Limited Risk Sharing and International Equity Returns

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Abstract

I study international consumption risk sharing with limited stock market participation in each country. I present new evidence, employing micro-level household consumption data in the U.S. and U.K., showing that stockholders' consumption growth correlation is considerably higher than that of the aggregate consumption growth. Empirically, for stock markets that are integrated with the U.S. market (such as European markets), U.S. stockholders long-run consumption growth can explain its equity cross-section, but not that of segmented markets. I construct an incomplete market model that features limited risk sharing within each country due to limited stock market participation. Besides matching the salient features of asset prices (high and volatile equity premium, low and smooth risk free rate), the model quantitatively rationalizes the empirical evidence above, as well as the low aggregate consumption growth correlation and high asset return correlation. The model suggests that financial integration significantly reduces the consumption volatility of the stockholders and the amount of aggregate risks borne by them, hence improves their welfare. However, the benefits are almost all captured by the stockholders.

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Stock markets around the world exhibit high correlations in returns relative to the correlations in aggregate economic fundamentals. In the post Bretton Woods period, the U.S. quarterly equity return has an average correlation of 0.6 with that of Australia, Canada, France, Germany, Italy and the United Kingdom, as shown in Table 1. The same correlation of their financial income growth (defined as corporate profit minus investment) is 0.02, and that of non-durable consumption growth is 0.09.

This discrepancy between the financial and fundamental correlation increases along the dimension of financial integration, in both the time-series and the cross-section. By 2011, U.S. investors held as much as 24% of the market capitalization of the U.K. stock market, which was only 13% in 1997. [1] From 1973 to 1996, the quarterly return correlation between U.S. and U.K. equity indices is 0.64, rising to 0.88 from 1997 to 2013, while the correlation of their economic fundamentals exhibits no such increase.[2]

In the cross-section, the fraction of the foreign market capitalization held by U.S. investors in 1997 is strongly positively correlated with the subsequent return correlation between the foreign and U.S. stock market from 1998 to 2013, and explains 22% of the variation (see Figure 1). The consumption growth correlation remains low across.

Therefore, the asset market and the macro quantity-based views give very different answers to the following questions: 1) Is the current consumption risk sharing between financially integrated countries good or bad? 2) What is the potential gain (or the historical gain) from the global financial integration?

The typical approach for making the connection is to consider alternative preferences or shocks regarding the representative agent in each country. What is largely ignored, often for modeling convenience or due to data restriction, is the limited risk sharing within a country. In particular, in the U.S., only about 50% of individuals invest in the stock market,

[1] I use 1997 as the dividing point, since 1997 is the earliest date when the bilateral investment data are available.

[2] The literature has not reached a consensus over the magnitude and direction of these correlation changes. For example, Heathcote and Perri (2004) documents that the correlation of GDP and consumption between U.S. and the rest or the world decreased from 0.76 and 0.51 pre-1986 to 0.26 and 0.13 post-1986. However, Kose, Otrok, and Prasad (2010) show that during the period of financial globalization (1985-2008), there is a small convergence of business cycle fluctuations among developed countries, but also a concomitant decline in the relative importance of the global factor.

either directly or indirectly (e.g., via investment vehicles for retirement or non-retirement accounts). The participation rate tends to be lower in Europe (Grinblatt, Keloharju, and Linnainmaa, 2011).

The limited stock market participation leads to significantly different consumption risk sharing patterns within a country. A novel dataset of U.S. and U.K. household-level consumption survey reveals that from 1988 to 2007, the 12-quarter consumption growth correlation between U.S. and U.K stockholders is as high as 0.5, compared to 0.2 for the non-stockholders. The correlation of the aggregate is only 0.3.

Since the stockholders are the marginal agents in pricing the assets, the evidence can potentially reconcile the asset market view and the macro quantity view. I provide an incomplete market model to quantitatively evaluate the conjecture. I adopt the consumption risk sharing framework in the tradition of Obstfeld (1994a, b), but model the limited risk sharing both within and between countries.

The imperfect risk sharing within a country arises due to the limited stock market participation. There are two types of agents in each country: non-stockholders only trade in a global bond market, whereas stockholders have access to the two stock markets as well as the bond market. The risk sharing between countries is also imperfect, due to the undiversifiable labor income risks.

The model quantitatively explains the dichotomy between the correlation in returns and quantities. Home stockholders aggressively diversify their income risk with the foreign stockholders by directly holding the foreign equity, as well as actively re-balancing their portfolio positions. The correlation of their consumption growths is high (0.5 in both model and data). Equity returns reflect the risk sharing between the marginal pricers of the asset, or the stockholders, therefore, are highly correlated (0.8 in both model and data). The non-stockholders, nevertheless, can only smooth their consumption through the bond market. It leads to low correlation in their consumption growths and further the low correlation in the aggregate consumption growths (0.3 in both model and data).

Noticeably, the model delivers a low and smooth risk free-rate, together with a high and volatile equity risk premium, thanks to the preference heterogeneity. In the model, non-stockholders have lower elasticity of intertemporal substitution (EIS, 0.1) than stockholders (0.3), consistent with empirical estimates.[3] To smooth away consumption fluctuations due to the country idiosyncratic labor income risks, the non-stockholders actively borrow and lend with each other. For the global aggregate labor income risks, the stockholders provide insurance to the non-stockholders, because they are more willing to substitute intertemporally. Hence, the global aggregate risk is concentrated on stockholders, and they require a high equity risk premium for compensation.

The incompleteness within a country allows reassessing the welfare of financial integration, and analyzing distributive effects. When stock markets are closed to foreign investors, all consumption smoothing can only be conducted through the bond market, and within a country only. Since the bond is an inefficient way to achieve the purpose, the cross-country correlation risk sharing is very limited for all agents. Equity return correlation is also low. The stockholders have to insure the domestic non-stockholders against a large fraction of country-specific labor income shocks. Therefore, the equity claim appears very risky to them, and carries high risk premium.

As soon as the stock market open up to foreign investors, in other words, when financial markets integrate, stockholders can diversify away a significant amount of country-specific risk through the international equity market. This accompanies an increase in the consumption growth correlation for the stockholders. Naturally, the return correlation between countries dramatically rises: The common discount rate effect dominates the low cash flow correlation. This is consistent with the the increase of return correlation between the U.K. and U.S., as well as in the cross-section of countries as the level of financial integration increases.

The stockholders reaps a lot of benefit from the financial integration in terms of welfare. Now, the stockholders only need to insure the non-stockholders against the global labor income shocks, but not the country-specific. Further, they now only bear the global, but

[3]See Attanasio, Banks, and Tanner (2002), Brav, Constantinides, and Geczy (2002) and Vissing-Jorgensen (2002).

not country-specific, financial income risk, by taking advantage of the foreign investment opportunities. This leads to a fall in their consumption volatility. So, they not only have need to provide less aggregate insurance, but the cost of providing the insurance is low also.

Nevertheless, the non-stockholders are excluded from this financial advance. They bear as much income risk as in the financial segmentation scenario and their consumption is also as volatile. Welfare calculation shows that, the financial integration favors different asset holders and in an extreme way: The stockholders capture almost all of the welfare improvement from the financial integration.

1 Related Literature

The limited stock market participation literature has achieved success in closed-economy pricing. For example, Basak and Cuoco (1998), Gomes and Michaelides (2008) and Guvenen (2009) show that accounting for limited participation can help rationalize the high equity risk premium. Empirically, Vissing-Jorgensen (2002), Attanasio, Banks, and Tanner (2002), Parker and Julliard (2005) and Malloy, Moskowitz, and Vissing-Jorgensen (2009) find evidence on the pricing ability of the stockholders consumption growth. I bring the limited stock market participation into the international context and provide, to my knowledge, the first empirical evidence on the pricing of international assets from the perspective of domestic stockholders.

The disconnect of asset prices from economic fundamentals in international finance draws a lot of attention, starting from Cole and Obstfeld (1991) in the endowment economy framework and Backus, Kehoe, and Kydland (1992) in the production economy framework. One strand of literature, for example Lewis (1998), Kehoe and Perri (2002) and Bai and Zhang (2012) among others, focuses on investigating the frictions required in order to generate the excessive low consumption correlation in data. Another strand of literature studies the risk sharing and asset prices jointly, such as Dumas (1992), Farhi and Gabaix (2008), Verdelhan (2010), Colacito and Croce (2011) and Pavlova and Rigobon (2007, 2012).[4] Most of this line

[4]Amongst others see also: Stathopoulos (2012), Hassan (2013), Martin (2011), Heyerdahl-Larsen (2012),

of research assume complete markets[5]. I instead take an incomplete market view and more importantly, deviate from the homogeneity assumption of each countrys population. Theoretical analysis demonstrates that the different access to stock markets, hence risk sharing opportunities, helps connect risk sharing with asset prices. I also exploit a novel dataset and provide new empirical evidence on the different levels of cross-country risk sharing for different asset holders, consistent with the model.

In parallel with the theoretical work, a growing empirical literature provides evidence on the linkage between international asset pricing and economic fundamentals, for instance, Lustig and Verdelhan (2007) and Borri and Verdelhan (2011) for currency and sovereign bond returns respectively.[6] I add to the literature by providing evidence on the pricing of international equity returns in consumption CAPM framework.

My research further studies the impacts of financial integration, especially the stock market integration. The literature on its asset pricing implications focuses mainly on emerging markets. For example, Bekaert and Harvey (1997) document in event studies that the correlation between the emerging market and the world market increases after the domestic stock market opens up. [7]

I document that globally there is a tight relation between cross-country asset returns and asset holding shares, as well as provide a theoretical framework to analyze the mechanism and its quantitative impacts.

Obstfeld (1998) is one of the first to examine the welfare impact of financial integration. More recent work, such as Colacito and Croce (2010), Favilukis, Ludvigson, and Van Nieuwerburgh (2010), Martin (2010) and Lewis and Liu (2012) attempts to estimate the *aggregate* welfare impacts in asset pricing context. I instead highlight the *distributional* perspective, i.e, who benefits more from this process.

Farhi et al. (2009).

[5]Notable exceptions include Alvarez, Atkeson, and Kehoe (2009) which studies time-varying levels of market segmentation, and Maggiori (2011) as well as Gabaix and Maggiori (2013) which examine the role of financial intermediation

[6]See also Brunnermeier, Nagel, and Pedersen (2009), Lustig, Roussanov, and Verdelhan (2010), Lettau, Maggiori, and Weber (2013), Jurek (2014).

[7]There is another strand literature that studies the determinates and measurements of financial integration, see Stulz (1981), Schindler (2008), Bekaert et al. (2011) and Karolyi and Stulz (2003) etc.

My research is also part of the recent theoretical effort to incorporate portfolio choices in international macro finance models. The related literature includes Devereux and Sutherland (2009, 2011) and Pavlova and Rigobon (2010, 2012) among others.[8]

The rest of the paper is organized as follows. In Sections 2 and 3, I describe the empirical framework, hypotheses, and results. I construct the theoretical framework, featuring limited participation, in Section 4. In Sections 5 and 6, I report the quantitative results and explore the empirical implications. In Section 7, I provide concluding remarks.

2 Empirical Preliminaries

In this section, I describe the data sets adopted, calculate the correlation of U.S. and U.K. consumption growth rates for stockholders and non-stockholders.

2.1 The Consumption Data

I start by introducing the two household-level consumption survey data.

The U.S. Consumption Data

I draw the U.S consumption data from the Consumer Expenditure Survey (CEX) data of the U.S. for the period 1982-2012. I calculate the quarterly consumption growth rates for stockholders and non-stockholders respectively. The CEX data over a shorter sample period have been used in previous studies, such as Vissing-Jorgensen (2002) and Malloy, Moskowitz, and Vissing-Jorgensen (2009) (MMV hence) among others.

The CEX data are available from 1980: Q1 to 2012: Q1. Each household in the sample was surveyed five times, three months apart. I identify stockholders, following Vissing-Jorgensen (2002), based on the response to the survey question indicating positive holdings of "stocks, bonds, mutual funds and other such securities" on the last day of last month. Households also report the change in positions from a year ago. I require households to hold

[8]See also Bacchetta and Van Wincoop (2010), Tille and Van Wincoop (2010) and Duzhak, Mertens, and Zhang (2013).

a positive amount of securities a year ago. I discuss further details of the sample and data construction in the Appendix.

Aggregation of Household Consumption Growth Rates

I calculate the non-durable consumption growth rates for each household. The quarterly consumption growth rate for a particular group g (stockholders/non-stockholders) from t to $t+1$ is defined as

$$\frac{1}{H_t^g}\sum_{h=1}^{H_t^g}\left(c_{t+1}^{h,g}-c_t^{h,g}\right)$$

where $c_t^{h,g}$ is the log quarterly consumption of household h in group g at time t, and H_t^g denotes the number of households of group g at time t.

The U.K. Consumption Data

For the U.K. consumption growth, I use the U.K. Family Expenditure Survey(FES) data from 1988 and 2000, and the U.K. Expenditure and Food Survey (EFS) data from 2001 to 2007. The data are used by Attanasio, Banks, and Tanner (2002) and Blundell and Etheridge (2010) among others. I again discuss the details about data in the Appendix for brevity.

Attanasio, Banks, and Tanner (2002) point out that it is important to adjust for the increase in the stock market participation in U.K.. They report that the increase in the level of direct share ownership in the U.K. is “precarious” during 1985 - 1987, due to a number of measures to promote “share-owning democracy”. It starts to stabilize in 1988. Therefore, 1988 is chosen as the start point of the sample. In 2001, this dataset merged with the UK National Food Survey to create the Expenditure and Food Survey (EFS), and I refer to both datasets as FES is the text below. Stockholders are identified by their response to the question “How much is invested in stocks/shares at present”.

Aggregation of Household Consumption Growth Rates

The FES data are repeated cross-section, rather than panel data, which forces me to assume a representative agent within each stockholder- and non-stockholder-group, in order to determine the consumption growth rate of each group. The log consumption growth rate is calculated as

$$\frac{1}{H^g_{t+s+1}} \sum_{h=1}^{H^g_{t+s+1}} c^{h,g}_{t+1+s} - \frac{1}{H^g_{t+s}} \sum_{h=1}^{H^g_{t+s}} c^{h,g}_{t+s}$$

where c denotes the per capita log consumption level and H^g denotes the number of households in group g.

I calculate the per capita non-durable consumption data per period, equalized by the OECD (Organisation for Economic Co-operation and Development) adult equalization measure. To remove seasonality in the data, I further regress the change in the log consumption on a set of monthly dummies, and use the residual as the quarterly consumption growth measure.

2.2 Correlation of U.S. and U.K. consumption growth rates

I calculate the correlation of consumption growth rates for U.S. and U.K. stockholders and non-stockholders. Results are reported in Table 2. For ease of presentation, I only report the average for U.S. and U.K., for the within-country correlation, and the cross-country correlation between the stockholders and the non-stockholders. I recover the correlation of aggregate consumption growth rates from the two survey data sets, which is low, as emphasized in the literature.

The result shows that:

$$\begin{aligned}
corr(\Delta c^{US,stockholders}, \Delta c^{UK,stockholders}) &> corr(\Delta c^{US,aggregate}, \Delta c^{UK,aggregate}) \\
corr(\Delta c^{US,stockholders}, \Delta c^{UK,stockholders}) &> corr(\Delta c^{US,non-stockholders}, \Delta c^{UK,non-stockholders}) \\
corr(\Delta c^{i,stockholders}, \Delta c^{j,stockholders}) &> corr(\Delta c^{i,stockholders}, \Delta c^{j,non-stockholders})
\end{aligned}$$

where $i, j \in \{U.S., U.K.\}$, $i \neq j$.

In sum, although the aggregate consumption correlation between U.S. and U.K. is low (0.31 at 12-quarter horizon), the consumption correlation between U.S. and U.K. stockholders is much higher (0.51 at 12-quarter horizon).

3 Empirical Asset Pricing Results

Before explaining the model, I test the following key empirical predictions of the reasoning:

Home stockholders' consumption growth a) can price both home and integrated foreign stock markets, and can price them better than that of non-stockholders; b) but cannot price the segmented foreign stock markets.

The tests are important for at least two reasons: First, if empirically prediction a) holds, it could help ensure that the model about financial integration is a sensible description of the world to begin with; second, if prediction b) holds, it provides evidence about the dispersion in the degree of integration between countries. I briefly describe the test and present a main result here. I refer readers to an earlier version of this paper for full tests with robustness tests.

3.1 Empirical Framework for Asset Pricing Tests

I adopt recursive preference specification following Kreps and Porteus (1978), Epstein and Zin (1989), and Weil (1989). I follow the formulation in Hansen, Heaton, and Li (2008), and the empirical implementation of MMV (2009).

Stockholders have recursive preferences of the form

$$V_t = \left[(1-\beta)C_t^{1-\frac{1}{\sigma}} + \beta(E_t[V_{t+1}^{1-\gamma}])^{\frac{1-\frac{1}{\sigma}}{1-\gamma}}\right]^{\frac{1}{1-\frac{1}{\sigma}}} \tag{1}$$

Following MMV (2009), I assume that the growth rate of the log consumption c_t is a linear function of the state of the economy x_t, which evolves according to a first-order VAR:

$$c_{t+1} - c_t = \mu_c + U_c x_t + \lambda_0 w_{t+1} \quad (2)$$

$$x_{t+1} = G x_t + H w_{t+1} \quad (3)$$

I focus on the special case where the EIS (for stockholders) equals one. To avoid the potentially imprecise results from estimating conditional expectations over a relatively short sample period, I estimate equation (**??**) using only the unconditional covariance term, consistent with MMV (2009)'s baseline approach. This approach leads to a consistent estimate of γ, if the expected return is constant over time, or if $cov(E_t \sum_{s=0}^{\infty} \beta^s (c_{t+1+s} - c_{t+s}), E_t \left(r^i_{t+1} - r^f_{t+1} \right))$ is identical across the set of test assets (i.e., all expected asset returns in the same way when the consumption growth rate varies). I include a constant term in the regression to ensure the consistent estimate of γ in this specification. [9] Therefore, the equation simplifies to

$$\begin{aligned} &E(r^i_{t+1} - r^f_{t+1}) + \frac{1}{2}V(r^i_{t+1}) - \frac{1}{2}V(r^f_{t+1}) \\ \approx &(\gamma - 1) cov(\sum_{s=0}^{\infty} \beta^s (\hat{c}_{t+1+s} - \hat{c}_{t+s}), r^i_{t+1} - r^f_{t+1}) \end{aligned} \quad (4)$$

I use $\hat{c}_t$ to denote the sample estimate of c_t. The I estimate the equation via Generalized Method of Moments (GMM), following MMV (2009). The point estimate is equivalent to that obtained from OLS.

3.2 Hypotheses Testing

The European market is a good candidate for a market integrated with U.S.. The European financial market is open, with few regulatory restrictions. From the U.S. point of view, Europe shares a lot of similarities from language and institutions to culture. Absent most physical and informational frictions, European markets are popular hosts of U.S. foreign

[9] MMV (2009) shows that explicitly imposing a VAR structure on the consumption growth to estimate the covariance does not change the results, using 25 Fama-French portfolios for the U.S..

equity investments. In 1997, the U.S. investors hold 11.7 percent of the European market capitalization, which increased to 17.7 percent in 2007.

Table 3 reports the results using the 25 Fama-French portfolios with European assets. Panel A covers the estimation using U.S. stockholder consumption growth rates. The implied risk aversion in order to price the cross section from 8Q onwards is around 10, similar to the estimates from the 25 U.S. Fama-French portfolio. The R^2 is in general lower than when I use the 25 U.S. portfolios as test assets; however, it is still high. Taken together, the evidence lends strong support to the pricing ability of U.S. stockholder consumption risk for European assets.

Panel B reports the estimates using U.S. non-stockholder consumption growth rates. The implied risk aversion estimates are unstable, and not statistically different from 0. This variable explains virtually none of the cross-sectional variation.

There are two reasons why the U.S. non-stockholder consumption risk fails to price the European markets. First, non-stockholders do not hold the assets to begin with, therefore, their Euler equation does not necessarily hold with respect to these assets. In the domestic asset case, the U.S. non-stockholders' consumption growth rate has a certain amount of pricing ability, due to the correlation of their long-run consumption growth rates with the domestic stockholders. However, it completely fails using the European test assets. This result implies that the correlation of consumption growth between a typical US non-stockholder with a typical European stockholder (the natural pricer of the European assets) is low, consistent with Table 2.

Second, the EIS of non-stockholders is estimated to be lower than reported for stockholders in the literature, and hence is significantly different from 1. For instance, Barsky et al. (1997) estimate the distribution of the EIS parameter in the population and find the average to be below 0.3, but the highest percentiles exceed unit elasticity. Vissing-Jogensen (2002) finds that for risky asset holders the EIS estimate is greater than 0.3, while for the remaining households, the estimates are small and insignificantly different from 0.

The level of financial integration from the U.S. investors' perspective significantly differs across countries. In 1997, the U.S. holds in 6.1 percent of the Japanese stock market. For comparison, the median level of market fraction that U.S. investors held is 7.5% in 1997. Similarly, for countries in the Asian (ex-Japan) portfolio (i.e., Australia, Hong Kong, New Zealand, and Singapore), the fraction of local market capitalization is 8.4% in 1997, and it remained at a similar level for the next decade. Although these countries have open foreign investment policies and few restrictions, the geographic distance (Portes and Rey, 2005) may have prevented U.S. investors from making them primary investment destinations. Moreover, as Van Nieuwerburgh and Veldkamp (2009) shows, through active learning, investors could amplify an initial small informational advantage (toward home countries and culturally approximate European countries), and largely avoid investing in the others (such as Asian countries in this case). Therefore, I consider the Asia-Pacific markets as segmented from the U.S. markets.

Tables 4 and 5 report the estimates from the regression using Japanese assets and Asia-Pacific (ex. Japan) respectively. In sharp contrast to the previous results, the empirical model prices the assets of segmented markets poorly. The risk aversion estimates are unstable, and mostly are not statistically different from 0. The R^2 is close to 0 in most cases. Therefore, U.S. residents' consumption growth has little explanatory power for the equity returns of segmented markets.

4 An Incomplete Market Model with Limited Stock Market Participation

In this section, I explain the empirical facts in a quantitative incomplete market model that can jointly match the salient features of asset returns, portfolio positions, and consumption.

The main empirical facts that I want to explain are as follows:

Fact 1. International asset returns are highly correlated, while the correaltion for the consumption growth is low (International equity premium puzzle);

Fact 2. Stock market integration (hence the increase in cross-country asset positions) accompanies the increase in asset return correlations (Figure 1);

Fact 3. Home stockholders' consumption growth can price both home and integrated foreign stock markets, and can price them better than that of non-stockholders; but cannot price the segmented foreign stock markets.

4.1 Model Setup

There are two endowment economies. Each country is endowed with labor income and capital income (from a Lucas tree) each period. The capital income endowments of Home and Foreign country are $D_{h,t}$ and $D_{f,t}$, respectively. They are subject to normally distributed country specific risks u_h and u_f.

$$D_{h,t+1} = (1-\kappa_h)\bar{D}_h + \kappa_h D_{h,t} + u_{h,t+1} \quad (5)$$

$$D_{f,t+1} = (1-\kappa_f)\bar{D}_f + \kappa_f D_{f,t} + u_{f,t+1} \quad (6)$$

Agents receive labor income endowments L_t from their own country. They follow the following processes:

$$L_{h,t+1} = (1-\rho_h)\bar{L}_h + \rho_h L_{h,t} + z_{h,t+1} \quad (7)$$

$$L_{f,t+1} = (1-\rho_f)\bar{L}_f + \rho_f L_{f,t} + z_{f,t+1} \quad (8)$$

There are three assets in the economies: one-period real bonds B, and Home and Foreign stocks S_h and S_f. They trade at prices p^b_t, $p^s_{h,t}$, and $p^s_{f,t}$, respectively.

Stocks are aggregate claims to home and foreign dividend/capital streams, and there is one home stock and one foreign stock outstanding, respectively. Zero-net supply real bonds give 1 unit of consumption next period.

Limited stock market participation is the key feature of the model. There are two types of agents in each country: non-stockholders, who get $1-\mu_i$ of country i's labor income, and stockholders, who get μ_i of country i's labor income. Non-stockholders can save or borrow only. Stockholders can invest in all three assets: the risk-free bond, and Home and Foreign stocks.

Non-stockholder's Optimization Problem

Non-stockholders choose saving (or borrowing) in the risk free bond $b^n_{i,t}$, and consumption $C^n_{i,t}$ to maximize their expected utility

$$\max_{C^n_{i,t}, b^n_{i,t}} V^n_{i,t} = \left((1-\beta)(C^n_{i,t})^{1-\frac{1}{\sigma_n}} + \beta\left(E(V^n_{i,t+1})^{1-\gamma_n}\right)^{\frac{1-\frac{1}{\sigma_n}}{1-\gamma_n}}\right)^{\frac{1}{1-1/\sigma_n}}$$

where σ_n is the EIS of non-stockholders, subject to their budget constraint and borrowing constraint

$$\begin{aligned} C^n_{i,t} + p^b_t b^n_{i,t} &= (1-\mu_i)L_{i,t} + b^n_{i,t-1} \\ b^n_{i,t} &\geq \underline{b}^n \end{aligned}$$

where $\underline{b}^n$ denotes the bond position limit. The positions are symmetric across the countries, therefore, I drop the country index i.

The borrowing constraints can be micro-founded by either private information or limited commitment (e.g., Hart and Moore (1988), Mendoza, Quadrini, and Ríos-Rull (2009) and Chatterjee, Corbae, and Rios-Rull (2008), etc). I abstract from the microeconomic modelling, but impose the exogenous borrowing constraint directly. The borrowing constraint also stabilizes the wealth distribution and enables the computation of the moments of the equilibrium objects.

Stockholder's Optimization Problem

The representative stockholder of country i chooses his saving $W_{i,t}$, the consumption of goods $C^s_{i,t}$, shares of Home and Foreign stocks to hold $s_{ih,t}$ and $s_{if,t}$, and units of the real bond to buy $b_{i,t}$:

$$\max_{C^s_{i,t},W_{i,t},b_{i,t},s_{ih,t},s_{if,t}} V^s_{i,t} = \left((1-\beta)(C^s_{i,t})^{1-\frac{1}{\sigma}} + \beta\left(E(V^s_{i,t+1})^{1-\gamma}\right)^{\frac{1-\frac{1}{\sigma}}{1-\gamma}}\right)^{\frac{1}{1-1/\sigma}}$$

where σ is the EIS of stockholders, subject to his budget constraint and borrowing constraint:

$$\begin{aligned} s_{ih,t}p^s_{h,t} + s_{if,t}p^s_{f,t} + b_{i,t}p^b_t + C^s_{i,t} &= \mu_i L_{i,t} \\ &\quad + b_{i,t-1} + s_{ih,t-1}(p^s_{h,t} + D_{h,t}) + s_{if,t-1}(p^s_{f,t} + D_{f,t}) \\ b_{i,t} &\geq \underline{b}^s \\ s_{ij,t} &\geq 0 \end{aligned}$$

Market Clearing

I summarize the market clearing conditions below:

Resource constraints are given by:

$$C^n_h + C^n_f + C^s_h + C^s_f = Y_h + Y_f \tag{9}$$

Market clearing conditions for bonds are given by:

$$b^n_h + b^n_f + b_h + b_f = 0 \tag{10}$$

Market clearing conditions for stocks are given by:

$$s_{hh} + s_{fh} = 1 \tag{11}$$

$$s_{ff} + s_{hf} = 1 \tag{12}$$

One of the market clearing conditions above is redundant due to Walras' Law.

4.2 Equilibrium

This economy is incomplete in several ways: First, there are three assets and four shocks; second, part of the population does not participate in the stock market; last but not least, all agents in the economy are subject to borrowing constraints. Therefore, in addition to the exogenous shocks, I also need to keep track of the wealth of agents. Therefore, the state vector of the economy is as follows:

$$X = \left[L_h, L_f, D_h, D_f, b_h^n, b_f^n, W_h, W_f\right]$$

where W_i denotes the wealth of the stockholder in country i.

The equilibrium of this open economy consists of optimal consumption policy functions for home and foreign non-stockholders and stockholders C_h^n, C_f^n, C_h^s and C_f^s, and optimal portfolio policy functions W_h, W_f, b_h, b_f, b_h^w, b_f^w s_{hh}, s_{hf}, s_{fh} and s_{ff}; as well as asset prices p^b, p_h^s and p_f^s such that:

1. Consumption/saving decisions are optimal
2. Portfolio decisions are optimal
3. All individuals' budget constraints are satisfied
4. The asset markets clear
5. The good market clears

4.3 Solution Method

This model is challenging to solve, due to the large set of state variables, especially endogenous ones, as well as the indeterminacy of the portfolio positions in the non-stochastic steady state.

I solve the model using the perturbation method. First, I write a generic policy function G as a function of the state vector $G(X)$. Then, starting from the non-stochastic steady state, I take the Taylor expansion of the equilibrium conditions around the steady-state value of the state vector X_{ss}, and build the first and higher-order approximation of the state variable $G(X)$. I use the Barrier approach to smooth the borrowing constraints, which makes the construction of Taylor expansion possible. Higher-order approximation is necessary for at least two reasons. First, the risk premium is inherently a second-order object. Second, the portfolio positions can only be solved in the higher-order approximation, which I explain below.

The portfolio allocation problem of stockholders brings a subtle computation issue. At the non-stochastic steady state, the optimal portfolio position is indeterminate, for the Implicit Function Theorem does not apply. As I show in Figure 3 a), in the deterministic economy, every point on the Share-axis (or the entire blue line) is an optimal portfolio position. Hence, there is no steady-state value of portfolio positions to build the Taylor series around.

I deal with the issue applying the Bifurcation Theorem. The theorem implies that, there exists a unique bifurcation point around which we can build the Taylor series (Judd and Guu, 2001), and it can be identified at the second-order approximation. For example, in Figure 3 a), there is only one deterministic optimal portfolio A that is consistent with the limit portfolio when the volatility of the economy tends to 0. In companion work Duzhak, Mertens, and Zhang (2013), we show that the Bifurcation Theorem in R^n space applies to the case with multiple state variables. In Figure 3 b), any point in the $Volatility = 0$ plane (or the blue plane) is an optimal portfolio position in the non-stochastic steady state. However, there is only a boundary BB' (the bifurcation boundary), or a unique point w.r.t. each state variable/vector, that is consistent with the limit portfolios when the volatility of the economy tends to 0. This boundary is also the only boundary place the L'Hopital's rule holds. The dynamics of the portfolio positions is further solved at the 3rd order and higher. I describe the solution for the bifurcation boundary in detail in the Appendix.

5 Benchmark Calibration and Model Properties

In this section, I discuss the benchmark calibration and results, as well as the properties of the model. I highlight the first empirical fact that I try to explain: *Fact 1.* International asset returns are highly correlated, while the correlation for the consumption growth is low (International equity premium puzzle).

5.1 Benchmark Calibration

I explain the estimation of benchmark parameters and calibration procedure in this part.

5.1.1 Estimation of Stockholders' Labor Income Share

I estimate the income share of stockholders from the Survey of Consumer Finance data (SCF) for the following years: 1989, 1995, 2001, 2007 and 2010. Stockholders are those who hold (1) stock mutual funds, (2) bond funds (excluding Treasury and Municipal bond funds), (3) Combination funds that hold both stocks and bonds, (4) All other funds (mutual funds, hedge funds, or Real Estate Investment Trusts (REITs)), (5) individual stocks. The composition of Individual Retirement Account (IRA) is not explicitly surveyed. The estimation results are reported in Table 6.

Due to the international setting of my analysis, I focus on the wealthy stockholders and stockholders who invest in international stock markets. The SCF data reveals that, they not only have higher labor income and hold the majority of the stock positions, but also are less likely to focus on the stocks of their own companies. They are also more likely to diversify their positions and hold mutual funds.

For the benchmark measure, I follow Vissing-Jorgensen (2002) to focus on the top one-third of stockholders by their stock wealth. Among the rest of the population, less than 1% directly holds the international stocks, while this fraction for the top one-third is more than 25%. The average corresponding labor income sharing over the sample is 48.05%. I also consider a second measure: the stockholders who directly hold international stocks. Their labor income share, 16.82%, is a lower bound of the stockholders' labor income share. I use a third measure, where I measure the labor income share of households that directly hold foreign stocks, or have mutual fund holdings (the mutual funds can be domestic focused, or internationally diversified). This share, 54.28%, is an upper bound of the labor income share[10]. I adopt the average labor income share of the top one-third stockholders as the stockholders' labor income share, and conduct sensitivity analysis.

5.1.2 Parameter Calibration

Benchmark calibration parameters are reported in Table 7. Panel A reports the parameters for the endowment process. I estimate the financial and labor income processes using U.S. and U.K. quarterly national accounts data from 1980. From the asset pricing point of view, the income stream of agents investing in the firm is gross operating profit, minus investments (Santos and Veronesi (2006), and Coeurdacier and Gourinchas (2011)). I define the labor income as the total compensation for employees.

I first detrend and seasonally adjust the financial income and labor income using monthly dummy variables. I conduct the Johansen test for cointegration between labor income and capital income. No evidence for cointegration is identified. The unit root tests strongly reject that there is a unit root. Therefore, I consider an AR process as the appropriate specification. I estimate the empirical counterpart of Equations (5) and (7), and calculate Newey-West standard errors to control for serial correlation:

$$\begin{aligned}\log(\text{Financial Income}_t) &= c_1 + \phi_1 \log(\text{Financial Income}_{t-1}) + \varepsilon_{1,t} \\ \log(\text{Labor Income}_t) &= c_2 + \phi_2 \log(\text{Labor Income}_{t-1}) + \varepsilon_{2,t}\end{aligned}$$

Adjusting for the level of the labor and financial income share, the financial income shock is about twice as volatile as the labor income shock. For the correlation structure, ε_1^h and ε_2^h for a country h are slightly negatively correlated. The cross-country correlation in labor income shocks ε_2^h and ε_2^f is 0.39, which emphasizes cross-country spillover in labor productivity. The cross-country correlation between ε_1^h and ε_2^f is 0.13, which is lower than 0.39. This is consistent with Heathcote and Perri (2005) that, in the post-Bretton Woods era, the observed correlation of country real shocks is low, and the improved international risk sharing through financial markets further leads to a decrease in the correlation of dividend payouts.

[10] The 1989 survey does not identify whether stock holdings include foreign stocks, therefore, I do not report estimates for alternative measures.

For preference parameters, I set the risk aversion of stockholders to 10, the estimate in the previous section. It is also consistent with the literature, such as MMV (2009). In the benchmark calibration, I restrict the non-stockholders risk aversion to be the same as the stockholders.

I pick the standard discount factor 0.985, which is also consistent with my empirical implementation. I set the EIS of stockholders to 0.3, consistent with the existing empirical literature, such as Attanasio, Banks, and Tanner (2002), Brav, Constantinides, and Geczy (2002) and Vissing-Jorgensen (2002). In particular, Vissing-Jorgensen (2002) obtains estimates of the EIS that are greater than 0.3 for stockholders, while the estimates for remaining households are small and insignificantly different from zero. The EIS of non-stockholders is set to 0.1, the inverse of the risk aversion estimate.

Borrowing constraints are calibrated to match the asset price moments, as well as the volatility of asset positions. I set them to be one period of labor income for the respective group.

5.2 Calibration Results

I compute the long-run distribution of the model and report the moments of the benchmark calibration in Table 8. Specifically, I simulate the model for 10,000 periods, drop the first 500 periods, and compute the moments for the rest of the simulated data.[11]

All data moments are computed for the U.S., except for the consumption moments. The correlation of the real per capital consumption growth rates is calculated for the U.S. and U.K. household level survey data. In consistency with my empirical results, I use the 12-quarter correlation of consumption growth rates as the target moments, and calculate the counterpart in the simulation.

The model quantitatively replicates patterns in *Fact 1* that international asset returns are highly correlated, while the correlation for the consumption growth is low.

The correlation in equity returns is high (0.84), compared to 0.83 in data, while the

[11] The model has non-degenerate wealth distribution in the long run, due to the borrowing constraints.

simulated cross-country dividend correlation in levels is 0.12. The intuition is that the equity in each country is priced by the pricing kernel in both countries, and it induces high correlation in discount rates.

The correlation of aggregate consumption is low (0.33 vs. 0.31 in the data). As is documented in Table 2, the correlation of consumption between stockholders is high (0.52 vs. 0.51 in the data). Stockholders share their consumption risk in three ways. First, they invest in the foreign stock market. The model implies that home stockholders hold 65% of home stocks, and 35% of foreign stocks. It is symmetric for the foreign stockholders. Although the home and foreign stockholders' labor income growths only have a correlation of 0.32, the correlation of their aggregate income is significantly higher, through their equity holding of the other country. Second, they actively rebalance the equity portfolios. Third, they also use a small amount of the bond margin.

The correlation of consumption between non-stockholders is significantly lower at 0.24, compared to 0.26 in the data. The income growth correlation between the same groups is 0.15, and there is a mild amount of consumption correlation between home stockholders and foreign non-stockholders (0.16 vs. 0.07 in the data).

The model also successfully matches the salient features of asset prices and asset positions, both of which have been challenges for the international finance literature. The model implied risk-free rate is low (1.18% vs. 1.11% in the data); and the equity risk premium is high (4.79% vs. 5.65% in the data). The risk-free rate is smooth, with a volatility of 1.12% (vs. 1.59% in the data), and the risk premium is reasonably volatile, with a volatility of 12.05% (vs. 17.24% in the data). The annualized volatility of bond positions is reasonable at 2.63% (1.71% in data), and the same is true of equity positions(4.25% vs. 2.97% in the data).

The model falls short in matching the data in a couple of ways: first, the model generates higher consumption correlation between stockholders and non-stockholders within the same country (0.76 vs. 0.45 in the data); second, the model fails in matching the fact that the stockholders' consumption growth is more volatile than the non-stockholders' consumption growth. The reason for both is the simplifying assumption that the stockholders' and non-stockholders' consumption growths are perfectly correlated and as volatile. First, in the simulated data, the correlation of their income growth is as high as 0.69, and it drives the high same-country consumption correlation. Second, I find in the household-level survey data that, the stockholders' income growth is much more volatile. Taking into account this difference would help generate more volatile consumption growth for stockholders than non-stockholders.

5.2.1 The Risk Sharing Properties and the Source of High ERP

The model successfully generates high equity risk premium, which has been a challenge for many papers. From the cash flow perspective, I calibrate my income process to the data, where the financial income is much more volatile than the labor income. The sheer amount of risk embedded in the financial income makes the claim risky to begin with.

The risk sharing relation in this model further drives up the risk premium. The stockholders have a higher EIS (0.3) than the non-stockholders (0.1). Therefore, the non-stockholders borrow and save aggressively in bonds in order to smooth their consumption. Different from the closed economy models, the main lending and borrowing take place between home and foreign non-stockholders, since their incomes are as volatile, and their income correlation is low. They can achieve a significant amount of risk sharing through the risk-free bond market.

When times are bad for non-stockholders in both countries, both non-stockholders would want to borrow to consume. Their demand for bonds is relatively inelastic, for the non-stockholders are less willing to substitute intertemporally. Therefore, The stockholders take the other side of the bond positions and provide insurance to the non-stockholders, as in the closed economy. This process concentrates the non-diversifiable part of the global labor income risk among stockholders. So the stockholders demand a high premium for bearing this aggregate risk.

Stockholders tend not to use the bond margin, except to provide risk sharing to the non-stockholders. Indeed, the bond positions in each country are mainly taken by the non-stockholders, and stockholders rely more on stocks. The stockholders achieve a significant amount of risk sharing by holding foreign stocks, as well as rebalancing the equity positions, as is discussed above.

5.2.2 The Role of Limited Stock Market Participation

Limited stock market participation is the key feature of the model and gives rise to key features of the data. I analyze an alternative scenario, where I assume that all agents in each country participate in the stock markets, therefore, there is one representative agent in each country. In particular, the preference parameters of this representative agent are the same as the stockholders in the benchmark case. The comparison with the benchmark model is reported in Table 9 to highlight the role of the limited stock market participation.

As is discussed in the previous section, the stockholder provide insurance to the non-stockholders. This concentration of the aggregate risk generates high equity premium. In the case where there is non limited stock market participation, the equity risk premium collapses to 1%.

Moreover, the representative economy generates excessively high correlation in aggregate consumption growth across countries, compared to data. In the benchmark case, the non-stockholders are restricted from the stock market, therefore the correlation of their consumption growths across country is low. It further leads to the low correlation in the aggregate consumption growths. Therefore, the feature of the limited stock market participation is key to generate high return correlation as well as the low aggregate consumption growth correlation at the same time.

5.2.3 The Role of Heterogeneous Preferences

To further understand the properties of the model, I examine the effects of heterogeneity in the EIS and risk aversion parameters on risk sharing and asset prices. I conduct three experiments reported in Table 10. First, I eliminate the preference heterogeneity by reducing the EIS of the stockholders to 0.1, which make the preferences of stockholders CRRA. Due to the fact that the stockholders are relatively less willing to substitute intertemporally, they provide less insurance to the non-stockholders. Hence, they load on less aggregate labor income risk, as well as adjust their portfolio positions more aggressively to smooth their consumption. As a result, the consumption volatility of the stockholders decreases from 2.19% to 1.91%, and the consumption growth correlation between the home and foreign stockholders jumps from 0.52 to 0.76, which is counterfacturally high.

Second, I eliminate the preference heterogeneity by increasing the stockholders EIS to 0.3 (second column). This change generates a counterfactually high risk-free rate (5.24%), and a collapse in the equity premium to 0.72%, although the corresponding volatilities remain largely similar to the benchmark case. The consumption growth volatility of the non-stockholders increases from 2.59% to 2.76%, for they no longer have strong demand for consumption smoothing. They use the bond margin much less, which reduces the bond volatility to 0.05%. The stockholders also insure the non-stockholders less during bad times, and no longer require a high risk premium. Therefore, we see a sharp jump in the risk-free rate to 5.24%, and a collapse of the equity risk premium.

To summarize, the results demonstrate that the heterogeneity in the EIS is important to match both the consumption correlation and the equity premium, which are the key statistics that the model seeks to explain. The low EIS of the non-stockholders plays an important role in generating the high equity risk premium, while the high EIS of the stockholders is central to generate the relatively high (but not excessively high) consumption correlation between home and foreign stockholders.

Last, I examine the effect of non-stockholder risk aversion by reducing it to 5, half of the benchmark parameter 10. Comparing the third column to the fourth column shows that this change has a minor effect. The unconditional moments of risk premium barely change. This is due to the fact that the non-stockholders only affect asset prices through the bond market. And this demand is largely determined by their EIS, rather than their risk aversion.

6 Quantitative Analysis

I quantitatively examine whether the model could deliver the empirical *Fact 2 - 4* that I try to explain: Stock market integration accompanies the increase in asset return correlations; Home stockholders' consumption growth can price both home and integrated foreign stocks, and can price them better than that of non-stockholders; and Home stockholders' and non-stockholders' consumption growth cannot price the segmented foreign stocks.

6.1 Comparative Statics between Financial Integration and Segmentation

In this section, I discuss the financial integration/segmentation experiment. I solve the model at the steady state for two scenarios: 1) the integrated economy (the benchmark model), and 2) the segmented economy (the bond economy), where the two economies have integrated bond, but not stock, markets.

I quantitatively evaluate whether financial integration itself is able to account for *Fact 2* that the stock market integration accompanies the increase in asset return correlations (Figure 1).

I keep the benchmark calibration parameters for comparison. Moments for the bond economy are reported in Table 11. The equity return correlation collapses from 0.84 to 0.25. Both the cash flow and discount rate effect drive this result. As in the integrated economy, the cash flow correlation is low as 0.16. Moreover, the correlation of discount rates and consumption growths is significantly lower in the segmented markets than in the integrated economy. And the equity is only priced by the stockholders' pricing kernel in the same country, but not of that in the other country.

In the bond economy, the cross-country stockholder consumption correlation sharply decreases from 0.52 in the benchmark model to 0.12. The drop comes from two sources. First, home (foreign) stockholders are excluded from directly holding the foreign (home) equity, which leads to a decrease in the income correlation. Second, the stockholders can no longer diversify risk with each other through equity portfolio rebalancing.

Deprived of this one investment instrument for consumption smoothing, the stockholders' consumption volatility sharply increases from 2.19% to 2.59%. Moreover, the stockholders provide less insurance to all members of the economy. The consumption correlation among almost all pairs of agents drop. The consumption growth correlations between stockholders is as low as 0.12. It is lower than the correlation between home and foreign non-stockholders, driven by the fact that in the segmented economy, the income correlation of the stockholders is lower than the correlation of non-stockholders. It demonstrates that the high correlation of stockholders' consumption growth rates can only take place among financially integrated countries.

Due to the strengthened precautionary saving motive, and the increase in the amount of risk borne by the stockholders, the risk free rate slightly decreases, while the risk premium shoots up. There are two reasons. First, the stockholders suffer from the restriction on consumption risk sharing, therefore the discount rate effect pushes up the equity risk premium. Second, now the stockholders have to hold on to the risky cash flow, or the dividends. Specifically there are two kinds of risks embedded: the undiversifiable global risk and the country-specific risk. In the integrated economy, the country-specific risk can be diversified away through holding a global portfolio. As this global diversification becomes impossible, the equity is now a much more risky claim. Consequently, the equity risk premium jumps from 4.79% to 8.32%.

Therefore, financial segmentation is able to generate the significant decrease in asset return correlations as in the data, and only a mild decrease in the aggregate consumption correlation, even when the correlation of cash flows stays the same. Or, conversely, financial integration is able to generate the significant increase in asset return correlations as in data, and only a mild increase in the aggregate consumption correlation. The pattern is in line with the pattern in Figure 1. It also matches the decline in the expected equity risk premium in the past three decades (Pastor and Stambaugh, 2001, and Fama and French, 2002), as the financial globalization unfolded.

I defer the discussion of the risk sharing properties in the section, through the lens of the welfare analysis.

6.2 Welfare Analysis

I now analyze the welfare implications of stock market integration. I calculate the expected utility for both types of agents in the pre- and post-financial integration steady states. The expected utility of the non-stockholders does not move at all, up to the 5th digit. However, the stockholders' welfare improves by 0.062% of permanent consumption. Consistent with the well-known result, in my analysis, the welfare cost of (lack of) consumption risk sharing is small. However, the contrast between the two groups is stark.

This difference is consistent with the consumption moments that I discussed above. When the stock markets open up, the consumption volatility for the stockholders drop by 0.4%, while that of the non-stockholder barely moves. Moreover, stockholders share a significant amount of consumption risk with each other, shown by both the increase in their consumption correlation from 0.12 to 0.52, and the decrease in the equity risk premium from 0.832% to 4.79%.

In sum, almost all the welfare gains of financial integration are captured by the stockholders, and the potential cost of a financial sanction would be borne all by the stockholders alone also.

7 Conclusion

In this paper, I show that taking into account the limited stock market participation can help explain a series of facts in international risk sharing and asset prices.

I rationalize the high correlation in international stock markets despite the low correlation in the aggregate consumption (*International Equity Premium Puzzle*), by documenting that the correlation of stockholders' consumption growth is significantly higher than the correlation of the aggregate consumption growth, employing household-level survey data.

I construct a quantitative incomplete market model featuring limited participation. The model is able to account for the empirical facts above, as well as match the asset price and position moments. The model also generates the result that the stock market integration (measured by asset positions) accompanies increases in the asset return correlation, as I document in the data.

Several extensions to the current framework can be made. First, I am extending the model to allow for the different labor income processes for stockholders and non-stockholders. I estimate the processes using the household-level survey data, and find that, in particular, the stockholders' income growth is more volatile than the non-stockholders'. Second, the asymmetry in country sizes can be introduced. It would bring the model closer to the data, where the U.S. is a significantly bigger country than the U.K.. It would allow me to study the risk sharing properties and welfare implications in more generic cases.

The evidence presented in this paper suggests that limited participation could be a fruitful avenue to make sense of the dichotomy of prices and quantities in international finance. Much future research can be done: Currently, I am extending my work to incorporate exchange rate dynamics. This will allow me to study the Backus-Smith puzzle (the low correlation between changes in the real exchange rate and aggregate consumption growth differentials) and the uncovered interest rate parity deviations (the observation that high interest rate currencies tend to appreciate).

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8 Tables and Figures

Figure 1: Market Integration and Comovement

The x-axis shows the fraction of individual market share held by U.S. investors in 1997, the earliest available data point. The y-axis corresponds to the quarterly return correlation of the foreign stock market index with the S&P 500 index.

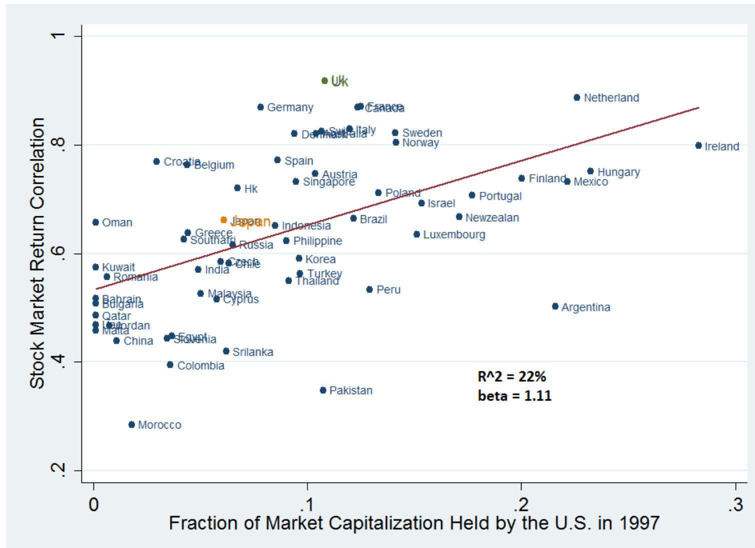


Figure 2: Market Integration and Comovement (II)

The x-axis shows the fraction of individual market share held by U.S. invetors in 2006 (pre the financial crisis). The y-axis corresponds to the quarterly return correlation of the foreign stock market index with the S&P 500 index.

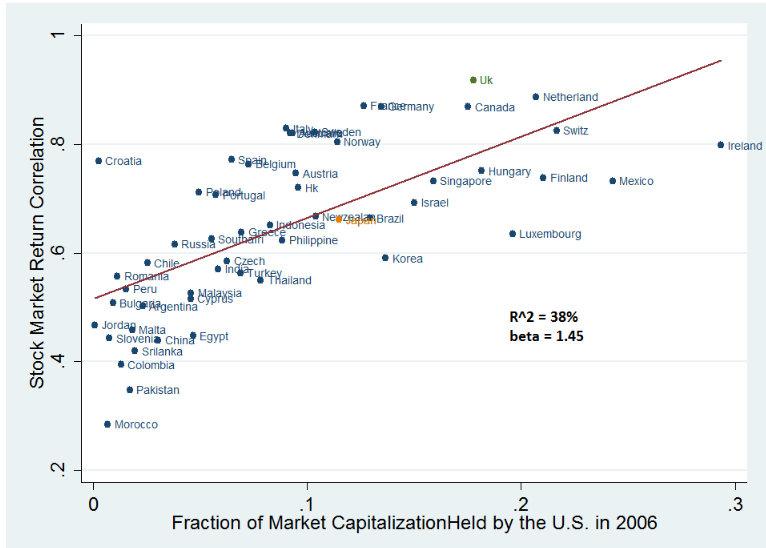
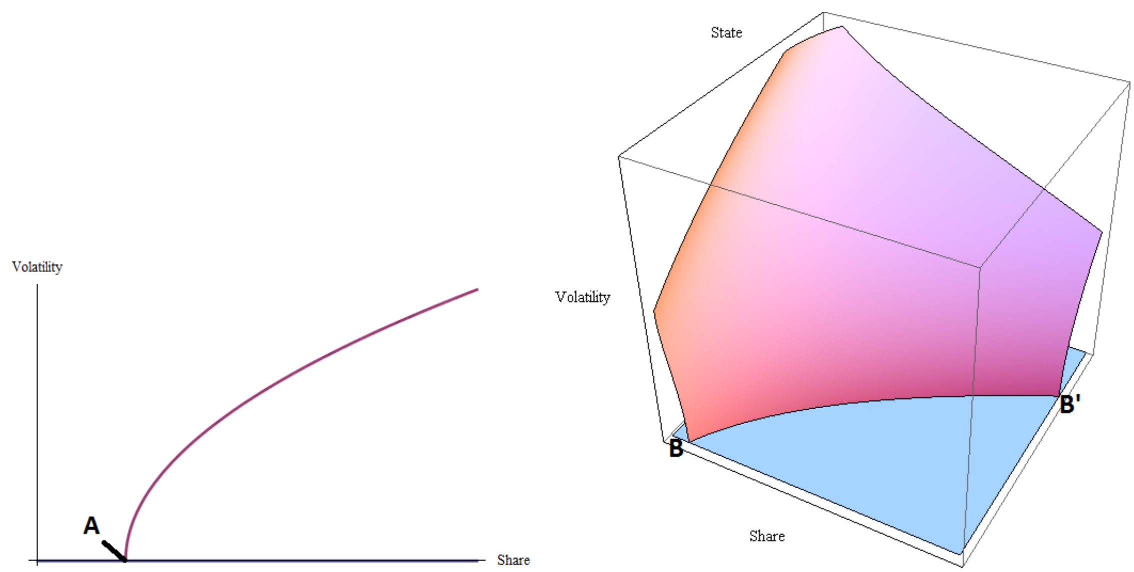


Figure 3: Illustration of Bifurcation Point and Boundary

In Figure a), the y-axis shows the volatility of shocks, and the x-axis shows the shares of the risky asset by the agent. In the deterministic economy, any point on the entire blue line is an optimal portfolio. In the stochastic economy, the blue line is the set of optimal portfolio positions. The point A is the bifurcation point.
In Figure b), the z-axis shows the volatility of shocks, the y-axis a state variable, and the x-axis shows the shares of the risky asset held by the agent. In the deterministic economy, any point on the blue surface is an optimal portfolio. In the stochastic economy, the red manifold are the optimal portfolio positions. The curve BB' is the bifurcation boundary.



a) The Bifurcation Point b) The Bifurcation Boundary

Table 1: Return and Fundamental Correlation with the U.S.

The table displays each country's correlation with the comparative variable of the U.S. The sample period is from Q1 1973 to Q4 2010, at quarterly frequency. I measure
Gross financial income = Gross operating profit - Gross capital formation - Tax

	Australia	Canada	France	Germany	Italy	U.K.
Equity Return	0.6578	0.6643	0.6953	0.5166	0.4575	0.7054
Gross Financial income	0.0579	-0.02	-0.023	0.002	-0.0641	0.1435
Non-durable consumption	0.2927	0.1671	0.4336	-0.1618	-0.3804	0.1826

Table 2: U.S. and U.K. Consumption Correlation

The sample period is from 1988 to 2007, the common sample period for the U.S. and U.K. data. All the estimates are significant at 5% level. Super-script S denotes the stockholders, and the super-script N denotes the non-stockholders.

	1 Q	4 Q	8 Q	12 Q	16 Q	20 Q
$(\Delta C^S, \Delta C^{S*})$	0.1502	0.3901	0.3601	0.5074	0.4955	0.4274
$(\Delta C^N, \Delta C^{N*})$	0.0986	0.1252	0.2148	0.2579	0.3383	0.3439
$(\Delta C^S, \Delta C^{N*})$	0.1308	-0.0012	-0.0668	0.0744	0.2527	0.3108
$(\Delta C^S, \Delta C^N)$	0.3603	0.3851	0.4276	0.4486	0.5296	0.5571
$(\Delta D^{agg}, \Delta C^{agg})$	0.0729	0.2124	0.2347	0.3115	0.4290	0.3737

Table 3: U.S. Stockholder Consumption Growth can Price 25 European Fama-French Portfolios

I run the following test equation, using the 25 European Fama-French portfolios as test assets, and consumption growth for the U.S. stockholders, or non-stockholders as the pricing factor. The sample period is from January, 1990 to September, 2012.

$$\begin{aligned} \hat{\mathbb{E}}[r^i_{t+1} - r^f_{t+1}] + \frac{\hat{\sigma}^2_i}{2} - \frac{\hat{\sigma}^2_f}{2} &= \alpha + (\gamma - 1)\hat{\sigma_{ic}} + e_i \\ \hat{\sigma}_{ic} &= c\hat{o}v\left(\sum_{s=0}^{S-1} \beta^s \left[\hat{c}^g_{t+1+s} - \hat{c}^g_{t+1}\right], r^i_{t+1} - r^f_{t+1}\right) \end{aligned}$$

	Panel A: Stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	26.95	8.100	9.655***	9.118***	9.059***	9.650***
	(23.38)	(11.29)	(2.475)	(2.214)	(2.085)	(2.225)
Const	0.0255***	0.0222**	0.00675	0.00872*	0.00959**	0.0114***
	(0.00244)	(0.00847)	(0.00526)	(0.00471)	(0.00415)	(0.00367)
adj. R^2	0.000	-0.016	0.422	0.405	0.442	0.447

	Panel B: Non-stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	33.14	10.052	6.325	2.923	5.485	6.618
	(36.76)	(9.429)	(6.337)	(4.327)	(5.265)	(5.704)
Const	0.0319***	0.0217***	0.0222***	0.0250***	0.0213***	0.0213***
	(0.00484)	(0.00590)	(0.00614)	(0.00597)	(0.00704)	(0.00599)
adj. R^2	-0.010	0.027	0.018	-0.028	0.024	0.052

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: U.S. Stockholder Consumption Growth cannot Price 25 Japanese Fama-French Portfolios

I run the following test equation, using the 25 Japanese Fama-French portfolios as test assets, and consumption growth for the U.S. stockholders, or non-stockholders as the pricing factor. The Europe market consists of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. The sample period is from January, 1990 to September, 2012.

$$\begin{aligned}\hat{\mathbb{E}}[r^i_{t+1} - r^f_{t+1}] + \frac{\hat{\sigma}_i^2}{2} - \frac{\hat{\sigma}_f^2}{2} &= \alpha + (\gamma - 1)\hat{\sigma_{ic}} + e_i \\ \hat{\sigma}_{ic} &= \hat{cov}\left(\sum_{s=0}^{S-1} \beta^s \left[\hat{c}^g_{t+1+s} - \hat{c}^g_{t+1}\right], r^i_{t+1} - r^f_{t+1}\right)\end{aligned}$$

	Panel A: Stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	-44.79***	-14.64	-4.988	-2.310	-3.386	-1.985
	(10.52)	(13.16)	(5.099)	(3.694)	(2.724)	(2.529)
Const	0.00860***	0.00278	0.00627	0.00172	0.00514*	0.00351
	(0.00205)	(0.00168)	(0.00453)	(0.00134)	(0.00275)	(0.00243)
adj. R^2	0.399	0.041	0.022	-0.001	0.043	0.008
	Panel B: Non-stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	25.86*	-4.692	-2.091	-3.662	-5.625	-7.737
	(15.04)	(16.37)	(7.388)	(4.670)	(4.359)	(6.743)
Const	0.00222	0.00331	0.00367	0.00661	0.00906	0.00821
	(0.00164)	(0.00753)	(0.00693)	(0.00560)	(0.00533)	(0.00543)
adj. R^2	0.061	-0.029	-0.035	0.002	0.058	0.049

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: U.S. Stockholder Consumption Growth cannot Price 25 Asia Pacific (ex-Japan) Fama-French Portfolios

I run the following test equation, using the 25 Asian-Pacific (excluding Japan) Fama-French portfolios as test assets, and consumption risk for the US stockholder, or non-stockholder as the pricing factor. The Asia Pacific market consists of Australia, Hong Kong, New Zealand, and Singapore. The sample period is from January, 1990 to September, 2012.

$$\begin{aligned}\hat{\mathbb{E}}[r^i_{t+1} - r^f_{t+1}] + \frac{\hat{\sigma}^2_i}{2} - \frac{\hat{\sigma}^2_f}{2} &= \alpha + (\gamma - 1)\hat{\sigma_{ic}} + e_i \\ \hat{\sigma}_{ic} &= c\hat{o}v\left(\sum_{s=0}^{S-1} \beta^s \left[\hat{c}^g_{t+1+s} - \hat{c}^g_{t+1}\right], r^i_{t+1} - r^f_{t+1}\right)\end{aligned}$$

	Panel A: Stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	-34.64*	-12.33	-10.37*	-3.504	-8.770**	-10.57***
	(18.74)	(8.416)	(5.665)	(5.233)	(3.559)	(3.620)
Const	0.0198***	0.0214***	0.0323***	0.0257***	0.0321***	0.0331***
	(0.00220)	(0.00184)	(0.00512)	(0.00432)	(0.00349)	(0.00388)
adj. R^2	0.101	0.086	0.066	-0.015	0.162	0.228
	Panel B: Non-stockholder Consumption Growth					
	1Q	4Q	8Q	12Q	16Q	20Q
γ	-6.539	-6.894	-11.22	-12.63	-17.37**	-7.245
	(32.47)	(17.05)	(10.76)	(7.962)	(7.426)	(6.049)
Const	0.0203*	0.0264***	0.0325***	0.0388***	0.0394***	0.0278***
	(0.0114)	(0.00681)	(0.00773)	(0.00891)	(0.00651)	(0.00315)
adj. R^2	-0.041	-0.033	0.012	0.064	0.151	-0.003

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Labor Income of Stockholders (%)

The labor income and the stockholder status are drawn from Survey of Consumer Finance (SCF). I report the wage share of each group surveyed. Stockholders include holders of (1) stock mutual funds, (2) bond funds (excluding Treasury and Municipal bond funds), (3) combination funds that hold both stocks and bonds, (4) all other funds (mutual funds, hedge funds, or REITs (Real Estate Investment Trusts)), (5) individual stocks. Top 3rd stockholders identify stockholders whose stock positions are among the top third of the stockholders.

	1989	1995	2001	2007	2010	Average
All stockholders	66.29	73.18	79.93	79.53	69.94	
Top 3rd stockholders	39.98	54.60	54.70	55.74	41.24	48.05
Holders of foreign individual stocks		24.30	14.75	18.86	12.2	16.82
Holders of foreign individual stocks and all mutual funds		49.32	55.05	61.90	63.83	54.28
Ratio of labor income per household of the identified group to rest of population						
All stockholders	3.71	4.70	5.24	6.05	3.42	
Top 3rd stockholders	5.12	8.59	7.18	8.42	6.92	
Holders of foreign individual stocks		5.56	2.54	2.67	2.43	
Holders of foreign individual stocks and all mutual funds		3.19	3.04	4.61	8.14	

Table 7: Benchmark Calibration: Parameters

Parameters	
Mean of Wage Share	$L_0 = 0.75$
Mean of Dividend Share	$D_0 = 0.25$
Persistence of Wage	$\rho = 0.99$
Persistence of Dividend	$\kappa = 0.89$
Vol of Wage Shock	$vol(z) = 0.0120$
Vol of Dividend Shock	$vol(u) = 0.0065$
Corr of Wage and Dividend Shock	$corr(u_i, z_i) = -0.05$
Cross Corr of Wage Shock	$corr(z_1, z_2) = 0.39$
Cross Corr of Dividend Shock	$corr(u_1, u_2) = 0.13$
Cross Corr of the Two Shocks	$corr(u_i, z_j) = 0.06$
Non-stockholder EIS	$\sigma_n = 0.1$
Stockholder EIS	$\sigma = 0.3$
Non-stockholder Risk aversion	$\gamma_n = 10$
Stockholder Risk aversion	$\gamma = 10$
Discount factor	$\beta = 0.985$
Income Share of Stockholders	$\mu = 0.48$
Non-stockholder Borrowing Limit	$\underline{b_n} = -0.39$
Stockholder Borrowing Limit	$\underline{b_s} = -0.36$

Table 8: Benchmark Calibration Results

All data moments are computed at quarterly frequency for the U.S., except for the consumption correlation. The correlation of the real per capital consumption growth rates is calculated for the U.S. and U.K. household-level survey data. To be consistent with the empirical results, the 12 quarter correlation of consumption growth rates are reported.

Moments	Model	Data
$Corr(R_h^s, R_f^s)$	0.84	0.83
$Corr(\Delta C_{h,12Q}^{agg}, \Delta C_{f,12Q}^{agg})$	0.33	0.31
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{s})$	0.52	0.51
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{f,12Q}^{n})$	0.24	0.26
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{n})$	0.16	0.07
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{h,12Q}^{s})$	0.76	0.45
Mean of Risk-free rate	1.18%	1.11%
Volatility of Risk-free rate	1.12%	1.59%
Mean of Equity Risk Premium	4.79%	5.65%
Volatility of Stock return	12.05%	17.24%
Vol of $\Delta C_{n,i}$	2.59%	2.14%
Vol of $\Delta C_{s,i}$	2.19%	3.76%
$Vol(b_i)$	2.63%	1.71%
$Vol(\Delta NetEquityPosition_i)$	4.25%	2.97%

Table 9: The Role of Limited Stock Market Participation

All data moments are computed at quarterly frequency for the U.S., except for the consumption correlation. The correlation of the real per capital consumption growth rates is calculated for the U.S. and U.K. household-level survey data. To be consistent with the empirical results, the 12 quarter correlation of consumption growth rates are reported.
Column Rep Agent represents the alternative model where there is full participation in the stock market in each country. Column Benchmark represents the benchmark model, where there is limited stock market participation.

Moments	Rep Agent	Bechmark	Data
$Corr(R_h^s, R_f^s)$	0.97	0.84	0.83
$Corr(\Delta C_{h,12Q}^{agg}, \Delta C_{f,12Q}^{agg})$	0.79	0.33	0.31
Mean of Risk-free rate	4.70%	1.18%	1.11%
Volatility of Risk-free rate	0.95%	1.12%	1.59%
Mean of Equity Risk Premium	1.00%	4.79%	5.65%
Volatility of Stock return	9.22%	12.05%	17.24%
$Vol(\Delta C_{i,agg})$	2.01%	2.18%	2.95%
$Vol(b_i)$	0.01%	2.63%	1.71%
$Vol(\Delta NetEquityPosition_i)$	1.63%	4.25%	2.97%

Table 10: The Role of Preference Heterogeneity

Moments	CRRA (0.1, 0.1)	Alt. EIS (0.3, 0.3)	Alt. RA $\gamma_n = 5$	Benchmark (0.1, 0.3)	Data
$Corr(R_h^s, R_f^s)$	0.94	0.84	0.84	0.84	0.83
$Corr(\Delta C_{h,12Q}^{agg}, \Delta C_{f,12Q}^{agg})$	0.48	0.30	0.40	0.33	0.31
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{s})$	0.76	0.52	0.63	0.52	0.51
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{f,12Q}^{n})$	0.23	0.14	0.23	0.24	0.26
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{n})$	0.37	0.20	0.19	0.16	0.07
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{h,12Q}^{s})$	0.77	0.75	0.71	0.76	0.45
Mean of Risk-free rate	-0.91%	5.24%	1.13%	1.18%	1.11%
Volatility of Risk-free rate	2.95%	1.34%	1.93%	1.12%	1.59%
Mean of Equity Risk Premium	5.94%	0.72%	4.79%	4.79%	5.65%
Volatility of Stock return	22.70%	12.01%	12.04%	12.05%	17.24%
Vol of $\Delta C_{n,i}$	2.62%	2.76%	2.61%	2.59%	2.14%
Vol of $\Delta C_{s,i}$	1.91%	2.21%	2.19%	2.19%	3.76%
$Vol(b_i)$	4.00%	0.05%	2.63%	2.63%	1.71%
$Vol(\Delta NetEquityPosition_i)$	4.52%	4.25	4.25%%	4.25%	2.97%

Table 11: Bond Economy Calibration Results

Moments	Segmented (Bond)	Integrated (Benchmark)	Data
$Corr(R_h^s, R_f^s)$	0.25	0.84	0.83
$Corr(\Delta C_{h,12Q}^{agg}, \Delta C_{f,12Q}^{agg})$	0.14	0.33	0.31
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{s})$	0.12	0.52	051
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{f,12Q}^{n})$	0.18	0.24	0.26
$Corr(\Delta C_{h,12Q}^{s}, \Delta C_{f,12Q}^{n})$	0.09	0.16	0.07
$Corr(\Delta C_{h,12Q}^{n}, \Delta C_{h,12Q}^{s})$	0.70	0.76	0.45
Mean of Risk-free rate	0.027%	1.18%	1.11%
Volatility of Risk-free rate	1.84%	1.12%	1.59%
Mean of Equity Risk Premium	8.32%	4.79%	5.65%
Volatility of Stock return	13.73%	12.05%	17.24%
Vol of $\Delta C_{n,i}$	2.62%	2.59%	2.14%
Vol of $\Delta C_{s,i}$	2.59%	2.19%	3.76%
$Vol(b_i)$	2.64%	2.63%	1.71%