (36). When the money supply rises, the domestic exchange rate depreciates, so $E^\$$ rises. This depreciation makes offshore deposits more attractive to foreigners, so deposits rise by $(d^f/D)\varepsilon_f$. This raises revenues. The depreciation also raises the domestic value of the tradable good, so Y rises, which lowers revenues-per-GDP by lowering deposits per GDP. The size of this effect is given by $E^\$ y_T/Y$ reflecting the weight of tradables on output. Since it works through the denominator of revenues-over-GDP, it does not depend on any elasticity. The second term on the right-hand side of equation (36) is the difference between these two effects and gives the net exchange-rate effect.

4.2 The slope of the Laffer curve

Under the baseline that the elasticity of demand for deposits is one, for both domestic households and foreigners, then the first term in equation (36) is approximately zero. The slope of the Laffer curve is then given solely by the exchange-rate term, whose sign depends on which of two terms inside the brackets is larger.

The first term captures the deposit-share effect. It is the product of the elasticity of deposit demand and the share of deposits held by foreigners. The BIS statistics that we used to target $D/Y = 0.15$ at the steady state also report the share of cross-border deposits not held by domestic residents, which we match to d^f/D. They are 0.46 for the EUR, 0.75 for the GBP, 0.92 for the JPY, and 0.62 for the CHF, so we target $d^f/D = 0.7$. Under a unit elasticity that term is then equal to 0.7. The second term is a tradables-weight effect: $E^\$ y_T/Y$ is the GDP share of tradable goods. The average in the OECD is roughly $1/6$.

Since $0.7 > 1/6$, the deposit-share effect is larger than the tradables-weight effect. Therefore, the exchange rate effect is positive. Printing more offshore money devalues the domestic exchange rate, and this raises revenues because foreigners hold more of the cheaper offshore currency. The Laffer curve slopes up because of this general equilibrium effect.

However, an elasticity of money demand of 1 is too large relative to the evidence. Benati et al. (2021) estimate money demand equations using functional forms that fit into the equations in our model. That paper concludes that the elasticity of money demand is about 0.5. The coefficient on the exchange-rate term in equation (36) falls to $0.35 - 1/6 \approx 0.18$ with this lower elasticity depressing the deposit-share effect.

At the same time, and more important, the first term in equation (36) is no longer zero. Rather, setting $\varepsilon_h = \varepsilon_f = 0.5$, the coefficient in that first term is now positive and approximately equal to 0.5. When the money supply rises, because the scarcity of deposits falls, the liquidity wedge τ falls, so $d\log(\tau - 1)/d\log M$ is negative. Therefore, the first term is negative, and fiscal revenues fall under its influence.

This is an application of a public finance principle: the elasticity of demand drives how much the tax base falls when the tax rate rises. Because the estimated elasticity is lower than 1, printing more money leads to a larger than equiproportionate fall in the opportunity cost of holding deposits. This lowers the revenue the government receives from both the new money and the outstanding stock of previous money. This negative stock effect is larger than the positive flow effect, and the fiscal revenues fall.

Is the negative effect from the first term larger than the positive one from the second term? For that we need to evaluate by how much τ falls and how much $E^\$$ rises after the money supply rises. Knowing these requires numerically solving the model, which we turn to next.

4.3 Calibration

We calibrate the parameters to a representative small open economy. For the real side of consumption and savings, we use standard values in the international macroeconomics literature. For the relative size of the offshore market and the international accounts of the country, we use round benchmarks close to the average values of countries in the data. Finally, for the parameters of the liquidity cost function associated with the offshore currency, we borrow from the Chinese experience with the offshore yuan. Table 1 collects all the parameters, the calibration targets, and the final values at which each parameter was set.

Real side of the economy. We set the net growth rate of the economy to 2%, so $g = 1.02$. We set tradable output to be 20% of non-tradable output by choosing the non-tradable endowment $y_{NT} = 1$ (a normalization) and the tradable endowment $y_T = 0.2$, standard values in the literature.

International accounts. For real returns, we choose $\beta = 0.981$ to hit a gross domestic return on domestic bonds $R = 1.04$, and likewise choose the foreign return to be $R^{\$} = 1.04$. A 4% net return is a relatively standard choice.

More specific to our model are net foreign assets, which are equal to $(E^{\$}B^{\$} - d^f)/Y$. We target a value of 50%, roughly in line with the average among surplus countries in 2023 in the External Wealth of Nations database.[3] We also target $E^{\$} = 1$ to ease the interpretation of how much the exchange rate moves across experiments. Note that with this calibration $E^{\$}y_T/Y = 1/6$.

These targets are achieved jointly by choosing the net foreign assets excluding deposits, $B^{\$}/Y$, to be 60.5% and, more significantly, by $\iota = 0.213$, so the expenditure share on tradables is $\iota/(1+\iota) = 17.6\%$ of GDP. In the OECD value-added tables, the import content of final consumption is estimated to be about 17–20% for the G-7 countries (depending on the year).

The size of the offshore market. As discussed before, using the BIS statistics, we target $D/Y = 0.15$ and $d^f/D = 0.7$. These two moments allow us to pick the domestic and foreign preference parameters for money, μ and γ_0, respectively.[4]

[3] More precisely, the nominal GDP-weighted average NFA position at the end of 2023 was 56% among the 54 economies with a positive NFA position.

[4] The calibration formula is: $\mu(\varepsilon_h) = \psi(x)(d^h/y_{NT})^{1/\varepsilon_h}$ and $\gamma_0(\varepsilon_f) = Y_0\left(\frac{d_0^f}{Y_0}\right)\left(\frac{R^{\$}-R_0^d}{R^{\$}E_0^{\$}}\right)^{\varepsilon_f}$.

Table 1 Calibration

Object	Calibration target (in steady state)	Value
	Panel A. Real side of the economy	
g	Growth rate of the economy	1.02
y_{NT}	Steady-state non-tradable output	1
y_T	Steady-state tradable output	0.2
	Panel B. International accounts	
$R^\$$	Foreign gross return	1.04
β	Achieve domestic returns $R = R^\$$	0.981
$B^\$/Y$	Achieve exchange rate $E^\$ = 1$	0.605
ι	Achieve net foreign assets $(E^\$ B^\$ - d^f)/Y = 0.5$	0.213
	Panel C. Size of offshore money market	
ε_h	Estimate by Benati et al. (2021)	0.5
ε_f	Estimate by Benati et al. (2021)	0.5
μ	Achieve deposits-to-output ratio $D/Y = 0.15$	2.89×10^{-5}
γ_0	Achieve foreign deposit share $d^f/D = 0.7$	0.013
	Panel D. Chinese offshore parameters	
M	Achieve money-deposit ratio $x = 0.27$	0.049
λ_1, λ_3	Fit liquidity cost function	$7.251, 10.493$
λ_2, λ_4	Achieve Tobin tax wedge $\tau = 1.01$	$1.236, 0.0192$

Note: (i) Since we normalize $y_{NT} = 1$, all level values are in non-tradable units. (ii) The targets for panel C come from the BIS locational statistics, while the targets for panel D come from Bahaj and Reis (2024)'s analysis of the offshore yuan (CNH). (iii) The scaling factor for λ_2, λ_4 relative to the fit to the CNH market is 0.650.

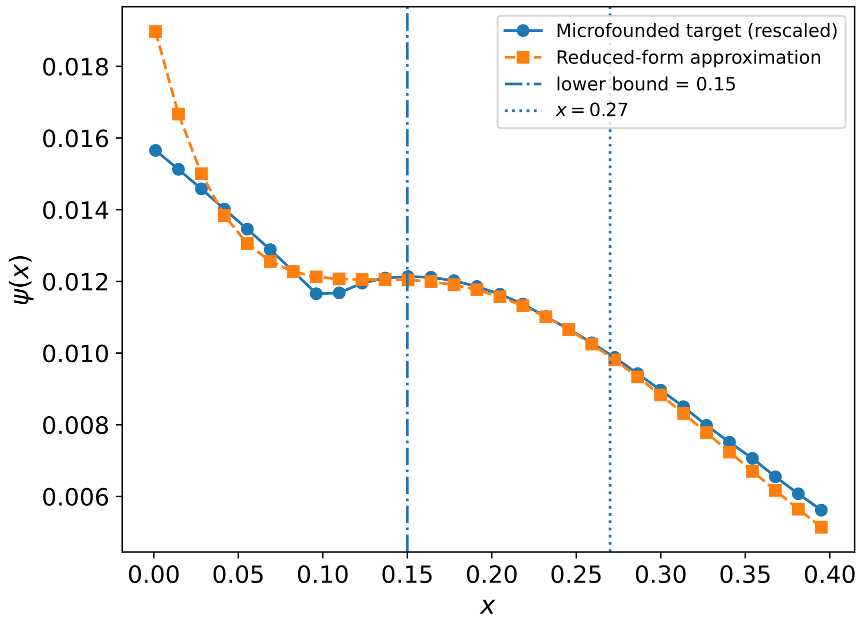
The liquidity cost function. For the parameters that refer to the offshore market more specifically, we use the Chinese experience where this worked successfully: the offshore yuan. First, we choose the value of M to target the average CNH money-deposit ratio, $x = 0.27$.

Second, we parameterize the marginal and total liquidity cost functions as:

$$\tilde{\phi}'(x) = -\lambda_2 \, x \, (1-x)^{\lambda_1} \qquad \text{and} \qquad \tilde{\phi}(x) = \lambda_4 (1-x)^{\lambda_3}, \tag{37}$$

for four fixed parameters $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$. Note that in the equilibrium solution of the model, the relevant objects are $\phi'(x)$ and $\psi(x)$. The parameterization above implies that $\tilde{\psi}(x) \equiv \tilde{\phi}(x) - x\tilde{\phi}'(x) = \lambda_4(1-x)^{\lambda_3} + \lambda_2 x^2 (1-x)^{\lambda_1}$.

Figure 1 The calibrated $\tilde{\psi}(x)$ function against the target function



Note: Both curves are rescaled so that $\psi(0.27) = 0.0099$ to match $\tau - 1 = 1\%$.

To choose the four λ's, we use the microfounded liquidity cost function in Bahaj and Reis (2024) calibrated to the data on the interbank CNH market in Hong Kong. Fitting the two functions above to that microfounded function, we estimate the λ's by nonlinear least squares in the range $x \in [0.15, 0.4]$. We choose this range because the CNH $\psi(x)$ function has a peak at 0.15, and in the CNH data, the average money-deposit ratio is 0.27. Figure 1 plots $\tilde{\psi}(x)$ against the targeted microfounded function.[5]

Scaling and fiscal benchmark. Finally, we scale down the two liquidity cost parameters λ_2 and λ_4 so that, using the formula in equation (34), the resulting net tax wedge is 1%. This allows us to compare our results on revenues as a share of GDP to the 0.15% baseline from Section 3.

The resulting return on deposits is $R^d = R(1 - \tilde{\psi}(0.27)) = 1.030$, so the costs of liquidity pass through to a rate paid to depositors that is 1 percentage point lower. In turn, the resulting interest on reserves at the central bank is $R^m = 1.0046$. Therefore, the net interest paid on offshore reserves is close to the norm of not remunerating reserves in scarce money regimes.

[5] Appendix E provides more details and displays the approximate functions of $\tilde{\phi}(x)$ and $\tilde{\phi}'(x)$ as well.

4.4 Numerically mapping the Laffer curve

Lemma 2 predicted $F(M) \approx 0.15\%$, and the solution of the model confirms this is accurate. With the full model, we can compare this to other numbers. The net investment income of the country (the third term in the equation in Lemma 1) is 1.19% of GDP, almost eight times larger than the fiscal revenue. The income the country earns from having an offshore currency is modest.

Figure 2(a) shows how changing the supply of offshore money M changes the exchange rate $E^{\$}$ together with the equilibrium foreign deposits d^f. After an increase in the stock of money, foreign deposits rise, since the current account of the country barely changes and foreign reserves have not changed. The currency then must depreciate to keep the balance of payments in equilibrium. Quantitatively, the effect is small: raising M from 4% of GDP to 6% depreciates the currency by 0.29%.

The top horizontal axis in Figure 2(b) shows the implicit tax wedge defined in equation (34). It falls as the supply of offshore money increases and so the premia associated with its scarcity fall. Quantitatively, the change in the wedge is significant: raising M from 4% of GDP to 6% lowers the wedge by 0.28 percentage points.

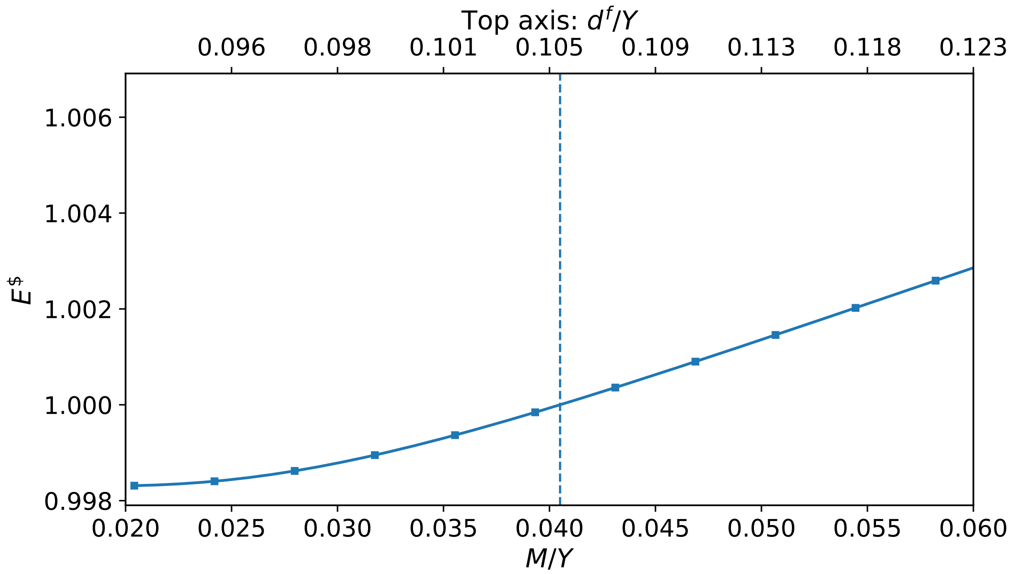
Combining the two effects, on the exchange rate and on the wedge, Figure 2(b) shows what happens to the fiscal offshore revenues $F(M)$. They fall as M rises. The calibrated economy lies on the downward-sloping portion of the Laffer curve for fiscal offshore revenues. As the supply of narrow money (reserves) expands, the equilibrium amount of broad money (deposits) expands by proportionately less than the wedge falls. Therefore, the first term in the equation in Lemma 3 is significantly negative, more than offsetting the positive second term.

Raising M/Y by two percentage points lowers fiscal revenues by approximately 0.02 percentage points. Cutting it has a smaller effect, since the Laffer curve is concave: lower money supply by two percentage points only raises revenues by approximately 0.015 percentage points.

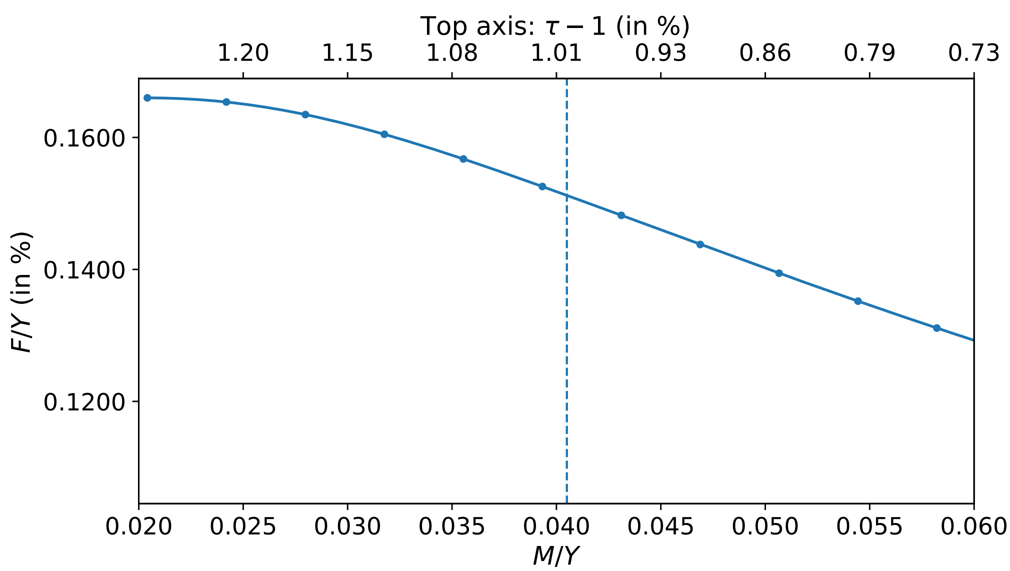
Either way, the change in total revenues is quite small. Any fluctuations in fiscal offshore revenues could be easily absorbed into the central bank's other accounts, without requiring any explicit fiscal transfer from the government. This part of the IPF is therefore unlikely to be turned into a tool for financial repression.

Figure 2 Varying the supply of offshore money

(a) The exchange rate and foreign deposits



(b) Fiscal offshore revenues and the tax wedge



Note: the vertical dashed line marks the baseline calibration of Table 1 ($M/Y = 4.1\%, x = 0.27$). The top axis of panel (a) reports deposits by foreigners as a share of GDP (d^f/Y) as M/Y changes; the top axis of panel (b) reports the implied net wedge $\tau - 1$. The vertical axes show the exchange rate ($E^{\$}$) and the fiscal offshore revenues as a share of GDP, $F(M)$, respectively.

4.5 Decomposing the fiscal flows

The two terms in the definition $F(M)$ in equation (33) may have separate Laffer curves. Starting from the steady-state money-deposit ratio, changes in the narrow money supply (reserves) will affect by how much banks change the broad money supply (deposits). Lemma 3 and the discussion that followed showed the importance of the elasticity of the demand for deposits for total revenues. The elasticity of the liquidity cost function in turn drives how these revenues are split between seigniorage and liquidity.

Figure 3 shows the decomposition of $F(M)$ into its seigniorage and liquidity terms. Starting with the total for the fiscal offshore revenues in the top line, reading down the dashed vertical line, we can see the weight of the different components.

With our parameter values, liquidity provision accounts for only about 7% of the fiscal revenues, while seigniorage generates the rest. Moving along the horizontal axis, the calibrated economy is on the downward-sloping segment of the Laffer curve for both types of revenue. However, there is a peak in the Laffer curve for seigniorage. Cutting M/Y below 3.5% lowers seigniorage revenues but raises liquidity revenues so sharply that total revenues rise. In this scarce range, banks face larger liquidity costs, and so these make up a higher share of the offshore fiscal revenues, relative to seigniorage. Therefore, seigniorage dominates at the calibrated values, but far to the left of them it is the slope of the liquidity-revenues Laffer curve that drives the total revenues.

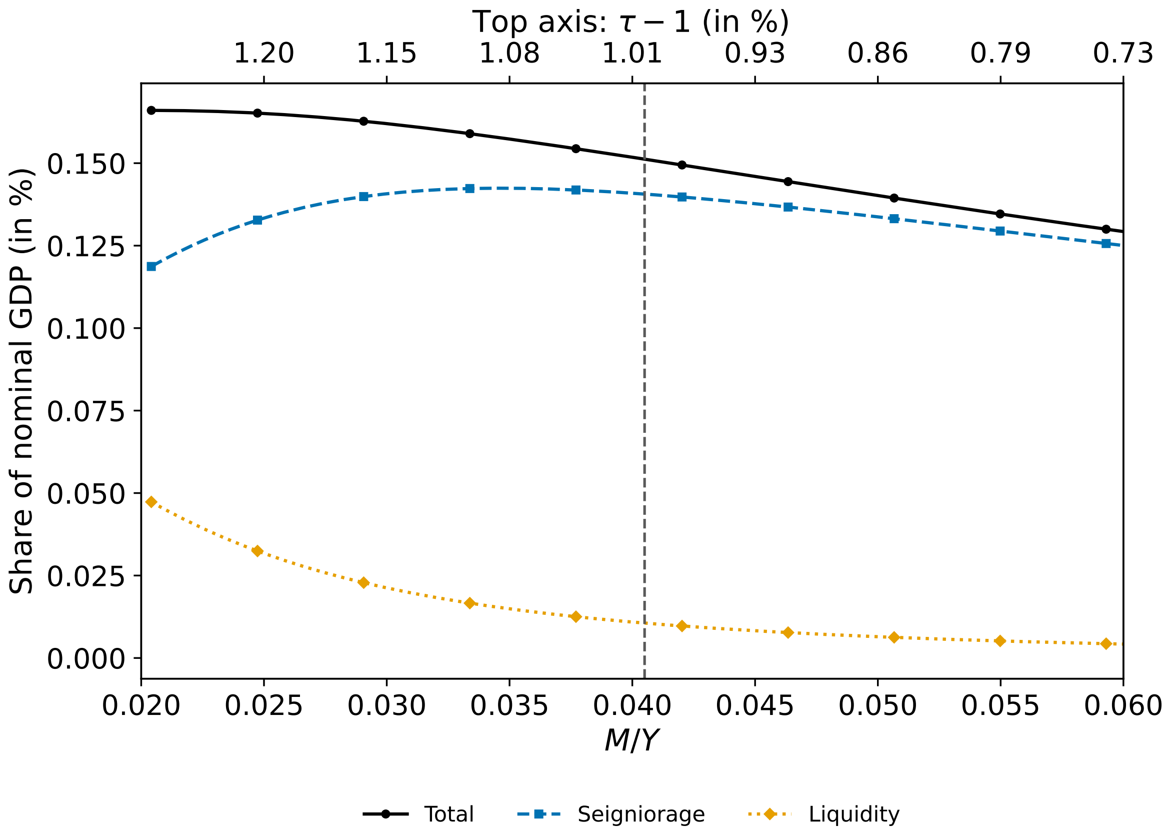
4.6 Differing elasticities of deposit demand

At our baseline calibration ($d^f/D = 0.7$), foreign investors bear 70% of these fiscal revenues, and domestic households the remaining 30%. Since we assumed they have the same elasticity of demand for deposits, their demand for deposits reacts proportionately to the change in the deposit rate R^d that is induced by a change in M. The foreign share of deposits is roughly unaffected by the supply of M, so the split between foreign and domestic depositors stays the same as M varies between 2% and 6%.

We do not have deposit-level data on the nationality of offshore holders that would let us estimate separate elasticities for the two types of depositors, and the literature does not provide estimates we can use. Figure 4 investigates the difference that this would make by raising ε_f from 0.5 to 10.

With that higher elasticity, the Laffer curve now slopes upward, driven entirely by the deposits of foreigners. Back to Lemma 3, with $\varepsilon_f = 10$, the coefficient in the first term is

Figure 3 Seigniorage and liquidity revenues as the supply of offshore money varies

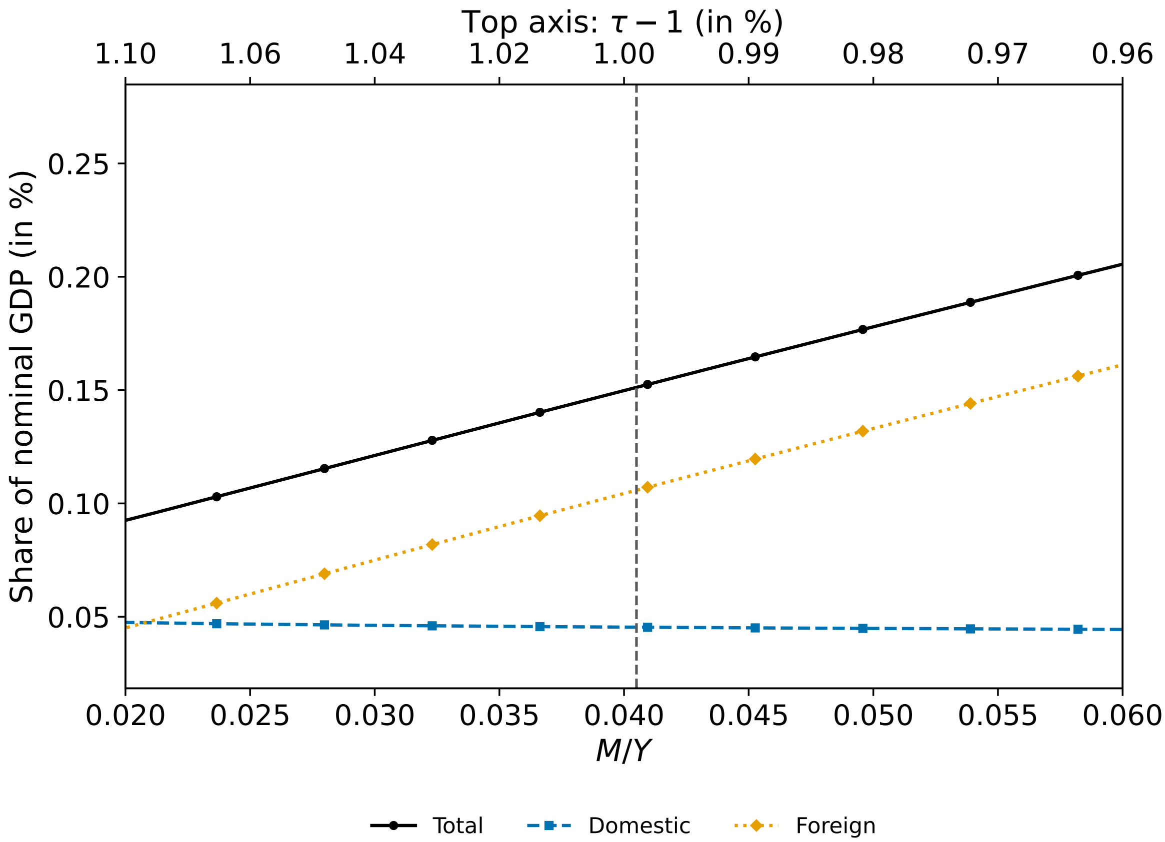


Note: the vertical dashed line marks the baseline calibration of Table 1 ($M/Y = 4.1\%$, $x = 0.27$). The top axis reports the implied net wedge $\tau - 1$ as M/Y changes.

now negative. Therefore, the fall in the wedge caused by the increase in the money supply now raises fiscal offshore revenues.

At the same time, as the top axis in the figure shows, with such a large elasticity, even large changes in the money supply now have only a small impact on the wedge. Therefore, reading the vertical axis in the figure, the impact on the revenues is larger but still limited to an extra 0.05% of GDP from raising the money supply by 50%. The conclusion remains that the slope of the Laffer curve is not quantitatively large enough, even in this extreme case, to generate large fiscal revenues that could tempt authorities to exert fiscal dominance over this policy.

Figure 4 Fiscal offshore revenues with more elastic foreign demand for deposits



Note: the vertical dashed line marks the baseline calibration of Table 1 ($M/Y = 4.1\%, x = 0.27$) but now $\varepsilon_f = 10$. The top axis reports the implied net wedge $\tau - 1$ as M/Y changes.

5 Alternative policies

This section investigates alternative policies to expanding the offshore money supply and letting the currency depreciate. The first of these is to sterilize the higher money supply to keep the exchange rate fixed. The second is to tighten liquidity regulations so that banks create less inside money (deposits), rather than to contract outside money (reserves). The third policy experiment asks whether the fiscal offshore revenues change significantly if the offshore currency increases its size as an international means of payment. In the end, our quantitative lessons that fiscal offshore revenues are small and the Laffer curve is flat are robust across these policy regimes, but along the way there are many differences that highlight the properties of the model.

5.1 Fixing the exchange rate

In Section 4, as policy raised offshore money M across counterfactuals, we kept foreign reserves $B^{\$}$ fixed. Therefore, the exchange rate $E^{\$}$ depreciated, and this gave rise to the second term in the Laffer curve in Lemma 3.

Now, we consider the case where policy raises $B^{\$}$ at the same time as M to keep the exchange rate $E^{\$}$ unchanged. Economically, this amounts to a sterilization of the increase in offshore money to peg the exchange rate. Since the balance of payments pins down net foreign assets as a function of the current account, this increase in foreign reserves is matched by an increase in foreign deposits.

Mathematically, Proposition 1 changes to take $E^{\$}$ as exogenous and solve for $B^{\$}$ endogenously in the system of equations defining an equilibrium. Relative to the previous case, the second term in Lemma 3 is now zero, so only the effect of the wedge remains.

Figure 5 shows the result of changing the supply of offshore money when policy responds to it by buying more foreign assets, starting from the same vertical line as in Figure 3. The two figures are similar, confirming our previous conclusion that the first term in Lemma 3 dominates the overall effect. The quantitative difference between the two policies on fiscal revenues is small.[6]

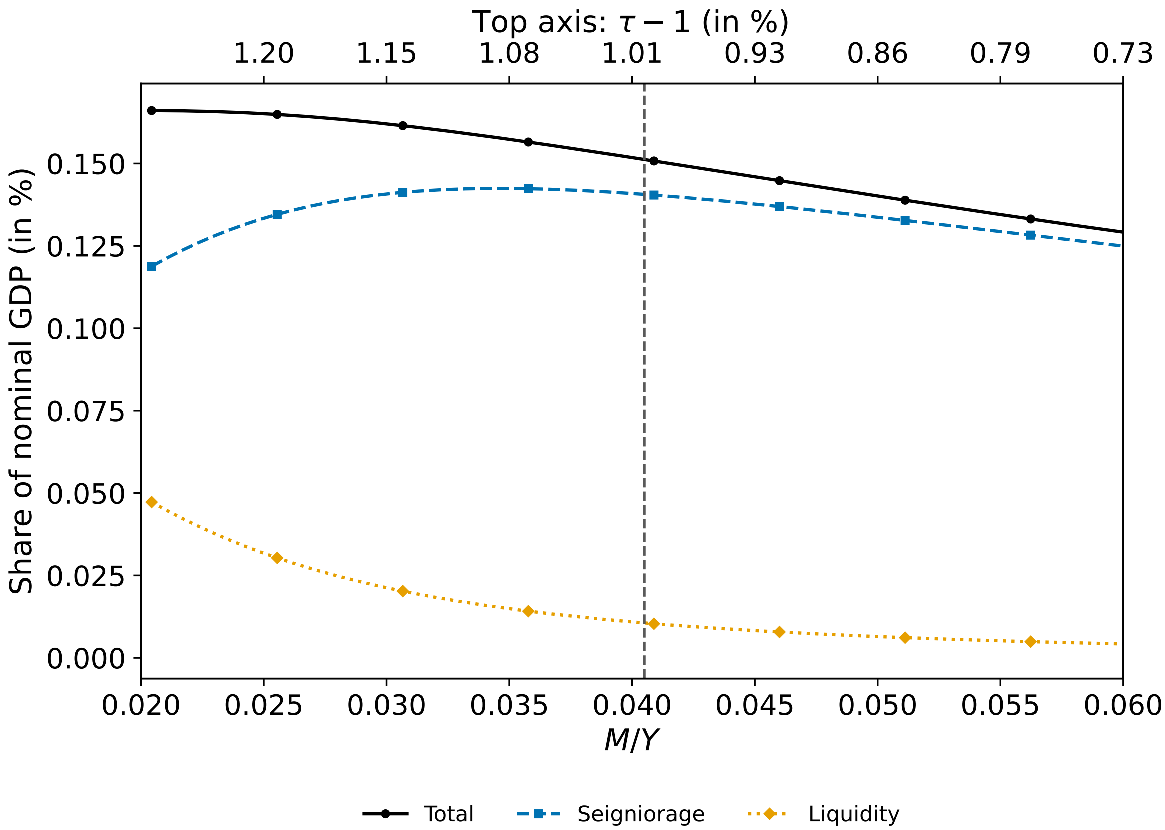
5.2 Liquidity policies

Bahaj and Reis (2024) discuss how liquidity policies—such as reserve requirements for banks, the interest rate charged on the discount window, or controls on the flow of liquidity between offshore and onshore wings of a bank—will shift the liquidity cost function. These policies can be as effective as changes in the supply of money to control the exchange rate. They work by changing the demand for money by banks, as opposed to its supply by the central bank. Bahaj and Reis (2024) find that in the Chinese experience with its offshore currency, these liquidity policies played a larger role than policies affecting money supply in managing the exchange rate.

To trace their fiscal implications, we run a different experiment with results in Figure 6. We proportionately raise the two scale parameters in the total and marginal liquidity cost functions (λ_2, λ_4), while keeping the parameters determining the shape of those functions

[6] Back to Lemma 1, sterilization, by raising foreign reserves, raises the foreign investment income. Given our calibration, doubling M from 4% to 8% would raise this revenue by 0.1 percentage points of GDP, under the extreme assumption that the private sector is unable to offset any of the increase in net foreign assets that results from the sterilization.

Figure 5 Fiscal offshore revenues and the tax wedge with a fixed exchange rate



Note: the vertical dashed line marks the baseline calibration of Table 1 ($M/Y = 4.1\%, x = 0.27$). The top axis reports the implied net wedge $\tau - 1$ as M/Y changes.

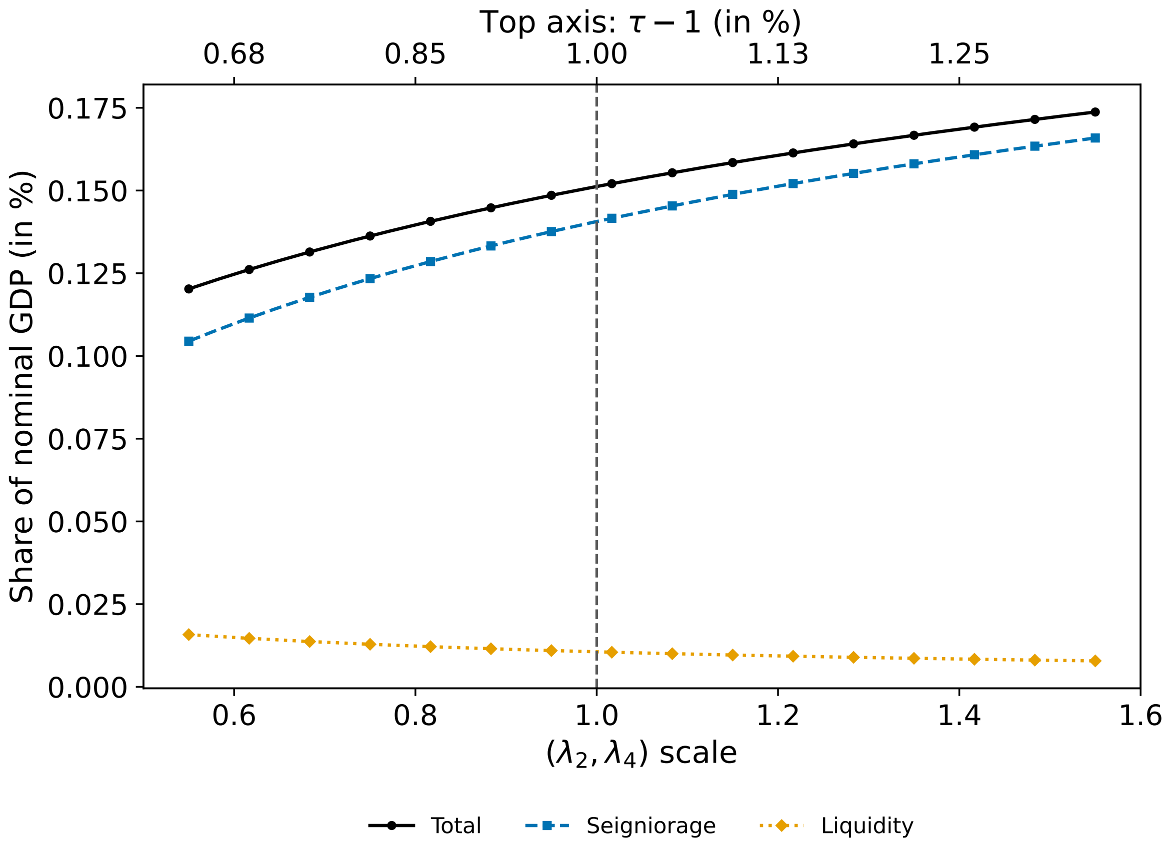
(λ_1, λ_3) the same.

There are two important differences in the impact of liquidity versus monetary policies. First, since the former raises the demand for money by banks, while the latter raises its supply, they have the opposite effect on the tax wedge. The top horizontal axis in Figure 6 shows that the wedge now rises as we move to the right. Therefore, the first term in Lemma 3 is now positive.

Second, as we scale the liquidity function up, then the exchange rate changes, just as it did when we varied the money supply instead. But now, as the cost of liquidity rises, the demand for offshore money rises, which appreciates the exchange rate ($E^{\$}$ falls). The exchange rate instead depreciated when policy raised the money supply. Therefore, the second term in Lemma 3 is now negative.

While the two terms driving the slope of the Laffer curve flip signs, their relative

Figure 6 Varying liquidity policies instead of the money supply



Note: the vertical dashed line marks the baseline calibration of Table 1 ($M/Y = 4.1\%$, $x = 0.27$). The top axis reports the implied net wedge $\tau - 1$ as (λ_2, λ_4) changes.

importance does not. The impact on the wedge continues to dominate, so that now the Laffer curve for total revenues in Figure 6 slopes upward. As before, the effect is quantitatively small. Our conclusion that an offshore currency system has a small fiscal footprint is robust whether it is implemented through the money supply or through liquidity policies.

However, the liquidity component of this revenue behaves differently from Figure 3, and in the direction that we would expect. The rise in the demand for money raises the money-deposit ratio. This lowers liquidity costs, just as it did when policy expanded the money supply. But now, the liquidity cost per unit of the money-deposit ratio has increased. The two effects make the slope of the liquidity curve flatter than it was before.

Moreover, this experiment tilts revenues toward seigniorage and away from liquidity costs. This happens because when we raise liquidity costs, banks wish to hold more reserves against their deposits. Therefore, the seigniorage revenue increases. This offsets the fall in the liquidity revenue that arises because banks issue fewer deposits.

5.3 Impact of internationalizing the currency

Starting from the baseline calibration, we change the parameters determining the demand for money μ and γ_0. We raise both of them so that the demand for offshore deposits doubles, while the share of those deposits held by foreigners d^f/D stays unchanged at 70%. We think of this experiment as capturing what would happen if the offshore currency became more widely used in transactions. This is especially relevant in the Chinese experience, given the policy goal of increasing the usage of the offshore yuan internationally.

Figure 7 shows the new size of the fiscal offshore revenues and the breakdown between seigniorage and liquidity. Series (a) in Figure 7 shows what happens when the offshore money supply M is kept fixed, while series (b) shows the case where policy accommodates the increase in money demand by raising the money supply M so that the money-deposit ratio x stays the same and the realized deposit-output ratio (D/Y) exactly doubles.[7]

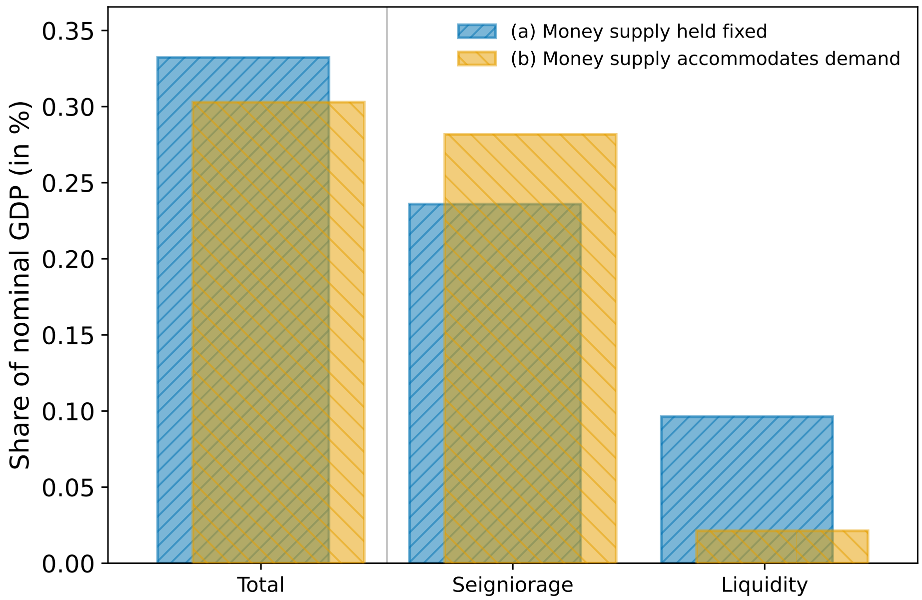
The fiscal revenues approximately double, from 0.15% to 0.30% of GDP. Not accommodating the rise in demand by providing more money has only a small extra fiscal impact: the revenues are 0.03 percentage points of GDP higher when the money supply is held fixed. Scaling up or down the size of the offshore market would approximately scale revenues proportionately.

The distributional differences between the two policies are more interesting. If the money supply accommodates the increase in demand, then the breakdown between seigniorage and liquidity also stays approximately the same, with the former dominating the latter. However, when the money supply is fixed, liquidity costs become more prominent. When the demand for deposits is met by banks while M is fixed, the money-deposit ratio $x = M/D$ falls in equilibrium. This raises the liquidity costs per deposit for banks. Therefore, the share of fiscal revenues coming from the operation of lending facilities is higher, relative to the classic seigniorage revenue from printing money.

At the same time, the revenues from seigniorage still rise compared to the baseline case in Figure 3, even though the narrow money supply M is the same. This is because the higher marginal benefit of reserves lowers the interest rate paid to banks on their reserves

[7]When M is kept fixed, the increase in demand for money raises the market-clearing opportunity cost of holding it, so in equilibrium D/Y increases by 81%.

Figure 7 Fiscal offshore revenues with a larger offshore market



Note: Both series show fiscal revenues after μ and γ_0 are raised so that the demand for offshore deposits doubles relative to the baseline calibration of Table 1. In series (a), the money supply is held at its baseline value, $M/Y = 4.1\%$, while in series (b), the money supply rises to $M/Y = 8.1\%$. At the baseline in Figure 3, total revenues are 0.15%, made up of 0.14% of seigniorage and 0.01% of liquidity.

to keep the onshore-offshore money peg.

6 Conclusion

The analysis of a macroeconomic policy is not complete without characterizing its fiscal implications. Many well-intended policies are never adopted because of the burden they put on the Treasury; many inferior policies are embraced because they bring in revenues in the short term.

The reality of financial transaction taxes is that they are used as much to manage capital flows as they are to collect revenues. Foreign exchange intervention is limited as much by its weak and uncertain effects on exchange rates as by the potential fiscal losses on the country's FX reserves. The experience with macro-prudential policy is filled with misuses that hurt bank solvency and distort the allocation of credit by forcing banks to hold government bonds at below-market rates.

This paper investigated the fiscal implications of an alternative policy to manage the exchange rate and capital flows: an offshore currency. An advantage of this monetary tool relative to financial transaction taxes and macro-prudential policies is that it may be easier to implement and to adjust at high frequencies. This paper added a further advantage: its fiscal footprint is small and changes little when policy moves the tool.

Our first result is that the fiscal footprint is approximately equal to the size of offshore deposits times a wedge that depends on the marginal liquidity cost of deposits. A policy that produces outcomes corresponding to a 1% financial transaction tax generates fiscal revenues of 0.15% of GDP. They mostly come from seigniorage collected from printing money, as opposed to liquidity revenues from lending to banks. Adopting an offshore currency as a tool in the IPF would leave a small dent in the Treasury accounts.

Our second result is that the Laffer curve depends on two effects: the impact on the tax wedge created by the scarcity of money, and the impact on the exchange rate of an injection of money. Their relative size depends on the elasticity of the demand for deposits. For a reasonable calibration, we found that the Laffer curve is downward sloping around the steady state, so that fiscal revenues could be higher by cutting the offshore money supply. Policymakers tempted to use the offshore printing press for fiscal purposes would find that revenues would actually fall. Quantitatively, we found that the change in revenues is small, even for large variations in the money supply. Therefore, an offshore currency system would not pose a significant temptation to be used for financial repression.

Our third result is that the two components of revenues—seigniorage and liquidity—change significantly as money expands, since each has a different Laffer curve. Seigniorage dominates in the level of revenues, but liquidity drives the slope of the Laffer curve. As the supply of money changes, the incentives for banks to supply deposits change as well, and money multipliers vary.

Our fourth result is that the small and insensitive fiscal footprint is robust to the elasticity of deposit demand, to whether policy chooses to float or peg the exchange rate, and to the use of policies that affect money demand or money supply. All of these changes have a significant effect on the breakdown of revenues between their wedge and exchange-rate components, between seigniorage and liquidity, and between the incidence on domestic and on foreign depositors. Finally, the fiscal revenues scale approximately one-to-one with the demand for the offshore currency.

Combined, these results suggest that policies regarding parallel currencies can stay within the domain of the central bank, without requiring fiscal support or succumbing to fiscal dominance.

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Appendix

This appendix contains additional material mentioned in the text. Appendix A proves Proposition 1; Appendix B proves Lemma 1; Appendix C proves Lemma 2; Appendix D proves Lemma 3; Appendix E gives the details of the liquidity-function calibration.

A Proof of Proposition 1

Proof. Recall that $\{y_{NT,t}, y_{T,t}, \gamma_t, M_t, B_t^{\$}, B_t^{g}\}$ all grow at rate g. Conjecture that $E_t^{\$}$ and x are constant. Since nominal output is:

$$Y_t = y_{NT,t} + E_t^{\$} y_{T,t}\,,$$

and $E^{\$}$ is constant in the balanced growth path, then nominal output grows at the same rate as its two components:

$$\frac{Y_{t+1}}{Y_t} = g.$$

The household Euler equation implies that:

$$R_t = \beta^{-1}\frac{y_{NT,t+1}}{y_{NT,t}} = \frac{g}{\beta}\,.$$

Under the offshore peg, deposit pricing gives

$$R_t^d = R_t(1-\psi(x_t)) = \frac{g}{\beta}(1-\psi(x))\,,$$

which is constant under the conjecture that x is constant.

Divide the foreign-demand and deposit-market equations by Y_t. Since the ratios γ_t/Y_t and M_t/Y_t and $y_{NT,t}/Y_t$ are constant, both equations reduce each period to the same static system in $(x_t, d_t^f/Y_t)$. Therefore x_t is constant on the balanced growth path.

The foreign-demand equation then becomes the second equation in the Proposition. The deposit-market equation becomes the third equation.

Finally, noting that $B_{t-1}^{\$} = B_t^{\$}/g$ and that $d_{t-1}^f = d_t^f/g$, together with the deposit pricing equation above, the balance-of-payments condition becomes:

$$E^{\$} y_T - \iota y_{NT} = \left(1 - \frac{R^{\$}}{g}\right) E^{\$} B^{\$} + \left(\frac{1-\psi(x)}{\beta} - 1\right) d^f\,.$$

Dividing by Y gives

$$1-(1+\iota)\frac{y_{NT}}{Y}=\left(1-\frac{R^{\$}}{g}\right)\frac{E^{\$}B^{\$}}{Y}+\left(\frac{1-\psi(x)}{\beta}-1\right)\frac{d^{f}}{Y},$$

which is the first equation in the Proposition.

Since M_t, $B_t^{\$}$, d_t^h, d_t^f, and D_t all grow at the same rate g as Y_t, they are constant fractions of GDP. The transfer formula is linear in these terms, so T_t/Y_t is also constant. ■

B Proof of Lemma 1

Proof. Start from the government flow budget:

$$T_t=(B_t^g-R_{t-1}B_{t-1}^g)+(M_t-R_{t-1}^m M_{t-1})+\phi(x_t)D_t-E_t^{\$}(B_t^{\$}-R^{\$}B_{t-1}^{\$}).$$

On the balanced growth path, Proposition 1 implies $B^{\$}, M, B^g$ are constant ratios to GDP, and $x, E^{\$}$ are constant. Moreover:

$$R^m=R(1+\phi'(x))=\frac{g}{\beta}(1+\phi'(x)).$$

Dividing each term in the budget constraint by Y_t and using: $B_{t-1}^g=B_t^g/g$, $M_{t-1}=M_t/g$ and $B_{t-1}^{\$}=B_t^{\$}/g$ we obtain

$$\begin{aligned}
\frac{B_t^g-R_{t-1}B_{t-1}^g}{Y_t}&=\left(1-\frac{R}{g}\right)\frac{B^g}{Y}=-\left(\frac{1}{\beta}-1\right)\frac{B^g}{Y},\\
\frac{M_t-R_{t-1}^m M_{t-1}}{Y_t}&=\left(1-\frac{R^m}{g}\right)\frac{M}{Y}=\left(1-\frac{1+\phi'(x)}{\beta}\right)\frac{M}{Y},\\
-\frac{E_t^{\$}(B_t^{\$}-R^{\$}B_{t-1}^{\$})}{Y_t}&=-\left(1-\frac{R^{\$}}{g}\right)\frac{E^{\$}B^{\$}}{Y}=\left(\frac{R^{\$}}{g}-1\right)\frac{E^{\$}B^{\$}}{Y}.
\end{aligned}$$

Substituting each term into the flow budget constraint gives

$$\frac{T}{Y}=\left(1-\frac{1+\phi'(x)}{\beta}\right)\frac{M}{Y}+\phi(x)\frac{D}{Y}+\left(\frac{R^{\$}}{g}-1\right)\frac{E^{\$}B^{\$}}{Y}-\left(\frac{1}{\beta}-1\right)\frac{B^g}{Y}.$$

Collecting terms gives the expression in the lemma. ■

C Proof of Lemma 2

Proof. Starting from the expression for $F(M)$ in equation (33), replace $M = xD$, to get:

$$F(M) = \left[\phi(x) - \frac{x\phi'(x)}{\beta}\right]\left(\frac{D}{Y}\right).$$

With $\beta \approx 1$, using the definition of $\psi(x)$, this becomes:

$$F(M) = \psi(x)\left(\frac{D}{Y}\right).$$

From equation (34), when $\tau \approx 1$ (or $\psi(x) \approx 0$), then $\tau - 1 \approx \psi(x)$. This gives the result. ■

D Proof of Lemma 3

Proof. The balanced-growth fiscal revenue in equation (33) is:

$$F(M) = \left(\psi(x) + \left(1 - \frac{1}{\beta}\right) x\phi'(x)\right)\left(\frac{D}{Y}\right). \tag{A1}$$

recalling that $M = xD$ and that $\psi(x) = \phi(x) - x\phi'(x)$.

Now, recall that, in equilibrium, the demand curves are

$$\frac{d^h}{Y} = \frac{y_{NT}}{Y}\left[\frac{\mu}{\psi(x)}\right]^{\varepsilon_h}, \tag{A2}$$

$$\frac{d^f}{Y} = \frac{\gamma}{Y}\left[\frac{E^\$}{\psi(x)}\right]^{\varepsilon_f}, \tag{A3}$$

where we imposed $R = R^\$$, as we used in the calibration.

In the balanced growth paths defined in Proposition 1, y_{NT}/Y, μ, and γ/Y are constants that can be treated as fixed parameters. Therefore, totally differentiating these two expressions:

$$d\log\left(\frac{d^h}{Y}\right) = -d\log Y - \varepsilon_h d\log\psi\,, \tag{A4}$$

$$d\log\left(\frac{d^f}{Y}\right) = -d\log Y + \varepsilon_f d\log E^\$ - \varepsilon_f d\log\psi\,. \tag{A5}$$

From the definition of GDP, taking total derivatives with respect to the only variable that moves across equilibria (the exchange rate):

$$d\log Y = \left(\frac{E^{\$}y_T}{Y}\right) d\log E^{\$}\,. \tag{A6}$$

Moreover, since $\psi = (\tau-1)/\tau$, then $d\log\psi(x) = \tau^{-1}d\log(\tau-1)$. Therefore, the two expressions above can be re-written as:

$$d\log\left(\frac{d^h}{Y}\right) = -\left(\frac{E^{\$}y_T}{Y}\right) d\log E^{\$} - \left(\frac{\varepsilon_h}{\tau}\right) d\log(\tau-1)\,, \tag{A7}$$

$$d\log\left(\frac{d^f}{Y}\right) = \left(\varepsilon_f - \frac{E^{\$}y_T}{Y}\right) d\log E^{\$} - \left(\frac{\varepsilon_f}{\tau}\right) d\log(\tau-1)\,. \tag{A8}$$

Now, since $D/Y = d^h/Y + d^f/Y$, then:

$$d\log(D/Y) = \left(\frac{d^h}{D}\right) d\log(d^h/Y) + \left(\frac{d^f}{D}\right) d\log(d^f/Y)\,. \tag{A9}$$

Plugging in the previous two expressions and rearranging:

$$d\log(D/Y) = -\left[\left(\frac{d^h}{D}\right)\varepsilon_h + \left(\frac{d^f}{D}\right)\varepsilon_f\right]\frac{d\log(\tau-1)}{\tau} + \left[\left(\frac{d^f}{D}\right)\varepsilon_f - \frac{E^{\$}y_T}{Y}\right] d\log E^{\$}\,. \tag{A10}$$

Back to equation (A1), totally differentiating it:

$$d\log(F(M)) = \eta(x)\tau^{-1}d\log(\tau-1) + d\log(D/Y) \tag{A11}$$

defining $\eta(x) = d(\log(\psi(x) + (1-1/\beta)x\phi'(x)))/d\log(\psi(x))$. Combining the last two equations:

$$d\log(F(M)) = \left[\eta(x) - \left(\frac{d^h}{D}\right)\varepsilon_h - \left(\frac{d^f}{D}\right)\varepsilon_f\right]\frac{d\log(\tau-1)}{\tau} + \left[\left(\frac{d^f}{D}\right)\varepsilon_f - \frac{E^{\$}y_T}{Y}\right] d\log E^{\$}. \tag{A12}$$

Taking the derivative with respect to $\log(M)$ gives the result. ■

E Calibration of the reduced-form liquidity functions

We calibrate the reduced-form functions $\tilde{\phi}(x,\lambda)$, $\tilde{\phi}'(x,\lambda)$, and $\tilde{\psi}(x,\lambda)$ using the micro-founded banking block in Bahaj and Reis (2024, Section 7.4 and Appendix D.5). That paper derives the liquidity cost function from an underlying matching-and-bargaining environment that is calibrated to Chinese data, yielding microfounded counterparts for the per-deposit liquidity cost $\phi(x)$, the marginal liquidity benefit of an extra reserve $-\phi'(x)$, and the marginal cost of issuing another deposit $\psi(x) = \phi(x) - x\phi'(x)$. We take those microfounded objects as the target functions to be approximated in the quantitative model. As stated in the text, we then approximate these functions with the counterparts $\tilde{\phi}(x)$ and $\tilde{\phi}'(x)$ in the equations in (37) with four coefficients $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$ in the range $[0.15, 0.40]$.

An important point is that $\Phi'(.)$ is the partial derivative of $\Phi(.)$ with respect to the individual bank's money-deposit ratio, but $\phi'(x)$ is not the total derivative of $\phi(x)$. Recall that we defined $\phi'(x)$ to be the partial derivative of the $\Phi(m/d, M/D)$ function with respect to its first argument, evaluated where both arguments are equal to x. In words, the objects that matter in equilibrium are $\phi(.)$ and $\phi'(.)$, which vary with the aggregate money-deposit ratio. This is why we can treat these two objects separately and use two different functions to approximate them: $\tilde{\phi}(x)$ and $\tilde{\phi}'(x)$.

We fit $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$ by nonlinear least squares to the microfounded targets over the economically relevant range of money-deposit ratios. In particular, we first identify the local peak of the microfounded $\psi(x)$, which occurs at $x_{\text{peak}} \approx 0.15$, and then fit the approximation over the interval $[x_{\text{peak}}, 0.4]$. This range covers the region relevant for the Chinese calibration, with the benchmark value $x = 0.27$ lying near the center of the interval.

Following this procedure, the baseline fit implied by the Chinese microfoundation delivers:

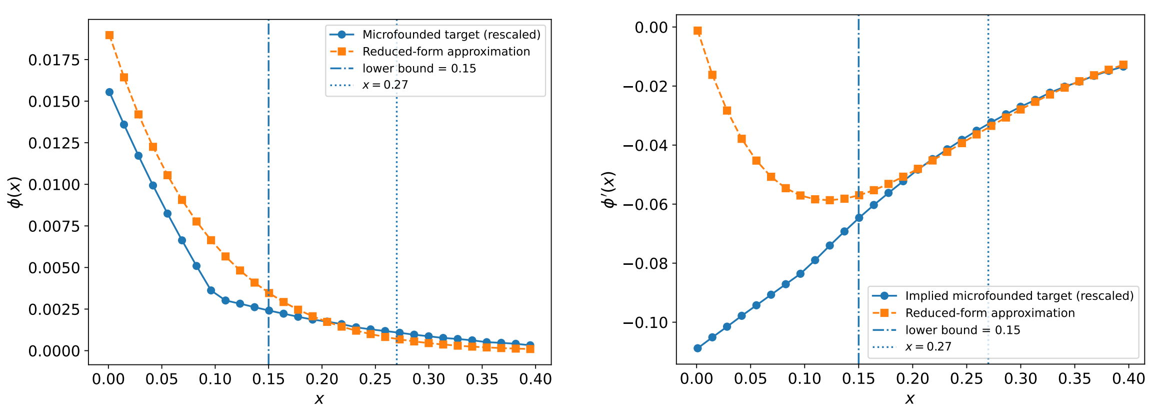
$$(\lambda_1, \lambda_2, \lambda_3, \lambda_4) = (7.2507,\ 1.9003,\ 10.4929,\ 0.029487)\,.$$

This implies a net wedge ($\tau(x) - 1 = \tilde{\psi}(x)/(1 - \tilde{\psi}(x))$) at the benchmark money-deposit ratio of $\tau(0.27) - 1 = 1.55\%$. We rescale the level parameters so that the implied wedge is instead $\tau(0.27) - 1 = 1\%$. Since varying the corridor width in the underlying microfounded model scales ϕ, ϕ', and ψ proportionally without materially changing their shape over the relevant range, this rescaling affects only λ_2 and λ_4. They are scaled down by a factor of 0.650. The final calibrated values used in the quantitative exercises are in Table 1.

Figure A1 complements Figure 1 in the main text by plotting the functions $\tilde{\phi}(x)$ and $\tilde{\phi}'(x)$ against their targets.

Figure A1 The calibrated liquidity cost functions against the target value

(a) $\tilde{\phi}(x)$ **(b)** $\tilde{\phi}'(x)$



Note: The curves are rescaled so that $\psi(0.27) = 0.0099$ to match $\tau - 1 = 1\%$.