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ABSTRACT

We introduce a new theoretical framework to analyze imperfectly competitive financial markets and trade in assets in an international context. We present a two-country macroeconomic model in which agents are risk averse, assets are imperfect substitutes, the number of financial assets is endogenous, and cross-border asset trade entails transaction costs. We show that demand effects have important implications for the link between market size, asset prices and financial market development. These effects are consistent with existing empirical evidence. Due to co-ordination failures, the extent of financial market incompleteness is inefficiently high. We also analyze the impact of domestic transaction costs and issuing costs on financial markets and returns.

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I) Introduction

This paper builds on insights of trade theory to analyze questions in finance. 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. More recent contributions have extended this line of work, including Svensson (1988), Persson and Svensson (1989). Some of the issues raised by these authors are similar to ours, but the approach they adopt is very different: contrary to our paper, this literature takes the number of securities traded as exogenous and bases the analysis of asset trade on autarky prices[1]. More importantly, 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 and Helpman and Krugman, 1985) to financial flows. Those models have the following basic structure: two countries, one homogenous freely traded good (the numéraire), and a variety of differentiated goods produced under monopolistic competition. This type of model has in particular been proposed to explain intra-industry trade as well as empirically observed relationships between the size of economies and the volume of trade between them.

To turn this model into a model of asset trade and make sense of several empirical findings of the finance literature, let the numéraire good be consumption today and the differentiated commodities be claims on consumption in different states of nature tomorrow. Those assets are imperfect substitutes because the investment projects on which they are based have linearly independent payoffs. Then standard assumptions of expected utility with CRRA preferences map to some extent into "love for diversity" Dixit-Stiglitz style preferences and monopolistic competition on financial markets. Intuitively, the "home

[1] For more recent studies of international trade in assets in an incomplete market setting, see Cole (1993) and Davis, Nalewaik and Willen (2001).

market" effects which translate into size effects in the trade literature also appear in the finance version we present here. There are interesting differences, however, as well as additional effects coming from the intertemporal nature of the questions we discuss.

The theoretical framework we propose to analyze international financial markets has the following four key characteristics: i) agents are risk-averse, ii) assets are imperfect substitutes and financial markets are imperfectly competitive, iii) the number of financial assets is endogenous, iv) cross-border asset trade entails some transaction costs.

In our model, the extent of financial market incompleteness is endogenous. 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 in the world. Because of co-ordination failures, the extent of market incompleteness is inefficiently high in equilibrium. This approach is related to the financial and macro-economic literature on incomplete asset markets and risk-sharing as well as to the literature on trade under uncertainty. Allen and Gale (1994) provide an excellent account of the literature on financial innovation and risk sharing[2]. But in their work, the number of risky investment projects is exogenously given (unlike in our model). They introduce issuing costs for securities but have no transaction costs, nor do they analyze international asset trade. More closely related to this paper is Pagano (1993). He looks at the decision to float of companies on the stock market and introduces trading externalities. But his model is a pure exchange closed economy; we endogenize the investment decisions of entrepreneurs and analyze international capital flows. Obstfeld (1994) studies the links between international trade in assets and growth.

Our work is close to Acemoglu and Zilibotti (1997), which studies the impact of risk diversification on growth. There are two major differences: in our model transaction costs

[2] See also Magill and Quinzii (1996) who survey the general equilibrium theory of incomplete markets and Obstfeld and Rogoff (1996). A recent model of endogenously incomplete asset markets is Bisin (1998). The origin of market incompleteness in this paper is quite different from that in our work. In our model,

play a major role as well as monopolistic competition on financial markets. Furthermore, they focus on capital accumulation and growth. We study the interactions between size, incompleteness of markets, and price of financial assets in open economies. Finally our work is related to Matsuyama (2001) which emphasizes the role of domestic credit market imperfection to generate inequality across countries when financial globalization occurs.

In section II, we review in detail some empirical results that motivate our theoretical approach. We argue in particular that several empirical findings show the importance of demand and size effects on financial markets, a point which is not well explained in classic finance models and which comes out naturally in our model.

The general framework is presented in Section III. Section IV illustrates the effect of country size on financial markets in a model without intertemporal smoothing 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 V 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 VI analyses some implications of our general model for financial integration, portfolio diversification, home bias in equities and financial trade flows. Section VII discusses welfare implications. The impact of domestic transaction costs and issuing costs is presented in section VIII. Section IX concludes.

II. Empirical motivation

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endogeneous incompleteness comes from the fixed cost in the development of investment projects. In this paper

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

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 (August 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* evidence of a downward-sloping demand curve for stocks[4]. Furthermore, Wurgler and Zhuravskaya (August 2000) show convincingly that the degree of substitutability across stocks is not as high as commonly thought, so that supply and demand shocks have significant price effects. Stocks are much

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it comes from costly financial intermediation.

[3] See Scholes (1972).

[4] Further evidence is provided by Kaul, Mehrotra and Morck (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), Lynch and Mendenhall (1997).

more like "unique works of art" than Scholes (1972) recognized. 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 very naturally downward-sloping demand curves and upward-sloping supply curves due to imperfect substituability and risk aversion. A logical consequence is therefore that assets with larger demand have a higher price. In an international framework with segmented markets, this translates into size effects: larger economies 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, Cheol and Janakiraman (1988) find that non US firms which get listed on the NYSE attain a significantly higher share price[5].

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 (1998), 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.

A voluminous literature (surveyed in Lewis 1999) has emphasized that investors hold what seems to be a disproportionate amount of domestic assets. An international CAPM predicts that agents should hold equities in proportion to market capitalizations provided that there are no barriers to international equity investment. 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

[5] There is an abundant literature which supports this finding. Recent examples are Bekaert and Harvey (1997),

1980s). In 1997, the market capitalization of the US amounted to 48% of the world market capitalization. In our model, a "home bias" for equities arises for two reasons: the existence of transaction costs in asset trade that interact with the degree of risk aversion; and imperfect competition on asset markets that induces firms owners to retain a disproportionate amount of their equity.

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 VI, we use the Portes-Rey data set to estimate the specific equation of bilateral equity flows that come from our theoretical model. The findings are consistent with our theoretical implications.

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 framework, the menu of financial assets available is wider in equilibrium in the large and rich economy.

III. The general framework

Foerster and Karolyi (1998) and Miller (1999).

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 N exogenously determined and equally likely states of nature and M different contingent projects whose dividends are the following:

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

Shares of these projects (claims on the risky dividends) are traded on the stock markets of the two countries. 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 Zillibotti (1997), this formalization captures the first main feature of our model: different projects and assets are imperfectly correlated, so that assets are imperfect substitutes.

The fixed-size investment projects are costly to develop. An agent $h_A \in \{1,\ldots n_A\}$ chooses to develop z_{hA} different projects (z_{hB} for an agent $h_B \in \{1,\ldots n_B\}$ in country B). 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. M, the total number of projects (and assets) in the world is then $\sum_{h_A=1}^{n_A} z_{hA} + \sum_{h_B=1}^{n_B} z_{hB}$. The set of projects that have been developed in country A and country B are M_A and M_B respectively. The equilibrium total number of assets in the world $M = M_A + M_B$ is endogenous. We restrict parameters so that $M < N$: 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:

$$\text{Matrix of payoffs:} \quad \begin{array}{l} \xleftrightarrow{\quad M \quad} \\ \begin{bmatrix} d & 0 & 0 & 0......0 & 0 \\ 0 & d & 0 & 0......0 & 0 \\ 0 & 0 & d & 0......0 & 0 \\ 0 & 0 & 0 & d......0 & 0 \\ \multicolumn{5}{c}{\dots\dots\dots\dots\dots\dots\dots} \\ 0 & 0 & 0 & 0......0 & 0 \end{bmatrix} \\ \xleftrightarrow{\qquad\qquad N \qquad\qquad} \end{array}$$

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 $f(z_{hA})$, with $f'(z) > 0$ and $f''(z) > 0$. The 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.

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 transit. As in the trade literature, from which it is borrowed, the iceberg form greatly simplifies the results because it eliminates the need to introduce financial intermediaries as an additional 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[6]; 2) exchange-rate transaction costs; 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 $p_{h_A} s_{h_B}^{h_A}(1+\tau)$, where p_{h_A} is the price of a share of a project developed by agent h_A and $s_{h_B}^{h_A}$ 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. Profits 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.

[6] Danthine et al. (2000) estimate for example that cross-border financial transactions in Europe cost ten to twenty 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.

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.

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:

$$c_{1h_A} + f(z_{h_A}) + \sum_{i \notin z_{hA}}^{M_A} p_i s_{h_A}^i + \sum_{j}^{M_B} (1+\tau) p_j s_{h_A}^j = y + \sum_{k}^{z_{hA}} p_{h_A}^k \alpha_{h_A}^k \qquad \textbf{(1A)}$$

where c_{1hA} is consumption of agent h_A in period 1. The second term on the left-hand side is the cost of investment in risky projects. The two last terms on the left-hand side represent the demands for domestic and foreign assets. There are (M_A- z_{hA}) different 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 $\alpha_{h_A}^k$ of each project $k \in z_{hA}$ that he has developed. $(1-\alpha_{h_A}^k)$ is the portion of the project that agent h_A keeps and does not float on the market. Hence, we also interpret $\alpha_{h_A}^k$ as a measure of the extent of diversification chosen by agent h_A. The reason is that if $\alpha_{h_A}^k$ 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:

$$c_{1h_B} + f(z_{h_B}) + \sum_{i \notin z_{hB}}^{M_B} p^i s_{h_B}^i + \sum_{j}^{M_A} (1+\tau) p^j s_{h_B}^j = y + \sum_{k}^{z_{hB}} p_{h_B}^k \alpha_{h_B}^k \qquad \textbf{(1B)}$$

IV. An illustrative version of the model without intertemporal smoothing effects

We first illustrate the size effects in a model where intertemporal smoothing 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 V. Since smoothing 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, and Helpman and Krugman, 1985, p 205-209 for example). In order to eliminate the intertemporal smoothing 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:

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

where β is the rate of discount of the future and σ is the inverse of the degree of risk aversion. The utility of agents in country *B* is similar. The state of the world is revealed at the beginning of the second period, so that given the description of the payoffs of the different projects, and our assumption that all states of nature have the same probability 1/*N*, the expected utility of agent h_A is:

$$\begin{aligned} EU_{h_A} = c_{1h_A} &+ \beta\left(\frac{1}{N}\right)\frac{d^{1-1/\sigma}}{1-1/\sigma}\left(\sum_{i\notin z_{hA}}^{M_A} s_{h_A}^{i\;1-1/\sigma}\right) + \beta\left(\frac{1}{N}\right)\frac{[d(1-\tau)]^{1-1/\sigma}}{1-1/\sigma}\left(\sum_{j}^{M_B} s_{h_A}^{j\;1-1/\sigma}\right) \\ &+ \beta\left(\frac{1}{N}\right)\frac{d^{1-1/\sigma}}{1-1/\sigma}\left(\sum_{k}^{z_{h_A}}(1-\alpha_{h_A}^{k})^{1-1/\sigma}\right) \end{aligned} \tag{3}$$

The second element in equation **(3)** 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 measure of the extent to which he has decided not to diversify his own risk is therefore $1-\alpha_{h_A}^{k}$ for each project/asset $k \in \{1,\ldots,z_{hA}\}$. The expected utility of an agent in country B is symmetric. This simplified model allows us to draw interesting parallels with the trade literature. Equation **(3)** looks similar to 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. Note also that because of the intertemporal nature of our set-up, the usual Cobb-Douglas structure of preferences, used extensively in the international trade in goods literature, would not be appropriate here. By contrast to the trade in goods model, the share of total income that goes into first-period consumption (the homogenous good in the trade version) and the share of income that goes into second-period consumption (the differentiated goods in the trade version) are not constant.

Market structure

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[7]. 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. It is easy to check that the perceived elasticity of demand for any asset k with respect to its price is:

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

$(\partial \alpha^k / \partial p^k)/(\alpha^k/p^k) = -\sigma,\ k \in M$. The owner of the asset exploits this imperfectly competitive structure and sells only a portion of his project. 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 one. 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 policy on the aggregate outcome. This is similar to the structure of trade models with differentiated products.

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_A^B is the demand for an asset of country B by an agent of country A.

Asset demands and supplies

Agents in country A maximize expected utility given by **(3)** under the budget constraint **(1A)**. Agent h_A in country A chooses consumption[8] 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: $1-\alpha_{h_A}^k$ for each project/asset $k \in \{1, \ldots, z_{hA}\}$. When buying shares on the stock market, agents are price-takers. When selling shares, agents use their *ex post* monopoly power.

We define the parameter δ by: $\delta \equiv \left(\frac{\sigma}{\sigma-1}\right)^{\sigma} > 1$

The first order conditions give the individual supplies and demands for shares as a function of prices:

$$\begin{aligned}
&\alpha_A = 1-\delta p_A^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma}; \alpha_B = 1-\delta p_B^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma} \\
&s_A^A = p_A^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma}; s_B^B = p_B^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma} \\
&s_A^B = p_B^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma}\frac{(1-\tau)^{\sigma-1}}{(1+\tau)^{\sigma}}; s_B^A = p_A^{-\sigma}\left(\frac{\beta}{N}d^{1-1/\sigma}\right)^{\sigma}\frac{(1-\tau)^{\sigma-1}}{(1+\tau)^{\sigma}}
\end{aligned} \qquad \textbf{(4)}$$

The first line of equation **(4)** indicates that the supply of each asset on the market is an increasing function of the price and a decreasing function of the dividend d. 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. 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[9].

[8] We only consider high enough values of y so that optimal first period consumption is strictly positive.
[9] We come back to this in more detail in section VI.

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:

$$\begin{aligned} &\textit{stock market in } A: \alpha_A = (n_A - 1)s_A^A + (1+\tau)n_B s_B^A \\ &\textit{stock market in } B: \alpha_B = (n_B - 1)s_B^B + (1+\tau)n_B s_A^B \end{aligned} \quad \textbf{(5)}$$

The portions of each project sold on the stock markets are respectively:

$$\alpha_A = \frac{n_A - 1 + n_B\phi}{n_A - 1 + \delta + n_B\phi} \quad ; \quad \alpha_B = \frac{n_B - 1 + n_A\phi}{n_B - 1 + \delta + n_A\phi} \quad \textbf{(6)}$$

where $\phi \equiv \left(\frac{1-\tau}{1+\tau}\right)^{\sigma-1}$ 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 risk aversion leads foreign agents to restrain their demand for domestic assets. Lower transaction costs lead to lower market segmentation and higher ϕ.

Prices and number of risky projects

Asset prices are given by:

$$\begin{aligned} p_A &= \frac{\beta}{N} d^{1-1/\sigma}\left[n_A - 1 + \delta + n_B\phi\right]^{1/\sigma} \\ p_B &= \frac{\beta}{N} d^{1-1/\sigma}\left[n_B - 1 + \delta + n_A\phi\right]^{1/\sigma} \end{aligned} \quad \textbf{(7)}$$

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*. Because the number of projects must be a natural number, we have to assume that *N* is large enough so that the equilibrium can be considered as an approximation:

$$f'(z_A) = p_A \ ; \ f'(z_B) = p_B \quad \textbf{(8)}$$

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 $N-(n_A z_A)-(n_B z_B)$. We only consider the more realistic and interesting case where financial markets are incomplete: not all states of the world are covered by an Arrow-Debreu asset. In some states of the world consumption is zero in the second period. The case of incomplete markets arises for example for N large enough or for parameters such that the cost function $f(z)$ is sufficiently convex.

Size effects

The size effects are very clear in this example: if country A is the larger economy (has a larger population), then more diversification occurs in the large country than in the small one: $\alpha_A > \alpha_B$. Project owners in the large country choose to retain fewer shares of their projects and to sell more on the stock market. 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 the price for shares. 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: $d/(Np_i)$, $i = A, B$. The expected return is smaller in the large country than in the small one. The size effect in this example comes solely from the presence of transaction costs and risk aversion coupled with imperfect substitution between assets. If international transaction costs were zero ($\phi = 1$), then asset prices would be equal in the two countries. Note also that if agents were risk neutral ($\sigma \to \infty$), 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.

As long as the cost function *f* is convex, the large country, which has the higher asset price, sustains more projects per agent: $z_A > z_B$. This implies that the number of different assets per capita is higher in the large country. Large countries will exhibit a broader menu of financial assets (financial "super-markets"). We could also interpret this result as saying that firms in the large country are made of more projects.

It is also possible to endogenize *d*, which can be interpreted as the size of each project in the model. 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.

To gain intuition on these results, we come back to the first order conditions of the agents. When choosing how much to sell of their own projects on the domestic stock market, 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:

$$\frac{\beta}{N} d^{1-1/\sigma}(1-\alpha_A)^{-1/\sigma} = p_A\left(\frac{\sigma-1}{\sigma}\right) \quad ; \quad \frac{\beta}{N} d^{1-1/\sigma}(1-\alpha_B)^{-1/\sigma} = p_B\left(\frac{\sigma-1}{\sigma}\right) \qquad \textbf{(9)}$$

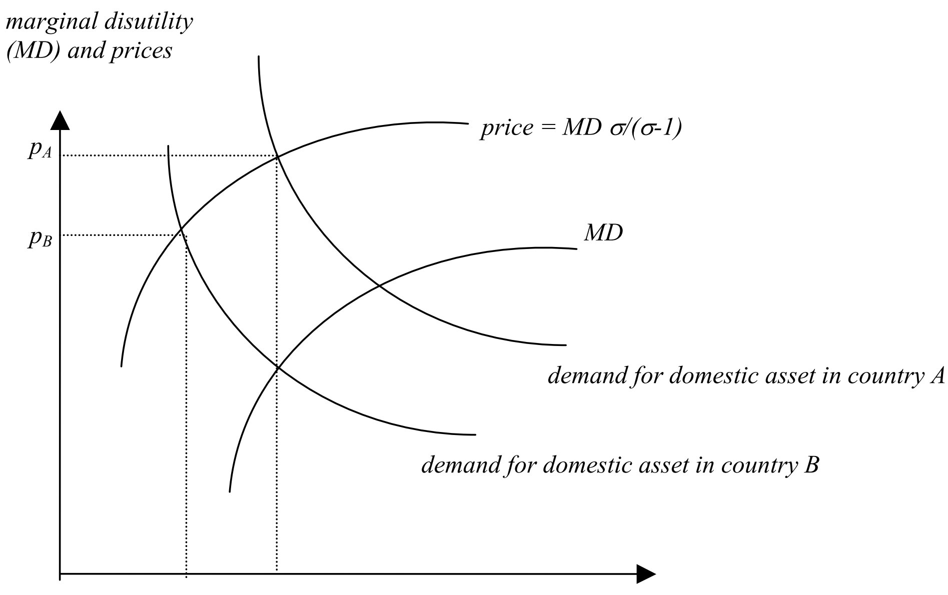
These are respectively the optimality condition, for the representative agent in *A* and in *B*. The expected marginal disutility of selling one more share of the project is the expected welfare loss due to consumption thus foregone (left hand side of the equation). Note that because of the concavity of the expected utility in consumption, this marginal loss in utility is naturally rising with the portion of the project sold. The marginal gain is less than the price of the asset as an increase in the supply of the asset implies a decrease in its price. At the optimum, the price of a share is equal to its marginal disutility multiplied by the mark up $\sigma/(\sigma-1)$. Note (see equations **(6)** and **(7)**) that quite intuitively, the more imperfectly competitive the asset markets are (the higher δ), the higher the asset prices and the lower the diversification (α).

Using the equilibrium on asset markets, and the demands given in **(4)**, we get the aggregate demand for a specific asset in both countries:

$$\alpha_A = \left(\frac{\beta d^{1-1/\sigma}}{N}\right)^{\sigma} p_A^{-\sigma}(n_A - 1 + n_B\phi) \; ; \; \alpha_B = \left(\frac{\beta d^{1-1/\sigma}}{N}\right)^{\sigma} p_B^{-\sigma}(n_B - 1 + n_A\phi) \qquad \textbf{(10)}$$

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: 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. As can also be seen from the equation above, demands in both countries are decreasing in the price. On graph 1, we illustrate the determination of the prices of assets, p_A and p_B, and of the extent of diversification, α_A and α_B which are also measures of the supply of assets**:**

Graph 1: determination of asset price and diversification



As pointed out in the introduction, 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. But in our setup, in addition to effects on the supply and on the number of assets, country size also influences asset prices. This supplementary effect comes from the supply curve that is increasing in the price of the asset, a feature that is derived directly from risk aversion.

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 intertemporal 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

V. A more general model with intertemporal substitution effects

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

$$U_{h_A} = \left(\frac{c_{1h_A}^{1-1/\sigma}}{1-1/\sigma} \right) + \beta E \left(\frac{c_{2h_A}^{1-1/\sigma}}{1-1/\sigma} \right) \tag{11}$$

for an agent h_A in country A (and symmetrically for an agent in country B). The first order conditions are similar to those given in equation **(4)** except that they also depend on consumption per capita in the first period.

The equilibrium conditions on the stock markets are still given by equation **(5)** and combined with the first order conditions we get modified levels of diversification and asset prices:

$$\alpha_A = \frac{(n_A - 1)c_{1_A} + n_B \phi c_{1_B}}{(n_A - 1 + \delta)c_{1_A} + n_B \phi c_{1_B}} \quad ; \quad \alpha_B = \frac{(n_B - 1)c_{1_B} + n_A \phi c_{1_A}}{(n_B - 1 + \delta)c_{1_B} + n_A \phi c_{1_A}} \tag{12}$$

and

$$p_A = \frac{\beta}{N} d^{1-1/\sigma} \left[(n_A - 1 + \delta) c_{1A} + \phi n_B c_{1B} \right]^{1/\sigma};$$
$$p_B = \frac{\beta}{N} d^{1-1/\sigma} \left[(n_B - 1 + \delta) c_{1B} + \phi n_A c_{1A} \right]^{1/\sigma} \qquad \textbf{(13)}$$

Because the marginal utility of consumption in the first period is not constant, there is intertemporal smoothing. 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 **(8)** so that a higher price of assets induces more risky projects ("financial super-market" effect).

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:

$$dc_{1A} = \frac{\gamma_B}{\gamma_A \gamma_B - \lambda_A \lambda_B} dy_A + \frac{\lambda_A}{\gamma_A \gamma_B - \lambda_A \lambda_B} dy_B \qquad \textbf{(14)}$$

and a symmetric expression for consumption in B. The parameters γ_A, λ_A, γ_B and λ_B are given in the appendix. It is possible to show that $\gamma_i > \lambda_i$, $i = A,B$. The parameter $\lambda_A / (\gamma_A \gamma_B - \lambda_A \lambda_B)$ measures the financial transmission effect of a change in income of country B on consumption in country A. Quite intuitively, in the case of financial autarky (infinite transaction costs, i.e. ϕ

= 0), this parameter goes to zero. Because $\gamma_A > \lambda_A$ and $\gamma_B > \lambda_B$, the induced effect on foreign consumption of an increase in home income is always less than on home consumption. Hence, it is easy to see that the country with highest per capita income is also the country with highest consumption per capita. Combining this and equation **(13)**, we then find that, when the two countries have equal population ($n_A = n_B$), the country with higher income also benefits from the higher asset price. From equation **(12)**, 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 also induces an increase in price higher in country A than in country B, as in the linear utility case. Both income per capita *and* population size affect asset prices and therefore 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 on cross-listing described in section II.

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:

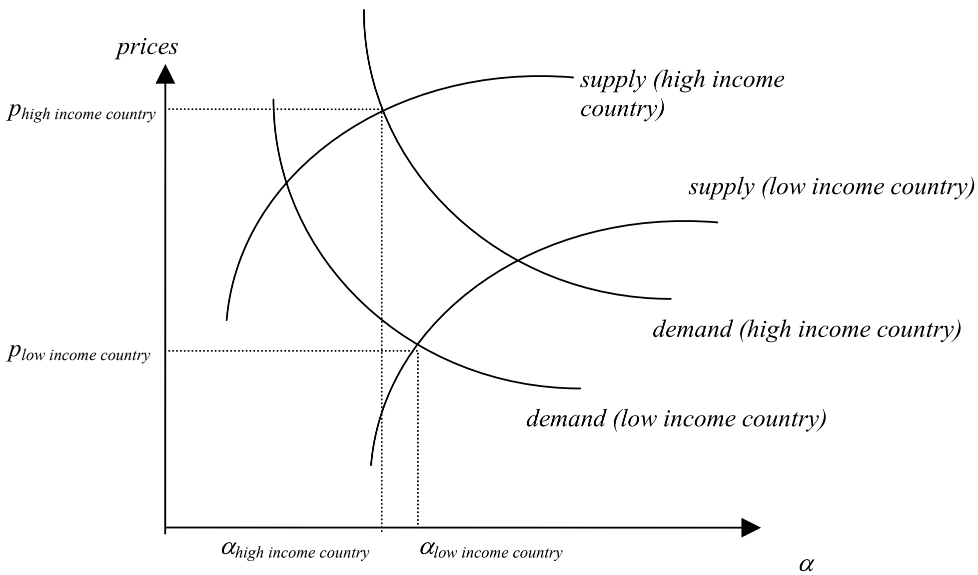
$$\alpha_A = \left(\frac{\beta d^{1-1/\sigma}}{N} \right)^{\sigma} p_A^{-\sigma} \left[(n_A - 1) c_{1A} + n_B \phi c_{1B} \right]; \; \alpha_B = \left(\frac{\beta d^{1-1/\sigma}}{N} \right)^{\sigma} p_B^{-\sigma} \left[(n_B - 1) c_{1B} + n_A \phi c_{1A} \right] \quad \textbf{(15)}$$

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:

$$\alpha_A = 1 - c_{1A} \delta p_A^{-\sigma} \left(\frac{\beta}{N} d^{1-1/\sigma} \right)^{\sigma}; \; \alpha_B = 1 - c_{1B} \delta p_B^{-\sigma} \left(\frac{\beta}{N} d^{1-1/\sigma} \right)^{\sigma} \quad \textbf{(16)}$$

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 graph 2.

Graph 2: The impact of income per capita on asset prices and diversification (with equal population size)



Using equation **(13)**, it is easy to check that the price of assets in country *A* is higher than in country *B* if the following inequality holds:

$$\left[n_A (1-\phi) + \delta - 1 \right] c_{1A} > \left[n_B (1-\phi) + \delta - 1 \right] c_{1B}$$

Remember that the parameter δ can be interpreted as a measure of imperfect competition on capital markets. When those markets are perfectly competitive, δ goes to unity and investors retain a lower share of their investment. In that case the differential in price depends only on the differential in aggregate consumption, which depends on the differential in aggregate income. This is the *size effect* in this version of the model. The effect is a demand effect; as can be seen in equation **(15)**, it depends on the presence of international transaction costs (ϕ <1), that is on the existence of market segmentation.

When asset markets are not competitive, that is when δ is more than unity, then in addition to the size effect (aggregate consumption and income) the level of consumption *per capita* plays a role in the determination of the asset price. This effect comes from the supply side. The reason is that 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 consumptions per capita, that is if income per capita, differ.

VI. 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 IV and to the fully-fledged model of section V.

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[10] of this type can be modeled as an increase in ϕ. We look at the

[10] Martin and Rey (2000) analyse in detail the effect of financial integration on the geographical location of

effect of such an increase in the symmetric case where countries *A* and *B* are identical[11]. 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*):

$$\frac{\partial p_A}{\partial \phi} = \frac{n_A p_A c_A^1 f''(z_A)}{(n_A - 1 + \delta + n_A \phi)\left[\sigma c_A^1 f''(z_A) + p_A^2\right]} \quad \textbf{(17)}$$

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 II on the impact of financial integration on asset prices. It is also easy to check that the extent of diversification increases when transaction costs between financial markets fall.

Portfolio diversification 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:

$$\delta s_A^A = 1 - \alpha_A; \quad \delta s_B^B = 1 - \alpha_B \quad \textbf{(18)}$$

This equation implies that agents in both countries do not fully diversify their domestic portfolio as $1 - \alpha_A > s_A^A$ and $1 - \alpha_B > s_B^B$ 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: $1 - \alpha_A = s_A^A$. *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

financial centres in a simpler three-country model.

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

competition on asset markets. The case where agents do not exploit their monopolistic power on asset markets can be analyzed by setting δ=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 analyzed in the previous section 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.

Home bias

We derive the value of domestic assets[12] of a representative agent as a percentage of the value of his whole portfolio (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:

$$\frac{p_A z_A (n_A - 1) s_A^A + p_A z_A (1-\alpha_A)}{p_A z_A (n_A - 1) s_A^A + p_A z_A (1-\alpha_A) + (1+\tau) p_B z_B n_B s_A^B} > \frac{n_A p_A z_A}{n_A p_A z_A + n_B p_B z_B} \quad \textbf{(19)}$$

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 is given by:

$$n_A n_B (1-\phi^2) + (n_A + n_B)(\delta - 1) + (\delta - 1)^2 > 0 \quad \textbf{(20)}$$

The home bias, which we described in section II, arises here if international transaction costs exist *(ϕ <1)* or if the asset markets are imperfectly competitive *(δ>1).* The home bias due to international transaction costs is straightforward. Note the interaction between transaction costs and the degree of risk aversion $\left(\phi \equiv \left(\frac{1-\tau}{1+\tau}\right)^{\sigma-1}\right)$, which influences

[12] The value of the non-traded portion of wealth (the part of each project kept by the project owner) is given by

the level of home bias. Imperfect competition on asset markets also induces a home bias in equity holdings because it implies that investors keep a disproportionate amount of their projects.

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 :

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

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 between *A* and *B*. 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 there is a major difference: 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.

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 equation **(21)**. We can use the Portes-Rey (1999) data set to do this. The data is a panel of gross bilateral portfolio equity flows between 14 developed countries for 8 years (1456

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the indirect utility function which at the optimum is valued at the market price.

observations)[13]. 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 look at the "between" estimator. The results are very striking (see below): all the variables suggested by the theory are significant and appear with the expected sign. And 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.

	Coeff.	St. 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

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

VII. Welfare implications

[13] See Appendix for more details on the data sources.

The market equilibrium is not efficient for two reasons. First, a world planner would choose a higher number of projects per person and therefore issue a higher number of 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[14].

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.

To compare the market and the planner's equilibrium we choose the symmetric case where both countries are identical ($n_A = n_B$ 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. He maximizes the utility of a representative agent in A 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 therefore the following (in the case of the non linear utility in the first period[15]):

$$s_A^A = \frac{1}{n_A(1+\phi)} \quad ; \quad s_A^B = \frac{1-\tau}{1+\tau}\frac{\phi}{n_A(1+\phi)} \quad ; \quad f'(z_A) = \frac{\beta}{N} d^{1-1/\sigma} \frac{\sigma}{\sigma-1}\left[n_A(1+\phi)c_1^A\right]^{1/\sigma} \qquad \textbf{(22)}$$

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

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[14] For a related study of efficiency in the context of trade models, see for example Matsuyama (1995).
[15] The case of linear utility would give the same qualitative welfare conclusions.

$$s_A^A = \frac{1}{n_A(1+\phi)-1+\delta}\,;\, s_A^B = \frac{1-\tau}{1+\tau}\frac{\phi}{n_A(1+\phi)-1+\delta}\,;$$
$$f'(z_A) = \frac{\beta}{N} d^{1-1/\sigma}\left\{\left[n_A(1+\phi)-1+\delta\right]c_1^A\right\}^{1/\sigma} \tag{23}$$

Hence, the extent of diversification is too small in the market equilibrium: s_A^A and s_A^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.

At first glance, 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 the demand for assets and therefore diversification, and also the price level, so that in equilibrium the optimal number of assets is developed. The value of this subsidy is simply $v = 1/\sigma$, 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.

VIII. Domestic transaction costs and issuing costs

So far, we have not introduced domestic transaction costs on asset markets in the main analysis. This can be interesting in the context of studying size effects because 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 smoothing effects developed in section IV.

Suppose now that when agents buy domestic assets, and receive the dividend on those assets, they have to bear transaction costs similar in nature to the international transaction costs we have analyzed in the previous sections but which are lower than the international ones[16]. We denote transaction costs of that sort τ_A and τ_B respectively on the asset markets of country *A* and *B*. In addition, when firms issue shares, they incur costs even before the transaction stage. These issuing costs could be represented, at least partly, as proportional to the amount of shares issued: we suppose that these issuing costs are u_A and u_B per share issued and again incurred in units of the share itself.

The analysis is very similar to the analysis of international transaction costs and therefore we do not repeat all the steps for finding the equilibrium. The different demands for the assets are :

$$\delta s_A^A = (1-\alpha_A)\frac{(1-\tau_A)^{\sigma-1}}{(1+\tau_A)^{\sigma}}(1-\mathrm{u_A})^{\sigma}\ ;\ \delta s_B^B = (1-\alpha_B)\frac{(1-\tau_B)^{\sigma-1}}{(1+\tau_B)^{\sigma}}(1-\mathrm{u_A})^{\sigma}$$

$$\delta s_A^B = (1-\alpha_A)\frac{(1-\tau)^{\sigma-1}}{(1+\tau)^{\sigma}}\left(\frac{p_A}{p_B}\right)^{\sigma}(1\text{-}u_A)^{\sigma}; \qquad \textbf{(24)}$$

$$\delta s_B^A = (1-\alpha_B)\frac{(1-\tau)^{\sigma-1}}{(1+\tau)^{\sigma}}(1\text{-}u_B)^{\sigma}\left(\frac{p_B}{p_A}\right)^{\sigma}$$

The limited diversification result becomes stronger when domestic transaction costs and issuing costs are taken into account.

The portions of each project sold on the stock market are now:

$$\alpha_A = \frac{(n_A - 1)\phi_A + n_B\phi}{(n_A - 1)\phi_A + n_B\phi + (1 - u_A)^{1-\sigma}\delta}$$
$$\alpha_B = \frac{(n_B - 1)\phi_B + n_A\phi}{(n_B - 1)\phi_B + n_A\phi + (1 - u_B)^{1-\sigma}\delta} \qquad \textbf{(25)}$$

where $\phi_i = \left(\frac{1-\tau_i}{1+\tau_i}\right)^{\sigma-1}$ $(i = A, B)$ is less than 1, and decreasing in transaction costs

and where $\phi = \left(\frac{1-\tau}{1+\tau}\right)^{\sigma-1}$ 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:

$$p_A = \frac{\beta}{N} d^{1-1/\sigma}(1-u_A)^{-1/\sigma}\left[(n_A - 1)\phi_A + n_B\phi + (1-u_A)^{1-\sigma}\delta\right]^{1/\sigma}$$
$$p_B = \frac{\beta}{N} d^{1-1/\sigma}(1-u_B)^{-1/\sigma}\left[(n_B - 1)\phi_B + n_A\phi + (1-u_B)^{1-\sigma}\delta\right]^{1/\sigma} \qquad \textbf{(26)}$$

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

$$f'(z_A) = p_A(1-u_A) \;\; ; \;\; f'(z_B) = p_B(1-u_B) \qquad \textbf{(27)}$$

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 less risky projects.

The intuition can be understood in reference to Graph 3 below. 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

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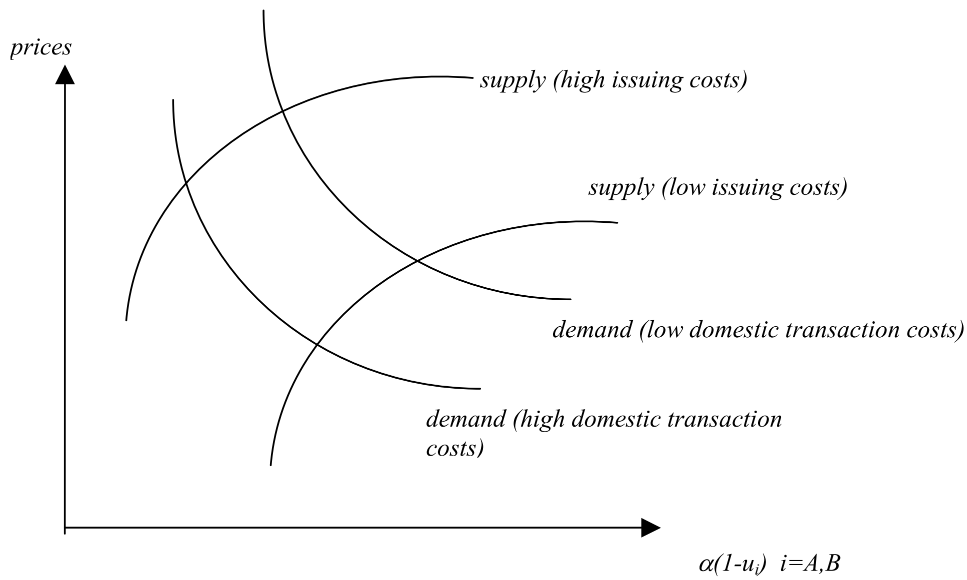
[16] This is consistent with the empirical evidence described in Danthine et al. (2000).

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.

Graph 3: The impact of domestic transaction costs and of issuing costs



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 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.

IX. Conclusion

This paper has presented a two-country macroeconomic 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. These issues have been largely overlooked by the traditional macroeconomic and finance literature. They arise very naturally in our model because we have endogenously incomplete asset markets, imperfect substitutability of assets and transaction costs. The model is very simple and conveys clear intuitions. It makes sense of several empirical findings such as significant demand and market size effects on asset prices which have been unexplained so far in a unified model.

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). 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[17] and their implications for the

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

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, Sørensen and Yosha (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.

Appendix:

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

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

and the symmetric expressions for γ_B and λ_B.

Data Sources and definitions[18]

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 agregate consumption: Datastream.

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

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

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