Equity Home Bias and Regret: An International Equilibrium Model

Bruno Solnik*

First Draft: April, 2005
Current Draft: September 12, 2006

Abstract

I postulate that investors add foreign stocks to their domestic equity portfolio for their upside potential to overperform domestic equity, not only for their return/risk diversification benefits. When foreign stocks underperform domestic equity they feel the pain of regret of having invested abroad. Following regret theory, investors are assumed to construct their portfolios taking simultaneously into account their aversion to risk and to regret. In equilibrium, the expected return of foreign equity relative to domestic equity is equal to that dictated by the traditional CAPM plus a regret premium. This regret premium is a function of the difference of regret aversion across investors and net foreign positions. With similar regret aversion worldwide, the traditional CAPM pricing relation holds, even though investors exhibit home bias in their portfolio holdings. In equilibrium, it is sufficient to have regret aversion in a single country to observe home bias in portfolio holdings of investors from all countries. I calibrate the model using recent IMF data on the geographical breakdown of equity portfolios. The regret premium is likely to be rather small despite a large observed home bias in every country.

* HEC Paris, 1 rue Libération, 78351 Jouy en Josas, Cedex, France and GREGHEC. solnik@hec.fr.
I thank Fondation HEC and Institut Europlace de Finance for their financial support. Part of this research was conducted while Bruno Solnik was visiting professor at the School of Banking and Finance of the University of New South Wales. I am grateful to Michael Adler, Ines Chaieb, Ian Cooper, Vihang Errunza, Thierry Foucault, Christian Gollier, Sébastien Michenaud, René Stulz and Axel Waldecker for useful comments.

1. Introduction

It has been repeatedly claimed that investors have a bias towards home equity. This is consistently observed in every country. To claim a bias, one must define the norm. Under the assumption of a perfect world capital market, one can develop an equilibrium CAPM. Solnik (1974) and Adler and Dumas (1985) showed that, even in the presence of currency risk, the optimal risky portfolio for each investor should be the world market portfolio made up of equity with market capitalization weights. This portfolio would be partly hedged against currency risks, but its equity component would be identical for all investors. One could claim that the international CAPM is derived under extreme assumptions. But even if I assume ignorance about expected returns and simply search for the global allocation which minimizes risk (portfolio variance), all studies show that the risk-minimizing share of foreign equity is well above that found in actual portfolios (e.g. Lewis-1999).

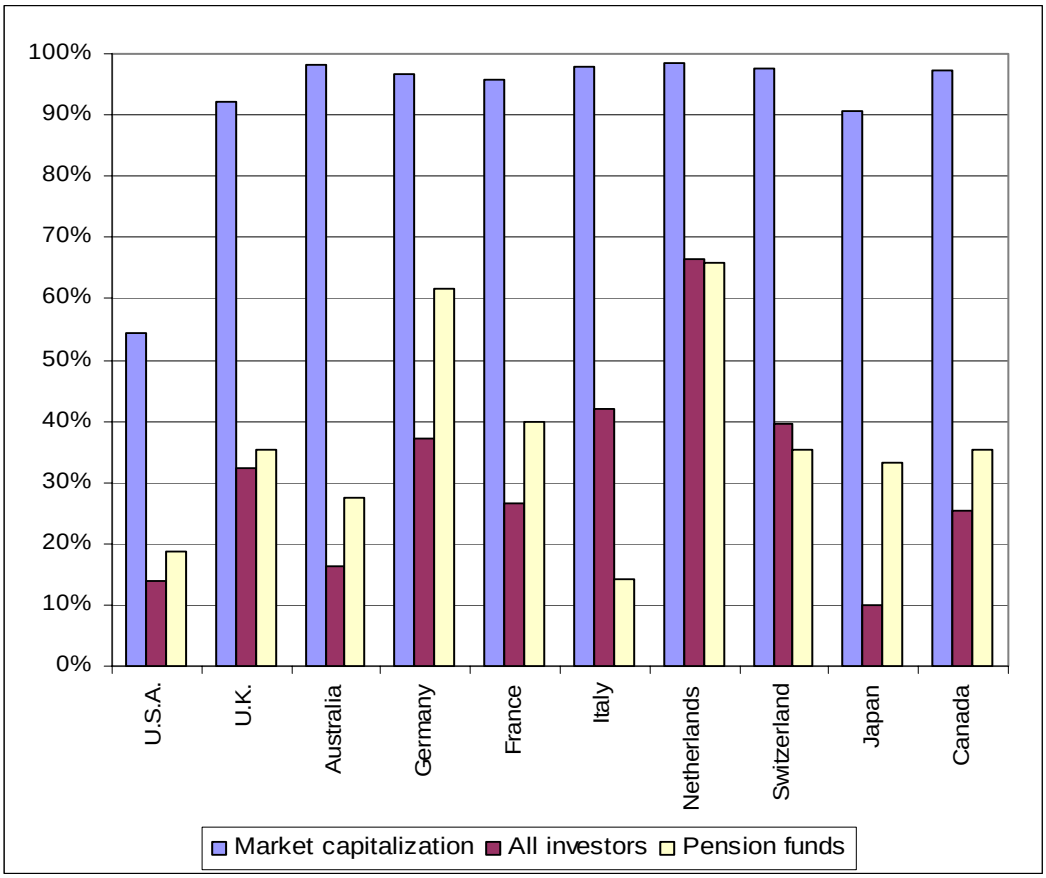
Home bias is not limited to individual investors. It also applies to sophisticated institutional investors who have easy access to foreign investments, as shown in Figure 1. Figure 1 gives estimates of the ratio of foreign to total equity holdings of pension funds investors and of all investors from major countries at the end of 2003[1]. It also indicates the ratio of foreign to world market capitalization for all these countries. While institutional investors from many countries seem to be more global in their investment policies than individual investors, they are still far from investing according to capitalization weights. For example, non-US equity markets represent some 54.3% of world market capitalization, but US investors only hold an average of 13.8% in foreign stocks within their equity portfolios; US pension funds only hold 18.6% in foreign stocks within their equity portfolios. So the deviation from capitalization weights is 40.5%=54.3%-13.8% for all US investors and 35.7% for US pension funds. A typical measure used for the home bias is calculated as one minus the ratio of the weights of foreign stocks in the investors' portfolio and in the world market portfolio (see Kho, Stulz and Warnock, 2006). The home bias ratio for all US investors at the end of 2003 is 1-13.8/54.3 = 75.% This ratio would be zero in the absence of home bias and one if no foreign assets were held. Equity home bias is not only prevalent in the US. Investors from all countries exhibit a large home bias. The share of foreign stocks held by non-US investors tends to be larger than for US investors, but their domestic market is much smaller, so the capitalization weight of foreign stocks from their local perspective is much higher. For example, British investors hold 32.4% of their equity portfolio in foreign stocks, while the capitalization weight of foreign stocks from a British perspective is 92.1%. The home bias ratio for British investors is 65%. It ranges from 32% for Dutch investors to 89% for Japanese investors. If we use the IMF data to aggregate all non-US countries into a single entity called "international" country, we find that international investors only hold 7.9% of US stocks in their overall equity portfolio, while the US capitalization weight is 45.7%. The aggregate home bias ratio of non-US investors

[1] The IMF has started to publish an annual Coordinated Investment Portfolio Survey. CIPS provides detailed statistics on the geographical breakdown of foreign holdings per country of origin. It covers all member countries of the IMF. The 2003 CIPS results used here have been made available in April 2005. The data for pension funds come from Solnik and McLeavey (2004) and have been updated by the author; such estimates vary according to the type of funds included.

is 83%, slightly higher than for US investors. In all cases, the home equity bias is substantial.

Figure 1: Ratio of Foreign Equity Holdings to Total Equity Holdings per Nationality of Investors

For investors from each country, the first bar gives the ratio of foreign to world market capitalization for end-2003, as reported by the International Federation of Stock Exchanges. The second bar gives the ratio of foreign to total equity holdings for all investors calculated using the data reported by the IMF in their CIPS database for end-2003. The third bar gives the ratio of foreign to total equity holdings for pension funds estimated in Solnik and Mc Leavey (2004).



Numerous tentative explanations have been provided for the observed home equity bias. Reviews can be found in Lewis (1999), Strong and Xu (2003) or Karolyi and Stulz (2003) and a brief discussion is provided in the next section. Explanations include explicit barriers to international investments (regulations, costs), asymmetry of information (where local investors have better information on their home markets than foreign investors), hedging motives (inflation, currency and human capital risks), and behavioral traits (relative optimism about and familiarity with domestic investments). Numerous authors[2] have questioned whether non-behavioral explanations could justify the extent of the observed home bias. Back in 1991, French and Poterba (1991) suggested that the explanations for the home bias puzzle were behavioral, not institutional. Kho, Stulz and Warnock (2006, p. 4) state: "However, except for behavioral biases, the reasons for the home bias advanced by this literature cannot explain the magnitude of the home bias". For example, globalization has largely removed barriers to international investments, at least in developed markets. Information is now widely and rapidly disseminated, at least for large firms that make up the bulk of world market capitalization. Currency risk can be easily hedged. Besides the huge magnitude of the home bias, what is puzzling is its slow decrease over time. Kho, Stulz and Warnock (2006) studied the evolution of the home bias of US investors since the wave of financial liberalization in the nineties. They found a rather weak decrease in the average home bias from 1994 to 2004 and conclude that "one cannot reject the hypothesis that there was no change in the average home bias between 1994 and 2005" (p. 22). Rapid globalization and reduction in differential access to information should have led to a drastic reduction in home bias, if it were caused by barriers to capital movements or information asymmetry. Kho, Stulz and Warnock (2006) provided an original explanation for the evolution of home bias based on insider ownership. Poor governance can allow (domestic) corporate insiders to extract private benefits; hence investors shun investing abroad, especially in countries with poor governance and concentrated insider ownership. However this can be only a partial explanation of home bias as non-US investors exhibit a larger home bias towards US equity (a country with good corporate governance and the lowest insider ownership) than US investors do towards the rest of the world.

In this paper, I propose a original behavioral modeling of the home bias that builds on the insight by Statman (1999). I develop a utility-based model where investors regard foreign stocks as upside-potential assets, as observed by Statman (1999). Kahneman and Lovallo (1993) suggest that decision makers are excessively prone to treat problems as unique. Rather than looking at the whole portfolio as prescribed by traditional utility theory, investors tend to put different types of investments in different mental compartments (or *layers* or *narrow frames*)[3]. Typically foreign stocks are purchased not only for their return/risk diversification benefits, but also for their upside potential to overperform domestic stocks. Investors have a core portfolio made of domestic stocks. They do not regard foreign stocks as belonging to the same layer. For example, Statman (1999, page 16) states: "Typical investors who bought foreign stocks in the 1990s did not buy them for their mean-variance benefits. They bought them for the upside-potential layer of their behavioral portfolio; they expected foreign stocks to make them rich". But when foreign stocks underperform domestic stocks, investors feel the pain of regret. As stated by Bell (1985), regret is a psychological reaction to making a wrong choice on the basis of actual

[2] See for example, French and Poterba (1991), Jeske (2001), Karolyi and Stulz (2003), Kho, Stulz and Warnock (2006).

[3] See also Barberis ad Huang (2004).

outcomes, where a better investment decision could have been taken, namely not investing abroad. There is ample anecdotal evidence that foreign stocks are regarded as "exotic" (less familiar) even by institutional investors. Indeed they are assigned to an asset class separate from domestic equity. The performance of international equity indices is highly visible and publicly reported in the media on a daily basis. Under-performing peers who have chosen a lesser international exposure can be painful for institutional investors. Surveys of institutional investors (e.g. Gerrans, Gardner, Clark-Murphy and Speelman-2005) have shown that they even tend to reduce their foreign exposure following periods of poor performance of foreign stocks relative to domestic ones; an indication that the pain of regret can lead to subsequent asset allocation changes.

Following regret theory introduced by Loomes and Sugden (1982) and Bell (1982), I assume that investors act rationally in reaching optimal asset allocation by maximizing expected utility. But their expected utility takes into account the expected regret they might feel if foreign stocks underperform domestic stocks, besides traditional risk aversion. This leads investors to underinvest in foreign stocks in order to reduce the potential for regret, and thereby creates a home bias. I derive the optimal asset allocation for an investor that is averse to regret risk and compare it to the asset allocation that would obtain for a regret-free investor. However, global equilibrium expected returns could be different if investors are regret averse or not. Hence, I derive equilibrium results assuming that investors of all countries exhibit (possibly-different) regret aversion and I discuss how regret aversion influence equilibrium expected returns and holdings. I calibrate the model using detailed information on actual global portfolio holdings reported by the IMF for the end of 2003.

Behavioral explanations to date have been primarily empirical; some behavioral heuristics (relative optimism, familiarity) that could justify the home bias is postulated and tested on some partial data set about investor's expectations or holdings. Here, I derive the equilibrium implications of the behavioral model on portfolio holdings and asset pricing. The paper is theoretical but it has interesting empirical implications. If investors exhibit regret aversion (in addition to risk aversion), there will be a significant home bias even if markets are fully efficient. As regret aversion is likely to evolve slowly, it is not surprising to find a slow evolution of the home bias despite the rapid liberalization of the recent years. In equilibrium, it is sufficient for investors of a single country to be regret-averse to induce a home bias in every country. Furthermore, if investors have a similar level of regret aversion worldwide, assets would be priced according to the traditional CAPM (only traditional risk is priced) even though the home bias in holdings is significant. So regret aversion can introduce large home biases without any pricing differential. This is quite different from CAPMs derived with some form of segmentation (see section 2), where investment barriers necessarily lead to pricing biases. Needless to say, the behavioral trait described here is only one of several possible behavioral explanations for the home bias. But it is a step towards deriving equilibrium implications of investor's behavior which are consistent with the observed home bias.

The remainder of the paper proceeds as follows. Section 2 provides a brief review of the literature on the home bias. Section 3 provides a refresher on regret theory, while its application to the modeling of international allocation choices is introduced in Section 4. Section 5 discusses the characteristics of optimal domestic/foreign allocation under different degree of risk aversion; our discussion focuses on the role of regret aversion relative to traditional risk aversion. The properties of market equilibrium in the presence of

regret aversion are derived in Section 6, where I also calibrate the model. Section 7 concludes and discusses empirical implications.

2. Literature on Home Bias

A traditional explanation provided in the past is "physical" barriers to international capital movements. In some countries, institutional investors still face some regulatory restrictions to their foreign holdings, but constraints are often not binding as actual foreign investment is below the allowed limit. Another barrier is when the foreign ownership in some securities is restricted ("segmentation"). Asset pricing models developed under the assumption of total or partial segmentation (e.g. Errunza and Losq, 1985; Stulz; 1981; Chaieb and Errunza, 2007) conclude that restricted securities should have a higher expected return in equilibrium than non-restricted securities. As mentioned in the introduction, the current magnitude of the home bias is not consistent with the removal of most physical investment barriers[4] in the past decades. Following the traditional finance paradigm, other explanations of the home equity bias have been searched in the *expected return* or *risk* dimensions, as I shall successively discuss below.

French and Poterba (1991) provide a simple yet powerful framework to quantify the financial relevance of home bias. In the mean-variance approach, there is a linear relation between expected excess returns and optimal country weights in the optimal portfolio. They take the market covariance matrix estimated from historical data and infer the market expected return that would be consistent with the observed investors' holdings. To hold a portfolio biased towards the home market, an investor would have to expect more (less) return from the home (foreign) market than equilibrium returns. French and Poterba use historical stock index data on the period 1975-89 and estimates of portfolio allocation for American, British, and Japanese investors as of 1989. They find a differential domestic-foreign expected return that ranges from 200 to 500 basis points. Jeske (2001) conducts a similar experiment for eleven countries on the 1991-2000 period and his differential ranges from 150 to 1500 basis points. As French and Poterba (1991, p. 223) state, “substantial differences in expected returns across countries are needed to rationalize observed portfolio holdings". They claim that institutional differences across markets, such as differential taxes, transaction costs, management and custodial fees cannot justify such a differential. Cooper and Kaplanis (1994), as well as Tesar and Werner (1995) come to a similar conclusion. Indeed, global surveys of execution costs (market impact, commission and taxes) indicate that the execution cost for typical institutional trades differ by less than 50 basis points among all developed markets (e.g. Solnik and McLeavey –2004), far below the order of magnitude reported above. The rapid liberalization of financial markets, for developed markets but also for several emerging markets, make investment barriers or costs an even less likely explanation of the persistence of a large home bias.

Alternative “expected return” explanations are behavioral in nature. Some claim that domestic investors exhibit *relative optimism* about their home market compared to foreign investors. Shiller, Kon-Ya and Tsusui (1996) used survey data in Japan and the US during the Nikkei crash of the early nineties and found that investors are relatively more optimistic about their home equity market than about foreign markets. Strong and Xu (2003) and

[4] Most emerging markets still impose significant restrictions but they do not apply to a large proportion of the world market capitalization.

Bascoul and Solnik (2006) report a similar finding for asset managers from Europe, Japan, UK and the U.S, using survey data from 1995-2000 and 1997-2005 respectively. However, the asset management industry is becoming increasingly global, and the same global asset management firm or broker can hardly post publicly different sets of market expectations depending on the location of its office. So the relative-optimism explanation can at best be partial. A related psychological bias is *perceived competence*. In a lab experiment with German and US students, Kilka and Weber (2000) conclude that people on average feel more competent in judging domestic stocks than in judging foreign stocks and that they are more optimistic about domestic stocks than about foreign stocks. Graham, Harvey and Huang (2006) also stress the potential importance of perceived competence in explaining the home bias.

A second line of explanations is that foreign investments are *perceived as more risky*. We can again take the approach used by French and Poterba (1991) to assess the differential in risk perception that would be consistent with the observed biased allocations, assuming that investors have no domestic bias on expected return. Jeske (2001) found that a differential of 25 to 100% between the home and foreign market volatilities would be consistent with observed holdings, a rather huge figure. *Currency risk* can add to the volatility of foreign markets, as measured in its local currency. But historical data shows that the contribution of currency risk to the total risk of international equity investments is much smaller than the risk differential estimated above, and, more importantly, it can easily be eliminated by currency hedging. Furthermore, international CAPMs with currency risk still conclude that the world market portfolio is optimal for each investor (see Solnik,1974; Adler and Dumas, 1985).

Asymmetric information, where local investors have better information on their home markets than foreign investors, could justify the existence of a home bias. Gehrig (1993) develops a model where the information signal is more precise for domestic stocks than for foreign stocks; this makes foreign stocks appear more risky than domestic stocks and leads to home bias (see also Brennan and Cao, 1997; and Brennan, Cao, Strong and Xu, 2005). Empirical evidence on the existence of information asymmetry can be found in Kang and Stulz (1997), Grinblatt and Keloharju (2000), Dvorak (2005) among others. Note that asymmetric information does not mean that the domestic market is expected to yield a higher return on average; domestic investors get a more precise signal on domestic stocks, but the signal's mean is zero. However, the size of the volatility differential (and hence the differential in signal precision) that is required to explain observed home bias is very large, while geographic information advantage on large companies that dominate market indexes is likely to be small as any news is quickly disseminated worldwide by media and global financial institutions. The rapid reduction in information costs should have led to a drastic reduction in home bias, which is not observed. As mentioned by Jeske (2001) and Kho, Stulz and Warnock (2006), there are other weaknesses to the information asymmetry explanation. If domestic investors had better information than foreigners on their home market in aggregate, they would tend to reduce their domestic allocation when they get a bad signal and increase it when they get a good signal. But this is in stark contrast with the observation of a stable home bias. If the better information was at the level of individual domestic firms, domestic investors should outperform foreign investors. Yet , the empirical evidence is mixed and several authors find that foreign investors outperform domestic investors (e.g. Seasholes, 2004; Grinblatt and Kelorhaju, 2000).

More generally, the term "*familiarity*" (see Huberman-2001) refers to the observation that investors are more familiar with domestic companies and therefore prefer to invest in them as they are perceived as less risky.[5] The fact that investors tend to prefer local stocks is also true within a country; see Coval and Moskowitz (1999), Ivkovic and Weisbenner (2005). Massa and Simonov (2006) test the influence of "familiarity" on portfolio holdings of a detailed dataset of Swedish investors. They try to distinguish between familiarity due to some behavioral heuristics or to better information on local stocks. Their results tend to favor information-based familiarity. Another "familiarity" approach has been to model consumption preferences to be domestically biased (e.g. Shore and White-2003-). Aggregate national consumption/wealth explicitly enters the agents' utility function. In this approach, sometimes called "keeping up with the Joneses", agents have exogenous preferences to mimic the consumption of people in their community (e.g. country). It naturally implies that agents tend to mimic portfolio choices of those living in their country. In a way, foreign assets will look riskier than domestic assets if they have a lesser correlation with national wealth. Domestic assets are used to hedge local consumption risks[6]. This approach is further discussed in section 4.

In this paper, I introduce a behavioral explanation that differs from "relative optimism" or "familiarity", namely aversion to regret.

3. Regret Theory

Regret is defined as a cognitively-mediated emotion of pain and anger when, with hindsight, I observe that I took a bad decision in the past and could have taken one with better outcome. Contrary to mere disappointment, which is experienced when a negative outcome happens relative to prior expectations, regret is an emotion strongly associated with a feeling of responsibility for the choice that has been made.

There is an extensive literature in experimental psychology that supports the assumption that regret influences decision-making under uncertainty beyond disappointment and traditional uncertainty measures. Reviews of experiments can be found in Gilovich and Medvec (1995), and Zeelenberg, van Dijk, Manstead and van der Pligt (2000). The relevance of regret in investment choices has been widely observed and led to simple rules such as formulated by Markowitz (1998):

> *"I should have computed the historical covariance of the asset classes and drawn an efficient frontier. Instead I visualized my grief if the stock market went way up and I wasn't in it--or if it went way down and I was completely in it. My intention was to minimize my future regret, so I split my [pension scheme] contributions 50/50 between bonds and equities."*
>
> Harry Markowitz. As quoted in Zweig, 1998, "America's top pension fund", Money, 27, page 114.

[5] The concept of perceived competence is related to that of familiarity, as higher perceived competence is associated with lower dispersion of the subjective probability distribution (see Kilka and Weber, 2000).

[6] Another " risk" explanation of the home bias has been linked to the hedging demand for some state variable such as human capital or domestic inflation. I agree with Kang and Stulz (1997, p. 8) that " unfortunately we are not aware of a well-specified hypothesis for state-variable risks predicting that investors hold portfolios with a substantial home bias."

Based on this concept of regret, Loomes and Sugden (1982) and Bell (1982) derived independently an economic theory of regret. They proposed a theory of choices under uncertainty that explains many observed violations of the axioms used to build the traditional expected utility approach. Regret theory (RT) assumes that agents are rational but base their decisions not only on expected payoffs but also on expected regret. It predicts Allais' paradox ("common consequences effect") and many other axiom violations[7] reported in experiments by Kahneman and Tversky (1979) and others. RT bears some similarities with prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) as many results of RT are consistent with the empirical observations of human behavior that constitute the building blocks of prospect theory. But prospect theory is primarily descriptive while RT is a normative theory of rational choice under uncertainty: RT incorporates regret into the utility function in addition to the traditional value function of total wealth. Investors reach their investment decision by maximizing the expected value of this modified utility. So investors try to anticipate regret and take it into account in their investment decisions in a consistent manner.

Loomes and Sugden (1982) and Bell (1982) derive a modified utility function of final wealth x resulting from a given investment choice, knowing that a different investment choice would have led to a final wealth y:

$$U(x, y) = v(x) + f(v(x) - v(y)) \qquad (1)$$

where $U(x,y)$ is the modified utility of achieving x, knowing that y could have been achieved. $v(x)$ is the traditional von Neumann-Morgenstern utility function, also called *value function* or choiceless utility. It is the "value" or utility that an investor would derive from outcome x if he experienced it without having to choose. This value function is assumed to be monotonically increasing and concave (risk aversion) as in traditional finance. So it does reflect return and risk of the overall portfolio. The difference $v(x) - v(y)$ is the value loss/gain of having chosen x rather than a forgone choice y. The regret function $f(.)$ is monotonically increasing and decreasingly concave[8], with $f(0) = 0$. Note that the argument of $f(.)$ can be positive if the chosen investment has a better outcome than the alternative. Rejoicing, as named by Loomes and Sugden (1982), is the additional pleasure of knowing, ex post, that the best decision has been selected. Concavity of the regret function, $f''<0$, implies regret aversion. This (modified) utility is defined over the ex-post (final) outcomes of investment choices; and rational investors would make choices ex-ante by maximizing their expected utility. Loomes and Sugden (1982, 1983) and Bell (1982, 1983) conclude that this is a well-behaved parsimonious functional form that allows to take regret into account and is consistent with empirically-observed deviations from traditional expected utility theory.

It is worth stressing the differences of RT with traditional expected utility and other behavioral approaches:

- A major difference with *traditional utility* is that the modified utility takes into account the outcome of investments that have not been chosen. Traditional utility only assigns

[7] Including the "common ratio effect", the "isolation effect", the "preference reversal effect", the "reflection effect", and "simultaneous gambling and insurance"

[8] Bell (1982, 1983) and Loomes and Sugden (1982,1983) show that several behavioral patterns which contradict traditional expected utility theory are predicted by regret theory with a function $f(.)$ that is concave for negative values of the argument and with $f'''>0$, so that $f(.)$ is decreasingly concave.

value to the outcome of investments that are actually chosen. RT adds a regret function stemming from the comparison with other unchosen investments. In its simple form, the maximization of traditional expected utility reduces to an expected return-risk optimization, where the risk measure is the volatility of the global portfolio. In RT, this translates into an optimization with two risk attributes: traditional volatility and regret.

- *Prospect theory* has inspired some utility models that typically include a disappointment term with a kink at the current investment value (zero return or risk-free rate) where the slope of utility is higher for losses than for gains ("loss aversion"). Barberis and Huang (2004) propose a sophisticated dynamic consumption and portfolio allocation model, introducing narrow framing and loss aversion by adding a piece-wise linear disappointment term for selected (narrow-framed) assets in a traditional utility function. They offer a simple example with two risky assets, with only one being narrow-framed with linear disappointment, and suggest that it could apply to foreign stocks. Loss aversion (LA) is easier to model than regret as the benchmark expectation for a given investment is usually set as a fixed number (typically the current situation), while in RT I have to wait for the realization of the "best" investment strategy in the investment decisions universe.
- Another class of preference-based models also assume loss aversion, but derive these preferences from *Disappointment Aversion theory* (Gul, 1991), an axiomatic and normative decision theory using the Chew-Dekel class of risk preferences. Gul's preferences extend the expected utility framework by discriminating good and bad outcomes, i.e. outcomes above or below the certainty equivalent; bad outcomes are more heavily weighted than good outcomes. As a result, agents are more sensitive to bad outcomes and less to good ones, hence the name "disappointment aversion" (LA) preferences. Ang, Bekaert and Liu (2005) provide an interesting comparison of LA and DA preferences. DA and LA models imply an aversion to losses, but the attractivity of DA models compared to LA models is that the reference point is endogenously determined as the certainty equivalent, instead of some arbitrary preset value. Both LA and DA models imply first-order risk aversion[9]; in that sense LA and DA investors are "more" risk averse than traditional expected utility investors. All these approaches assume that utility is only defined over what the investor's own.

DA and LA models are quite different from RT, as the reference value for a given investment is usually set as a fixed, ex-ante number (possibly the current situation plus a risk-free rate in LA models, or the endogenous certainty equivalent as in DA models), while in RT the best forgone alternative used to measure regret can only be determined ex-post and may vary with actual states of the world. This feature has important consequences on the implied risk preferences of regret averse investors. Contrary to DA and LA, RT does not uniformly induce increased risk aversion relative to the expected utility paradigm. Our approach introduces two dimensions of risk. Loosely speaking, the first one is traditional volatility, linked to deviations of the chosen portfolio return from its expected value. The second one is regret risk, linked to deviations of the chosen portfolio returns from the return of the best forgone alternative. The two types of risks are neither identical nor fully correlated.

[9] First-order risk aversion means that the risk premium required on a risky gamble is proportional to the volatility (σ) of the outcome. In traditional expected utility, I have second-order risk aversion, meaning that the risk premium is proportional to σ^2 . In DA and LA model I have a kink in utility at the reference point.

RT is clearly relevant to investors who compare the performance of their portfolio to forgone alternatives that they could have chosen, or to peers and benchmark portfolios whose performance could have been achieved. But the application of RT is technically difficult, because it involves two risk attributes in the utility function. There are few applications of RT to investment choices. Muermann, Mitchell and Volkman (2005) study the influence of regret on asset allocation between a riskfree and a risky asset in a comparative statics setting. Compared to a risk-averse investor, they find that "the investor who takes regret into account will hold more stock when the equity premium is low but less stock when the equity premium is high." But they do not derive explicit solutions for the portfolio holdings of regret-averse investors. Dodonova and Khoroshilov (2005) include some simplified form of regret in a model of asset pricing, but their utility function is not consistent with RT, as developed by Bell, Loomes and Sugden. All these models do not derive explicit solutions but focus on comparative statics. Gollier and Salanié (2006) study the properties of a class of utility functions, that exhibit some form of regret aversion, in an Arrow-Debreu economy. They derive some interesting implications for asset allocation decisions and asset pricing. Michenaud and Solnik (2006) derive optimal currency hedging choices for regret-averse investors in a setting somewhat related to ours. They also find that regret-averse investors tend to "hedge their bets". In the empirical finance literature, regret avoidance is mentioned as an explanation of several investment behaviors, such as the "disposition effect" (Shefrin and Statman, 1985), but formal RT modelization has not been developed. In contrast, our paper derives closed-form solutions for optimal investment choices.

4. Application to international asset allocation choices

In this article I apply regret theory to the modeling of international asset allocation. Foreign stocks are narrow-framed as upside-potential assets and investors experience regret when they fail to outperform domestic stocks and rejoice if they do. Hence our model is fairly simple. It incorporates a regret function that compares the return on the chosen global asset allocation to the return that would have been achieved with a portfolio fully invested in domestic assets. In equation (1), x is the outcome of the chosen global allocation and y is the outcome of a purely-domestic allocation. Loosely speaking, the spirit of the approach as outlined in Statman (1999) is that of a US investor who regards US equity as the core portfolio and considers investing in "exotic" foreign equity to boost return.

I have two countries and one asset per country. One country is referred to as "home", and the other as "international". I have investors in both countries who consider investing in domestic and foreign assets.[10] To simplify notations, I use subscript i for investors from the international country i and no subscript for home investors.

Let's first consider home investors. Of their initial invested wealth w, investors have allocated $(1-\alpha)w$ to their domestic asset and αw to the international asset i. All valuations are conducted in a common currency assuming a *fixed* exchange rate. I denote R and R_i the stochastic returns on the home and international asset.[11]

[10] So the countries are "home" and "international" and investors in both countries allocate to assets that are regarded as domestic and foreign from their own viewpoint.

[11] I will later introduce an investor from the international country investor who will treat R_i as the return on his domestic asset i and R the return on the foreign asset from the viewpoint of country i.

I have the final wealth w^1 given by:

$$w^1 = w\left[1+(1-\alpha)R+\alpha R_i\right] = w + w\left[R+\alpha(R_i-R)\right] = w + w(R+\alpha s) \qquad (2)$$

With:

$$s = R_i - R$$

The value (traditional utility) of final wealth, can be written explicitly as a function of α, the sole decision variable and of the two stochastic variables R and s : $v(w\left[R+\alpha s\right])$.

The modified utility can be written as:

$$U(w^1) = v(w\left[R+\alpha s\right]) + f(v(w\left[R+\alpha s\right]) - v(wR)) \qquad (3)$$

Where $v(.)$ and $f(.)$ are monotonically increasing and concave; $f(.)$ is decreasingly concave ($f''<0$, $f'''>0$) and $f(0)=0$.

Risk considerations are taken into account in the value function, but, in addition, investors may experience regret on their upside-potential investments, namely on their decision to invest abroad. Investors only experience regret on the performance of their foreign allocation. If foreign equity underperforms domestic equity, they experience regret of having invested abroad. Their optimal decision would have been not to invest abroad. On the other hand, they rejoice if foreign equity outperforms domestic equity. The regret term in equation (3) is not symmetric in R and R_i . When the domestic asset underperforms the foreign asset ($R_i - R = s > 0$), domestic investors experience no regret, actually they even rejoice that their decision to invest abroad turned out right. Of course, the higher their allocation to foreign asset α, the happier they are. They only experience regret when the foreign asset does not deliver the upside potential that they were looking for ($R_i - R = s < 0$). The larger their allocation to foreign asset α, the stronger is their regret. Concavity in the regret function assures regret aversion[12]. In a sense, the return on domestic equity is used as benchmark for foreign stocks. But note that the regret function $f(.)$ is defined over a difference in utility, not over a difference in return as is typical in a benchmarking approach. Hence regret theory takes into account risk-adjusted performance in a comprehensive manner.

This asymmetric formulation is related to the "keeping up with the Joneses" approach of consumption preferences as in Abel (1990), Shore and White (2003), Gollier (2004), DeMarzo, Kaniel and Kramer (2004). In their approach, agents have exogenous preferences to mimic the consumption of people in their community (e.g. country) and therefore agents tend to mimic portfolio choices of those living in their country. Following the relative consumption literature, Shore and White (2003) use a direct utility function defined on the agent's consumption relative to an external habit linked to aggregate national consumption. In DeMarzo, Kaniel and Kramer (2004), the model of the economy results in an indirect utility that is a power function of the agent's wealth multiplied by a state variable function of aggregate national wealth. As stressed by Gollier (2004), relative consumption preferences are not sufficient to induce home bias. Generally, the resulting equilibrium will imply that everyone holds the world market portfolio; agents do mimic the portfolio held by

[12] Underperforming the domestic benchmark by 10% provides more pain of regret (loss in utility) than an overperformance of 10% provides rejoicing (gain in utility).

other nationals, but that portfolio is the world market portfolio. To induce home bias, some financial market imperfection must be introduced. Shore and White (2003) and Demarzo, Kaniel and Kramer (2004) *assume* that some agents exhibit an "exogenous" bias towards domestic securities: this could be justified by a behavioral "familiarity" bias towards investing in local firms or some form of investment constraints[13]. In equilibrium, all local investors will hold a home-biased portfolio because they mimic national aggregate wealth which includes the portfolios of the exogenously-biased investors.

"Keeping up with the domestic Joneses" is a consumption approach that could motivate our behavioral model where investors exhibit regret aversion on their foreign equity position relative to domestic assets. The equilibrium frameworks discussed above are clearly "richer" than ours as they include consumption, while I start from the indirect utility function of wealth and only consider investment decisions. But they require to specify exogenously some arbitrary level of home bias (or market imperfection) for a category of investors, which I do not have to do. Regret theory offers a general and axiomatic formulation of the indirect utility function that leads to an equilibrium under perfect financial markets. I are able to characterize the properties of the equilibrium solely as a function of the levels of risk and regret aversions, and market observables.

5. Optimal foreign asset allocation

The optimal asset allocation α^* is obtained by maximizing the expected modified utility with respect to α;

$$EU(w^1) = Ev(w[R + \alpha s]) + Ef(v(w[R + \alpha s]) - v(wR)) \qquad (4)$$

This is a well-behaved optimization problem, as I show in the Appendix that $EU(.)$ is concave with respect to α.

To derive analytical allocation rules, I need to make specific assumptions on the functions $v(.)$ and $f(.)$ to be used as well as on the distribution of R and s. If $f(.)$ is linear, then the problem reduces to traditional expected utility maximization, as the maximization with respect to α. of the expected utility given in (4) reduces to the maximization of $Ev(R + \alpha s)$. With a linear regret function, RT always reduces to traditional expected utility theory.

In general $f(.)$ is assumed concave (regret aversion). Except for very particular and simplistic functions[14] $v(.)$ and $f(.)$, I cannot derive explicit allocation rules and would have to resort to numerical solutions with little generality. The problem already arises in the traditional maximization of expected utility in portfolio theory, but there exist some interesting cases where explicit rules can be worked out.[15] In our model, the problem is compounded by the presence of a concave regret function defined over a value function. An ad-hoc assumption, that would make the model a bit more tractable, could be to model the regret term as defined over payoffs, not valuation of payoffs. But this simplification would

[13] Demarzo, Kaniel and Kramer (2004) also consider the case where some agents are constrained on their financial market trades, leading to a necessarily-home-biased portfolio: some agents are assumed to be only endowed with claims on domestic goods that they cannot sell to invest in foreign assets.

[14] An unattractive alternative is to assume that v is linear and f quadratic.

[15] When the utility function belongs to the HARA class and asset returns are multivariate normally distributed, there is a linear relation between optimal portfolio weights and the wealth level.

not be consistent with RT and I would lose the theoretical and empirical appeal of this approach.

An interesting alternative is to use the two-moment approximation proposed by Pratt (1964) to conduct his analysis of risk aversion for small risks. I use a Taylor expansion of (3) and take its expected value, ignoring moments higher than two. I then maximize with respect to α and are able to derive explicit asset allocation rules with interesting economic interpretation. This two-moment Arrow-Pratt approximation is very similar in spirit and results to the multivariate normality assumption for return distributions that was introduced in the finance literature (or lognormality in the case of continuous-time models). In both cases, I end up with models relying solely on the first two moments of return distributions. In traditional finance models, the normality assumption implies that for well-behaved utility functions, expected utility *Eu*(.) can be expressed as a function of the means and covariances. So parameters of the utility function only affect investment choices to the extent that they affect the risk aversion parameter in the expected utility function. In our model, the modified utility function is complex with two attributes, risk and regret. To allow for economic interpretation, I wish to retain explicitly the parameters of the modified utility in the optimal asset allocation derived under maximization of the expected modified utility. This cannot be done by simply assuming normality of returns. However, I can do it using the Arrow-Pratt approach, as shown below.[16] Most of the asset allocation literature has been using the two-moment assumption of multivariate normal distributions for *R* and *s*. As I will compare our results to this traditional mean-variance optimization, I are quite satisfied with making an equivalent two-moment assumption.

Let us write $R = \bar{R} + r$, where $\bar{R}$ is the expected return on the home market and *r* is stochastic with a zero expected return. For a given allocation α, I develop the Taylor expansion around $\bar{R}$ for small price movements. I develop the value function *v*(.) around $\bar{R}$ and the regret function *f*(.) around 0. So the implicit arguments is $\bar{R}$ for all derivatives of *v*(.), and 0 for all derivatives of *f*(.). The derivations are given in the Appendix with the additional notations $\Sigma_r = E(r^2)$, $\Sigma_s = E(s^2)$ and $\text{cov}(r,s) = E(rs)$, the optimal allocation to foreign equity by home investors is given by:

$$\alpha^* = -\frac{\left[\bar{s}v' + \text{cov}(r,s)wv''\right] \times (1 + f')}{w\Sigma_s(v'' + v''f' + v'^2 f'')} \tag{5}$$

The allocation to domestic equity is equal to $1 - \alpha^*$.

Let's first consider the case where there is no regret aversion, $f(.) \equiv 0$. I will refer to this case as "traditional". Then the optimal allocation to foreign stocks reduces to:

$$\alpha^*_{no} = -\frac{\left[\bar{s}v' + \text{cov}(r,s)wv''\right]}{w\Sigma_s v''} = -\frac{\bar{s}v'}{w\Sigma_s v''} - \frac{\text{cov}(r,s)}{\Sigma_s} = \frac{\bar{s}}{\lambda\Sigma_s} - \frac{\text{cov}(r,s)}{\Sigma_s} \tag{6}$$

[16] Strictly speaking, the Arrow-Pratt approximation is valid for small risks. The quality of the two-moment approximation depends on the actual return distributions and the shape of the utility function. This has been extensively discussed in the literature, see Samuelson (1970), Loistl (1976), Levy and Markowitz (1979), and Kroll, Levy and Markowitz (1984). I thank Christian Gollier for his support in getting a clearer view of this approach.

Where α_{no}^{*} is the optimal foreign allocation with no regret and $\lambda = -\frac{wv''}{v'}$ is the traditional measure of relative risk aversion. This is the standard result under the assumption of multivariate normality.[17] As mentioned before, the traditional result also obtains if *f*(.) is linear (no regret aversion).

In the presence of regret aversion, I can rewrite equation (5) as:

$$\alpha^{*} = -\frac{\bar{s}v' + \mathrm{cov}(r,s)wv''}{w\Sigma_s v''} \times (1 - \frac{f''v'^2/v''}{1 + f' + f''v'^2/v''}) = \alpha_{no}^{*} \times (1-\theta) \qquad (7)$$

where $\theta = \frac{f''v'^2/v''}{1 + f' + f''v'^2/v''} > 0$ as $f'>0$, $f''<0$ and $v''<0$.

Following Bell (1983), define regret aversion γ as: $\gamma = -\frac{wv'f''}{1+f'}$.[18] I obtain:

$$\theta = \frac{\gamma}{\lambda + \gamma} = \frac{\gamma/\lambda}{1 + \gamma/\lambda} \qquad (8)$$

Then equation (7) can be written as:

$$\alpha^{*} = \left[\frac{\bar{s}}{\lambda\Sigma_s} - \frac{\mathrm{cov}(r,s)}{\Sigma_s}\right] \times (1 - \frac{\gamma/\lambda}{1+\gamma/\lambda}) = \left[\frac{\bar{s}}{\lambda\Sigma_s} - \frac{\mathrm{cov}(r,s)}{\Sigma_s}\right] \times (1-\theta) \qquad (9)$$

The term between brackets is the traditional result, the second term adjusts for regret aversion. Note that regret aversion only enters optimal demands and θ through its ratio to traditional risk aversion. The parameter θ can be regarded as "normalized" regret aversion; its value is zero in the absence of regret aversion and ranges up to one when regret aversion dominates risk aversion. Normalized regret aversion θ measures the extent of home bias. The ratio of regret aversion to risk aversion γ/λ, is what drives θ and the home bias.

Some specific cases can be discussed:

- In the absence of regret aversion ($\gamma = 0$), there is no home bias ($\theta = 0$).
- If regret aversion is extremely large relative to risk aversion ($\gamma/\lambda = \infty$), home investors will hold no foreign assets ($\theta = 1$, full home bias).
- If a regret-averse investor exhibits a regret aversion that is of the same order of magnitude as her traditional risk aversion ($\gamma/\lambda = 1$), then the foreign allocation is only half of that for a regret-free investor ($\theta = 0.5$, 50% home bias).

I have compared the optimal foreign allocation of traditional and regret-averse investors, but estimating the home equity bias in this way could be misleading. Global market equilibrium would be different if investors have different utility functions. If I assume that risk measures are exogenous, expected returns resulting from global market equilibrium

---

[17] Lewis (1999) derives it under her equation (3). The similarity can be observed by noting that $\mathrm{cov}(r,s) = \mathrm{cov}(R, R_i) - \Sigma_r$

[18] A discussion of foreign risk/regret aversion is provided in the Appendix.

will differ whether investors have traditional or regret-averse utility. I will now derive market equilibrium assuming that investors have regret-averse utility of the form (4).

6. Global market equilibrium

I derive a CAPM under regret aversion, with two countries and a representative investor in each country. There is a fixed exchange rate and expectations are homogeneous. As above, I have no riskless asset. Admittedly, this is a restrictive assumption[19] but it allows us to focus on the domestic/foreign equity allocation. In terms of equilibrium asset pricing I can only derive the pricing (expected return) of one country equity relative to the other. In terms of portfolio choice, I have only one decision variable, namely the domestic/foreign equity allocation. Unfortunately, introducing a second decision variable, namely the allocation between risky and riskless assets, would make the analysis intractable given the complexity of our utility functions. In any case, our current formulation is sufficient to focus on the question at hand, the home equity bias.

In each country I have a representative investor with preferences given in (4). Investors located in the country called "international" allocate their wealth to their domestic asset, with return R_i, and to the foreign asset (from the country called "home") with a return R. Investors from country i have a wealth w_i and allocate βw_i to their local asset i, and $(1-\beta)w_i$ to the other country's asset.

$$EU_i(w_i^1) = Ev_i(w_i[R+\beta s]) + Ef_i(v_i(w_i[R+\beta s]) - v_i(w_i[R+s])) \qquad (10)$$

The problem is symmetric. I define:

$W = w + w_i$

$M = m + m_i$

where W is total wealth, M is total market capitalization, m and m_i are the market capitalization of each country. I have in equilibrium $M=W$.

Asset demands for investors from the "home" country are given in equation (9). Asset demands for investors from the "international" country are derived in the Appendix. I derive the allocation to its domestic asset (asset i) by the international investor as:

$$\beta^* = \left[\frac{\overline{s}}{\lambda_i \Sigma_s} - \frac{\mathrm{cov}(r,s)}{\Sigma_s} \right] \times (1-\theta_i) + \theta_i \qquad (11)$$

where $\theta_i = \dfrac{\gamma_i / \lambda_i}{1+\gamma_i / \lambda_i}$

International Asset pricing relation

I now aggregate asset demands and equate them to supplies (market capitalization). I assume that all risk parameters are exogenous and study the expected differential return $\overline{s}$

[19] Note that national riskless assets are generally assumed in zero net supply in each country, so that the aggregate position in the riskless asset for a representative investor is null.

resulting from market equilibrium.[20] As the focus of our analysis is on the role of regret, I make the simplifying assumption that investors from the two countries have the same traditional risk aversion λ, but different regret aversion γ and γ_i, and hence different θ and θ_i. The derivations are given in the Appendix. I obtain the international asset pricing relation:

$$\overline{s} = \lambda \times \mathrm{cov}(R_w, s) - \lambda \times \Sigma_s \frac{m_i}{W} \delta_i \qquad (12)$$

where $R_w = \frac{m}{W} R + \frac{m_i}{W} R_i$ is the return on the world market portfolio and $\delta_i = \frac{(w_i / m_i)\theta_i - \theta_W}{1 - \theta_W}$ is the differential in normalized regret aversion of investor *i* relative to the world-average regret aversion $\theta_W = (w\theta + w_i\theta_i)/W$:

In the absence of regret aversion ($\theta = \theta_i = \delta_i = 0$), the asset pricing relation (12) yields a familiar result[21] : all assets are priced according to their covariance with the world market portfolio. Risk diversification benefits are priced. The traditional result obtains the sense that, ceteris paribus, the lower the covariance of foreign assets with the world market portfolio, and hence with the home asset, the lower the expected return.[22] Foreign assets that offer good diversification benefits for home investors justify a lower expected return ceteris paribus

But regret aversion can affect the relative expected return of the two countries. The first term of equation (12) is the traditional asset pricing relation in the absence of regret and the second term can be viewed as a regret premium. Let's for a moment assume that investors in the "international" country (and therefore also in the "home" country) have zero net foreign investments (their wealth equals the market value of their domestic assets, $w_i = m_i$). When investors in both countries exhibit the same level of regret aversion ($\theta = \theta_i$), the asset pricing relation is identical to that found in the traditional case (no regret premium). The conclusion is that regret aversion does not affect asset pricing, although it does affect asset holdings. It is only when regret aversion differs across countries that a regret premium enters international asset pricing. If investors from the international country are more regret-averse than investors from the home country ($\theta_i > \theta$), the expected return on international equity is going to be lower than in the traditional case. Ceteris paribus, investors from the more regret-averse country have a stronger demand for domestic equity and are therefore willing to accept a lower expected return. This effect is magnified when investors of the international country have a greater wealth than the market value of their domestic assets.

---

[20] As I only have two assets, equilibrium will only dictate their relative expected return $\overline{s}$. As usual in static CAPMs, with n assets I can price n-1 assets relative to one asset; the last one usually being the risk-free rate.

[21] See Lewis (1999), equation (4).

[22] Remember that $\mathrm{cov}(R_w, s) = \mathrm{cov}(R_w, R_i) - \mathrm{cov}(R_w, R)$. Ceteris paribus, the lower the covariance between R_i and R, the lower the covariance between R_w and R.

The absolute magnitude of the regret premium depends on the diversification benefits provided by the foreign asset to home investors.[23] The lower the covariance of foreign assets with home assets, the higher the absolute value of the regret premium. Under-investing in foreign assets that offer good diversification benefits must be compensated by a larger regret premium. But the sign (direction) of the regret premium is determined by relative regret aversion, as discussed above.

Hence, the stylized facts is that countries with the lower expected return are those with higher regret aversion and with lesser covariance with the world market portfolio.

Equilibrium holdings

Optimal equilibrium holdings of asset *i* for investors of both countries can then be derived from (9) and (11) as:

$$\alpha^* = \frac{m_i - w_i\theta_i}{W - (w\theta + w_i\theta_i)} \times (1-\theta) = \frac{m_i}{W} \times (1-\delta_i) \times (1-\theta)$$

and (13)

$$\beta^* = \frac{m_i - w_i\theta_i}{W - (w\theta + w_i\theta_i)} \times (1-\theta_i) + \theta_i = \frac{m_i}{W} \times (1-\delta_i) \times (1-\theta_i) + \theta_i$$

The traditional equilibrium holdings of asset *i* in the absence of regret for all investors are given by m_i/W. In the presence of regret, equilibrium holdings differ from the traditional holdings because of the investor's level of (normalized) regret aversion and because of its differential with world-average regret aversion.

Equilibrium holdings for the home-country asset are trivially derived as one minus the holdings in (13).

Note that equilibrium holdings[24] are not explicitly function of the return distributions. Clearly, holdings depend on the parameters of regret aversion in each country. Also note that regret and risk aversion parameters only enter (13) through θ and θ_i. Since $\theta = (\gamma/\lambda)/(1+\gamma/\lambda)$, it is only the ratio of regret aversion to traditional risk aversion that affects equilibrium holdings.

It is important to observe that, even if investors in one country are regret-free, they will exhibit a home bias in equilibrium. For example, assume that $\theta_i = 0$ but $\theta > 0$: then the international investor will tend to over-invest in his own country as $\beta^* = \frac{m_i}{W - w\theta} > \frac{m_i}{W}$. Regret-averse investors from the home country will have a strong demand for their domestic asset pushing its expected return down relative to the international asset; in equilibrium this will make the asset from the home country less attractive to investors from the international country. So it is sufficient to have regret aversion in one country to observe a world-wide home bias. This is illustrated in the simple example below.

---

[23] Σ_s is always positive and equal to the sum of the variances of the two assets minus twice their covariance.

[24] In the absence of regret aversion ($\theta = \theta_i = \delta_i = 0$), all investors hold the world market portfolio. They invest their wealth in each country proportionally to the country's market capitalization.

Simple example

Assume a fully symmetric world. Each country has the same size and no net foreign position ($m_i = m = w_i = w = 0.5$).

Table 1 gives the equilibrium holdings (as a proportion of total holdings) of international-country equity for various assumptions of risk/regret aversion. Holdings in home-country equity can be deducted by taking one minus the international-country holdings reported in Table 1. The first column assumes that investors in both country experience no regret aversion but only risk aversion; this is the traditional case used as benchmark. The second column assumes that investors in both countries have a regret aversion γ similar to their risk aversion λ. In other words they fear regret as much as volatility (ratio of regret aversion to risk aversion equal to one). Home and international investors will only hold 25% of their portfolio in foreign stocks (and 75% in domestic stocks), a significant home bias. Remember, however, that asset pricing is not affected in this case (because regret aversion is similar in both countries) and remains similar to the traditional relation. In this symmetric example, the home bias will not necessarily lead to a reduction in expected return on the global portfolio (for example if the two markets have the same expected return). But it will lead to an increase in total portfolio risk compared to a full diversification without home bias. This difference in portfolio volatility is caused by aversion to regret risk. To reduce regret risk, one is willing to take more portfolio volatility.

In the third column, I assume that home investors are regret averse and have a ratio of regret aversion to risk aversion equal to one but international investors have no regret aversion. Equilibrium still results in a significant home bias, as both investors hold 67% of their portfolios in domestic equities.; as seen in (12), there will be a regret premium that will increase the expected return on international equity compared to the traditional case. However, to explain the magnitude of the home bias found in actual data, one has to assume higher regret aversion. Columns four and five assume that both investors have a ratio of regret aversion to risk aversion equal to two and four respectively. Investors hold 90% of their portfolios in domestic equity when regret aversion is four times larger than risk aversion.

Table 1: Equilibrium holdings of the international asset by investors of the home country and investors of the international country

Holdings are expressed as a proportion of the total equity portfolio. Various hypotheses for regret aversion are given in the column heading. γ and γ_i are the regret aversion of investors of the home and international countries; λ is traditional risk aversion set identical for all investors.

	$\gamma_i = \gamma = 0$	$\gamma_i = \gamma = \lambda$	$\gamma_i = 0,\ \gamma = \lambda$	$\gamma_i = \gamma = 2\lambda$	$\gamma_i = \gamma = 4\lambda$
Home investor	0.50	0.25	0.33	0.17	0.10
International investor	0.50	0.75	0.67	0.83	0.90

Calibration of regret aversion parameters

I now estimate the regret aversion parameters that would be consistent with the equity holdings reported in Figure 1. Using the IMF CIPS data for all investors, I aggregate non-US countries into a single "international" or "rest-of-the-world" country.[25] The resulting data for *W*, *w*, w_i, m_i, and *m* are reproduced in the top panel of Table 2. It should be noted that US residents are net foreign investors. Their holdings of foreign stocks amount to $2.08 trillion, while international investors only hold $1.282 trillion of US stocks. Hence, total US holdings are greater than the US equity market capitalization.

I use estimates of market volatility for the 10-year period January 1995-January 2005. The volatilities of the MSCI equity indexes for the US market and the EAFE markets ((Europe, Australasia and Far East, i.e. non-American markets) are equal to 15.3% per year. The correlation between the two indexes is 0.73. Hence I have $\Sigma_S = 0.0126$.

Although equation (13) look like a fairly-simple system of two equations with two unknowns θ and θ_i, they are not independent. Actually α is technically linked to β by the accounting relation:

$$w\alpha + w_i\beta = m_i \qquad (14)$$

Hence, observed equity holdings only impose a relation between θ and θ_i, and hence between regret aversion γ / λ and γ_i / λ_i, in the two countries. While a given pair of regret aversion parameters will induce a unique equilibrium allocation and expected return (regret premium), one needs to specify both the allocation and the expected return to deduct the regret aversion in the two countries. We cannot observe expected returns, but it is interesting to study the case where asset pricing would be identical to the traditional case, namely when the regret premium is zero. Combining equation (13) with $\delta_i = \dfrac{(w_{i/}m_i)\theta_i - \theta_W}{1-\theta_W} = 0$, we find that:

$$\gamma / \lambda = 2.92,\ \gamma_i / \lambda_i = 4.77$$

Regret aversion is higher for international investors as their foreign holdings are relatively lower than US investors. Their higher regret aversion explains why international investors hold so little of assets from the home country. We basically have the result of a large home bias in equity holdings with assets that should be priced according to a standard international CAPM.

If we now assume that US and international investors have the same level of regret aversion, we find that the common level of regret aversion is 3.60 and the regret premium a positive 0.12%. US investors are net foreign investors and to induce them to hold that position, a positive regret premium is required on international equity. Note that the regret premium is rather small despite a huge home bias. This result contrasts with conclusions of

[25] I cannot conduct a similar analysis for pension funds holdings as I do not have information for pension funds from many countries nor the detailed geographical breakdown of holdings. The CIPS data reports detailed geographical breakdown for holdings of investors in all countries in a consistent manner.

CAPMs derived under the assumption of partial market segmentation (investment barriers). There, market equilibrium implies that home biases are linked to pricing differentials for constrained assets.

It could be that traditional risk aversion is lesser in the presence of regret aversion in the modified utility function. But, to the best of my knowledge, no one has yet conducted experiments to estimate parameters of investors' regret function. Presently, it is impossible to conclude whether the magnitude of regret aversion required to justify the observed home bias is reasonable. But I have been able to quantify the extent of the "optimal" home bias that is justified by regret theory, something that other behavioral approaches do not afford.

Table 2: Actual foreign/domestic holdings of Equity

This table reports statistics from CIPS at the end of 2003. Non-US countries have been aggregated in an "international" country. Regional market capitalizations are reported in US dollars and in proportion of total capitalization. Holdings of foreign stocks by investors of a country are reported in US dollars and in proportion of the total equity holdings of investors of that country..

Portfolio data	**In thousands of US$**	**In %**
World Market Capitalization: $W=M$	31,202,300	100.00
US market cap: m	14,266,024	45.72
International market cap: m_i	16,936,276	54.28
US wealth (total equity holdings): w	15,064,640	48.28
International wealth (total equity holdings): w_i	16,137,660	51.72
Holdings of international stocks by US investors: α	2,080,302	13.81
Holdings of US stocks by international investors: 1- β	1,281,686	7.94

7. Conclusions

Numerous explanations have been advanced for the home bias, but psychological biases remain the most likely candidates to explain its persistent magnitude. Corporate governance and insider control have been shown to explain some patterns in the home bias across countries, but these reasons fail to explain why international investors exhibit such a strong home bias towards the US equity market. In this article, I introduced a novel behavioral approach based on Statman's insight (1999), namely regret theory. I postulate that investors add foreign stocks to their domestic equity portfolio for their upside potential to overperform domestic equity, not only for their return/risk diversification benefits. When foreign stocks underperform domestic equity they feel the pain of regret of having invested abroad. Following regret theory, investors are assumed to construct their portfolios taking simultaneously into account their aversion to risk and to regret. I show that regret aversion could provide an explanation for the home bias in equity portfolios observed worldwide. So long as foreign stocks are not treated on the same footing as domestic stocks, regret aversion makes the home bias "rational". If investors exhibit regret aversion (in addition to risk aversion), there will be a significant home bias even if markets are fully efficient.

Some equilibrium results are worth stressing. If investors in all countries exhibit similar levels of regret aversion, regret will have no impact on asset pricing, even though the home bias can be large. On the other hand, In equilibrium, it is sufficient to have regret aversion in a single country to observe home bias in portfolio holdings of investors from all countries. This is because regret-averse investors bid up their home asset price reducing its expected return and making it less attractive to other investors. Our calibration show that the regret premium is likely to be rather small despite huge home biases in portfolio holdings. Other international CAPMs have been developed under the assumption of various forms of investment constraints on some securities. In the presence of investment barriers, home bias in portfolio holdings is necessarily associated with differential pricing of the constrained securities (pricing bias), a marked difference with my result. Here, a pricing bias is induced by national differentials in regret aversion, but with similar levels of national regret aversion there would be no pricing bias despite a home bias on portfolio holdings.

Most rational justifications of the home bias fail to explain the observed pattern of the home bias, in particular the fact that it has not drastically trended down in the past twenty years. Behavioral explanations are better fit to explain a slow trend. Investors' psychology is not likely to change rapidly. As regret aversion toward foreign investments is likely to evolve slowly, it is not surprising to find that the home bias did not change much despite the rapid capital market liberalization of the recent years. Differences in regret aversion are likely to be cultural and linked to "nationalism". For example, it would not be surprising that Dutch or Swiss investors feel more at ease with foreign investments than French investors.

I are not claiming that regret aversion is the only phenomenon at work to explain the equity home bias. It seems likely a combination of the factors discussed above come into play. But regret aversion may be relevant in a world where performance is measured relative to benchmarks and peers and where foreign investments are not treated on the same footing as domestic investments. An attractive feature of our approach is that it allows to quantify the impact of regret on optimal international holdings in an equilibrium framework; a feature not shared by most other behavioral explanations of the home bias. Experimental research

is required to test whether regret contributes to a better explanation of the equity home-bias puzzle. Direct estimates of investors' regret and risk aversions require data that is not presently available. An indirect test would be to study whether the expected return on a national equity market is negatively related to the observed level of home bias of their nationals. But such a test would be confronted with the problem that has marred all CAPM tests, namely estimating expected returns. Another direction of research is to study whether the cross-national pattern of actual home bias is linked to national cultural or societal differences, lending support to a behavioral explanation of the home bias.

Appendix : Various derivations

Concavity of EU with respect to α

I first show that *u* is concave in α. Let's take derivatives with respect to α of *EU* in (3).

The first derivative is:

$$\frac{\partial U}{\partial \alpha} = wsv' + wsf' \times v' = wsv'(1+f')$$

Where the argument of *v'* is $w\left[R+\alpha s\right]$, and the argument of *f'* is $v(w\left[R+\alpha s\right]) - v(wR)$. So $\frac{\partial U}{\partial \alpha}$ is always positive and continuous.

The second derivative is:

$$\frac{\partial^2 U}{\partial \alpha^2} = w^2 s^2 \left[v''(1+f') + v'^2 f'' \right] \qquad (15)$$

Where *v'* and *v''* are valued at $w\left[R+\alpha s\right]$ and *f'* and *f''* are valued at is $v(w\left[R+\alpha s\right]) - v(wR)$.

The second derivative $\frac{\partial^2 U}{\partial \alpha^2}$ is negative for all values of α, *R* and *s*, as $v', f' > 0$ and $v'', f'' < 0$.

Let's now turn to *EU* which can be written as a function of α. The second derivative of *EU* with respect to α is :

$$\frac{\partial^2 EU}{\partial \alpha^2} = E\frac{\partial^2 U}{\partial \alpha^2} = w^2 E(s^2 \left[v''(1+f') + v'^2 f'' \right])$$

Because $\frac{\partial^2 U}{\partial h^2}$ is negative for all values of α, *R* and *s*, so is $\frac{\partial^2 EU}{\partial h^2}$.

Optimal allocation of home investor

Let's write $R = \bar{R} + r$, where $\bar{R}$ is the expected return on the home market. For a given allocation α, I develop the Taylor expansion[26] around $\bar{R}$ for small price movements. I develop the value function *v*(.) around $\bar{R}$ and the regret function *f*(.) around 0. So the implicit arguments is $\bar{R}$ for all derivatives of *v*(.), and 0 for all derivatives of *f*(.).With the additional notations $\Sigma_r = E(r^2)$, $\Sigma_s = E(s^2)$ and $\mathrm{cov}(r,s) = E(rs)$, I get:

$$Ev(w\left[R+\alpha s\right]) \approx v(w\bar{R}) + w\alpha\bar{s}v' + \frac{w^2}{2}\left[\Sigma_r + 2\alpha \mathrm{co\,v}(r,s) + \alpha^2\Sigma_s\right]v'' \qquad (16)$$

[26] Our derivations could be made a bit more formal by taking *s*=ξ*s*', r=ξr' and letting ξ become very small. This is a direct application of the "compact" derivations of the approximation by Samuelson (1970).

and:

$$Ef(v(w[R+\alpha s])-v(wR)) \approx E\left[v(w[R+\alpha s])-v(wR)\right] f' + \frac{1}{2}E\left[v(w[R+\alpha s])-v(wR)\right]^2 f'' \quad (17)$$

with:

$$E(v\left(w[R+\alpha s]\right)-v(wR)) \approx w\alpha \bar{s}v' + w^2\alpha \operatorname{cov}(r,s)v'' + \frac{w^2}{2}\alpha^2\Sigma_s v''$$

$$E\left[v(w[R+\alpha s])-v(wR)\right]^2 \approx w^2\alpha^2\Sigma_s v'^2$$

Hence (17) becomes:

$$Ef(v(w[R+\alpha s])-v(wR)) \approx \left[w\alpha \bar{s}v' + w^2\alpha \operatorname{cov}(r,s)v'' + \frac{w^2}{2}\alpha^2\Sigma_s v''\right] f' + \frac{w^2}{2}\alpha^2\Sigma_s v'^2 f'' \quad (18)$$

The expected utility is the sum of two terms:

EU = (16) + (18)

Then:

$$EU \approx v(w\bar{R}) + \frac{w^2}{2}\Sigma_r v'' + w\alpha \bar{s}v' + w^2\alpha \operatorname{cov}(r,s)v'' + w\alpha \bar{s}v' f' + w^2\alpha \operatorname{cov}(r,s)v'' f' + \frac{w^2}{2}\alpha^2\Sigma_s v'' + \frac{w^2}{2}\alpha^2\Sigma_s v'' f' + \frac{w^2}{2}\alpha^2\Sigma_s v'^2 f'' \quad (19)$$

Let's compute the optimal allocation by setting to zero the derivative of $EU(.)$ with respect to α. This the first order condition without constraints on α::

$$0 = \bar{s}v' + \operatorname{cov}(r,s)wv'' + \bar{s}v' f' + \operatorname{cov}(r,s)wv'' f' + w\alpha\Sigma_s v'' + w\alpha\Sigma_s v'' f' + w\alpha\Sigma_s v'^2 f''$$

The optimal allocation to foreign equity by home investors is:

$$\alpha^* = -\frac{\left[\bar{s}v' + \operatorname{cov}(r,s)wv''\right]\times(1+f')}{w\Sigma_s(v'' + v''f' + v'^2 f'')} \quad (20)$$

The allocation to domestic equity is equal to $1-\alpha^*$.

Foreign regret/risk aversion

Given the utility function stated in (3), investors exhibit both regret aversion and risk aversion on their foreign wealth position.

I can derive an interesting measure of aversion to a change in value of the foreign position ($w\alpha s$). Following the risk aversion literature, I define Foreign Relative Aversion (*FRA*) as:

$$FRA = -w\frac{\frac{\partial^2 U}{\partial(w\alpha s)^2}}{\frac{\partial U}{\partial(w\alpha s)}} \tag{21}$$

Let's take derivatives with respect to $w\alpha\sigma$ of *EU* in (3).

The first derivative is:

$$\frac{\partial U}{\partial(w\alpha s)} = v' + f' \times v' = v'(1+f')$$

Where the argument of v' is $w\left[R+\alpha s\right]$, and the argument of f' is $v(w\left[R+\alpha s\right]) - v(wR)$. So $\frac{\partial U}{\partial \alpha}$ is always positive and continuous.

The second derivative is:

$$\frac{\partial^2 U}{\partial(w\alpha s)^2} = \left[v''(1+f') + v'^2 f''\right]$$

Where v' and v'' are valued at $w\left[R+\alpha s\right]$ and f' and f'' are valued at is $v(w\left[R+\alpha s\right]) - v(wR)$.

Hence, foreign relative aversion is equal to:

$$FRA = -w\frac{v''(1+f') + v'^2 f''}{v'(1+f')} = -w\frac{v''}{v'} - w\frac{v' f''}{1+f'} = \lambda + \gamma \tag{22}$$

Where, $\lambda = -\frac{wv''}{v'}$ is the traditional measure of relative risk aversion and $\gamma = -w\frac{v' f''}{1+f'}$ measures relative regret aversion.

Intuition for this measure of regret aversion can be gained by remembering that the regret function *f*(.) is defined over values *v*(.), not over monetary payoffs. So $v'^2 f'$ represents the curvature of the regret term in the modified utility, while $v'(1+f')$ is the first derivative of the modified utility.

Regret aversion increases foreign risk aversion. Based on the regret aversion estimates of Section 6, I find that foreign relative aversion (*FRA*) including both regret and risk aversion could be a multiple of traditional risk aversion.

Optimal allocation of international investor

Investors from country *i* have a wealth w_i and allocate βw_i to their local asset *i*, and $(1-\beta)w_i$ to the other country's asset.

$$EU_i(w_i^1) = Ev_i(w_i\left[R+\beta s\right]) + Ef_i(v_i(w_i\left[R+\beta s\right]) - v_i(w_i\left[R+s\right])) \tag{23}$$

The problem is symmetric. So I could use the results derived for investors from "home" country in equation (5), where I replace α by (1-β), R by R_i and $s=R_i - R$ by $-s$ and note that $\Sigma_{-s} = \Sigma_s$ and:

$$\text{cov}(R_i, -s) = \text{cov}(R + s, -s) = -\text{cov}(r, s) - \Sigma_s$$

Hence, the optimal foreign asset allocation by investors of the foreign country is given by:

$$1 - \beta^* = -\frac{\left[-\bar{s}v_i' - \text{cov}(r,s)w_i v'' - w_i \Sigma_s v_i''\right] \times (1 + f_i')}{w_i \Sigma_s (v_i'' + v_i'' f_i' + v_i'^2 f_i'')}$$

Hence, the optimal asset allocation of investors of country *i* to their own asset is:

$$\beta^* = 1 + \frac{\left[-\bar{s}v_i' - \text{cov}(r,s)w_i v'' - w_i \Sigma_s v_i''\right] \times (1 + f_i')}{w_i \Sigma_s (v_i'' + v_i'' f_i' + v_i'^2 f_i'')} =$$

$$- \frac{\left[\bar{s}v_i' + \text{cov}(r,s)w_i v_i''\right] \times (1 + f_i') - w_i \Sigma_s v_i'^2 f_i''}{w_i \Sigma_s (v_i'' + v_i'' f_i' + v_i'^2 f_i'')}$$

I get:

$$\beta^* = \left[\frac{\bar{s}}{\lambda_i \Sigma_s} - \frac{\text{cov}(r,s)}{\Sigma_s}\right] \times \left(1 - \frac{\gamma_i / \lambda_i}{1 + \gamma_i / \lambda_i}\right) + \frac{\gamma_i / \lambda_i}{1 + \gamma_i / \lambda_i}$$

$$\beta^* = \left[\frac{\bar{s}}{\lambda_i \Sigma_s} - \frac{\text{cov}(r,s)}{\Sigma_s}\right] \times (1 - \theta_i) + \theta_i \qquad (24)$$

International asset pricing relation

I now aggregate asset demands and equate them to supplies (market capitalization). I assume that all risk parameters are exogenous and study the expected differential return $\bar{s}$ resulting from market equilibrium.[27] As the focus of our analysis is on the role of regret, I make the simplifying assumption that investors from the two countries have the same traditional risk aversion λ, but different regret aversion γ and γ_i, and hence different θ and θ_i.

Looking at asset *i*, I have:

$$m_i = w\,\alpha^* + w_i \beta^*$$

$$m_i = \left[\frac{\bar{s}}{\lambda \Sigma_s} - \frac{\text{cov}(r,s)}{\Sigma_s}\right] \times \left[w(1-\theta) + w_i(1-\theta_i)\right] + w_i \theta_i$$

Hence:

$$\frac{\bar{s}}{\lambda \Sigma_s} - \frac{\text{cov}(r,s)}{\Sigma_s} = \frac{m_i - w_i \theta_i}{W - (w\theta + w_i \theta_i)} \qquad (25)$$

[27] As I only have two assets, equilibrium will only dictate their relative expected return $\bar{s}$. As usual in static CAPMs, with n assets I can price n-1 assets relative to one asset; the last one usually being the risk-free rate.

Note that equation (25) could be written as function of *m* and *w*:

$$\frac{m_i - w_i\theta_i}{W-(w\theta + w_i\theta_i)} = 1 - \frac{m - w\theta}{W-(w\theta + w_i\theta_i)}$$

Let's denote the average wealth-weighted regret aversion $\theta_W = (w\theta + w_i\theta_i)/W$. Then the right-hand side of (25) can be written as:

$$\frac{m_i - w_i\theta_i}{W-(w\theta + w_i\theta_i)} = \frac{m_i}{W}\left(\frac{1-\frac{w_i}{m_i}\theta_i}{1-\theta_W}\right) = \frac{m_i}{W} + \frac{m_i}{W}\left(\frac{\theta_W - \frac{w_i}{m_i}\theta_i}{1-\theta_W}\right) = \frac{m_i}{W}(1-\delta_i)$$

with $\delta_i = \dfrac{\frac{w_i}{m_i}\theta_i - \theta_W}{1-\theta_W}$.

The parameter δ_i can be interpreted as the differential in regret aversion of investor *i*. For example, assume that investors from both countries have the same regret aversion ($\theta = \theta_i$) and have no net foreign investment ($m_i = w_i$ and hence $m = w$); then the aversion differential is zero. Of course, the differential is also zero if all investors exhibit no regret aversion ($\theta = \theta_i = 0$).

The asset pricing relation (25) can be rewritten as:

$$\overline{s} = \lambda\left(\mathrm{cov}(r,s) + \Sigma_s \frac{m_i}{W}(1-\delta_i)\right) \qquad (26)$$

Let's now introduce the world market portfolio with return R_w. I have:

$$R_w = \frac{m}{W}R + \frac{m_i}{W}R_i$$

Since $R_i = R + s$, I get:

$$R_w = R + \frac{m_i}{W}s$$

and:

$$\mathrm{cov}(R_w, s) = \mathrm{cov}(r,s) + \frac{m_i}{W}\Sigma_s .$$

Replacing in (26), I obtain the pricing relation:

$$\overline{s} = \lambda \times \mathrm{cov}(R_w, s) - \lambda \times \Sigma_s \frac{m_i}{W}\delta_i \qquad (27)$$

As I only have two countries equation (27) is sufficient to characterize the equilibrium. It can be trivially transformed as a function of m and δ with:

$$\frac{m_i}{W}\delta_i = -\frac{m}{W}\delta$$

$$\delta = \frac{\frac{w}{m}\theta - \theta_W}{1 - \theta_W}$$

References

Abel, A.B., "Asset Prices under Habit Formation and Catching Up with the Joneses", *American Economic Review*, 80, 38-42, 1990.

Adler, Michael and Bernard Dumas, “International Portfolio Choice and Corporate Finance: A Synthesis”, *Journal of Finance*, 38, 925-984, 1983.

Ang, A., Bekaert, G., Liu, J., "Why Stocks may Disappoint", *Journal of Financial Economics*, 76, 471-508, 2005.

Barberis, Nicolas and Ming Huang, “Preferences with Frames: A New Utility Specification that Allows for the Framing of Risks”, *Working Paper*, March 2004.

Bascoul, G. and B. Solnik, " Are Financial Market Expectations Driven by Economic Patriotism?", mimeo, September 2006.

Bell, David E., “Regret in Decision Making Under Uncertainty”, *Operations Research*, 30(5), 961-981, September-October 1982.

Bell, David E., “Risk premiums for Decision Regret”, *Management Science*, 29(10), 1156-1166, October 1983.

Bell, David E., “Disappointment in Decision Making Under Uncertainty”, *Operations Research*, 33(1), 1-27, January-February 1985.

Brennan, M.J., and H.H. Cao, "International Portfolio Investment Flows", *Journal of Finance*, 52, 1851-1880, 1997.

Brennan, M.J., and H.H. Cao, N. Strong and X. Xu, "The Dynamics of International Equity Market Expectations", *Journal of Financial Economics*, 77, 257-288, 2005.

Chaieb, I. And V. Errunza, "International Asset Pricing under Segmentation and PPP Deviations", *Journal of Financial Economics*, forthcoming 2007.

Cooper, I., and E. Kaplanis, "Home Bias in Equity Portfolios, Inflation Hedging and International Capital Market Equilibrium", *Review of Financial Studies*, 7, 45-60, 1994.

Coval, J.D., and T.J. Moskowitz, "Home Bias at Home: Local Equity Preference in Domestic Portfolios", *Journal of Finance*, 54, 2045-2073, 1999.

DeMarzo, P, Kaniel, R., and I.. ,Kremer, "Diversification as a Public Good: Community Effects in Portfolio Choices", *Journal of Finance*, 59, 1677-1715, 2004.

Dodonova, A., Khoroshilov, Y., 2005. Applications of regret theory to asset pricing. Unpublished working paper, University of Ottawa.

Dvorak, T., "Do Domestic Investors Have an Information Advantage? Evidence from Indonesia", *Journal of Finance*, 60, 817-840, 2005.

Errunza, V., and E. Losq, "International Asset Pricing under Mild Segmentation: Theory and Test", *Journal of Finance*, 40, 105-124, 1985.

French, K. and J. Poterba, "Investor Diversification and International Equity Markets", *American Economic Review*, 81, 222-226, 1991.

Gehrig, T., "An Information Based Explanation of Domestic Bias in International Equity Investment", *Scandinavian Journal of Economics*, 95, 97-109, 1993.

Gerrans, P., Gardner, D., Clark-Murphy, M., and C., Speelman, "Member Investment Choice and International Asset Exposure: A Preliminary Investigation of Home Bias", working paper, Edith Cowan University, 2005.

Gilovich, T., and V. H. Medvec, "The Experience of Regret: What, When, and Why," *Psychological Review*, 102(2), 379-395, 1995.

Gollier, C., "Misery Loves Company: Equilibrium Portfolios with Heterogeneous Consumption Externalities", *International Economic Review*, 45, 1169-1192, 2004.

Gollier, C., Salanié, B., 2006. Individual decisions under risk, risk sharing and asset prices with regret. Unpublished working paper, Université de Toulouse, IDEI.

Graham, J. R., C. R. Harvey, and h; Huang, "Investor Competence, Trading Frequency and Home Bias", Unpublished working paper, 2006.

Grinblatt, M., and M. Keloharju, "The Investment Behavior and Performance of Various Investor Types: a Study of Finland's Unique Dataset", *Journal of Financial Economics*, 55, 43-67, 2000.

Gul, F., 1991, "A theory of disappointment aversion", *Econometrica*, 59(3), 667-86.

Huberman, G., "Familiarity Breeds Investment", *Review of Financial Studies*, 14, 659-680, 2001..

Ivkovic, Z. and S. Weisbenner, "Local Does as Local Is: Information Content of the Geography of Individual Investors' Common Stock Investments", *Journal of Finance*, 60, 267-306, 2005.

Jeske, K., "Equity Home Bias: Can Information Cost Explain the Puzzle?", *Economic Review of Federal Reserve Bank of Atlanta*, 3rd quarter, 31-42, 2001.

Kahneman, Daniel and D. Lovallo, "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking", *Management Science*, 39, 17-31, 1993.

Kahneman, Daniel and Amos Tversky, "Prospect Theory: an Analysis of Decisions under Risk", *Econometrica*, 47, 263-291, 1979.

Kang, J., and R. M. Stulz, "Why is there a Home Bias? An Analysis of Foreign Portfolio Equity Ownership in Japan", *Journal of Financial Economics* 46, 3-28, 1997.

Karolyi, A., and R. Stulz. "Are Financial Assets Priced Locally or Globally?" in George Constantinides, Milton Harris, and Rene M. Stulz, eds.: *The Handbook of the Economics and Finance*, North-Holland, New York, 2003.

Kho, B-C, R.M. Stulz and F. E. Warnock, "Finacial Globalization, Governance, and the Evolution of the Home Bias", mimeo, June 2006.

Kilka, M., and M. Weber, "Home Bias in International Stock return Expectations", *Journal of Psychology and Financial Markets*, 1, 176-192, 2000.

Kroll, Y., H. Levy, and H. M. Markowitz, 1984, "Mean-Variance Versus Direct Utility Maximization," *Journal of Finance*, 39(1), 47-61.

Levy, H., and H. M. Markowitz, "Approximating Expected Utility by a Function of Mean and Variance," *American Economic Review*, 69, 308-317, 1979.

Lewis, K., "Trying to Explain Home Bias in Equities and Consumption", *Journal of Economic Litterature*,37, 571-608, 1999.

Loistl, O., “The Erroneous Approximation of Expected Utility by Means of a Taylor Expansion: Analytic and Computational Results,” *American Economic Review*, 66(5), 904-910, 1976.

Loomes, Graham and Robert Sugden, “Regret Theory: An alternative Theory of Rational Choice under Uncertainty”, *Economic Journal*, 92, 805-824, December 1982.

Loomes, Graham and Robert Sugden, “A Rationale for Preference Reversal”, *American Economic Review*, 73(3), June 1983.

Massa, M. and A. Simonov, "Hedging, Familiarity and Portfolio Choice", *Review of Financial Studies*, forthcoming, 2006.

Michenaud, S. and B. Solnik, " Applying Regret Theory to Investment Choices: Currency Hedging Decisions', mimeo, 2006.

Muermann, A., Mitchell, O., Volkman, J. "Regret, Portfolio Choice, and Guarantees in Defined Contribution Schemes" *Insurance: Mathematics and Economics*, forthcoming, 2006..

Pratt, J. W., 1964. Risk aversion in the small and in the large. Econometrica 32, 122-136.

Samuelson, P. A., “The Fundamental Approximation Theorem of Portfolio Analysis in Terms of Means, Variance and Higher Moments,” *Review of Economic Studies*, 37(4), 537-542, 1970.

Seasholes, M. S., "Re-Examining Information Asymmetries in Emerging Markets", Working paper, U.C. Berkeley, 2004.

Shiller, R.J., Kon-Ya, F.and Y. TsuTsui, "Why did the Nikkei Crash? Expanding the Scope of Expectations Data Collection", *Review of Economics and Statistics*,78, 156-164, 1996.

Shore, S., and J. White, "External habit Formation and the Home Bias Puzzle", Working paper, Wharton School of Business, September 2003.

Solnik, B. “An Equilibrium Model of the International Capital Market,” *Journal of Economic Theory*, July/August 1974.

Solnik B. and D. McLeavey, *International Investments*, 5th ed., Pearson Addison Wesley, 2004.

Shefrin, H., Statman, M., "The Disposition to Sell Winners too Early and Ride Losers too Long: Theory and Evidence", *Journal of Finance* 40,777–790, 1985.

Statman, M., "Foreign Stocks in Behavioral Portfolios", *Financial Analysts Journal*, 12-16, March/April 1999.

Strong, N., and X. Xu, "Understanding the Home Equity Bias: Evidence from Survey Data", *Review of Economics and Statistics*, 85, 307-312, 2003.

Stulz, R. , "On the Effects of Barriers to International Investment", *Journal of Finance*, 36, 923-934, 1981.

Tesar, L., and I.M. Werner, "Home Bias and High Turnover", *Journal of International Money and Finance*, 14, 467-492, 1995.

Tversky, Amos and Daniel Kahneman, “Advances in Prospect Theory: Cumulative Representation of Uncertainty", *Journal of Risk and Uncertainty*, 5, 297-323, 1992.

Zeelenberg, M., W. W. van Dijk, A. S. R. Manstead and J. van der Pligt, “On Bad Decisions and Disconfirmed Expectancies: The Psychology of Regret and Disappointment,” *Cognition and Emotion*, 14(4), 521—541, 2000.