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International Consumption Risk Sharing with Incomplete Goods and Asset Markets

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Preliminary and incomplete.
Comments welcome.

Abstract

Perfect consumption risk sharing requires both, frictionless goods as well as frictionless financial market integration. This project aims at analyzing the consequences of both type of frictions for the allocation of risk across countries in a unified framework. To this end, the theoretical model by Ghironi and Melitz (2005) is extended to allow for international trade in equities. This setup incorporates impediments to international trade in goods and assets. Impulse responses show that the degree of financial market integration and the time horizon considered, substantially alter the extent of consumption risk sharing depending on the nature of the underlying shock.

Keywords: International portfolio choice, consumption risk sharing, trade frictions, financial market frictions

JEL Classification: F32, F42

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1 Introduction

International consumption risk sharing requires both, complete goods as well as complete asset markets. International financial market integration offers the opportunity for investors to hedge consumption risk across countries by holding an internationally diversified portfolio in an environment characterized by macroeconomic shocks. At the same time, international integration in goods markets enables countries to share resources across borders and to smooth consumption.

This project aims at developing a dynamic stochastic general equilibrium model with incomplete goods and asset markets in a two-country framework. The model helps analyzing both, the impact of financial market frictions and non-tradedness of goods on countries' portfolio allocations in the presence of macroeconomic shocks. Impediments to international trade in financial assets are modelled via transaction costs. Incomplete goods market integration is modelled through the assumption of a non-traded goods sector in each country. The novel feature of the model is that the size of the economies' non-traded goods sector is determined endogenously in a model with international portfolio choice. Hence, the degree of integration of goods markets itself is influenced by macroeconomic shocks.

To see the importance of modelling incomplete integration of goods and financial markets simultaneously, recall the implications of a world without frictions. In a complete markets model, agents' international portfolio choices lead to an efficient international allocation of country-specific consumption risk. Under standard assumptions with regard to agents' preferences, this implies that consumption growth rates are perfectly correlated across countries. In such a setting, the outcome of stochastic events, such as the realization of an uncertain output level, does not alter the portfolio allocation since all risks have been traded efficiently on international markets ex ante.

Yet, the implications of such a complete markets model are not necessarily met by the empirical evidence. Sorensen, Wu, Yosha, and Zhu (2007) use a panel of OECD countries and find that risk sharing has increased significantly during the 1990s, a finding that is confirmed by Kalemli-Ozcan, Sorensen, and Yosha (2004) for member countries of the European Monetary Union. In contrast, Obstfeld (2007) documents a worsening of consumption risk sharing.

There are different explanations for the lack of consumption risk sharing across countries. The first explanation is simply that gains from international trade in risky assets may be small. In a seminal paper, Cole and Obstfeld (1991) show that movements in the terms of trade may offset any disturbances in countries' production processes, making international trade in assets redundant. However, their findings critically depend on the underlying parameterization of their model. If terms of trade alone do not fully absorb idiosyncratic shocks, the question remains how size and composition of international portfolios respond to these shocks and how other macroeconomic aggregates are affected by this adjustment process. If welfare gains from risk sharing are indeed small, even small market frictions could be sufficient to significantly influence portfolio decisions.

The second explanation for the lack of consumption risk sharing could thus be that there are trading costs in international financial markets. Fees and commissions for financial intermediaries or agents' unfamiliarity with foreign markets could be reasons for this. There might also be information costs stemming from different languages, differences in institutions or handling of transactions. In addition, there may be policy barriers such as tariffs or capital controls. Ghironi, Lee, and Rebucci (2007), for instance, introduce quadratic transaction costs on asset purchases. Similar to their model, asset markets in our setup are imperfect due to financial intermediation costs, which make it costly for agents to be engaged in international financial markets. Households in both countries hold a portfolio which consists of a non-contingent riskless bond and equities of both, exporting firms and those firms which only produce for the domestic markets. Equities are modelled as pure claims on firms' profits.

Since it is one of the main challenges in a model with international portfolio choice and incomplete markets to solve for the specific portfolio analytically, this paper is also related to recent advances in this research area. Evans and Hnatkovska (2005) combine continuous time approximations with numerical solution techniques to analyze dynamic portfolio choices in an international setting. Devereux and Sutherland (2007) and Tille and Wincoop (2007) introduce an approximation method based on higher order Taylor series expansions to achieve this aim.

A third explanation for a lack of consumption risk sharing could be that frictions in goods markets curtail international diversification (Obstfeld and Rogoff 2000). In fact, a recent study by Fitzgerald (2007) shows empirically that trading costs in goods and in financial markets are important to explain the low degree of international risk sharing.

Most naturally, trade costs in goods markets may arise due to freight expenses. In addition, as in asset markets, costs in trading goods may be caused by gathering information and unfamiliarity with a foreign market (Anderson and van Wincoop 2004). If a good is very costly to transport, it may even become a non-traded good. Theoretically, the assumption of fixed costs of exporting that are higher than firms' expected revenues from export activity leads to a non-traded goods sector. These fixed costs, however, are often modelled independently from the characteristics of the firms producing these goods.

In this project, I will model fixed costs of exporting as suggested by recent empirical work on export behavior. Empirically, firms engaged in international goods trade tend to have higher productivity levels than those firms producing only for the domestic market, see e.g. Bernard and Jensen (2004). However, if productivity determines the number of exporting firms in an economy, the size of the traded goods sector itself should adjust in the presence of macroeconomic shocks as well. Standard open-economy models which do not account for this and take the size of the exported goods sector as given and invariant to disturbances might be ill-suited to deal with this issue adequately.

In this setup, goods markets are incomplete due to fixed costs of exporting. Firms produce in monopolistically competitive markets with their output being exposed to country-wide technology shocks. In addition, firms are heterogeneous in their productivity level, so that only firms with a productivity high enough to cover these fixed costs are able to supply their goods to the foreign country. As in recent trade models, these differences in productivity are modelled by assuming that each firm draws its distinct productivity level from a distribution as in Ghironi and Melitz (2005). This productivity level, in turn, enables the firm to produce one special type of good. This setup leads to an endogenously determined share of non-traded goods in each country, which may evolve over time due to the presence of shocks.

Modelling the integration of goods and financial markets simultaneously will be particularly important in a European context. Lowering barriers to goods and financial markets integration has been a key policy goal of the European integration process. Hence, this project will aim at assessing the impact of this simultaneous integration process on the shock transmission process.

The purpose of this draft is to present a model that combines frictions in the goods market with frictions in international asset trade. To this end, the model by Ghironi and Melitz (2005) is extended to allow for international portfolio choice. The rest of this paper is structured as follows. Section 2 presents the theoretical framework of optimizing firms and households. The structure of the aggregate economy is given in Section 3. Simulation dynamics are presented in Section 4. Section 5 concludes.

2 The model

This model adds international trade in equities to the model by Ghironi and Melitz (2005). Since I adopt most elements of their model, I briefly describe the main ingredients of the setup and focus on the novel feature of households' portfolio decisions.

There are two countries of equal size. As there are no nominal rigidities prices are fully flexible, and variables are expressed in real terms. Foreign variables are marked by an asterisk.

2.1 Households' preferences and demand

In each country, there is a unit mass of identical households. The representative household at home supplies L hours of labor inelastically at the nominal wage rate W_t.[1] Labor is immobile across countries. The household maximizes expected lifetime utility discounting period utility from consumption with its subjective discount factor $\beta \in (0,1)$:

$$E_t \left[\sum_{s=t}^{\infty} \beta^{s-t} \frac{C_s^{1-\gamma}}{1-\gamma} \right], \tag{1}$$

where $\gamma > 0$ is the coefficient of relative risk aversion.

The household consumes a CES basket that consists of a continuum of goods Ω:

$$C_t = \left(\int_{\omega \in \Omega} c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}},$$

with symmetric elasticity of substitution between goods $\theta > 1$ and $c(\omega)$ the consumption of good $\omega \in \Omega$. However, in each period only a subset of goods is available $\Omega_t \subset \Omega$. Denoting $p(\omega)$ with the price for good ω, the consumption-based price index is given by

$$P_t = \left(\int_{\omega \in \Omega_t} p_t(\omega)^{1-\theta} d\omega \right)^{\frac{1}{1-\theta}}$$

[1] Since households are homogeneous, an index specifying an individual household is omitted for convenience.

so that the demand for a single variety can be written as

$$c_t(\omega) = \left(\frac{p_t(\omega)}{P_t}\right)^{-\theta} C_t.$$

Utility and the demand system in the foreign country are symmetrically defined with the same parameters β, γ, and θ. However, the subset of goods consumed in the foreign country, $\Omega_t^* \subset \Omega$, may differ from that in the home country.

2.2 Firms

In each country, there is a continuum of monopolistically competitive firms each producing a differentiated good ω with labor as the sole input factor. The output of home firms depends on aggregate labor productivity Z_t as well as on an distinct idiosyncratic productivity z, which is time-invariant. Aggregate labor productivity Z_t is stochastic and reflects the effectiveness of labor per worker. Technology for a home firm with firm-specific productivity level z is given by $y_t(z) = zZ_t l_t(z)$, with individual labor demand $l_t(z)$.

Firms at home and abroad set prices as a constant markup $\theta/(\theta-1)$ over marginal costs. Since firms are heterogenous with respect to their productivity level z, marginal costs of production differ for each firm, given by $w_t/(zZ_t)$ in units of the consumption good, where w_t denotes the real wage rate.

In every period there is a mass of potential entrants in both countries. Before entering the market, firms face a sunk entry cost $f_{E,t}$ in effective labor units. Since each start-up hires $f_{E,t}/Z_t$ domestic workers to cover these costs, these are equal to $w_t f_{E,t}/Z_t$ in units of the home consumption good. Prior to market entry each home firm draws its idiosyncratic productivity level from a Pareto distribution $G(z) = 1 - (z_{\min}/z)^{-k}$, with lower bound $z_{\min}$ and shape parameter k. Productivity of foreign firms is distributed identically.

Firms that enter the market today do not start producing until tomorrow, which leads to a time-to-build lag. In addition, any firm, already operating in the market or just entering, may be hit by an exogenous shock that forces market exit. This death shock occurs at the very end of each period with probability δ and is identical for the foreign country. Both assumptions imply that the total number of firms producing at home, $N_{D,t}$, evolves according to $N_{D,t} = (1-\delta)(N_{D,t-1} + N_{E,t-1})$, where $N_{E,t-1}$ denotes the number of entrants at time $t-1$.

In principle, each good ω is tradable. However, exporting is costly. Each firm faces fixed export costs $f_{X,t}$ in effective labor units in every period which correspond to $w_t f_{E,t}/Z_t$ units of the consumption good. In addition, there are variable iceberg-type trade costs $\tau_t \geq 1$.

Given households' demand with elasticity θ, firms set the nominal prices as a markup over marginal costs. Nominal prices for goods sold at home and for goods that are shipped abroad are denoted as $p_{D,t}(z)$ and $p_{X,t}(z)$, respectively. Prices are expressed relative to the price index of the destination market. These are given by

$$\rho_{D,t}(z) \equiv \frac{p_{D,t}(z)}{P_t} = \frac{\theta}{\theta-1}\frac{w_t}{zZ_t}, \qquad \text{and} \qquad \rho_{X,t}(z) \equiv \frac{p_{X,t}(z)}{P_t^*} = Q_t^{-1}\tau\rho_{D,t}(z), \tag{2}$$

with the real exchange rate $Q_t = \mathcal{E}_t P_t^*/P_t$ that reflects home consumption in terms of foreign consumption and the nominal exchange rate $\mathcal{E}_t$ in price quotation. Due to fixed costs, exporting is only profitable for firms with a productivity level above a certain threshold $z_{X,t}$, that may vary over time.[2] Total profits, $d_t(z)$, for a firm with $z \geq z_{X,t}$ are then given by the sum of profits earned from domestic activity, $d_{D,t}(z)$, and profits from exporting, $d_{X,t}(z)$. In real terms, these are given by

$$\begin{aligned} d_t(z) &= d_{D,t}(z) + d_{X,t}(z) \\ &= \frac{1}{\theta}\left[\rho_{D,t}(z)\right]^{1-\theta} C_t + \frac{Q_t}{\theta}\left[\rho_{X,t}(z)\right]^{1-\theta} C_t^* - \frac{w_t f_{X,t}}{Z_t} \end{aligned} \tag{3}$$

If the firm-specific productivity is below the cut-off level $z_{X,t}$, the firm produces only the for the domestic market and $d_{X,t}(z) = 0$. At time t, the share of firms that serve both, the home as well as the foreign market, in the total number of firms operating in the domestic country is given by $N_{X,t}/N_{D,t} = 1 - G(z_{X,t})$, where $N_{X,t}$ is the number of firms with a productivity of at least $z_{X,t}$. To deal with the issue of heterogeneity among firms in the aggregate, Melitz (2003) defines two average productivity levels

$$\tilde{z}_D \equiv \left[\int_{z_{\min}}^{\infty} z^{\theta-1}\,\mathrm{d}G(z)\right]^{\frac{1}{\theta-1}} \quad \text{and} \quad \tilde{z}_{X,t} \equiv \left[\frac{1}{1-G(z)}\int_{z_{X,t}}^{\infty} z^{\theta-1}\,\mathrm{d}G(z)\right]^{\frac{1}{\theta-1}},$$

where $\tilde{z}_D$ is the average productivity of all firms operating in the home country and $\tilde{z}_{X,t}$ is the average productivity of all exporting firms.[3] With these in hand, average profits from domestic activity and average profits from exporting can be defined as $\tilde{d}_{D,t} \equiv d_{D,t}(\tilde{z}_D)$ and

[2]This cut-off level is assumed to be always above the lower bound $z_{\min}$.

[3]Averages are denoted by a "$\tilde{}$" in the following.

$\tilde{d}_{X,t} \equiv d_{X,t}(\tilde{z}_{X,t})$, respectively. Average total profits are therefore $\tilde{d}_t \equiv \tilde{d}_{D,t} + [1 - G(z_{X,t})]\, \tilde{d}_{X,t}$.

Entrants maximize their discounted expected future profits after entering the market taking the probability of a death shock into account. Since equity is traded internationally, firms use the stochastic discount factor of home and foreign shareholders weighted by households' share in home equity as discount factor when optimizing. There is an incentive to enter until the average firm value is equalized with the entry cost, *i.e* the free entry condition is given by $\tilde{v} = w_t f_{E,t}/Z_t$.

Since the productivity distribution of foreign firms is identical to the home country, cut-off level and averages are similar.

2.3 Household's intertemporal choices

The representative domestic household consumes and receives income from labor (supplied inelastically), and portfolio investments that consist of holdings of a bond that is only traded domestically and home and foreign equity that is traded across borders.

In each country, domestic equity is bundled in a mutual fund and issued in the respective market. The home mutual fund consists of $N_{H,t} + N_{E,t}$ home firms and the foreign mutual fund consist of $N^*_{H,t} + N^*_{E,t}$ foreign firms existing at time t. In each period the household purchases $x_{H,t+1}$ shares in the home mutual fund and $x_{F,t+1}$ shares in the foreign mutual fund. Fund managers in both countries do not distinguish between exporting firms and firms operating for the domestic market only. As in Ghironi and Melitz (2005), each fund returns a dividend equal to the average total profits of all firms in each country. However, since firms exit the market with a probability of δ at the end of period t, only $N_{D,t+1} = (1-\delta)(N_{D,t} + N_{E,t})$ firms in the home market and $N^*_{D,t+1} = (1-\delta)\left(N^*_{D,t} + N^*_{E,t}\right)$ firms in the foreign market will produce in $t+1$ and pay dividends. The price in real terms of a share in the home and foreign mutual fund for the home household is equal to the average real present discounted value of future profit streams of firms in each country expressed in home consumption units, *i.e.* $\tilde{v}_t$ and $Q_t \tilde{v}^*_t$.

The assumption that home and shares on home and foreign equity can be traded via mutual funds is made for computational simplicity. The model is isomorphic to a setup, in which each country's households can buy shares of individual firms directly. The number of assets available, the extensive margin of international equity trade, is then determined endogenously as the number of firms is determined endogenously as well.

The portfolio holdings of domestic and foreign equity chosen in period t are given by

$$\alpha_{H,t+1}\mathscr{P}_{t+1} = x_{H,t+1}\left(N_{D,t}+N_{E,t}\right)\tilde{v}_t \text{ and } \alpha_{F,t+1}\mathscr{P}_{t+1} = x_{F,t+1}Q_t\left(N^*_{D,t}+N^*_{E,t}\right)\tilde{v}^*_t, \tag{4}$$

where $\alpha_{H,t+1}$ and $\alpha_{F,t+1}$ are the portfolio shares of domestic and foreign equity, respectively, and $\mathscr{P}_{t+1}$ denotes the real value of the portfolio at the end of period t.

When holding home and foreign equity, households have to pay quadratic fees to financial intermediaries as in Ghironi, Lee, and Rebucci (2007).[4] Besides introducing frictions in financial markets, these convex costs solve the problem of indeterminacy of the portfolio composition in the deterministic steady state as they pin down portfolio shares and ensure stationarity in response to stochastic shocks.[5] Financial costs for holding home and foreign equity are given by

$$\frac{\xi_{H,t}}{2}\left(\alpha_{H,t+1}\mathscr{P}_{t+1}\right)^2 \quad \text{and} \quad \frac{\xi_{F,t}}{2}\left(\alpha_{F,t+1}\mathscr{P}_{t+1}\right)^2. \tag{5}$$

The scaling parameters $\xi_{H,t}$ and $\xi_{F,t}$ reflect the extent of frictions in financial markets. These fees are redistributed from financial intermediaries to the household in a lump-sum fashion equal to

$$\bar{F_t} = \frac{\xi_{H,t}}{2}\left(\alpha_{H,t+1}\mathscr{P}_{t+1}\right)^2 + \frac{\xi_{F,t}}{2}\left(\alpha_{F,t+1}\mathscr{P}_{t+1}\right)^2. \tag{6}$$

The household takes this redistribution as given when maximizing utility. There are no transaction costs on bonds, since these are traded only domestically so that equilibrium bond holdings are zero in the aggregate.

The intertemporal budget constraint of the representative home household is then given by

$$\begin{aligned} &\mathscr{P}_{t+1} + \frac{\xi_{H,t}}{2}\left(\alpha_{H,t+1}\mathscr{P}_{t+1}\right)^2 + \frac{\xi_{F,t}}{2}\left(\alpha_{F,t+1}\mathscr{P}_{t+1}\right)^2 \\ &= \left(\alpha_{H,t}R_{H,t} + \alpha_{F,t}R_{F,t} + \left(1-\alpha_{H,t}-\alpha_{F,t}\right)R_{B,t}\right)\mathscr{P}_t + w_tL - C_t + \bar{F_t}, \end{aligned} \tag{7}$$

where $R_{B,t}$ is the real return on the riskless bond. $R_{H,t}$ and $R_{F,t}$ denote the return on

[4]Note that these portfolio fees have to be paid each period, irrespective of the actual change in the portfolio. Thus, these quadratic equity holding costs might also be interpreted as a progressive capital tax.

[5]In addition to convex portfolio costs, Schmitt-Grohé and Uribe (2003) explore alternative ways to achieve stationarity in a setting with incomplete asset markets.

domestic and foreign equity, respectively, expressed in home consumption units. Keeping in mind that only a fraction $(1-\delta) = N_{D,t}/\left(N_{D,t-1} + N_{E,t-1}\right)$ of all pre-financed firms in $t-1$ produces and earns non-zero profits in t, these returns can be written as

$$R_{H,t} = \frac{\tilde{v}_t + \tilde{d}_t}{\tilde{v}_{t-1}}(1-\delta) \quad \text{and} \quad R_{F,t} = \frac{Q_t}{Q_{t-1}} \frac{\tilde{v}_t^* + \tilde{d}_t^*}{\tilde{v}_{t-1}^*}(1-\delta). \tag{8}$$

Maximization of lifetime utility (1) with respect to the intertemporal budget constraint (7) leads to the following set of Euler equations:

$$1 = E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} R_{B,t+1}\right] \tag{9}$$

$$1 = E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \frac{R_{H,t+1}}{1+\xi_{H,t}\alpha_{H,t+1}\mathscr{P}_{t+1}}\right] \tag{10}$$

$$1 = E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \frac{R_{F,t+1}}{1+\xi_{F,t}\alpha_{F,t+1}\mathscr{P}_{t+1}}\right]. \tag{11}$$

As in Ghironi, Lee, and Rebucci (2007), transaction costs link portfolio holdings to the growth rates of marginal utility. Using (8), the Euler equations for domestic and foreign equity can be rewritten in terms of the average firm values and total average profits as

$$\tilde{v}_t = (1-\delta)E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \frac{\tilde{v}_{t+1}+\tilde{d}_{t+1}}{1+\xi_{H,t}\alpha_{H,t+1}\mathscr{P}_{t+1}}\right] \tag{12}$$

$$\tilde{v}_t^* = (1-\delta)E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \frac{Q_{t+1}}{Q_t}\frac{\tilde{v}_{t+1}^*+\tilde{d}_{t+1}^*}{1+\xi_{F,t}\alpha_{F,t+1}\mathscr{P}_{t+1}}\right]. \tag{13}$$

In the Appendix, I show that these Euler equations are consistent with firms' present discounted value of expected profits, described in the previous section.

A similar budget constraint and optimality conditions hold for the foreign household.[6]

[6]Transversality conditions for bonds and shares are omitted.

3 Aggregation and model summary

The main equations of the model for the home as well the foreign country are summarized in Table 1. The model is closed using net foreign assets and the equilibrium on the labor market.

Net foreign assets

Equity market clearing implies that home and foreign holdings in each mutual fund sum to one. Since bond holdings are zero in the aggregate, portfolio shares of home foreign equity in each country also equal one:

$$x_{H,t} + x^*_{H,t} = 1, \quad x_{F,t} + x^*_{F,t} = 1 \tag{14}$$

$$\alpha_{H,t} + \alpha_{F,t} = 1, \quad \alpha^*_{F,t} + \alpha^*_{H,t} = 1 \tag{15}$$

Because financial fees are redistributed to the household, the aggregate budget constraint for the home country can be written as

$$\mathscr{P}_{t+1} = \left(\alpha_{H,t} R_{H,t} + \alpha_{F,t} R_{F,t}\right) \mathscr{P}_t + w_t L - C_t. \tag{16}$$

Substituting the value of each portfolio position (4) and the definition of returns (8), equation (16) can be expressed as

$$\begin{aligned} & x_{H,t+1}\left(N_{D,t} + N_{E,t}\right)\tilde{v}_t + Q_t x_{F,t+1}\left(N^*_{D,t} + N^*_{E,t}\right)\tilde{v}^*_t \\ & = x_{H,t} N_{D,t}\left(\tilde{v}_t + \tilde{d}_t\right) + Q_t x_{F,t} N^*_{D,t}\left(\tilde{v}^*_t + \tilde{d}^*_t\right) + w_t L - C_t. \end{aligned} \tag{17}$$

Each portfolio position may not only change because of fluctuations in asset prices and the exchange rate. In this setup, valuation effects may also arise because of the endogenously evolving number firms in each country. For the foreign country the aggregate budget constraint looks similar

$$\begin{aligned} & x^*_{F,t+1}\left(N^*_{D,t} + N^*_{E,t}\right)\tilde{v}^*_t + Q_t^{-1} x^*_{H,t+1}\left(N_{D,t} + N_{E,t}\right)\tilde{v}_t \\ & = x^*_{F,t} N^*_{D,t}\left(\tilde{v}^*_t + \tilde{d}^*_t\right) + Q_t^{-1} x^*_{H,t} N_{D,t}\left(\tilde{v}_t + \tilde{d}_t\right) + w^*_t L^* - C^*_t. \end{aligned} \tag{18}$$

Multiplying (18) by the real exchange rate and subtracting the foreign budget constraint in terms of home consumption from (17) yields an expression for home's net foreign assets that depend on home and foreign equity holdings, consumption and labor income

$$
\begin{aligned}
& Q_t x_{F,t+1}\left(N_{D,t}^* + N_{E,t}^*\right)\tilde{v}_t^* - x_{H,t+1}^*\left(N_{D,t} + N_{E,t}\right)\tilde{v}_t \\
& = -x_{H,t+1}\left(N_{D,t} + N_{E,t}\right)\tilde{v}_t + Q_t x_{F,t+1}^*\left(N_{D,t}^* + N_{E,t}^*\right)\tilde{v}_t^* \\
& + \left(x_{H,t} - x_{H,t}^*\right) N_{D,t}\left(\tilde{v}_t + \tilde{d}_t\right) + Q_t\left(x_{F,t} - x_{F,t}^*\right) N_{D,t}^*\left(\tilde{v}_t^* + \tilde{d}_t^*\right) \\
& + w_t L - Q_t w_t^* L^* - C_t + Q_t C_t^*. \qquad (19)
\end{aligned}
$$

Labor market clearing

As in Ghironi and Melitz (2005) labor demand in the home country is given

$$L_t = \frac{\theta - 1}{w_t} N_{D,t}\tilde{d}_{D,t} + \frac{\theta - 1}{w_t} N_{X,t}\tilde{d}_{X,t} + \frac{\theta - 1}{Z_t} N_{X,t} f_{X,t} + \frac{1}{Z_t} N_{X,t} f_{X,t} + \frac{1}{Z_t} N_{E,t} f_{E,t}$$

The first term on the right hand side gives the number of workers hired for production of all domestic firms, the second and the third term capture the labor employed to produce export goods. The last two terms reflect labor demand to cover fixed costs of exporting and sunk entry costs, respectively. Given that labor is supplied inelastically by households and immobile across borders, the equilibrium in the labor market is then

$$L = \frac{\theta - 1}{w_t}\left(N_{D,t}\tilde{d}_{D,t} + N_{X,t}\tilde{d}_{X,t}\right) + \frac{1}{Z_t}\left(\theta N_{X,t} f_{X,t} + N_{E,t} f_{E,t}\right). \qquad (20)$$

Labor demand and supply is similar for the foreign country.

4 Model dynamics

4.1 Calibration

The calibration of model parameters follows Ghironi and Melitz (2005) and is summarized in Table 2. The model is log-linearized around a symmetric, non-stochastic steady state, where $\tau = \tau^*$ $L = L^*$, $Z = Z^*$, $f_E = f_E^*$, $f_X = f_X^*$. The solution of key steady state variables is given in the Appendix.

Two scenarios with different degrees of financial integration are examined. First, I consider the empirically more relevant case of domestic equity bias in both countries. Frictions in financial markets are assumed to be $\xi_{H,t} = \xi_{F,t}^* = 0.01$ and $\xi_{F,t} = \xi_{H,t}^* = 0.03$ implying that each country's access to its own equity is less costly than purchasing equity abroad. Second, this home bias scenario is contrasted with a setting where countries are more financially integrated. Frictions are assumed to be small and equal across countries: $\xi_{H,t} = \xi_{F,t} = \xi^*_{F,t} = \xi^*_{H,t} = \xi = 0.0025$.[7] In the following figures, periods are interpreted as quarters. All responses are given in percentage deviations from the initial steady state.[8]

4.2 Permanent productivity shock

Figure 1 gives the model dynamics in response to a permanent one percent increase in home productivity.

A positive shock to labor productivity leads to a rise of effective labor units in the home country. Entering the more productive home economy becomes more attractive. In contrast to the case of financial autarky, these new entrants $N_{E,t}$, are financed by both, home as well as foreign households. Since foreign households want to benefit from the favorable productivity shock in the home country, they purchase shares in the home mutual fund. These share holdings in home equity increase regardless of the degree of financial integration. As it is less costly for both countries to hold home equity, the number of home entrants is higher if financial markets are more integrated. At the same time, portfolio holdings of foreign equity of both countries decrease initially. If there is domestic equity bias, this effect is even more pronounced for home holdings of foreign equity, as the costs of holding foreign equity are higher. As a consequence, home net foreign assets decrease.

Since the number of firms operating in the home country $N_{D,t}$ steadily increases with inelastically supplied labor in the economy, wages w_t rise in the home country. In contrast, in the foreign country, the number of entrants $N^*_{E,t}$ decreases as it is more attractive to enter the home country. This effect is even larger if countries are more financially integrated, as more entrants are financed in the home country at the expense of foreign entrants. Labor costs in the foreign country must fall to lower entry costs and attract new entrants. Wages w^*_t decline initially and then increase. However, this increase is not as pronounced as in the home country, so foreign labor costs relatively decrease.

Consumption in the home country increases for two reasons. First, labor income improves due to rising wages and, second, because of higher income from portfolio invest-

[7] This number still is large enough to achieve stationarity in response to transitory shocks.

[8] The responses of the endogenous variables in the case of more integrated financial markets are denoted by a dashed line in the following figures. The responses in the case of domestic equity bias are denoted by a solid line.

ments. The increase in profits of home firms $\tilde{d}_t$ and the steady increase in firm value $\tilde{v}_t$ raises the return on home equity $R_{H,t}$ and boosts the value of the portfolio. This benefit from home portfolio investments is even higher if there is home bias in equities. As a result, consumption is higher compared to the case of financially integrated countries, despite lower labor income.

Increased consumption in the home country raises demand for home as well as imported goods. Because of this increased demand for foreign goods, the number of exporting firms in the foreign country $N^*_{X,t}$ increases. As exporting becomes more profitable, less productive firms also choose to serve the home market, which lowers $z^*_{X,t}$.

The number of exporting firms also increases in the home country. But there are two opposing effects. On the one hand, with rising labor costs, exporting becomes more costly which results in a higher export cut-off level $z_{X,t}$ as only more productive firms will decide to ship their goods. This effect, however, is only prevalent if there are less frictions in financial markets. On the other hand, as more and more firms enter the home market, the number of exporting firms $N_{X,t}$ increases despite higher fixed costs of exporting. The impulse responses show that the latter effect dominates.

Output in both countries increases in the long run.[9] In the foreign country, the number of entrants $N^*_{E,t}$ is below its initial steady state value during most periods of the transition. The number of firms that "depreciate" (that are hit by the death shock with probability δ) is larger than new firms entering the foreign market, so the number of firms operating in the foreign market $N^*_{D,t}$ is always below its initial steady state level. If markets are more financially integrated, this decrease of the number firms operating in the foreign country is even more severe than in the domestic equity bias scenario. As a result, output in the foreign country decreases during the first twelve years.

Higher labor income in the foreign country also leads to higher consumption of foreign households. In contrast to the home country, the increase of foreign consumption is lower when there is domestic equity bias because foreign households hold more financial wealth and consume less. In addition, they benefit less from the increasing return on home equity, as they hold fewer shares in home firms. Since consumption in the home country is higher in the presence of larger frictions in financial markets, one might suspect that financial integration is not welfare improving. However, world consumption (not shown) is higher when financial markets are more integrated.

To evaluate the extent to which this model generates deviations from efficient con-

[9] Home (foreign) output is defined as $y \equiv w_t L + N_{D,t}\tilde{d}$ ($y^* \equiv w^*_t L^* + N^*_{D,t}\tilde{d}^*$).

sumption risk sharing in the presence of shocks, I draw on a frequently used measure going back to Backus and Smith (1993). For two *ex ante* symmetric countries and additive separable utility with constant relative risk aversion as in (1) that trade a full set of state-contingent securities, efficient risk sharing implies that $(C_t/C_t^*)^\gamma = Q_t$.[10] This condition holds irrespective of frictions in the goods markets as long as financial markets are complete and fully integrated. Of course, in this setup, in addition to frictions in goods markets that lead to deviations from purchasing power parity, financial markets are neither complete, as only two assets are traded, nor fully integrated, as engagement in financial markets is subject to transaction costs. However, deviations from the Backus-Smith-condition reflect the degree of how much financial markets imperfections impede consumption risk sharing in the presence of goods market imperfections. The impulse responses show that there is a positive deviation from this benchmark, which implies that consumption risk sharing is only partial throughout the transmission process. As expected, this deviation is larger if there is home bias in equities.

4.3 Transitory productivity shock

Figure 2 shows the impulse responses to a one percent transitory increase in home productivity with persistence 0.9. As in the case of a permanent productivity shock, the home and the foreign country purchase home equity to finance new home entrants. Here, however, the home country also increases its portfolio holdings of foreign firms, whereas the foreign countries decreases its holdings of foreign equity. In sum, the number of foreign entrants and the total number foreign firms increases, except initially.

Home consumption is positive throughout the transmission process before returning to its old steady state level, as home households benefit from rising labor income and initially increasing returns on home and foreign equity. Consumption in the foreign country also increases initially. This increase is even more pronounced in the case of more financially integrated markets, where savings decline (P_t^* decreases). However, foreign consumption falls below its initial steady state level after five years in the domestic equity bias scenario (after eight years if markets are more financially integrated).

Home households' investments in foreign equity increases, whereas foreign households hold less shares of foreign equity in their portfolio throughout the whole transmission process. As a consequence, home net foreign assets are positive, except on impact,

[10] If countries are asymmetric in steady state, this condition holds times a constant. Tille (2005) explores the role of this wedge. Since this model is solved around a symmetric steady state, this constant equals one.

before returning to their old steady state level.

In the long run, the value and profits of home and foreign firms converge to their old steady state, implying that returns on equity are also equal to their initial level in the long run. Given that frictions in financial markets are unchanged throughout the transition, portfolio shares also gradually adjust to their old steady state levels.

Again, in both scenarios, there are departures from the Backus-Smith condition. These deviations are initially larger for the domestic equity bias scenario. However, after ten years this picture reverses and risk sharing is worse if there are less frictions in financial markets. Nevertheless, world consumption is higher, if markets are more integrated.

4.4 Deregulation

As in Ghironi and Melitz (2005), deregulation in the home market is modelled as a one percent permanent decrease in home sunk entry costs $f_{E,t}$. The impulse responses are depicted in Figure 3.

As entering the home market is less costly, the number of home entrants $N_{E,t}$ increases leading to a higher number of firms operating in the home market $N_{D,t}$. This, in turn, increases the real wage rate w_t, since labor supply is fixed and immobile across countries. As a result, consumption in the home country rises above its initial steady state level, despite lower financial wealth during the first periods of the transition. Foreign consumption decreases initially, as wages decline initially to attract new entrants in the foreign country.

There is a positive deviation from the Backus-Smith condition in both scenarios of financial market integration. Only during the first four years after the shock, this departure is larger if financial markets are more integrated across countries. As in the case of a permanent productivity shock, this deviation from efficient risk sharing is larger in the long run if there is domestic equity bias.

4.5 Goods and financial market liberalization

To examine how frictions in goods markets and frictions in financial markets affect efficient consumption risk sharing, the economic liberalization of the home country is examined.[11] To this end, I start from the domestic equity bias scenario. The opening up of

[11] Note that symmetric changes in policy instruments would not alter risk sharing between the two countries.

financial markets is modelled as a one percent permanent decrease in the costs of holding domestic equity for foreign households $\xi^*_{H,t}$. In addition, as domestic fixed export costs can be interpreted as policy instruments of the country abroad, home trade liberalization is reflected by a one percent permanent decrease in fixed export costs of the foreign country $f^*_{X,t}$. The responses of the endogenous variables to these combined shocks are given in Figure 4.

As foreign export costs are decreasing permanently, less productive firms in the foreign country will also serve the home market, which results in a higher number of foreign exporting firms $N^*_{X,t}$. This is mirrored by a decline in the average export productivity, *i.e.* $z^*_{X,t}$ falls.

The foreign country initially increases its portfolio holdings of home equity. As it saves more, consumption is below its original steady state value. Home households' investments in foreign equity rise, and holdings of home equity are declining. The home household consumption increases as their financial wealth $\mathscr{P}_t$ is declining. Since the increase of home portfolio holdings of foreign equity is smaller than the increase of foreign portfolio holdings of home equity, home net foreign assets steadily decrease.

Similar to the case of a permanent productivity shock, labor costs in the foreign country must initially fall since more home entrants are financed in the home country than in the foreign country. As wages rise above their original steady level, consumption increases in the foreign country.

The real exchange rate depreciates, except on impact. This change in the real exchange rate is caused by a higher relative number of exporting firms in the foreign country and a lower relative number of foreign firms, which leads to a decreasing home price index relative to the foreign one.

The effect of financial and goods market liberalization on risk sharing is ambiguous. In the long-run, there is a negative deviation from the Backus-Smith condition as foreign consumption is higher in the long run than home consumption. However, during the first five years of the transition, there is a positive deviation from the risk sharing condition in favor of the home country.

5 Conclusion

This project analyzes the impact of goods and asset market imperfections on international consumption risk sharing. To this end, the setup of Ghironi and Melitz (2005) is extended to allow for international trade in equities. Firms are heterogenous with respect to their productivity level, which leads to an endogenously determined size of the non-traded goods sector and to an endogenously evolving number of firms operating in each country. Building on this framework, impediments in international asset markets are introduced. Impulse responses show that there are substantial differences in international consumption risk sharing depending on the nature of the underlying shock, the degree of financial market integration and the time horizon considered.

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Appendix

A Firm entry

Before entering the market, entrants maximize their present discounted value of expected profit streams. They use the stochastic discount factors of both, the home household as well as the foreign household weighted by their respective share in the home mutual fund.

$$\tilde{v}_t = E_t \left[\sum_{s=t+1}^{\infty} (1-\delta) \left(x_{H,t+1} \frac{\beta^{s-t}(C_s)^{-\gamma}}{(C_t)^{-\gamma}(1+\xi_{H,s-1}\alpha_{H,s}\mathscr{P}_s)} \right. \right.$$
$$\left. \left. + x^*_{H,t+1} \frac{Q_t}{Q_s} \frac{\beta^{s-t}(C^*_s)^{-\gamma}}{(C^*_t)^{-\gamma}(1+\xi^*_{H,s-1}\alpha^*_{H,s}\mathscr{P}^*_s)} \right) \tilde{d}_s \right]. \qquad (21)$$

Stochastic discount factors at home and abroad are adjusted by marginal transaction costs and are given by[12]

$$m_s \equiv \frac{\beta^{s-t}(C_s)^{-\gamma}}{(C_t)^{-\gamma}(1+\xi_{H,s-1}\alpha_{H,s}\mathscr{P}_s)}, \quad \text{and} \quad m^*_s \equiv \frac{\beta^{s-t}(C^*_s)^{-\gamma}}{(C^*_t)^{-\gamma}(1+\xi^*_{H,s-1}\alpha^*_{H,s}\mathscr{P}^*_s)}.$$

Note that this is consistent with households' optimal behavior, *i.e* the Euler equations for home equity of the home and foreign households, (12) and the foreign counterpart:

$$\tilde{v}_t(C_t)^{-\gamma} = (1-\delta)E_t \left[\beta(C_{t+1})^{-\gamma} \frac{\tilde{v}_{t+1} + \tilde{d}_{t+1}}{1+\xi_{H,t}\alpha_{H,t+1}\mathscr{P}_{t+1}} \right]$$
$$\frac{\tilde{v}_t(C^*_t)^{-\gamma}}{Q_t} = (1-\delta)E_t \left[\frac{\beta(C^*_{t+1})^{-\gamma}}{Q_{t+1}} \frac{\tilde{v}_{t+1} + \tilde{d}_{t+1}}{1+\xi^*_{H,t}\alpha^*_{H,t+1}\mathscr{P}^*_{t+1}} \right].$$

Iterating both equations forward and ruling out Ponzi schemes gives

$$\tilde{v}_t = (1-\delta)E_t \left[\sum_{s=t+1}^{\infty} \frac{\beta^{s-t}(C_s)^{-\gamma}}{(C_t)^{-\gamma}(1+\xi_{H,s-1}\alpha_{H,s}\mathscr{P}_s)} \tilde{d}_s \right]$$
$$\tilde{v}_t = (1-\delta)E_t \left[\sum_{s=t+1}^{\infty} \frac{Q_t}{Q_s} \frac{\beta^{s-t}(C^*_s)^{-\gamma}}{(C^*_t)^{-\gamma}(1+\xi^*_{H,s-1}\alpha^*_{H,s}\mathscr{P}^*_s)} \tilde{d}_s \right].$$

[12]Similar stochastic discount factors have been applied in a previous draft of the paper by Ghironi, Lee, and Rebucci (2007).

Now multiplying both sides of each equation with the shares held in the home mutual fund by home households and foreign households, respectively, and bearing in mind that $x_{H,t+1} + x^*_{H,t+1} = 1$, then the sum of these two expressions yields (21).

B Steady state

The model is solved around a symmetric non-stochastic steady state, where $f_E = f^*_E$, $f_X = f^*_X$, $\tau = \tau^*$, $L = L^*$, and $Z = Z^* = 1$. It follows that $Q = 1$. Steady state variables are denoted without time subscripts.

Portfolio shares

In steady state, the Euler equations for equity holdings of the home household (12) and (13) and their foreign analogs are given by

$$\tilde{v} = \frac{\beta(1-\delta)}{1-\beta(1-\delta)+\xi_H \alpha_H \mathscr{P}} \tilde{d} \tag{22}$$

$$\tilde{v} = \frac{\beta(1-\delta)}{1-\beta(1-\delta)+\xi^*_H \alpha^*_H \mathscr{P}^*} \tilde{d} \tag{23}$$

for home equity and

$$\tilde{v}^* = \frac{\beta(1-\delta)}{1-\beta(1-\delta)+\xi_F \alpha_F \mathscr{P}} \tilde{d}^* \tag{24}$$

$$\tilde{v}^* = \frac{\beta(1-\delta)}{1-\beta(1-\delta)+\xi^*_F \alpha^*_F \mathscr{P}^*} \tilde{d}^* \tag{25}$$

for foreign equity. Combining (22) with (23) and (24) with (25), it follows that

$$\frac{\xi_H}{\xi^*_H} \alpha_H = \alpha^*_H \tag{26}$$

$$\frac{\xi^*_F}{\xi_F} \alpha^*_F = \alpha_F. \tag{27}$$

Since bond holdings are zero in the aggregate, the shares of home and foreign equity holdings sum to one

$$\alpha_H + \alpha_F = 1 \tag{28}$$

$$\alpha_H^* + \alpha_F^* = 1. \tag{29}$$

Portfolio shares by home and foreign households are then given by

$$\alpha_H = \frac{\xi_H^*}{\xi_H + \xi_H^*} = \frac{\xi_F}{\xi_F^* + \xi_F}, \qquad \alpha_F = \frac{\xi_F^*}{\xi_F + \xi_F} = \frac{\xi_H}{\xi_H + \xi_H^*}, \tag{30}$$

$$\alpha_H^* = \frac{\xi_H}{\xi_H + \xi_H^*} = \frac{\xi_F^*}{\xi_F + \xi_F}, \qquad \alpha_F^* = \frac{\xi_F}{\xi_F^* + \xi_F} = \frac{\xi_H^*}{\xi_H + \xi_H^*}. \tag{31}$$

In a symmetric steady state, home portfolio shares of home equity and foreign portfolio shares of foreign equity are equal, so households in both countries face the same relative access to financial markets, $\xi_H = \xi_F^*$ and $\xi_F = \xi_H^*$. Portfolio shares are determined exogenously in steady state, however, the value of each asset position held in the portfolio is endogenous as in Devereux and Sutherland (2007).

Financial wealth at home and abroad equals each other in steady state, $\mathscr{P} = \mathscr{P}^*$, and sum to world equity market capitalization

$$\mathscr{P} + \mathscr{P}^* = \tilde{v}\,(N_D + N_E) + \tilde{v}^*\,(N_D^* + N_E^*)\,. \tag{32}$$

Together with the value of home portfolio holdings of home and foreign equity given in (4) and their foreign counterparts

$$\alpha_H \mathscr{P} = x_H\,(N_D + N_E)\,\tilde{v}, \qquad \alpha_F \mathscr{P} = x_F\,(N_D^* + N_E^*)\,\tilde{v}^*, \tag{33}$$

$$\alpha_H^* \mathscr{P}^* = x_H^*\,(N_D + N_E)\,\tilde{v}, \qquad \alpha_F^* \mathscr{P}^* = x_F^*\,(N_D^* + N_E^*)\,\tilde{v}^*, \tag{34}$$

this implies that in steady state, portfolio shares of each asset are equal to the respective shares held in the mutual funds

$$\alpha_H = x_H, \qquad \alpha_F = x_F, \tag{35}$$

$$\alpha_H^* = x_H^*, \qquad \alpha_F^* = x_F^*. \tag{36}$$

Table 1: Model Summary

Price indexes	$N_{D,t}\left(\tilde{\rho}_{D,t}\right)^{1-\theta}+N_{X,t}^{*}\left(\tilde{\rho}_{X,t}^{*}\right)^{1-\theta}=1$ $N_{D,t}^{*}\left(\tilde{\rho}_{D,t}^{*}\right)^{1-\theta}+N_{X,t}\left(\tilde{\rho}_{X,t}\right)^{1-\theta}=1$
Profits	$\tilde{d}_t=\tilde{d}_{D,t}+\frac{N_{X,t}}{N_{D,t}}\tilde{d}_{X,t}$ $\tilde{d}_t^{*}=\tilde{d}_{D,t}^{*}+\frac{N_{X,t}^{*}}{N_{D,t}^{*}}\tilde{d}_{X,t}^{*}$
Free entry	$\tilde{v}_t=w_t\frac{f_{E,t}}{Z_t}$ $\tilde{v}_t^{*}=w_t^{*}\frac{f_{E,t}^{*}}{Z_t^{*}}$
Zero-profit export cutoffs	$\tilde{d}_{X,t}=w_t\frac{f_{X,t}}{Z_t}\frac{\theta-1}{k-(\theta-1)}$ $\tilde{d}_{X,t}^{*}=w_t^{*}\frac{f_{X,t}^{*}}{Z_t^{*}}\frac{\theta-1}{k-(\theta-1)}$
Share of exporting firms	$\frac{N_{X,t}}{N_{D,t}}=(z_{\min})^{k}(\tilde{z}_{X,t})^{-k}\left[\frac{k}{k-(\theta-1)}\right]^{\frac{k}{\theta-1}}$ $\frac{N_{X,t}^{*}}{N_{D,t}^{*}}=(z_{\min})^{k}(\tilde{z}_{X,t}^{*})^{-k}\left[\frac{k}{k-(\theta-1)}\right]^{\frac{k}{\theta-1}}$
Number of firms	$N_{D,t}=(1-\delta)\left(N_{D,t-1}+N_{E,t-1}\right)$ $N_{D,t}^{*}=(1-\delta)\left(N_{D,t-1}^{*}+N_{E,t-1}^{*}\right)$
Euler equations for bonds	$1=E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\left(R_{B,t+1}\right)\right]$ $1=E_t\left[\beta\left(\frac{C_{t+1}^{*}}{C_t^{*}}\right)^{-\gamma}\left(R_{B,t+1}^{*}\right)\right]$
Euler equations for home equity	$\tilde{v}_t=(1-\delta)E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\frac{\left(\tilde{v}_{t+1}+\tilde{d}_{t+1}\right)}{\left(1+\xi_{H,t}\alpha_{H,t+1}\mathscr{P}_{t+1}\right)}\right]$ $\tilde{v}_t=(1-\delta)E_t\left[\beta\left(\frac{C_{t+1}^{*}}{C_t^{*}}\right)^{-\gamma}\frac{Q_t}{Q_{t+1}}\frac{\left(\tilde{v}_{t+1}+\tilde{d}_{t+1}\right)}{\left(1+\xi_{H,t}^{*}\alpha_{H,t+1}^{*}\mathscr{P}_{t+1}^{*}\right)}\right]$
Euler equations for foreign equity	$\tilde{v}_t^{*}=(1-\delta)E_t\left[\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\frac{Q_{t+1}}{Q_t}\frac{\left(\tilde{v}_{t+1}^{*}+\tilde{d}_{t+1}^{*}\right)}{\left(1+\xi_{F,t}\alpha_{F,t+1}\mathscr{P}_{t+1}\right)}\right]$ $\tilde{v}_t^{*}=(1-\delta)E_t\left[\beta\left(\frac{C_{t+1}^{*}}{C_t^{*}}\right)^{-\gamma}\frac{\left(\tilde{v}_{t+1}^{*}+\tilde{d}_{t+1}^{*}\right)}{\left(1+\xi_{F,t}^{*}\alpha_{F,t+1}^{*}\right)\mathscr{P}_{t+1}^{*}}\right]$

Continued.

Table 1 continued.

Net foreign assets	$Q_t x_{F,t+1}\left(N^*_{D,t}+N^*_{E,t}\right)\tilde{v}^*_t - x^*_{H,t+1}\left(N_{D,t}+N_{E,t}\right)\tilde{v}_t$ $= -x_{H,t+1}\left(N_{D,t}+N_{E,t}\right)\tilde{v}_t + Q_t x^*_{F,t+1}\left(N^*_{D,t}+N^*_{E,t}\right)\tilde{v}^*_t$ $+\left(x_{H,t}-x^*_{H,t}\right)N_{D,t}\left(\tilde{v}_t+\tilde{d}_t\right)+Q_t\left(x_{F,t}-x^*_{F,t}\right)N^*_{D,t}\left(\tilde{v}^*_t+\tilde{d}^*_t\right)$ $+w_t L - Q_t w^*_t L^* - C_t + Q_t C^*_t$
Labor market clearing	$L=\frac{\theta-1}{w_t}\left(N_{D,t}\tilde{d}_{D,t}+N_{X,t}\tilde{d}_{X,t}\right)+\frac{1}{Z_t}\left(\theta N_{X,t} f_{X,t}+N_{E,t} f_{E,t}\right)$ $L^*=\frac{\theta-1}{w^*_t}\left(N^*_{D,t}\tilde{d}^*_{D,t}+N^*_{X,t}\tilde{d}^*_{X,t}\right)+\frac{1}{Z^*_t}\left(\theta N^*_{X,t} f^*_{X,t}+N^*_{E,t} f^*_{E,t}\right)$

Table 2: Model Calibration

Subjective time preference factor β	0.99
Relative risk aversion γ	2
Elasticity of substitution θ	3.8
Shape parameter of Pareto distribution k	3.4
Lower bound of Pareto distribution $z_{\min}$	1
Trade costs τ, τ^*	1.3
Fixed export costs f_X, f^*_X	0.09
Sunk entry costs f_E, f^*_E	1
Probability of market exit δ	0.025
Labor supply L, L^*	1

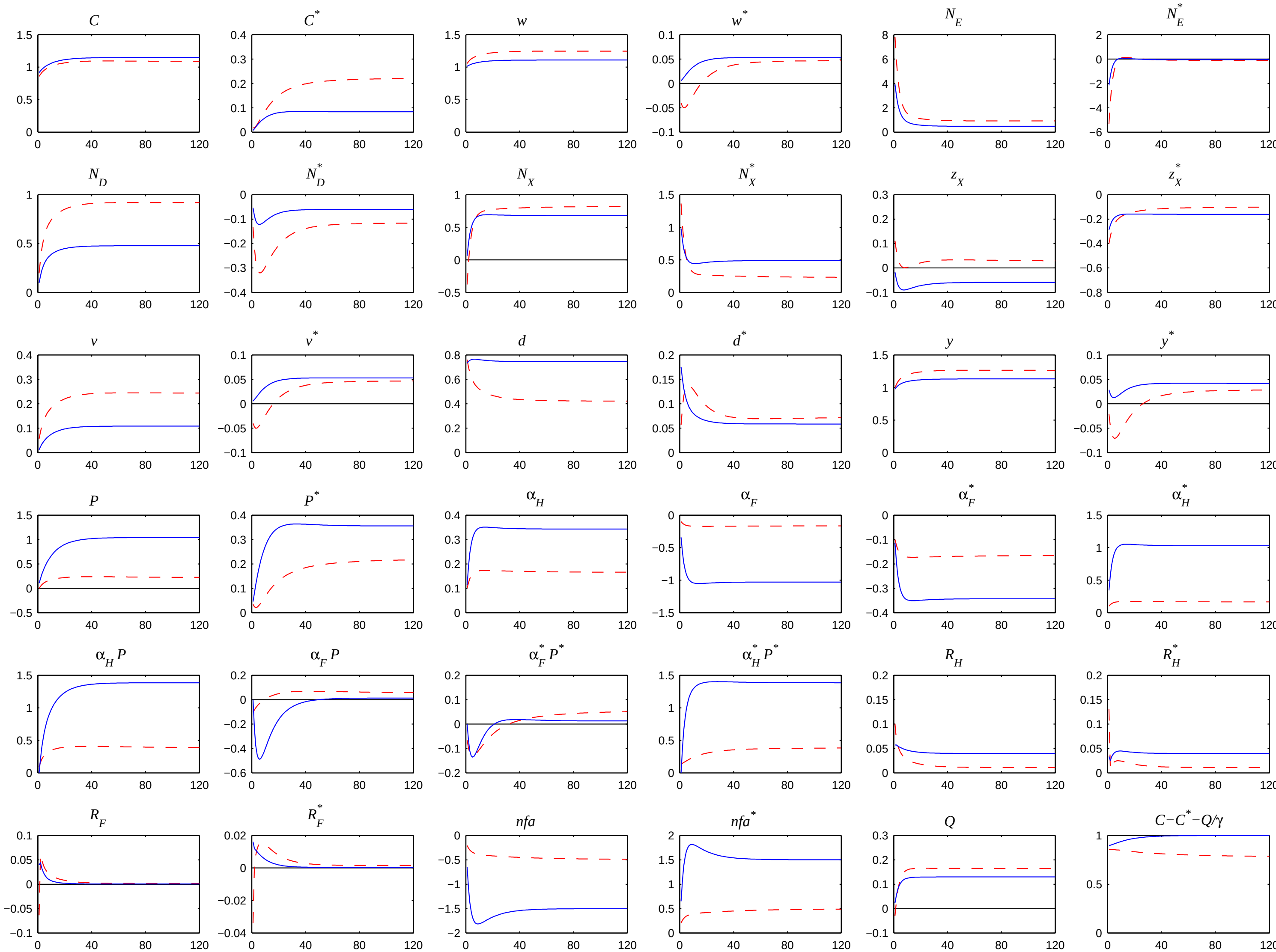

Figure 1: Permanent technology shock. (*Notes*: The solid line denotes the domestic equity bias scenario, the dashed line denotes financially more integrated economies.)

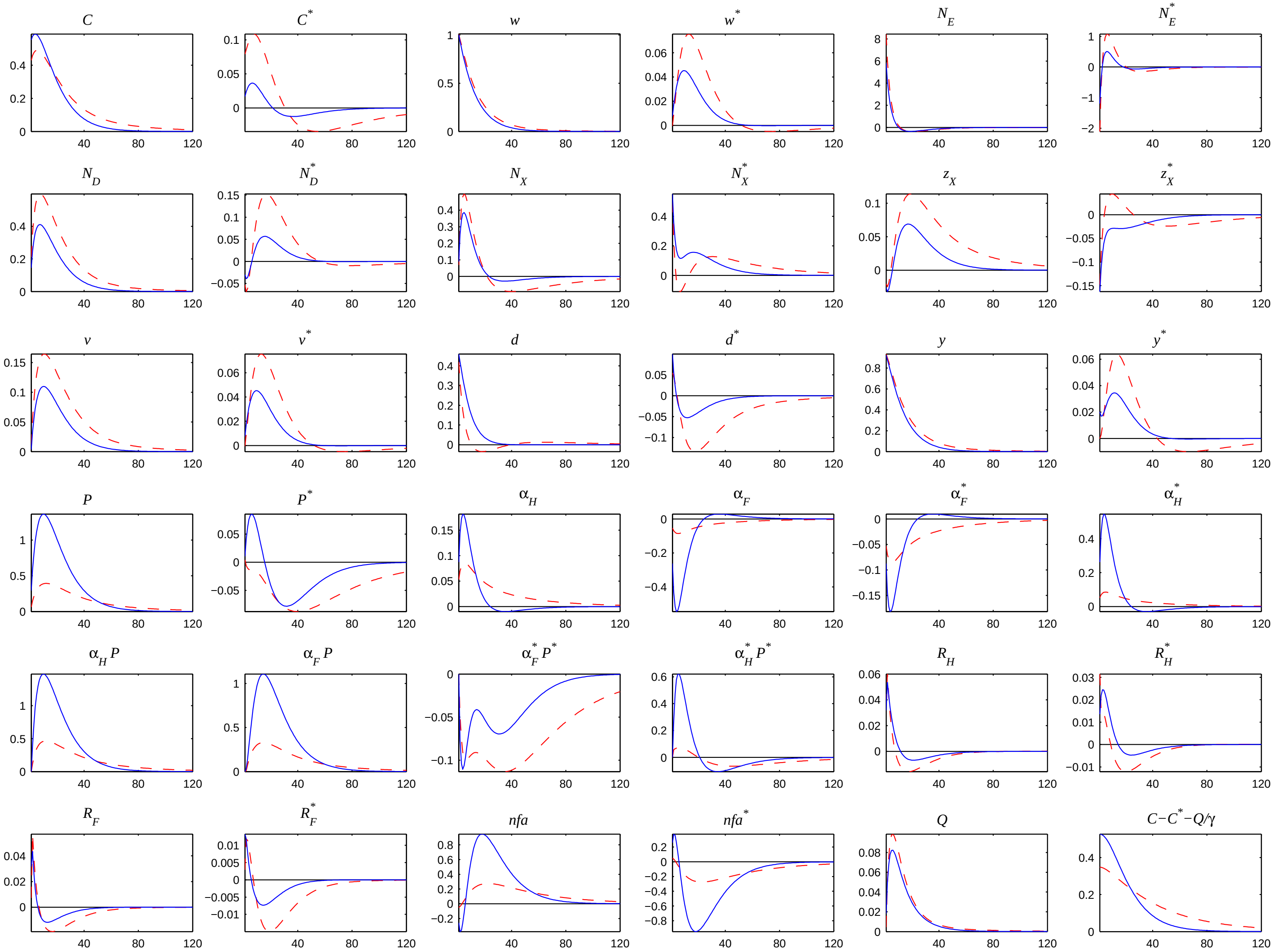

Figure 2: Transitory technology shock. (*Notes*: See Figure 1.)

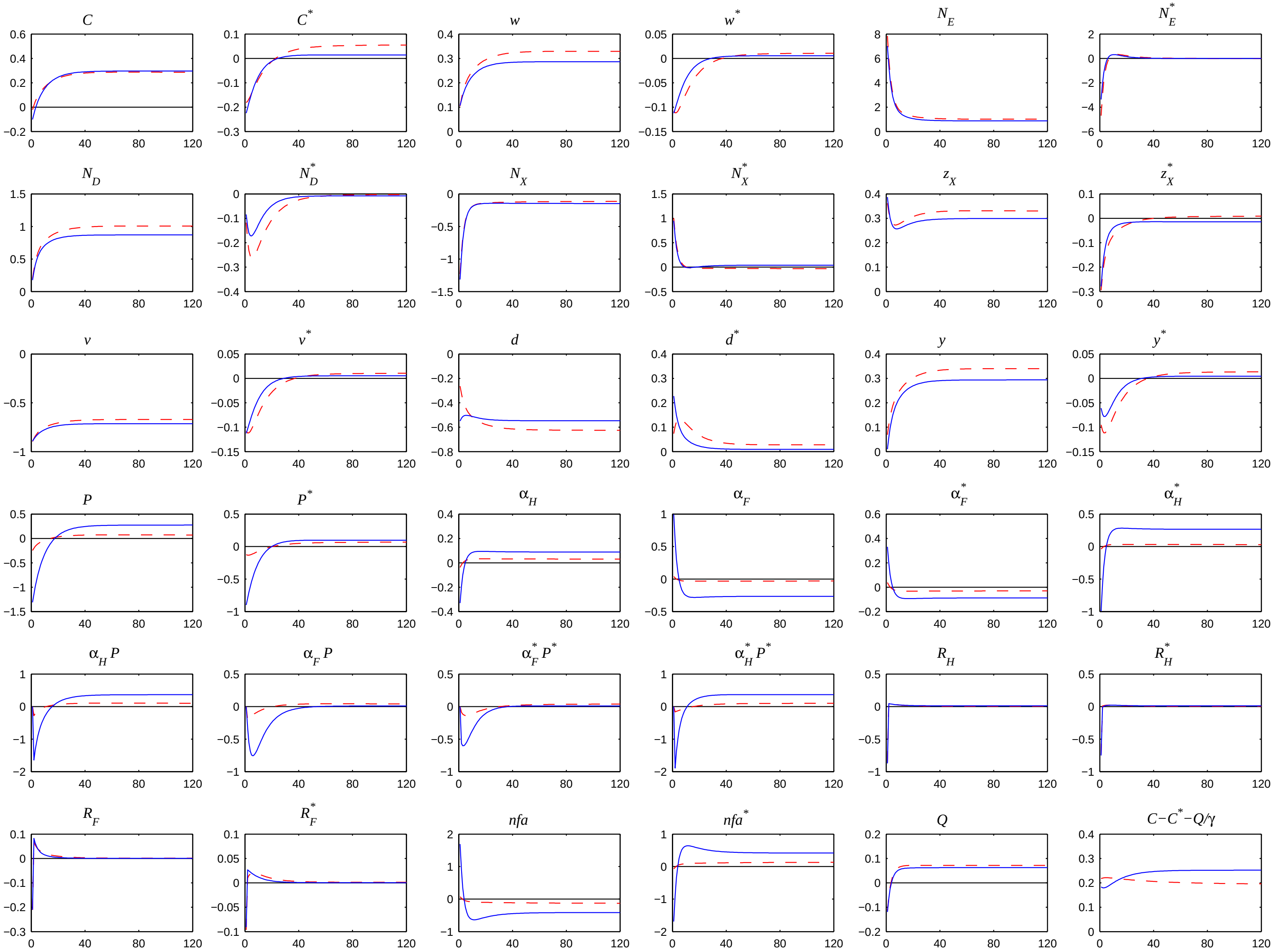

Figure 3: Deregulation. (*Notes*: See Figure 1.)

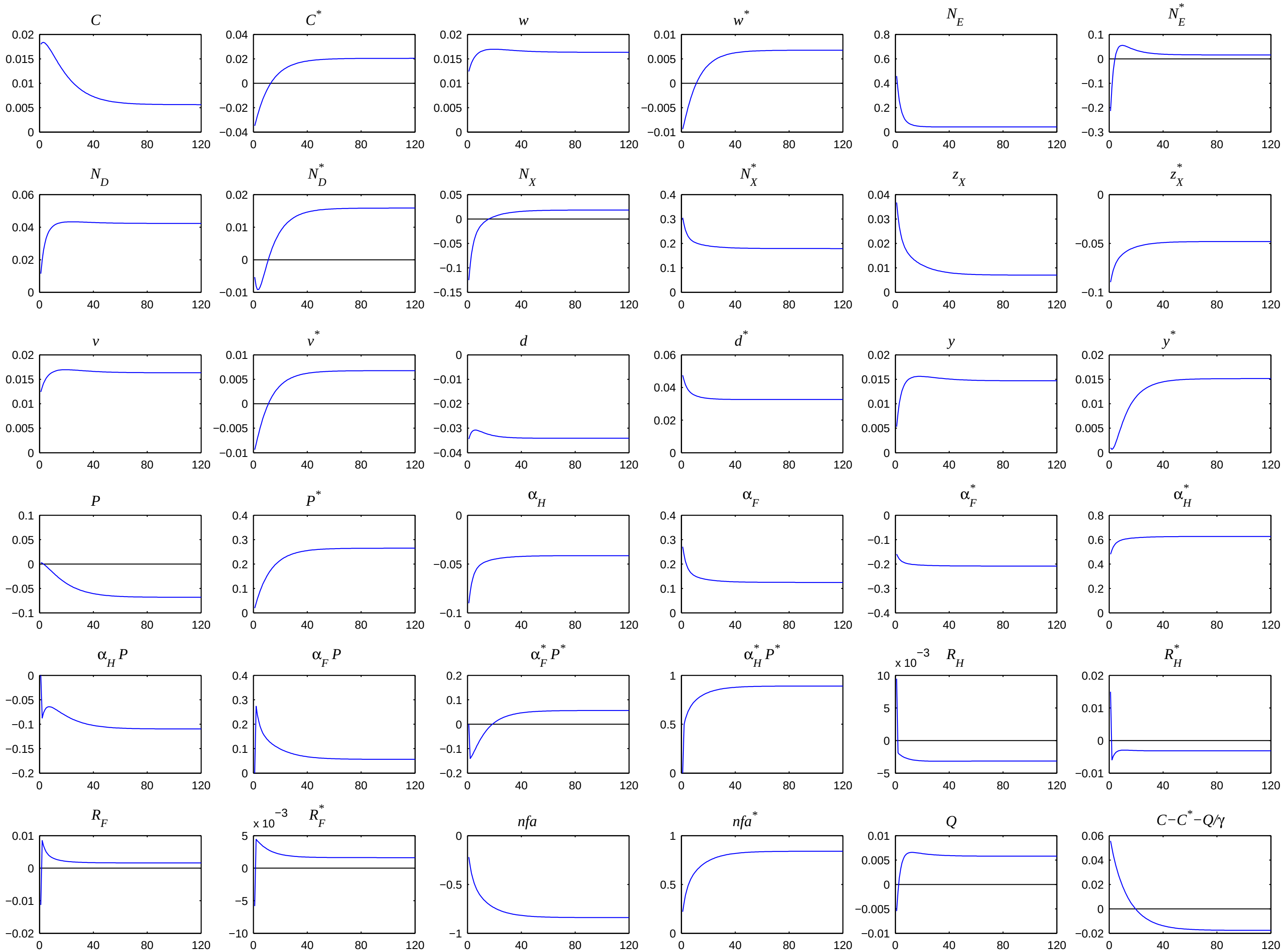

Figure 4: Trade and financial liberalization.