Stock-Flow Consistent Monetary Operations: Sectoral Balances and the Refutation of Loanable Funds

Technical Documentation

February 3, 2026

Abstract

We present a formal Stock-Flow Consistent (SFC) framework for understanding monetary operations in a modern fiat currency system. We derive the fundamental sectoral balance identity, demonstrate that bank credit creates deposits endogenously (horizontal money), show how fiscal operations inject net financial assets (vertical money), and prove that quantitative easing and bond operations are portfolio swaps that preserve private sector net wealth. This framework refutes the loanable funds doctrine by showing that credit is not constrained by prior savings. This document provides the theoretical foundation for an interactive web application that allows users to experiment with these operations and observe the balance sheet effects in real time.

Contents

1   Introduction

The loanable funds model treats savings as a prerequisite for investment, implying that banks are intermediaries between savers and borrowers. The Stock-Flow Consistent (SFC) framework, developed by Wynne Godley and refined by Modern Monetary Theory (MMT) economists including Warren Mosler and Stephanie Kelton, demonstrates that this view is fundamentally incorrect for modern monetary systems.

This document formalizes the accounting identities and operational mechanics that underpin an interactive Stock-Flow Consistent monetary laboratory. The web application implements these equations and allows users to post transactions and observe the resulting balance sheet changes across all four sectors simultaneously.

This document formalizes the key results:

- The sectoral balance identity relating private and public net worth

- The mechanics of horizontal money (bank credit expansion)

- The mechanics of vertical money (fiscal operations)

- The nature of monetary operations (bonds, QE, QT)

- Balance sheet consistency across all sectors

2   The Four-Sector Framework

We model the economy using four consolidated balance sheets (see Figure 1):

Definition 2.1 (The Four Sectors). Let the economy consist of four sectors with balance sheets:

1. **Treasury**: Assets A_T, Liabilities L_T, Net Worth $NW_T = A_T - L_T$

2. **Central Bank (Fed)**: Assets A_F, Liabilities L_F, Net Worth $NW_F = A_F - L_F$

3. **Banking System**: Assets A_B, Liabilities L_B, Net Worth $NW_B = A_B - L_B$

4. **Households**: Assets A_H, Liabilities L_H, Net Worth $NW_H = A_H - L_H$

2.1   Balance Sheet Components

Let us define the key stock variables:

$$D := \text{Bank deposits (household asset, bank liability)} \tag{1}$$
$$L := \text{Bank loans (bank asset, household liability)} \tag{2}$$
$$R := \text{Bank reserves (bank asset, Fed liability)} \tag{3}$$
$$B_H := \text{Treasury bonds held by households} \tag{4}$$
$$B_F := \text{Treasury bonds held by Fed} \tag{5}$$
$$\text{TGA} := \text{Treasury General Account (Treasury asset, Fed liability)} \tag{6}$$
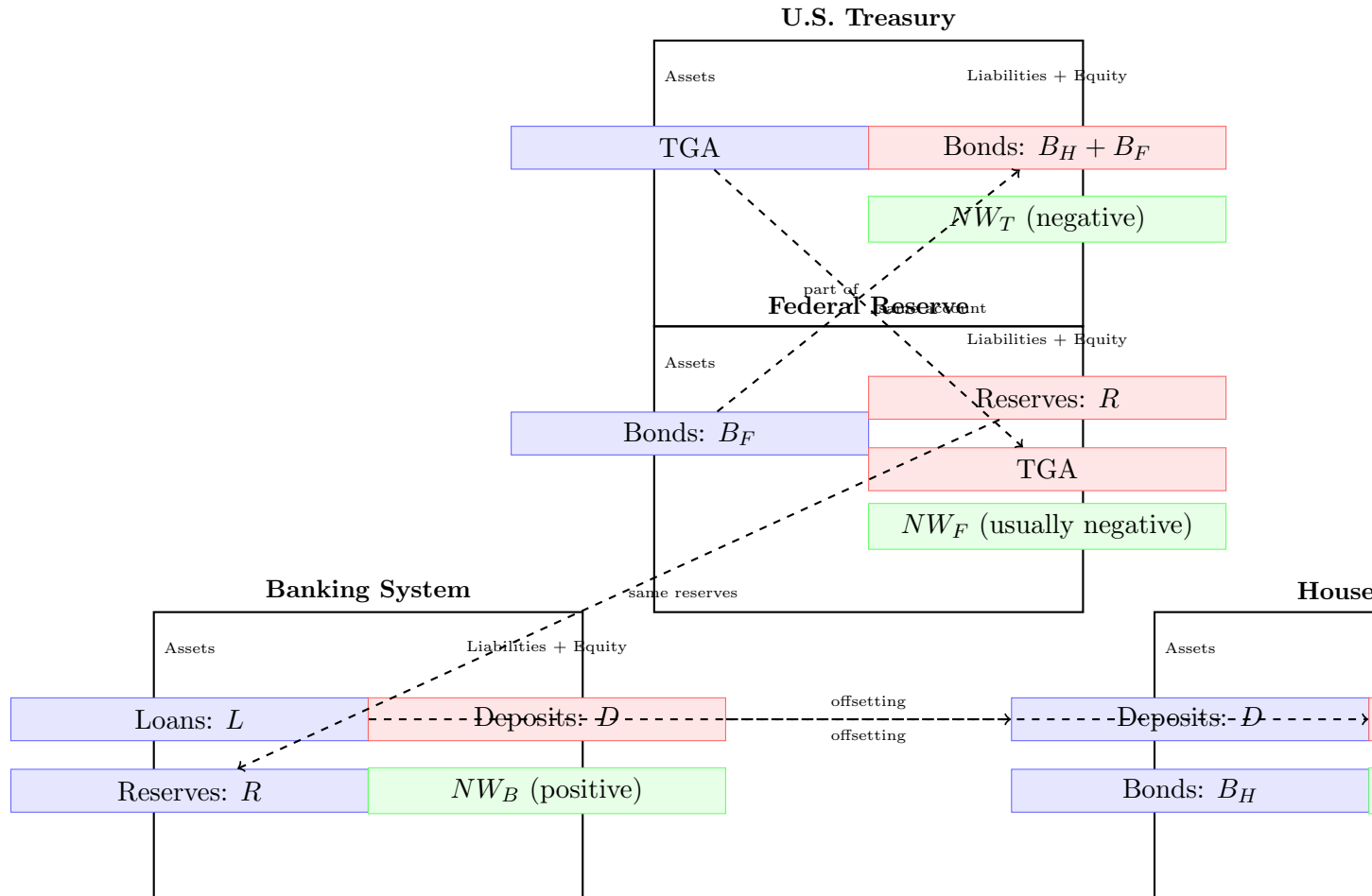
U.S. Treasury

Assets | Liabilities + Equity

TGA | Bonds: $B_H + B_F$

NW_T (negative)

part of ... Account

Federal Reserve

Assets | Liabilities + Equity

Bonds: B_F | Reserves: R

TGA

NW_F (usually negative)

Banking System

Assets | Liabilities + Equity

same reserves

Loans: L | Deposits: D | offsetting | Deposits: D

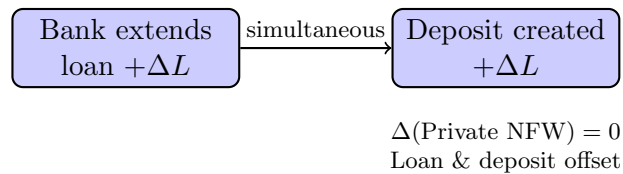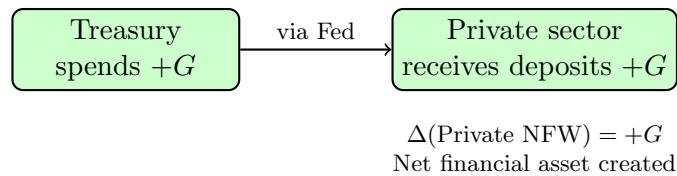Reserves: R | NW_B (positive) | offsetting | Bonds: B_H

House

Assets

Figure 1: Four-Sector Balance Sheet Structure. Dashed lines show offsetting entries across sectors. Private Net Financial Wealth $= R + B_H = -($Treasury NW + Fed NW$)$.

Horizontal Money (Endogenous)

| Bank extends loan $+\Delta L$ | simultaneous → | Deposit created $+\Delta L$ |

$\Delta(\text{Private NFW}) = 0$
Loan & deposit offset

Vertical Money (Exogenous)

| Treasury spends $+G$ | via Fed → | Private sector receives deposits $+G$ |

$\Delta(\text{Private NFW}) = +G$
Net financial asset created

Quantitative Easing (Asset Swap)

| Households hold bonds B_H | → | Fed buys bonds pays with reserves | → | Households hold reserves R |

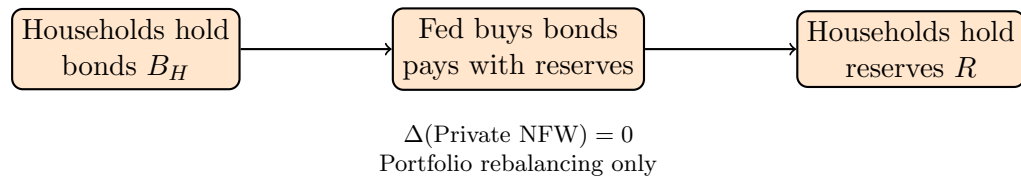$\Delta(\text{Private NFW}) = 0$
Portfolio rebalancing only

Figure 2: Three Types of Monetary Operations. Horizontal money (bank lending) creates offsetting assets and liabilities. Vertical money (fiscal operations) changes net financial wealth. QE is a portfolio swap that preserves net wealth.

3 The Fundamental Sectoral Balance Identity

Theorem 3.1 (Sectoral Balance Identity)**.** *The private sector's net financial wealth equals the negative of the consolidated public sector's net worth:*

$$Private\ NFW = -(NW_T + NW_F)$$

where Private Net Financial Wealth (NFW) is defined as:

$$Private\ NFW = R + B_H$$

Proof. We construct the balance sheets for each sector and derive the identity.

Treasury Balance Sheet:

$$A_T = \text{TGA} \tag{7}$$
$$L_T = B_H + B_F \tag{8}$$
$$NW_T = \text{TGA} - (B_H + B_F) \tag{9}$$

Federal Reserve Balance Sheet:

$$A_F = B_F \tag{10}$$
$$L_F = R + \text{TGA} \tag{11}$$
$$NW_F = B_F - R - \text{TGA} \tag{12}$$

Consolidated Public Sector:

$$NW_{\text{Public}} = NW_T + NW_F \tag{13}$$
$$= (\text{TGA} - B_H - B_F) + (B_F - R - \text{TGA}) \tag{14}$$
$$= -B_H - R \tag{15}$$

Private Net Financial Wealth: The private sector holds reserves R and bonds B_H as financial assets (netting out loans and deposits which cancel):

$$Private\ NFW = R + B_H = -(NW_T + NW_F)$$

$\square$

Remark 3.2. This identity is an accounting identity, not a behavioral relationship. It holds by construction in a closed economy with consolidated sectors.

4 Horizontal Money: Endogenous Credit Creation

See Figure 2 for a visualization of the three types of monetary operations.

Definition 4.1 (Horizontal Money)**.** Horizontal money refers to money created through bank lending. It expands both assets and liabilities on bank and household balance sheets simultaneously.

Proposition 4.2 (Bank Credit Expansion)**.** *When a bank extends credit of amount $\Delta L > 0$:*

1. *Bank assets increase by ΔL (new loan)*

2. *Bank liabilities increase by* ΔL *(new deposit)*

3. *Household assets increase by* ΔL *(new deposit)*

4. *Household liabilities increase by* ΔL *(new loan)*

5. *Private Net Financial Wealth is unchanged:* $\Delta(Private\ NFW) = 0$

6. *Public sector net worth is unchanged:* $\Delta(NW_{Public}) = 0$

Proof. The double-entry bookkeeping entries are:
  Bank:

- Debit: Loans $+\Delta L$

- Credit: Deposits $+\Delta L$

  Household:

- Debit: Deposits $+\Delta L$

- Credit: Loans $+\Delta L$

  Bank equity: $NW_B = (A_B + \Delta L) - (L_B + \Delta L) = NW_B$ (unchanged)
  Household net worth: $NW_H = (A_H + \Delta L) - (L_H + \Delta L) = NW_H$ (unchanged)
  Private NFW consists of reserves and bonds, neither of which changed, so $\Delta(\text{Private NFW}) = 0$. $\qquad \square$

Corollary 4.3 (Refutation of Loanable Funds - Part I)**.** *Bank lending does not require prior savings. Deposits are created simultaneously with loans.*

5 Vertical Money: Fiscal Operations

Definition 5.1 (Vertical Money)**.** Vertical money refers to money created through government fiscal operations (spending and taxation). It changes the net financial assets held by the private sector.

5.1 Fiscal Spending

Proposition 5.2 (Fiscal Spending)**.** *When the Treasury spends amount* $G > 0$:

1. *Treasury's TGA decreases by* G

2. *Bank reserves increase by* G

3. *Household deposits increase by* G

4. *Private Net Financial Wealth increases by* G

5. *Public sector net worth decreases by* G

Proof. The double-entry operations:
  Treasury:

- Credit: TGA $-G$

Federal Reserve:

- Debit: Reserves $+G$

- Credit: TGA $-G$

Banking System:

- Debit: Reserves $+G$

- Credit: Deposits $+G$

Households:

- Debit: Deposits $+G$

Changes to sectoral net worth:

$$\Delta NW_T = -G \tag{16}$$
$$\Delta NW_F = 0 \quad \text{(both assets and liabilities increased by } G\text{)} \tag{17}$$
$$\Delta(\text{Private NFW}) = +G \quad \text{(reserves increased)} \tag{18}$$

Verifying the identity: $\Delta(\text{Private NFW}) = -\Delta(NW_T + NW_F) = -(-G + 0) = +G$ ✓ $\qquad \square$

5.2 Taxation

Proposition 5.3 (Taxation). *Taxation is the inverse of spending. When taxes $T > 0$ are collected:*

1. *Private Net Financial Wealth decreases by T*

2. *Public sector net worth increases by T*

Corollary 5.4 (Fiscal Deficits Create Net Financial Assets). *A fiscal deficit $(G - T) > 0$ increases private sector net financial wealth by exactly $(G - T)$.*

6 Monetary Operations: Portfolio Swaps

6.1 Bond Issuance

Proposition 6.1 (Bond Issuance). *When the Treasury issues bonds B to the private sector:*

1. *Household deposits decrease by B*

2. *Household bond holdings increase by B*

3. *Bank reserves decrease by B*

4. *Treasury's TGA increases by B*

5. *Private Net Financial Wealth is unchanged*

Proof. This is an asset swap for households: reserves $\to$ bonds.
Private NFW before: $R + B_H$
Private NFW after: $(R - B) + (B_H + B) = R + B_H$
Therefore $\Delta(\text{Private NFW}) = 0$. $\qquad \square$

6.2 Quantitative Easing (QE)

Proposition 6.2 (Quantitative Easing). *When the Fed purchases bonds Q from the private sector:*

1. *Household bond holdings decrease by Q*

2. *Fed bond holdings increase by Q*

3. *Household deposits increase by Q*

4. *Bank reserves increase by Q*

5. *Private Net Financial Wealth is unchanged*

Proof. Another asset swap for households: bonds $\rightarrow$ reserves.
  Private NFW before: $R + B_H$
  Private NFW after: $(R + Q) + (B_H - Q) = R + B_H$
  Therefore $\Delta(\text{Private NFW}) = 0$. $\qquad\square$

Remark 6.3. QE and QT (Quantitative Tightening, the reverse operation) are portfolio rebalancing operations. They do not change the private sector's net financial wealth, only its composition.

7 Balance Sheet Integrity

We can verify that all four balance sheets remain balanced after each operation:

Theorem 7.1 (Balance Sheet Consistency). *For each sector $i \in \{T, F, B, H\}$, the accounting identity $A_i = L_i + NW_i$ holds before and after any monetary operation.*

8 Implications and Conclusion

8.1 Refutation of Loanable Funds

The loanable funds doctrine asserts that:

1. Banks lend out savings (FALSE: Proposition 4.2)

2. Government deficits crowd out private investment (FALSE: Proposition 5.2)

3. Central bank operations change money supply (MISLEADING: they change composition, not net wealth)

  The SFC framework shows:

- Banks create deposits when they lend (endogenous money)

- Fiscal deficits create the net financial assets the private sector desires

- QE/QT swap asset types without changing private wealth

8.2 Policy Implications

1. The binding constraint on bank lending is not deposits but creditworthy borrowers and capital requirements

2. Government deficits are necessary to provide net financial assets to the private sector when the private sector desires to net save

3. Interest rate changes via QE/QT work through portfolio rebalancing effects, not changes in the quantity of money

4. The Treasury General Account (TGA) target mechanism shown in the interactive application demonstrates how bond issuance coordinates with fiscal operations to maintain desired government deposit levels

8.3 Interactive Application

The accompanying web application (`src/App.jsx`) implements these operations with the following features:

- Real-time balance sheet updates across all four sectors

- Automatic TGA targeting via bond issuance/redemption

- Visual verification of the sectoral balance identity: Private NFW + Public NW = 0

- Constraints that prevent operations from creating negative stocks (e.g., cannot tax more than existing deposits)

Users can experiment with different magnitudes of fiscal spending, taxation, bank lending, and monetary operations to develop intuition for how these transactions flow through the consolidated sectoral accounts.

9 References

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