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Financial super-markets: size matters for asset trade

Philippe Martin[a,*], Hélène Rey[b]

[a] University of Paris I Panthéon Sorbonne, CERAS and CEPR, 48 Boulevard Jordan, 75014 Paris, France
[b] Princeton University CEPR and NBER, Department of Economics, Fisher Hall, Princeton, NJ 08544-1021, USA

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Abstract

Empirically, demand and market size effects play an important role for international trade in assets and the determination of asset prices. Financial integration decreases the cost of capital, asset prices increase with investors base and market size determines international financial flows. We present a two-country model with an endogenous number of financial assets, where the interaction of a risk diversification motive and market segmentation explains those facts. In our set up, an imperfectly competitive structure of financial markets emerges naturally and provides a new source for home bias in equity holdings. Due to co-ordination failures, the extent of financial market incompleteness is inefficiently high in equilibrium.

Keywords: International financial flows; Monopolistic competition; Transaction costs; Endogenously incomplete markets; Home bias

JEL classification: F4; F12; G1; G12

1. Introduction

Demand and size effects play an important role in international financial markets. When a stock is included in the S&P 500 index, its share price goes up. When a firm from a small country lists its stocks in a larger financial area, its share price goes up. When emerging markets open to foreign financial investment, their stock index goes up. Stocks from emerging economies exchanges migrate to large international financial

* Corresponding author. Tel.: +33-1-43-13-63-85; fax: +33-1-43-13-63-82.
E-mail addresses: martin-p@enpc.fr (P. Martin), hrey@princeton.edu (H. Rey).

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centers. And country size is an important determinant of international trade in financial assets.[1]

This paper presents an integrated framework to model international trade in assets, determinants of market capitalization and international relative asset prices. This simple approach can account for the previously described stylized facts and allows drawing welfare implications. The theoretical model has the following four key characteristics: (i) agents are risk-averse, (ii) assets are not perfect substitutes so that financial markets are imperfectly competitive, (iii) the number of financial assets is endogenous and (iv) cross-border asset trade entails some transaction costs. Because of imperfect substitution of assets and of transaction costs, the size of demand influences asset prices, the number of financial assets and diversification. In particular, we show that the larger country will benefit from higher asset prices, more financial assets and more diversification per capita than the smaller country. Furthermore, financial integration leads to an increase in asset prices and the model leads to a simple equation for international trade in assets for which we find strong empirical support. The imperfect competitive structure also leads to a new source of home bias in equity holdings.

In our model, agents choose how many risky projects they want to develop and how much of the risk of these projects they want to trade on the stock exchange. Hence, the extent of financial market incompleteness is endogenous. Furthermore, the decision by one agent to develop a new risky investment and to put a new security on the market enhances risk-sharing opportunities for all agents. Because of co-ordination failures, the extent of market incompleteness is inefficiently high in equilibrium.

Related to this paper are Obstfeld (1994), Acemoglu and Zilibotti (1997) and Pagano (1993). Obstfeld (1994) studies the links between international trade in assets and growth.[2] In his model portfolio diversification encourages a global shift from relatively low return, low risk investments into high-return riskier ones. In his model, different types of capital are costlessly interchangeable and international arbitrage in his frictionless world rules out market size effect, which are central in our approach. Acemoglu and Zilibotti (1997) also studies the impact of risk diversification on growth. There are several major differences between their approach and our set up: they do not have transaction costs nor monopolistic competition on financial markets, whereas these features play a central role in our analysis; they focus on capital accumulation and growth whereas we study the interactions between size, incompleteness of markets and price of financial assets in open economies. Furthermore, the complementarity between risky assets is at the heart of their analysis, whereas in our model, this mechanism is absent and the action comes from the interaction

[1] Other factors, such as information and institutions may of course also partly explain some of those facts. In Section 2 of this paper, we discuss in detail the empirical literature from which this list of stylized facts is drawn.

[2] We also build on insights of goods trade theory. We are not the first ones to take this road. Helpman and Razin (1978) introduced a stock market economy à-la-Diamond into a framework that fits the standard Ricardian and Hecksher–Ohlin models of international trade. Svensson (1988) and Persson and Svensson (1989) have extended this line of work. Contrary to our paper, this literature takes the number of securities traded as exogenous and bases the analysis of asset trade on autarky prices, which do not have an empirical counterpart. Our analysis goes beyond the Ricardian interpretation of trade in assets and applies some of the insights of static models of intra-industry trade (Krugman, 1979, Dixit and Norman, 1980; Helpman and Krugman, 1985) to financial flows.

of market size effects and transaction costs. Pagano (1993) looks at the decision of companies to float on the stock market and introduces trading externalities. His model differs from ours in several important dimensions: He studies a pure exchange closed economy, whereas we endogenize the investment decisions of entrepreneurs and analyze international capital flows and international market segmentation. Finally, our work is linked to Matsuyama (2001), who emphasizes the role of domestic credit market imperfection to generate inequality across countries when financial globalization (free trade in financial assets) occurs. In Section 2, we discuss the empirical evidence motivating our work. The general framework is presented in Section 3. Section 4 illustrates the effect of country size on financial markets in a model without income effects. This simplified model conveys clear intuitions about the results. It also allows us to draw interesting comparisons with the models of intra-industry trade. Section 5 shows that in a more general model, the relevant measure of the size effect is aggregate income. In that part, we can also study richer intertemporal questions. Section 6 analyses some implications of our general model for financial integration, portfolio diversification, home bias in equities and financial trade flows. Section 7 discusses welfare implications. The impact of domestic transaction costs and issuing costs is briefly presented in Section 8. Section 9 concludes.

2. Empirical motivation

Our framework is consistent with several empirical findings regarding demand and market size effects on equity prices, financial integration and the pattern of international equity flows.

2.1. Demand effects, market size and price of stocks

A number of empirical papers in finance uncover downward sloping demand curves for equities, a fact that is consistent with imperfect substituability of equities. This contrasts with textbook finance models[3] that produce flat demand curves. Indeed, as long as equities are modeled as claims to residual cash flows with many perfect substitutes, the price elasticity of demand for equities should be infinite. These empirical papers disentangle pure demand effects from information effects on the price of stocks by studying specific events such as the inclusion of stocks in specific indexes or changes in their weighting. Shleifer (1986) argues that the inclusion of stocks in the S&P 500 index leads to a rise in demand for those stocks, since they automatically fall into the shopping basket of many mutual funds. He finds a permanent price increase of 2.79% for those stocks, which implies a demand elasticity of roughly −1. Wurgler and Zhuravskaya (2000) show that stocks without close substitutes experience differentially higher price jumps upon inclusion in the S&P 500. They find a relatively flat demand curve for stocks which have close substitutes (elasticity of −11.2) but a much steeper slope for stocks with no close substitutes (elasticity of −5.32). In these papers, the price increase is prima facie

[3] See Scholes (1972).

evidence of a downward-sloping demand curve for stocks.[4] Although less has been written on the supply curves for equities, the existing empirical evidence (see Bagwell, 1992) suggests that they are upward-sloping.

Our theoretical framework generates downward-sloping demand curves and upward-sloping supply curves due risk aversion and to the fact that assets are not perfect substitute. Therefore, assets with larger demand have a higher price. In an international framework with segmented markets, this translates into a market size effect: larger financial areas exhibit higher asset prices. Evidence is provided by studies that analyze the price difference when the same asset is issued on the stock market of a small economy and on the market of a large economy (typically the New York Stock Exchange). For example, Alexander et al. (1988) find that non-US firms which get listed on the NYSE attain a significantly higher share price.[5] Claessens et al. (2002) document that emerging markets firms increasingly take advantage of these higher prices and list on larger stock markets.

2.2. Financial integration

In our model, financial integration between two markets (lower transaction costs) can be interpreted as an increase in effective market size: It generates an increase in total demand for assets and induces higher asset prices. This finding is supported by Stulz (1999), Bekaert and Harvey (2000), Hardouvelis et al. (1999) and Henry (2000) for various experiences of market liberalization. The last paper finds that when foreigners are allowed to purchase shares, a country's aggregate equity price index increases significantly.

2.3. Bilateral portfolio equity flows

The model also demonstrates the importance of size of economies and transaction costs for trade flows in assets. This is consistent with recent empirical evidence on bilateral gross cross-border equity flows in Portes and Rey (1999). They show that such flows depend positively on various measures of country size (GDP, market capitalization or financial wealth) and sophistication of the market and negatively on transaction costs and informational frictions (proxied by distance or the phone call traffic). These variables explain as much as 83% of the cross-sectional variation of the data. These "gravity" equations for financial trade flows are therefore comparable in terms of explanatory power to the "gravity" equations for trade flows, which are one of the strongest empirical regularities in international economics. In Section 6, we use the Portes–Rey data set to

[4] Further evidence is provided by Kaul et al. (April 2000) who look at weighting adjustments of stocks constituting the TSE 300 index (Toronto Stock Exchange). These weighting adjustments are announced in advance to market participants, and they do not contain any information about the performance of the companies; they are purely arbitrary phenomena. The authors show that 31 stocks which saw an increase in their weights and therefore a positive demand shock experienced statistically significant event-week excess returns of 2.34%. The point estimate of the cumulative excess return 15 weeks after the event was virtually identical to its event-week value. The corresponding elasticity of demand is -10.5. See also Bagwell (1992) and Lynch and Mendenhall (1997).

[5] There is an abundant literature which supports this finding. Recent examples are Bekaert and Harvey (1997); Foerster and Karolyi (in press); Miller (1999) and Doidge et al. (2001).

estimate the specific equation of bilateral equity flows that comes from our theoretical model. The findings are consistent with our theoretical implications.

2.4. Home bias in equity holdings

A voluminous literature (surveyed in Lewis, 1999) has emphasized that investors hold what seems to be a disproportionate amount of domestic assets. Ahearne et al. (2000) report that the home bias of US equity holders has decreased since the mid-1980s but remains at a high level. In 1997, foreign equities represented around 10% of US equity holdings (2% in the late 1980s). In our model, a "home bias" for equities arises for two reasons. The first one is the presence of transaction costs in asset trade. We show in Section 6 that, unlike the previous literature,[6] our model can generate high degrees of home bias even with small transaction costs since in our set up transaction costs *interact non-linearly* with the elasticity of substitution between assets. The second reason for home bias in our model is novel. Asset markets are imperfectly competitive, which induces investors to retain a disproportionate amount of the equity of their own projects. A recent paper by Pinkowitz et al. (2001) shows that indeed home bias is well explained by the extent to which shares are held by controlling shareholders. They give to this result an interpretation based on corporate governance that differs from ours.

2.5. Financial super-market

Finally, at a more qualitative level, the US is sometimes described as a "super-market" for financial assets. American markets offer a wide range of financial assets and are both very broad and liquid. In our model, the menu of financial assets available is wider in the large and rich economy.

3. The general framework

We consider a two-period model with two countries or financial areas, A and B. They are respectively populated with n_{A} and n_{B} risk-averse immobile identical agents. In the first period, agents are respectively endowed with y_{A} and y_{B} units of a freely traded good (the numéraire), which they can choose to consume, invest in fixed-size risky projects or use to buy shares on the stock market. In the second period, there are L exogenously determined and equally likely states of nature and different contingent projects whose dividends are the following:

$$\text{project } i \text{ pays} = \begin{cases} d \text{ if state } i \in \{1, \ldots, L\} \text{occurs} \\ 0 \text{ otherwise} \end{cases}$$

[6] See, in particular, French and Poterba (1991).

These dividends are the sole source of consumption in second period. Shares of these projects (claims on the risky dividends) are traded on the stock markets of the two countries in first period. This implies that investing in a specific project (either directly or through the stock market) is equivalent (in terms of pay-off) to buying an Arrow–Debreu asset that pays in only one state of nature. As in Acemoglu and Zilibotti (1997), this formalization captures the first main feature of our model: Different projects and assets are imperfectly correlated so that there is an incentive to diversify.

The fixed-size investment projects are costly to develop. We denote by N_{A} the set of agents of country A and by n_{A} the cardinal of this set: n_{A}=card(N_{A}). An agent $h_{\mathrm{A}} \in N_{\mathrm{A}}$ chooses to develop $z_{h\mathrm{A}}$ different projects. Let us call $Z_{h\mathrm{A}}$ the set of projects developed by agent h_{A}; we have therefore $z_{h\mathrm{A}}$=card($Z_{h\mathrm{A}}$).[7] In equilibrium, because all projects have the same expected return and because we assume that the set of projects is common knowledge, agents have no interest in duplicating a project that has already been developed. Also, because agents of the same country are identical ex ante, they choose to develop the same number of projects. The total number of projects that have been developed in country A and country B are $m_{\mathrm{A}} = \sum_{h_{\mathrm{A}} \in N_{\mathrm{A}}} z_{h\mathrm{A}}$ and $m_{\mathrm{B}} = \sum_{h_{\mathrm{B}} \in N_{\mathrm{B}}} z_{h\mathrm{B}}$, respectively (we denote by M_{A} and M_{B} the corresponding sets of projects). The equilibrium total number of assets in the world $m_{\mathrm{A}}+m_{\mathrm{B}}$ is endogenous. We restrict parameters so that $m_{\mathrm{A}}+m_{\mathrm{B}}<L$: Markets in general are not complete, meaning that it is not possible to eliminate all risk by holding a portfolio of all traded assets. In some states of the world in the second period, there is no production, so that consumption is zero. Hence, in general, the matrix of the pay-offs of projects has the following form:

$$\text{Matrix of payoffs:}\quad \overbrace{}^{m_A+m_B} \atop \underbrace{\begin{bmatrix} d & 0 & 0 & 0\ldots\ldots 0 & 0 \\ 0 & d & 0 & 0\ldots\ldots 0 & 0 \\ 0 & 0 & d & 0\ldots\ldots 0 & 0 \\ 0 & 0 & 0 & d\ldots\ldots 0 & 0 \\ \ldots & \ldots & \ldots & \ldots\ldots\ldots & \ldots \\ 0 & 0 & 0 & 0\ldots\ldots 0 & 0 \end{bmatrix}}_{L}$$

The cost of each new project is increasing with the number of projects an agent is performing: We assume that the monitoring of each project becomes more complex and costly as the number of projects increases. The total cost in units of the numéraire of the investment in risky projects of an agent h_{A} is $f(z_{h\mathrm{A}})$, with $f'(z)>0$ and $f''(z)>0$.[8] The

[7] N_B, n_B, Z_{hB} and z_{hB} are defined in a symmetric way for country B.

[8] By an abuse of notation, we take z_{hA} and z_{hB} to be real numbers.

investment cost function in country B is similar. There is no restriction on the development of new projects. This determines the equilibrium number of projects and therefore the equilibrium number of assets. One way to interpret the model is that the risky projects that agents develop are combined to create firms, so that each agent creates a firm with possibly a different number of projects.

3.1. Transaction costs

In the first period, agents raise capital by selling shares of their projects and they buy shares of other projects. The second essential feature of the model is the presence of international transaction costs on asset markets. When agents trade assets internationally, they incur a transaction cost τ, which is paid in units of the share itself. The same transaction cost also applies to the stochastic dividend and is paid in units of the dividend. For our set up to make sense, we need to assume that these transaction costs cannot be evaded by going through the goods market on which, for convenience, we assume no transaction costs.

The transaction cost is modeled as an iceberg cost: Part of the share and part of the dividend "melt" during the transaction. As in the trade literature, from which it is borrowed, the iceberg form simplifies the results because it eliminates the need to introduce a financial sector. It also implies that the elasticity of demand for an asset with respect to its price is the same whether the transaction cost is paid or not, that is, whether the asset is a domestic or a foreign one.

The presence of international transaction costs on assets captures different types of costs: (1) banking commissions and variable fees[9]; (2) exchange-rate transaction costs; and (3) some information costs. Gordon and Bovenberg (1996) use the same type of proportional transaction costs on capital flows and focus on the asymmetry of information between foreign and domestic investors to justify them. There are two ways to introduce these transaction costs on the international trade in assets. The first is to make buyers of the assets bear the transaction cost. In this case, the amount paid by an agent h_{B} located in country B to buy an asset sold on the stock market in country A by an agent h_{A} is $p_{h_{\mathrm{A}}} s_{h_{\mathrm{B}}}^{h_{\mathrm{A}}}(1+\tau)$, where $p_{h\mathrm{A}}$ is the price of a share of a project developed by agent h_{A} and $s_{h\mathrm{B}}^{h\mathrm{A}}$ is the demand of agent h_{B} for an asset sold by agent h_{A}. If an asset pays a dividend d in period 2, then a shareholder in country B receives only $(1-\tau)d$ per share. Dividends generated by projects in country A are denominated in the currency of country A, so that agents in country B have to incur the transaction cost at that stage, too. The second possible way to introduce transaction costs is to have project owners bear the transaction cost. These two ways of introducing transaction costs produce the same results as long as we assume that international transaction costs paid by agents buying shares and by project owners selling shares are identical.

[9] Danthine et al. (2001) estimate, for example, that cross-border financial transactions in Europe cost 10–20 times more than domestic ones. This comes from the fact that cross-border payments and securities settlements are substantially more expensive, time-consuming and complicated than domestic ones. Custody risk is also increased by the number of intermediaries and juridictions involved.

3.2. Budget constraint

We choose to present the version of the model where buyers pay the transaction costs as they anyway bear the cost. In this configuration, the budget constraint for an agent h_{A} in country A is:

$$c_{1h_{\mathrm{A}}} + f(z_{h_{\mathrm{A}}}) + \sum_{\substack{i \in M_{\mathrm{A}} \\ i \notin Z_{h\mathrm{A}}}} p_i s^i_{h_{\mathrm{A}}} + \sum_{j \in M_{\mathrm{B}}} (1+\tau) p_j s^j_{h_{\mathrm{A}}} = y_{\mathrm{A}} + \sum_{k \in Z_{h_{\mathrm{A}}}} p^k_{h_{\mathrm{A}}} \alpha^k_{h_{\mathrm{A}}} \tag{1}$$

where $c_{1h\mathrm{A}}$ is consumption of agent h_{A} in period 1; i and k index domestic projects and j foreign ones. The second term on the left-hand side is the investment cost of risky projects. The two last terms on the left-hand side represent the demands for domestic and foreign assets. There are $(m_{\mathrm{A}} - z_{h\mathrm{A}})$ domestic assets that agent h_{A} demands as he only buys assets of projects he has not developed himself. There are m_{B} different foreign assets on which he has to incur the transaction cost τ. On the revenue side, in addition to endowment y, agent h_{A} sells a portion $\alpha^k_{h\mathrm{A}}$ of each project $k \in Z_{h\mathrm{A}}$ that he has developed. $(1-\alpha^k_{h\mathrm{A}})$ is the portion of the project that agent h_{A} keeps and does not float on the market. Hence, we also interpret $\alpha_{h\mathrm{A}}$ as a measure of the extent of diversification chosen by agent h_{A}. The reason is that if $\alpha^k_{h\mathrm{A}}$ is low, it means that the agent keeps a large portion of the risky investment projects he has developed. In this case, he does not diversify much the risk attached to those projects. The budget constraint of an agent h_{B} in country B is symmetric. In the second period, consumption of agent h_{A} is given by the dividends of the asset (net of transaction costs) that pays in the particular state of nature it covers. If the state of nature is such that no asset gives dividends, then consumption is zero:

$$\begin{aligned}
&c_{2h_{\mathrm{A}}} = d s^i_{h_{\mathrm{A}}} \text{ if state } i \in M_{\mathrm{A}},\ i \notin Z_{h\mathrm{A}} \text{ occurs;} \\
&c_{2h_{\mathrm{A}}} = d(1-\tau) s^j_{h_{\mathrm{A}}} \text{ if state } j \in M_{\mathrm{B}} \text{ occurs;} \\
&c_{2h_{\mathrm{A}}} = d(1-\alpha^k_{h_{\mathrm{A}}}) \text{ if state } k \in Z_{h\mathrm{A}} \text{ occurs; } c_{2h_{\mathrm{A}}} = 0 \text{ otherwise.}
\end{aligned} \tag{2}$$

4. An illustrative version of the model without income effects

We first illustrate the size effects in a model where income effects are eliminated because it simplifies the analysis and it allows us to draw parallels easily with the international trade in goods literature. We study the more general version of the model in Section 5. Since income effects are absent in this example, we assume that the per capita endowments received in first period are identical for all agents in the world. This implies that difference in country size is solely driven by differences in population size. This follows the tradition of the "home market" effect in trade theory with increasing returns (see Krugman, 1980; Helpman and Krugman, 1985, pp. 205–209 for example). In order to eliminate the income effects, we adopt a linear utility in the first period so that the utility of an agent h_A in country A has the following form:

$$\mathrm{EU}_{h_A} = c_{1h_A} + \beta E\left(\frac{c_{2h_A}^{1-1/\sigma}}{1-1/\sigma}\right) \tag{3}$$

where β is the rate of discount of the future and σ is the inverse of the degree of risk aversion. We assume $\sigma > 1$ so that utility is defined in zero production and consumption states. The utility of agents in country B is similar. The state of the world is revealed at the beginning of the second period. Given the description of the payoffs of the different projects, and our assumption that all states of nature have the same probability $1/L$, the expected utility of agent h_A is:

$$\mathrm{EU}_{h_A} = c_{1h_A} + \frac{D}{1-1/\sigma}\left(\sum_{\substack{i\in M_A \\ i\notin Z_{hA}}} s_{h_A}^{i^{1-1/\sigma}}\right) + \frac{D(1-\tau)^{1-1/\sigma}}{1-1/\sigma}\left(\sum_{j\in M_B} s_{h_A}^{j^{1-1/\sigma}}\right) + \frac{D}{1-1/\sigma}\left(\sum_{k\in Z_{h_A}} (1-\alpha_{h_A}^{k})^{1-1/\sigma}\right) \tag{4}$$

where $D \equiv \beta d^{1-1/\sigma}/L$ is a transformation of the discounted expected dividend. The second element in Eq. (4) is the expected consumption in states i backed by assets of risky projects developed by agents in country A other than those developed by agent h_A himself. The third element is the expected consumption in states j backed by assets of risky projects developed by agents in country B. The last element is the expected consumption in states which are backed by assets of risky projects developed by the agent h_A himself. The extent to which he does not diversify his own risk is therefore $1-\alpha_{hA}^{k}$ for each project/asset $k \in Z_{hA}$. The expected utility of an agent in country B is symmetric. This simplified model allows us to draw interesting parallels with the trade literature. Eq. (4) resembles a Dixit–Stiglitz "love for diversity" type of utility function. Here, however, the "love for diversity" comes entirely from risk aversion and the strong structure we impose on the matrix of payoffs.

4.1. Asset demands

Agents in A maximize expected utility given by Eq. (4) under budget constraints (1) and (2). Agent h_A in country A chooses consumption[10] in period 1, c_{1hA}, the number of projects z_{hA} he develops, the demands for the different assets (domestic and foreign) and the portion of each of his projects that he retains in the second period: $1-\alpha_{hA}^{k}$ for each project/asset $k \in Z_{hA}$. When buying shares on the stock

[10] We only consider high enough values of y_A so that optimal first period consumption is strictly positive.

market, agents are price-takers. Hence, first-order conditions give the individual asset demands:

$$s^{i}_{h_{\mathrm{A}}} = p_i^{-\sigma} D^{\sigma} \quad i \in M_{\mathrm{A}} - \{Z_{h_{\mathrm{A}}}\}; \quad s^{j}_{h_{\mathrm{A}}} = p_j^{-\sigma} D^{\sigma} \frac{(1-\tau)^{\sigma-1}}{(1+\tau)^{\sigma}} \quad j \in M_{\mathrm{B}} \tag{5}$$

and the symmetric for an agent in country B. The demands for assets are decreasing in the price and increasing in the dividend. The demands for foreign assets are in addition decreasing in the transaction costs in a non-linear way. This implies that our model is able to generate high levels of home bias with small transaction costs (see Section 6). Because all agents in the same country are ex ante identical and projects are symmetric, the demands for assets of a given country by agents of the same nationality is symmetric. Even though agents, in equilibrium, are not identical because they hold different amounts of the different assets, they are symmetric in the sense that their diversification choice is identical. Also, the prices of all projects/assets developed by agents of the same country are identical for the same reason. Hence, from now on, we omit notations that refer to the identity of the agents and of the assets. Agents (and their projects/assets) are identified only by their nationality A or B. The superscript denotes the origin of the asset and the subscript denotes the nationality of the buyer. Hence, for example, $s_{\mathrm{A}}^{\mathrm{B}}$ is the demand for an asset of country B by an agent of country A.

4.2. Market structure and asset supplies

The fixed cost that is required to develop a new project insures that no agent will ever find it optimal to replicate an already existing project. If he were to do so, the supply of the corresponding asset would necessarily increase so that its equilibrium price would decrease.[11] It is therefore always more profitable to develop a project that has not been opened yet. Each agent has an ex post monopoly power on the projects that he has developed and therefore on the sale of the assets that correspond to these projects. This is a departure from the Arrow–Debreu world where asset markets are assumed to be perfectly competitive. From Eq. (5), it can be seen that the perceived elasticity of demand for any asset with respect to its price is: $-\sigma$. We assume that the owner of the asset exploits optimally this imperfectly competitive structure. The fact that firms extensively buy and sell their own stocks to affect the price of their shares is consistent with this feature of our setup. We show below, however, that the monopolistic competition structure on asset markets is not essential for most of our results. This structure of the market also implies that σ, the price elasticity, is necessarily more than 1. Otherwise, the model would be degenerate, as asset suppliers would always be better off selling less of the asset at a higher price. Also, for the monopolistic competition structure to make sense the parameters must be such that the number of projects each agent develops is small relative to the total number of projects. Otherwise, agents would take into account the effect of their pricing

[11] As noted earlier, we assume that the choice of projects by all agents is public knowledge.

policy on the aggregate outcome. This is similar to the structure of trade models with differentiated products. As for demands, we omit notations that refer to the identity of agents and denote $\alpha_A$and α_B the supply of a typical asset in countries A and B.

The first-order conditions give the individual supplies of shares as a function of prices:

$$\alpha_A = 1 - \delta p_A^{-\sigma} D^{\sigma};\ \alpha_B = 1 - \delta p_B^{-\sigma} D^{\sigma} \tag{6}$$

where $\delta \equiv \left(\frac{\sigma}{\sigma-1}\right)^{\sigma} > 1$.The supply of each asset on the market is an increasing function of the price and a decreasing function of the dividend. Note that the supply of assets depends negatively on δ. It is easy to check that, in the exact same setup, if agents were not to perceive or to exploit their monopolistic power, then the same first-order conditions would apply except that δ would be set to 1. Hence, from now on, we interpret δ as a measure of imperfect competition on asset markets.[12]

We use the equilibrium conditions for each stock market and for each asset. The amount of shares offered for a specific asset equals the aggregate domestic demand plus the aggregate foreign demand inclusive of transaction costs:

$$\text{stock market in } A : \alpha_A = (n_A - 1)s_A^A + (1+\tau) n_B s_B^A \tag{7}$$

$$\text{stock market in } B : \alpha_B = (n_B - 1)s_B^B + (1+\tau) n_B s_A^B$$

Using Eqs. (4), (5) and (6), we find the portions of each project sold on the stock markets:

$$\alpha_A = \frac{n_A - 1 + n_B\phi}{n_A - 1 + \delta + n_B\phi};\ \alpha_B = \frac{n_B - 1 + n_A\phi}{n_B - 1 + \delta + n_A\phi} \tag{8}$$

where $\phi \equiv ((1-\tau)/(1+\tau))^{\sigma-1}$ is a useful transformation of transaction costs and is less than 1 (σ>1). This parameter is an indicator of market segmentation. It measures the extent to which the interaction between transaction costs and the elasticity of substitution between assets leads foreign agents to restrain their demand for domestic assets. Lower transaction costs lead to lower market segmentation and higher ϕ. Since the transaction cost enters non-linearly in the expression of ϕ, market segmentation can be large even with low transaction costs if the elasticity of substitution between assets is high.

4.3. Prices and number of assets

Asset prices are given by:

$$p_A = D[n_A - 1 + \delta + n_B\phi]^{1/\sigma} \tag{9}$$

$$p_B = D[n_B - 1 + \delta + n_A\phi]^{1/\sigma}$$

[12] We come back to this in more detail in Section 6.

Finally, we determine the optimal choice for z_A and z_B, the number of projects and therefore the number of assets developed by each agent in country A and B[13]:

$$f'(z_A) = p_A;\ f'(z_B) = p_B \tag{10}$$

Due to perfect competition on the market for developing projects, the choice for the number of projects, z_A and z_B, is such that the price of the asset (p_A and p_B, respectively) is equal to the marginal cost of the last project. The assumed convexity of the cost function implies that the number of projects/assets is increasing in asset prices in both countries. Free entry on the market for investment projects determines the total number of projects/assets and therefore the extent of financial market incompleteness defined by $L-(n_A z_A)-(n_B z_B)$.

4.4. Size effects

The size effects are very clear in this example: If country A is the larger economy (has a larger population), then project owners choose to retain fewer shares of their projects and to sell more on the stock market: $\alpha_A > \alpha_B$. In this sense, financial markets are more developed in the large country, so there exists a market size effect on financial markets.

The second size effect is on share prices. These shares of projects developed by agents located in the large country have a higher price than those developed in the small country: $p_A > p_B$. This has an immediate implication for the expected returns of an asset defined as: $d/(Lp_i)$, i=A,B. The expected return is smaller in the large country than in the small one. The size effect comes from the combination of transaction costs and imperfect substitutability of assets. International trading costs induce agents to increase spending on domestic assets. This hurts the firms of the smaller economy since they rely more heavily on foreigners to purchase their shares. If international transaction costs were zero (ϕ=1), then asset prices would be equal in the two countries and size differences would not matter. More generally, it can be checked that the price difference between the two countries increases with transaction costs. Note also that if agents were risk neutral ($\sigma \rightarrow \infty$), then again the price difference between the two countries would vanish. In this case, the price of the asset collapses to the traditional expected discounted dividend. It can be checked also that as σ increases the effect of country size on price differentials decreases.

With a convex cost function, the large country, with the higher asset price, sustains more projects per agent: $z_A > z_B$. Hence, the number of different assets per capita is higher in that country.[14] Large countries will exhibit a broader menu of financial assets (financial "super-markets").

To gain intuition on these results, we come back to the first-order conditions and derive the supply and demand functions of assets. When choosing how much to float of their own

[13] Since the number of projects is a natural number, we assume that L is large enough so that the equilibrium and the derivatives can be considered as approximations.

[14] It is also possible to endogenize d, which can be interpreted as the size of each project. If we assume that, subject to a convex cost function, agents can choose larger projects (projects with larger dividends), then it is easy to show that each agent of the large economy develops more projects and also projects of larger size.

projects, agents set the marginal loss in utility of doing so equal to the marginal gain (the Lagrangian is equal to 1 because of linearity of utility in first period) so that:

$$D(1-\alpha_A)^{-1/\sigma} = p_A\left(\frac{\sigma-1}{\sigma}\right);\; D(1-\alpha_B)^{-1/\sigma} = p_B\left(\frac{\sigma-1}{\sigma}\right) \tag{11}$$

The expected marginal disutility of selling one more share is the expected welfare loss due to consumption thus foregone (left-hand side of the equation). Since the utility is concave, this marginal loss in utility is rising with the portion of the project sold. At the optimum, the price of a share is equal to its marginal disutility multiplied by the mark up $\sigma/(\sigma-1)$.

Using the equilibrium on asset markets, and the individual demands given in Eq. (5), we get the aggregate demand for a specific asset in both countries:

$$\alpha_A = D^{\sigma}p_A^{-\sigma}(n_A - 1 + n_B\phi);\; \alpha_B = D^{\sigma}p_B^{-\sigma}(n_B - 1 + n_A\phi) \tag{12}$$

The market size effect is a demand side effect. If country A is larger than country B, aggregate saving is larger in A than in B. The existence of transaction costs ($\phi<1$) induces a home bias in the demand for assets which are substitutes ($\sigma>1$): The total demand for an asset of the large country is larger than the demand for an asset in the small country for a given price. Note importantly that this home bias is non-linear with the transaction costs as $\phi\equiv((1-\tau)/(1+\tau))^{\sigma-1}$. As can also be seen from Eq. (12), demands in both countries are decreasing in the price. In Fig. 1, we illustrate the determination of the prices of assets, p_A and p_B, and of α_A and α_B which are the portions of each project floated on the market and thus constitute publicly held shares.

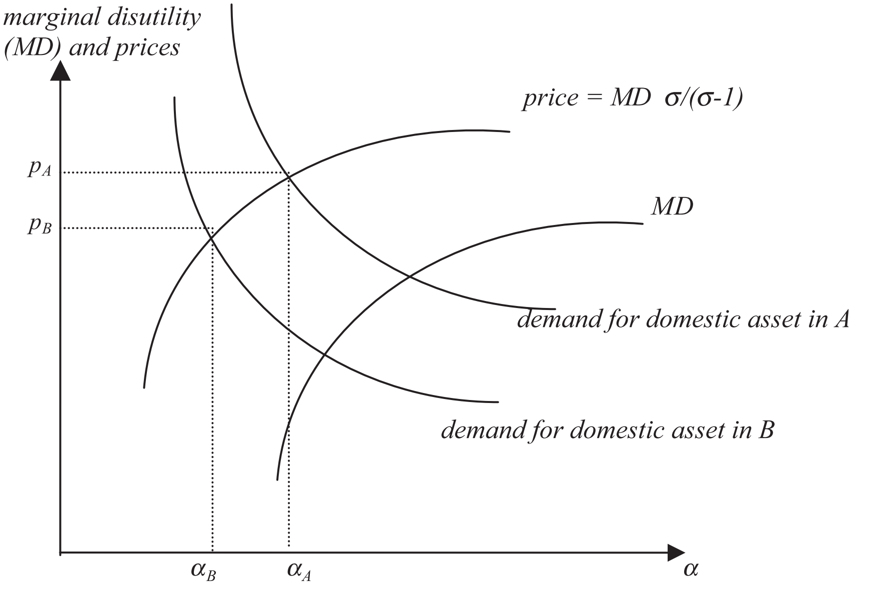

Fig. 1. Determination of asset price and publicly held shares.

These market size effects are reminiscent of the home market effect in the new trade and geography literatures (Helpman and Krugman, 1985). As in the trade literature, they come from the combination of imperfect substitution and transaction costs.

In the version of the model we have presented here, the size effect is, as in the trade literature, an effect that rests on population size. This is an obvious limitation of this simple framework. Hence, in the next section, we introduce a richer structure in order to show that when utility is non-linear in the first period, the relevant measure of the size effect is aggregate income.

5. A more general model with income effects

We now analyze the same framework with a more general utility function that allows for income effects. In this case, the utility of agents has the following form:

$$U_{h_A} = \left(\frac{c_{1h_A}^{1-1/\sigma}}{1-1/\sigma} \right) + \beta E \left(\frac{c_{2h_A}^{1-1/\sigma}}{1-1/\sigma} \right) \tag{13}$$

for an agent h_A in country A (and symmetrically for an agent in country B). The asset demands and supplies are similar to those given in Eqs. (5) and (6), except that they depend on consumption per capita in the first period.

The equilibrium conditions on the stock markets are still given by Eq. (7) and combined with the first-order conditions we get modified levels of publicly held shares and asset prices:

$$\alpha_A = \frac{(n_A - 1)c_{1_A} + n_B \phi c_{1_B}}{(n_A - 1 + \delta)c_{1_A} + n_B \phi c_{1_B}}; \ \alpha_B = \frac{(n_B - 1)c_{1_B} + n_A \phi c_{1_A}}{(n_B - 1 + \delta)c_{1_B} + n_A \phi c_{1_A}} \tag{14}$$

and

$$p_A = D[(n_A - 1 + \delta)c_{1A} + \phi n_B c_{1B}]^{1/\sigma}; \ p_B = D[(n_B - 1 + \delta)c_{1B} + \phi n_A c_{1A}]^{1/\sigma} \tag{15}$$

Because the marginal utility of consumption in the first period is not constant, consumption in the first period affects the demand and supply of assets and therefore their equilibrium price. Note that in addition to the size effects analyzed above, an increase in home per capita consumption in the first period increases the price of home assets but decreases the equilibrium portion of projects sold on the stock market. The number of assets in each country is still determined by the equilibrium condition (9) so that a higher price of assets induces more risky projects ("financial super-market" effect).

5.1. Income, consumption and asset prices

Consumption per capita in both countries is determined by the consumer budget constraint. Because of the non-linear relation between asset prices and consumption, we cannot give an analytical solution for consumption. We can, however, analyze how income per capita affects consumption per capita, which in turn influences asset prices. We first derive the impact of an increase in income per capita y on the equilibrium consumption per capita in the first period. Using the consumer budget constraint and differentiating it, we get:

$$\mathrm{d}c_{1\mathrm{A}} = \frac{\gamma_\mathrm{B}}{\gamma_\mathrm{A}\gamma_\mathrm{B} - \lambda_\mathrm{A}\lambda_\mathrm{B}}\mathrm{d}y_\mathrm{A} + \frac{\lambda_\mathrm{A}}{\gamma_\mathrm{A}\gamma_\mathrm{B} - \lambda_\mathrm{A}\lambda_\mathrm{B}}\mathrm{d}y_\mathrm{B} \tag{16}$$

and a symmetric expression for consumption in B. The parameters γ_A, λ_A, γ_B and λ_B are given in Appendix A and are all positive. It is possible to show that $\gamma_i > \lambda_i$, i=A,B. The parameter $\lambda_\mathrm{A}/(\gamma_\mathrm{A}\gamma_\mathrm{B} - \lambda_\mathrm{A}\lambda_\mathrm{B})$ measures the financial transmission effect of a change in income of country B on consumption in country A. Intuitively, in the case of financial autarky (ϕ=0), this parameter goes to zero. Because $\gamma_\mathrm{A} > \lambda_\mathrm{A}$ and $\gamma_\mathrm{B} > \lambda_\mathrm{B}$, the induced effect on foreign consumption of an increase in home income is always less than on home consumption. Hence, the country with highest per capita income is also the country with highest consumption per capita. Combining this and Eq. (14), we then find that, when the two countries have equal population ($n_\mathrm{A} = n_\mathrm{B}$), the country with higher income also benefits from the higher asset price. From Eq. (14), it can also be checked that the country with higher income per capita has a lower α. The reason is that higher income per capita leads to an increase in saving which translates into both an increase in demand and a (larger) decrease in supply for each asset.

Moreover, we can show that, evaluated in the symmetric equilibrium, an increase in population size of country A induces an increase in price higher in country A than B, as in the linear utility case. Both income per capita and population size affect asset prices and the number of projects and assets in each country. Hence, the relevant size effect here is in terms of aggregate income. Therefore, the model predicts that if investors in the "small" country (in the sense of small aggregate income) could—maybe subject to some fixed cost—issue their assets on the stock market of the "large country", they would be able to sell their asset at a higher price than when they issue it at home. This is consistent with the evidence described in Section 2.

5.2. Demands and supplies of assets

To gain intuition on these results, we can again examine the demand and supply curves for an asset. The demand curves are now given by:

$$\alpha_\mathrm{A} = D^\sigma p_\mathrm{A}^{-\sigma}[(n_\mathrm{A} - 1)c_{1\mathrm{A}} + n_\mathrm{B}\phi c_{1\mathrm{B}}];\ \alpha_\mathrm{B} = D^\sigma p_\mathrm{B}^{-\sigma}[(n_\mathrm{B} - 1)c_{1\mathrm{B}} + n_\mathrm{A}\phi c_{1\mathrm{A}}] \tag{17}$$

In the presence of international transaction costs, the size of aggregate consumption influences the position of the demand curves. The supply curves are now given by:

$$\alpha_\mathrm{A} = 1 - c_{1\mathrm{A}}\delta p_\mathrm{A}^{-\sigma} D^\sigma;\ \alpha_\mathrm{B} = 1 - c_{1\mathrm{B}}\delta p_\mathrm{B}^{-\sigma} D^\sigma \tag{18}$$

The supply of each asset is low when income per capita (and thus consumption) is high because agents increase savings and therefore keep a larger share of their own investment projects. These demand and supply curves are shown on Fig. 2. Furthermore, using Eq. (16), it is possible to show that the equilibrium is unique.

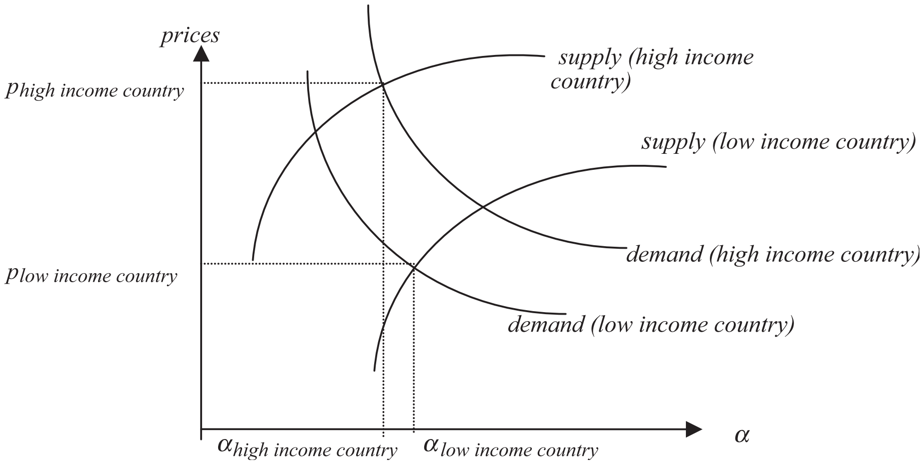

Fig. 2. Impact of income per capita on asset prices and publicly held shares (equal population).

Using Eq. (15), it is easy to check that the price of assets in country A is higher than in country B if and only if the following inequality holds:

$$[n_{\mathrm{A}}(1-\phi)+\delta-1]c_{1\mathrm{A}} > [n_{\mathrm{B}}(1-\phi)+\delta-1]c_{1\mathrm{B}}$$

Remember that the parameter δ can be interpreted as a measure of imperfect competition on capital markets. When they are perfectly competitive, δ goes to unity and investors retain a lower share of their investment. In that case, the price differential depends only on the aggregate consumption differential. This is the *size effect* in this version of the model. This effect is a demand effect and depends on the presence of international transaction costs (ϕ<1).

When asset markets are not competitive, that is when δ is more than unity, then in addition to the size effect, the level of consumption per capita plays a role in the determination of the asset price. This effect comes from the supply side. When income and consumption per capita are larger, all agents, in order to save more, reduce the supply of equities of the project they have developed. This supply effect does not depend on the presence of transaction costs on asset markets so that asset prices across markets are not equal even without transaction costs if income per capita differ.

6. General implications of the model

In this section, we analyze several characteristics of the model which are common to the illustrative model developed in Section 6 and to the fully fledged model of Section 5.

6.1. Financial integration and asset prices

One way to look at the impact of market size in our model is to analyze the effect of lower transaction costs on international trade in assets, which de facto implies an increase in market size for all assets in the world. The reason is that lowering transaction costs between A and B implies that agents in A (B) increase their demand for assets of country B (A). In our model, financial integration[15] of this type can be modeled as an increase in ϕ. We look at the effect of such an increase in the symmetric case where countries A and B are identical.[16] In this case, for the general model, we get the following comparative statics for the price of assets in country A (and in country B):

$$\frac{\partial p_{\mathrm{A}}}{\partial \phi} = \frac{n_{\mathrm{A}} p_{\mathrm{A}} c_{\mathrm{A}}^{1} f''(z_{\mathrm{A}})}{(n_{\mathrm{A}} - 1 + \delta + n_{\mathrm{A}}\phi)\left[\sigma c_{\mathrm{A}}^{1} f''(z_{\mathrm{A}}) + p_{\mathrm{A}}^{2}\right]} \tag{19}$$

The price of assets increases as the demand for assets from foreign agents increases with lower transaction costs. This is consistent with the evidence cited in Section 2 on the impact of financial integration on asset prices. It is also easy to check that the portion of each project floated on the market increases when transaction costs between financial markets fall.

6.2. Floatation of shares and imperfect competition on asset markets

The first-order conditions, whatever the form of utility in the first period, provide the different demands for domestic shares by nationals as a function of α:

$$\delta s_{\mathrm{A}}^{A} = 1 - \alpha_{\mathrm{A}}; \quad \delta s_{\mathrm{B}}^{B} = 1 - \alpha_{\mathrm{B}} \tag{20}$$

This equation implies that agents in both countries do not fully diversify their domestic portfolio as $1-\alpha_{\mathrm{A}}>s_{\mathrm{A}}^{\mathrm{A}}$ and $1-\alpha_{\mathrm{B}}>s_{\mathrm{B}}^{\mathrm{B}}$ whenever $\delta>1$. Because assets are all ex ante symmetric, full domestic diversification would imply that agents keep no more ownership of their own projects than they buy of projects developed by other agents in the same country. If agents fully diversified in country A, they would set: $1-\alpha_{\mathrm{A}}=s_{\mathrm{A}}^{\mathrm{A}}$. Ex post all agents in a given country would hold the exact same portfolio. This is not the case, and agents in both countries keep more shares of their own project than they buy of those projects developed by others. By doing so, each agent exploits the non-competitive structure of the asset market. This confirms our interpretation of the parameter δ as a measure of imperfect competition on asset markets. The case where agents do not exploit their monopolistic power on asset markets can be analyzed by setting $\delta=1$. It can be checked that although prices and diversification are altered, the qualitative results on the size effects remain intact in the case of perfect competition. The effect of per capita consumption on the supply and price of assets would not appear, however. If we interpret firms as combinations of projects, then firms have, a "nationality", in equilibrium. Due to imperfect competition, there is one agent with a specific nationality who chooses optimally to keep a higher share of the project he has himself developed.

[15] Martin and Rey (2000) analyse in detail the effect of financial integration on the geographical location of financial centres in a simpler three-country model.

[16] The results with asymmetric countries are qualitatively similar.

Table 1

	Coefficient	Standard error	T	P>t
McapA	1.122	0.128	8.774	0.000
RealConsB	1.068	0.103	10.409	0.000
TranscostA	−0.045	0.015	−3.033	0.003
ReturnA	20.381	2.519	8.091	0.000
Constant	−21.623	1.682	−13.041	0.000

Regression on group means: number of groups=182, $F(4,77)=70.41$, R^2 "between"=0.61.
The dependent variable is the sales of portfolio equities of country A to country B (log).

6.3. Financial trade flows: theory and evidence

We can easily analyze (in both versions of the model) the determinants of trade flows in financial assets. The total value (inclusive of transaction costs) of bilateral asset flows (assets of country A bought by agents of country B) is given by the following expression: $T_B^A = n_A n_B p_A z_A s_B^A (1+\tau)$. Taking the log of this expression and using the equilibrium demand for assets (in the general model), we get that financial trade flows from A to B are:

$$\log T_B^A = \log(n_A p_A z_A) + \log(n_B c_{1B}) + \log\phi + \sigma \log \frac{d}{L p_A} + \log(\beta^\sigma / d) \tag{21}$$

The first term is aggregate financial wealth in country A. The second term is aggregate consumption in country B. The third term is a transformation of transaction costs. The fourth term is a function of the expected return of assets in A and the last term is a constant. This equation has very strong similarities with a "gravity" equation in trade. Given the link between our model and trade theories that have been used to justify gravity equations (see Helpman, 1987 for example), this resemblance is not surprising. But for trade in goods, trade costs are mainly seen as transport costs and are usually proxied by distance. For trade in assets, trade costs are mainly transaction or information costs.[17]

These results are consistent with the empirical results reported by Portes and Rey (1999). These authors do not, however, test an equation that has the exact form of Eq. (21). We can use the Portes and Rey (1999) data set to do this. The data are a panel of gross bilateral portfolio equity flows between 14 developed countries for 8 years (1456 observations).[18] The dependent variable is the sales of portfolio equities of country A to country B (log). The right-hand side variables are (1) McapA: the market capitalization of country A (log) (as a proxy for traded and non-traded financial wealth), (2) RealConsB: the aggregate real consumption of country B (log), (3) TranscostA: proportional transaction costs on market A (commissions) and (4) ReturnA: the stock market return for country A (log). Given that our model is static and that most of the variation in the data comes from the cross-sectional dimension, we present the result of the between-estimator.

The results given in Table 1 are very striking. All the variables suggested by the theory are significant at the 1% level and appear with the expected sign. With this parsimonious specification, we explain 61% of the cross-sectional variance of the data. We also ran a pooled regression including time dummies: the results were very similar.

[17] Portes and Rey (1999) show that these information costs are well proxied by distance.
[18] See Appendix A for more details on the data sources.

6.4. Home bias

We analyze the implications of our model for two definitions of home bias.

Definition 1. First, we define home bias in terms of total (traded and non-traded) wealth. More precisely, we derive the value of domestic assets[19] of a representative agent as a percentage of the value of his whole portfolio (traded and non-traded shares, inclusive of transaction costs) and compare it to the ratio of the total value of home assets to the value of all assets in the world. We will say that a "home bias" exists in country A if the first ratio is larger than the second, that is, if:

$$\frac{p_A z_A (n_A - 1) s_A^A + p_A z_A (1 - \alpha_A)}{p_A z_A (n_A - 1) s_A^A + p_A z_A (1 - \alpha_A) + (1 + \tau) p_B z_B n_B s_A^B} > \frac{n_A p_A z_A}{n_A p_A z_A + n_B p_B z_B}$$

Whatever the form of the utility function in the first period, the condition for a home bias to exist is the same in both countries and can be shown to be:

$$n_A n_B (1 - \phi^2) + (n_A + n_B)(\delta - 1) + (\delta - 1)^2 > 0 \tag{22}$$

Therefore, home bias arises if international transaction costs exist ($\phi<1$) or if asset markets are imperfectly competitive ($\delta>1$). Imperfect competition on asset markets induces a home bias in equity holdings because it implies that investors keep a disproportionate amount of their projects.[20]

Definition 2. Traditionally, the degree of home bias has been quantified by the ratio of domestic traded shares to the value of all traded shares in the portfolio of domestic residents.[21] In our model, this ratio (inclusive of transaction costs) for symmetric countries is simply given by

$$\left(\frac{s_A^A}{s_A^A + (1 + \tau) s_B^A}\right) = \left(\frac{1}{1 + \phi}\right) \tag{23}$$

Hence, the home bias due to international transaction costs is not as trivial quantitatively in our model as is generally found in the previous literature. It is the *non-linear* interaction between transaction costs and the elasticity of substitution between assets ($\phi \equiv ((1-\tau)/(1+\tau))^{\sigma-1}$), which influences the level of home bias. This non-linearity implies that even with low degrees of transaction costs, our model generates high degrees of home bias.. The regression on international equity flows, presented above, allows us to infer a value for σ. The estimated elasticity of substitution between assets is the coefficient on the return, which is equal to 20.4 with a standard deviation of 2.5. In Fig. 3, we used Eq. (23) to compute the combinations of σ and τ able to generate the degree of home bias observed in the US. At the end of 1997, the US holdings of US equity (as a

[19] The value of the non-traded portion of wealth (the part of each project kept by the project owner) is given by the indirect utility function which at the optimum is valued at the market price.

[20] See Section 2 for empirical evidence on this.

[21] This definition is appealing from a descriptive point of view, and we use it to be able to compare our results with the existing empirical evidence. From a conceptual point of view, however, we prefer our Definition 1 of home bias as it takes into account both the traded and the non-traded part of wealth.

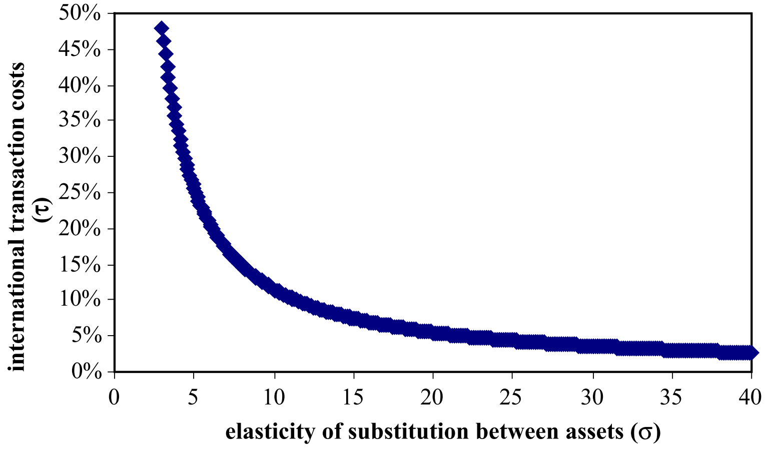

Fig. 3. Combinations of elasticity of substitution and transactions costs that replicate us home bias.

percentage of total holdings) were 89% according to the benchmark survey of the US Treasury. In our model, using our point estimate of 20.4 for σ, this corresponds to proportional transaction costs of around 5%, which is way below previous estimates,[22] and within the realm of plausibility. The figure shows that as the elasticity of substitution increases, the transaction costs required to get the US level of home bias decrease rapidly. A related paper on this point is Heathcote and Perri (2003) which also explores the relation between transaction costs, international asset trade and home bias.

7. Welfare implications

The market equilibrium is not efficient for two reasons. First, a world planner would choose a higher number of projects and therefore issue more assets than in the market equilibrium. This sub-optimally high degree of market incompleteness is due to the existence of a coordination failure. An agent, when developing a new project, does not internalize the benefits that other agents get from the risk diversification provided. This is because in the decentralized equilibrium, the asset price reflects the marginal utility of an extra share of a given project but not the marginal utility of opening a new market, which is the consequence of the development of a new project.[23]

The other source of inefficiency in the model is the imperfectly competitive structure of the asset market, which has two consequences. On the one hand, it leads agents to choose to retain too much ownership of the projects they have developed themselves, so that in equilibrium there is too little risk diversification. On the other hand, the monopolistic power increases the incentives of agents to open risky projects.

[22] See, in particular, French and Poterba (1991).

[23] For a related study of efficiency in the context of trade models, see, for example, Matsuyama (1995).

To compare the market and the planner's equilibria we choose the symmetric case with identical countries (n_A=n_B and y_A=y_B). This simply allows us to ignore any distributional problem but does not change the problem fundamentally. The planner is subject to the same technological constraints as the agents in the economy and maximizes the utility of a representative agent under the following resource constraint: y=c_{1A}+$f(z_A)$. We also assume that the planner is subject to the same transaction costs as in the market equilibrium when he redistributes assets across the world. The planner's solution is the following (in the case of the non-linear utility in the first period[24]):

$$s_{\mathrm{A}}^{A} = \frac{1}{n_{\mathrm{A}}(1+\phi)}; \quad s_{\mathrm{A}}^{B} = \frac{1-\tau}{1+\tau}\frac{\phi}{n_{\mathrm{A}}(1+\phi)}; \quad f'(z_{\mathrm{A}}) = D\frac{\sigma}{\sigma-1}\left[n_{\mathrm{A}}(1+\phi)c_1^A\right]^{1/\sigma} \tag{24}$$

which we can compare to the market equilibrium in the case of identical countries:

$$s_{\mathrm{A}}^{A} = \frac{1}{n_{\mathrm{A}}(1+\phi)-1+\delta}; \quad s_{\mathrm{A}}^{B} = \frac{1-\tau}{1+\tau}\frac{\phi}{n_{\mathrm{A}}(1+\phi)-1+\delta};$$
$$f'\,(z_{\mathrm{A}}) = D\left\{\left[n_{\mathrm{A}}(1+\phi)-1+\delta\right]c_1^A\right\}^{1/\sigma} \tag{25}$$

Hence, the extent of diversification is too small in the market equilibrium: s_A^A and s_B^B in the market equilibrium are smaller than in the planner's solution. The number of projects per agent is also smaller in the market equilibrium than in the planner's solution.

Comparing z_A in the planner's and in the decentralized equilibrium is not obvious. This is because there are two market failures that have contradictory effects on the choice of z_A in the market equilibrium. On the one hand, the coordination failure already described means that there are too few projects developed. On the other hand, because the asset market is not perfectly competitive, the price of an asset is above its marginal cost in terms of utility. This induces agents to develop more projects. However, it can be shown that this second effect is always less important than the coordination failure effect, so that in equilibrium too few projects are developed, and too few assets are traded. Hence, the extent of financial market incompleteness is too large in the decentralized equilibrium. Note that the planner does not in general choose an equilibrium with financial market completeness. The reason is that the planner is subject to the same technological constraints as the agents: It is costly (in terms of first period consumption) to develop new projects and assets.

It is also easy to show that to attain the social optimum in the market equilibrium, a subsidy on the demand for traded assets is sufficient. This subsidy must be financed by a lump sum tax in the first period. It increases asset demand and therefore floatation of assets, and also the price level, so that in equilibrium, the optimal number of assets is developed. The value of this subsidy is simply v=1/σ, the degree of risk aversion. This is quite intuitive as a higher degree of risk aversion induces a greater monopolistic power of asset issuers and a higher welfare cost due to an insufficient diversification.

[24] The case of linear utility would give the same qualitative welfare conclusions.

8. Domestic transaction costs and issuing costs

So far, we have not introduced domestic transaction costs on asset markets in the main analysis. High domestic transaction costs reduce the effective domestic demand for assets and therefore financial market size. To analyze this case more clearly, we go back to the illustrative model without income effects developed in Section 4.

Suppose that when agents buy domestic assets, they bear transaction costs denoted by τ_A and τ_B, respectively. In addition, when firms issue shares, they incur issuing costs, u_A and u_B, which are proportional to the amount of shares issued. They are also incurred in units of shares.

The analysis is very similar to the analysis of international transaction costs and therefore we do not repeat all the steps. The portions of each project sold on the stock market are now:

$$\alpha_A = \frac{(n_A - 1)\phi_A + n_B\phi}{(n_A - 1)\phi_A + n_B\phi + (1 - u_A)^{1-\sigma}\delta}$$
$$\alpha_B = \frac{(n_B - 1)\phi_B + n_A\phi}{(n_B - 1)\phi_B + n_A\phi + (1 - u_B)^{1-\sigma}\delta} \qquad (26)$$

where $\phi_i = ((1 - \tau_i)/(1 + \tau_i))^{\sigma-1}(i = A, B)$ is less than 1, and decreasing in transaction costs and where $\phi = ((1 - \tau)/(1 + \tau))^{\sigma-1}$ as in the previous sections, with $\phi<\phi_A$ and ϕ_B as we assume that international transaction costs are higher than domestic ones. The prices of assets in the two countries are now:

$$p_A = D(1 - u_A)^{-1/\sigma}\left[(n_A - 1)\phi_A + n_B\phi + (1 - u_A)^{1-\sigma}\delta\right]^{1/\sigma}$$
$$p_B = D(1 - u_B)^{-1/\sigma}\left[(n_B - 1)\phi_B + n_A\phi + (1 - u_B)^{1-\sigma}\delta\right]^{1/\sigma} \qquad (27)$$

The modified condition on the optimum number of projects per agent is:

$$f'(z_A) = p_A(1 - u_A); \quad f'(z_B) = p_B(1 - u_B) \qquad (28)$$

These results imply that markets with high domestic transaction costs and issuing costs are less developed (α is smaller). But the impact on prices is ambiguous: High domestic transaction costs lead to low asset prices, while high issuing costs lead to high asset prices. Nevertheless, it can be shown that both high transaction costs and issuing costs induce agents to develop fewer risky projects.

The intuition can be understood in reference to Fig. 4. Higher domestic transaction costs reduce the domestic demand for assets and shift the demand curve downwards. The supply curve is unaffected. In the case of issuing costs, the marginal cost of issuing a share is increased by $1/(1-u_A)$ and $1/(1-u_B)$, respectively, which shifts the supply curve to the left. The demand curve not inclusive of issuing costs is unaffected.

Note that if country A reduces domestic transaction costs, it benefits from three effects: (1) a direct positive effect as the cost of diversifying risk is reduced; (2) a financial terms

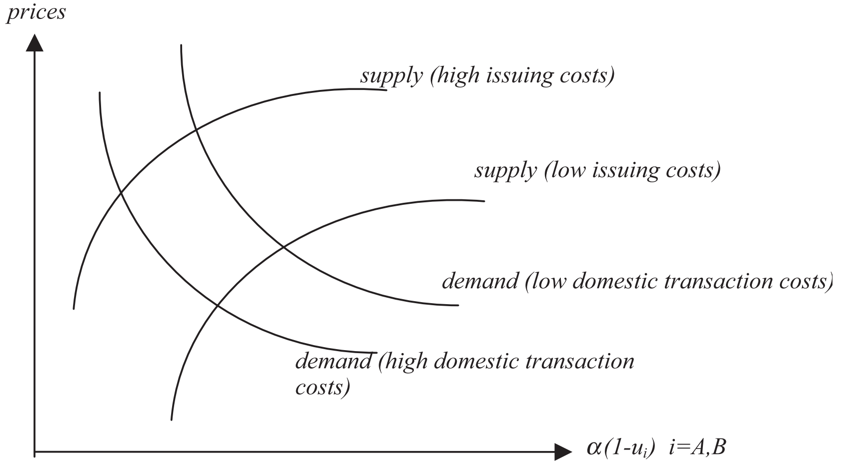

Fig. 4. The impact of domestic transaction costs and of issuing costs.

of trade improvement as the price of its assets rises relative to the price of foreign assets it must buy to diversify risk; (3) a reduction in global risk as markets become less incomplete: The increase in asset price induces agents to invest in more risky projects and therefore to issue more assets. Hence, welfare unambiguously rises for this country. For country B, the welfare effect of lower domestic transaction costs in B is ambiguous: it benefits from global risk reduction but suffers a financial terms of trade deterioration, as it must pay a higher price to diversify risk when buying assets from A.

9. Conclusion

This paper has presented a two-country model with an endogenous number of financial assets. This framework can be used to analyze various questions. It links the size of economies to the determination of asset returns, the breadth of financial markets and the degree of risk sharing and home bias. Size effects have been largely overlooked by the traditional international macroeconomic and finance literature. They arise very naturally in our model because we have endogenously incomplete asset markets, assets that are not perfect substitutes and transaction costs. The model is simple and conveys clear intuitions. It makes sense of several empirical findings such as the impact of financial integration on asset prices, the determinants of international financial flows and cross listing decisions, market size effects on asset returns. To the best of our knowledge these stylized facts have been unexplained so far in a unified model. The model also provides a novel explanation for home bias: in imperfectly competitive asset markets, it is optimal for project developers to keep a high share in their own projects. Therefore, at the country level, ownership of equity is biased towards domestic nationals. Furthermore, we were able to quantify the impact of transaction costs on asset holdings and home bias in our framework. Since transaction costs and elasticity of substitution between assets enter non-linearly in our measure of market segmentation, we showed that even small transaction costs (in the order of 5%) were able to generate high degrees of home bias (in the order of 87%).

The theoretical framework developed here can be applied to analyze the impact of regional financial integration on welfare and on the geographical location of financial centers (see Martin and Rey, 2000 for a theoretical model and Claessens et al., 2002 for empirical evidence). Our model is also a natural framework to analyze the effect of regulations that forbid or make it difficult for home agents to buy foreign assets or for foreign agents to buy home assets. The first type of regulation is prevalent in industrialized countries where pension funds for example cannot easily invest abroad. This could be modeled as an imposition of asymmetric transaction costs on the purchase of foreign assets. The impact of such policies is quite clear in our framework. As the demand for foreign assets decreases, the price of these assets decreases, which induces a favorable financial terms of trade effect for the home country. The positive effect of such unilateral policy should, however, be weighed against the increase in global risk it induces: As the price of foreign assets decreases, the number of foreign projects/assets decreases, so that financial incompleteness rises.

It would be interesting to extend the model to include monopolistic competition on the goods market. This would allow us to study the interactions between transportation costs on the goods market and transaction costs on the asset market[25] and their implications for the magnitude of current account deficits and portfolio choice. Our set up provides also a direct theoretical link between the extent of industrial specialization and asset market integration. Kalemli-Ozcan et al. (1999) document empirically that capital market integration leads to higher specialization in production through better risk sharing. This finding is very much in line with our analysis.

Finally, our framework is a natural vehicle to analyze in detail the international transmission of shocks through the channel of financial markets. We leave these considerations for future research.

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[25] For a recent model describing the impact of transport costs on asset holdings, see Obstfeld and Rogoff (2001).

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Appendix A

$$\gamma_A \equiv 1 + \frac{p_A^2}{f''(z_A)}\frac{c_{1A}}{\sigma}\left[\frac{n_A - 1 + \delta}{(n_A - 1 + \delta)c_{1A} + n_B\phi c_{1B}}\right]^2 + \left(\frac{\sigma - 1}{\sigma}\right)p_A n_B c_{1B} z_A \phi \times \frac{n_A - 1 + \delta}{[(n_A - 1 + \delta)c_{1A} + n_B\phi c_{1B}]^2} + \frac{p_B^2}{f''(z_B)}\frac{n_A n_B \phi^2 c_{1A}}{\sigma} \times \frac{1}{[(n_B - 1 + \delta)c_{1B} + n_A\phi c_{1A}]^2} + p_B n_B z_B \phi \frac{(n_B - 1 + \delta)c_{1B} + \frac{1}{\sigma}n_A\phi c_{1A}}{[(n_B - 1 + \delta)c_{1B} + n_A\phi c_{1A}]^2}$$

$$\lambda_A \equiv -\frac{p_A^2}{f''(z_A)}\frac{c_{1A}}{\sigma}n_B\phi\frac{n_A - 1 + \delta}{[(n_A - 1 + \delta)c_{1A} + n_B\phi c_{1B}]^2} + p_A n_B z_A \phi \frac{(n_A - 1 + \delta)c_{1A} + \frac{1}{\sigma}n_B\phi c_{1B}}{[(n_A - 1 + \delta)c_{1A} + n_B\phi c_{1B}]^2} + \left(\frac{\sigma - 1}{\sigma}\right)p_B n_B c_{1A} z_B \phi \frac{n_B - 1 + \delta}{[(n_B - 1 + \delta)c_{1B} + n_A\phi c_{1A}]^2} - \frac{p_B^2}{f''(z_B)}\frac{n_B\phi c_{1A}}{\sigma} \times \frac{n_B - 1 + \delta}{[(n_B - 1 + \delta)c_{1B} + n_A\phi c_{1A}]^2}$$

and the symmetric expressions for γ_B and λ_B.

Data sources and definitions.[26]

Bilateral portfolio equity flows: Cross Border Capital, London 1998.

The data used are gross cross-border portfolio equity flows. They are principally derived from three sources: national balance of payments statistics; official national stock exchange transactions; published evidence of international asset switches by major fund management groups.

Stock returns, equity market capitalization and real aggregate consumption: Datastream.

Transaction costs data: http://www.elkins-mcsherry.com/.

[26] For more details regarding the data set, see Portes and Rey, 1999.

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