Global Asset Pricing

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Abstract

Financial markets have become increasingly global in recent decades, yet the pricing of internationally traded assets continues to depend strongly upon local risk factors, leading to several observations that are difficult to explain with standard frameworks. Equity returns depend upon both domestic and global risk factors. Further, local investors tend to overweight their asset portfolios in local equity. The stock prices of firms that begin to trade across borders increase in response to this information. Foreign exchange markets also display anomalous relationships. The forward rate predicts the wrong sign of future movements in the exchange rate, implying that traders can make profits by borrowing at lower interest rate currencies and investing in higher interest rate currencies. Furthermore, the sign of the foreign exchange premium changes over time, a fact difficult to reconcile with consumption variability. In this review, I describe the implications of the current body of research for addressing these and other global asset pricing challenges.

1. INTRODUCTION

Financial markets have become increasingly global in recent decades. Indeed, the recent financial crisis highlighted the strong interlinkages among global capital markets. Therefore, the casual observer might logically presume that internationally traded assets are globally priced. Nevertheless, the body of international financial research shows that prices of globally traded assets depend upon local country-specific risks. Although the importance of these local factors may be diminishing over time, studies continue to point to the significance of both global and local effects.

What are the country-specific effects that matter in a global financial market? These factors naturally surround differences in capital markets that are inherently national. First, many countries maintain their own monetary policy. Therefore, asset prices across countries often incorporate aspects of currency risk. Moreover, these differences in aggregate price policy can affect asset pricing relationships in models without money through real exchange rate changes. Second, countries often differ in the openness of the capital markets. These differences can be explicit as in the case of a government policy to restrict capital movements internationally as well as regulations related to trading, e.g., short sale constraints, margin requirements, and prohibitions on non-domestic holders. Or they can arise in more subtle forms due to different trading liquidities across markets or higher informational costs to foreigners. Collectively, these differences are often called segmented capital markets. Finally, countries differ through government fiscal policy, affecting returns in various ways. For example, the government may tax returns directly or increase the perceived risk of future taxes. Alternatively, the government's fiscal behavior may generate perceived sovereign risk that impacts the returns of all securities from that country.

Although monetary policy, fiscal policy, and segmented markets identify convenient groupings of factors affecting international asset pricing, they are by no means mutually exclusive. For example, international investors may perceive greater sovereign risk in a country with a large fiscal deficit, and that country may also have more segmented capital markets.

Incorporating country-specific differences across countries into standard asset pricing relationships leads to several observations that are difficult to explain with standard models. For example, equity returns depend upon both domestic and global risk factors. Moreover, this dependence on local factors is mirrored by a tendency for local investors to overweight their asset portfolios in local equity, an observation called the home equity bias. The pricing behavior for foreign firms that begin to trade across borders, a phenomenon known as cross-listing, is also cited as evidence for segmentation. The stock price on these foreign firms increases around the cross-listing initiation time. Foreign exchange markets also display anomalous relationships. The most studied of these relationships is the forward discount bias, the phenomenon that the forward rate predicts the wrong sign of future movements in the exchange rate. Because forwards are tied to interest differences across countries, this bias implies that traders can make profits by borrowing in lower interest rate currencies and investing in higher interest rate currencies, generating a money-making strategy called the carry trade. Furthermore, the sign of the foreign exchange premium changes over time, a fact difficult to reconcile with variability in consumption and currency comovements.

In Section 2, I describe the literature on international equity markets and its relationship to the anomalies above. In Section 3, I illustrate the forward discount bias relationship along with proposed explanations. Section 4 provides a short discussion of research that has attempted to combine return behavior across different asset markets. Concluding remarks are provided in Section 5.

2. INTERNATIONAL EQUITY PRICING

To frame the discussion of international asset returns, consider a canonical framework based upon the seminal Lucas (1982) model. Representative consumer-investors live in J countries indexed by j, each endowed with a process that pays out dividends in units of nondurable goods. The dividend payout at time t to investors in country j is defined as Y_t^j. Further, investors in each country j have common time-additive utility, with period utility, $U(C_t)$, and discount factor δ. Thus, the intertemporal marginal rate of substitution of investor of country j, hereafter called the stochastic discount factor (SDF), is defined as $q_{t+1}^j = \rho U'(C_{t+1}^j)/U'(C_t^j)$, and the discount factor between time t and any future period τ is defined as $\delta_{t,\tau}^j \equiv \prod_{h=1}^{\tau} q_{t+h}^j = \rho U'(C_{t+\tau}^j)/U'(C_t^j)$. Although this discount factor depends upon the time-additive utility assumption, matching many features of asset pricing data requires recursive utility such as in Epstein & Zin (1989) along with low-frequency uncertainty in consumption as I describe later in this review.

If the economy is fully segmented so that $C_t^j = Y_t^j$, the stock price of this country, $\hat{z}_t^j$, is given by the standard closed-economy pricing relationship:

$$\hat{z}_t^j = E_t \sum_{\tau=1}^{\infty} \hat{\delta}_{t,\tau}^j Y_{t+\tau}^j, \tag{1}$$

where in the closed-economy case the discount factor depends only on domestic output: $\hat{\delta}_{t,\tau}^j = \prod_{h=1}^{\tau} \hat{q}_{t+h}^j = \delta U'(C_{t+\tau}^j)/U'(C_t^j) = \left[\delta U'(Y_{t+\tau}^j)/U'(Y_t^j)\right]$. For this closed-economy stock price to exist, the expected discounted sum of future output must be bounded. Therefore, the literature typically restricts utility and output processes to ensure this existence. For now, I assume investors share the same time-additive iso-elastic utility function such as constant relative risk aversion (CRRA) and that the endowments follow stationary processes, common assumptions to provide boundedness.

Assume now that capital markets are open so that investors can trade claims on the endowment streams from other countries. Because investors share the same iso-elastic utility, they optimally choose to hold a world mutual fund paying out dividends from the aggregate endowments across countries: $\overline{Y}_t \equiv \sum_{j=1}^{J} Y_t^j$. Thus, the consumption of the investor in country j is now equal to its equity share in world output and is therefore proportional to world output so that $C_t^j = \mu^j \, \overline{Y}_t$.[1] In this case, the open economy price of country j in world markets, $\bar{z}_t^j$, is

$$\bar{z}_t^j = E_t \sum_{\tau=1}^{\infty} \overline{\delta}_{t+\tau} Y_{t+\tau}^j, \tag{2}$$

where the SDF is now shared across countries so that $\overline{\delta}_{t+\tau} = \prod_{h=1}^{\tau} \overline{q}_{t+\tau} = \rho U'(C_{t+\tau}^j)/U'(C_t^j) = \left[\rho U'(\overline{Y}_{t+\tau})/U'(\overline{Y}_t)\right]$.

[1]For more discussion of this result, see for example Obstfeld (1994) and Lewis (2000). The share of consumption in world output is constant only under certain assumptions such as common time-additive iso-elastic utility. Below, I describe recent approaches that extend these assumptions.

This very simple framework illustrates a key feature of the canonical international equity pricing model. Under segmented markets, the equity price is determined by the SDF derived from domestic output alone. In this case, relationships between equity prices simply depend upon the exogenous correlation of the endowment processes, Y_t^j. However, integrated markets imply that prices endogenously comove according to the common SDF, $\overline{q}_t$.

This straightforward implication was one of the first international asset pricing relationships considered in the literature using excess returns of equities across countries. Defining the gross real return on equity as $R_{t+1}^i \equiv \left[\left(z_{t+1}^i + Y_{t+1}^i\right)/z_t^i\right]$ and the gross real risk-free rate as R_t^{rf}, the Euler equation implies

$$E_t\left[r_{t+1}^i q_{t+1}^j\right] = 0, \tag{3}$$

where $r_{t+1}^i \equiv R_{t+1}^i - R_t^{rf}$, the excess return. Thus, when international equity markets are integrated, Equation 3 and Equation 2 imply that returns are priced by the covariance with a common global factor. By contrast, when markets are segmented as in Equation 1, excess returns will be priced according to their covariance with local factors, potentially generating J many factors.

In this section, I review the literature on these relationships in three steps. First, I summarize the extensive literature that rejects the hypothesis that returns depend upon a set of common world factors in favor of models including local factors. Second, I discuss models that have attempted to relate these local factors to sources of country-specific idiosyncratic risk and to behavioral and informational asymmetries. Finally, I describe other features related to these models such as portfolio holdings and capital flows.

2.1. Global and Local Factors: The Empirical Evidence

The potential for a common global risk factor to determine international expected equity returns carries an obvious appeal. In early work, Solnik (1974a) and Grauer et al. (1976) described a world capital asset pricing model (CAPM) in which the standard Sharpe-Littner CAPM holds but the world market portfolio replaces the domestic market. Stulz (1981a) developed an intertemporal version of this model showing that all returns are determined by a common global source of risk under purchasing power parity. Solnik (1974b) and Stehle (1977) found that the World CAPM pricing relationship could not be rejected based upon unconditional mean returns. However, subsequent papers using conditional models found that the simple framework can be rejected and that local risks are important (see Karolyi & Stulz 2003 for a survey). Nevertheless, the appeal of the simple model continues until today, as the World CAPM is often used as a benchmark. For example, the World CAPM is used as a benchmark in some studies of home equity bias (see Ahearne et al. 2004 for an example).

To understand the implication of these rejections for international equity pricing, I next describe three groups of papers that empirically evaluate the World CAPM either directly or indirectly through global factors. The first group of papers analyzes the expected equity returns across countries at an aggregate market-index level. The second group considers international equity pricing at the firm level. The third group of empirical studies assesses the importance of global- relative to local- or country-level risks. The results from these three different angles give a profile of international equity return behavior that has motivated various international asset pricing models I describe later in this review.

2.1.1. Explaining aggregate international equity returns. Some of the earliest conditional tests of international equity returns were based upon the Euler equation relationship given in Equation 3, which followed the pioneering work in foreign exchange by Hansen & Hodrick (1983). Rewriting the investor's Euler equation in terms of covariances and dropping the superscript on q without loss of generality implies

$$E_t r_{t+1}^i = -Cov_t(R_{t+1}^i, q_{t+1}) R_t^{rf}. \tag{4}$$

Because Equation 4 holds for any asset, the risk-free rate can be substituted out to obtain the relationship

$$E_t r_{t+1}^i = \frac{Cov_t(R_{t+1}^i, q_{t+1})}{Cov_t(R_{t+1}^b, q_{t+1})} E_t r_{t+1}^b, \tag{5}$$

where r_{t+1}^b is the excess return on an arbitrary benchmark asset. Several authors, such as Cumby (1990), Lewis (1991), Campbell & Hamao (1992), and Bekaert & Hodrick (1992), tested these restrictions across several international asset markets including equity. These papers generally rejected the hypothesis of a priced risk factor structure across markets that could be attributed to a common SDF.

An independent but related line of research examined the factor pricing relationships in excess returns using the World CAPM as a benchmark. The first set of studies assumed purchasing power parity. Harvey (1991) and Ferson & Harvey (1993) considered whether expected excess returns of market indices across a set of industrialized countries could be explained by their covariance with the world equity return. They found that the model had explanatory power for returns. However, the latter paper showed that the expected returns were better explained by multifactor models that include local sources of risk.

Dumas & Solnik (1995) estimated both unconditional and conditional versions of the World CAPM. Whereas the unconditional version of the model was not rejected, the conditional version was rejected. Their results are reported in **Table 1**, panel A. The unconditional version of the model is not rejected at a p-value of 0.16, but the conditional version is strongly rejected at a p-value less than 0.001. Furthermore, they strongly reject the hypothesis that the price of global and currency risks are constant, suggesting that the unconditional tests lack power. When they consider the same hypotheses for an asset pricing model that allows for exchange rate risk (Adler & Dumas 1983), they find that the unconditional version is only marginally rejected at 5%, whereas the conditional version is not rejected. Moreover, the hypothesis that exchange rate risk is not priced is strongly rejected. The general conclusions that exchange rate risk is priced and that the price of risk is time-varying appears in several papers, including De Santis & Gerard (1997) and Vassalou (2000).

2.1.2. Explaining firm-level international equity returns. Firm-level stock return behavior presents another dimension of international equity pricing. The World CAPM represents a

Table 1 Global and local factors in equity pricing[a,b]

Panel A: World and international asset pricing model			
Model version	**World**	**International**	**No priced currency risk**
Unconditional	0.161	**0.049**	0.740
Conditional	<**0.001**	0.228	<**0.001**
Panel B: Firm-return factor models			
	World CAPM	**World FF**	**World APT**
World CAPM	—	**−6.77**	**−3.10**
World + Local	**−5.50**	**−5.53**	**−8.38**
Heston- Rouwenhorst	**−2.84**	−0.29	0.29
	World + Local CAPM	World + Local FF	World + Local APT
Heston-Rouwenhorst	**5.00**	**7.28**	**7.31**
Panel C: Loadings for foreign company returns on U.S. + local market $r_t^{i\ell} = \alpha + \beta^{US} r_t^u + \beta^{local} r_t^\ell$			
1. Equally weighted means			
Total foreign MNCs in U.S.	β on U.S.	β on local	R^2
Full sample	−0.024	**0.760**	0.200
2. Market-weighted means			
U.S. exchange subset in 2004	β on U.S.	β on local	Corr(R^u, R^ℓ)
Before cross-listing	**0.486**	**0.647**	0.198
After cross-listing	**0.740**	**0.766**	0.289
3. Based on cross-listing event			
Abnormal returns[c]		Change in beta	
Prelisting	Postlisting	Local	Global
0.15	**−0.14**	**−0.321**	**0.135**

[a]Sources: Panel A is from Dumas & Solnik (1995, tables III and VI). The cells report the *p*-value for the hypothesis in the column. Panel B is from Bekaert et al. (2009, table IIA), reporting *t*-stats for MSE difference for model in row minus model in column. Panel C1 and C2 is from Chua et al. (2010, table 7) and author's calculations. Panel C3 is from Foerster & Karolyi (1999, table VI).
[b]Abbreviations: APT, arbitrage pricing theory (Ross 1976); CAPM, capital asset pricing model; FF, Fama-French (1992); MSE, mean squared errors; MSL, marginal significance level.
[c]Returns in weekly percent. Numbers in bold are significantly different from zero at 5% MSL.

straightforward extension of the domestic CAPM to the international market. However, as has been demonstrated in the domestic empirical literature (e.g., Fama & French 1992, Carhart 1997), this model does not explain the cross section of returns compared to a model augmented by factors that depend upon size, the value of the firm, and possibly momentum.

The obvious question raised by this evidence is: What model best explains firm-level returns internationally? Because no empirically implementable theoretical model has yet been derived to explain the importance of factors such as size and value, papers that address this question typically rely on a simple factor structure to explain returns.[2] The effect on expected equity returns from risk exposure to these factors are measured empirically by the loadings on factor-mimicking portfolios.

Fama & French (1998) studied an international cross section of firm equity returns using a global market factor and a factor based upon book value relative to market value. They found that the value premium, characteristic of U.S. firm returns, is pervasive in the 13 countries studied. Griffin (2002) included the size factor and also considered whether the effects on equity returns differ depending on whether the factors are domestic or foreign. He found that country-specific versions of the three-factor model were more useful at explaining portfolio and individual stock returns than a world three-factor model. Hou et al. (2011) provided an extensive analysis of 27,000 stocks from 49 countries to investigate the factors that drive firm-level returns across countries. The model that best explains variation in returns across these stocks is a multifactor model that depends upon the ratio of cash flow to price as well as momentum. Fama & French (2010) examined returns using size, value, and momentum factors for four regions, considering both integrated and local models. They found that the local model explains returns best across three regions.

2.1.3. Global versus local factors: the scope for diversification. Although studies find that local factors are important for explaining cross-sectional expected returns, the restriction that intercepts equal zero is usually rejected. Therefore, mean foreign equity returns often cannot be measured with much precision. Nevertheless, the importance of local and country risks in international equity returns together with the low correlation across markets suggests that holding foreign equity can help reduce the risk of the domestic equity portfolio.

Along these lines, Heston & Rouwenhorst (1994), hereafter HR, asked whether firm-level returns are driven by country or industry effects. For this purpose, they studied all of the firms in the Morgan Stanley Capital International (MSCI) indices of 12 European countries. They grouped these firms into industries and then considered cross-sectional regressions for each firm's return, R_t^j, according to

$$R_t^j = \alpha_t + \phi_t^i + \gamma_t^k + e_t^j, \tag{6}$$

where α_t is a time-fixed effect and thus a base level of return at time t; where ϕ_t^i and γ_t^k are coefficients on dummy variables if the firm operates in industry i, or comes from country k, respectively; and e_t^j is the firm-specific shock. Instead of choosing country and industry returns as benchmark factors for these returns, they constructed an average firm from an equally weighted portfolio. Using these estimates, they found that the country effect explained an average of 24% across industries, whereas the industry effect only explained an average of 5% across countries. They also discovered that 62% of the variance on an average stock can be eliminated by diversifying across industries within a country, whereas diversifying across countries within an industry eliminates 80% of this variance. They concluded that country diversification is more important than industry diversification.

[2]However, Gomes et al. (2003) develop a theoretical model that matches the domestic empirical findings.

Bekaert et al. (2009) considered various factor models to determine which one best explains the variation in international equity returns for all of the firms in the MSCI world index. Because first moments of equity returns are imprecisely estimated, they focused upon time-varying second moments. They then ran a horse race both with and without local factors for four different models: the World CAPM, the model augmented with Fama-French factors, an arbitrage pricing theory (APT) factor model (Ross 1976) estimated by principal components, and the HR model.

Table 1, panel B provides some summary information about these tests. The table reports *t*-statistics for the difference in mean squared errors (MSE)[3] of the model in the row minus the MSE of the model in the column. Thus, the first line shows that the MSE of the World CAPM is significantly higher than both the MSE of the World Fama-French (−6.77) and the World APT (−3.10) models. Clearly, the World CAPM is dominated by these other models. However, the second line shows that all of these models are improved by adding local factors. As such, all the versions of models with local factors significantly dominate world-only factor models. Because the HR model inherently imposes the restriction that the factor loadings are effectively one, it does not explain returns as well as any of the other models except the World CAPM.

Several papers have suggested that industry effects are becoming more important than country effects. These papers include Cavaglia et al. (2000), Ferreira & Gama (2005), Carrieri et al. (2007), and Carrieri et al. (2008). Bekaert et al. (2009) reconciled their results with this literature by testing for differences in trend correlations over time. Using more recent data, they found that country effects are still significantly important in explaining international equity returns even after controlling for industry effects.

Another feature of global and local factors is the relatively high comovement between company returns and local factors, as demonstrated by the coefficients on the World plus Local CAPM model. This factor sensitivity affects the ability to diversify internationally. Although Bekaert et al. (2009) showed that other models explain returns better, this simple two-factor model continues to be a benchmark for many studies that consider international events such as cross-listings. To illustrate this relationship, panel C1 reports the cross-sectional mean of time-series regression coefficients for all foreign companies that have traded on a U.S. equity exchange since 1975 through 2010, approximately 1,100 total. These companies are important because they are the most likely to be globally priced. Nevertheless, a simple mean of coefficients from return regressions of these foreign companies on the U.S. market suggests they would be an excellent hedge given that the beta is essentially zero and the coefficient on the local market is approximately 0.8.

This simple statistic ignores the correlation across U.S. and foreign returns as well as the increase in that correlation over time, however. Even early studies such as Longin & Solnik (1995) showed that the correlation across major countries increased from 1960 to 1990. The evolution toward more integrated equity return exposures has been substantiated in later studies (e.g., Baele 2005, Bekaert et al. 2007, Eun & Lee 2010). This relationship is likely to hold true in firm returns as well. Indeed, as panel C shows under section 2, the relationship between the firm returns and the market returns changes significantly after the foreign firm begins trading on U.S. exchanges, an event called cross-listing. The table reports results from Chua et al. (2010) for a market-weighted set of firms that are listed

[3]The MSE is the time series–weighted mean of errors between the sample data and the model.

on U.S. exchanges in 2004. Using a test that endogenously chooses break dates, they found that the foreign firm betas on the U.S. market increased over time after cross-listing. These results corroborate evidence from several authors that condition on cross-listing dates, beginning with Foerster & Karolyi (1999, 2000). Section 3 of panel C restates some of their estimates showing that the average global beta increased after cross-listing whereas the local beta declined. (Karolyi 2006 provides a review of the literature and describes the robustness of these relationships.) Thus, although foreign firms tend to have low betas against the U.S. and other world markets, these betas appear to be increasing over time.

2.2. Local Market Risks and International Equity Pricing Models

Overall, the evidence on international equity returns shows that the standard World CAPM and the associated single-factor model of returns are rejected by the data. Empirical international equity pricing studies show that returns depend upon more than a single factor and that at least some of these additional factors depend upon local sources of risk. Developing models to explain both global and local sources of risk is challenging given that the two are typically associated with different views of market integration. In the simple framework above, equity prices are either priced in completely segmented markets as in Equation 1 so that all factors are local, or else they are priced in fully integrated markets as in Equation 2 so that all factors are global. The evidence, therefore, poses a challenge to develop models that allow for investors to have access to international markets yet retain exposure to local shocks that cannot be diversified away.

2.2.1. Purchasing power parity deviations and exchange rate risk. Purchasing power parity deviations generate one potential answer to this challenge. In a seminal paper, Adler & Dumas (1983) showed how purchasing power parity deviations affect equity returns. Even though investors may trade in fully open capital markets, purchasing power parity deviations imply that the real return to investors varies across countries. As a result, investors view the expected return and risk from investing in securities differently depending upon their country of residence. The pricing of international securities therefore depends upon the covariance of the security returns with the home investor's inflation, a local risk factor, and also the covariance of this security's returns with all the rest of the world's purchasing power parity deviations, a set of global risk factors.

A necessary condition for this model to hold in the data is that exchange rate risk be priced, a condition established in the literature I describe above. However, because individual equity returns also depend upon other local factors, currency appears to be only part of the explanation for international equity returns.

2.2.2. Emerging markets and capital market liberalizations. Some governments restrict access to their countries' capital markets. Because these restrictions segment global capital markets, they provide another reason for local factors to affect equity returns. This explanation was described in theoretical papers as early as Black (1974) and Stulz (1981b). These papers considered the impact on equity returns if the domestic investor must pay extra costs on foreign relative to domestic investments. Errunza & Losq (1985, 1989) developed a framework to consider more direct capital market restrictions among countries. Although these papers did not relate the equity returns directly to a world and local factor model, they generally found that the capital market equilibrium returns differ across countries and, as emphasized by Stulz (1981b), need not correspond to a completely segmented or integrated model.

Bekaert & Harvey (1995) examined this relationship in equity returns of emerging markets. They considered an empirical model that switched between two regimes. In the first regime, markets are completely integrated as in Equation 2. Rewriting the SDF into components of the world price of risk, the Euler equation (Equation 3) under integration implies that the market returns for country *j* depend upon the covariance with the world according to[4]

$$E_t r_{t+1}^j = \lambda_t Cov_t(r_{t+1}^j, r_{t+1}^W), \tag{7}$$

where r_{t+1}^W is the return on the world market and λ_t is the time t expected world price of risk. Alternatively, the second regime is characterized as an emerging market with closed capital markets. In this case, the returns within a country are determined solely by their covariance with the domestic market as in Equation 1. The stock market return for country *j* is then given by

$$E_t r_{t+1}^j = \lambda_t^j Var_t(r_{t+1}^j), \tag{8}$$

where λ_t^j is the corresponding price of country *j*'s risk. They pointed out that an econometrician analyzing emerging market returns would observe data over both regimes. Thus, the returns would be explained by both the integrated world factor in Equation 7 and the segmented local market factor in Equation 8 according to

$$E_t r_{t+1}^j = \pi_t^j \lambda_t Cov_t(r_{t+1}^j, r_{t+1}^W) + (1 - \pi_t^j)\lambda_t^j Var_t(r_{t+1}^j), \tag{9}$$

where π_t^j is the probability of country *j* being in the integrated regime based upon time t information. They estimated this model and found that indeed there is time-varying integration generated by the probability of the two regimes.

The potential for time-varying integration poses issues for valuing assets in emerging markets. Bekaert & Harvey (1997) considered the implications for measuring volatility and pricing behavior. Henry (2000) and Chari & Henry (2008) looked at the impact on aggregate and individual stock returns when markets announce a liberalization. Bekaert & Harvey (2000) analyzed a present-value model based upon dividend yields to measure the effects on cost of capital from liberalization. Bekaert et al. (2002) used data on stock market returns together with macroeconomic variables to estimate the date of the liberalization across several episodes. They found that the dates estimated with returns align well with the announcements. Surveys of the implications of liberalization on equity pricing and on capital markets are given in Bekaert & Harvey (2003) and in Henry (2007), respectively.

Overall, the empirical equity pricing literature on emerging markets and liberalizations provides one explanation for the presence of global and local factors in returns. These two sets of factors coexist in returns as countries transition to more open markets. However, transition to openness seems less likely to explain the importance of local and global factors in equity returns of developed countries.

[4]Dumas & Solnik (1995) describe the steps required for this rewriting.

2.2.3. Information differences across markets. Equity returns depend upon both global and local sources of risk. So far, I have described how these sources of risk can result from differing real returns, or explicit restrictions to capital movements. However, these sources of risk can also arise from more subtle impediments such as informational differences across international markets.

Several papers developed asymmetric information models to consider international investment flows. The basic model in Brennan & Cao (1997) has become a benchmark for this literature. In this model, domestic and foreign investors receive public and private signals about payoffs on investments in the home and foreign market. The precision of the signals to investors is higher in their own market, capturing the idea that these investors have more information about home securities. A random supply of exogenous liquidity traders arrive every period, purchase the assets, and help determine the price. Thus, the equilibrium price depends upon the signals of the two sets of investors. Although the models in this literature are developed to explain investment flows rather than returns per se, the stock price solutions illustrate the intuition that asymmetric information will generate both local and foreign risk factors in returns.

Dumas et al. (2011) considered whether differences in the ability to assess information across countries can generate an asset pricing model with local and global risk factors, among other empirical regularities. In their model, domestic and foreign investors observe signals about the expected growth of dividends. In contrast to the asymmetric information literature, all signals are public but domestic investors understand better how to use that information to forecast future dividends. Because investors react to the same information differently, this behavior induces an additional source of risk. The model implies that returns have a two-factor structure that depends upon both home consumption and foreign consumption. Moreover, the equilibrium equity returns depend upon all of the state variables in their model, including up to seven factors, coincidentally consistent with the number of factors found in Bekaert et al. (2009).

2.2.4. International equity pricing overview. No single asset pricing model appears to fit the empirical result that returns are simultaneously priced with local and global factors across a wide range of countries and firms. Nevertheless, there is some support for each explanation individually. Equity returns appear to include the pricing of foreign exchange, consistent with the importance of inflation differences. Equity returns from emerging markets depend upon a combination of segmented and integrated market risks, and the shifts in these patterns correspond to liberalization dates. Finally, differences in information across markets generate sources of domestic and foreign risks that should theoretically be priced in equilibrium, though these risks are difficult to measure.

2.3. Other Implications of Equity Pricing Models

So far, I have described research related to international equity pricing relationships. But many of the models used to describe these relationships have other capital market implications as well. I next highlight three of these: home equity bias, the relationship between international capital flows and returns, and equity responses to international cross-listing.

2.3.1. Home equity preference. Domestic investors hold a disproportionate share of their equity portfolio in domestic firms. This observation was noted in the United States at least as early as Grubel (1968) and Levy & Sarnat (1970) and was shown in a data set across several developed countries by French & Poterba (1991). Moreover, Ahearne et al. (2004) have shown that the proportion of foreign equity holdings in the U.S. portfolio is only approximately 12%, whereas the foreign portfolio share in world markets is approximately 50%. Thus, the so-called home bias phenomenon appears to persist.

Whether this phenomenon is puzzling clearly depends upon how well the domestically biased portfolios achieve the objectives of home investors. If international equity returns are determined by a single-factor model such as the World CAPM, then domestic investment in foreign equities indeed falls short of the optimal holdings implied by a market-weighted share of foreign equities in the world portfolio. However, as described above, the literature on international equity pricing demonstrates that this simple version of the model is rejected by the data. Thus, whether home equity bias is surprising must be put into the context of other asset pricing models that can potentially fit the data better. Toward this purpose, I now reconsider home equity preference in the context of the asset pricing models described above.[5]

One reason why investors may hold different portfolio allocations than the world market portfolio is that returns differ according to the country of residence. In their seminal paper, Adler & Dumas (1983) derived the equilibrium portfolio holdings for investors facing purchasing power parity deviations and, hence, real exchange rate risk. The desired portfolio for an investor in a given country depends upon two components: a common portfolio across investors that maximizes the log of mean gross returns and a country-specific portfolio that hedges the real exchange rate risk. Cooper & Kaplanis (1994) combined moments of equity returns and portfolio holdings to determine whether currency risk can explain home bias. They found that it cannot. They then used their estimates to back out the size of implicit transactions costs required to prevent investors from holding these positions. These estimates appear unrealistically high.

Although country-specific risk in the form of real exchange rate variation cannot explain home bias, investors may use domestic assets to diversify other idiosyncratic country-specific risks. These risks may include shocks to nontradeable goods (Baxter et al. 1998) and human capital (Baxter & Jermann 1997, Jermann 2002).

Whether these arguments help or hurt the home equity bias explanation depends upon how well domestic assets hedge these country-specific risks relative to foreign assets. If domestically traded assets can provide diversification opportunities without the need to directly invest in foreign assets, even small transactions costs and informational asymmetries may induce investors to overweight domestic equities. To investigate this possibility, Errunza et al. (1999) constructed optimally weighted portfolios of U.S.-traded securities that are likely to have foreign risk components, securities such as U.S. multinationals, foreign stocks listed on U.S. exchanges, and country funds. They then tested whether these U.S.-traded portfolios span the risk in foreign market indices. Interestingly, they could not reject this hypothesis except for some of the emerging markets. Their results call into question the benefits of holding foreign equities directly on foreign stock exchanges given that this diversification can be duplicated on the domestic exchange with lower transactions costs. Stocks from emerging markets form

[5]A full survey of home equity bias is beyond the scope of this review. For a longer but dated survey, see Lewis (1999). Coeurdacier & Rey (2010) give an excellent recent survey of home bias in macroeconomic models.

an exception to this result, but for these stocks capital market restrictions may be more significant.

Another potential problem with the standard home equity preference argument involves the time-varying variances of international equity returns. Several papers such as King et al. (1994) and Longin & Solnik (1995, 2001) showed that the correlation between international equity returns are higher when the market declines than when it increases. If so, argued Ang & Bekaert (2002), the diversification potential of foreign equity may be diminished given that correlations are high when hedging motives are most needed. Nevertheless, these authors showed that the benefits of international diversification remained during bear markets as well as bull markets. However, Chua et al. (2010) showed that foreign equities traded in the United States would not have provided diversification benefits during the recent financial crisis.

Finally, asymmetric information between domestic and foreign investors may generate a tendency to hold domestic assets. Gehrig (1993) showed that if domestic investors have more precise information about home equity compared to foreign investors, they will choose to hold relatively more domestic equity. Intuitively, foreign stocks will seem riskier because domestic investors are less informed about them. In this framework, home bias stems from the assumption that domestic investors are more informed about domestic securities, leading one to ask why foreign investors do not become more informed about the domestic securities.

To address this question, Van Nieuwerburgh & Veldkamp (2009, 2010) developed a model in which investors choose how informed they wish to be about a group of assets. In this model, domestic investors have more initial information about the domestic asset so that they have a comparative advantage in local information acquisition. In equilibrium, they endogenously choose to remain less informed about the foreign assets in favor of domestic assets.

This line of research would seem to suggest that home bias results simply from an informational disadvantage in foreign assets. However, Dumas et al. (2011) showed that this view is too simplistic. In their model, foreign investors have an informational disadvantage in processing domestic signals (following the difference in information-processing frameworks in Dumas et al. 2009 and Scheinkman & Xiong 2003.) As such, foreign investors overreact to domestic dividend changes. The foreign investor views the domestic equity as being riskier because he does not understand how to interpret all the publically available information. The presence of confused foreign investors creates additional risk in domestic equity returns, thereby reducing desired domestic equity holdings by domestic investors. Dumas et al. (2011) found that the informational advantage effect dominates the foreign sentiment risk effect on average, but that these two effects generate time-varying home bias.

2.3.2. Foreign capital inflows and equity returns. Capital flows and equity returns comprise another relationship that depends upon global asset pricing. Bohn & Tesar (1996) found that monthly U.S. portfolio flows are positively related to contemporaneous flows in most large equity markets. The standard asset pricing model with complete information and markets provides little guidance about capital flows given that prices can equilibrate without any associated capital flows. By contrast, asset pricing models based upon asymmetric information generate capital flow predictions as investors attempt to trade on their private information.

Brennan & Cao (1997) developed these implications by assuming that investors in the home country have access to more precise private signals about domestic dividend payouts. As a result, foreign investors over-react to common public signals, thereby creating a positive correlation between domestic returns and foreign capital inflows. They empirically studied this relationship for both developed and emerging markets. Similar to Bohn & Tesar (1996), they found that the purchases of U.S. equities by foreign developed countries and U.S. purchases of equities in these same countries were generally positively related to returns, though the results were more mixed for emerging markets. Using a model with international differences in opinion described above, Dumas et al. (2011) also generate covariation between domestic returns and foreign capital inflows.

Although the Brennan & Cao (1997) model implies a contemporaneous movement between returns and capital flows, in practice empirical studies relate lagged capital flows to contemporaneous returns to adjust for information lags. As such, the relationship is typically associated with trend-following behavior by foreigners, as found in several papers.[6] Brennan et al. (2005) argued that differences in lags of portfolio flows make the trend-following evidence difficult to interpret. Instead, they used surveys of institutional investors to study how market returns across countries affect the bullishness of these investors. Consistent with their model, they found that the fraction of foreign institutional investors that are bullish about a given market increases with the return on that market. However, Curcuru et al. (2011) examined newly available data on country allocations and showed that U.S. investor trades are consistent with portfolio rebalancing, not with an informational disadvantage.

Baker et al. (2010) examined more directly the empirical implications of potential differences of opinion on international returns. Following the approach taken by Baker & Wurgler (2006) for the United States alone, they constructed a sentiment index for six developed countries using principal components of several data variables related to bullishness of the market. They then used the common component across these markets to characterize a global sentiment index. They found that the global sentiment index rather than the local sentiment index was important for explaining the cross section of returns. As they argued, capital flows are one mechanism for this sentiment to spread across countries.

2.3.3. International equity cross-listing. The stock price response of firms that cross-list in other markets is often cited as evidence of market segmentation. For example, **Table 1**, panel C3 reports the abnormal returns from Foerster & Karolyi (1999) for the window of one year prior to the cross-listing event at approximately 15 basis points weekly or approximately 7% annually. The listing week displays another 12 basis point increase (not shown), and then the returns decline by approximately 14 basis point, though not significantly. As surveyed in Karolyi (2006), this pattern is robust. Across a variety of studies, returns on stocks tend to be abnormally high around their cross-listing event, with estimates ranging from 1.5% and 7% per annum. Even with an event window as long as ten years, Sarkissian & Schill (2009) found significant abnormal returns.

[6] See for example, Choe et al. (1999, 2005), Grinblatt & Keloharju (2000), Froot et al. (2001), Dahlquist & Robertsson (2004), Griffin et al. (2004), and Edison & Warnock (2008). However, Grinblatt & Keloharju (2000) find that foreign institutional investors make more profits on their investments.

The dramatic effect on firm returns raises obvious questions about the reason. Obvious explanations such as risk sharing are easily ruled out. As described by Karolyi (2006), firms do not appear to be motivated by lower beta in the United States. Indeed, most of the cross-listed firms come from countries such as Canada that already comove strongly with the United States. However, the biggest price effects are documented for firms from countries with more lax disclosure requirements than the United States.

Coffee (2002) argued that these effects are generated by a bonding effect. Foreign cross-listed companies bond themselves to a more stringent set of disclosure requirements by committing to abide by U.S. accounting standards and securities regulations. As a result, the market views these firms as less risky, and accordingly their stock price rises.

2.4. International Equity Market Summary

Equities comprise an important global asset market. Despite the increase in integration across countries over time, equity returns continue to depend strongly on local factors. Models developed to understand this codependency range from country-specific risks to capital market restrictions and informational asymmetries. These models also highlight some well-known regularities in these markets such as home equity bias, the comovement of returns and foreign capital flows, and abnormal returns during international equity cross-listing. These models provide a context for considering other global asset markets such as currency and fixed income.

3. FOREIGN EXCHANGE AND INTERNATIONAL BOND RETURNS

Currency is a risk characteristic that distinguishes one country's return from another. Indeed, exchange rate risk appears to be priced in international equity returns, as described above. Moreover, the price of exchange rate risk can be addressed directly by analyzing the expected return from borrowing in one currency and investing in another currency. Standard foreign exchange risk models treat the borrowing and investing interest rates as short-term risk-free rates. However, as recent concerns regarding Europe have shown, returns across countries can also embody sovereign default risk as well as potential credit risk differences. In this section, I begin by describing the behavior of foreign exchange returns and its associated literature before turning to the implications for sovereign default risk.

3.1. Foreign Exchange Returns: Structure and Empirical Evidence

Foreign exchange returns are typically characterized by a long-short strategy often used to motivate interest parity. The investor borrows at a domestic currency nominal risk-free rate, owing gross return $\tilde{R}_t^{rf}$, and then invests the proceeds per unit of domestic currency in a foreign nominal risk-free asset earning gross return $\tilde{R}_t^{rf*}$ in foreign currency units. Thus, the investor engaged in such a strategy will earn $\left(S_{t+1}\tilde{R}_t^{rf*}\right)\Big/\left(S_t\tilde{R}_t^{rf}\right)$ in units of domestic currency, where S_t is the spot domestic currency price of foreign currency. Defining the nominal home and foreign currency risk-free rates as i_t and i_t^*, respectively, the logarithm of this strategy can be written as:

$$r_t^{fx} \equiv s_{t+1} - s_t + \left(i_t - i_t^*\right),$$

where $1+i_t \approx \ln R_t^{rf}$, $1+i_t^* \approx \ln R_t^{rf*}$, and where lower-case letters refer to the logarithm. The forward premium equals the difference between the domestic and foreign interest rate by covered interest parity; that is, $f_t - s_t = i_t - i_t^*$. Rewriting this strategy in terms of the forward rate implied by covered interest arbitrage, the excess returns from the strategy becomes

$$r_t^{fx} \equiv s_{t+1} - f_t. \tag{10}$$

The foreign exchange return is therefore equivalent to taking a long position in the foreign currency and short position in the domestic currency. If the foreign currency appreciates relative to the forward rate, the future spot price of foreign currency exceeds the forward rate so that the position generates profits.

If the forward rate is an unbiased predictor of the future exchange rate, then interest parity holds and foreign exchange returns earn zero profits on average. Studies find that interest parity holds over long horizons, but shorter-term deviations can be predictable and significant, conditional on interest rates. To provide a structure to describe this phenomenon, I first restate the Euler equation structure in Section 2. I then use this structure to consider the empirical evidence.

3.1.1. Euler equation implications. To consider the foreign exchange return using the Euler equation above, I evaluate the strategy of going long in foreign currency in percent terms $(E_t S_{t+1}\text{-}F_t)/S_t$ and rewrite the SDF in nominal terms.[7] Defining the price index of the consumption good in the home country as P_t and that of the foreign country as P_t^*, the nominal SDF for domestic and foreign currency can be written as Q_t and Q_t^* where

$$\begin{aligned} E_t Q_{t+1} &\equiv E_t\left[\frac{\delta U'(C_{t+1})/P_{t+1}}{U'(C_t)/P_t}\right] = 1/\widetilde{R}_t^{rf}, \\ E_t Q_{t+1}^* &\equiv E_t\left[\frac{\delta U'(C_{t+1}^*)/P_{t+1}^*}{U'(C_t^*)/P_t^*}\right] = 1/\widetilde{R}_t^{rf*} \end{aligned} \tag{11}$$

Thus, Q_{t+1} is the intertemporal marginal rate of substitution of one unit of domestic currency between period t and $t+1$, and similarly for Q_{t+1}^*. The spot rate is simply the contemporaneous ratio of nominal rates of substitution in consumption implying[8]

$$(S_{t+1}/S_t) = \left(Q_{t+1}^*/Q_{t+1}\right). \tag{12}$$

[7]See for example Backus et al. (1993). The approach can also be written in real terms by including two goods that provide a role for real exchange rate variability. For an early example, see Hodrick & Srivastava (1984).

[8]The exchange rate is the relative price of domestic consumption relative to foreign consumption in currency units. Thus, the relative price is determined by the ratio of marginal utilities: $S_t = \left[\dfrac{\frac{U'(C_t)}{P_t}}{\frac{U'(C_t^*)}{P_t^*}}\right], S_{t+1} = \left[\dfrac{\frac{U'(C_{t+1})}{P_{t+1}}}{\frac{U'(C_{t+1}^*)}{P_{t+1}^*}}\right].$
Taking the ratio of exchange rates at t and t+*1* and multiplying the top and bottom by δ implies Equation 12.

Using the risk-free rates in Equation 11 and the spot rates in Equation 12, the foreign exchange risk premium can be rewritten as[9]

$$\left(\frac{E_t S_{t+1} - F_t}{S_t}\right) = E_t\left(\frac{Q^*_{t+1}}{Q_{t+1}}\right) - \left(\frac{E_t Q^*_{t+1}}{E_t Q_{t+1}}\right). \tag{13}$$

In other words, the risk premium depends upon the difference between the expected ratio of the SDFs and the ratio of their expectations. Euler equation–based explanations must depend upon variation in this covariance.

3.1.2. The Fama result. Early papers on interest parity noted that the forward rate is not an unbiased predictor of the future exchange rate (e.g., Bilson 1981). Subsequent papers explored the nature of deviations from interest parity. In an influential paper, Fama (1984) used a regression test to demonstrate the significance of these deviations. The test regresses the change in the spot rate on the forward premium, $f_t - s_t$, as given by

$$\Delta s_{t+1} = \beta_0 + \beta_1(f_t - s_t) + u_{t+1}, \tag{14}$$

where Δ is the lagged difference, β_0 and β_1 are regression coefficients, and u_{t+1} is the residual. The probability limit of the coefficient on the forward premium can be written as

$$\beta_1 = \frac{Cov[E_t \Delta s_{t+1}, (f_t - s_t)]}{Var(f_t - s_t)}. \tag{15}$$

Fama (1984) showed that if the coefficient is less than a half, then the variance of expected returns exceeds the variance of the expected change in the exchange rate. In other words, if $\beta_1 < \frac{1}{2}$, then $Var\left(E_t r_t^{fx}\right) > Var(E_t \Delta s_{t+1})$.[10]

Studies typically find that the estimate of β_1 is not only less than $\frac{1}{2}$ but negative.[11] Negative β_1 implies that the exchange rate is predicted to move in the opposite direction of the forward premium. Panel A of **Table 2** illustrates the basic result for monthly returns between August 1978 and October 2010 for the U.S. dollar relative to three representative currencies: the Japanese yen, the Swiss franc, and the British pound. (All spot rate data are from MSCI through Datastream, and forward rates are implied through covered interest parity using Datastream Eurocurrency 30-day deposit rates.) The estimate of β_1 is significantly negative for all three currencies. As a result, the hypothesis that β_1 is less than $\frac{1}{2}$ is rejected at marginal significance levels less than 1%.

[9]Taking the expectation of Equation 12 implies that $E_t S_{t+1}/S_t = E_t(Q^*_{t+1}/Q_{t+1})$. Because $F_t/S_t = R_t^{rf}/R_t^{rf*}$ by covered interest parity, Equation 11 implies that $F_t/S_t = E_t Q^*_{t+1}/E_t Q_{t+1}$. Then, $\left(\frac{E_t S_{t+1} - F_t}{S_t}\right) = E_t(Q^*_{t+1}/Q_{t+1}) - E_t Q^*_{t+1}/E_t Q_{t+1}$, verifying Equation 13.

[10]To see why, note that the predicted return on foreign exchange can be written as $E_t r_{t+1}^{fx} \equiv E_t[\Delta s_{t+1} + (f_t - s_t)]$, and the variance of the forward premium can be related to the variance of the expected return on the foreign exchange strategy according to $Var(E_t r_t^{fx}) = Var(E_t \Delta s_{t+1}) - 2Cov[E_t \Delta s_{t+1}, (f_t - s_t)] + Var(f_t - s_t)$. Substituting Equation 15 into this expression and rewriting implies $Var(E_t r_t^{fx}) = Var(E_t \Delta s_{t+1}) + (1 - 2\beta_1)Var(f_t - s_t)$. Then considering $\beta_1 < \frac{1}{2}$ shows the result.

[11]Surveys of this literature can be found in Lewis (1995) and Engel (1996). Bansal & Dahlquist (2000) and Burnside et al. (2007) found that emerging market returns display different behavior than developed country returns, although deposit rates in these countries may exhibit sovereign risk, making the connection to foreign exchange risk alone unclear.

Table 2 Foreign exchange return regressions and consumption covariations[a,b,c]

Panel A: Fama regressions estimates $\Delta s_{t+1} = \beta_0 + \beta_1(f_t - s_t) + u_{t+1}$			
Currency	β_0	β_1	MSL Ho: $\beta_1 < \frac{1}{2}$
Japanese yen	**0.009**	**−2.57**	0.0001
British pound	−0.004	**−1.94**	0.0016
Swiss franc	0.005	**−1.30**	0.0032
Panel B: Carry-trade regression estimates $sign(f_t - s_t) * (s_{t+1} - f_t) = b_0 + b_1 abs(f_t - s_t) + e_{t+1}$			
Coefficients		**Predicted carry trade**	
Currency	b_0	b_1	Mean (std. dev.)
Japanese yen	−0.006	**3.02**	3.02 (7.16)
British pound	−0.002	**2.68**	3.54 (5.17)
Swiss franc	**−0.006**	**2.83**	2.20 (7.88)
Panel C: Implied risk premium and consumption variances			
Japanese yen	**British pound**	**Swiss franc**	**U.S. consumption**
46.87	20.07	19.46	1.76

[a]Source: Author's calculations using MSCI exchange rate data and Datastream Eurocurrency deposit rates from August 1978 to October 2010. Consumption is U.S. real consumption expenditure from national income and product accounts for 1978 Q3 to 2010 Q3.
[b]Numbers in bold are significantly different from zero at 5% MSL.
[c]Abbreviations: MSCI, Morgan Stanley Capital International; MSL, marginal significance level.

Figure 1*a* (see color insert) reports the predicted returns for the yen and pound against the dollar based upon this simple regression, along with 90% significance bands. The magnitude of the predictable returns is large, sometimes reaching 30% per annum, and changes sign over time.

These two sets of results highlight the challenges for models explaining the foreign-exchange risk premium. First, the model must deliver a negative relationship between the forward premia and future exchange rates, further requiring the variance of the risk premium to exceed the variance of the exchange rate change. In other words, the variance of nominal SDFs as in Equation 13 must exceed the variance of the ratio of expected nominal SDFs themselves in Equation 12. Second, the model must produce the alternating sign pattern of foreign exchange returns found in the data. Therefore, the conditional relationship between SDFs in Equation 13 must change signs in a pattern consistent with predictable foreign exchange returns.

For standard consumption-based models to explain the foreign exchange relationship, the consumption growth rate must be relatively volatile. However, panel C of **Table 2** shows that the variability of U.S. consumption is only approximately 1.765%, and standard studies find this variance is fairly stationary. Yet, the variances of foreign exchange returns are typically greater than 20%. The challenge for risk-based models of the foreign exchange risk premium is therefore to generate greater stochastic volatility in the SDFs than is readily apparent from casual observation.

3.1.3. The carry trade.

The negative relationship between the forward premium and the subsequent exchange rate change suggests a simple strategy often called the carry trade. Because the forward premium is the domestic and foreign interest differential, the Fama result says that if the foreign interest rate is higher than the domestic interest rate, the foreign currency is likely to appreciate. The carry-trade strategy then consists of borrowing in the low–interest rate currencies and investing in the high–interest rate currencies. The carry-trade return can therefore be rewritten as $sign(f_t - s_t)*(s_{t+1} - f_t)$.

Table 2, panel B reports the results from regressing these carry-trade returns on the absolute value of the forward premium.[12] The coefficients are significant and the mean returns are positive, as reported in the final column. **Figure 1*b*** illustrates the predicted values of this regression over time for the dollar relative to the yen and the pound, whereas **Figure 1*c*** shows the level of interest rates behind this trade. Despite some reversals, the carry trade exhibits prolonged periods of gains. Although these figures report the returns using the dollar interest rate alone, in practice speculators typically use a much wider range of currencies to implement the strategy generating more significant returns. Nevertheless, the returns from the strategy are clearly risky.

3.2. Predictable Foreign Exchange Returns Models

Much of the literature has sought to develop models that can generate these relationships between expected returns and interest rate differentials across countries. I begin by describing the models based upon standard risk-based explanations before considering alternative explanations such as rare events, crash risk, and informational asymmetries.

3.2.1. The foreign exchange risk premium.

Any consumption-based model of the foreign exchange risk premium must confront the two challenges I note above: the higher variance of conditional covariances of SDFs across currencies than the variance of these SDFs themselves and the changing sign pattern of conditional covariances of SDFs.[13] Both of these results require high variability in the marginal utility of consumption. However, early studies beginning with Mark (1985) found that standard consumption volatility is not sufficient to generate this foreign exchange risk premium. Backus et al. (1993, 1995) considered a model with habit persistence that implicitly increased marginal utility variability, but still rejected the model. Bekaert (1996) combined a variety of modifications to the standard model, including habit persistence and heteroskedasticity, that improved the ability of the model to fit the data. However, the model still could not account for the foreign exchange risk premium. Moreover, as described in Section 2, Euler equation models imply a single latent variable generated by a common SDF, whereas a large body of research rejects these restrictions.

These early papers focused upon bilateral returns from borrowing in one country and investing in another. However, Lustig & Verdelhan (2007) formed portfolios of carry-trade

[12] Similarly, Bansal (1997) found that the coefficient depends on the sign of interest differentials. He also relates this phenomenon to a term structure model.

[13] Spot exchange rates provide another problem with these types of models. As a long literature beginning with Meese & Rogoff (1983) has shown, exchange rates cannot be explained by standard fundamentals. As described in Obstfeld & Rogoff (2001, p. 339), this "exchange rate disconnect problem" continues to plague international macroeconomic models. I do not discuss this literature in the text given that exchange rate pricing is inherently a macroeconomic issue and, hence, beyond this review's scope.

returns according to low relative to high interest rates, rebalanced each year. They found an increasing Sharpe ratio in the currencies with higher interest rates. They then used a utility function that nests several different versions of utility, including durables and non-durables and Epstein & Zin (1989) preferences. Based upon this model, they estimated a factor model using U.S. consumption data, finding that it explains up to 87% of the cross-sectional variation in annual returns on the portfolios. To obtain this result, Lustig et al. (2011) showed that the time-varying covariation between the SDF and the global factor is important.

Whereas the Lustig & Verdelhan model focused upon the cross-sectional variation in the predictable excess returns, Lustig et al. (2010) examined the time variation in similar portfolios. They found that the predicted foreign currency excess returns are countercyclical, using U.S. macro variables. As a result, they demonstrated that the foreign exchange returns portfolios can provide a hedge against cyclical variations so that the predictable returns are, indeed, compensation for risk.

Overall, these more recent results suggest that portfolios of foreign exchange returns may have more power to uncover risk-based explanations than the earlier bilateral time-series relationships.

3.2.2. Rare events, crash premia, and skewed returns. Currency markets have a long history of infrequent realignments, as a matter of either explicit or anticipated government reactions. Perhaps not surprisingly, therefore, the impact of rare events on asset prices was first noted in foreign exchange markets. According to standard folklore, Milton Friedman coined the term peso problem in the early 1970s to describe why Mexican peso interest rates remained substantially higher than the U.S. dollar interest rates, even though the exchange rate had been fixed for a decade. The forward rates continued to predict a weaker Mexican peso than was realized until the peso was devalued in the late 1970s. (Empirical analysis of this phenomenon first appeared in Rogoff 1980 and Krasker 1980. Lizondo 1983 provided a theoretical model.)

Clearly, the potential for rare devaluations appears most prominent in currencies with fixed exchange rates. However, the term has also been applied when discrete changes are anticipated in asset prices other than currency. [The peso problem has been considered as an explanation of asset pricing behavior ranging from the term premium (Evans & Lewis 1994, Bekaert et al. 2001) to IPO underpricing (Ang et al. 2007). For more references see Lewis 2008.] Moreover, flexible exchange rates also appear to experience infrequent shifts. For example, studies such as Engel & Hamilton (1990) and Kaminsky (1993) found that the dollar exchange rate follows persistent regimes of appreciation and depreciation. Therefore, Evans & Lewis (1995) asked whether anticipated discrete shifts in exchange rate regimes could explain the forward discount bias. They found that the anticipated switch from an appreciating to a depreciating regime does, indeed, bias downward the β_1 coefficient in the Fama regression by as much as -1 and increases the bias in measured risk premium by 3%–20%. Still, the hypothesis that the true β_1 is equal to 1 is strongly rejected.

If investors anticipate an infrequent shift in rates, those with exposure to this event would buy insurance against adverse effects on utility, driving up the price of options against this event. This relationship is the insight of Bates (1996a,b). He showed that infrequent exchange rate jumps are necessary to explain the higher price of out-of-the-money options, the so-called volatility smile. However, the jumps priced in the options do not appear to predict actual rates, though this finding may reflect the short sample period. Several studies also found that hedges against jumps appear to be priced in currency and other option prices. (See, for example, Bates 1991 for stocks and Bakshi et al. 2008 for currency.)

More recently, Burnside et al. (2011) and Jurek (2009) used options data to reexamine the foreign exchange return by combining it with hedged positions. They characterized the position as the combination of a carry trade, borrowing in the low interest rate and investing in the high interest rate currency, plus an option to hedge against the possible depreciation in the high interest rate currency. Burnside et al. examined these returns using at-the-money options for a sample ending before the financial crisis, finding significant positive gains. Jurek conducted his analysis over various out-of-the-money strike prices and included a sample extended through the financial crisis period of 2008. Although the hedged carry trades earned positive Sharpe ratios through 2007, he found that excess returns to crass-neutral carry trades were insignificantly different from zero once the crisis was taken into account. The pattern of positive returns that are eliminated once an infrequent event occurs is consistent with a peso problem explanation.

The original Mexican peso problem was envisioned as an effect on the forward premium that would arise even with risk-neutral investors. As such, the early literature typically treated the risk premium as an exogenous persistent component to predictable excess returns or as an empirical characterization of the risk-neutral distribution in options. However, risk-averse agents would want to hedge against the utility loss from a rare disaster event, thus generating a premium to positions that bear the risk. This observation was made in the context of the equity premium puzzle by Rietz (1988) and more recently restated by Barro (2006). Along these lines, Farhi & Gabaix (2009) proposed a model of a rare global event that affects all countries, but with a differing mean-reverting risk exposure by country. Combining these ingredients, they showed that those countries more exposed to disaster risk commanded higher risk premia manifested in a depreciated exchange rate and higher interest rate, consistent with the Fama result.

Farhi et al. (2009) developed a framework for assessing the importance of disaster risk in currency markets using currency options and foreign exchange returns. They combined both the insights from the cross-sectional behavior of portfolios of carry trades as in Lustig et al. (2011) and the disaster risk story in Farhi & Gabaix (2009) to evaluate disaster risk. For this purpose, they used a two-country, two-period model of disaster risk and considered both hedged and unhedged carry-trade returns as in Jurek (2009). They found evidence in favor of the link between exchange rates and asymmetries in the option prices, but more limited evidence of exchange rate predictability, similar to Bates (1996a,b).

Brunnermeier et al. (2009) showed that carry trades exhibit negative skewness; that is, most of the time carry trades earn a positive return but infrequently there are large reversals. One interpretation of their results is that carry-trade positions are subject to liquidity spirals (Brunnermeier & Pedersen 2009). According to this explanation, speculators invest in these positions because they have positive average return. However, these positions are also subject to crash risk captured by negative skewness in these returns. Because these speculators have funding constraints, shocks that lead to losses are amplified as they unwind their positions. The authors indeed found that carry-trade positions are positively related with trading volume in futures positions, consistent with their story.

3.2.3. Heterogeneous investors. The endurance of the forward discount bias and the apparent profitability of the carry trade has led some researchers to consider models with heterogeneous investors.

Alvarez et al. (2009) considered a model that assumes investors differ in their financial market participation. In their model, households must pay a fixed cost to participate in the financial market. Those who pay the cost are active participants, but the others simply consume current real balances. The model generates a relationship between money growth and the risk premium, though it is unclear how much of the forward discount bias can be explained by this relationship.

Osambela (2010) develops a model that allows for domestic and foreign investors to differ in their beliefs about the information content of publicly observed signals. He shows that the Fama regression omits one regressor: a heterogeneous beliefs risk premium, which compensates for deviations in beliefs about the expected exchange rate depreciation. He then simulates his model and reruns the Fama regression, finding that the slope coefficient is biased downward away from one.

3.2.4. Other low-frequency movement explanations. Infrequent crashes in currency markets with or without consumption-based microfoundations form the basis for the models described above. These stories suggest that a low-frequency factor may help explain foreign exchange returns. Similarly, motivations for persistent underlying risk in asset markets have been proposed to help explain well-known domestic market anomalies such as the equity premium puzzle (Mehra & Prescott 1985) and the risk-free rate puzzle (Weil 1989). The two main approaches in this line of work are based upon the habit-persistence framework of Campbell & Cochrane (1999) and the long-run risk specification of Bansal & Yaron (2004). Although the two approaches differ, they both generate low-frequency variability in the SDF. Given the importance of low-frequency risk in currency markets, researchers have begun to ask whether these approaches may plausibly help resolve the forward discount puzzle.

Using the habit-persistence framework, Verdelhan (2010) developed a two-country model in which the consumption-surplus ratio induced by the habit is correlated across countries. In this framework, the exchange rate change depends upon both consumption and the interaction of consumption and interest differentials. As a result, when the foreign interest rate is higher than the domestic rate, the domestic investor faces more consumption growth risk. Accordingly, the model generates the Fama relationship as well as the equity premium.

Using long-run risk, Colacito & Croce (2010b) considered a two-country model with an exogenous endowment process in each country that has a long-run risk component. The two endowments are combined to create a consumption good in each country and each country has a bias toward their own endowment. Among other empirical regularities, this model generates a negative Fama coefficient and the attendant excess volatility of the risk premium relative to expected exchange rates. This relationship arises endogenously through the time-varying market prices of risk across the two countries.

Bansal & Shaliastovich (2010) also used a two-country model with long-run risk but focused upon regularities in the term premium in the bonds market and the equity premium. They found that the slope coefficients in the foreign exchange projections are negative at one-month horizons, though they increase with maturity, becoming positive at one year.

3.3. Foreign Bonds and Sovereign Risk

So far, I have discussed research on international equity markets and foreign exchange, reflecting the concentration of the literature. However, a growing literature examines aspects related to bond markets. Recent events concerning sovereign risk have highlighted the importance of these studies. The potential pricing of bonds in international markets was described by Stulz (1983) and Adler & Dumas (1983), who showed that foreign bonds provide a means to hedge currency risk. However, these papers treat bonds as risk-free, similar to the foreign exchange literature above.

The history of sovereign debt has been anything but risk-free, however. As Reinhart & Rogoff (2009) showed over many centuries and countries, governments can and do default on government debt. This default risk generates differences in yield spreads across countries. Erb et al. (1999) and Arellano & Ramanarayanan (2010), among others, studied the yields on spreads in emerging markets. Aguiar & Gopinath (2006) and Arellano (2008) examined the spreads on sovereign lending in the presence of default, assuming risk-neutral investors. By contrast, Borri & Verdelhan (2010) analyzed these spreads from the perspective of risk-averse investors, finding that the returns can be explained by a risk-based model.

Whereas the literature has largely focused upon sovereign bond yields, the more recent credit default swap (CDS) market provides direct evidence on the pricing of credit risk. Longstaff et al. (2011) used CDS spreads across countries to analyze whether the risks priced in these spreads are primarily country specific or driven by global factors. They found that the excess returns from investing in sovereign credit are largely compensation for bearing global risk. This result suggests that sovereign credit risk is largely influenced by an integrated world market, unlike the relationships we have seen in equity markets above. More recently, Dieckmann & Plank (2011) used CDS spreads during the recent financial crisis to evaluate the implied risk of a group of mostly developed countries. Because they discovered that the risk is positively related to the size of banking in the economy, they argued that market participants incorporate expectations about financial industry bailouts into the pricing of CDSs.

The literature has largely focused upon international fixed income asset pricing in the form of short-term risk-free rates or sovereign default risk and not international corporate credit risk. However, recent papers have considered the implications of foreign bonds for domestic investors. Using data for 40 countries, Burger & Warnock (2007) found that foreigners shun bonds from countries with high variance. Liu (2010) analyzed the return dynamics of international corporate bonds, finding that foreign bonds provided a significantly better hedge against U.S. risk factors than did foreign equity during the recent crisis.

3.4. Foreign Exchange and International Bond Returns: Summary

The large literature on foreign exchange returns has generated several challenges for typical asset pricing models. Currency forward rates conditionally predict a change in the exchange rate in the opposite direction, and excess foreign exchange returns change sign over time. However, standard models based upon CRRA and independent and identically distributed (IID) consumption growth cannot explain this behavior. The variance of consumption volatility is too low, and the covariance of consumption growth rates across countries do not change signs in a pattern that matches predictable returns.

Studies have more success when these standard conditions are modified. Carry-trade portfolios appear to be priced with risk-based measures in the cross section and over the cycle. Moreover, the skewness in carry-trade returns appears to be priced in options so that there are no long-term gains, consistent with a crash-risk interpretation. Successes have also been found when allowing for heteregeneity in investor responses to financial market information through limited participation or differences in opinion. Similarly, allowing for low-frequency movements in consumption risk can generate some features of the forward premium anomaly.

Because foreign exchange risk depends upon interest rate differentials, foreign bonds can provide a hedge against this exchange rate risk. However, foreign fixed income securities may depend upon sovereign debt risk. Although sovereign debt risk appears to be priced in global markets, the size of the banking sector also appears to be important.

4. INTEGRATING FINANCIAL MARKETS AND CONSUMPTION RISK SHARING

So far, I have discussed the equity markets and the fixed income–foreign exchange markets separately. From an asset pricing perspective, these markets are related, of course. A common component across all markets is the intertemporal consumption decision of each country investor embodied in the Euler equation (Equation 3). As shown above, the common SDF implied by such a model is rejected for returns across markets. Also, as pointed out by Backus et al. (1992), under complete markets and CRRA utility, consumption should be perfectly correlated across countries, though it typically has a lower correlation than output.[14] Using data across a wide cross section of countries, Lewis (1996) showed that not only is the first-order condition for consumption risk sharing rejected for standard nondurable consumption, this rejection cannot be explained by the country-specific effects of nontradeable and durables consumption. Brandt et al. (2006) used the Euler equation relationship between exchange rates and SDFs in Equation 12 as a benchmark for consumption risk sharing. Using data on stock returns and exchange rates, they noted that the variance of exchange rates is high but the volatility of SDFs implicit in stock returns is even higher, implying that risk sharing is relatively high or, alternatively, exchange rates are not variable enough. However, their result is based upon asset prices and not consumption. Indeed, when the authors used consumption data to recompute their risk-sharing index, they found the standard result that consumption risk-sharing is quite low.

Another way to assess the degree of global integration using information across markets is to analyze the correlations, as proposed in Dumas et al. (2003). They showed that the correlation of stock returns can be used to evaluate integration only after conditioning on

[14]A full survey of the voluminous literature on international consumption risk sharing is beyond the scope of this review. Lewis (1999) provides a partial survey.

macroeconomic fundamentals such as income. They found that the correlations in the data are more consistent with integration than segmentation of markets.

These papers focus upon analyzing the second moments of returns without addressing the first moments. As noted above, one approach toward explaining risk premia levels is to incorporate low-frequency risk in consumption. Colacito & Croce (2011) analyzed the SDFs across countries by incorporating a long-run risk as in Bansal & Yaron (2004), using data for the United States and the United Kingdom. Assuming each country consumes a unique good, they extracted the low-frequency component in consumption and found that they could match both the correlation between exchange rates and equity returns as well as the individual variances.

Although rejection of the Euler equation implies a rejection of perfect risk sharing under the canonical model, it does not provide direct evidence for the reason behind this rejection. One possible source of rejection is that the gains from risk sharing are not very large. If so, even small transactions costs can generate imperfect risk sharing. Consumption-based models tend to find that the gains are modest (van Wincoop 1994, Tesar 1995, Hoxha et al. 2009), whereas models using financial data, as in Brandt et al. (2006), suggest the gains are large. Indeed, Lewis (2000) showed that the differences chiefly reflect the discrepancy between consumption-based models and the behavior of SDFs required to match asset pricing returns. Colacito & Croce (2010c) used a two-good model with long-run risk to consider the implications on gains from risk sharing. They found that the gains can be high over plausible parameter ranges. Lewis & Liu (2010) also used a long-run risk model to evaluate the gains from risk sharing using a single composite good. They found that the gains from risk sharing depend strongly upon the correlation of long-run risk across countries. Although the verdict is still out on the appropriate model for relating consumption to asset returns, the international risk-sharing gains appear to exceed the apparently low costs of international diversification.

Another problem with tests that reject risk sharing derives from the utility and stochastic assumptions of the model. In particular, risk-sharing tests typically assume time-additive iso-elastic utility either implicitly or explicitly. However, recent research that reconciles consumption and asset price behavior requires preferences that are either recursive or habit dependent, as discussed above. Furthermore, early work using recursive preferences to look at international risk sharing, as in Obstfeld (1994), assumed IID processes for consumption. However, recent models that attempt to match the asset pricing behavior with consumption data typically assume persistent consumption growth together with recursive preferences. In these models, consumption growth rates need not be perfectly correlated even when there is perfect risk sharing. (Even if the investor's preferences are recursive, the social planner's problem is not recursive, leading to possibly time-varying consumption allocation weights across investors. See, for example, Duffie et al. 1994 and Dumas et al. 2000.) Indeed, Colacito & Croce (2010a) show in a two-country model that even with IID output processes the time-variation in consumption weights can generate significant movements in the means and variances of returns.

Heterogeneous beliefs present another set of models that can generate imperfectly correlated consumption, even with perfect risk sharing. For example, Dumas et al. (2011) showed that the risk generated by foreign reaction to public signals implies the consumption correlations across countries are less than one, even under complete international risk sharing.

5. CONCLUDING REMARKS

Despite decades of increased globalization, the prices of many internationally traded assets continue to depend upon local risk factors. Some of these local factors, such as exchange rate risk, are consistent with fully integrated markets. However, other local risk factors seem to suggest that international asset markets are still segmented. For example, firm-level equity returns depend significantly on domestic equity risk factors such as value, size, and market return, even when conditioned on global equity counterparts. At the aggregate market-index level, the dependence of equity returns on local factors seems most pronounced for emerging markets, suggesting some degree of market segmentation.

The continuation of market segmentation does not imply that globalization has had no impact, however. Indeed, several studies document the increasing trend toward integration across a variety of capital markets. This trend has increased the correlations in returns and other sources of risk sensitivities, thereby reducing the gains to international portfolio diversification. Although diversification gains still appear to be important at this time, further globalization of asset markets will likely reduce their importance in the future.

Globalization has yet to eliminate other well-known international asset market anomalies that may be related to market segmentation. Foreign assets, fixed income securities and equity alike, continue to provide substantial diversification opportunities, yet these assets are underweighted in the standard domestic investor portfolio. Stocks that are cross-listed across international borders experience abnormal returns at the time of listing. Deviations from uncovered interest parity continue to be predictable in the short run as forward premia predict the wrong direction of future exchange rates. Whether these anomalies are due to explicit barriers to capital flows or more implicit effects such as heterogeneous information processing will only be revealed over time as capital market restrictions are removed.

Even if asset markets could be considered fully integrated across countries, models of global asset pricing face several challenges beyond the standard closed-economy models. For example, a typical closed-economy problem is that the investor's intertemporal marginal utility is not large or variable enough to explain asset return premia or their volatility. Open economy asset pricing models confront even more dimensions given that the differences in marginal utility across countries must explain cross-country phenomena such as the exchange rate risk premium or the correlation of stock returns. Some promising research has emerged by allowing for low-frequency variation in consumption risk to address pieces of this global asset pricing picture. As these research pieces come together, a clearer picture will surely emerge.

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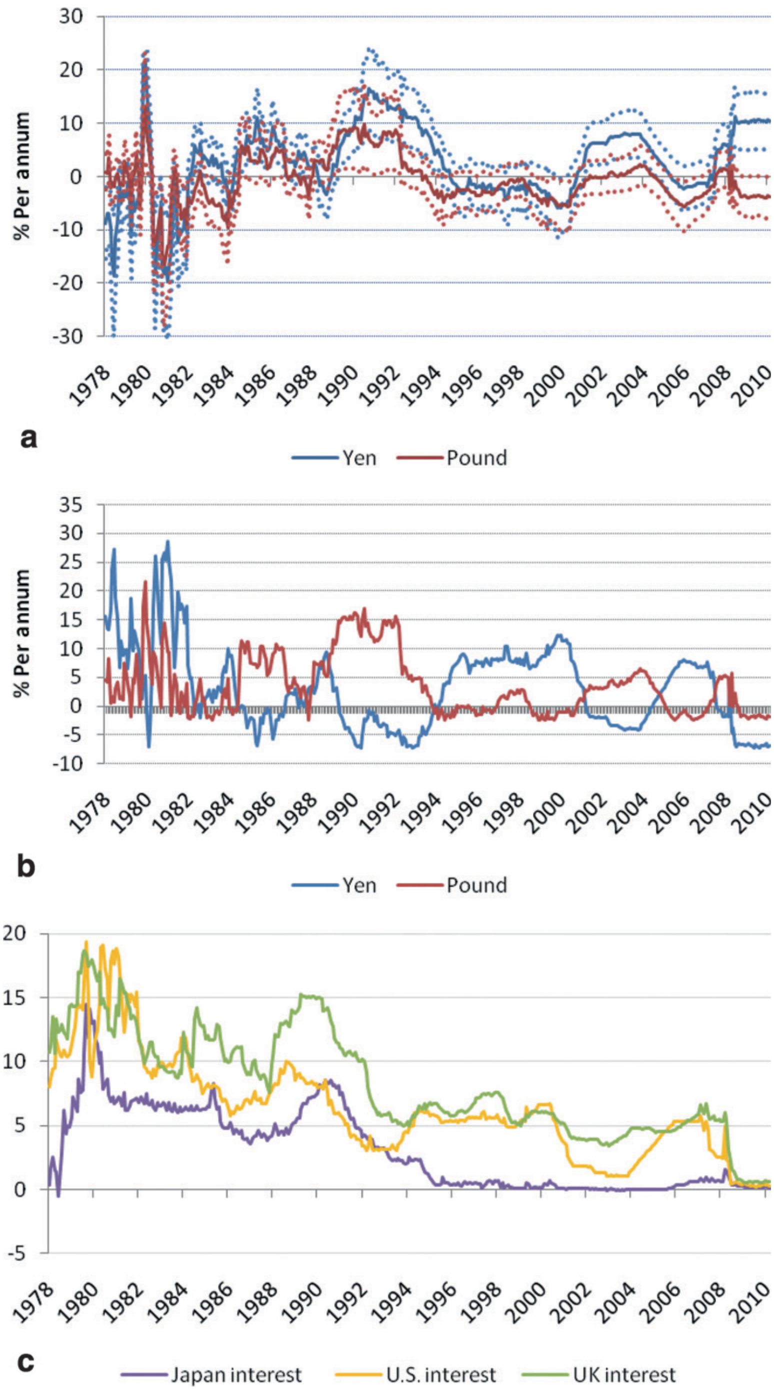

Figure 1

Foreign exchange returns conditioned on interest differentials. (*a*) Predictable foreign exchange returns. (*b*) Predicted carry-trade returns. (*c*) Interest rates.

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Errata

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