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MONASH BUSINESS SCHOOL

Department of Economics
ISSN number 1441-5429

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Discussion Paper no. 2025-19

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1. Introduction

The Ricardian model of comparative advantage (Ricardo, 1817) remains a cornerstone of international trade theory. However, its traditional formulation assumes a barter economy, neglecting the pivotal role of money in facilitating trade. In reality, trade occurs within monetary systems that influence balance-of-payments dynamics and macroeconomic stability. This paper bridges this gap by extending the classical Ricardian model into a monetary framework and examining how different international monetary systems shape trade outcomes.

This model advances a monetary theory of production and exchange (Keynes, 1933), emphasizing the pivotal role of the banking system. In autarky, each country's banking system issues credit to initiate production (Graziani, 2003) and provides payment services to all domestic market participants including the government. When international trade opens, the banking systems of the trading countries interconnect to facilitate cross-border transactions.

Since banks mediate all domestic and international transactions, we use transaction flow matrices – representing bank balance sheets – to track the flow of funds at every stage, from loan issuance and wage payment to tax collection and trade (Godley and Lavoie, 2007).

We study international trade under three distinct monetary systems: (1) the Euro system, where a single currency is used for both domestic and international transactions; (2) the Bancor system, which relies on a supranational currency to mediate trade between nations; and (3) the Dollar system, in which one country's national currency serves as the international media of exchange.

Our analysis reaffirms the Ricardian insight that specialization based on comparative advantage enhances global efficiency. We also identify key distinctions arising from each monetary system.

Under the Euro system, since countries do not face foreign exchange constraints, international trade is economically indistinguishable from domestic trade, and there is no built-in mechanism to correct trade imbalances.

Under the Bancor system, the use of a supranatural currency makes international transactions economically distinct from domestic ones, and trade imbalances may be corrected through exchange rate adjustments.

Crucially, neither the Euro nor the "Banor" system inherently generates trade imbalances. In contrast, the Dollar system creates an asymmetric demand for the national currency used to conduct international trade. Since the currency demanded must be earned through net exports, trade imbalances are an intrinsic feature of the Dollar

system.

This work builds on two strands of literature.

The first examines the role of currency in the international monetary system. Matsuyama et al. (1993) develop a two-country model showing the conditions for multiple equilibria with competing international currencies. Goldberg and Tille (2008) and Devereux and Shi (2013) analyze how vehicle currencies reduce transaction costs in trade. Doepke and Schneider (2017) argue that a dominant unit of account mitigates risks. Gopinath and Stein (2021) demonstrate that the functions of a currency – unit of account, store of value, trade invoicing and banking – are complementary, and the complementarity can lead to the emergence of a dominant currency.

The second strand of literature investigates the design and implications of alternative monetary systems.

The Euro system reflects the theory of optimal currency areas (OCAs), which posits that a shared currency is advantageous for a region with high trade integration and factor mobility (Mundell, 1961). There is also empirical evidence suggesting that the adoption of a common currency strengthens trade ties and increases business cycle synchronization (Frankel & Rose, 1998).

The Bancor system, first proposed by J. M. Keynes in 1942, envisioned an International Clearing Union (ICU) operating on a supranational bank-money, Bancor. Each member State would have an ICU account with a designated quota. Imbalances – whether surpluses or deficits exceeding 25% of the quota – would trigger corrective measures: fees, currency adjustments (appreciation for surplus states and devaluation for deficit states), and other remedies (IMF, 1996).

Despite its ingenious design, Keynes' proposal was ultimately rejected at Bretton Woods in favor of the White Plan, which established a dollar-centric system anchored to gold. Although the Bretton Woods system collapsed in 1971 when the US suspended the dollar's gold convertibility, the US not only retained but expanded its global dominance in the decades that followed.

Under the Dollar system – whether gold-backed or not – the US dollar is the global primary reserve and vehicle currency. The fact that other countries accept dollars as payments grants the US an extraordinary privilege. As General Charles de Gaulles put it in a press conference in 1965:

"…when the US owe something, they can pay for it, at least in part, with dollars that they can issue, instead of using gold, whose value is real and has to be earned and which one cannot transfer to others without risk and sacrifice. This unilateral facility that the United States has means that the dollar is not an impartial means of

international exchange, since it is a means of issuing credit for one state." (Quoted in Gourinchas et al., 2019, p. 860)

In essence, the country that issues a reserve currency can finance a portion of its imports and foreign investments simply by issuing debt, since that debt serves as both a means of payment and reserve assets for other nations. This unique advantage – what Valéry Giscard d'Estaing, finance minister under de Gaulles, famously called the "exorbitant privilege" – grants the US significant economic benefits. Chief among these benefits is the ability to borrow at low costs (Caballero et al., 2008), while earning excess returns on its net foreign asset position (Gourinchas and Rey, 2005). Additionally, US corporations can raise capital abroad through dollar-denominated debt issuance (Maggiori et al., 2020).

The exorbitant privilege of dollar dominance comes with a structural counterpart: the global economy's reliance on the US dollar for trade settlement and reserve accumulation. Since these dollars must be earned through net exports or assets sales, the system inherently generates balance of payments imbalances. As Triffin (1961) observed, the US must run balance of payment deficits to supply the world with sufficient liquidity. As the world economy grows, the demand for liquidity also grows, which means the US must run ever-larger deficits. A contradiction, known as the "Triffin dilemma", manifests under a gold-back dollar system: expanding deficits without corresponding increases in gold reserves would undermine confidence in the dollar, while restricting deficits could result in a global liquidity shortage.

Remarkably, the dilemma endures even after the dollar's delinking from gold. If foreign-held dollar reserves grow too large relative to the size of the US economy, confidence in the dollar could falter. Conversely, insufficient dollar liquidity could destabilize international financial markets (Gourinchas and Rey, 2005).

For developing nations, the imperative to accumulate dollar reserves carries significant economic costs (UNCTAD, 2023). Beyond diverting resources from domestic priorities, the reliance on the dollar leaves them vulnerable to spillovers from US monetary policy shifts (Cheng and Zhang, 2012a, 2012b). For instance, a monetary expansion in the US may prompt nations of the Global South to increase their dollar holdings, which effectively channel real resources to the US economy (Cheng and Zhang, 2016).

This paper makes two contributions to the existing literature. First, it extends the Ricardian framework to incorporate money. It uses transaction flow matrices to comprehensively trace fund movements across all exchanges including loan issuance, wage payment, tax collection, sales and loan repayments. This approach provides a unified accounting of monetary flows between market participants domestically and internationally.

Second, it compares the financial flows and equilibrium outcomes under three distinct

monetary systems. Through this comparative approach, it reveals fundamental structural asymmetries in the dollar system, demonstrating how reserve currency dominance necessarily generates trade imbalances, and grants the reserves currency country the privilege of deferring deficit settlement indefinitely.

The results of this paper have implications for several debates in international monetary economics: the theory of optimal currency areas, the sustainability of dollar system (Eichengreen, 2004, 2011), and international monetary reforms (Farhi et al., 2011). The analytical framework developed here also provides new a new tool for studying distributional consequences of different international monetary arrangements.

The remainder of the paper proceeds as follows: Section 2 outlines the monetary Ricardian model in autarky, Section 3 analyzes trade outcomes under the three different monetary systems, and Section 4 concludes.

2. A Monetary Ricardian Model in Autarky

Consider a world with two countries, country A with population N_A, and country B with population N_B. Residents in each country consume two tradable goods, X, Y and receive government services, G, funded by taxes.

All goods are produced with only labour. The production functions for the goods X, Y, and government services G in country *i* (*i* = A, B) are:

$$X_i = a_{ix} L_{ix} \tag{1}$$

$$Y_i = a_{iy} L_{iy} \tag{2}$$

$$G_i = a_{i\mathrm{G}} L_{i\mathrm{G}} \tag{3}$$

where L_{ix}, L_{iy}, and L_{iz} are labour devoted to the production of goods X, Y, and government services G, respectively.

In autarky, both countries produce goods X, Y for self-consumption, and the government in each country provides services G for its residents. The decision problem of a representative resident in country *i* (*i* = A, B) is:

$$\max_{x_i, y_i} u_i = G_i \, x_i^{\alpha} y_i^{\beta} \quad (\alpha + \beta = 1)$$

subject to the budget constraint:

$$p_{ix} x_i + p_{iy} y_i = w_i (1 - t_i)$$

where G_i, x_i and y_i are quantities of government services, good X and good Y consumed, respectively; p_{ix} and p_{iy} are prices of good X and good Y, respectively; t_i is the income tax rate; and w_i is the money wage, or the wage-unit (Keynes, 1936). As a standard measure of real output, the wage-unit is treated as exogenous. Its numerical value is expressed in the national currency unit which serves as the numeraire.

In country *i* (*i* = A, B), domestic transactions are conducted using currency *i* and facilitated by the country's banking system. The flow of funds can be tracked by examining changes in the balance sheets of the central bank and commercial banks. We use transaction flow matrices (Godley and Lavoie, 2007) to record all transactions and their corresponding financial flows.

In these matrices, an increase in assets is recorded with a "−" sign and an increase in liabilities a "+" sign. Since every payment entails an equal increase in one party's assets and the counter-party's liabilities, double-entry accounting ensures that each row sums to zero. Each column also sums to zero when all participants' budget constraints are satisfied.

Table 1 presents the transaction flow matrices for country *i* (*i* = A, B) under autarky. The matrices show that economic activities in each country unfold in four steps:

(1) Banks lend to producers

The central bank lends to the government, and commercial banks lend to the firms producing good X and good Y ("firm X" and "firm Y").

In this model, both the government and the firms are "producers". Following Graziani (2003), production begins with input purchases financed by credit. Since labour is the only input, the borrowed funds are used exclusively to pay wages. The wage bills include: government wages ($L_{iG}w_i$), wages in firm X ($L_{ix}w_i$), and wages in firm Y ($L_{iy}w_i$).

The central bank's loan to the government increases its assets (recorded as $-L_{iG}w_i$) and creates a government deposit (a liability, recorded as $+L_{iG}w_i$).

Commercial bank loans to firm X and firm Y increase the banks' assets (recorded as $-L_{ix}w_i$ and $-L_{iy}w_i$), and create corresponding firm deposits (liabilities, recorded as $+L_{ix}w_i$ and $+L_{iy}w_i$).

Table 1. Transaction Flow Matrices: Autarky in Country *i* (*i* = A, B)

Central Bank in country i (Central Bank i)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{iG}w_i$		$+L_{iG}w_i$	0
(2) Government pays workers		$+L_{iG}w_i$	$-L_{iG}w_i$	0
(3) Workers pay taxes		$-N_i t_i w_i$	$+N_i t_i w_i$	0
(4) Government repays loan	$+L_{iG}w_i$		$-L_{iG}w_i$	0
Sum	0	0	0	0

Commercial banks in country i (Bank i)

Transactions	Assets	Liabilities			Sum
		Firm X	Firm Y	Workers	
(1) Loan to firm X	$-L_{ix}w_i$	$+L_{ix}w_i$			0
Loan to firm Y	$-L_{iy}w_i$		$+L_{iy}w_i$		0
(2) Government pays workers	$-L_{iG}w_i$			$+L_{iG}w_i$	0
Firms pay workers		$-L_{ix}w_i$	$-L_{iy}w_i$	$+(L_{ix}+L_{iy})w_i$	0
(3) Workers pay taxes	$+N_i t_i w_i$			$-N_i t_i w_i$	0
Workers purchase goods		$+p_{ix}X_i$	$+p_{iy}Y_i$	$-(1-t_i)N_i w_i$	0
(4) Firms repay loans	$+(L_{ix}+L_{iy})w_i$	$-p_{ix}X_i$	$-p_{iy}Y_i$		0
Sum	0	0	0	0	0

(2) Producers pay workers.

When the government pays its workers, on the commercial banks' balance sheet, the workers' deposit increases ($+L_{iG}w_i$), matched by an equal increase in bank reserves ($-L_{iG}w_i$). On the central bank's balance sheet, the government's deposits decrease ($-L_{iG}w_i$), and commercial banks' reserves increase by an equal amount ($+L_{iG}w_i$).

When firm X and firm Y pay their workers, on the commercial banks' balance sheet, the firms' deposits decrease ($-L_{ix}w_i$, $-L_{iy}w_i$) and the workers' deposits increase by the total wage payments ($+\left(L_{ix}+L_{iy}\right)w_i$).

The production of goods and government services proceeds after wage payment. While production is not explicitly recorded in the transaction flow matrices, it is implied by the financial flows.

(3) Workers pay taxes and purchase consumption goods.

Once production is completed, the government collects taxes from workers, reducing their deposit balances ($-N_i t_i w_i$) and decreasing commercial bank reserves ($+N_i t_i w_i$). On the Central Bank's balance sheet, this reduction in banks reserves is matched by an equal increase in the government's deposit balance.

Workers use their disposable income to buy consumption goods from firm X and firm Y, transferring deposits from workers ($-(1-t_i)N_i w_i$) to firms ($+p_{ix}X_i$ and $+p_{iy}Y_i$).

(4) Producers repay bank loans.

The government repays its central bank loan with tax revenue. This repayment reduces the central bank's balance sheet to zero.

Firms repay their commercial bank loans with sales revenue. These repayments reduce commercial banks' balance sheet to zero.

With all debts settled, the cycle of economic activities can repeat following the same four-step process.

The economic activities described above have three notable characteristics.

First, the banking system does not lend out existing deposits; rather, it creates deposits when extending loans. This aligns with contemporary monetary theory and practice as

articulated by the Bank of England[1].

Second, while banks create credit, they cannot generate *real purchasing power* ex nihilo. Purchasing power must ultimately be backed by real goods and services. What banks lend out is an acknowledgement of debt (IOU) used as a means of payment.[2] When a bank lends, it commits to executing payments on the borrower's behalf.

Third, wage payments "monetize" real goods and services (Schmitt, 1984; Cencini, 2001, 2005). Since wage income deposited with the bank represent a financial claim on newly produced goods, bank loans are implicitly backed by real goods and services. While bank loans temporally proceed production, their validity depends on subsequent output. In other words, bank credit enables production, and must in turn be validated by production.

Having established the cyclical process of economic activities – from credit creation and production to taxation, consumption and debt settlement – we now follow the conventional analytical approach to solve for the equilibrium prices and quantities.

Solving the representative resident's decision problem formalized in the model specification, we obtain the following demand functions for good X and good Y:

$$x_i = \frac{\alpha w_i (1 - t_i)}{p_{ix}} \tag{4}$$

$$y_i = \frac{\beta w_i (1 - t_i)}{p_{iy}} \tag{5}$$

Assuming competition in the production of both goods so that all firms receive zero economic profit, we derive the prices for each good:

$$p_{ix} = \frac{w_i}{a_{ix}} \tag{6}$$

$$p_{iy} = \frac{w_i}{a_{iy}} \tag{7}$$

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[1] See Bank of England, Explainers, How is money created? https://www.bankofengland.co.uk/explainers/how-is-money-created.

[2] In our model (as in real economies during normal times), commercial bank IOUs (bank deposits) are on par with central bank IOUs (reserves and government deposits).

Assuming that government services are fully funded by taxes:

$$w_i L_{i\mathrm{G}} = w_i t_i N_i$$

which implies:

$$L_{i\mathrm{G}} = t_i N_i \tag{8}$$

In equilibrium, all markets clear, which means the following conditions are met:

Labor market:

$$L_{ix} + L_{iy} + L_{iG} = N_i \tag{9}$$

Goods market:

$$N_i x_{\mathrm{i}} = X_i \tag{10}$$

$$N_i y_{\mathrm{i}} = Y_i \tag{11}$$

Equations (4) - (10) together with equations (1) - (3) (the production functions) give us a system of 10 equations (equation (11) is redundant). This allows us to solve the equilibrium values of 10 endogenous variables. The solutions are presented in Table 5.

Starting from autarky, we now let the two countries open to international trade, and consider the trade relations between them. From the autarky money prices, we derive the relative price of good X to good Y in country *i*, (i = A, B):

$$\frac{p^*_{ix}}{p^*_{iy}} = \frac{a_{iy}}{a_{ix}}$$

Without loss of generality, we assume that country A has a comparative advantage in good X, and country B has a comparative advantage in good Y, that is:

$$\frac{p^*_{Ax}}{p^*_{Ay}} < \frac{p^*_{Bx}}{p^*_{By}}$$

which implies:

$$\frac{a_{Ax} a_{By}}{a_{Ay} a_{Bx}} > 1$$

We study the trade relations between the two countries under three alternative international monetary systems: (1) the Euro system, where both countries use a common currency for domestic and international trade; (2) the Bancor system, where a

supranational currency, Bancor, is created to settle cross-border transactions; and (3) the Dollar system, where country A's national currency is used as the international currency.

For simplicity, we only consider the case of complete international division of labor, in which country A specializes in producing good X and country B specializes in producing good Y.[3]

3. Alternative monetary systems

3.1. The Euro system

Currency arrangement and economic activities

Under the Euro system, country A and country B form a monetary union and use a common currency. Country A specializes in producing and exporting good X, country B specializes in producing and exporting good Y. Both governments provide services for their own residents.

We summarize the economic activities in three transaction flow matrices. Table 2A and 2B report flow of funds in country A and country B, respectively. Table 2C reports cross-border trade settlement.

The cycle of economic activities in both countries proceeds in 6 steps:

(1) Banks lend to producers.

(2) Producers pay workers.

(3) Banks lend to importers.

(4) Importers pay for imports.

(5) Workers pay taxes and purchase consumption goods.

(6) Producers and importers repay bank loans.

[3] If the two countries are sufficiently different in economic size, the international division of labor will be "partial", which means the "larger" country needs to produce both traded goods (Cheng, Liu & Yang, 2000; Cheng, Sachs, & Yang, 2000).

Table 2A. Transaction Flow Matrices: The Euro System

Central Bank in country A (Central Bank A)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{AG}w_A$		$+L_{AG}w_A$	0
(2) Government pays workers		$+L_{AG}w_A$	$-L_{AG}w_A$	0
(4) Importer Y pays for imports	$+p_yY_{AIm}$	$-p_yY_{AIm}$		0
Firm X receives payment for exports	$-p_xX_{AEx}$	$+p_xX_{AEx}$		0
(5) Workers pay taxes		$-N_At_Aw_A$	$+N_At_Aw_A$	0
(6) Government repays loan	$+L_{AG}w_A$		$-L_{AG}w_A$	0
Sum	$+p_yY_{AIm}-p_xX_{AEx}$	$-p_yY_{AIm}+p_xX_{AEx}$	0	0

Commercial banks in country A (Bank A)

Transactions	Assets	Liabilities			Sum
		Firm X	Importer Y	Workers	
(1) Loan to firm X	$-L_{Ax}w_A$	$+L_{Ax}w_A$			0
(2) Government pays workers	$-L_{AG}w_A$			$+L_{AG}w_A$	0
Firm X pay workers		$-L_{Ax}w_A$		$+L_{Ax}w_A$	0
(3) Loan to importer Y	$-p_yY_{AIm}$		$+p_yY_{AIm}$		0
(4) Importer Y pays for imports	$+p_yY_{AIm}$		$-p_yY_{AIm}$		0
Firm X receives payments for exports	$-p_xX_{AEx}$	$+p_xX_{AEx}$			0
(5) Workers pay taxes	$+N_At_Aw_A$			$-N_At_Aw_A$	0
Workers purchase goods		$+p_x(X_A-X_{AEx})$	$+p_yY_{AIm}$	$-p_x(X_A-X_{AEx})-p_yY_{AIm}$	0
(6) Firm X and importer Y repay loans	$+p_xX_A+p_yY_{AIm}$	$-p_xX_A$	$-p_yY_{AIm}$		0
Sum	$+p_yY_{AIm}-p_xX_{AEx}$	0	0	$-p_yY_{AIm}+p_xX_{AEx}$	0

Table 2B. Transaction Flow Matrices: The Euro System

Central Bank in country B (Central Bank B)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{BG}w_B$		$+L_{BG}w_B$	0
(2) Government pays workers		$+L_{BG}w_B$	$-L_{BG}w_B$	0
(4) Importer X pays for imports	$+p_xX_{BIm}$	$-p_xX_{BIm}$		0
Firm Y receives payment for exports	$-p_yY_{BEx}$	$+p_yY_{BEx}$		0
(5) Workers pay taxes		$-N_Bt_Bw_B$	$+N_Bt_Bw_B$	0
(6) Government repays loan	$+L_{BG}w_B$		$-L_{BG}w_B$	0
Sum	$+p_xX_{BIm}-p_yY_{BEx}$	$-p_xX_{BIm}+p_yY_{BEx}$	0	0

Commercial banks in country B (Bank B)

Transactions	Assets	Liabilities			Sum
		Firm Y	Importer X	Workers	
(1) Loan to firm Y	$-L_{By}w_B$	$+L_{By}w_B$			0
(2) Government pays workers	$-L_{BG}w_B$			$+L_{BG}w_B$	0
Firm Y pay workers		$-L_{By}w_B$		$+L_{By}w_B$	0
(3) Loan to importer X	$-p_xX_{BIm}$		$+p_xX_{BIm}$		0
(4) Importer Y pays for imports	$+p_xX_{BIm}$		$-p_xX_{BIm}$		0
Firm Y receives payment for exports	$-p_yY_{BEx}$	$+p_yY_{BEx}$			0
(5) Workers pay taxes	$+N_Bt_Bw_B$			$-N_Bt_Bw_B$	0
Workers purchase goods		$+p_y(Y_B-Y_{BEx})$	$+p_xX_{BIm}$	$-p_y(Y_B-Y_{BEx})-p_xX_{BIm}$	0
(6) Firm Y and importer X repay loans	$+p_yY_B+p_xX_{BIm}$	$-p_yY_B$	$-p_xX_{BIm}$		0
Sum	$+p_xX_{BIm}-p_yY_{BEx}$	0	0	$-p_xX_{BIm}+p_yY_{BEx}$	0

Table 2C. Transaction Flow Matrices: The Euro System

International settlement in the Euro System

	Assets	Liabilities		Sum
		Country A	Country B	
Country A imports good Y		$-p_y Y_{AIm}$	$+p_y Y_{AIm}$	0
Country B imports good X		$+p_x X_{BIm}$	$-p_x X_{BIm}$	0
Sum	0	$-p_y Y_{AIm} + p_x X_{BIm}$	$+p_y Y_{AIm} - p_x X_{BIm}$	0

This cycle is similar to that in autarky, with 2 additional steps – steps (3) and (4):

(3) Banks lend to importers.

Once production is completed, banks provide trade finance to importers. The common currency simplifies trade financing – importers obtain loans identically to domestic firms. As shown in Table 2A, Bank A lends the value of imports ($p_y Y_{AIm}$) to country A's importer of good Y ("importer Y"), which increases Bank A's assets ($-p_y Y_{AIm}$) and the importer's deposit ($+p_y Y_{AIm}$). Similarly, as shown in Table 2B, Bank B lends the value of imports ($p_x X_{BIm}$) to country B's importer of good X ("importer X"), which increases Bank B's asset ($-p_x X_{BIm}$) and importer X's deposit ($+p_x X_{BIm}$).

(4) Importers pay for imports.

Payment from importer Y (in country A) to firm Y (in country B) affects 3 transaction flow matrices: Table 2A, Table 2B, and Table 2C. In Table 2A, importer Y's deposits fall ($-p_y Y_{AIm}$), and so do Bank A's reserves ($+p_y Y_{AIm}$). In Table 2B, firm Y's deposit and Bank B's reserves increase by the same amount, $p_y Y_{BEx}$, where $Y_{BEx} = Y_{AIm}$ (i.e., good Y exported by country B equals good Y imported by country A). In Table 2C, the payment is settled between the central banks through a gross settlement system. The payment settlement results in an increase in Central Bank B's claim on the Euro system ($-p_y Y_{BEx}$), and an increase in Central Bank A's liabilities ($+p_y Y_{AIm}$).

Payment from importer X (in country B) to firm X (in country A) mirrors the above process. The settlement results in an increase in Central Bank B's claim on the Euro system ($-p_x X_{AEx}$), and an increase in Central Bank B's liabilities ($+p_x X_{BIm}$).

At the end of each cycle, bank loans are repaid, and the banking system balance sheets in each country show the country's trade balance. Recall that each column (on the liabilities side) of the transaction flow matrix represents an agent's budget constraint. If workers and governments in both countries meet their budget constraints, trade will be balanced, and the banking system balance sheet will be reset to zero after loan repayment. A new cycle of economic activities can then begin following the same 6-step process.

Equilibrium

We follow the same approach used in the autarky case to solve the trade equilibrium under the Euro system. Since each country specializes in producing its comparative advantage good, and provides its own government services, the relevant production functions are:

$$X_A = a_{Ax} L_{Ax} \tag{12}$$

$$Y_B = a_{By} L_{By} \tag{13}$$

$$G_A = a_{AG} L_{AG} \tag{14}$$

$$G_B = a_{BG} L_{BG} \tag{15}$$

The demand functions for goods X and Y in country A and country B are:

$$x_A = \frac{\alpha w_A (1 - t_A)}{p_x} \tag{16}$$

$$y_A = \frac{\beta w_A (1 - t_A)}{p_y} \tag{17}$$

$$x_B = \frac{\alpha w_B (1 - t_B)}{p_x} \tag{18}$$

$$y_B = \frac{\beta w_B (1 - t_B)}{p_y} \tag{19}$$

Government services in each country are assumed to be fully funded by taxes, which imply:

$$L_{AG} = t_A N_A \tag{20}$$

$$L_{BG} = t_B N_B \tag{21}$$

Under the condition of zero economic profit, money prices for goods X and Y are:

$$p_x = \frac{w_A}{a_{Ax}} \tag{22}$$

$$p_y = \frac{w_B}{a_{By}} \tag{23}$$

In equilibrium, all markets clear.

Clearance of labor market in country A and country B requires:

$$L_{Ax} + L_{AG} = N_A \tag{24}$$

$$L_{By} + L_{BG} = N_B \tag{25}$$

Clearance of goods market in country A requires:

$$N_A x_A = X_A - X_{AEx} \tag{26}$$

$$N_A y_A = Y_{AIm} \tag{27}$$

where X_{AEx} is country A's exports of good X, Y_{AIm} is country A's imports of good Y.

Clearance of goods market in country B requires:

$$N_B x_B = X_{BIm} \tag{28}$$

$$N_B y_B = Y_B - Y_{BEx} \tag{29}$$

Country A's exports is country B's imports, and vice versa:

$$X_{AEx} = X_{BIm} \tag{30}$$

$$Y_{AIm} = Y_{BEx} \tag{31}$$

Equations (12) – (31) make up a system of 20 equations, of which equation (27) is redundant. The remaining 19 independent equation determine the equilibrium values of 18 endogenous variables, and define one parameter condition for equilibrium.

The equilibrium solutions are presented in Table 5. The parameter condition is that the total expenditure on good Y in country A must equal the total expenditure on good X in country B:

$$N_A \beta w_A (1 - t_A) = N_B \alpha w_B (1 - t_B)$$

Since country A imports good Y and country B imports good X, the above condition implies balanced trade:

$$p_y Y_{BEx} = p_x X_{AEx}$$

It is easy to show that country A's residents benefit from international trade (i.e., trade provides higher utility levels than autarky) if and only if:

$$\frac{w_A a_{By}}{w_B a_{Ay}} > 1 \tag{32}$$

Country B's resident benefit from trade if and only if:

$$\frac{w_B a_{Ax}}{w_A a_{Bx}} > 1 \qquad (33)$$

Combining the two inequalities gives the condition for mutually beneficial trade:

$$\frac{a_{Ax}}{a_{Bx}} > \frac{w_A}{w_B} > \frac{a_{Ay}}{a_{By}}$$

This condition implies that the money price of each country's imported good should be lower than the price of that good in autarky.

Multiplying inequalities (32) and (33), we have a necessary condition for mutual benefit from trade:

$$\frac{a_{Ax} a_{By}}{a_{Ay} a_{Bx}} > 1$$

which is our assumption that country A has a comparative advantage in good X and country B has a comparative advantage in good Y.

3.2. The Bancor system

Currency arrangement and economic activities

Under the Bancor system – proposed by J. M. Keynes in 1942 – international trade would be settled in a supranational currency (Bancor) through an International Clearing Union (ICU). Each member state would hold an ICU account. Surplus countries would accumulate Bancor credits and deficit countries would have Bancor debts.

The system included a built-in mechanism to rebalance global trade. If a member state's Bancor credits or debts exceeded a 25% of its designated quota, corrective measures would take effect. Surplus countries might face fees, currency appreciation, requirements to boost domestic demand, or obligations to extend international development loans. Deficit countries could be subject to fees and currency depreciation (IMF, 1996).

In this paper's adaption of the Bancor system, country A and country B use their national currencies for domestic trade, but settle bilateral trade in Bancor. Their national currencies are pegged to the Bancor, and each central bank maintains Bancor account with the ICU.

Economic activities in both countries proceed in 6 steps:

(1) Banks lend to producers.

(2) Producers pay workers.

(3) Banks lend to importers.

(4) Importers pay for imports.

(5) Workers pay taxes and purchase consumption goods.

(6) Producers and importers repay bank loans.

These steps mirror those in the Euro system, with one key difference: in step (4) payments by importers are settled through the ICU. We capture the associated financial flows in 3 transaction flow matrices (Tables 3A, 3B and 3C).

These matrices diverge from their Euro system counterparts in two important respects:

First, all entries in each country's transaction flow matrices are denominated in the country's national currency, with goods priced in the producer's currency. Specifically, p_x is expressed in country A's currency ("currency A"), and p_y is expressed in country B's currency ("currency B"). Both currencies maintain fixed exchange rates with the Bancor: e_A (units of Bancor per currency A), and e_B (units of Bancor per currency B).

For example, in transaction (3) in Table 3A, where Bank A lends to importer Y the value of imports in currency A. The import value ($p_y Y_{AIm}$) is initially in currency B. It is converted to Bancor ($p_y Y_{AIm} e_B$), and then to currency A ($p_y Y_{AIm} e_B / e_A$).

Second, international payments are processed through both countries' banking systems and settled via the ICU.

For example, when importer Y (country A) makes a payment to firm Y (country B):

- Table 3A (Currency A): importer Y's deposit decreases ($-p_y Y_{AIm} e_B / e_A$), and Bank A's reserves decrease ($+p_y Y_{AIm} e_B / e_A$)
- Table 3C (Bancor): Central Bank A's ICU account is debited ($-p_y Y_{AIm} e_B$), and Central Bank B's ICU account is credited ($+p_y Y_{AIm} e_B$).
- Table 3B (currency B): Bank B's reserves increase ($+p_y Y_{BEx}$, where $Y_{BEx} = Y_{AIm}$), and firm Y's deposit increases ($+p_y Y_{BEx}$).

Table 3A. Transaction Flow Matrices: The Bancor System

Central Bank in country A (Central Bank A)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{AG}w_A$		$+L_{AG}w_A$	0
(2) Government pays workers		$+L_{AG}w_A$	$-L_{AG}w_A$	0
(4) Importer Y pays for imports	$+p_yY_{AIm}e_B$ (Bancor)	$-p_yY_{AIm}e_B/e_A$		0
Firm X receives payment for exports	$-p_xX_{AEx}e_A$ (Bancor)	$+p_xX_{AEx}$		0
(5) Workers pay taxes		$-N_At_Aw_A$	$+N_At_Aw_A$	0
(6) Government repays loan	$+L_{AG}w_A$		$-L_{AG}w_A$	0
Sum	$+p_yY_{AIm}e_B - p_xX_{AEx}e_A$	$-p_yY_{AIm}e_B/e_A+p_xX_{AEx}$	0	0

Commercial banks in country A (Bank A)

Transactions	Assets	Liabilities			Sum
		Firm X	Importer Y	Workers	
(1) Loan to firm X	$-L_{Ax}w_A$	$+L_{Ax}w_A$			0
(2) Government pays workers	$-L_{AG}w_A$			$+L_{AG}w_A$	0
Firm X pay workers		$-L_{Ax}w_A$		$+L_{Ax}w_A$	0
(3) Loan to importer Y	$-p_yY_{AIm}e_B/e_A$		$+p_yY_{AIm}e_B/e_A$		0
(4) Importer Y pays for imports	$+p_yY_{AIm}e_B/e_A$		$-p_yY_{AIm}e_B/e_A$		0
Firm X receives payments for exports	$-p_xX_{AEx}$	$+p_xX_{AEx}$			0
(5) Workers pay taxes	$+N_At_Aw_A$			$-N_At_Aw_A$	0
Workers purchase goods		$+p_x(X_A-X_{AEx})$	$-p_yY_{AIm}e_B/e_A$	$-p_x(X_A-X_{AEx})-p_yY_{AIm}e_B/e_A$	0
(6) Firm X and importer Y repay loans	$+p_xX_A+p_yY_{AIm}e_B/e_A$	$-p_xX_A$	$-p_yY_{AIm}e_B/e_A$		0
Sum	$+p_yY_{AIm}e_B/e_A-p_xX_{AEx}$	0	0	$-p_yY_{AIm}e_B/e_A+p_xX_{AEx}$	0

Table 3B. Transaction Flow Matrices: The Bancor System

Central Bank in country B (Central Bank B)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{BG}w_B$		$+L_{BG}w_B$	0
(2) Government pays workers		$+L_{BG}w_B$	$-L_{BG}w_B$	0
(4) Importer X pays for imports	$+p_xX_{BIm}e_A$ (Bancor)	$-p_xX_{BIm}e_A/e_B$		0
Firm Y receives payment for exports	$-p_yY_{BEx}e_B$ (Bancor)	$+p_yY_{BEx}$		0
(5) Workers pay taxes		$-N_Bt_Bw_B$	$+N_Bt_Bw_B$	0
(6) Government repays loan	$+L_{BG}w_B$		$-L_{BG}w_B$	0
Sum	$+p_xX_{BIm}e_A-p_yY_{BEx}e_B$	$-p_xX_{BIm}e_A/e_B+p_yY_{BEx}$	0	0

Commercial banks in country B (Bank B)

Transactions	Assets	Liabilities			Sum
		Firm Y	Importer X	Workers	
(1) Loan to firm Y	$-L_{By}w_B$	$+L_{By}w_B$			0
(2) Government pays workers	$-L_{BG}w_B$			$+L_{BG}w_B$	0
Firm Y pay workers		$-L_{By}w_B$		$+L_{By}w_B$	0
(3) Loan to importer X	$-p_xX_{BIm}e_A/e_B$		$+p_xX_{BIm}e_A/e_B$		0
(4) Importer X pays for imports	$+p_xX_{BIm}e_A/e_B$		$-p_xX_{BIm}e_A/e_B$		0
Firm Y receives payment for exports	$-p_yY_{BEx}$	$+p_yY_{BEx}$			0
(5) Workers pay taxes	$+N_Bt_Bw_B$			$-N_Bt_Bw_B$	0
Workers purchase goods		$+p_y(Y_B-Y_{BEx})$	$+p_xX_{BIm}e_A/e_B$	$-p_y(Y_B-Y_{BEx})-p_xX_{BIm}$	0
(6) Firm Y and importer X repay loans	$+p_yY_B+p_xX_{BIm}e_A/e_B$	$-p_yY_B$	$-p_xe_AX_{BIm}e_A/e_B$		0
Sum	$-p_xX_{BIm}e_A/e_B+p_yY_{BEx}$	0	0	$+p_xX_{BIm}e_A/e_B-p_yY_{BEx}$	0

Table 3C. Transaction Flow Matrices: The Bancor System

International Clearing Union

	Assets	Liabilities		Sum
		Country A	Country B	
Initial position	0	0	0	0
Country A imports good Y		$-p_y Y_{AIm} e_B$	$+p_y Y_{AIm} e_B$	0
Country B imports good X		$+p_x X_{BIm} e_A$	$-p_x X_{BIm} e_A$	0
Sum	0	$-p_y Y_{AIm} e_B + p_x X_{BIm} e_A$	$+p_y Y_{AIm} e_B - p_x X_{BIm} e_A$	0

The end result is: importer Y pays in its own currency (currency A), and exporter Y receives payments in its own currency (currency B); the payment is settled through the ICU – importer Y's central bank sees its ICU account debited, and exporter Y's central bank sees its ICU account credited.

Equilibrium

The system of equations characterizing the Bancor system is nearly identical to that of the Euro system (Equations (12) – (31)), with one key difference: under the Bancor system, goods are priced in the producer's currency, but importers and consumers pay in their own national currency. Consequently, we must introduce separate price equations for each country. The price of good X in country A (in currency A) is:

$$p_x = \frac{w_A}{a_{Ax}} \tag{22}$$

The price of good X in country B (in currency B) is:

$$p_{Bx} = \frac{p_x e_A}{e_B} \tag{22a}$$

Similarly, the price of good Y in country B (in currency B) is:

$$p_y = \frac{w_B}{a_{By}} \tag{23}$$

The price of good Y in country A (in currency A) is:

$$p_{Ay} = \frac{p_y e_B}{e_A} \tag{23a}$$

The solutions to the modified system of equations are presented in Table 5.

As in the Euro system, there is an equilibrium condition on parameters which requires that country A's expenditure on imports (in currency A) should equal country B's expenditure on imports (in currency B):

$$N_A \beta w_A (1 - t_A) = N_B \alpha w_B (1 - t_B)$$

Balanced trade requires:

$$p_y e_B Y_{BEx} = p_x e_A X_{AEx}$$

Given the equilibrium condition on parameters, trade is balanced when $e_A = e_B$, or

equivalently, when the bilateral exchange rate is one. Under this condition, the equilibrium prices and quantities coincide with those of the Euro system.

3.3. The Dollar system

Currency arrangement and economic activities

The international monetary system since Bretton Woods is dollar-centric, with the US dollar serving as the dominant reserve and vehicle currency for global trade and finance.

In our model's Dollar system, country A's national currency (currency A) is used to conduct international trade. Since country B must pay in currency A to import from country A, it holds currency A as foreign exchange (FX) reserves. To accumulate these reserves, country B must run a trade surplus. Essentially, country B's FX reserves are a loan to country A, which we assume is invested in country A's government bonds.

The cycle of economic activities in both countries consist of 7 steps:

(1) Banks lend to producers.

(2) Producers pay workers.

(3) Banks lend to importers.

(4) Importers pay for imports.

(5) Country B's government purchases country B's government bonds.

(6) Workers pay taxes, receive transfer payments (in country A), and buy goods.

(7) Producers and importers repay bank loans.

This cycle is similar to the 6-step Bancor system, but includes an additional step – step (5) – to account for country B's investment FX reserve investment in country A's government bonds.

We summarize the economic activities and their corresponding financial flows in two transaction flow matrices (Tables 4A and 4B). As in the Bancor system, goods prices are denominated in the producer's currency: p_x is expressed in currency A, and p_y is expressed in currency B. The exchange rate between the two currencies is denoted by e (units of currency B per currency A).

Table 4A. Transaction Flow Matrix: “The Dollar” System

Central Bank in country A (Bank A)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{AG}w_A$		$+L_{AG}w_A$	0
(2) Government pays workers		$+L_{AG}w_A$	$-L_{AG}w_A$	0
(5) Government sells bonds Central Bank B		$-p_yY_{AIm}/e + p_xX_{AEx}$	$+p_yY_{AIm}/e - p_xX_{AEx}$	0
Government transfer payment to workers		$+p_yY_{AIm}/e - p_xX_{AEx}$	$-p_yY_{AIm}/e + p_xX_{AEx}$	0
(6) Workers pay taxes		$-N_At_Aw_A$	$+N_At_Aw_A$	0
(7) Government repays loan	$+L_{AG}w_A$		$-L_{AG}w_A$	0
Sum	0	0	0	0

Commercial banks in country A (Central Bank A)

Transactions	Assets	Liabilities					Sum
		Firm X	Importer Y	Workers	Bank B	Central Bank B	
(1) Loan to firm X	$-L_{Ax}w_A$	$+L_{Ax}w_A$					0
(2) Government pays workers	$-L_{AG}w_A$			$+L_{AG}w_A$			0
Firm X pay workers		$-L_{Ax}w_A$		$+L_{Ax}w_A$			0
(3) Loan to importer Y	$-p_yY_{AIm}/e$		$+p_yY_{AIm}/e$				0
(4) Importer Y pays for imports			$-p_yY_{AIm}/e$		$+p_yY_{AIm}/e$		0
Firm X receives payments for exports		$+p_xX_{AEx}$			$-p_xX_{AEx}$		0
Bank B sells currency A to Central Bank B					$-p_yY_{AIm}/e + p_xX_{AEx}$	$+\Delta FX$	0
(5) Government borrows from Central Bank B	$+p_yY_{AIm}/e - p_xX_{AEx}$					$-\Delta FX$	
Government transfer payment to workers	$-p_yY_{AIm}/e + p_xX_{AEx}$			$+p_yY_{AIm}/e - p_xX_{AEx}$			
(6) Workers pay taxes	$+N_At_Aw_A$			$-N_At_Aw_A$			0
Workers purchase goods		$+p_x(X_A - X_{AEx})$	$+p_yY_{AIm}/e$	$-p_x(X_A - X_{AEx})$ $- p_yY_{AIm}/e$			0
(7) Firm X and importer Y repay loans	$+L_{Ax}w_A + p_yY_{AIm}/e$	$-L_{Ax}w_A$	$-p_yeY_{AIm}$				
Sum	0	0		0	0	0	0

Table 4B. Transaction Flow Matrix: “The Dollar” System

Central Bank in country B (Central Bank B)

Transactions	Assets	Liabilities		Sum
		Commercial bank	Government	
(1) Loan to government	$-L_{BG}w_B$		$+L_{BG}w_B$	0
(2) Government pays workers		$+L_{BG}w_B$	$-L_{BG}w_B$	0
(4) Buys currency A from Bank B (FX reserves increase)	$-\Delta FX$	$+p_yY_{BEx}-p_xX_{BIm}\,e$		0
(5) Government buys country A government bonds (the form of FX reserves changes, no impact on size of balance sheet)				
(6) Workers pay taxes		$-N_Bt_Bw_B$	$+N_Bt_Bw_B$	0
(7) Government repays loan	$+L_{BG}w_B$		$-L_{BG}w_B$	0
Sum	$-\Delta FX$	$-p_yY_{AIm}+p_xX_{AEx}/e$	0	0

Commercial bank in country B (Bank B)

Transactions	Assets	Liabilities			Sum
		Firm Y	Importer X	Workers	
(1) Loan to Y firm	$-L_{By}w_B$	$+L_{By}w_B$			0
(2) Government pays workers	$-L_{BG}w_B$			$+L_{BG}w_B$	0
Firm Y pays workers		$-L_{By}w_B$		$+L_{By}w_B$	0
(3) Loan to importer X in currency A	$-p_xX_{BIm}$		$+p_xX_{BIm}$		0
(4) Importer X pays for imports in currency A	$+p_xX_{BIm}$		$-p_xX_{BIm}$		
Firm Y receives payment for exports in currency B	$-p_yY_{BEx}/e$	$+p_yY_{BEx}$			0
Sells surplus currency A to Central Bank*	$+p_yY_{BEx}/e-p_xX_{BIm}$				
	$-p_yY_{BEx}+p_xX_{BIm}\,e$				
(6) Workers pay taxes	$+N_Bt_Bw_B$			$-N_Bt_Bw_B$	0
Workers purchase goods		$+p_{By}(Y_B-Y_{BEx})$	$+ep_xX_{Im}$	$-p_{By}(Y_B-Y_{Ex})-ep_{Ax}X_{Im}$	0
(7) Y Firm and importer X repay loans	$+L_{By}w_B+ep_xX_{Im}$	$-p_{By}Y_B$	$-ep_xX_{Im}$		0
Sum	$+ep_{Ax}X_{Im}-ep_{Ay}Y_{Ex}$	0	0	$-ep_{Ax}X_{Im}+ep_{Ay}Y_{Ex}$	0

*This is equivalent to Bank B buying currency A on behalf of the importer and selling currency A on behalf of the exporter. As a result, in transaction (7), importer X repays its currency A loan in currency B.

The transaction flow matrices differ from their Bancor system counterparts in four key respects, all stemming from the use of country A's national currency as the international currency:

1. Banks in both countries extend loans to importers in currency A.

As shown in transaction (3) of Tables 4A and 4B, importers borrow the value of their imports in current A: importer Y (country A) receives $p_y Y_{AIm}/e$, and importer X (country B) receives $p_x X_{BIm}$.

2. International payments are settled in currency A through country A's banking system.

Since no independent settlement institution exists, all cross-border payments are settled in currency A via country A's banking system. Country A's commercial banks ("Bank A") act as the correspondent banks of country B's commercial banks ("Bank B"), and hold the FX reserves of Central Bank B. As shown in Table 4A, both Bank B and Central Bank B maintain accounts with Bank A.

The payment flows corresponding to cross-border trade are as follows:

(i) Payment from importer Y (country A) to firm Y (country B)

On Bank A's balance sheet (Table 4A, Transaction 4), importer Y's account is debited ($-p_y Y_{AIm}/e$), and Bank B's account is credited ($+p_y Y_{AIm}/e$).

On Bank B's balance sheet (Table 4B, Transaction 4), Bank B's assets increase ($-p_y Y_{BEx}/e$, where $Y_{BEx} = Y_{AIm}$), and firm Y's account is credited in currency B ($+p_y Y_{BEx}$).

(ii) Payment from importer X (country B) to firm X (country A)

On Bank B's balance sheet (Table 4B, Transaction 4), importer X's account is debited ($-p_x X_{BIm}$), and Bank B's assets decreases ($+p_x X_{BIm}$).

On Bank A's balance sheet (Table 4A, Transaction 4), Bank B's account is debited ($-p_x X_{AEx}$), and firm X's account is credited ($+p_x X_{AEx}$, where $X_{AEx} = X_{BIm}$).

3. Country B accumulates currency A reserves and invests them in country A's government bonds.[4] Country A's government distributes the bond proceeds to its

[4] The FX reserves may be invested differently, but ultimately, they finance country A's trade deficit.

workers.

Since country B must pay for imports in currency A, it holds currency A reserves ("FX reserves"), which must grow as trade expands.[5] To accumulate additional FX reserves, country B must run a trade surplus.

The payment flows corresponding to FX reserve accumulation, investment, and distribution are as follows:

(i) FX reserve accumulation

As shown in Transaction 4 of Table 4A, Bank B's account with Bank A is credited when country B receives exports payments ($+p_y Y_{AIm}/e$), and debited when country B pays for imports ($-p_x X_{AEx}$). The resulting trade surplus in currency A is ($p_y Y_{AIm}/e - p_x X_{AEx}$). Bank B sells this surplus to Central Bank B, which increases Central Bank B's FX reserves ($+\Delta FX$). In exchange, Bank B receives reserves in currency B ($+p_y Y_{BEx} - p_x X_{BIm}\ e$, Table 4B, Transaction 4).

(ii) FX reserve investment: Central Bank B invests the additional FX reserves in country A's government bonds

On Bank A's balance sheet, Central Bank B's account is debited ($-\Delta FX$), this reduction in deposits is offset by an increase in bond holding, leaving Central Bank B's total assets unchanged.

On Central Bank A's balance sheet, country A's government receives the bond proceeds ($+p_y Y_{AIm}/e - p_x X_{AEx}$), and Bank A's reserves decrease by the same amount.

(iii) Distribution of bond proceeds: country A's government distributes the bond proceeds as transfer payments to workers

On Bank A's balance sheet, workers deposits increase ($+p_y Y_{AIm}/e - p_x X_{AEx}$), and Bank A's reserves increase by an equal amount.

On Central Bank A's balance sheet, the government's deposits decrease ($-p_y Y_{AIm}/e +$

[5] Starting from autarky when country B does not have any FX, it must earn FX before it can import. Here the implicit assumption is that country B has already earned sufficient FX to meet current transaction demand and wants to increase its holdings to facilitate a growing trade volume in the future. While trade growth is not included in the model, it could come with an exogenous increase in the countries' labor force, L_A and L_B.

$p_x X_{AEx}$) and Bank A's reserves increase by an equal amount.

4. At the end of the economic cycle, country A's government has a net debt, which is financed by the savings of country B's workers.

In country A, after the government, firm X and importer Y repay their bank loans, the balance sheets of Central Bank A and Bank A reduce to zero (Table 4A). However, the government bonds remain outstanding. This public debt is a liability of country A's Treasury and does not appear on Central Bank A's balance sheet.

In country B, after loan repayments, Bank B' balance sheet shows workers' savings ($-ep_{Ax}X_{Im} + ep_{Ay}Y_{Ex}$, which equals to the trade surplus). These savings are matched by Bank B's reserves. Central Bank B's balance sheet shows Bank B's reserves (in currency B), matched by the increase in FX reserves (in currency A).

Clearly, country B' trade deficit (or government deficit) is ultimately financed by the savings of country B's workers. However, the workers' savings and the corresponding FX reserves are "empty" – they not backed by real resources because by the cycle's end, all goods and services produced have been consumed. Specifically, the FX reserves are merely uncollateralized claims on country A's banking system (IOUs). In other words, as the reserve currency issuer, country A avoids transferring real resources to offset its deficit. Instead, it defers actual payment by issuing IOUs (promises to pay later). This is the "exorbitant privilege" tied to currency A's reserve currency status (Eichengreen, 2011).

Equilibrium

Under the Dollar system, country B emerges as the creditor nation, with its representative resident being a net saver, while country A becomes the debtor country with its government being the net borrower. Importantly, these positions are not the result of active individual lending or borrowing decisions, but rather are structurally determined by the architecture of the Dollar system. Since Country B's accumulated FX reserves are held in country A's banking system, country B's savings are automatically recycled back into country A's economy, financing country A's trade deficit.

The decision problem of the representative resident in country A is:

$$\max_{x_A, y_A} u_A = G_A \, x_A^{\alpha} y_A^{\beta} \quad (\alpha + \beta = 1)$$

subject to the budget constraint:

$$p_x x_A + (p_y/e) y_A = w_A(1 - t_A + r_A)$$

where p_y is the price of good Y in currency B, e is the exchange rate, and p_y/e is the price of good Y in currency A; r_A is the rate of tax rebate.

Country A's representative resident spends more than its after-tax income, $w_A(1-t_A)$. The additional spending is made possible because of country A's government debt which finances a transfer payment in the form of a tax rebate, $w_A r_A$.

The decision problem of the representative resident in country B is[6]:

$$\max_{x_B, y_B} u_B = G_B\, x_B^{\alpha} y_B^{\beta} \quad (\alpha + \beta = 1)$$

subject to the budget constraint:

$$p_x e x_B + p_y y_B = w_B(1 - t_B - s_B)$$

where p_x is the price of good X in currency A, e is the exchange rate, and $p_x e$ is the price of good Y in currency B; s_A is the ("forced") savings rate.

Country B's representative resident spends less than its after-tax income. The forced savings, $w_B s_B$, are country B's foreign exchange reserves per person.

Solving the decision problems of the representative residents, we obtain the demand functions for goods X and Y in both countries:

$$x_A = \frac{\alpha[w_A(1 - t_A + r_A)]}{p_x} \tag{34}$$

$$y_A = \frac{\beta w_A(1 - t_A + r_A)}{p_y/e} \tag{35}$$

$$x_B = \frac{\alpha w_B(1 - t_B - s_B)}{p_x e} \tag{36}$$

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[6] Alternatively, the decision problem of country B's representative resident can be modelled by treating foreign exchange reserves as a "good" that enters the utility function. The money-in-utility function approach is equivalent to the approach that includes money as a function of liquidity costs in the budget constraint (Feenstra, 1986).

$$y_B = \frac{\beta w_B (1 - t_B - s_B)}{p_y} \tag{37}$$

It is assumed that country B sets its own desired foreign exchange holdings, thus ΔFX is exogenous. Given ΔFX, country B's required (forced) savings rate s_B is determined. This in turn determines country A's rate of borrowing because country A's debt has to equal country B's savings, that is:

$$N_A w_A r_A = N_B w_B s_B / e = \Delta FX \tag{38}$$

Apart from the added equation (38) and the revised demand functions for goods (equations (34)-(37)), other equations characterizing the Dollar system are the same as those for the Euro system. We solve the system of equations and present the solutions in Table 5.

3.4. Summary and comparison

Table 5 displays the equilibrium solutions for both autarkic economies and open economies under three distinct international monetary systems: the Euro, the Bancor and the Dollar. The production pattern is the same across the three monetary systems. As a result of division of labor based on comparative advantage, international trade enables greater total global output and higher consumption levels compared to autarky.

The Euro and the Bancor systems yield identical import and export volumes between the two countries. In fact, when the two countries maintain parity exchange rates against the Bancor ($e_A = e_B$), the equilibrium solutions of the Bancor system converge to those of the Euro system.

Despite this equivalence in trade quantities, the two systems differ fundamentally in their monetary architecture. The Euro system effectively eliminates national monetary sovereignty, as member countries share a common currency. Despite the involvement of the central banks and the international settlement system, cross-border trade is economically indistinguishable from domestic trade between regions. Just as interregional trade imbalances within a nation raise no policy concerns, the Euro system lacks institutional mechanisms to correct trade imbalances between member states.

Table 5. Equilibrium

	Autarky	The Euro System	The Bancor System	The Dollar System
Labor allocation:	$L^*_{Ax} = \alpha(1 - t_A)N_A$ $L^*_{Ay} = \beta(1 - t_A)N_A$ $L^*_{AG} = t_A N_A$ $L^*_{Ax} = \alpha(1 - t_A)N_A$ $L^*_{Ay} = \beta(1 - t_A)N_A$ $L^*_{AG} = t_A N_A$	$L^*_{Ax} = (1 - t_A)N_A$ $L^*_{AG} = t_A N_A$ $L^*_{By} = (1 - t_B) N_B$ $L^*_{BG} = t_B N_B$	$L^*_{Ax} = (1 - t_A)N_A$ $L^*_{AG} = t_A N_A$ $L^*_{By} = (1 - t_B) N_B$ $L^*_{BG} = t_B N_B$	$L^*_{Ax} = (1 - t_A)N_A$ $L^*_{AG} = t_A N_A$ $L^*_{By} = (1 - t_B) N_B$ $L^*_{BG} = t_B N_B$
Production	$X^*_A = N_A \alpha a_{Ax}(1 - t_A)$ $Y^*_A = N_A \beta a_{Ay}(1 - t_A)$ $G^*_A = N_A t_A a_{AG}$ $X^*_B = N_B \alpha a_{Bx}(1 - t_B)$ $Y^*_B = N_B \beta a_{By}(1 - t_B)$ $G^*_B = N_B t_B a_{BG}$	$X^*_A = a_{Ax}(1 - t_A)N_A$ $Y^*_B = a_{By}(1 - t_B) N_B$ $G^*_A = a_{AG} t_A N_A$ $G^*_B = a_{BG} t_B N_B$	$X^*_A = a_{Ax}(1 - t_A)N_A$ $Y^*_B = a_{By}(1 - t_B) N_B$ $G^*_A = a_{AG} t_A N_A$ $G^*_B = a_{BG} t_B N_B$	$X^*_A = a_{Ax}(1 - t_A)N_A$ $Y^*_B = a_{By}(1 - t_B) N_B$ $G^*_A = a_{AG} t_A N_A$ $G^*_B = a_{BG} t_B N_B$
Money prices in the currency of the good-producing country:	$p^*_{Ax} = \frac{w_A}{a_{Ax}}$ $p^*_{Ay} = \frac{w_A}{a_{Ay}}$ $p^*_{Bx} = \frac{w_B}{a_{Bx}}$ $p^*_{By} = \frac{w_B}{a_{By}}$	$p^*_x = \frac{w_A}{a_{Ax}}$ $p^*_y = \frac{w_B}{a_{By}}$	$p^*_x = \frac{w_A}{a_{Ax}}$ $p^*_y = \frac{w_B}{a_{By}}$	$p^*_x = \frac{w_A}{a_{Ax}}$ $p^*_y = \frac{w_B}{a_{By}}$

Table 5. Equilibrium (continued)

	Autarky	The Euro System	The Bancor System	The Dollar System
International trade		$X^*_{AEx} = X^*_{BIm} = N_A a_{Ax}\beta(1-t_A)$ $Y^*_{BEx} = Y^*_{AIm} = N_B a_{By}\alpha(1-t_B)$	$X^*_{AEx} = X^*_{BIm} = N_A a_{Ax}\beta(1-t_A)$ $Y^*_{BEx} = Y^*_{AIm} = N_B a_{By}\alpha(1-t_B)$	$X^*_{AEx} = X^*_{BIm} = N_A a_{Ax}[\beta(1-t_A) - \alpha r_A]$ $Y^*_{BEx} = Y^*_{AIm} = N_B a_{By}[\alpha(1-t_B) + \beta s_B]$ $e = \frac{\alpha N_B w_B(1-t_B)}{\beta N_A w_A(1-t_A)}$ $r_A = \frac{\Delta FX}{N_A w_A}$ $s_B = \frac{\Delta FXe}{N_B w_B}$
Balance of payments		Clearance of import markets implies trade balance.	Trade balance requires $e_A = e_B$.	Trade unbalanced as long as $\Delta FX > 0$.
Individual consumption of goods X and Y:	$x^*_A = \alpha a_{Ax}(1-t_A)$ $y^*_A = \beta a_{Ay}(1-t_A)$ $x^*_B = \alpha a_{Bx}(1-t_B)$ $y^*_B = \beta a_{By}(1-t_B)$	$x^*_A = \alpha a_{Ax}(1-t_A)$ $y^*_A = \frac{\alpha a_{By}(1-t_B)\,N_B}{N_A}$ $x^*_B = \frac{\beta a_{Ax}(1-t_A)N_A}{N_B}$ $y^*_B = \beta a_{By}(1-t_B)$	$x^*_A = \alpha a_{Ax}(1-t_A)$ $y^*_A = \frac{\alpha a_{By}(1-t_B)\,N_B e_A}{N_A e_B}$ $x^*_B = \frac{\beta a_{Ax}(1-t_A)N_A e_B}{N_B e_A}$ $y^*_B = \beta a_{By}(1-t_B)$	$x^*_A = \alpha a_{Ax}(1-t_A+r_A)$ $y^*_A = \frac{\alpha N_B a_{By}(1-t_B)}{N_A}\left(1+\frac{r_A}{1-t_A}\right)$ $x^*_B = \frac{\beta a_{Ax}N_A(1-t_A)(1-t_B-s_B)}{N_B}(1-\frac{s_A}{1-t_B})$ $y^*_B = \beta a_{By}(1-t_B-s_B)$
Equilibrium condition on parameters		$\frac{w_A}{w_B} = \frac{\alpha N_B(1-t_B)}{\beta N_A(1-t_A)}$	$\frac{w_A}{w_B} = \frac{\alpha N_B(1-t_B)}{\beta N_A(1-t_A)}$	

In contrast, the Bancor systems preserves national monetary sovereign while conducting international trade in a supranational currency. Unlike domestic transactions, cross-border trade under this system faces a distinct constraint: neither country's banking system can create Bancor-denominated credit to finance imports. This structural feature makes international trade economically distinct from domestic trade. Furthermore, since both countries require Bancor for trade settlement, the system can incorporate mechanisms (such as exchange rate adjustments) to correct trade imbalances.

Despite their differences, the Euro and the Bancor systems share a key characteristic of neutrality: their system rules do not inherently generate trade imbalances.[7] This stands in clear contrast to the Dollar system.

Under the Dollar system, while each country maintains its own sovereign currency, country A's currency assumes an international role which extends its monetary sovereignty beyond national borders. This creates a structural asymmetry: country B needs to holding currency A for trade settlement, while country A has no corresponding need for currency B. This asymmetry inherently predisposes the system towards imbalance, as country B must earn currency A through trade surplus to acquire its reserves.

The results in Table 5 demonstrate this system outcome. Under the Dollar system, country A's exports are lower than and country B's exports are higher than the corresponding quantities under the Euro or the Bancor systems. This directly translates into welfare effects: country A's residents enjoy higher consumption, and country B's residents experience lower consumption than those under the Euro or the Bancor system.

Country B's FX reserves, invested in country A's government bonds, represent a peculiar form of asset. As noted earlier, at each economic cycle's conclusion, all goods in both economies are consumed. Therefore, the outstanding government bonds are claims unbacked by any real resources. Moreover, since Country B must continue to hold these reserves for trade settlement, the debt is perpetually renewed rather than repaid. From this perspective, these reserves function less as conventional savings and more as a cost of participating in international trade – an entrance fee for accessing the Dollar-based trading system.

[7] In our model, trade is balanced under both the Euro and the Bancor systems due to the symmetric, binding budget constraints imposed on representative residents in each country. While trade imbalances could theoretically emerge in either system, such imbalances would necessarily stem from exogenous factors rather than from monetary architectures themselves.

4. Conclusion

This paper extends the classical Ricardian trade model from a barter system to a monetary framework. It analyzes how finance, production and trade in each country unfold step by step. It compares the economic outcomes of three distinct international monetary systems: the Euro, the Bancor and the Dollar.

While preserving the Ricardian principle of comparative advantage, the model highlights key features of these monetary systems. First, the Euro system renders international trade economically equivalent to domestic trade. Second, the Euro and the Bancor systems are both "neutral" to trade imbalances, though the Bancor system can address trade imbalances through exchange rate adjustment mechanisms. Third, the Dollar system inherently generates trade imbalances, and grants the reserve currency country the privilege of indefinitely deferring deficit settlement.

A natural extension of this study would be to incorporate capital into the model. Introducing capital to the production function could reveal how real savings and interest rate affect trade flows. Additionally, allowing international capital mobility would enable the study of financial services as a tradable sector, shedding lights on the Dollar system's implications for capital flows and balance-of-payments dynamics (Gourinchas & Rey, 2005).

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