Divergence in Equity Home Bias between Developed and Developing Economies: A Role of Financial Development*

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Abstract

Does financial development stimulate international portfolio diversification? While financial development helps domestic investors increase their access to foreign markets and diversify investments abroad, it can promote investment within a domestic market by substituting for foreign investment. Our multi-country general equilibrium (GE) model of portfolio choice with a simple cost structure analyzes the mixed effect of financial development on international equity positions. The model closely traces the real pattern of equity home bias in developed and developing countries and identifies the GE effects of changes in financial development across countries: simultaneous financial development reduces home equity holdings in financially developed countries, not developing ones, which contributes to divergence in equity home bias between the two groups of countries.

JEL code: F36; F41; G11; G15

Keywords: Financial development; International portfolio diversification; Multi-country model; Equity home bias, Domestic volatility

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1. Introduction

Home bias in equity remains a pervasive phenomenon across countries and over time (French and Poterba, 1991; Tesar and Werner, 1995; Lewis 1999; for recent evidence, see also Sercu and Vanpee, 2007). In particular, Coeurdacier and Rey (2013) present the evolution of equity home bias measures in developed countries as well as emerging and developing economies—the two groups of countries exhibit not only different levels of equity home bias but also heterogeneous patterns of the home bias (Hereinafter, we use developing countries to represent emerging and developing economies). Thus, it is important to understand not only the main drivers of equity home bias, which is viewed in contrast to international portfolio diversification,[1] but also financial market factors and conditions that marginally influence the degree of home bias.

[Insert Figure 1 here]

Figure 1 shows changes in the average level of equity home bias and financial development in 92 countries for 1980–2007. Panel A shows the respective time-series variations in equity home bias in developed and developing countries. The equity home bias of country *i* is denoted as 1− (share of country *i*'s holdings of foreign equity in country *i*'s total equity portfolio or that of foreign equity in the world portfolio)[2]. Previous studies created measures for equity home bias on the basis of the notion that the proportion of home equities in investors' portfolios should equal the concerned country's share of global market capitalization, assuming that homogenous investors

[1] Some researchers have used frictions in international financial markets to explain equity home bias. The explanations related to frictions comprise information asymmetry (Gehrig, 1993; Van Nieuwerburgh and Veldkamp, 2009), tariff or transaction costs (Heathcote and Perri, 2004; Martin and Rey, 2004), and trade costs and non-tradable goods (Obstfeld and Rogoff, 2000). Another strand of research has explained equity home bias as a result of risk diversification by arguing that domestic assets can be better hedges against country-specific risks than foreign assets (e.g., Heathcote and Perri, 2009; Coeurdacier, Martin, and Kollmann, 2010). Recent research considers various factors to explain equity home bias such as government spending shock (Berriel and Bhattarai, 2013) and product variety risk (Hamano 2014).

[2] Baele et al. (2007), Sorensen et al. (2007), and Sercu and Vanpee (2007), among many others, introduce I-CAPM-based measures for equity home bias.

participate in perfectly integrated financial markets. Note that the home bias is zero if the country exhibits no preference for equity that is domestically issued. As suggested by Coeurdacier and Rey (2013), Panel A shows that equity home bias has diverged between two groups of countries, that is, home bias has decreased over the past 20 years among developed countries, but remains significantly high in developing economies.

However, it is hard to reconcile the widening gap in equity home bias between developed and developing countries with their "evolving" financial development in Panel B. This is because the two groups of countries exhibit similar changes in the level of financial development. Moreover, the initial gap in financial development between them has remained constant. Mendoza et al. (2009) also present this constant gap in financial development between two groups of countries with a different measurement. Thus, if the impact of financial development on equity home bias is identical in both groups over time, all other things being equal, explaining the divergence in equity home bias is difficult, at least in the context of the patterns of financial development. Note that previous works focus on the role of financial liberalization in reducing equity home bias, particularly in developed countries over time.[3] However, rare research examines the relationship between equity home bias and financial development and its interaction with financial openness.

Another complex concern is that whether financial development decreases or increases equity home bias *ex post* is not evident. Among many studies, Forbes (2010) suggests that financial underdevelopment in emerging markets induces their investors to increase holdings of foreign

[3] The divergence of equity home bias in Figure 1 is also in accordance with the financial liberalization in developed countries, which is far more rapid relative to developing countries (Lane and Milesi-Ferretti, 2006; see also Appendix A Figure). Our study relates to previous works such as Baele et al. (2007), Sorensen et al. (2007), and Mondria and Wu (2010), who shed light on the development of home equity bias. In particular, Baele et al. (2007) and Sorensen et al. (2007) determine that equity home bias has declined over the years and suggest that this is related to an increase in the possibility to share risk through financial integration. Mondria and Wu (2010) argue that the time series of declining equity home bias can be reproduced through interactions between rational inattention and capital market liberalization.

assets, especially US debt assets. [4] This implies that if a home country has lower domestic costs and better institutions (more developed financial markets), investors will further increase investments at home than abroad. However, Lane and Milesi-Ferretti (2008) find that financial development promotes international diversification *ex-post* and espouse a strong complementarity between domestic financial development and foreign asset holdings. Thus, any conclusion on the true effect of financial development on international equity positions should take these findings into consideration.

This study attempts to explain divergence in equity home bias with evolution of financial development as shown in Figure 1. First, we provide systematic empirical evidence about financial development and equity home bias for developed and developing countries. To explain this interesting finding, we construct a simple multi-country general equilibrium (GE) model following the spirit of Dedola, Lombardo, and Straub (2011), Bergin and Pyun (2016) and Pyun (2017). The multi-country model relaxes the symmetry assumption in a conventional two-country model[5] and makes it possible to examine how the different levels of financial development and financial openness across countries influence both their domestic and foreign equity holdings simultaneously.

Our multi-country GE model closely traces the real pattern of equity home bias in developed and developing countries. More importantly, this exemplary model with multi-country setting predicts that simultaneous changes in financial development (through decreases in domestic cost) have asymmetric effects on equity home bias in developed and developing countries; that is, financial development decreases long positions in home equity in developed financial markets,

[4] There is caveat: The United States, which is certainly perceived to have the safest financial market in the world, is attractive to foreign investors.
[5] In particular, in the model of portfolio choice, symmetric two country setting sees to it that home long position leads to foreign short position in equilibrium.

whereas it increases those in relatively underdeveloped financial markets if the world countries undergo financial development that occurs at the same pace.

The result is surprising but the intuition behind the multi-country model is clear. It's all about the interaction between simultaneous financial development and the different level of financial openness! Simultaneous financial development across countries attracts the world investors to invest more in the financial market. However, the investors in a less developed country *marginally* increase their investment toward home assets more than foreign ones owing to relatively higher barriers to the international financial market, while those in a more developed world increase their investment more proportionally in home and foreign as compared to developing countries.

Our simple model of financial development is in line with Caballero et al. (2008) in that we introduce *a la* asset pledgeability by allowing cost parameter on domestic equity returns to proxy the level of financial development. Furthermore, financial openness interacted with financial development helps explain divergence in equity home bias as is in Mendoza et al. (2009). While these two studies are motivated to explain global imbalance (net total asset position), we focus specifically on the evolvement in international "equity" position with respect to constant gap in financial development between developed and developing countries over time. In this regard, our results are complementary to these works and improve the understanding of net equity positions between two groups of countries. Another contribution of this study is that we calibrate the domestic (volatility) cost as a proxy for financial (under)development based on previous literature that finds a negative linkage between domestic volatility and financial development (Easterly et al., 2000; Denizer et al., 2002; Raddatz, 2006).

The remainder of this paper is organized as follows. Section 2 presents additional empirical

evidence for the effect of financial development on equity home bias. Section 3 introduces a three-country portfolio choice model with the various cost structure. Section 4 reports the calibration and simulation results for the three-country model. Concluding remarks follow in Section 5.

2. Further empirical evidence

This section provides more systematical evidence on financial development and equity home bias between developed and developing countries. Few empirical studies exist on the relationship between financial development and equity home bias: many studies focus on foreign asset holdings across countries and show that a country's financial depth (measured as stock market capitalization or GDP per capita) in country pairs are positively associated with cross-border financial asset holdings (e.g., Portes and Rey, 2005). However, these previous studies are limited to determining the effect of financial development on a country's equity home bias because they do not distinguish between the differing effects of financial development on domestic and foreign asset holdings. Motivated by Figure 1, we empirically investigate the effect of "simultaneous" financial development on equity position more thoroughly.

The dependent variable is the measure of equity home bias, 1−(share of country *i*'s holdings of foreign equity in country *i*'s total equity portfolio or that of foreign equity in the world portfolio), which was introduced by Baele et al. (2007), Sorensen et al. (2007), and Sercu and Vanpee (2009) using the concept of I-CAPM. We construct an equity home bias measure for 92 countries from 1980 to 2007. We introduce the ratio of liquid liabilities to GDP, a widely available indicator of financial depth, as our baseline measure of financial development (King and Levine, 1993; Beck, Demirgüç-Kunt, and Levine, 2010). The liquid liabilities measure the size of financial intermediaries (=currency plus the demand and interest-bearing liabilities of banks and nonbank

financial intermediaries)[7]. Other alternative measures for financial development are introduced for the robustness of the results. In the empirical framework, we use two different ways to identify simultaneous financial development across countries shown in Figure 1: i) Following the idea from Bergin and Pyun (2012), we introduce the multilateral financial development term which is a mean of the level of financial development for other countries. ii) we use a mean of financial development across countries as a regressor.

The following are explanatory variables for equity home bias; measures for financial openness are included. *De facto* financial openness is computed as total external assets plus total external liabilities as a proportion of GDP (Lane and Milesi-Ferretti, 2006). We also introduce *de jure* financial openness indices (Chinn and Ito, 2006; Quinn and Toyoda, 2008) as a robustness check.19F[8] To address country heterogeneity, we control for dummy variables for developed countries (advanced countries as categorized by the IMF; see the list of countries in Appendix B)20F[9]. We add trade openness (bilateral trade over GDP), the log of real GDP per capita (converted at PPP exchange rates in current international dollars, Penn World Table 8), and a dummy for international financial centers (UK, Belgium, Netherlands, and Switzerland, as proposed by Lane and Milesi-Ferretti (2008)). We also include inflation volatility (the annual standard deviation of monthly CPI changes) as a proxy for internal risks or another source of macroeconomic vulnerability. By allowing this inflation volatility measure, we may isolate the effect of decreased volatility driven by financial development on portfolio allocation from that of volatility emerging from other domestic sources. Exchange rate volatility (the annual standard

[7] Since we focus on the equity holdings of a country, one may argue that we use stock market development as a measure of financial development. However, we use liquid liabilities/GDP, which represents the financial depth or development of the domestic financial market to avoid endogeneity problems because our dependent variable, the equity home bias measure, comprises information on stock market capitalization, foreign assets, and foreign liabilities.
[8] The empirical results with other financial openness measures are consistent with our main results, which are available from the author upon request.
[9] Excluding Malta and Turkey, countries with IMF IFS codes lower than 199 are classified as advanced.

deviation of the monthly percentage change in the exchange rate against the relevant base country over the current year, IFS, IMF) is included. It not only measures transaction costs from buying foreign assets but also captures external risk factors in trading international financial assets. The descriptive statistics of variables used in the analysis are reported in Appendix C.

2.1. Main results

Table 1 presents the estimation results for the effects of financial development, *FINDEV1*, on equity home bias. Column (1) in Table 1 includes financial development, multilateral financial development, financial openness and additional variables that influence equity home bias. Financial openness has a significantly negative effect on equity home bias, but financial development has a negative but insignificant coefficient, which shows ambiguous effect of financial development on equity home bias.

[Insert Table 1 here]

An important motivation in this study is that financial development decreases home equity holdings in the most developed financial market, but increases those in the least developed financial market. To inspect this observation, we include the interaction term between financial development and the developed country dummy. Column (2) of Table 1 shows that the estimated coefficient of the interaction term is significantly negative at the 1% significance level, while that of financial development is insignificant. This indicates that financial development contributes to reducing equity home bias in developed countries, whereas it does not lead to decreasing equity home bias in emerging and developing countries. Column (3) implements tobit estimation to control for a right censored property of the dependent variable. Column (4) includes country fixed effects that capture a country's time-invariant unobserved characteristics. The interaction terms

between financial development and the developed country dummies in both columns remain negative and are significant at the 1% level. We, therefore, confirm that financial development has asymmetric effects on equity home bias in developed and emerging or developing countries. Interestingly, in the result with country fixed effect that exploit time-series variations in equity home bias in column (4), the estimated coefficient of *FINDEV1* becomes significantly positive at the 1% level. This supports that financial development encourages long positions in home equity for emerging and developing economies.

Note that total effect of financial development needs to be evaluated with the sum of the coefficients associated to FINDEV1 and the interaction between FINDEV1 and developed dummy. Given the relative order of magnitudes between the sum of the coefficients, the average effect of financial development on equity home bias is insignificant in pooled OLS result in column (2) or shows close to zero, 0.002, despite its statistical significance in fixed effect result in column (4). Lastly, the estimated coefficients of the other variables are expected over all columns.[10]

To reinforce our findings in columns (2) to (4), we conduct the estimation with developed and emerging or developing country sub-samples. Columns (5) and (6) show that the effects of financial development on equity home bias indeed differs in these samples. The effect of financial development on equity home bias in the developed country sample is negative, whereas financial development has a significantly positive effect on equity home bias in the emerging or developing country sample.

[Insert Table 2 here]

[10] The estimated coefficient of trade openness is insignificant, whereas other factors that affect home equity holdings, such as financial openness and the log of GDP per capita, have coefficients of expected signs. This is consistent with previous findings that trade costs do not have enough explanatory power for equity home bias, under which the incentive of equity investment to hedge against real exchange rate risk is marginal (van Wincoop and Warnock, 2010; Pyun, 2017). Further, the estimated coefficient of inflation volatility on equity home bias is significantly negative and that of exchange rate volatility is significantly positive, as expected.

Table 2 implements another exercise to examine the effect of simultaneous financial development on equity home bias. We include the mean value of financial development across countries and check its heterogonous effects on equity home bias in terms of a group of country. Column (1) shows that an increase in mean of financial development has ambiguous effect on the home bias as expected. However, when we control for country heterogeneity, columns (2) to (4) show that that financial development decreases the home bias in developed countries, but increases that in emerging and developing countries.

2.2. Robustness

2.2.1. Alternative measures

To determine the robustness of the results, we introduce alternative measures for financial development. The second measure is M2 over GDP, which has been conventionally used to measure financial development in previous studies (e.g., Mckinnon, 1973). The third measure is private credit (issued by deposit money banks and other financial institutions) over GDP, which is a proxy for the activities of financial intermediaries (Levine, Loayza, and Beck, 1999). The fourth variable is the ratio of stock market value added to GDP, which measures stock market activity or liquidity (Beck, Demirgüç-Kunt, and Levine, 2010).

We estimate the specifications of columns (3) and (4) in Table 3 by replacing our baseline measure, *FINDEV1*, with other measures of financial development. Columns (1)–(6) in Table 3 consistently show that the coefficient of the interaction term between *FINDEV* and the developed country dummy is significantly negative, while the estimated coefficients of all *FINDEV* measures are significantly positive. Thus, we confirm that the positive effect of financial development on

equity home bias prevails in emerging or developing countries; however, the negative effect of financial development is clearly dominant in developed countries.

[Insert Table 3 here]

2.3.2. Tracing the effect of financial development on home bias (TBU)

[Insert Figure 2 here]

2.3.3. Interaction between financial development and financial openness (TBU)

[Insert Figure 3 here]

3. Theoretical underpinning

3.1. Background: modeling financial development

Many previous studies emphasize the importance of financial development in domestic financial asset transactions: McKinnon (1973) suggests that financial deepening (or development) reflects an increasing use of financial intermediation by agents and permits the efficient flow of resources into a country over time. Rajan and Zingales (1998) argue that financial development reduces the cost of external finance to financially dependent firms, which allows these firms and industries to grow faster. Love (2003) shows that firm's financing constraints decrease with financial development. Moreover, previous studies, such as Easterly et al. (2000), Denizer et al. (2002), and Raddatz (2006), suggest that financial development decreases macroeconomic volatility, because a more developed financial market acts as a stabilizer that helps cushion agents from any shocks in the economy and provides a more stable environment for investment[11]. In sum, the development of a domestic financial system facilitates investments in domestic assets by reducing the overall

[11] Beck et al. (2006) provide a model that predicts a dampening effect of financial intermediaries on the propagation of real shocks and a magnifying effect on that of monetary shocks. They find that financial intermediaries magnify the impact of inflation volatility in countries while dampen that of trade (real) volatility. They, therefore, conclude that financial intermediaries have no overall effect on growth volatility.

(first- and second-moment) costs within the market, such as those related to imperfect information, limited enforcement, uncertainty, or domestic transactions costs.

To model financial development and openness, we use a simple approach of introducing frictions (costs) not only in asset trade across countries but also within domestic market. First, we include transaction costs incurred by purchasing foreign assets to measure barriers in financial openness (Heathcote and Perri, 2004; Martin and Rey, 2004). Thus, equity home bias is generated by the transaction cost in the model. Designing financial (under)development using domestic cost is in line with an idea of asset pledgeability in Caballero et al. (2008). They introduce an index of financial development that measures the extent to which property rights over earning are well defined and tradable in financial markets. The idea of this index is an iceberg type parameter on the present value of economy's return, which dilutes the profit of asset returns.

In the model, in addition to transaction cost of foreign assets, domestic cost works as another friction and the two costs play a similar role in determining asset allocation. However, the real value added of introducing domestic cost is that we generate the observed levels of home bias in terms of realistic variations in this cost parameter (see our calibration and model's results in the section 3). Furthermore, we argue that this cost helps identify the effect of financial development on equity home bias. Note that a formidable task is to calibrate domestic cost as a proxy for the level of financial development and therefore in section 4.1, we discuss in detail how to identify this domestic cost. Lastly, the model does not explicitly consider the (endogenous) spillover effects of financial development on financial openness or vice versa. However, we will examine the interaction between the two variables under specific conditions as Chinn and Ito (2006) did.

3.2. Setup of the three-country model

To analyze the heterogeneous effects of financial development on equity home bias, we build a simple endowment economy three-country portfolio allocation model that includes transaction costs from buying foreign assets as well as domestic volatility. Consider a representative consumer in the following dynamic optimization problem for country *i*:

$$Max\ E_t \sum_{k=1}^{\infty} \beta^k \left(\frac{C_{i,t+k}^{1-\gamma}}{1-\gamma} \right) \qquad \text{for } i = 1, 2, 3. \tag{1}$$

$$\text{s.t. } C_{it} + p_{jt}^S \sum_{j}^{3} s_{ij,t+1} = y_{it}^L + (p_{it}^S + d_{it}) s_{ii,t} + \sum_{j, j \neq i}^{3} (p_{jt}^S + d_{jt}) s_{ij,t} (1 - \tau_{ij}), \tag{2}$$

where C_{it} is country *i*'s aggregate consumption in period *t*. y_{it}^L is country *i*'s labor income and d_{it} is a dividend paid out to the shareholders of stocks in country *i*, which is identical to capital income. $s_{ij,t}$ represents the real holdings of country *j*'s stocks by country *i* at *t*. p_{jt}^S represents the share prices of stocks in country *j*. τ_{ij} is the transaction cost from buying foreign assets of country *j* paid by country *i* ($j \neq i$). This is equivalent to a tax on foreign dividends and assumed to be negatively related to the financial openness of country *i*. γ is the coefficient of relative risk aversion ($\gamma > 1$). To keep the setup simple, we do not model trade in goods and services, but focus on portfolio allocations among countries.

The labor and capital endowments are determined using the following simple stochastic processes, as presented in Devereux and Sutherland (2011). The log of country *i*'s labor income ($i = 1, 2, 3$) is assumed to be as follows:

$$\log y_{i,t}^L = \log \bar{y}_i^L + g_i + \varepsilon_{i,t}^L \text{ for } i = 1, 2, 3, \tag{3}$$

where $\bar{y}_i^L$ is the steady-state level of labor income, g_i is labor income growth on a balanced growth path, and $\begin{pmatrix} \varepsilon_{1,t}^L \\ \varepsilon_{2,t}^L \\ \varepsilon_{3,t}^L \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_L^2 & 0 & 0 \\ 0 & \sigma_L^2 & 0 \\ 0 & 0 & \sigma_L^2 \end{pmatrix}\right)$.

A country's return of capital, d_{it}, can be calculated as follows:

$$\log d_{i,t} = \log \bar{d}_i + \mu_i - v_i + \varepsilon_{i,t} \text{ for } i = 1, 2, 3, \tag{4}$$

where $\bar{d}_i$ is the steady-state level of capital income, μ_i is the return growth rate on a balanced growth path, and $\begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & 0 & 0 \\ 0 & \sigma_2^2 & 0 \\ 0 & 0 & \sigma_3^2 \end{pmatrix}\right)$. Both the log of labor income and that of capital income (dividend) of country i (i = 1, 2, 3) are assumed to not be cross-dependent.

A new feature in this model is the introduction of the internal cost faced by every country: v_i is the cost of return on domestic capital. We subtract the term v_i from the mean log dividend, which implies that v_i is the cost for obtaining a certain level of dividend.

3.3. Asset market equilibrium conditions

The first-order conditions (FOCs) with respect to equity portfolio holdings, $s_{ji,t}$, can be obtained using the following dynamic optimization problem[12]:

[12] Equation (5) is recursively solved with the transversality condition $\lim_{T\to\infty} \beta^T \cdot E_t\left[\left(\frac{C_{i,t+T}}{C_{it}}\right)^{-\gamma} p_{t+T}^S\right] = 0$

$$C_{i,t}^{-\gamma} = \beta \cdot E_t \left[\frac{(p_{jt+1}^S + d_{jt+1})}{p_{jt}^S} (1-\tau_{ij}) C_{i,t+1}^{-\gamma} \right] \quad \text{for } i, j = 1, 2, 3 \text{ (9 FOCs) and } i \neq j, \tag{5}$$

where $R_{j,t+1}^i$ is country i's gross returns of stock *j* are as follows:

$$R_{j,t+1}^i = \frac{(p_{jt+1}^S + d_{j,t+1})}{p_{jt}^S} (1-\tau_{ij}). \tag{6}$$

For instance, combining the FOCs of the home and foreign assets for country 1, and writing them in terms of the excess return of country *j*'s assets generates

$$E_t[C_{1,t+1}^{-\gamma}(R_{j,t+1}^1 - R_{1,t+1}^1)] = 0. \qquad \text{for } j = 2, 3 \tag{7}$$

These excess return terms are defined for countries 2 and 3; there are a total of six equations.

Market clearing in the asset market implies that

$$s_{i1,t} + s_{i2,t} + s_{i3,t} = 1, \quad \text{for } i = 1, 2, 3. \tag{8}$$

Net equity supply is imposed as 1,

$$s_{1i,t} + s_{2i,t} + s_{3i,t} = 1, \quad \text{for } i = 1, 2, 3. \tag{8'}$$

A goods market clearing condition with dividends requires that

$$C_{1t} + C_{2t} + C_{3t} = y_{1t}^L + y_{2t}^L + y_{3t}^L + d_{1t} + d_{2t} + d_{3t}. \tag{9}$$

Here, as in Heathcote and Perri (2004), we assume that transaction costs (or tax revenues) are rebated to consumers through lump sum payments.

3.4. Model solution

To solve portfolio holdings, we first express the zero-order component ($\bar{x}$) of equilibrium portfolios. At the steady state equilibrium, the prices of assets are the same and the zero

components of prices are assumed to be $\overline{p}_1^S = \overline{p}_2^S = \overline{p}_3^S$. A country's holdings of local stock is represented by s_{ii}, and s_{ij} is a country i's holdings of country j's stock. Also assume that transaction cost of buying foreign assets depend on source country's capital account policy; $\tau_{ij} = \tau_i$ (j≠i). On the basis of equilibrium portfolio share *s,* we rewrite Equation (2) as the following 'static' budget constraint for country 1 at time t that equilibrium portfolio shares, *s*, satisfies:

$$C_{1t} = y_{1t}^L + d_{1t}s_{11} + d_{2t}(1-\tau_1)s_{12} + d_{3t}(1-\tau_1)s_{13}. \tag{2'}$$

The log deviations of the variables from the steady-state equilibrium are denoted by (^), such that $\hat{x} \equiv \left(\frac{x-\overline{x}}{\overline{x}}\right)$, where $\overline{x}$ is the value at equilibrium. A first-order approximation of the budget constraint for country 1 in (2') is

$$\hat{C}_{1t} = (1-\alpha)\hat{y}_{1t}^L + s_{11}\alpha\hat{d}_{1,t} + s_{12}(1-\tau_{12})\alpha\hat{d}_{2,t} + s_{13}(1-\tau_{13})\alpha\hat{d}_{3,t}, \tag{10}$$

where $\frac{\overline{y}_i^L}{\overline{y}_i} = (1-\alpha)$, $\frac{\overline{d}_i}{\overline{y}_i} = \alpha$, and α is the capital income's share of output. We also take a first-order approximation of each country's FOCs—i.e., country 1 has two FOCs, from Equation (6), for a total six FOCs—and find a portfolio solution by combining these first-order approximations of the FOCs and market clearing conditions from equations (8), (8') and (9) (see Appendix D for the detailed solution procedure).

4. Calibration and simulation

We introduce baseline parameter values and calibrate transaction cost of buying foreign assets and domestic cost, referencing previous literature and real data. Then, we report the results from the model with calibrated parameters and further simulate the numerical experiments of our three-

country model. We demonstrate three points. First, because of transaction costs, the model is capable of generating equity home bias as an equilibrium portfolio. Second, even under home bias, the model confirms the intuition that when domestic costs vary, investors change their portfolio allocations of home and foreign assets—a decrease in domestic cost results in home investors holding more domestic assets, all other things being equal. We also investigate the effects of simultaneous changes in domestic costs on international equity positions across countries. Third, using equity shares from the model, we provide a measure of equity home bias. In this model, the home equity share is directly linked to the size of the equity home bias because of the same market size in the three countries.

4.1. Calibration

First of all, we employ conventional parameter values such that the capital income share is 0.3 and the time discount rate is 0.99. The coefficient of relative risk aversion is set to $\gamma = 2$ (Backus et al., 1994). We assume the factor—labor and capital—income growth rates across countries are the same: 0.033 (3.3%). Note that since we focus on the explanatory power of financial development in the model, we use the same level of income growth for developed and developing countries. We also did some exercises to allow variations in the growth rates between developed and developing countries but our main results rather have improved. Transaction cost parameters are based on Tobin tax rate from Darvas and Von Weitzsaker (2010). We use 0.005 (0.5%) as the parameter value for the transaction cost of buying foreign assets, and allow a little perturbation (plus and minus 0.003% from baseline transaction costs parameter) to generate differences in financial openness across countries. Again, we are not calibrating the difference in cost parameters seriously because we pay attention to the role of financial development in shaping the pattern of

equity home bias rather than financial openness. Furthermore, in this model with the first moment, even very small return difference driven by transaction costs leads to home bias.

[Insert Table 4 here]

Table 4 shows the key results of calibration on domestic cost, which is closely linked with financial underdevelopment. To calibrate the level of financial development using domestic cost parameter in the model, we borrow an idea from previous studies that identify the role of financial development in reducing domestic volatility (Easterly et al., 2000; Denizer et al., 2002; Raddatz, 2006). These previous studies show consistent quantitative results on the negative relationship between financial development and domestic volatility. Thus, we first compute the extent which financial development reduces domestic volatility. Then, a remaining task is how to retrieve this second moment volatility (cost) to the first moment domestic cost. Here, we follow an idea from Lucas (1987) that measures business cycle volatility as certainty equivalence of return. In our calibration, domestic cost, v_i is assumed to be captured by only volatility which is a proxy for financial underdevelopment. [14] A country i pays v_i, which is assumed to be $\frac{1}{2}\sigma_i^2$, when it faces volatility (σ_i^2) in domestic financial market. Due to the properties of the log-normal distribution, $E(d_{it}) = \bar{d}_i e^{\mu_i - v_i + \frac{1}{2}\sigma_i^2} = \frac{\bar{d}_i e^{\mu_i + \frac{1}{2}\sigma_i^2}}{e^{v_i}}$ [15]. In the model, volatility becomes the denominator for the expected return on capital[16].

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[14] When $v_i = \frac{1}{2}\sigma_i^2$, the expected dividend is mean preserved: $E(d_{it})\big|_{v_i = \frac{\sigma_i^2}{2}} = \bar{d}_i e^{\mu}$.

[15] Obstfeld (1994) subtracts $\frac{1}{2}\sigma_i^2$ from the log of consumption to ensure that increases in the variance of the error term of the log of consumption are mean-preserving spreads on the consumption level. A seminal work by Lucas (1987) gauges the welfare costs of consumption uncertainty by quantifying volatility costs through the certainty equivalence of a consumption path.

[16] The idea of volatility cost and transaction cost is closely linked to the Sharpe ratio, an excess return over asset variance used to evaluate asset performance in the finance literature.

Easterly et al. (2000) and Raddatz (2006) provide the values of domestic volatility measured as the standard deviation of GDP per capita or that of aggregate manufacturing value added in developed and developing countries. Then, we include their estimates on domestic volatility. In addition, we introduce equity price index data to calibrate the volatility of return on capital. The annual standard deviations of equity returns for 49 countries (21 advanced countries and 28 emerging and developing countries) are constructed for 1980–2007 using monthly stock price indices from DataStream.

[Insert Table 4 here]

In Table 4, the standard deviation of return on capital varies across countries as well as over time. As expected, developed countries have a lower standard deviation of return (volatility) than developing countries. In addition, volatilities in the two groups of countries decreased over time. Interestingly, Easterly et al.'s (2000) measured volatilities for 1960-1990 show relatively low values than what we found in real data, while the values of measured volatility estimated in Raddatz (2006) are close to our estimates using equity return data.

4.2. Simulation I: tracing the real data

On the basis of input parameters and calibrations, we derive the 3×3 transformed equity share matrix, $S_{3\times3} = \begin{pmatrix} s_{11} & s_{12} & s_{13} \\ s_{21} & s_{22} & s_{23} \\ s_{31} & s_{32} & s_{33} \end{pmatrix}$, where s_{ji} is country i's holdings of country j's assets[17]. In the model, our reference point is a balanced portfolio across countries (i.e., each has a one-third share), in which foreign equities are assumed to represent two-thirds of the world market portfolio.

[17] Equity home bias of country 1 is $HB_1 = 1 - \frac{1 - s_{11}}{(2/3)}$, where s_{11} represents its home equity holdings.

In the model, we suppose that country 1 (developing country) has the highest volatility, reflecting the lowest financial development, followed by countries 2 and 3 (developed country). We set the costs of country 1 to $v_1 = \frac{1}{2}\sigma_1^2 = 0.0036$, for which the standard deviation of home equity return growth is 0.085 (Table 2), and the volatility cost of country 3 to $v_3 = 0.0013$ (s.d. = 0.052). Note that we set up the volatility cost of country 2 between v_1 and v_3, that is, $v_2 = 0.0024$. As mentioned, we allow for heterogeneous transaction costs among countries. The different levels of transactions cost of buying foreign assets help generate the different levels of home equity holdings across countries.

[Insert Table 5 here]

We discuss the model's validity by comparing the results with real data. In Table 5 (column (1), Panel A), using a calibrated parameter for mean volatility cost for 1980-2007, the equity home bias of developed countries generated from the model is 0.77, which exactly matches 0.77 from real data in column (3); on the other hand, that of developing countries shows a full home bias of 1, a bit higher than what is observed in real data (0.92 in column (3)). The results in column (2), which is based on median volatility over the sample period, also generate equity home bias close to the results in column (3).

Furthermore, Panel B in Table 5 displays equity home bias generated from the model on the basis of the calibration of domestic volatilities for the 1980s and 2000s (Table 5). Motivated by Figure 1, which shows divergence in equity home bias between developed and developing countries over time, we generate the model's results in the two periods separately and compare them. Although equity home bias for developing countries consistently shows full home bias of 1, which is higher than what we observed in real data, our results for equity home bias in developed

countries is similar to real data. In the 1980s, the equity home bias of developed countries from the model is 0.79, which is somewhat less than 0.85 from real data. In the 2000s, equity home bias for developed countries decreased to 0.67 with reduced volatility cost. The home bias from the model for the 2000s is more close to the real data of 0.64.[18]

4.3. Simulation II: Model's main message

Although our model traces equity home bias close to real data, one may argue that this simple endowment economy model is problematic to fully understand underlying mechanism of financial development and equity home bias. However, we emphasize model's intuition instead of its rigor or closeness to real economy. Thus, in the following simulation, we examine the effects of simultaneous, cross-country decreases in domestic volatility cost on equity positions in domestic assets by utilizing the advantages of the multi-country GE model. This simultaneous change in the GE framework provides some ideas on explaining the findings in Figure 1. First, we compute domestic volatility cost in developed and developing countries in the 2000s and report the results in the left columns of Table 6:

[Insert Table 6 here]

Then, we perform our simulation by decreasing domestic volatility cost unilaterally by 40% for each group under the assumption that financial development measures show similar changes in the two groups of countries. If we compare the results of the simulation in Table 6, the simultaneous decreases in domestic volatility cost do not cause symmetric changes in domestic equity holdings across countries. A country 1, which has the highest volatility and is the least

[18] We assume growths of capital returns are the same in the two periods to focus on the role of volatility costs. For instance, if we vary the return growth over time (i.e. higher return growth (3.8%) in the 1980s and lower growth (2.8%) in the 2000s as per mean growth over the whole sample period (3.3%)), our result become more close to the real data.

developed financial market, exhibits an increase in long positions in home equity (from 1.25 to 1.27). However, a country 3, which has the lowest volatility and is the most developed financial market, shows a decrease in domestic asset holdings (from 0.8 to 0.76) despite the decrease in home volatility. Thus, we find that the negative effect of reduced volatility cost on long positions in home equity is only observed in the most developed financial market, not in the least developed financial market.

Intuitively, simultaneous decreases in volatility cost across countries leads that all investors invest in not only their own financial market but also other country's financial market. However, the investors in the least developed market would increase their investment in home not as much as in foreign because of relatively higher barriers to foreign market, whereas those in the developed market with highest financial openness would increase investment not only in home but also abroad more proportionally. Hence, we are able to explain our findings about the divergence in equity home bias between developed countries and developing countries (see Figure 1).

4.5. Quantification: link the model to the empirical results (needs to be updated)

Another challenge in this study is to provide a realistic linkage between volatility and financial development. Indeed, volatility does not emerge from financial underdevelopment alone. However, the fact that financial development has a negative effect on volatility enables us to implement a comparative analysis of financial development among international equity positions through the channel of volatility. A simple estimation of the effect of financial development on aggregate volatility based on Raddatz (2006), suggests that an increase in financial development (over GDP) by 50 percentage points would result in almost a one percentage point decline in the standard deviation of real GDP per capita growth. This magnitude is about 80% and 50% of the

effects estimated by Denizer et al. (2002) and Easterly et al. (2000) for a similar increase. Hence, using this estimate for the marginal effects of financial development on volatility, we continue our discussion quantitatively on the effect of financial development on equity home bias in the following.

We compute the response of equity home bias to a one standard deviation change in our main variables of interest, financial development and financial openness, gauging the relative importance of each explanatory variable in influencing the degree of home bias. (TBU)

5. Concluding remarks

The topic of financial development has been discussed by many scholars and policy makers because it is not only related to the establishment of efficient and well-functioning domestic financial systems and institutions but also expected to have (positive) spillover effects on real economic growth and development. However, this study investigates the role of financial development from a different perspective: it takes financial development into account when examining the drivers of the development of equity home bias, which is regarded as an anomaly in international portfolio diversification.

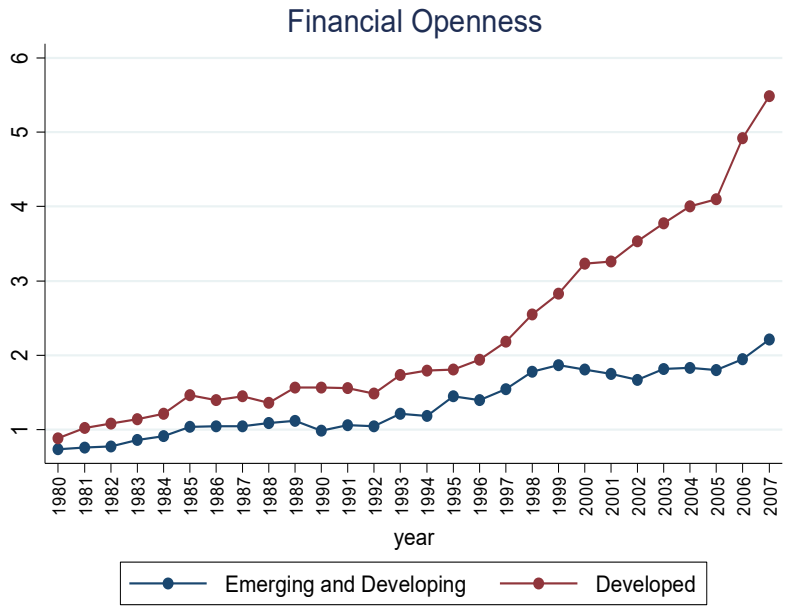
Our portfolio choice model comprising a multi-country GE framework with a simple cost structure allows for the different levels of financial development across countries to simultaneously influence these countries' home and foreign equity asset holdings. Our model successfully explains the different patterns of equity home bias in developed and developing countries in terms of the evolvement of domestic volatility cost, a proxy for financial (under)development. Our work provides profound implications in the future of international portfolio allocation as it predicts the divergence in equity home bias between developed and

developing countries with regard to the patterns of financial development in the two country groups.

Does financial development stimulate international portfolio diversification? Our study has a clear answer that financial development has mixed effects on international portfolio allocation (or equity home bias) when the effect of financial development is discussed in a multi country GE framework. Simultaneous financial development does not guarantee this positive effect, but rather has asymmetric effects on equity home bias in developed and developing countries. In particular, our findings suggest that the marginal effect of financial development on international portfolio diversification (complementarity between domestic financial development and foreign assets) is greater in developed than in developing countries. Hence, developing countries require much greater improvement in financial development to reach the level of portfolio diversification in developed countries.

Appendix

A. Financial openness



Note: Financial openness is the sum of the total foreign portfolio assets and liabilities over GDP (Lane and Milesi-Ferretti, 2006).

B. List of countries

Developed countries (20)
Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.
(Emerging and) Developing countries (72)
Argentina, Armenia, Bahrain, Bangladesh, Bolivia, Botswana, Brazil, Bulgaria, Cote d'Ivoire, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, El Salvador, Estonia, Fiji, Georgia, Ghana, Guyana, Hungary, India, Indonesia, Iran, Islamic Republic., Israel, Jamaica, Jordan, Kazakhstan, Kenya, Republic of Korea, Kuwait, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Malawi, Malaysia, Mauritius, Mexico, Mongolia, Morocco, Nepal, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Saudi Arabia, South Africa, Sri Lanka, St. Kitts and Nevis, Swaziland, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, Venezuela, Vietnam, Zambia.

C. Descriptive Statistics

i) Summary statistics

	Obs.	Mean	S.D.	Min.	Max.
Equity home bias	1632	0.886	0.159	0.070	1.000
FINDEV1 (Liquid liabilities/GDP)	1632	0.549	0.330	0.057	2.422
FINDEV2 (M2/GDP)	1578	0.541	0.339	0.062	2.390
FINDEV3 (Private credit/GDP)	1628	0.548	0.418	0.032	2.698
FINDEV4 (Stock market total value traded/GDP)	1401	0.244	0.487	0.00001	4.279
De facto financial openness (Lane and Milesi-Ferretti, 2007)	1632	1.678	1.980	0.246	29.023
De jure financial openness (Chinn–Ito index)	1602	0.560	1.544	-1.856	2.456
De jure financial openness (Quinn index)	1332	67.952	25.529	12.500	100.000
Dummy for developed countries	1632	0.298	0.458	0	1
Trade/GDP	1632	0.739	0.362	0.133	2.204
(log) GDP per capita	1632	8.800	1.086	6.223	11.106
Finance center	1632	0.066	0.249	0	1
Inflation volatility	1632	0.137	2.114	0.001	66.195
Exchange rate volatility	1632	0.145	0.998	0.000	24.072

ii) Correlation among key variables

	FINDEV1 (Liquid liabilities/GDP)	*FINDEV2* (M2/GDP)	*FINDEV3* (Private credit/GDP)	*FINDEV4* (Stock market total value traded/GDP)
FINDEV1 (Liquid liabilities/GDP)	1.0000			
FINDEV2 (M2/GDP)	0.9844	1.0000		
FINDEV3 (Private credit/GDP)	0.7260	0.7356	1.0000	
FINDEV4 (Stock market value traded/GDP)	0.3997	0.4373	0.5994	1.0000

D. Solving the model

Take a first-order approximation of country 1's two portfolio FOCs in Equation (7) to yield

$$E_t[-\tau_1 + \gamma\tau_1\hat{C}_1 + \hat{d}_2(1-\tau_1) - \hat{d}_1] = 0, \tag{A1}$$

$$E_t[-\tau_1 + \gamma\tau_1\hat{C}_1 + \hat{d}_3(1-\tau_1) - \hat{d}_1] = 0. \tag{A2}$$

Take a first-order approximation of country 2's portfolio FOCs to yield

$$E_t[-\tau_2 + \gamma\tau_2\hat{C}_2 + \hat{d}_1(1-\tau_2) - \hat{d}_2] = 0, \tag{A3}$$

$$E_t[-\tau_2 + \gamma\tau_2\hat{C}_2 + \hat{d}_3(1-\tau_2) - \hat{d}_2] = 0. \tag{A4}$$

Take a first-order approximation of country 3's portfolio first-order equation to yield

$$E_t[-\tau_3 + \gamma\tau_3\hat{C}_3 + \hat{d}_1(1-\tau_3) - \hat{d}_3] = 0, \tag{A5}$$

$$E_t[-\tau_3 + \gamma\tau_3\hat{C}_3 + \hat{d}_2(1-\tau_3) - \hat{d}_3] = 0. \tag{A6}$$

By (A1) and (A3),

$$E_t[\gamma(\tau_1\hat{C}_1 + \tau_2\hat{C}_2) - \hat{d}_1\tau_2 - \hat{d}_2\tau_1 - \tau_1 - \tau_2] = 0. \tag{A7}$$

By (A2) and (A5),

$$E_t[\gamma(\tau_1\hat{C}_1 + \tau_3\hat{C}_3) - \hat{d}_1\tau_3 - \hat{d}_3\tau_1 - \tau_1 - \tau_3] = 0. \tag{A8}$$

By (A4) and (A6),

$$E_t[\gamma(\tau_2\hat{C}_2 + \tau_3\hat{C}_3) - \hat{d}_2\tau_3 - \hat{d}_3\tau_2 - \tau_2 - \tau_3] = 0. \tag{A9}$$

The first-order accurate solution for $(\hat{C}_{1,t+1} + \hat{C}_{3,t+1})$, $(\hat{C}_{2,t+1} + \hat{C}_{3,t+1})$ and $(\hat{C}_{1,t+1} + \hat{C}_{3,t+1})$ can also be derived from (10). Then, we combine (A7) and (A8) and (A7) and (A9) respectively, and these three equations are collapsed into two equations.

Moreover, we modify market-clearing condition (9) to the first-order approximated version:

$$\hat{C}_{1t} + \hat{C}_{2t} + \hat{C}_{3t} = (1-\alpha)\hat{y}_{1t}^{L} + (1-\alpha)\hat{y}_{2t}^{L} + (1-\alpha)\hat{y}_{3t}^{L} + \alpha\hat{d}_{1t} + \alpha\hat{d}_{2t} + \alpha\hat{d}_{3t}. \quad (9')$$

We solve the equity share solutions with two equations derived from (A7)–(A9), the three asset market clearing conditions from (8) and three net equity supply conditions from (8'), and the market clearing condition from (9') (9 unknowns and 9 equations).

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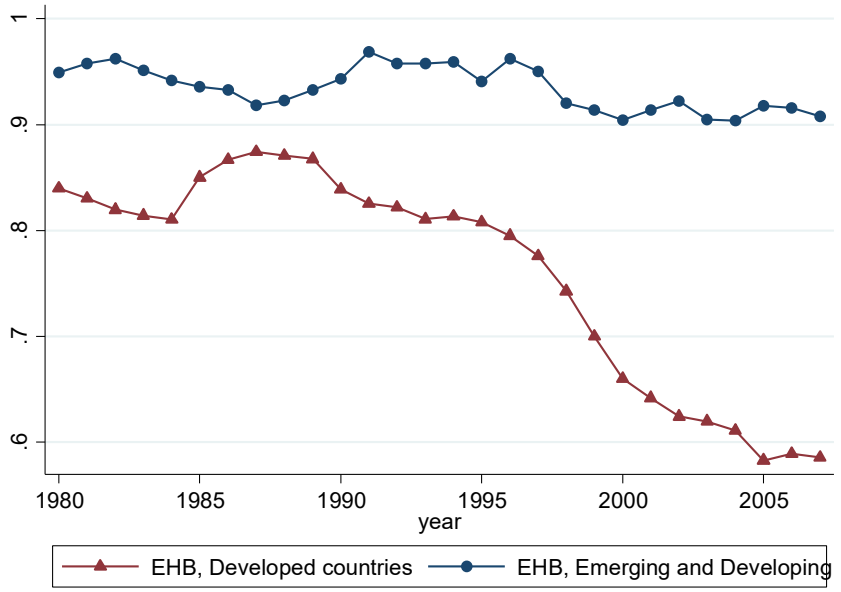
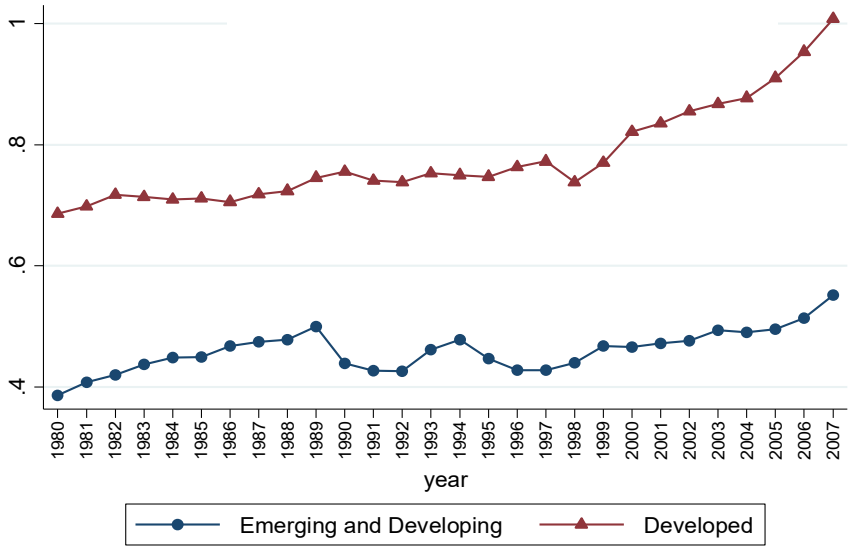
Figure 1. Equity home bias and financial development in developed and developing countries

Panel A. Equity home bias



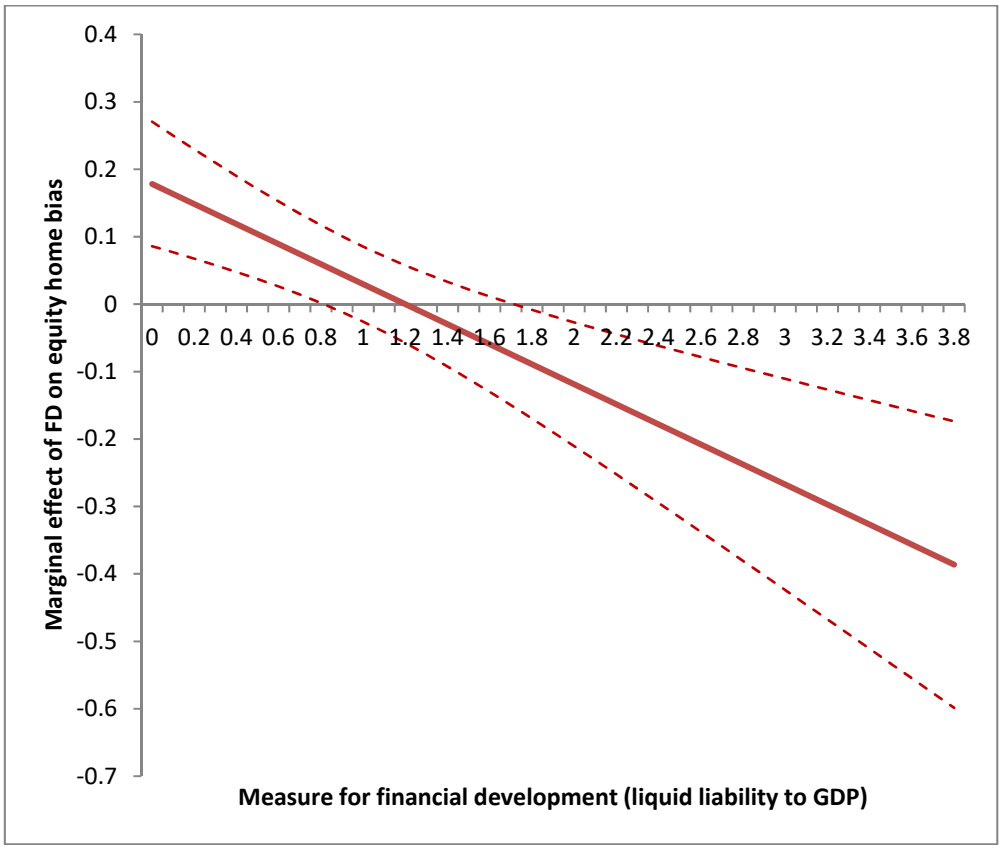
Note: The equity home bias of country *i* is 1 (share of country *i*'s holdings of foreign equity in country *i*'s total equity portfolio or that of foreign equity in the world portfolio).

Panel B. Financial development



Note: Financial development measures the size of financial intermediaries and is equal to the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP (King and Levine, 1993; Beck, Demirgüç-Kunt, and Levine, 2010).

Figure 2. Marginal effect of financial development on equity home bias in terms of level of financial development



Note: Estimated equation is as follows:

$$EHB = \underset{(0.047)^{***}}{0.178} \times FD - \underset{(0.019)^{***}}{0.074} \times FD^2 + \text{Other controls (including country and year FEs)}$$

Other controls include developed country dummy, financial openness, trade/GDP, (log) GDP per capita, inflation volatility, exchange rate volatility. The estimated coefficients on the controls are statistically significant and their signs are consistent with those in main results of Table 5.

Figure 3. Marginal Effect of FD on Equity home bias w.r.t Financial openness

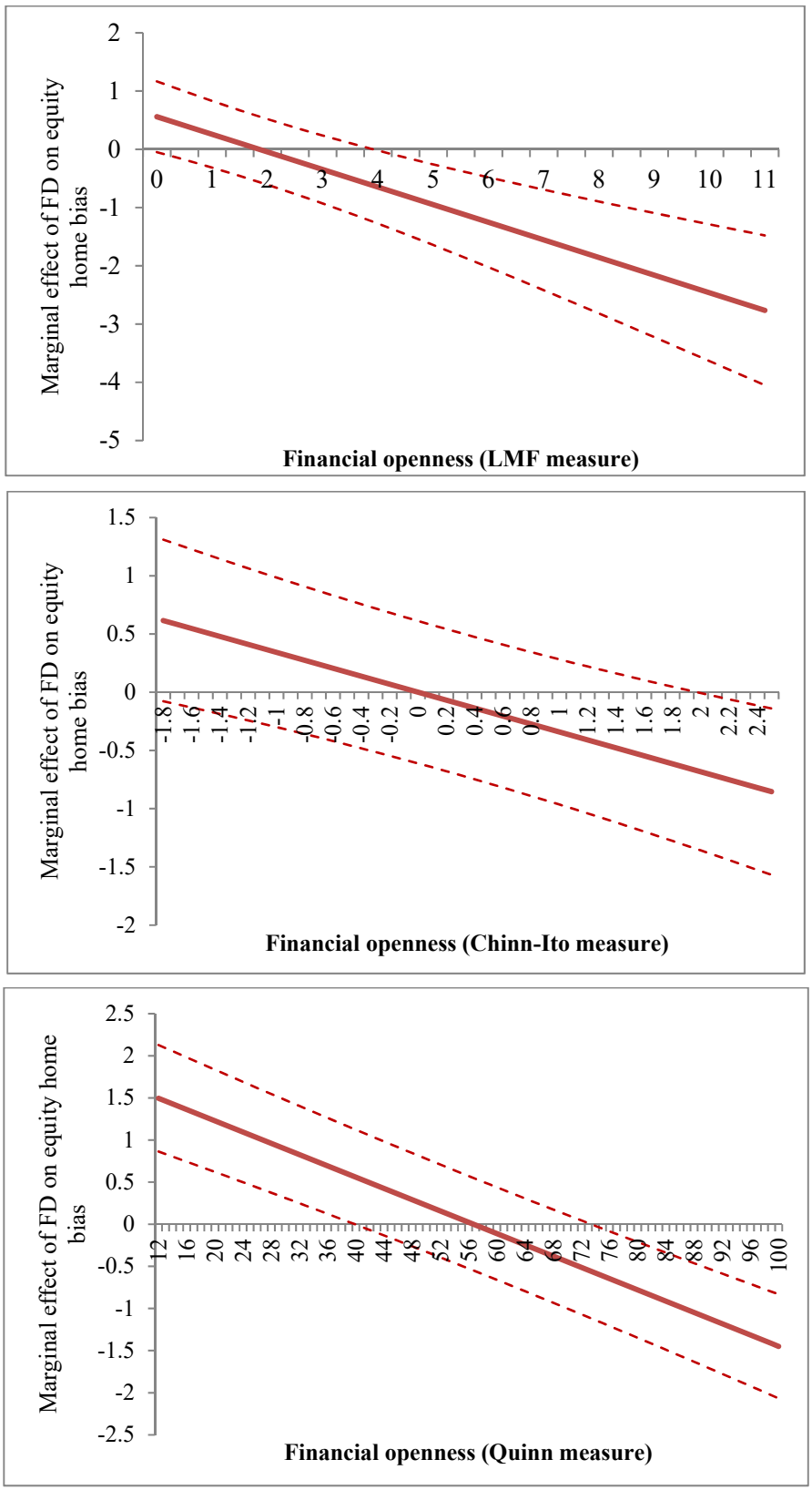


Table 1. Main result: Financial development and equity home bias

Dependent variable	Measure of equity home bias					
		w/ interaction term	Tobit	Country FEs	Sub-sample regressions	
					Developed countries	Developing countries
	(1)	(2)	(3)	(4)	(5)	(6)
FINDEV1 (Liquid liabilities/GDP)	-0.01	-0.009	-0.035	0.185***	-0.029*	0.057***
	[0.075]	[0.076]	[0.082]	[0.067]	[0.017]	[0.011]
Multilateral FINDEV1	-9.266	-13.206	-17.896	9.296	-0.402	-0.133
	[10.680]	[10.691]	[11.912]	[10.542]	[0.269]	[0.121]
***FINDEV1* × developed dummy**		-0.071***	-0.069***	-0.183***		
		[0.020]	[0.022]	[0.052]		
Developed country dummy	-0.094***	-0.049***	-0.041**			
	[0.012]	[0.017]	[0.018]			
Financial openness	-0.023***	-0.023***	-0.022***	-0.044***	-0.022***	-0.020***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.006]	[0.004]
Trade/GDP	0.011	-0.002	0.016	0.033*	-0.215***	0.027***
	[0.008]	[0.009]	[0.011]	[0.019]	[0.027]	[0.008]
(log) GDP per capita	-0.027***	-0.029***	-0.060***	0.013	-0.113***	-0.030***
	[0.004]	[0.004]	[0.006]	[0.021]	[0.024]	[0.003]
Financial center	-0.124***	-0.109***	-0.119***		-0.021	
	[0.018]	[0.018]	[0.018]		[0.023]	
Inflation volatility	-0.003***	-0.003***	-0.005***	-0.003***	-9.946***	-0.003***
	[0.001]	[0.001]	[0.001]	[0.000]	[2.714]	[0.001]
Exchange rate volatility	0.158	0.163	3.362*	0.071	-19.26	0.392
	[0.448]	[0.447]	[1.734]	[0.574]	[45.019]	[0.501]
Country fixed effects	No	No	No	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	No	No
No. of countries	92	92	92	92	20	72
Observations	1,703	1,703	1,703	1,703	489	1,214
R^2	0.366	0.369	--	0.719	0.558	0.118

Note: Robust standard errors are reported in parentheses. ***, **, and * indicate that the estimated coefficients are statistically significant at 1%, 5%, and 10%, respectively.

Table 2. Simultaneous financial development

Dependent variable	Measure of equity home bias			
		w/ interaction term	Tobit	Country FEs
	(1)	(2)	(3)	(4)
Mean FINDEV1$_t$ (Liquid liabilities/GDP)	-0.007	0.499*	0.48	0.103
	[0.289]	[0.297]	[0.342]	[0.277]
***Mean FINDEV1$_t$* × developed dummy**		-1.513***	-1.166***	-1.162***
		[0.276]	[0.299]	[0.233]
Developed country dummy	-0.083***	0.643***	0.490***	
	[0.013]	[0.133]	[0.145]	
Financial openness	-0.021***	-0.018***	-0.017***	-0.036***
	[0.004]	[0.004]	[0.004]	[0.005]
Trade/GDP	0.018**	0.011	0.031***	0.034*
	[0.008]	[0.008]	[0.009]	[0.019]
(log) GDP per capita	-0.024***	-0.024***	-0.055***	0.034*
	[0.004]	[0.004]	[0.006]	[0.020]
Financial center	-0.121***	-0.127***	-0.134***	
	[0.017]	[0.016]	[0.016]	
Inflation volatility	-0.004***	-0.004***	-0.005***	-0.003***
	[0.001]	[0.001]	[0.001]	[0.000]
Exchange rate volatility	0.167	0.143	3.314*	0.028
	[0.428]	[0.496]	[1.734]	[0.442]
Country fixed effects	No	No	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
No. of countries	92	92	92	92
Observations	1,703	1,703	1,703	1,703
R^2	0.355	0.371	--	0.723

Note: Robust standard errors are reported in parentheses. ***, **, and * indicate that the estimated coefficients are statistically significant at 1%, 5%, and 10%, respectively.

Table 3. Robustness check: various financial development measures

Dependent variable	Measure of equity home bias					
	FINDEV2 (M2/ GDP)		*FINDEV3* (Private credit/GDP)		*FINDEV4* (Stock market total value traded/GDP)	
	(1)	(2)	(3)	(4)	(5)	(6)
FINDEV	-0.061	0.085	-0.178***	-0.045	0.042**	0.090***
	[0.083]	[0.067]	[0.054]	[0.048]	[0.021]	[0.015]
Multilateral FINDEV	-26.126**	-15.292	-30.407***	-4.035	--	--
	[13.052]	[11.221]	[7.756]	[7.930]		
***FINDEV* × developed dummy**	-0.066***	-0.083**	-0.063***	-0.077**	-0.042*	-0.091***
	[0.017]	[0.041]	[0.018]	[0.032]	[0.025]	[0.019]
Developed country dummy	-0.050***		-0.038**		-0.093***	
	[0.017]		[0.018]		[0.015]	
Financial openness	-0.021***	-0.044***	-0.018***	-0.038***	-0.024***	-0.045***
	[0.004]	[0.004]	[0.004]	[0.005]	[0.006]	[0.005]
Trade/GDP	-0.014	0.038**	-0.011	0.034*	-0.006	0.059**
	[0.010]	[0.019]	[0.010]	[0.019]	[0.012]	[0.024]
(log) GDP per capita	-0.037***	0.012	-0.032***	0.034	-0.031***	-0.055***
	[0.004]	[0.020]	[0.004]	[0.021]	[0.004]	[0.019]
Financial center	-0.097***		-0.113***		-0.080***	
	[0.017]		[0.016]		[0.022]	
Inflation volatility	-0.003***	-0.003***	-0.003***	-0.003***	-0.004***	-0.004***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Exchange rate volatility	-0.184	-0.369	0.237	0.031	1.329**	-0.039
	[0.713]	[0.481]	[0.469]	[0.472]	[0.648]	[0.384]
Country fixed effects	No	Yes	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,778	1,778	1,715	1,715	1,309	1,309
R^2	0.348	0.729	0.341	0.731	0.409	0.813

Note: Robust standard errors are reported in parentheses. ***, **, and * indicate that the estimated coefficients are statistically significant at 1%, 5%, and 10%, respectively.

Table 4. Calibration of volatility (v_i)

	Developing		Developed
Easterly et al.(2000) (1960–1990)[1]			
s.d.	0.052		0.022
volatility cost (v_i)	0.0014		0.0002
Real data (1960–1990)			
s.d.	0.096		0.056
volatility cost (v_i)	0.0046		0.0016
Raddatz (2006)[2]			
s.d.	0.09		
volatility cost (v_i)	0.0041		
Real data (1980–2007)			
- median			
s.d.	0.085		0.052
volatility cost (v_i)	0.0036	0.0025	0.0014
- mean			
s.d.	0.091		0.055
volatility cost (v_i)	0.0041	0.0029	0.0016
1980s			
s.d.	0.097		0.062
volatility cost (v_i)	0.0047	0.0033	0.0019
2000s			
s.d.	0.068		0.048
volatility cost (v_i)	0.0023	0.0017	0.0012

Note: s.d. denotes standard deviation. Volatility cost is computed by $v_i=\sigma^2/2$.
1) Easterly et al. (2000) report the standard deviation of real GDP (output) growth for OECD (developed) countries and non-OECD countries.
2) Raddatz (2006) reports the standard deviation of the growth of real manufacturing value add during 1981–1998 for 15 developing countries and computes it using each country's average productive structure and sector variance–covariance (Table 6, p. 700)

Table 5. Equity home bias based on volatility cost: model vs. data

Panel A. Over the sample period (1980-2007)

	Model 1 (mean volatility cost) close to Raddatz (2006)	Model 2 (median volatility cost)	Data (1980–2007)
	(1)	(2)	(3)
Developing countries	1	1	0.92
	(eq share: 1.26)	(1.26)	
Developed countries	0.77	0.75	0.77
	(0.85)	(0.84)	

Note: Home equity share generated from the model is also reported in parentheses.

Panel B. Model vs. data (the 1980s vs. 2000s)

	1980s		2000s	
	Model	Data	Model	Data
Developing countries	1	0.93	1	0.9
	(1.25)		(1.27)	
Developed countries	0.79	0.85	0.67	0.64
	(0.86)		(0.78)	

Note: Home equity share generated from the model is also reported in parentheses.

Table 6. Simulation: time-series comparison

Based on calibration parameter in the 2000s			Unilateral decrease in volatility by 40%		
Domestic volatility cost		Equity share	Domestic volatility cost		Equity share
v_1	0.0023	$S_{3\times3}$ =	v_1	0.00138	$S_{3\times3}$ =
v_2	0.00175	***1.2537*** *-0.2036 -0.0501*	v_2	0.00105	***1.2693*** *-0.2361 -0.0332*
v_3	0.0012	*-0.2036 0.9500 0.2535*	v_3	0.00072	*-0.2361 0.9668 0.2692*
		-0.0501 0.2535 ***0.7966***			*-0.0332 0.2692* ***0.7640***

Note: We allow difference in transaction costs across countries from our reference, country 2's transaction costs. We use a little perturbation, plus and minus 0.003% of $\tau_2 = 0.005$, for the transaction costs of countries 1 and 3.