New Goods and International Risk Sharing

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Abstract

Because consumption growth rates are weakly correlated across countries, standard one-good models indicate that the degree of international risk sharing is low. In this paper, I develop a model which identifies another form of risk sharing: the exchange of new goods. In the model, consumers have a love of variety, and the composition of consumption also determines welfare. As a result, the exchange of new goods now constitutes a form of risk sharing; to determine the degree of international risk sharing, comparing consumption growths is not enough.

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Introduction

Is consumption risk shared well internationally? Despite large flows of capital and goods across borders, a large body of research says "no": if country-specific shocks are shared internationally, cross-country consumption growth rate correlations should be high. They are not: correlations are typically 0.4 or so; output growth correlations are higher (Backus, Kehoe and Kydland (1992)). Altering the basic model - for example, incorporating nontradable goods - does not greatly change the basic prediction. According to Obstfeld and Rogoff (2000), this apparent lack of consumption risk-sharing is one of the "six major puzzles in international macroeconomics".

In this paper, I develop a simple model where international risk-sharing can occur through the exchange of new goods. The idea is simple. In a standard one-good setting, risk-sharing can only occur through the exchange of some representative good. In this setting, consumption growth correlations fully reflect the degree of risk-sharing. But if consumers betray a love of variety, then the composition of consumption also matters for welfare. Assuming equal prices, the social planner now equates the growth of consumption *services* - a function of consumption quantity *and* variety - across countries. Introducing a love of variety, therefore, implies the exchange of new goods now constitutes a form of risk-sharing. To determine the degree of international risk-sharing, comparing the growth of quantities is not enough.

To give an example, consider two endowment economies, A and B. Each year A receives an endowment of an apple and an orange; B receives an apple. Now suppose one year A receives an extra pear, and he transfers a quarter of it to B. So A's consumption level rises from 2 to 2.75 (i.e., by about 30 percent), while B's rises from 1 to 1.25 (i.e., by 25 percent). According to consumption data, risk sharing is imperfect. But if consumers in B betray a love of variety, the degree of risk sharing is unclear: although consumption growth is higher in A, variety growth is higher in B.

Do new goods flow across borders in this way? Significantly, the "new trade theory" predicts so. Here, a love of variety *is* the driving force behind trade between developed countries (Krugman (1979)): increasing returns causes firms to produce different goods, which are then traded internationally. This theory has successfully explained why intraindusty trade now comprises the bulk of trade between developed countries. The main contribution of this paper is to show that the welfare gains stressed by Krugman should also be incorporated in calculations of the degree of international risk sharing. In a world where a large, innovative economy such as the United States exports about 10 percent of GDP, these effects are potentially large.

In addition, the model sheds light on a puzzle recently highlighted by Brandt, Cochrane and Santa-Clara (2006). The high level of the equity premium suggests marginal utility growth is relatively volatile. And assuming complete markets, the growth of the bilateral real exchange rate is equal to the difference in the countries' marginal utility growths. But compared to variation in marginal utility (as revealed by asset prices), variation in real exchange rates is relatively low. As we shall see, this implies marginal utility growths are strongly correlated across countries; i.e., the degree of risk sharing is high. Thus, incorporating variety growth into the standard model not only helps explain why marginal utility is more volatile, but also offers an explanation for why it is more correlated across countries.

I proceed as follows. In Section 1, I describe a partial equilibrium model, where utility depends on the consumption of domestic and foreign goods. In contrast to the standard one-good model, marginal utility is now a function of product variety; consumption growth rates are no longer a sufficient statistic for changes in marginal utility. I introduce applications to finance in Section 2. By raising the volatility of marginal utility, changes in variety growth can rationalize a higher equity premium and also provide an explanation for why marginal utility is more correlated across countries. I also present some empirical evidence, which provides suggestive evidence of the importance of this channel. Finally, Section 3 concludes.

1 The Model

To begin, I describe the model. There are two countries, Home (H) and Foreign (F), of size $0 < n < 1$ and $1 - n$, respectively. Here, size indicates a country's share in world production. Both countries share the same preferences, and each is inhabited by a representative consumer. All goods are tradable. Goods available in Home have a price of p_t in Home currency at time t; goods available in Foreign have a price of p_t^* in Foreign currency at time t. Therefore, p_t and p_t^* represent the Home and Foreign price levels at time t. Throughout, I denote Foreign variables with with an asterisk.

The Home composite commodity is a CES index of domestically produced brands:

$$C_{Ht} \equiv \mathfrak{m}_{ht}^{v+1-\frac{1}{\alpha}} \left(\int_0^{m_{ht}} c_{it}^{\alpha} \, di \right)^{\frac{1}{\alpha}}, \tag{1}$$

where $0 < \alpha < 1$, and $m_{ht} > 0$ denotes the number of home brands available in Home; $\mathfrak{m}_{ht} > 0$ the number of those goods consumed.[1] (More generally, $\mathfrak{m}_x$ denotes the number of goods of type x that are consumed in equilibrium.) To keep things simple, an increase in the number of brands can also represent an increase in quality if brands embody quality improvements.

From the standpoint of a consumer in Home, the Foreign composite commodity is a CES index of Foreign produced brands available for purchase in Home:

$$C_{Ft} \equiv \mathfrak{m}_{ft}^{v+1-\frac{1}{\alpha}} \left(\int_0^{m_{ft}} c_{it}^{\alpha} \, di \right)^{\frac{1}{\alpha}}, \tag{2}$$

where $m_{ft} > 0$ denotes the number of foreign produced brands available in Home. The constant $v > 0$ governs the consumer's love of variety.

Symmetrically

$$C_{Ht}^{*} \equiv \mathfrak{m}_{ht}^{*v+1-\frac{1}{\alpha}} \left(\int_0^{m_{ht}^{*}} c_{it}^{*\alpha} \, di \right)^{\frac{1}{\alpha}}, \tag{3}$$

where $0 < m_{ht}^{*} \leq m_{ht}$ denotes the number of home brands available in Foreign. And

$$C_{Ft}^{*} \equiv \mathfrak{m}_{ft}^{*v+1-\frac{1}{\alpha}} \left(\int_0^{m_{ft}^{*}} c_{it}^{*\alpha} \, di \right)^{\frac{1}{\alpha}}, \tag{4}$$

where $m_{ft}^{*} \geq m_{ft}$ denotes the number of foreign brands available in Foreign.

Consumption services in Home are given by a Cobb-Douglas index of Home and Foreign CES composites:

$$\tilde{C}_t \equiv \frac{C_{Ht}^{n} C_{Ft}^{1-n}}{n^n (1-n)^{1-n}}. \tag{5}$$

Since preferences over the Home and Foreign bundles are Cobb-Douglas, there is a unitary elasticity of substitution between them. This indicates that Home and Foreign goods are less substitutable than brands and conveys the idea of comparative advantage: each country specializes in a certain type of good. Relaxing the assumption of a unit elasticity of substitution does not affect the main insights of the model. For consumers in Foreign, consumption services are given by

[1] Strictly speaking, these are measures. For ease of exposition, I refer to them as numbers.

$$\tilde{C}_t^* \equiv \frac{C_{Ht}^{*n} C_{Ft}^{*1-n}}{n^n (1-n)^{1-n}}. \tag{6}$$

Finally, the Home consumer solves:

$$\max_{\{C_t\}} \mathbb{U} \equiv \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\tilde{C}_t^{1-\theta}}{1-\theta}, \tag{7}$$

where $\theta > 0$, $0 < \beta \equiv \frac{1}{1+\rho} < 1$, and $\mathbb{E}_0\{\,\}$ is an expectations operator, conditional on information at time $t = 0$. The intertemporal elasticity of substitution of consumption services $\tilde{C}_t$ is $\frac{1}{\theta}$. In this power utility setting, this is also the inverse of the coefficient of relative risk aversion θ. Except for $\tilde{C}_t^*$ replacing $\tilde{C}_t$, lifetime utility in Foreign is symmetric.

1.1 Solution to the Intratemporal Problem

Since the model is symmetric, I only solve the Home problem. First I solve the intratemporal problem in period t and determine how the Home consumer allocates a given amount of expenditure over the $m_{ht} + m_{ft}$ goods available in Home.

Assume nominal consumption expenditure (denominated in Home currency) in period t is E_t. Given Cobb-Douglas preferences, the Home consumer spends nE_t on Home goods and $(1-n)E_t$ on Foreign ones. Given equal prices of p_t, coupled with the strict concavity of utility from each good in the consumption baskets, the consumer buys $\frac{nE_t}{p_t m_{ht}}$ of each Home good (so $\mathfrak{m}_x = m_x$ in equilibrium). Plugging these demands into Home subutility (eq. 1) yields optimal utility from Home goods of $nm_{ht}^v \frac{E_t}{p_t}$. Similarly, the consumer buys a quantity $\frac{(1-n)E_t}{p_t m_{ft}}$ of each Foreign good. This yields an optimal utility of $(1-n)m_{ft}^v \frac{E_t}{p_t}$ from Foreign goods. Now let $C_t \equiv \frac{E_t}{p_t}$ denote the level of real expenditure in Home in period t. Substituting these optimal subutilities into eq. (5) above gives the optimal level of Home consumption services:

$$\sup\ \tilde{C}_t = C_t m_{ht}^{nv} m_{ft}^{(1-n)v}. \tag{8}$$

Indirect utility from consumption services in period t is thus:

$$V_t = \frac{\tilde{C}_t^{1-\theta}}{1-\theta},$$

and lifetime utility reduces to

$$\mathbb{U} \equiv \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t m_{ht}^{nv} m_{ft}^{(1-n)v}\right)^{1-\theta}}{1-\theta}. \tag{9}$$

1.2 Marginal Utility with Consumption Variety

Given equation (8) above, we can consider C_t, m_{ht}^{nv}, and $m_{ft}^{(1-n)v}$ as inputs into the production of consumption services, $\tilde{C}_t$. Because the inputs enter in Cobb-Douglas form, the elasticity of substitution between them is unity.

Importantly, the consumer has preferences over the composition of the consumption basket each period *and* the distribution of consumption services over time. If $\theta > 1$, then services across periods are not good substitutes relative to inputs into consumption services, and vice versa. In this case, the consumer places more weight on having an even profile of consumption services over time than on having a similar amount of each input in the consumption basket. To give an example, consider the case of shoes. Consumers strongly desire a left and right shoe each period. Assume now that this desire is stronger than the desire for having an even level of consumption services over time. In this case, an increase in the number of right shoes in a period means consumers now also want more left shoes. Given *relatively* strong preferences for a similar amount of each good in the consumption basket, consumers want to draw resources from other periods to increase consumption this period. By contrast, if the inputs are easily substitutable relative to consumption services across time, then an increase in any input would lower marginal utility that period. Now the consumer aggressively desires to shift resources to other periods.

Now from equation (9) marginal utility in Home is given by:

$$V'(C_t) = \frac{\left(m_{ht}^{nv} m_{ft}^{(1-n)v}\right)^{1-\theta}}{C_t^{\theta}}. \tag{10}$$

Thus product variety makes marginal utility state dependent. Except in the case of no love of variety (i.e., $v = 0$), equating marginal utility across countries does not in general imply consumption levels are the same. In particular, real consumption itself is no longer a sufficient statistic for marginal utility.

Following the reasoning above, if $\theta > 1$, the marginal utility of consumption, C_t, in any given period is falling in the level of consumption services. In this case, consumers prioritize the smoothing of consumption services over time. Therefore, an increase in product variety in a given period acts to reduce marginal utility and induces the consumer to spread consumption to other periods. Conversely, if $\theta < 1$, the consumer is more concerned with having an even allocation of inputs in a given period. Thus, if product variety increases in a given period, the consumer also wants to increase the amount of consumption that period; i.e., the marginal utility of consumption is higher that period. Finally, if $\theta = 1$, marginal utility is independent of the number of goods in a period. From now on, I will assume $\theta > 1$, since this is the empirically relevant case.

Taking logs and differentiating (10) with respect to time, the growth rate of marginal utility in Home is now:

$$\frac{\dot{V'(C)}}{V'(C)} = (1-\theta)\left(nv\frac{\dot{m}_{ht}}{m_{ht}} + (1-n)v\frac{\dot{m}_{ft}}{m_{ft}}\right) - \theta\frac{\dot{C}_t}{C_t}.$$

Thus, comparing consumption growths does not give an accurate indication of marginal utility growth. Provided consumers have a love of variety, variety growth also affects marginal utility growth. For instance, suppose Home is relatively small (i.e., $n < .5$), and variety growth increases rapidly in Foreign. Assuming this is reflected in imports, then the term $(1-n)v\frac{\dot{m}_{ft}}{m_{ft}}$ is large. Therefore, marginal utility growth can change without any change in consumption. In particular, there is no a priori reason to use consumption correlations alone to determine marginal utility growth. The strength of this effect depends on the love of variety, v, and the size of the country. However, to the extent that some countries might experience both large consumption and variety growth, while others do not, risk-sharing could now in fact be worse than in the standard one-good model. In the next section, I use asset prices to show that marginal utility growths are indeed highly correlated across countries, indicating that the introduction of variety most likely enhances risk-sharing.

2 Inferring Risk Sharing From Asset Prices

In this section, I discuss the implications of the above framework to asset pricing. First I discuss asset pricing in the domestic economy, and then discuss asset pricing in the context of international financial markets.

2.1 The Equity Premium and Marginal Utility Variation

From the usual intertemporal problem, the Euler equation for a risky asset with a net real return r_{t+1} is

$$V'(C_t) = \beta \mathbb{E}_t[(1 + r_{t+1})V'(C_{t+1})]. \tag{11}$$

For a risk-free asset with return $r_{f_{t+1}}$, the Euler equation is

$$V'(C_t) = \beta \mathbb{E}_t[(1 + r_{f_{t+1}})V'(C_{t+1})]. \tag{12}$$

The asset pricing kernel is $M_{t+1} = \beta \frac{V'(C_{t+1})}{V'(C_t)}$, which is unique under the assumption of complete markets. Then, from equation (12), we have: $\mathbb{E}_t[M_{t+1}(1 + r_{f_{t+1}})] = 1 \Rightarrow 1 + r_{f_{t+1}} = \frac{1}{\mathbb{E}_t(M_{t+1})}$. In reality, the net risk-free rate is almost zero, so $\mathbb{E}\left(M\right) = 1$.

Combining equations (11) and (12) gives:

$$0 = \beta \mathbb{E}_t[(r_{t+1} - r_{f_{t+1}})V'(C_{t+1})]. \tag{13}$$

Now suppose the risky asset is the market portfolio. Dropping time-scripts and denoting excess equity returns over the risk-free return by $r^e = r - r_f$, equation (13) implies $\mathbb{E}(Mr^e) = 0$. From this, Hansen and Jagannathan (1991) derive bounds on the volatility of the stochastic discount factor, M. The Hansen-Jagannathan bound is:[2]

$$\frac{\sigma_M}{\mathbb{E}\left(M\right)} \geq \frac{\mathbb{E}\, r^e}{\sigma_{r^e}}.$$

The Sharpe ratio $\frac{\mathbb{E}\, r^e}{\sigma_{r^e}}$ is the mean of expected excess returns divided by the standard deviation of expected excess returns. Empirically, the Sharpe ratio is about .3 across time and countries, and $\mathbb{E}\left(M\right) \approx 1$, so according to the bounds:

$$\sigma_M \geq 0.3.$$

And likewise for Foreign:

[2]We know that $\mathbb{E}\left(Mr^e\right) = 0 = \mathbb{E}\left(M\right)\mathbb{E}\left(r^e\right) + Cov(M, r^e) = \mathbb{E}\left(M\right)\mathbb{E}\left(r^e\right) + \sigma_M \sigma_{r^e} \rho(M, r^e)$. Noting that $\rho(M, r^e) \leq 1$, the bound follows.

$$\sigma_{M^*} \geq 0.3.$$

Intuitively, to rationalize the high equity premium, the kernel must be highly volatile and covary significantly with equity returns. Note that $M_{t+1} = \mathbb{E}_t\left(M_{t+1}\right) + \epsilon_{t+1}$, where $\mathbb{E}_t\left(\epsilon_{t+1}\right) = 0$. Since the unconditional mean $\mathbb{E}\left(M_{t+1}\right)$ is fairly constant, most variation in the kernel must be unpredictable and come from random variation in ϵ.

Because consumption growth is relatively stable, standard one-good preferences do not satisfy the volatility bounds. In this case, the kernel is $M_{t+1} = \frac{\beta V'(C_{t+1})}{V'(C_t)} = \beta(\frac{C_{t+1}}{C_t})^{-\theta} > 0$, which is relatively stable. The failure of the bounds to hold using consumption data is of course another manifestation of the well-known equity premium puzzle.

2.1.1 The Consumption Real Exchange Rate Anomaly

Assume now that each country has a different currency, and there is a complete set of Arrow-Debreu securities. The exchange rate, e, is the Home price of Foreign currency. Consumers in Home and Foreign can trade state-contingent securities, which can be purchased on an international market. Without loss of generality, they can be purchased in Foreign currency for ξ_t and pay off one unit of Foreign currency in period $t+1$ if a given state of nature occurs (which occurs with objective probability π_t).

The optimality condition for a Home consumer buying such a security is:

$$\frac{e_t \xi_t}{p_t} V'(C_t) = \pi_t V'(C_{t+1}) \frac{e_{t+1}}{p_{t+1}} \qquad \Rightarrow \qquad \frac{V'(C_{t+1})}{V'(C_t)} \frac{p_t}{p_{t+1}} \frac{e_{t+1}}{e_t} = \frac{\xi_t}{\pi_t}, \tag{14}$$

that is, the cost of buying the security equals the expected benefit. Meanwhile, for a Foreign consumer buying the security:

$$\frac{\xi_t}{p_t^*} V'(C_t^*) = \pi_t V'(C_{t+1}^*) \frac{1}{p_{t+1}^*} \qquad \Rightarrow \qquad \frac{V'(C_{t+1}^*)}{V'(C_t^*)} \frac{p_t^*}{p_{t+1}^*} = \frac{\xi_t}{\pi_t}. \tag{15}$$

Combining (14) and (15) we have:

$$M_t \frac{p_t}{p_{t+1}} \frac{e_{t+1}}{e_t} = M_t^* \frac{p_t^*}{p_{t+1}^*} \Rightarrow M_t = M_t^* \frac{\frac{e_t p_t^*}{p_t}}{\frac{e_{t+1} p_{t+1}^*}{p_{t+1}}}.$$

Denoting the real exchange rate by $\epsilon_t \equiv \frac{e_t p_t^*}{p_t}$, we have:[3]

$$M_t = M_t^* \frac{\epsilon_t}{\epsilon_{t+1}}$$

$$\Rightarrow \log \frac{\epsilon_{t+1}}{\epsilon_t} = \log M_t^* - \log M_t. \tag{16}$$

And taking unconditional variances gives:

$$Var(\log \frac{\epsilon_{t+1}}{\epsilon_t}) = Var(\log M_t^*) + Var(\log M_t) - 2Cov(\log M_t^*, \log M_t). \tag{17}$$

For our purposes, this is an important condition. According to Colacito and Croce (2006), the standard deviation of the logarithm of the real exchange rate is on average about 11 percent in annualized terms in developed countries. And to rationalize an equity premium of around 6 percent, the standard deviation of the logarithm of the stochastic discount factor must be about 30 percent. As a result, from equation (17), $Cov(\log M_t^*, \log M_t)$ must be high. In particular, this implies the correlation of the stochastic discount factors in Home and Foreign is 0.94. Following this reasoning, Brandt, Cochrane and Santa-Clara (2006) infer a substantial degree of international cross-country risk-sharing. Moreover, this conclusion that exchange rates are relatively smooth relative to marginal utility growths holds for any equity premium exceeding 1 percent.

Brandt et al. consider it a "puzzle" that standard utility functions, which measure risk-sharing by consumption correlations, indicate a poor degree of international risk sharing. Furthermore, the standard model cannot satisfy equation (17) above. Consumption data is relatively stable, but exchange rates are quite volatile; in the data, there is no relationship between consumption growth rates and real exchange rates. This is the Backus-Smith puzzle or the consumption real exchange rate anomaly (Backus and Smith (1992)) and is often taken as evidence of incomplete markets.[4] As with the equity premium puzzle, the source of the puzzle is the stability of aggregate consumption growth.

To reconcile price and quantity data, marginal utility must betray two more properties. First, to explain the equity premium, marginal utility must be more volatile. Second, to rationalize the low

[3]Under the assumption of purchasing power parity, we have $p_t = e p_t^* \Rightarrow \epsilon_t = 1$.

[4]Notably, economists generally do not regard incomplete markets as a solution to the equity premium/risk-free rate puzzle.

volatility of exchange rates, marginal utility in different countries must be strongly correlated. As we shall see next, introducing new goods to the model helps on both margins.

2.2 The Variety-Based Model

Having presented the theory, I now turn to the implications of the model for risk-sharing. From equation (10), the asset pricing kernels are:

$$M_{t+1} = \beta \frac{V'(C_{t+1})}{V'(C_t)} = \beta\Big(\frac{C_{t+1}}{C_t}\Big)^{-\theta}\Big(\frac{m_{h_{t+1}}}{m_{h_t}}\Big)^{vn(1-\theta)}\Big(\frac{m_{f_{t+1}}}{m_{f_t}}\Big)^{v(1-n)(1-\theta)} > 0.$$

$$M^*_{t+1} = \beta \frac{V'(C^*_{t+1})}{V'(C^*_t)} = \beta\Big(\frac{C^*_{t+1}}{C^*_t}\Big)^{-\theta}\Big(\frac{m^*_{h_{t+1}}}{m^*_{h_t}}\Big)^{vn(1-\theta)}\Big(\frac{m^*_{f_{t+1}}}{m^*_{f_t}}\Big)^{v(1-n)(1-\theta)} > 0.$$

Two important points follow from these expressions. First, the introduction of new state variables potentially makes the kernels more volatile, thus making it easier to satisfy the Hansen-Jagannathan volatility bounds. In Scanlon (2007), I show that variety growth is quite volatile, and, for reasonable parameter values, generates an equity premium of about 2-3 percent (and almost certainly above one percent.) By increasing consumption risk, the procyclicality of variety growth over the business cycle makes equities riskier.

Second, taking logarithms of the kernels gives:

$$\log M_{t+1} = -\rho - \theta(\frac{C_{t+1}}{C_t}) + vn(1-\theta)(\frac{m_{h_{t+1}}}{m_{h_t}}) + v(1-n)(1-\theta)(\frac{m_{f_{t+1}}}{m_{f_t}}) > 0. \qquad (18)$$

$$\log M^*_{t+1} = -\rho - \theta(\frac{C^*_{t+1}}{C^*_t}) + vn(1-\theta)(\frac{m^*_{h_{t+1}}}{m^*_{h_t}}) + v(1-n)(1-\theta)(\frac{m^*_{f_{t+1}}}{m^*_{f_t}}) > 0. \qquad (19)$$

To ensure a high degree of risk sharing - as predicted by real exchange rates - we must have:

$$\frac{m_{h_{t+1}}}{m_{h_t}} \approx \frac{m^*_{h_{t+1}}}{m^*_{h_t}} \qquad \text{and} \qquad \frac{m_{f_{t+1}}}{m_{f_t}} \approx \frac{m^*_{f_{t+1}}}{m^*_{f_t}}. \qquad (20)$$

If these conditions hold, the utility function presented here can help rationalize the high degree of risk-sharing indicated by equation (17); that is, $Cov(\log M^*_t, \log M_t) \approx 1$. Because consumption growth is fairly smooth, highly correlated variety growths imply highly correlated stochastic discount factors. With a higher love of variety v, these effects are stronger. Below I briefly discuss how these conditions accord with the data.

2.3 Discussion

In theory, introducing new goods into the standard model can rationalize a higher equity premium and higher risk sharing. Whether this channel is important in reality depends on the degree of love of variety and the extent to which new goods flow across borders.

The new trade theory predicts variety growth is highly correlated across countries. Here, the presence of scale economies causes different countries to specialize in distinct brands and then engage in trade. For developed countries, this seems a reasonable first approximation: the product space is quite similar across the OECD. In another theoretical contribution, Romer (1994) shows how trade barriers, by reducing variety, reduces welfare. Broadly speaking, the empirical estimates of the welfare gains to variety growth are large, suggesting large gains to the exchange of new goods across borders (see e.g., Scanlon (2007) for a discussion).

Turning to more direct empirical evidence, a number of recent studies have explored the role of new goods (i.e., the extensive margin) in international trade (see e.g., Hummels and Klenow (2005), Kehoe and Ruhl (2003), Broda and Weinstein (2006) and Ghironi and Melitz (2005)). These studies stress that the extensive margin plays a significant role in international trade. For example, Hummels and Klenow (2005) provide evidence that the extensive margin accounts for about 60 percent of higher exports of rich countries. They also find an important role for quality: a given product from a rich country commands a higher price. According to Debaere and Mostashari (2006), for about 80 percent of countries, over 40 percent of all goods categories exported to the United States in 1998-2000 were in newly traded goods that were not exported in the period 1989-91. In the United States, imports of differentiated products rose from 47.4% in 1975 to 75.5% in 2000; meanwhile, the proportion of United States exports of differentiated goods increased from 61.3% in 1979 to 78.6% in 2000.

Another piece of evidence is the procyclicality of the level of imports and exports. Ghironi and Melitz (2006) note that cross-country evidence indicates a strong correlation between imports and the number of imported varieties. Because imports are procyclical, this indicates procyclical variety growth. Given the synchronization of international business cycles, the procyclicality of trade flows suggests consumption services are more highly correlated across countries than consumption levels alone. As a result, consumption correlations likely underestimate the correlation of consumption *services* across countries.

Equation (17) predicts bilateral exchange rate volatility increases with distance. According to

Bernard, Redding and Schott (2007), more distant countries trade in very few new goods and the number of exported products falls sharply with distance. More generally, gravity equations indicate trade flows fall with distance. Consistent with equation (17), Alesina, Barro and Tenreyro (2003) show that real exchange rate volatility is increasing in distance. Choi (1995) develops a trade based real exchange rate and shows that including bilateral trade flows in regressions of exchange rates and consumption growth alleviates the Backus-Smith puzzle. Assuming bilateral trade flows proxy for trade in new varieties, this empirical result lends support to the model presented here. Finally, to the extent that ideas and innovations are nonrivalrous, they will diffuse across borders to be developed by domestic producers. In this case, risk sharing can occur without any trade in commodities or financial assets.

3 Conclusion

This paper has examined the role of trade in new goods in the context of international risk sharing. Provided new goods are traded across borders and consumers have a love of variety, then consumption correlations likely underestimate the the degree of international risk sharing. A number of recent studies indicate that the extensive margin of trade is significant, suggesting that trade in new goods is an important form of risk-sharing.

The paper offers a possible resolution to evidence on risk sharing revealed by asset prices. Equity returns indicate marginal utility is relatively volatile, and exchange rate data indicate marginal utility growths are highly correlated across nations. Incorporating variety growth into the standard one-good model makes marginal utility more volatile and is one way to make the model consistent with highly correlated marginal utility growths across nations. Moreover, the international evidence suggests the potential solution to the equity premium puzzle offered by Scanlon (2007) is more plausible. Given little correlation in consumption growth across nations, the international evidence seems hard to reconcile with suggested solutions - such as habit persistence -, which rely solely on consumption data.

More speculatively, the paper suggests a possible explanation for the home bias puzzle. Trade in new goods can only occur via commodity trade, not trade in financial assets. In this sense, significant consumption insurance occurs via commodity trade alone, without the existence of large net positions in foreign assets. This might explain the high degree of home bias and the seeming paradox of limited risk sharing in the face of enormous gross international flows of capital.

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