International Equilibrium Portfolios and Capital Flows

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Abstract

We study the interaction between cross-border financial flows and asset prices in a two-country, two-good production economy where households trade domestic and foreign bonds and equity. We solve for equilibrium portfolios using the Recursive Negishi Approach. Under log preferences, Cobb-Douglas aggregation, and multiplicative capital accumulation, equity payoffs are collinear and portfolio holdings are indeterminate, showing that home bias is not a generic implication of international risk sharing. Relaxing these assumptions, we solve the model numerically and find that equilibrium portfolios vary with the capital stock, enabling the study of capital flow dynamics. Higher trade costs tilt portfolios toward domestic assets and reduce gross capital flows, as the hedging value of cross-border positions weakens with goods-market frictions.

Keywords: portfolio choice, cross-border financial flows, home bias, asset prices

JEL Codes: F41, G11, G12, G15.

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1 Introduction

Understanding the relationship between cross-border financial flows and asset prices is central to international macroeconomics. A large body of empirical work documents that gross capital flows are large, volatile, and procyclical, that countries exhibit strong home bias in their equity portfolios, and that valuation effects — driven by changes in asset prices and exchange rates — account for a significant share of movements in countries' net foreign asset positions. Yet the theoretical mechanisms that jointly generate these patterns remain incompletely understood, in part because standard models either abstract from production and endogenous asset prices or rely on partial-equilibrium portfolio choice.

In this paper, we study the interaction between cross-border financial flows and asset prices in a two-country, two-good production economy. Households in each country can trade domestic and foreign one-period bonds and equity claims on domestic and foreign firms, an asset structure that dynamically completes the markets. We solve for equilibrium portfolios using the Recursive Negishi Approach (RNA), which characterizes Pareto optimal allocations as a function of welfare weights and then identifies the welfare weight that can be decentralized as a competitive equilibrium without transfers. We proceed in two steps. First, we derive a closed-form benchmark under log preferences, Cobb-Douglas Armington aggregation, and a multiplicative capital accumulation technology. In this special case, all equilibrium quantities and prices are proportional to domestic output, and equity payoffs become perfectly collinear. As a result, equilibrium equity holdings are indeterminate: many portfolio combinations decentralize the same allocation. This indeterminacy result makes precise a sense in which home bias is not a generic implication of international risk sharing — it requires some departure from the knife-edge benchmark.

Second, we relax these restrictions and solve the model numerically. The quantitative model features CES Armington aggregation, a CES capital installation technology, and iceberg trade costs. We find that as trade costs rise, equilibrium portfolios tilt toward domestic assets: households hold more equity in the domestic firm and reduce their cross-border bond positions. This is consistent with the mechanism in Obstfeld and Rogoff [2000], who argue that goods-market frictions are a common source of several puzzles in international macroeconomics. Higher trade costs weaken the insurance value of cross-border positions, reducing both inflows and outflows and shrinking gross capital flows.

The paper is organized as follows. Section 2 presents the model. Section 3 derives the closed-form benchmark and defines the main macroeconomic aggregates. Section 4 presents the quantitative results. Section 5 concludes.

1.1 Related Literature.

This paper contributes to three strands of the international macroeconomics literature.

Portfolio choice and home bias. A central puzzle in international finance is why investors hold disproportionately large shares of domestic assets relative to what standard diversification arguments would suggest. Obstfeld and Rogoff [2000] argue that trade costs in goods markets can simultaneously account for this and several other anomalies in international macroeconomics. Our quantitative results confirm this mechanism in a production economy with endogenous asset prices: higher iceberg trade costs reduce the gains from international portfolio diversification and generate more pronounced home bias in equilibrium.

Asset market structure and international efficiency. Heathcote and Perri [2013] study a two-country production economy where households trade claims on domestic and foreign equity. Under a linear investment technology, they find a fixed equilibrium portfolio strongly tilted toward domestic stocks, driven by a hedging motive: holding a larger share of the domestic firm provides insurance against domestic productivity shocks. Our paper embeds this result and extends it in two directions. First, we adopt a CES capital installation technology that nests both the linear and Cobb-Douglas cases as special limits, which breaks the knife-edge conditions that deliver a time-invariant portfolio. Second, because equilibrium portfolios in our model vary with the capital stock, we can study not just the level of cross-border positions but also the dynamics of capital flows between countries as the economy moves away from and back toward steady state.

Gross capital flows. Broner et al. [2013] document that gross capital flows — the sum of inflows and outflows — are large, volatile, and behave differently from net flows over the business cycle, particularly during financial crises. We use their definition of inflows and outflows to compute and decompose capital flows in our model, and find that gross flows fall with trade costs as the hedging motive for cross-border asset trade weakens.

2 Model

There are two countries, $i \in \{1, 2\}$, each populated by a representative infinitely-lived household. Time is discrete, $t = 0, 1, 2, \ldots$. Each country produces a single tradable good: good 1 is produced in country 1 and good 2 is produced in country 2. Labor is not mobile across countries.

2.1 Shocks

Let $s_t = (z_{1,t}, z_{2,t})$ denote the aggregate state. We assume $(z_{1,t}, z_{2,t})$ follows a finite-state Markov chain with transition probabilities $\pi(s'|s)$ and induced history probabilities $\pi(s^t)$ in the standard way. Productivity in country i is $A_i(s_t)$.

2.2 Preferences

Country i's representative household has expected utility

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \, \pi(s^t) \, u_i\Big(C_{i,t}(s^t), \, n_{i,t}(s^t)\Big),$$

where $C_{i,t}$ is composite consumption and $n_{i,t}$ hours worked. The baseline utility is separable and features CRRA in consumption and a standard Frisch-disutility term,

$$u_i(C, n) = \frac{C^{1-\sigma_c} - 1}{1 - \sigma_c} - \chi_i \, \frac{n^{1+\xi}}{1 + \xi},$$

with $\sigma_c > 0$, $\xi \geq 0$, and $\chi_i > 0$; when $\sigma_c = 1$ we use the usual log limit, $u_i(C, n) = \log C - \chi_i n^{1+\xi}/(1+\xi)$.

Composite consumption and composite investment are Armington/CES aggregates over home and imported varieties:

$$C_{i,t} = \Gamma_c\Big(c_{i,t}, c^*_{i,t}\Big) = \Big[\gamma_c^{1/\theta_c} c_{i,t}^{(\theta_c - 1)/\theta_c} + (1 - \gamma_c)^{1/\theta_c} (c^*_{i,t})^{(\theta_c - 1)/\theta_c}\Big]^{\theta_c/(\theta_c - 1)},$$
$$X_{i,t} = \Gamma_x\Big(x_{i,t}, x^*_{i,t}\Big) = \Big[\gamma_x^{1/\theta_x} x_{i,t}^{(\theta_x - 1)/\theta_x} + (1 - \gamma_x)^{1/\theta_x} (x^*_{i,t})^{(\theta_x - 1)/\theta_x}\Big]^{\theta_x/(\theta_x - 1)},$$

where $c_{i,t}$ and $x_{i,t}$ are country-i absorption of the domestically produced good, while $c^*_{i,t}$ and $x^*_{i,t}$ are absorption of the imported good. The parameters (γ_c, θ_c) govern home bias and the elasticity of substitution in consumption; (γ_x, θ_x) are the analogous parameters for investment. The model allows these parameter pairs to differ; in our baseline quantitative exercises we impose the restriction $\gamma_c = \gamma_x$ and $\theta_c = \theta_x$, and we use robustness checks to study deviations.

2.3 Technology

In country i, firms operate a Cobb–Douglas production technology

$$y_{i,t} = A_i(s_t) \, K_{i,t}^{\alpha_k} \, L_{i,t}^{1-\alpha_k},$$

with $\alpha_k \in (0, 1)$. Labor market clearing implies $L_{i,t} = n_{i,t}$.

Capital accumulation uses a CES "installation" technology that combines depreciated old capital with new investment goods:

$$K_{i,t+1} = \Big[\delta^{1/\sigma_k}\Big((1-\kappa)K_{i,t}\Big)^{(\sigma_k-1)/\sigma_k} + (1-\delta)^{1/\sigma_k} X_{i,t}^{(\sigma_k-1)/\sigma_k}\Big]^{\sigma_k/(\sigma_k-1)},$$

where $\kappa \in (0,1)$ is depreciation and $\sigma_k > 0$ is the elasticity of substitution between old and new capital. This nests Cobb–Douglas accumulation as $\sigma_k \to 1$ and the linear law of motion as $\sigma_k \to \infty$.

2.4 Goods markets and iceberg trade costs

We take good 1 as numeraire. Let p_t denote the relative price of good 2 in units of good 1. We assume symmetric iceberg trade costs $\tau \in [0,1)$: to deliver one unit of a good abroad, $1/(1-\tau)$ units must be shipped. Hence, the consumer price of the imported variety is scaled up by $1/(1-\tau)$. In particular, country 1 faces import price $p_t/(1-\tau)$ for good 2, while country 2 faces import price $1/(1-\tau)$ for good 1.

Let $P_{i,t}$ denote the unit expenditure price index for *consumption* in country i (measured in units of good 1) and let $P^x_{i,t}$ denote the analogous price index for *investment*. Standard CES aggregation implies

$$P_{1,t} = \left[\gamma_c + (1-\gamma_c)\left(\frac{p_t}{1-\tau}\right)^{1-\theta_c}\right]^{\frac{1}{1-\theta_c}}, \qquad P^x_{1,t} = \left[\gamma_x + (1-\gamma_x)\left(\frac{p_t}{1-\tau}\right)^{1-\theta_x}\right]^{\frac{1}{1-\theta_x}},$$

$$P_{2,t} = \left[\gamma_c\, p_t^{1-\theta_c} + (1-\gamma_c)\left(\frac{1}{1-\tau}\right)^{1-\theta_c}\right]^{\frac{1}{1-\theta_c}}, \qquad P^x_{2,t} = \left[\gamma_x\, p_t^{1-\theta_x} + (1-\gamma_x)\left(\frac{1}{1-\tau}\right)^{1-\theta_x}\right]^{\frac{1}{1-\theta_x}}.$$

Resource feasibility for the physical goods reflects iceberg shipping. Let $j \neq i$. Then

$$y_{i,t} = c_{i,t} + x_{i,t} + \frac{c^*_{j,t} + x^*_{j,t}}{1-\tau}, \qquad i \in \{1,2\}.$$

When $\tau = 0$, these constraints reduce to frictionless-trade feasibility.

2.5 Financial markets

Households trade ex-dividend equity claims on both firms and one-period bonds issued by each country. Let $\theta^j_{i,t+1}(s^t)$ be country-i holdings chosen at t of equity in firm $j \in \{1,2\}$, priced at $v^j_t(s^t)$ (in good-1 units). The outstanding shares are normalized to one: $\sum_i \theta^j_{i,t+1} = 1$.

Each country j also issues a one-period risk-free bond that pays one unit of good j next period. Let $q^j_{R,t}(s^t)$ be its price in good-1 units and let $b^j_{i,t+1}(s^t)$ denote country-i holdings chosen at t. We normalize initial bond holdings to zero.

2.6 Competitive Equilibrium

We define a competitive equilibrium with sequential markets. Let $w_{i,t}(s^t)$ denote the country i's wage rate at date t in units of the consumption good of country 1.

2.6.1 The Representative Household's Problem

Each country i's representative household faces the following problem

$$\max_{\left(C_{i,t},(\theta^j_{i,t+1},b^j_{i,t+1})_{j=1,2},n_{i,t}\right)_{t=0}^{\infty}} \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \, \pi(s^t)\, u_i\left(C_{i,t}(s^t), n_{i,t}(s^t)\right),$$

subject to

$$P_{i,t}C_{i,t} + \sum_{j=1,2} v^j_t \, \theta^j_{i,t+1} + \sum_{j=1,2} q^j_{R,t}(s^t)\, b^j_{i,t+1} = w_{i,t}\, n_{i,t} + \sum_{j=1,2} (d_{j,t} + v^j_t)\, \theta^j_{i,t} + b^1_{i,t} + p_t\, b^2_{i,t}.$$

where $(\theta^1_{i,0}, \theta^2_{i,0}) > 0$ are given and $b^1_{i,0} = b^2_{i,0} = 0$.

2.6.2 The Representative Firm's Problem

Suppose that there is a representative firm in each country that operates the domestic technology and owns the corresponding domestic stock of capital.[1] This firm is operated by a fictitious agent who takes state prices $\left(Q_t(s^t)(s')\right)_{s'}$ as given. Here $Q_t(s^t)(s')$ denotes the s^t-value of one unit of the country 1 consumption good next period if $s_{t+1} = s'$, in units of country 1 consumption good.

Firms take prices as given. Firm i hires labor $L_{i,t}$ at wage $w_{i,t}$ and chooses composite investment $X_{i,t}$, which is assembled from domestic and imported investment goods using $\Gamma_x(\cdot)$. Let $P^x_{i,t}$ denote the corresponding unit expenditure index defined in Section 2.4. The total cost of purchasing $X_{i,t}$ is therefore $P^x_{i,t}X_{i,t}$ in units of good 1 (with the appropriate import-price wedge implied by τ embedded in $P^x_{i,t}$).

Consequently, date t dividends for the firm located in country 1 are

$$d_{1,t} = y_{1,t} - P^x_{1,t}X_{1,t} - w_{1,t}L_{1,t},$$

while for the firm located in country 2 are

$$d_{2,t} = p_t y_{2,t} - P^x_{2,t}X_{2,t} - w_{2,t}L_{2,t}.$$

[1] This assumption is innocuous as technologies display constant return to scale

Firms make investment decisions to maximize their ex-dividend equity value, v_t^j, according to the state prices:

$$v_t^j(s_t, K_t^j(s^{t-1})) \quad = \quad \max_{(X_{j,t}, L_{j,t})} \left(d_{j,t} + \sum_{s_{t+1}} Q_t(s^t)(s')\, v_{t+1}^j(s', K_{t+1}^j(s^t)) \right),$$

subject to

$$K_{j,t+1} = \left[\delta^{1/\sigma_k} \Big((1-\kappa) K_{j,t} \Big)^{(\sigma_k - 1)/\sigma_k} + (1-\delta)^{1/\sigma_k} X_{j,t}^{(\sigma_k-1)/\sigma_k} \right]^{\sigma_k/(\sigma_k-1)}.$$

The role played by this assumption of "inactive" financial policies (both dividend and debt) will be discussed in more detail later.

2.6.3 Competitive Equilibrium

In this setting with constant returns to scale, it is immaterial if the accumulation technology is operated either by the firms or by the households. The equilibrium concept is standard and it can be stated as follows.

Definition 2.1. *An allocation* $\left\{ (\widehat{c}_{i,t}, \widehat{c}^*_{i,t}, \widehat{n}_{i,t})_{i=1,2}, (\widehat{x}_{j,t}, \widehat{x}^*_{j,t}, \widehat{L}_{j,t})_{j=1,2} \right\}_{t=0}^{\infty}$*, portfolios for each representative household i* $\left\{ (\widehat{\theta}^j_{i,t+1}, \widehat{b}^j_{i,t+1})_{j=1,2} \right\}_{t=0}^{\infty}$ *and a price system* $\left\{ (\widehat{P}_{i,t})_{i=1,2}, \widehat{p}_t, (\widehat{q}^R_{j,t}, \widehat{v}_{j,t})_{j=1,2}, \widehat{Q}_t \right\}_{t=0}^{\infty}$ *constitute a Competitive Equilibrium as*

C.E.1 Given $\left\{ (\widehat{P}_{i,t})_{i=1,2}, \widehat{p}_t, (\widehat{q}^R_{j,t}, \widehat{v}_{j,t})_{j=1,2}, \widehat{Q}_t \right\}_{t=0}^{\infty}$, $\left\{ \widehat{c}_{i,t}, \widehat{c}^*_{i,t}, \widehat{n}_{i,t}, (\widehat{\theta}^j_{i,t+1}, \widehat{b}^j_{i,t+1})_{j=1,2} \right\}_{t=0}^{\infty}$ *solves the representative household i's problem;*

C.E.2 Given $\left\{ (\widehat{P}_{i,t})_{i=1,2}, \widehat{p}_t, (\widehat{q}^R_{j,t}, \widehat{v}_{j,t})_{j=1,2}, \widehat{Q}_t \right\}_{t=0}^{\infty}$, $\left\{ \widehat{x}_{j,t}, \widehat{x}^*_{j,t}, \widehat{L}_{j,t} \right\}_{t=0}^{\infty}$ *solves the representative firm j's problem;*

C.E. 3 Good, Labor and Asset markets clear; i.e.for $i, j = 1, 2$

$$\begin{aligned} \widehat{y}_{i,t} &= \widehat{c}_{i,t} + \widehat{x}_{i,t} + \frac{\widehat{c}^*_{j,t} + \widehat{x}^*_{j,t}}{1-\tau}, \\ \widehat{L}_{i,t}(s^t) &= \widehat{n}_{i,t}(s^t), \\ \sum_{i=1,2} \widehat{b}^j_{i,t+1} &= 0, \\ \sum_{i=1,2} \widehat{\theta}^j_{i,t+1} &= 1. \end{aligned}$$

2.7 Competitive Equilibrium: Computation

Here we implement the so-called Recursive Negishi Approach (RNA) which uses the planner's policy functions to define and characterize the implicit financial wealth needed to decentralize an allocation with no transfers.

2.7.1 Pareto Optimal allocations

We study competitive equilibrium allocations that are Pareto optimal (PO). In order to do that, we follow the indirect Negishi approach in which PO allocations are recursively parametrized by welfare weights. Then we characterize the PO allocation, and so vector of welfare weights, that can be decentralized as a competitive equilibrium with no transfers. Finally, we compute the corresponding portfolios that support that competitive equilibrium allocations for the particular asset market structure discussed in detail below.

Let α_i be the welfare weight corresponding to country i. The recursive Pareto problem (RPP) is

$$V(s, K_1, K_2, \alpha) = \max_{(c_i, c_i^*, x_i, x_i^*, K_i', n_i)_{i=1,2}} \left[\sum_{i=1,2} \alpha_i \Big(u_i \left(C_i, n_i \right) \Big) + \beta \sum_{s'} \pi(s, s') V(s', K_1', K_2', \alpha) \right],$$

subject to

$$\begin{aligned} A_i(s)\, K_i^{\alpha_k}\, n_i^{1-\alpha_k} &= c_i + x_i + \frac{c_j^* + x_j^*}{1-\tau}, \qquad j \neq i, \\ K_i' &= \left[\delta^{1/\sigma_k} \Big((1-\kappa) K_i \Big)^{(\sigma_k - 1)/\sigma_k} + (1-\delta)^{1/\sigma_k} X_i^{(\sigma_k-1)/\sigma_k} \right]^{\sigma_k/(\sigma_k - 1)}, \\ C_i &= \Gamma_c(c_i, c_i^*), \\ X_i &= \Gamma_x(x_i, x_i^*). \end{aligned}$$

where C_i and X_i denote country i's aggregate consumption and investment, respectively.

Let (λ_i, μ_i) be the Lagrange multiplier of country-i resource and capital accumulation constraints, respectively, and

$$\Big(c_i, c_i^*, x_i, x_i^*, K_i', n_i \Big)_{i=1,2}$$

the corresponding policy functions.

2.7.2 The Recursive Negishi Approach

In order to proceed, we first define the Arrow–Debreu state-price kernel (in good-1 units)

$$Q(s,K,\alpha)(s') \quad = \quad \beta\,\pi(s'|s)\,\frac{u_{1,C}(C_1(s',K',\alpha),n_1(s',K',\alpha))}{u_{1,C}(C_1(s,K,\alpha),n_1(s,K,\alpha))}\,\frac{P_1(s,K,\alpha)}{P_1(s',K',\alpha)}.$$

and

$$\begin{aligned} w_1(s,K,\alpha) &= (1-\alpha_k)\,A_1(s)\,K_1^{\alpha_k}\,n_1(s,K,\alpha)^{-\alpha_k}, \\ w_2(s,K,\alpha) &= p(s,K,\alpha)\,(1-\alpha_k)\,A_2(s)\,K_2^{\alpha_k}\,n_2(s,K,\alpha)^{-\alpha_k}. \end{aligned}$$

where

$$p(s,K,\alpha) = \frac{\lambda_2(s,K,\alpha)}{\lambda_1(s,K,\alpha)}$$

is the implicit relative price of the consumption good 2 with respect to 1; i.e. the implicit terms of trade. Compounded prices $(P_1(s,K,\alpha),P_2(s,K,\alpha))$ are constructed accordingly.

We define financial wealth as the solution to the functional equation

$$W_i(s,K,\alpha) = P_i(s,K,\alpha)C_i(s,K,\alpha) - w_i(s,K,\alpha)n_i(s,K,\alpha) + \sum_{s'} Q(s,K,\alpha)(s')W_i(s',K',\alpha).$$

We construct recursive asset prices (in good-1 units) directly from the state-price kernel Q:

$$\begin{aligned} v^j(s,K,\alpha) &= \sum_{s'} Q(s,K,\alpha)(s')\Big[d_j(s',K',\alpha) + v^j(s',K',\alpha)\Big], \qquad j\in\{1,2\}, \\ q_R^1(s,K,\alpha) &= \sum_{s'} Q(s,K,\alpha)(s'), \\ q_R^2(s,K,\alpha) &= \sum_{s'} Q(s,K,\alpha)(s')\,p(s',K',\alpha). \end{aligned}$$

where

$$\begin{aligned} d_1(s,K,\alpha) &= y_1(s,K,\alpha) - P_1^x(s,K,\alpha)\,X_1(s,K,\alpha) - w_1(s,K,\alpha)n_1(s,K,\alpha) \\ d_2(s,K,\alpha) &= p(s,K,\alpha)y_2(s,K,\alpha) - P_2^x(s,K,\alpha)\,X_2(s,K,\alpha) - w_2(s,K,\alpha)n_2(s,K,\alpha). \end{aligned}$$

As we define for all (s,K)

$$A_i(s,K,\alpha) \quad = \quad W_i(s,K,\alpha) - \theta_{i,0}^1 v^1(s,K,\alpha) - \theta_{i,0}^2 v^2(s,K,\alpha),$$

the following proposition follows by standard arguments (continuity of A_i in α and the boundary conditions implied by the planner's problem).

Proposition 2.1. *Given s_0, K_0, there exists an $\alpha_0(s_0, K_0)$ such that $A_i(s_0, K_0, \alpha_0(s_0, K_0)) = 0$ and so*

$$W_i(s_0, K_0, \alpha_0(s_0, K_0)) \quad = \quad \theta^1_{i,0} v^1(s_0, K_0, \alpha_0(s_0, K_0)) + \theta^2_{i,0} v^2(s_0, K_0, \alpha_0(s_0, K_0)).$$

2.7.3 Decentralization

Given the asset market structure, we proceed to construct the objects that will deliver equilibrium portfolios. As $\alpha_0(s_0, K_0)$ is given by Proposition 2.1, let

$$\left(b^1_i(K, \alpha_0),\ b^2_i(K, \alpha_0),\ \theta^1_i(K, \alpha_0),\ \theta^2_i(K, \alpha_0)\right)$$

solve the corresponding spanning system for each $K = (K_1, K_2)$ (the dimension depends on the set of traded assets).

$$W_i(s, K, \alpha_0) = b^1_i(K, \alpha_0) + b^2_i(K, \alpha_0)\, p(s, K, \alpha_0) \qquad + \sum_{j=1,2} \left[v^j(s, K, \alpha_0) + d_j(s, K, \alpha_0)\right] \theta^j_i(K, \alpha_0). \quad (1)$$

for all s.

The following Proposition follows by standard arguments (see Appendix for the derivation).

Proposition 2.2. *Given the PO allocation parametrized by α_0 and (s_{0,K_0}), construct a sequential allocation recursively as follows*

$$\begin{aligned}
c_{i,t}(s^t) &= c_i(s_t, K_t(s^{t-1}), \alpha_0) \\
c^*_{i,t}(s^t) &= c^*_i(s_t, K_t(s^{t-1}), \alpha_0) \\
n_{i,t}(s^t) &= n_i(s_t, K_t(s^{t-1}), \alpha_0) \\
x_{j,t}(s^t) &= x_j(s_t, K_t(s^{t-1}), \alpha_0) \\
x^*_{j,t}(s^t) &= x^*_j(s_t, K_t(s^{t-1}), \alpha_0) \\
K_{j,t+1}(s^t) &= K'_j(s_t, K_t(s^{t-1}), \alpha_0) \\
L_{j,t}(s^t) &= L_j(s_t, K_t(s^{t-1}), \alpha_0)
\end{aligned}$$

for $i, j = 1, 2$ and for all t and s^t. Similarly, construct prices and portfolios recursively

$$\begin{aligned}
P_{i,t}(s^t) &= P_i(s_t, K_t(s^{t-1}), \alpha_0) \\
p_t(s^t) &= p(s_t, K_t(s^{t-1}), \alpha_0) \\
q^R_{j,t}(s^t) &= q^R_j(s_t, K_t(s^{t-1}), \alpha_0) \\
v_{j,t}(s^t) &= v_j(s_t, K_t(s^{t-1}), \alpha_0) \\
Q_t(s^t)(s_{t+1}) &= Q(s_t, K_t(s^{t-1}), \alpha_0)(s_{t+1}) \\
\theta^j_{i,t+1} &= \theta^j_i(s_t, K_t(s^{t-1}), \alpha_0) \\
b^j_{i,t+1} &= b^j_i(s_t, K_t(s^{t-1}), \alpha_0)
\end{aligned}$$

for $i, j = 1, 2$ and for all t and s^t.

This allocation, these portfolios and this price system constitutes a Competitive Equilibrium.

3 Equilibrium portfolios in a simple version

This section presents a closed-form benchmark that clarifies the mapping from optimal risk sharing to equilibrium asset holdings. We solve the planner's problem using the Recursive Negishi Approach: for a given Pareto weight $\alpha \in (0, 1)$ we characterize the Pareto allocation, and then choose α_0 so that the implied Pareto allocation can be decentralized as a competitive equilibrium without transfers. Appendix A provides the full derivations.

3.1 Benchmark assumptions

We impose three restrictions:

1. **Log preferences.** $\sigma = 1$ and $\chi_i = 0$, so instantaneous utility is log in consumption and log in leisure:
$$u_i(C_i, \eta_i) = \ln(C_i) + \nu \ln(1 - n_i).$$
2. **Cobb–Douglas aggregator.** $\theta = 1$ for both consumption and investment composites:
$$C = \Gamma(c, c^*) = c^\gamma (c^*)^{1-\gamma}, \qquad X = \Gamma(x, x^*) = x^\gamma (x^*)^{1-\gamma}.$$

3. **Multiplicative investment.** Capital evolves according to

$$K_i' = \Delta_i K_i^{\delta} X_i^{1-\delta}, \qquad 0 < \delta < 1,$$

where Δ_i captures investment efficiency.

3.2 Closed-form characterization

Let $Y_i(s,K) \equiv A_i(s) K_i^{\alpha_k} \bar{n}_i^{1-\alpha_k}$ denote output in country i (in units of good i), where $\bar{n}_i \in (0,1)$ is constant in the benchmark. Under assumptions 1–3, the Pareto allocation is homothetic and all quantities scale with (Y_1, Y_2) via state-invariant coefficients. In particular, total absorption in each good is a constant fraction of output:

$$C_i^T = \Theta_i^T(\alpha) Y_i, \qquad X_i = \left[1 - \Theta_i^T(\alpha)\right] Y_i,$$

and the imported and domestic components of C_i and X_i follow Cobb–Douglas shares. The coefficients $\Theta_i^T(\alpha)$ and the associated constants (N_1, N_2, T_1, T_2) are derived in Appendix A.

Prices inherit the same homogeneity. The state price (in units of good 1) satisfies

$$Q(s,K,\alpha)(s') = \beta\, \pi(s'|s) \frac{Y_1(s,K)}{Y_1(s',K')},$$

and the terms of trade are proportional to relative output:

$$p(s,K,\alpha) = \frac{Y_1(s,K)}{Y_2(s,K)} \frac{N_2}{N_1},$$

with (N_1, N_2) constant in the benchmark (Appendix A).

3.3 Wealth, equity values, and portfolio indeterminacy

Define (cum-dividend) financial wealth recursively by

$$W_i(s,K,\alpha) = P_i(s,K,\alpha) C_i(s,K,\alpha) - w_i(s,K,\alpha) n_i(s,K,\alpha) + \sum_{s'} Q(s,K,\alpha)(s')\, W_i(s',K',\alpha),$$

where prices are in units of good 1. In the benchmark, wealth is linear in Y_1:

$$W_1(s,K,\alpha) = \left(\frac{\alpha/N_1 - (1-\alpha_k)}{1-\beta} \right) Y_1(s,K,\alpha),$$
$$W_2(s,K,\alpha) = \left(\frac{(1-\alpha)/N_1 - (1-\alpha_k)(N_2/N_1)}{1-\beta} \right) Y_1(s,K,\alpha).$$

Firm dividends in units of good 1 are

$$d_1 = Y_1\left(\alpha_k - \frac{\beta(1-\delta)T_1}{N_1}\right), \qquad d_2 = Y_1\left(\alpha_k \frac{N_2}{N_1} - \frac{\beta(1-\delta)T_2}{N_1}\right),$$

so equity prices are linear in Y_1 as well:

$$v^j = \frac{\beta}{1-\beta}\, d_j, \qquad j = 1, 2.$$

Because both equities payoffs are perfectly collinear in this benchmark (they are proportional to Y_1), equilibrium equity holdings are not uniquely pinned down: many (θ^1, θ^2) combinations decentralize the same wealth. This illustrates that home bias is not a generic implication in a nontrivial set of economies; the quantitative section studies how equilibrium portfolios become pinned down (and how home bias arises) as we relax assumptions 1–3.

3.4 Definitions

The main macroeconomic aggregates that we study are the Current Account, Net Foreign Assets Position, and Financial Capital Flows, Capital Gains, and Financial Capital Flows adjusted by Capital Gains.

Definition 3.1. ***Current Account.*** *The current account is the sum of the trade balance plus net dividend payments plus net interest payments (Pavlova and Rigobon, 2010). Because all values are expressed in units of good 1, the payoff value of a claim to one unit of good 1 is normalized to one. Let*

$$e_{1,t} \equiv 1, \qquad e_{2,t} \equiv p_t,$$

where p_t is the endogenous relative price of good 2 in units of good 1. Thus $e_{k,t}$ denotes the value, in good-1 units, of one unit of good k. A bond issued by country k pays one unit of good k, so its payoff at date t is $e_{k,t}$ in good-1 units. Thus, the current account of country i, at time t, is given by:

$$CA_{i,t} \equiv TB_{i,t} + \left(\sum_{k=1}^{2} d_{k,t}\theta^k_{i,t} - d_{i,t}\right) + \sum_{k=1}^{2}\left(e_{k,t} - q^k_{R,t-1}\right) b^k_{i,t}. \tag{2}$$

The dividend term is net dividend income: using equity-market clearing, $\sum_{k=1}^{2} d_{k,t}\theta^k_{i,t} - d_{i,t} = d_{j,t}\theta^j_{i,t} - d_{i,t}(1-\theta^i_{i,t})$ for $j \neq i$.[2] *$TB_{i,t}$ is the trade balance of country i at time t, defined as export receipts minus*

[2]The bond-income term follows from the timing convention that $b^k_{i,t}$ is the date-t payoff amount of country-k bonds carried from $t-1$ to t, while $q^k_{R,t-1}b^k_{i,t}$ is the previous-period purchase value. Hence the net interest component is $(e_{k,t} - q^k_{R,t-1})b^k_{i,t}$, expressed in units of good 1.

import payments (in good-1 units). With iceberg trade costs, foreigners pay for the shipped quantity, so

$$TB_{i,t} \equiv e_{i,t}\,\frac{c^*_{j,t} + x^*_{j,t}}{1-\tau} - e_{j,t}\,\frac{c^*_{i,t} + x^*_{i,t}}{1-\tau}, \qquad j \neq i, \tag{3}$$

which reduces to the standard expression when $\tau = 0$.

Definition 3.2. ***Net Foreign Assets position (NFA) or Net International Investment position (NIIP).*** *The NFA of a country is the value of the assets that the country owns abroad, minus the value of the domestic assets owned by foreigners. The net foreign asset position of a country reflects the indebtedness of that country. The change in NFA is given by:*

$$\Delta NFA = Current\ Account + Valuation\ Effects$$

Definition 3.3. ***Financial Capital Flows: Inflows, Outflows and Net.*** *Financial capital inflows (and outflows) are given by the sum of equity inflows (outflows) and bond inflows (outflows) from country i, at time t. Net financial capital flows in country i, at time t, are given by financial capital inflows minus financial capital outflows. Let* $j \neq i$ *denote the other country.*

$$\begin{aligned}
Financial\ Capital\ Inflows &\equiv Equity\ Inflows + Bond\ Inflows \\
&= v^i_t(\theta^i_{j,t} - \theta^i_{j,t-1}) + q^i_{R,t}\left(b^i_{j,t} - b^i_{j,t-1}\right) \\
Financial\ Capital\ Outflows &\equiv Equity\ Outflows + Bond\ Outflows \\
&= v^j_t(\theta^j_{i,t} - \theta^j_{i,t-1}) + q^j_{R,t}\left(b^j_{i,t} - b^j_{i,t-1}\right) \\
Net\ Inflows &\equiv Inflows - Outflows
\end{aligned} \tag{4}$$

Definition 3.4. ***Capital Gains or Valuation Effects.*** *The change in NFA given by the changes in the prices of assets held at time t.*

$$\begin{aligned}
Valuation\ Adjustment\ in\ Equity &\equiv (v^j_t - v^j_{t-1})\theta^j_{i,t-1} - (v^i_t - v^i_{t-1})\theta^i_{j,t-1} \\
Valuation\ Adjustment\ in\ Bonds &\equiv (q^j_{R,t} - q^j_{R,t-1})b^j_{i,t-1} - (q^i_{R,t} - q^i_{R,t-1})b^i_{j,t-1}
\end{aligned} \tag{5}$$

Definition 3.5. ***Financial Capital Flows Adjusted by Capital Gains: Inflows, Outflows and Net.*** *Financial capital flows adjusted by capital gains are given by the sum of financial capital flows and the* *changes in valuations. For country i, at time t, they are given by:*

$$
\begin{aligned}
\textit{Adjusted Net Inflows of Equity} \equiv & v_t^i \theta_{j,t}^i - v_{t-1}^i \theta_{j,t-1}^i - \left[v_t^j \theta_{i,t}^j - v_{t-1}^j \theta_{i,t-1}^j \right] \\
= & v_t^i (\theta_{j,t}^i - \theta_{j,t-1}^i) + (v_t^j - v_{t-1}^j)\theta_{i,t-1}^j - \left[v_t^j (\theta_{i,t}^j - \theta_{i,t-1}^j) + (v_t^i - v_{t-1}^i)\theta_{j,t-1}^i \right] \\
\textit{Adjusted Net Inflows of Bonds} \equiv & \left(q_{R,t}^i b_{j,t}^i - q_{R,t-1}^i b_{j,t-1}^i \right) - \left(q_{R,t}^j b_{i,t}^j - q_{R,t-1}^j b_{i,t-1}^j \right) \\
= & \; q_{R,t}^i (b_{j,t}^i - b_{j,t-1}^i) \\
& + (q_{R,t}^i - q_{R,t-1}^i) b_{j,t-1}^i \\
& - q_{R,t}^j \left(b_{i,t}^j - b_{i,t-1}^j \right) \\
& - (q_{R,t}^j - q_{R,t-1}^j) b_{i,t-1}^j
\end{aligned} \tag{6}
$$

Finally, we decompose financial capital flows into a "return chasing" and a "portfolio rebalancing component" (See Bohn and Tesar, 1996 or Evans and Hnatkovska, 2014), and into a "portfolio reallocation" component and a "growth" component (For example, Tille and van Wincoop, 2010).

Definition 3.6. ***Return chasing and portfolio rebalancing.*** *Capital inflows and outflows can be decomposed into a "return chasing" and a "portfolio rebalancing" component. Let $W_{i,t}^C$ denote country i's financial wealth (portfolio value) at date t evaluated at date-t prices and define $\alpha_{i,t}^j \equiv \frac{v_t^j \theta_{i,t}^j}{W_{i,t}^C}$. Then, one can write equity outflows as:*

$$
\begin{aligned}
v_t^j (\theta_{i,t}^j - \theta_{i,t-1}^j) = & \alpha_{i,t}^j W_{i,t}^C - \alpha_{i,t-1}^j W_{i,t-1}^C \frac{v_t^j}{v_{t-1}^j} \\
v_t^j (\theta_{i,t}^j - \theta_{i,t-1}^j) = & (\Delta \alpha_{i,t}^j) W_{i,t}^C + \left[\alpha_{i,t-1}^j (\Delta W_{i,t}^C) - \left(\frac{v_t^j}{v_{t-1}^j} - 1 \right) \alpha_{i,t-1}^j W_{i,t-1}^C \right]
\end{aligned}
$$

where the first term is referred to as "return chasing" and captures portfolio flows resulting from changes in the optimal portfolio shares in response to changes in returns and risk. The second term is referred to as "portfolio rebalancing" and results from the agent's intention to sell off the asset when wealth changes or when there are capital gains to rebalance their portfolio.

Definition 3.7. ***Portfolio growth and portfolio reallocation, passive portfolio.*** *The portfolio growth component captures the capital flows that result when savings are invested at fixed portfolio shares. The portfolio reallocation component captures capital flows due to changes in the portfolio shares. Finally, the passive portfolio share captures the direct impact of movements in asset prices on the composition of portfolios.*

$$
\begin{aligned}
v_t^j(\theta_{i,t}^j - \theta_{i,t-1}^j) =& \alpha_{i,t}^j W_{i,t}^C - \alpha_{i,t-1}^j W_{i,t-1}^C \frac{v_t^j}{v_{t-1}^j} \\
v_t^j(\theta_{i,t}^j - \theta_{i,t-1}^j) =& \alpha_{i,t}^j (\Delta W_{i,t}^C) + \left[(\Delta \alpha_{i,t}^j) W_{i,t-1}^C - \left(\frac{v_t^j}{v_{t-1}^j} - 1 \right) \alpha_{i,t-1}^j W_{i,t-1}^C \right] \\
v_t^j(\theta_{i,t}^j - \theta_{i,t-1}^j) =& \alpha_{i,t}^j (\Delta W_{i,t}^C) + \left[\Delta \alpha_{i,t}^j - \left(\frac{v_t^j}{v_{t-1}^j} - 1 \right) \alpha_{i,t-1}^j \right] W_{i,t-1}^C
\end{aligned}
$$

where the first term is referred to as "portfolio growth" and captures how changes in wealth contribute to flows, and the second term is the "portfolio reallocation" component and identifies changes in portfolio due to changes in portfolio shares and asset prices. The part related to changes in asset prices in the second term is the component known as "passive portfolio share".

4 Quantitative Results

In this section, we relax the assumptions made in the previous section and study their implications for the portfolio allocations and asset pricing properties found in the simpler economy. To this end, we solve the economy numerically.

4.1 What changes relative to the closed-form benchmark

The closed-form analysis in the previous section relies on log consumption utility ($\sigma_c = 1$), Cobb–Douglas Armington aggregation ($\theta_c = \theta_x = 1$), and a multiplicative investment technology that delivers stationary coefficients and analytical portfolio spanning. The baseline quantitative implementation retains log consumption utility but relaxes the other knife-edge restrictions: the Armington aggregator is CES and capital accumulation uses the CES installation technology described above. The goal is to quantify (i) the implied equilibrium portfolios that decentralize the PO allocation without transfers, and (ii) the induced asset-pricing implications (return differentials, exchange-rate dynamics, and risk premia).

4.2 Numerical solution at a glance

For any candidate welfare weight α we solve the recursive Pareto problem (RPP) and recover the associated state-contingent prices. We then compute the implied financial wealth objects $W_i(s, K, \alpha)$

and solve for the equilibrium welfare weight α_0 such that the no-transfer decentralization condition holds. Finally, given α_0, we recover equilibrium portfolios from the spanning system implied by the asset market structure. Appendix A collects the benchmark derivations, Appendix B states the quantitative model we solve, and Appendix C documents the numerical algorithm.

4.3 Quantitative outputs

Throughout this section we refer to country 1 as the *domestic* country and country 2 as the *foreign* country. The calibration is quarterly, and all moments reported below are computed from simulated quarterly series (i.e., not annualized) unless stated otherwise. We report (i) business-cycle moments, (ii) equilibrium portfolio positions, and (iii) capital flows across symmetric iceberg trade costs $\tau \in \{0.015, 0.035, 0.14, 0.30\}$.

4.4 Calibration

We adopt a standard quarterly calibration and focus on matching qualitative real business-cycle properties in the domestic economy. Table 1 reports the parameter values used in the baseline exercises.

Parameter	Value	Interpretation
κ	0.02	capital depreciation
δ	0.66	old capital share in new capital
σ_k	40	elasticity of substitution between new capital and investment
γ	0.7	consumption and investment home bias
α_k	0.36	capital share in production
β	0.99	discount factor
σ_c	1	CRRA parameter
θ	1.5	domestic vs. foreign elasticity of substitution
ξ	2	inverse Frisch elasticity
χ	15	level parameter for labor disutility
ρ_{z1}	0.7	persistence domestic technology
σ_{z1}	0.03	std. dev. domestic technology
ρ_{z2}	0.7	persistence foreign technology
σ_{z2}	0.03	std. dev. foreign technology
corr	0.38	correlation domestic and foreign technologies

Table 1: Model parameters.

For each scenario we compute business-cycle statistics as follows. For each log variable we remove a quadratic time trend and work with the resulting cyclical component. For the trade-balance ratio, we first scale by trend GDP and then detrend the ratio using a quadratic trend. Table 2 reports the standard deviation, autocorrelation, and correlation with output (all computed from the cyclical components).

	$\tau = 0.015$			$\tau = 0.035$			$\tau = 0.14$			$\tau = 0.30$		
	Std. Dev.	Corr. with output	Autocorr.	Std. Dev.	Corr. with output	Autocorr.	Std. Dev.	Corr. with output	Autocorr.	Std. Dev.	Corr. with output	Autocorr.
Y_1	3.696	1.000	0.719	3.678	1.000	0.725	3.708	1.000	0.720	3.743	1.000	0.738
C_1	0.353	0.775	0.922	0.343	0.777	0.919	0.346	0.798	0.919	0.351	0.816	0.923
X_1	2.976	0.990	0.684	2.986	0.990	0.693	3.006	0.990	0.679	3.017	0.989	0.691
EX_1	0.946	0.836	0.663	0.944	0.831	0.670	0.935	0.824	0.672	0.923	0.817	0.681
IM_1	0.890	0.765	0.824	0.867	0.766	0.821	0.886	0.774	0.820	0.894	0.784	0.825
n_1	0.225	0.955	0.659	0.226	0.956	0.672	0.225	0.959	0.657	0.223	0.962	0.669
w_1	0.788	0.996	0.741	0.786	0.996	0.745	0.787	0.997	0.742	0.787	0.997	0.760
TB_1/Y_1	0.694	-0.260	0.624	0.706	-0.261	0.637	0.776	-0.291	0.632	0.886	-0.323	0.616

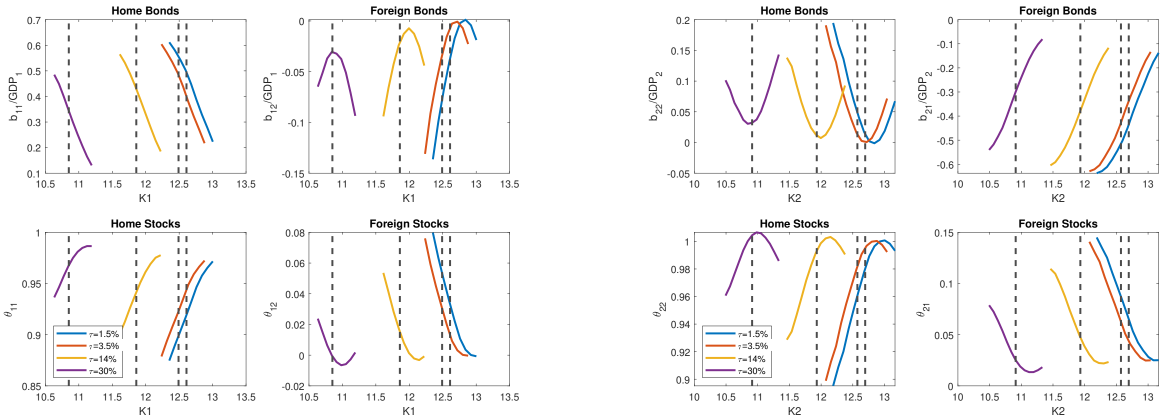
Table 2: Business-cycle statistics across trade-cost scenarios.

Overall, the model matches the high relative volatility of investment and the countercyclicality of the trade-balance ratio. As expected in an environment with (effectively) complete risk sharing, consumption is comparatively smooth.

4.5 Portfolio choice

We next study how equilibrium portfolios respond to trade costs. Consistent with the home-bias mechanism emphasized by Obstfeld and Rogoff [2000], higher trade costs tilt portfolios toward domestic assets: households increase equity holdings in the domestic firm and reduce exposure to the foreign firm. We also find a parallel pattern in bond positions: as trade costs rise, cross-border bond positions shrink in absolute value.

Figure 1 reports portfolios as functions of the capital stock. Bond positions are normalized by steady-state GDP and the plots focus on a neighborhood around the steady state.



(a) Portfolios: domestic household

(b) Portfolios: foreign household

Figure 1: Equilibrium portfolio positions across trade-cost scenarios.

Notes. b_i^j denotes country-i holdings of the one-period bond issued by country j; θ_i^j denotes country-i equity holdings in firm j. Bond positions are normalized by GDP. Dashed vertical lines indicate the steady state.

To summarize the magnitude of these changes, Table 3 reports the mean positions (evaluated over the ergodic distribution) and a portfolio–trade semi-elasticity. The semi-elasticities are computed numerically using finite differences and are reported in "percentage-point" units (i.e., as the sensitivity of the asset position to a one percentage-point increase in τ).

	b_1^1		b_1^2		θ_1^1		θ_1^2	
τ	Mean	Elast.	Mean	Elast.	Mean	Elast.	Mean	Elast.
0.015	0.5853	–	-0.1958	–	0.8990	–	0.0713	–
0.035	0.5841	-6.0452	-0.1865	46.6842	0.9023	16.2974	0.0673	-19.8037
0.14	0.5394	-36.773	-0.1635	25.8437	0.9177	14.8979	0.0522	-15.2930
0.30	0.4632	-42.838	-0.1599	12.5981	0.9414	14.8530	0.0335	-13.2476

Table 3: Mean portfolio positions and semi-elasticities across trade-cost scenarios (domestic household).

As trade costs rise, equity exposure shifts toward the domestic firm: θ_1^1 increases while θ_1^2 declines. Bond positions also compress: the domestic household reduces its long position in the domestic bond and becomes less short in the foreign bond, indicating reduced cross-border borrowing through bond markets.

4.6 Capital flows

Finally, we study gross and net capital flows. We compute financial capital inflows and outflows as defined in Definition 3.3. This matches the terminology in Broner et al. [2013], where inflows are net purchases of domestic assets by non-residents and outflows are net purchases of foreign assets by domestic residents. Net capital flows are inflows minus outflows and gross flows are their sum. We normalize flows by trend GDP and detrend using a quadratic trend before computing moments.

	τ	Std. Dev.	Corr. with output	Autocorr.	Mean
CIF	0.015	4.847	-0.177	0.476	-0.008
	0.035	4.836	-0.208	0.490	-0.003
	0.14	4.251	-0.171	0.399	-0.008
	0.30	3.842	-0.099	0.251	-0.006
COD	0.015	4.815	-0.174	0.451	-0.012
	0.035	4.800	-0.204	0.461	-0.008
	0.14	4.296	-0.165	0.371	-0.011
	0.30	3.917	-0.098	0.235	-0.006
CIF+COD	0.015	9.643	-0.176	0.464	-0.020
	0.035	9.616	-0.206	0.476	-0.012
	0.14	8.524	-0.168	0.385	-0.019
	0.30	7.736	-0.099	0.242	-0.012
CIF−COD	0.015	0.615	-0.027	0.392	0.004
	0.035	0.611	-0.042	0.391	0.005
	0.14	0.626	-0.025	0.389	0.003
	0.30	0.584	0.009	0.395	0.000

Table 4: Capital-flow moments across trade-cost scenarios (domestic country).

Higher iceberg trade costs reduce the steady-state import share and attenuate the exposure of domestic absorption to foreign shocks and relative-price movements. In this model, cross-border asset trade is valuable primarily because it insures against terms-of-trade and demand shifts that change the value of domestic production relative to desired absorption. As τ rises and goods-market linkages weaken, the hedging and intertemporal-trade motives for reallocating portfolios across countries become smaller, so both inflows and outflows shrink and gross flows (*CIF+COD*) fall with τ.

Robustness. Two parameters have especially transparent comparative statics. (i) The home-bias parameter γ in the Armington aggregator: lowering γ (greater openness) raises the import share and strengthens international insurance, which tends to increase equilibrium foreign positions and gross capital flows; raising γ has the opposite effect. (ii) The cross-country correlation of productivity shocks: higher correlation reduces diversification gains and typically compresses cross-border portfolios and gross flows, while lower correlation increases them. These qualitative predictions can be checked by re-running the same tables and portfolio plots across alternative values of γ and the shock correlation.

4.7 Impulse Response Dynamics: A Domestic Productivity Shock

To complement the steady-state comparative statics in Section 4.5, we study the transition dynamics following a one-standard-deviation productivity shock to country 1, comparing the low ($\tau = 1.5\%$) and high ($\tau = 30\%$) trade-cost economies. We simulate the shock starting from each economy's own deterministic steady state and report the impulse response, expressed as either a percent deviation from the pre-shock baseline or a percentage-point difference, depending on the variable.

4.7.1 Domestic responses and spillovers

Figure 2 reports the response of country 1's real allocation. Output rises on impact by close to 3.5%, driven by the direct productivity effect, while investment overshoots sharply (peaking above 10%) as the domestic firm front-loads capital accumulation. The terms of trade deteriorate on impact — good 1 becomes relatively abundant — which is mirrored in a trade balance that initially worsens before turning into a persistent surplus as the shock decays and the economy works off the accumulated capital stock. Capital itself rises gradually, peaking around quarter 8 and returning only slowly to its pre-shock level. Notably, the responses of domestic quantities are almost identical across the two trade-cost regimes: goods-market frictions have a negligible effect on how the shock propagates *within* country 1.

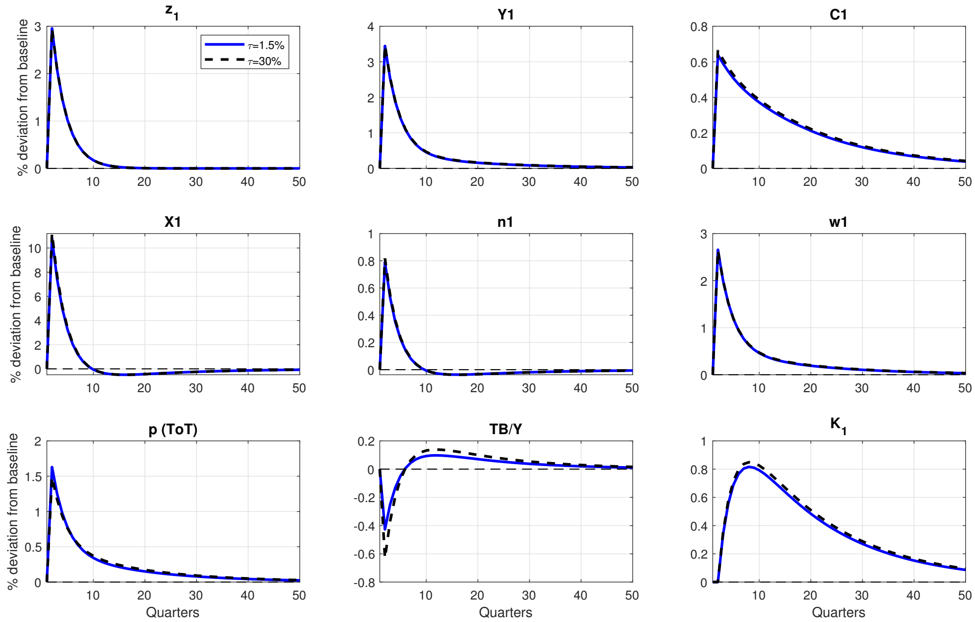


Figure 2: Impulse responses of country 1 variables to a one-standard-deviation domestic productivity shock, low (τ = 1.5%) vs. high (τ = 30%) trade costs. All variables in percent deviation from baseline except TB_1/Y_1, reported in percentage points difference.

The spillover to country 2, shown in Figure 3, tells a different story: here trade costs matter substantially. Under low trade costs, the increase in country 1's relative supply of good 1 raises country 2's demand for imported investment and consumption goods, generating a sizeable expansion in X_2, C_2, and ultimately K_2. Under high trade costs, this channel is muted — the peak response of X_2 and K_2 under $\tau = 30\%$ is roughly half of its counterpart under $\tau = 1.5\%$. This is the standard goods-market transmission channel: with higher iceberg costs, less of the domestic productivity gain is transmitted abroad through trade in goods.

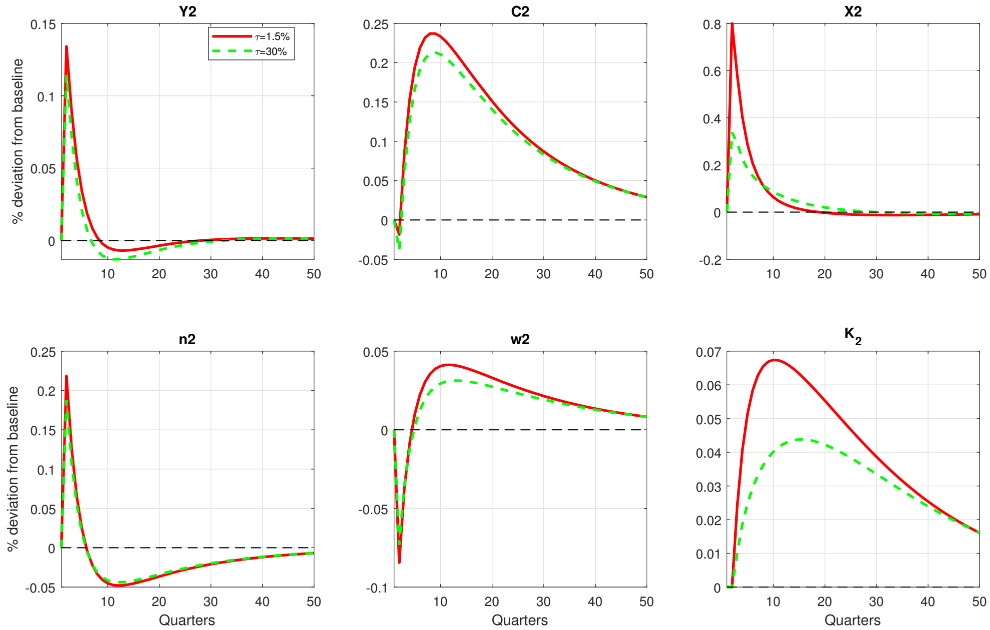
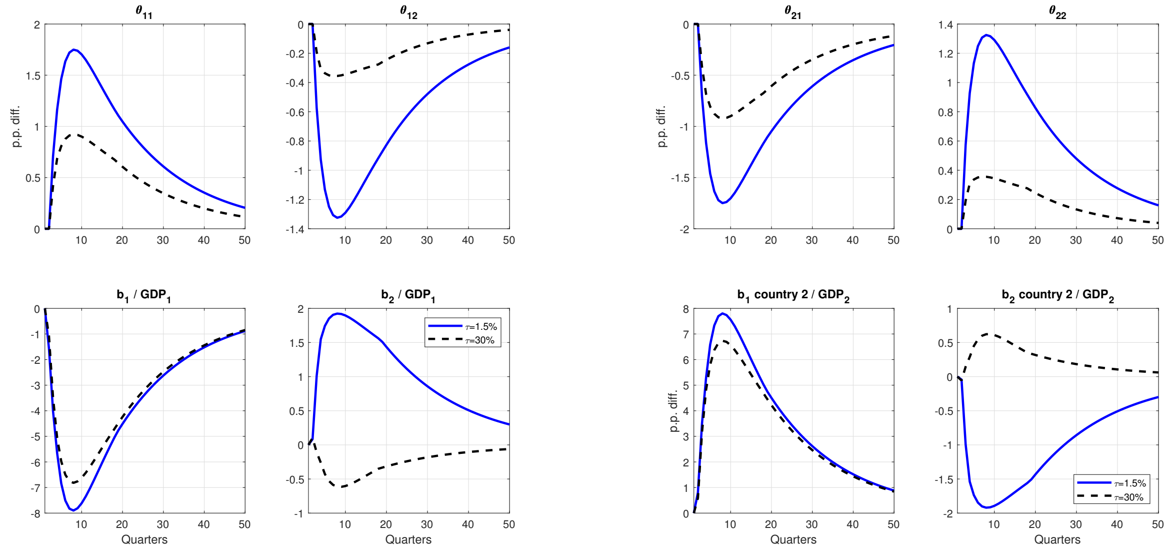


Figure 3: Spillover to country 2 of a domestic (country 1) productivity shock, low vs. high trade costs. All variables in percent deviation from baseline.

4.7.2 Portfolio reallocation

Figures 4a and 4b report the corresponding portfolio responses for the domestic and foreign household, respectively. Following the shock, country 1's household tilts its equity portfolio toward the domestic firm: θ_1^1 rises while θ_1^2 falls, financed partially by a sharp decrease in domestic bond position (b_1^1 falls). The magnitude of this rebalancing is markedly larger under low trade costs: the peak response of θ_1^1 is roughly twice as large under $\tau = 1.5\%$ as under $\tau = 30\%$, and the foreign bond position b_{12} moves in *opposite directions* across the two regimes — the domestic household increases its foreign bond position when trade costs are low but decreases its position abroad when trade costs are high. This is consistent with the hedging mechanism emphasized in Section 4.5: when goods-market frictions are small, cross-border asset positions are more valuable for insuring against the shock, so households reallocate their portfolios more aggressively in response.



(a) Domestic household

(b) Foreign household

Figure 4: Portfolio response to a country 1 productivity shock, low (τ = 1.5%) vs. high (τ = 30%) trade costs. All variables are measured in percentage points difference from baseline.

By market clearing, the foreign household's portfolio response in Figure 4b mirrors these movements: country 2 reduces its holdings of foreign equity (θ_2^1 falls) and increases its holdings of its own firm (θ_2^2 rises), while sharply increasing its lending to country 1 (inversely matching the fall in b_1^1). As with the domestic household, the foreign bond position b_2^2 switches sign across trade-cost regimes, mirroring b_1^2 exactly, as implied by the zero-net-supply bond market clearing condition.

4.7.3 Capital flows

Figure 5 translates this portfolio reallocation into the capital-flow measures defined in Section 3.4. On impact, both financial inflows (CIF) and outflows (COD) fall sharply — reflecting the abrupt portfolio adjustment following the shock — before rebounding and turning briefly positive as the economy transitions back toward the deterministic steady state. Gross flows (CIF+COD) exhibit a pronounced ∪-shaped pattern, collapsing on impact before recovering above baseline over the following quarters. Consistent with the steady-state results in Section 4.6, this response is dramatically dampened by trade costs: the initial collapse in gross flows is roughly four times larger under $\tau = 1.5\%$ than under $\tau = 30\%$, confirming that the hedging motive driving both the level and the dynamics of cross-border asset trade is substantially weaker once goods markets are more segmented. Net inflows (CIF−COD) spike sharply on impact under low trade costs before turning mildly negative and returning to baseline, while under high trade costs the net inflow response is an order of magnitude smaller throughout.

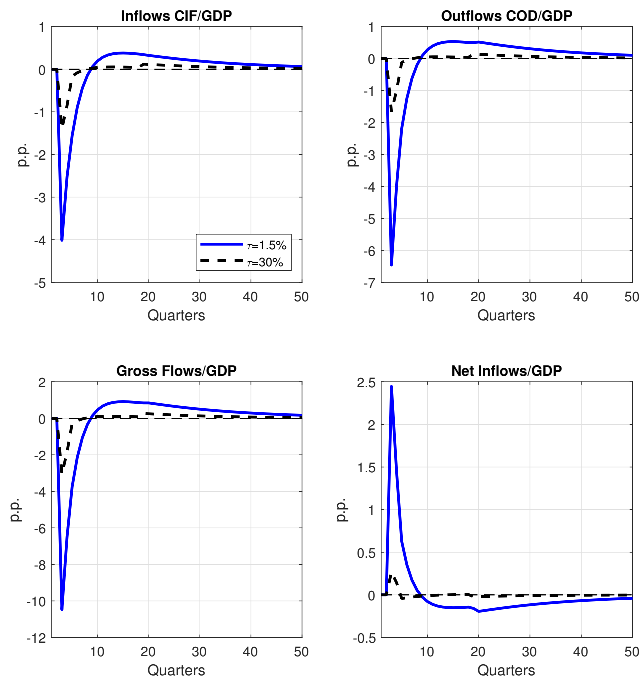


Figure 5: Financial capital flows following a country 1 productivity shock, low vs. high trade costs. All variables are measured in percentage points difference from baseline.

Taken together, these impulse responses reinforce the paper's central mechanism: while trade costs have little effect on the propagation of shocks to domestic quantities, they substantially dampen both the level and the dynamic response of equilibrium portfolios and gross capital flows, by weakening the insurance value of cross-border asset positions.

5 Conclusions

This paper studies how cross-border financial flows interact with asset prices in a two-country, two-good production economy with trade in domestic and foreign bonds and equity. The analytical benchmark isolates a tractable set of assumptions under which the Recursive Pareto Problem and the decentralization mapping can be characterized in closed form; in that benchmark, some asset prices become redundant, which makes equity positions indeterminate even though allocations and prices are pinned down. The quantitative implementation relaxes these knife-edge assumptions and uses the appendix algorithm to compute equilibrium wealth shares and portfolios, allowing us to assess how home bias and return differentials emerge once redundancy disappears.

These results highlight a simple quantitative mechanism: when goods-market linkages are weaker, the hedging value of cross-border positions is lower, and the equilibrium portfolios that decentralize efficient allocations display stronger home bias and smaller gross capital flows.

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A Appendix A: Analytical benchmark (closed form)

This appendix records a tractable benchmark used for intuition and for validating the numerical implementation. The benchmark imposes: (i) log utility in consumption ($\sigma_c = 1$) and inelastic labor ($n_i \equiv \bar{n}_i$); (ii) Cobb–Douglas Armington aggregators for both consumption and investment ($\theta_c = \theta_x = 1$ and $\gamma_c = \gamma_x \equiv \gamma$); (iii) frictionless trade ($\tau = 0$); and (iv) Cobb–Douglas (multiplicative) capital accumulation,

$$K_i' = \Delta_i \, K_i^{\delta} \, X_i^{1-\delta}, \qquad 0 < \delta < 1.$$

Under these restrictions, the planner problem admits a guess-and-verify solution with stationary coefficients. The following subsections collect the intratemporal reduction and the coefficient formulas used in the main text.

A.1 Reducing the intratemporal allocation

Define total absorption of each physical good,

$$C_1^T \equiv c_1 + c_2^*, \qquad C_2^T \equiv c_2 + c_1^*.$$

Cobb–Douglas aggregation implies constant expenditure shares. The planner's intratemporal first-order conditions give

$$g_1(\alpha) = \frac{\alpha\gamma}{\alpha\gamma + (1-\alpha)(1-\gamma)}, \qquad g_2(\alpha) = \frac{(1-\alpha)\gamma}{\alpha(1-\gamma) + (1-\alpha)\gamma},$$

so that

$$c_1 = g_1 C_1^T, \quad c_2^* = (1-g_1)C_1^T, \quad c_2 = g_2 C_2^T, \quad c_1^* = (1-g_2)C_2^T.$$

Using these identities,

$$\alpha_1 \ln C_1 + \alpha_2 \ln C_2 = \mathcal{M} + \gamma_1(\alpha) \ln C_1^T + \gamma_2(\alpha) \ln C_2^T,$$

where $\mathcal{M}$ is a constant and

$$\gamma_1(\alpha) \equiv \alpha\gamma + (1-\alpha)(1-\gamma), \qquad \gamma_2(\alpha) \equiv \alpha(1-\gamma) + (1-\alpha)\gamma.$$

A.2 Closed-form coefficients

Let $Y_i \equiv A_i K_i^{\alpha_k} \bar{n}_i^{1-\alpha_k}$ denote output in country i (in units of good i). In the benchmark, equilibrium prices and continuation values are proportional to Y_1, and key coefficients can be written in closed form.

Define

$$\Sigma \equiv 1 - \beta\Big[\delta + \gamma(1-\delta)\alpha_k\Big], \qquad \mathrm{P} \equiv \beta(1-\gamma)(1-\delta)\alpha_k.$$

Then the coefficients (T_1, T_2) satisfy

$$T_1(\alpha) = \alpha_k \, \frac{\gamma_1(\alpha)\Sigma + \gamma_2(\alpha)\mathrm{P}}{\Sigma^2 - \mathrm{P}^2}, \qquad T_2(\alpha) = \alpha_k \, \frac{\gamma_2(\alpha)\Sigma + \gamma_1(\alpha)\mathrm{P}}{\Sigma^2 - \mathrm{P}^2},$$

and the associated coefficients (N_1, N_2) are

$$N_1(\alpha) = \gamma_1(\alpha) + \beta(1-\delta)\Big[\gamma T_1(\alpha) + (1-\gamma)T_2(\alpha)\Big], \quad N_2(\alpha) = \gamma_2(\alpha) + \beta(1-\delta)\Big[\gamma T_2(\alpha) + (1-\gamma)T_1(\alpha)\Big].$$

The benchmark terms of trade and state prices satisfy

$$p(s, K, \alpha) = \frac{Y_1(s,K)}{Y_2(s,K)} \frac{N_2(\alpha)}{N_1(\alpha)}, \qquad Q(s,K,\alpha)(s') = \beta\, \pi(s'|s)\, \frac{Y_1(s,K)}{Y_1(s',K')}.$$

These coefficients are the objects that enter the closed-form expressions for wealth and equity values reported in Section 3.

B Appendix B: Quantitative model solved

The quantitative exercises solve the baseline model in the main text with (i) CRRA preferences, (ii) CES Armington aggregators for consumption and investment with potentially different parameter pairs (γ_c, θ_c) and (γ_x, θ_x), (iii) iceberg trade costs τ, and (iv) CES installation technology for capital accumulation with elasticity σ_k. When $\sigma_c = 1$, the objective below is interpreted using the usual log limit. For clarity, the planner problem can be written as

$$\begin{aligned}
V(K_1, K_2, s, \alpha) = \max_{\{c_i, c_i^*, x_i, x_i^*, n_i, K_i'\}_{i=1,2}} \sum_{i=1,2} \alpha_i \left[\frac{C_i^{1-\sigma_c} - 1}{1-\sigma_c} - \chi_i \frac{n_i^{1+\xi}}{1+\xi} \right] + \beta \sum_{s'} \pi(s'|s)\, V(K_1', K_2', s', \alpha) \\
\text{s.t.} \qquad A_i(s)\, K_i^{\alpha_k} n_i^{1-\alpha_k} = c_i + x_i + \frac{c_j^* + x_j^*}{1-\tau}, \quad j \neq i, \\
C_i = \Gamma_c(c_i, c_i^*), \qquad X_i = \Gamma_x(x_i, x_i^*), \\
K_i' = \Big[\delta^{1/\sigma_k}\Big((1-\kappa)K_i\Big)^{(\sigma_k-1)/\sigma_k} + (1-\delta)^{1/\sigma_k} X_i^{(\sigma_k-1)/\sigma_k}\Big]^{\sigma_k/(\sigma_k-1)}.
\end{aligned}$$

C Appendix C: Numerical algorithm (overview)

This appendix summarizes the numerical procedure used in the quantitative exercises.

1. **Solve the planner problem for a given welfare weight α.** For each state (s, K_1, K_2), solve the intratemporal system implied by the planner's FOCs and feasibility to recover (C_i, X_i) and the implied shadow prices (λ_1, λ_2), hence the terms of trade $p = \lambda_2/\lambda_1$ and price indices (P_i, P_i^x). Update the value function (and its derivatives with respect to K) by iterating to convergence on a grid in (K_1, K_2).

2. **Recover financial wealth and equilibrium welfare weight.** Given the converged policy functions and prices, compute financial wealth recursively:

$$W_i(s, K, \alpha) = P_i(s, K, \alpha)C_i(s, K, \alpha) - w_i(s, K, \alpha)n_i(s, K, \alpha) + \sum_{s'} Q(s, K, \alpha)(s')W_i(s', K', \alpha),$$

   where Q is defined in Section 4. Solve for α_0 such that the no-transfer condition holds, $W_i(s_0, K_0, \alpha_0) = \sum_j \theta^j_{i,0} v^j(s_0, K_0, \alpha_0)$.

3. **Compute equilibrium portfolios.** Given α_0, recover portfolios from the spanning system induced by the asset menu (two one-period bonds and two equities), using the identity

$$W_i = b_i^1 + p\, b_i^2 + \sum_{j=1,2} (v^j + d_j)\theta_i^j,$$

   state-by-state.