Discussion of "Macroeconomic and Fiscal Consequences of Quantitative Easing" by Adrian, Erceg, Kolasa, Lindé, and Zabczyk

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Adrian, Erceg, Kolasa, Lindé, and Zabczyk's very nice paper uses a rich DSGE model with segmented asset markets to evaluate the macroeconomic and fiscal consequences of quantitative easing (QE). The paper is very well done, in that the model calibration and the empirical exercises are carefully thought through. It is ambitious, in that it uses frontier approaches such as Gabaix (2020)'s cognitive discounting to mitigate the forward guidance puzzle (Del Negro et al., 2023). And finally, the paper's message is novel and obviously policy relevant: QE works effectively at providing economic stimulus when interest rate policy is constrained by the zero lower bound *and* its fiscal implications are superior to those of government spending. For the same amount of stimulus on economic activity, government spending increases public debt significantly while QE reduces it.

In order to do my job as a discussant I focus on something the authors neglect: the central bank (CB)'s budget constraint. The paper states that "our main focus is on how

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QE affects the consolidated fiscal position of the government and central bank... This is the natural metric for evaluating fiscal effects in our model where only the consolidated position matters for behavioral choices." Studying the fiscal implications from the perspective of the consolidated government budget constraint—that is, the budget constraint of the central bank and the fiscal authority added together—is perfectly fine. What may not be fine, I argue, is to assume that the central bank's budget constraint is irrelevant except for political economy reasons, that central bank losses are just a matter of *optics*. Central bank losses can in principle make a central bank "insolvent", in the precise sense defined later, and therefore in need of fiscal support. My point matters for the paper because the central bank's budget constraint may itself limit policy, and QE in particular, even if it has not done so thus far. I show that the reason it has not done so is that *currency*—the central bank's non-interest-bearing liability—has provided a crucial buffer for the Federal Reserve especially throughout the post-COVID QE episode. I argue that this buffer cannot be taken for granted: financial innovation leading toward a more cashless economy could erode it and therefore constrain the central bank's ability to undertake QE in the future. The case of Sweden today provides a clear illustration of how this can happen.

The CB budget constraint. I begin by discussing the CB intertemporal budget constraint. For the sake of simplicity, I do so using the stylized central bank model in Del Negro and Sims (2015). In that model, the CB holds Woodford (2001)-style bonds B^C that depreciate at rate δ, pay a coupon of $\delta + \chi$, and have duration δ^{-1}; q denotes the bond price. On the liability side, the CB issues overnight reserves V that pay the nominal interest rate r (the IORB rate), and currency M, which is non-interest-bearing and endogenously determined by money demand.[1] Remittances to the Treasury are denoted τ^C. The CB's

[1] V also includes other interest bearing liabilities of the Fed such as overnight reverse repos (ON RRP). For simplicity, in the remainder of the discussion I do not distinguish between reserves and ON RRP, in spite of the fact that they pay slightly different rates. Also, the liability side of the Fed also includes the Treasury General Account (TGA). The TGA does not pay interest so conceptually it can be included in M. Finally, other fed liabilities include other deposits, Federal Reserve capital, and other net liabilities, which are usually comparatively small and hence omitted here.

flow budget constraint is then:

$$q\frac{\dot{B}^C}{P} - \frac{\dot{V}+\dot{M}}{P} = (\chi + \delta - \delta q)\,\frac{B^C}{P} - r\,\frac{V}{P} - \tau^C. \tag{1}$$

The left-hand side is the change in the CB's net position (assets minus liabilities, valued at market prices) in real terms. The right-hand side is the CB's "profit and loss": coupon income on SOMA bonds, minus interest expense on reserves, minus remittances to the Treasury. Under the Federal Reserve's remittance accounting (see Board of Governors of the Federal Reserve System, 2025), operating within Section 7 of the Federal Reserve Act, the transfer is $\tau^C \approx \max\{(\chi+\delta-\delta q)B^C/P - rV/P,\ 0\}$: remittances are *non-negative*.[2] When the CB runs losses, it suspends remittances and accumulates a "deferred asset"—a claim on its own future earnings.

Integrating the flow constraint (1) forward yields the CB's *intertemporal* budget constraint:

$$\underbrace{q\,\frac{B_0^C}{P_0} - \frac{V_0}{P_0}}_{\text{net mkt. value of assets}} + \underbrace{\int_0^\infty \frac{\dot{M}_t}{P_t} e^{-\int_0^t \rho_s\,ds}\,dt}_{\text{PDV of seigniorage}} = \underbrace{\int_0^\infty \tau_t^C\,e^{-\int_0^t \rho_s\,ds}\,dt}_{\text{PDV of remittances}}, \tag{2}$$

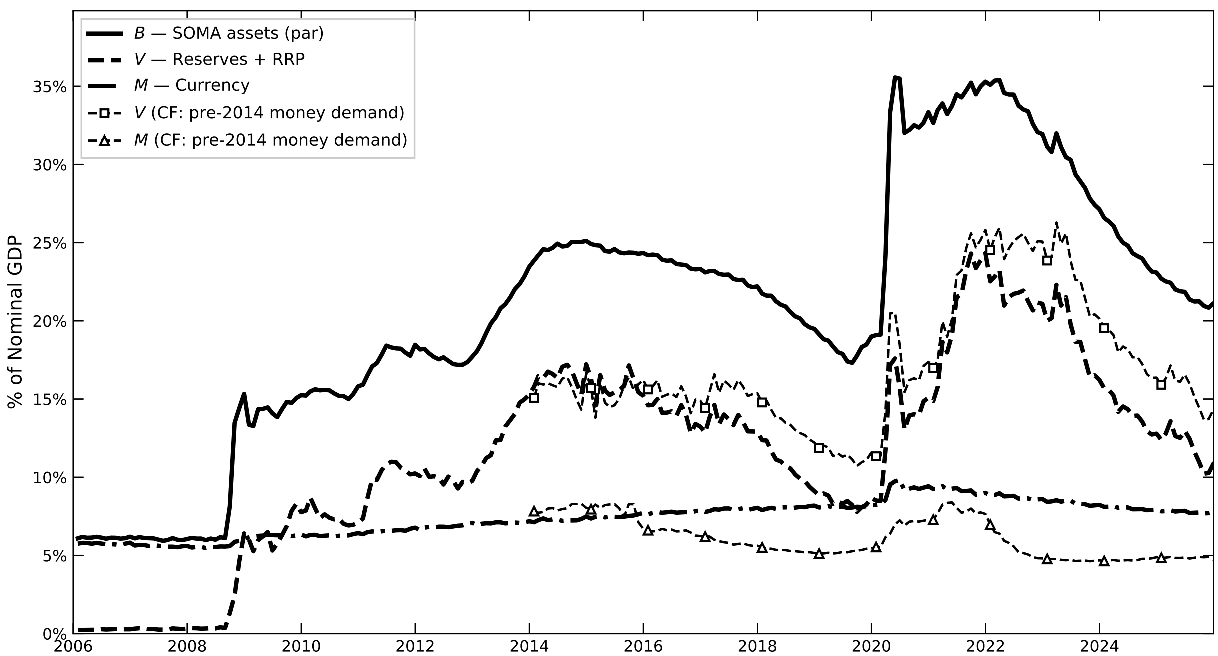
where $\rho = r - \dot{P}/P$. The left-hand side (LHS) of (2) is the sum of the market-value net worth of the CB's portfolio—assets valued at market prices minus interest-bearing liabilities—and the present discounted value (PDV) of future seigniorage. If the LHS of (2) is positive, the CB is "solvent" in the sense that it can meet all future obligations without any fiscal support: $\tau_t^C \geq 0$ for all t. In this case, the CB's budget constraint is irrelevant for equilibrium, exactly as the consolidated government's budget constraint is irrelevant under passive fiscal policy. If instead LHS < 0, the CB cannot cover its obligations from its own resources: reserves would need to grow without bound in real terms to satisfy (2), violating the private sector's transversality condition. This cannot be an equilibrium unless the CB obtains *fiscal support*—that is, $\tau_t^C < 0$ (see Del Negro and Sims, 2015).

Two points are worth discussing. First, the LHS of (2) is strictly positive in *all* states of nature *only if* the maturity of assets B^C matches the maturity of liabilities V—which

[2] The formula abstracts from dividends, the surplus cap, and operating costs.

is far from the case for a central bank conducting QE—*and* seigniorage is positive (see the discussion in Bassetto and Messer, 2013). Second, fiscal support is *not* envisioned in the Federal Reserve Act. Unlike the Bank of England, which has an explicit indemnity agreement with HM Treasury covering asset purchase facility losses, the Federal Reserve has no analogous explicit backstop. Therefore, Adrian et al. must either assume that such a backstop would somehow arise—and that, importantly, this would not constrain the CB's ability to do QE—or that for all practical purposes the LHS is always positive. I now examine how realistic this latter assumption has been in the past and under what conditions it will remain so in the future.

Figure 1: The Fed's balance sheet: B, V, and M



Note: B = total assets (par value; solid line); V = reserves + ON RRP (domestic and foreign; dashed line); M = currency in circulation (dash-and-dotted line). The dashed lines with markers show a *counterfactual* in which M follows the pre-2014 estimated money demand curve (3) rather than its actual path post-2019; the additional seigniorage foregone is replaced by interest-bearing reserves compounded at IORB (discussed below). Source: Federal Reserve H.4.1 release, FRED; author's calculations.

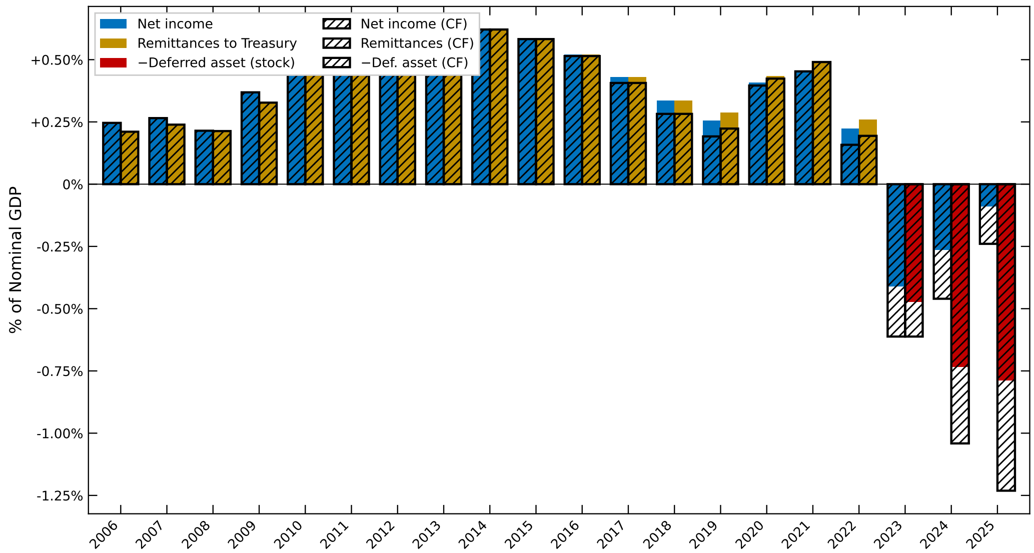
The Fed's balance sheet and income. Figure 1 shows the evolution of B, V, and M as fractions of GDP from 2006 to 2025 (thick lines without markers). The figure illustrates two facts. First, B and V move closely together—not surprisingly, since increases in assets B are funded mainly by issuing short-term interest-bearing liabilities V (reserves and ON RRP)—while M is fairly stable. Second, a substantial share of the CB's liabilities is non-interest-bearing currency M, which as of 2025 is almost as large as V.[3] This second fact has important implications for both the CB's income and its ability to avoid the need for Treasury recapitalization, as discussed below.

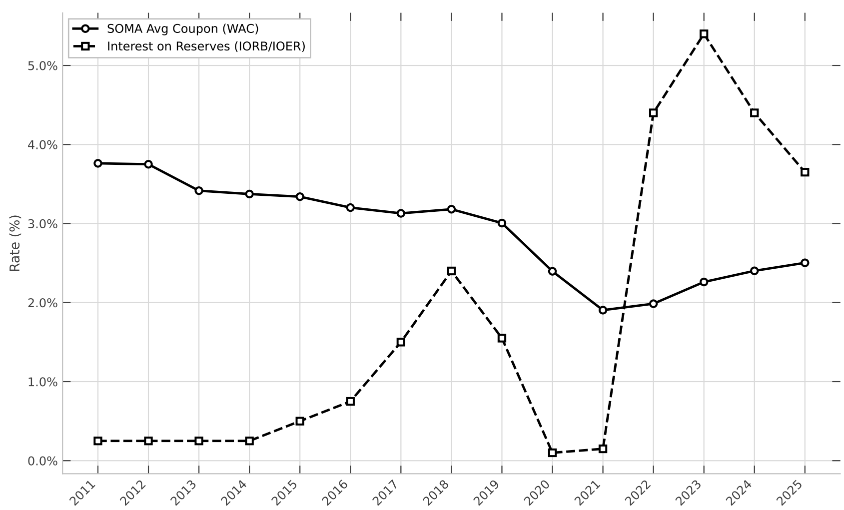
The upper panel of Figure 2 describes the evolution of the Fed's income (solid blue bars), remittances (solid yellow bars), and deferred asset (cumulative losses; solid red bar) during the same time period, all as fractions of GDP. The lower panel plots the interest rate on reserves (IORB, spliced with IOER prior to July 2021) against the SOMA weighted average coupon (WAC)—the average yield earned on the asset side. During the 2010s, the IORB was held well below the WAC throughout. As a consequence, both income and remittances were positive and significant—cumulative remittances from 2010 to 2019 exceeded 4 percent of GDP. In the post-COVID episode, the Fed tightened and the IORB surged well above the WAC, resulting in income losses since September 2022 and a deferred asset that was above 0.75 percent of GDP by the end of 2025. The deferred asset *per se* is an accounting device that prevents the CB from ever showing negative book equity; it is therefore irrelevant from an economic standpoint, as long as it can eventually be repaid—that is, as long as the LHS of the intertemporal budget constraint (2) remains positive.

$qB - V$, M, AND THE PDV OF SEIGNIORAGE. Table 1 reports the key components of the LHS of equation (2) for the Fed from 2011 to 2025, expressed as fractions of GDP. The first column shows $qB - V$, the market value of SOMA assets minus interest-bearing liabilities (reserves plus reverse repos). The second shows M/GDP, currency as a fraction of

[3] Figure 1 does not include the TGA in M, in spite of the fact that the TGA does not pay interest. The TGA is often quantitatively significant it has run around 1.52.7 percent of GDP for most of the past decade and exceeded 8 percent of GDP at its mid2020 peak. Adding the TGA to currency would therefore raise the M line for most periods, and make it more variable. Since currency plays a much more important role than the TGA for this discussion, I decided to omit it for simplicity. Also, B in figure 1 includes *all* CB assets. In the remainder of the discussion some of the data (WAC, market value, *et cetera*) will apply to SOMA assets only, as opposed to all assets. This is immaterial however as SOMA assets represent the vast majority of CB assets.

Figure 2: The Fed's income and remittances





Note: Upper panel: net income (blue bars), remittances (gold bars), and negative of cumulative deferred asset (red bars), all as fractions of GDP. Counterfactual bars (unfilled, with black outlines and diagonal hatching) show the same quantities under the assumption that M follows the pre-2014 estimated money demand curve (3) rather than its actual path post-2019; the additional seigniorage foregone is replaced by interest-bearing reserves compounded at IORB.
Lower panel: year-end IORB (spliced with IOER pre-July 2021; dashed line with square markers) and SOMA weighted average coupon (WAC; solid line with circle markers), in percent per annum. Source: Federal Reserve H.4.1 release; FRED; author's calculations. WAC data courtesy of Gabriel Herman, Linsey Molloy, and Rachel Wilson from the NY Fed's Markets Group. Their WAC calculations are based on public data.

GDP. The third approximates the PDV of seigniorage as $(M/GDP) \times k$, using the steady-state formula from Del Negro and Sims (2015), where $k = (\bar{\pi} + \gamma + n)/(\beta - n)$ is the ratio of the nominal growth rate to the gap between the discount rate and the real growth rate; Del

Table 1: $qB - V$, M/GDP, PDV of seigniorage, and the LHS of the CB's intertemporal budget constraint

Year	$qB - V$ (% GDP)	q	M (% GDP)	PDV Seign. (% GDP)	PDV τ^C (% GDP)
2011	8.2%	1.123	6.8%	101.7%	109.9%
2012	8.8%	1.144	7.1%	106.3%	115.1%
2013	7.4%	1.038	7.2%	107.8%	115.2%
2014	8.5%	1.086	7.5%	112.3%	120.8%
2015	9.3%	1.066	7.7%	115.8%	125.2%
2016	10.1%	1.053	7.9%	118.3%	128.4%
2017	9.3%	1.053	8.0%	120.7%	130.0%
2018	9.9%	1.031	8.2%	122.8%	132.7%
2019	9.6%	1.073	8.2%	123.0%	132.6%
2020	18.5%	1.103	9.4%	141.4%	159.9%
2021	10.9%	1.056	9.0%	135.0%	145.9%
2022	6.4%	0.903	8.6%	129.1%	135.5%
2023	6.7%	0.904	8.2%	123.5%	130.2%
2024	6.3%	0.872	7.9%	118.9%	125.2%
2025	7.0%	0.897	7.8%	116.5%	123.5%
2025 CF	3.6%		5.0%	74.4%	78.0%

Note: All entries as percent of GDP. q = fair (market) value qB / par value of SOMA domestic securities. qB (fair value) and book value (amortized cost) are taken from the Federal Reserve Banks Combined Financial Reports: for 2011-2024, the December 31 year-end value reported in the following year's first-quarter report; for 2025, the audited annual statements (released March 2026), "Total domestic SOMA portfolio securities holdings," p. 36 (December 31, 2025). Par value = book value − unamortized premiums/discounts (FRED `WUPSHO`, `WUDSHO`), and $q = qB/\text{par}$; book value is taken from the reports rather than the H.4.1 securities-held-outright series. V = reserves (`WRESBAL`) + ON RRP (`WLRRAOL`) + foreign RRP (`WLRRAFOIAL`) and M = currency in circulation (`WCURCIR`), both December year-end from H.4.1/FRED. PDV seigniorage ≈ $(M/\text{GDP}) \times k$ with $k = 15$ following Del Negro and Sims (2015). "2025 CF" shows the same quantities under the assumption that M follows the pre-2014 estimated money demand curve (3) rather than its actual path post-2019; the additional seigniorage foregone is replaced by interest-bearing reserves compounded at IORB. Source: Federal Reserve Banks Combined Financial Reports; H.4.1; FRED.

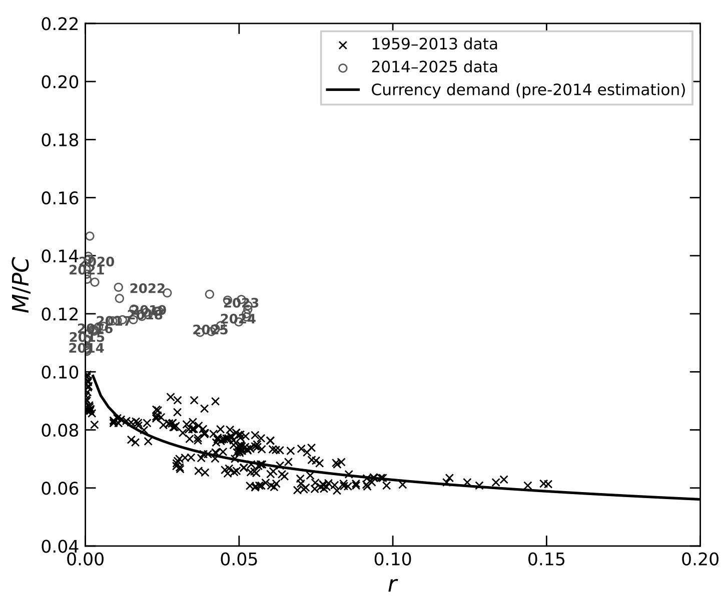
Negro and Sims calibrate $k = 15$ for the United States.[4] The final column sums the first and third columns to approximate the LHS of equation (2). These steady-state formulas should

[4] Following Del Negro and Sims (2015) (Table 3): $\bar{\pi} = 2\%$ (steady-state inflation), $\gamma = 1\%$ (productivity growth), $n = 0.75\%$ (population growth), and $\beta = 1\%$ (real discount rate), so $k = \frac{\text{nominal growth}}{\text{r - g}} = \frac{\bar{\pi} + \gamma + n}{\beta - n} = 15$. The large value reflects the small denominator r - g $= \beta - n$—a low real discount rate relative to growth.

be read as back-of-the-envelope calculations: for years far from steady state—e.g., during and immediately after COVID—the approximations may not be very reliable.

A few observations follow from Table 1. First, $qB - V$ declined substantially in the post-COVID episode: from a peak of 18.5 percent of GDP at end-2020—when QE was at its largest and bond prices were near historic highs—to 7 percent by 2025, reflecting the fact that q fell as yields rose. Second, $qB - V$ has been smaller than M since 2022. This means that if the United States were to become a completely cashless economy—so that M fell to zero and seigniorage vanished entirely—the LHS of (2) would be negative. Third, the PDV of seigniorage is potentially very large, although this number is of course sensitive to assumptions on k. Under Del Negro and Sims's assumption that $k = 15$, the PDV of seigniorage dwarfs $qB - V$ and makes the LHS of the CB's intertemporal budget constraint comfortably positive. Because seigniorage plays an important role in keeping the LHS of (2) positive, it is worth looking more closely at the demand for currency.

Figure 3: The demand for currency: M/PC versus r



Note: Scatter plot of real currency balances (M/PC, horizontal axis) against the short-term nominal interest rate r (vertical axis). Quarterly observations from 1959 to 2013 are shown as black cross markers (×); 2014-2025 observations are shown as open circles with year labels. The solid black line is the estimated money demand curve from Del Negro and Sims (2015), fitted on data through 2014. Source: FRED; author's calculations.

The demand for currency. Del Negro and Sims (2015) estimate a semi-log money demand function using U.S. data through 2014:

$$\log r = \log(\psi_0 \psi_1) - \psi_1 \frac{M}{PC}, \tag{3}$$

where r is the short-term nominal interest rate and M/PC is real currency balances: demand for real currency balances is a decreasing function of the opportunity cost r. Figure 3 plots real currency holdings against the short rate for the United States, distinguishing the pre-2014 sample used by Del Negro and Sims from the subsequent period. Two features of the data are apparent: 1) the estimated relationship fits the pre-2014 data reasonably well; 2) After 2014, and especially after COVID, there is a clear *upward shift* in the demand for currency—holdings are substantially higher than the pre-2014 money demand curve would predict, controlling for the level of interest rates. I now show that this shift—whatever its causes (e.g., precautionary demand during the pandemic)—has been an important source of support for the Federal Reserve's balance sheet.

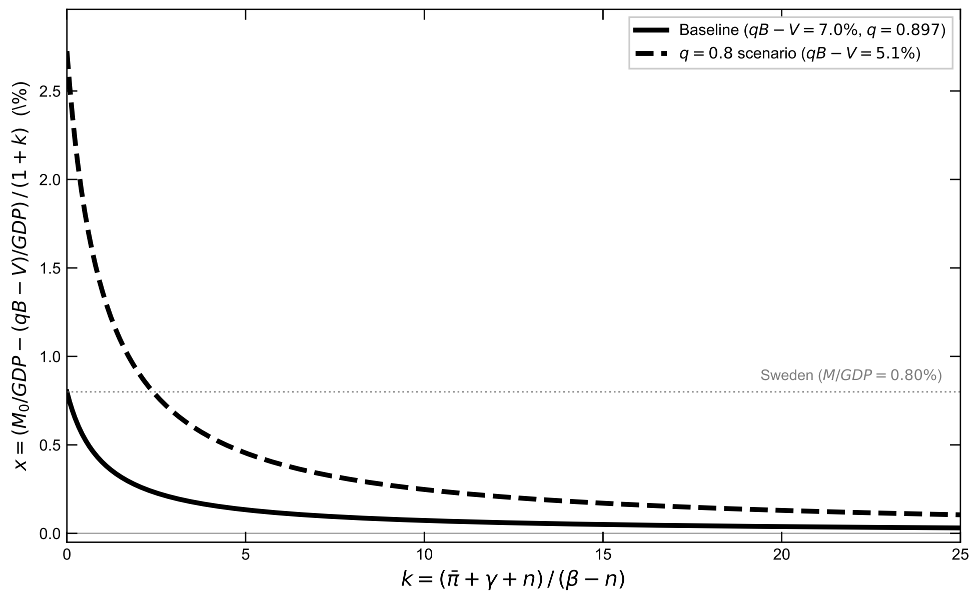
The importance of currency: a counterfactual. To quantify the role of the post-COVID upward shift in currency demand, I construct a counterfactual in which M does not shift upward after 2019 but instead remains on the pre-2014 estimated money demand curve. In this counterfactual, the additional currency that the Fed has actually issued is instead replaced by interest-bearing reserves, compounded forward at the IORB rate. The thinner lines with markers in Figure 1 show the resulting paths of M and V (as fractions of GDP), while the bars with diagonal hatching in upper panel of Figure 2 show the counterfactual paths of net income, remittances, and the deferred asset.[5]

The counterfactual makes the importance of currency clear. Without the upward shift in currency demand, the Fed would have paid substantially more in interest on reserves throughout 2014–2025, as V (interest-bearing reserves) would be higher, resulting in lower income and a deferred asset that in 2025 would be roughly fifty percent larger than its actual

[5]Note that since the LHS of equation (2) remains positive, the counterfactual change in currency demand is irrelevant for equilibrium so it is appropriate to assume that GDP stays the same.

value. The last line in table 1 shows that $qB - V$ in the counterfactual would be cut roughly in half relative to its actual value, and the PDV of seigniorage would be substantially lower. The importance of currency for the Fed's "solvency"—that is, for the components of the LHS of the intertemporal budget constraint (2)— motivates the question I turn to next.

Figure 4: Minimum sustainable M/GDP as a function of k



Note: The figure plots the minimum M/GDP consistent with LHS ≥ 0 in equation (2), as given by (5), as a function of the PDV multiplier k. Baseline curve (actual Dec-2025 values, $qB - V = 7.0\%$, $M_0/GDP = 7.8\%$): thick solid line. Stressed scenario ($q = 0.8$, $qB - V \approx 5.1\%$): thick dashed line. Horizontal dotted line: Sweden's $M/GDP = 0.80\%$ at end-2025. Source: Federal Reserve; FRED; author's calculations.

How cashless an economy can the Fed balance sheet withstand? That is, how far could currency demand fall before the CB's intertemporal budget constraint (2) becomes binding—i.e., before its left-hand side turns negative? Specifically, I ask: given current values of $qB - V$ and M_0/GDP, what is the minimum M/GDP level—call it x— such that the LHS of (2) remains non-negative? Rewriting equation (2) in terms of x we obtain:

$$\underbrace{\frac{qB - V}{GDP}}_{\text{net mkt. value}} - \underbrace{\left(\frac{M_0}{GDP} - x\right)}_{\text{seigniorage lost}} + \underbrace{x \cdot k}_{\text{remaining PDV seign.}} = 0, \tag{4}$$

where the second term captures the loss in accumulated seigniorage from the decline in

M relative to its current level M_0, and the third term is the PDV of seigniorage from the remaining currency stock x. Solving for x:

$$x \;=\; \frac{M_0/GDP \;-\; (qB - V)/GDP}{1+k}. \tag{5}$$

Since x depends crucially on what one assumes about the PDV of seigniorage multiplier k, the solid line in Figure 4 plots this minimum sustainable M/GDP as a function of k. The minimum sustainable M/GDP peaks at $M_0/GDP - (qB - V)/GDP \approx 0.8$ for $k \to 0$ (no future seigniorage), and is only about 0.05 percent at the Del Negro and Sims (2015) value of $k = 15$. Even if the United States were to become as cashless as Sweden is today (horizontal thin dashed line; $M/GDP \approx 0.80$ percent), the Fed's intertemporal budget constraint would therefore remain satisfied for any k.[6]

The dashed line in Figure 4 plots x under a "stressed" scenario where yields have risen further and q is as low as 0.8. Under this scenario the minimum sustainable $x = M/GDP$ rises to about 2.7 percent as $k \to 0$, and it exceeds Sweden's 0.8 percent for any k below about 2.4. In other words, in a high-yield/low-q environment combined with Sweden-like currency usage, the CB could breach its intertemporal budget constraint whenever the value of future seigniorage is only moderate ($k \leq 2.4$; for reference, De Vere et al. 2025 assume a multiplier k of about 0.6).

Bottom line. The paper (and much of the literature) ignores the central bank's budget constraint, and views the central bank's balance sheet as just a "political economy" matter. I argued that this view is incorrect: the CB balance sheet can place a constraint on policy, and on QE in particular. Such a constraint was not binding in the past because currency provided enough of a buffer that the central bank was "solvent" (it did not need any fiscal support) under most reasonable scenarios. This may no longer hold in the future if financial innovation triggers a fall in the demand for currency—especially if, at the same time, higher yields further depress the value of the CB's assets qB.

[6] Sweden's $M/GDP \approx 0.80\%$ is banknotes in circulation ($\approx$ SEK 56B at end-2025; Sveriges Riksbank, *The Riksbank's assets and liabilities, the Weekly Report*) divided by Swedish GDP (Statistics Sweden, SCB).

QE versus fiscal policy. The discussion above has focused on the CB's budget constraint as a potential limit on QE. Adrian et al.'s very interesting paper also raises a number of other questions. In particular, it argues persuasively that QE is, on net, fiscally superior to conventional expenditure-based stimulus: it achieves macroeconomic stabilization while actually reducing the consolidated government's interest burden. If one accepts this argument at face value, a natural question arises: why does the government not delegate debt maturity management to the Treasury as an explicit tool of *fiscal* policy? After all, the Treasury can readily shorten the duration of outstanding debt through buybacks of long-term bonds or by shifting issuance toward the short end of the curve—exactly the operation the Fed undertakes when it purchases long-term Treasuries (Greenwood et al., 2014, 2015). If the macroeconomic effects of QE operate primarily through the duration channel—as the paper's model implies—rather than through signaling the future path of interest rates, then this fiscal lever could be used by the Treasury independently of the Fed's actions.

One answer, which the paper does not explore, is that the distributional consequences of QE and of traditional government transfers are very different (see Schularick et al., 2024). That is, QE may disproportionately benefit households near the top of the wealth distribution who hold most of the financial assets; direct transfers, by contrast, reach households across the income and wealth spectrum. It would therefore be interesting to revisit the paper's main results within a heterogeneous-agent New Keynesian (HANK) framework á la Kaplan et al. (2018), where the distribution of asset holdings is explicitly modeled (Cui and Sterk 2021 explore the effects of QE in a heterogeneous-agent model). In such a setting, the differential impact of QE versus fiscal transfers on the macroeconomy and on government debt may differ from what this representative-agent framework implies.

To conclude, I thoroughly enjoyed reading Adrian, Erceg, Kolasa, Lindé, and Zabczyk's timely, ambitious, and carefully thought-out paper on the macroeconomic and fiscal consequences of QE. My discussion asked whether the CB's own budget constraint—independently of the consolidated one—can place a limit on QE. The answer, I have argued, is: not yet, but potentially in the future, depending on what happens to currency demand.

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