

Investor Experiences and International Capital Flows*

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Abstract

We propose a novel explanation for several classic international macro puzzles regarding capital flows and portfolio investment, which incorporates the recent macro-finance evidence on belief formation. We argue that experience-based learning (EBL) can explain the tendency of investors to hold an overproportional fraction of their equity wealth in domestic stocks (home bias), to withdraw capital from foreign equity markets in periods of foreign crises (fickleness), and to also withdraw from foreign equity markets in periods of domestic crises (retrenchment). The EBL framework generates additional implications regarding the strength of these puzzles in times of high and low economic activities, and depending on the demographics composition of market participants. We test and confirm these predictions in the data.

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1 Introduction

At least since [Obstfeld and Rogoff \(2000\)](#), researchers have tried to find a unifying explanation for the major puzzles in international macroeconomics that is empirically more convincing. The traditional emphasis on the dichotomy of traded versus non-traded goods had often seemed too rigid, and the assumed size of trade costs and other frictions can be unrealistic in terms of the magnitudes. In this paper, we aim to make progress on a different aspect of modeling realism: the implied psychological realism. Specifically, we argue that the belief formation process underlying international capital flows and portfolio investments should reflect the evidence and new approaches in the recent wave of macro-finance models of risk-taking.

The research on belief formation in macro-finance has been stimulated by investor behavior during the recent crises in the stock and housing markets and the long-lasting ramifications of those crises. The new generation of models of investor expectations aims to account both for classic asset-pricing puzzles such as return predictability ([Campbell and Shiller \(1988\)](#), [Fama and French \(1988\)](#)) and excess volatility ([LeRoy and Porter \(1981\)](#), [Shiller \(1981\)](#), [LeRoy \(2005\)](#)), and for micro-level stylized facts such as investors chasing past performances and the long-lasting effects of crises experiences. As argued by [Woodford \(2013\)](#), the empirical evidence suggests a need for dynamic models that go beyond the rational-expectations hypothesis.

One key element that all models in this new wave of macro-finance research aim to capture is investors' apparent overweighing of recent realizations of relevant economic variables when forming beliefs. Models of natural expectation formation ([Fuster, Hebert, and Laibson \(2011\)](#); [Fuster, Laibson, and Mendel \(2010\)](#)) and over-extrapolation ([Barberis, Greenwood, Jin, and Shleifer \(2015\)](#); [Barberis, Greenwood, Jin, and Shleifer \(2016\)](#)) deliver this feature of investor behavior, in addition to the puzzles mentioned above.

A second key element is the longer-lasting effect of crisis experiences and its system-

atic cross-sectional differences. As conveyed by the notion of “depression babies” or the “deep scars” of the 2008 financial crisis (Blanchard (2012), Malmendier and Shen (2017)), macro-economic shocks alter investment and consumption behavior for decades to come, and (then) younger cohorts tend to react significantly more strongly than (then) older cohorts. This is where models of experience-based learning (EBL) come in, which naturally generate both the overweighing of recent experiences and the long-lasting effects of lifetime experiences, in addition to the classical asset-pricing puzzles.

This literature on *experience effects* builds on the seminal work by Kahneman and Tversky on availability bias. Tversky and Kahneman (1974) show that, when individuals form beliefs about future realizations of stochastic variables, they tend to assign extra weight to information that is particularly easily “available” to them. Such information tends to be personally experienced outcomes, and in particular recent realizations. Building on this insight, Weber et al. (1993) provide extensive evidence that “learning from experience” is significantly more powerful than “learning from description.”¹

On the empirical side, the research on experience effects shows that individuals assign extra weight to realizations of macro-financial variables that they have personally experienced when they form beliefs about future outcomes of the same variables. For example, investors who have lived through periods of financial crisis tend to shy away from stock-market investment for decades to come and have particularly pessimistic beliefs about future stock market returns (Malmendier and Nagel (2011)).² Investors who have experienced periods of high inflation tend to overestimate future inflation, invest more in housing (as an inflation hedge), and finance their housing with fixed-rate mortgages, as they overestimate future inflation and interest rates (cf. Malmendier and Nagel (2016),

¹ Cf. also Hertwig, Barron, Weber, and Erev (2004) and Simonsohn, Karlsson, Loewenstein, and Ariely (2008).

² The same holds for IPO experiences and future IPO investment (Kaustia and Knüpfer (2008); Chiang, Hirshleifer, Qian, and Sherman (2011)).

Botsch and Malmendier (2018), and Malmendier and Steiny (2018)).³ Consumers who have experienced periods of economic downturn and high unemployment rates are more careful in their spending and progress less in their careers than their education, income, and wealth would predict (cf. Oreopoulos, von Wachter, and Heisz (2012); Malmendier and Shen (2017).)

A recent string of theory papers in finance have proposed conceptual frameworks to capture these stylized facts, e.g., Schraeder (2015), Collin-Dufresne, Johannes, and Lochstoer (2016), Ehling, Graniero, and Heyerdahl-Larsen (2017), Malmendier, Pouzo, and Vanasco (2018). These papers explore the role of experience-based learning (EBL) in OLG economies where agents make portfolio decisions between a risky and a safe asset. Agents in these models learn about the return of the risky asset from past asset returns, and in doing so, they overweight observations that they have personally lived through. The advantage of introducing EBL to otherwise standard models is that it provides a micro-foundation for belief heterogeneity which tightly links the distribution of beliefs in an economy to demographics and history. Since different cohorts, e.g., younger vs. older cohorts, have different experiences, EBL naturally generates belief heterogeneity, which has important implications for price volatility, trade volume, and other market outcomes.

These insights have direct implications for international macro models. Recency bias would naturally affect the reaction to both domestic and foreign crises, and long-lasting “scars” from crises experiences should apply to foreign events and foreign investment as well. Moreover, if agents learn more from personal experiences, then past events not only affect future beliefs of foreign and domestic agents, they also generate belief heterogeneity across these different types of agents (domestic vs. foreign), and differently so for younger versus older cohorts. As a result, different demographic compositions across countries have predictive power for economic outcomes.

³ Malmendier, Nagel, and Yan (2018) show that even FOMC members’ stated inflation beliefs are strongly affected by their personal lifetime experiences.

Nevertheless, most of the international macro models to date are formulated under the “rational expectation paradigm.” By and large, they work under the assumption that economic agents have the correct beliefs about the laws of complex economic processes.⁴

In this paper, our goal is to introduce experience-based learning into the international macro context and show its potential to explain some of the long-standing puzzles on capital flows and portfolio investment. We focus on home bias, fickleness, and retrenchment. The home-bias portfolio puzzle was first discussed by French and Poterba (1991), who calculated that, at the time, both Americans and Japanese hold more than 90% of their equity wealth in respective home countries’ stocks. While the extent of home bias is smaller in smaller countries and has declines relative to its high in the late 1990s, the bias remains strong across countries (Cooper, Sercu, and Vanpée 2013). Fickleness is the pattern of foreign capital exiting in periods of domestic crises ((Caballero and Simsek 2018)). And retrenchment describes the pattern of domestic investors reducing their foreign investment during periods of crisis (Forbes and Warnock 2012; Broner, Didier, Erce, and Schmukler 2013). As Caballero and Simsek (2018) point out the latter pattern is less researched but empirically as prevalent as fickleness.

We propose that *experience-based learning* offers a unifying explanation for all three puzzles, home bias, fickleness, and retrenchment, and allows to generate further testable predictions that account for the demographic composition of different countries. Our model set-up extends the OLG framework of Malmendier, Pouzo, and Vanasco (2018) to a two-country setting, the home country H and the foreign country F . Agents can invest in the home and the foreign risky asset, both in unit net supply, and each being a claim to a stream of future risky outputs of the respective country. They can also invest in a riskfree asset, which is in completely elastic supply. We assume that all agents know the shape of the distributions of outputs for both countries, including their variance, but

⁴ Some exceptions include Gourinchas and Tornell (2004), Van Nieuwerburgh and Veldkamp (2009), Chousakos, Gorton, and Ordóñez (2016).

that they are uncertain about the output means.

In this framework, experienced-based learning (EBL) means that agents over-weight realizations observed during their lifetimes when forecasting output, and that they tilt the excess weights towards the most recent observations. That is, even though all agents observe the entire history of output realizations in both countries, they choose to weigh observations more if they have personally *experienced* them and more so if these experienced events are recent. As information is available to all agents, prices do not add new information. We derive posterior beliefs and show that their variance decreases in age and in the precision of prior, and increases in the variance of output.

Turning to the equilibrium analysis, we first show that, in the benchmark case of known output means, all generations in all countries hold the same portfolios. We then derive equilibrium demand for the risky and the risk-free assets when agents face uncertainty about the true mean of the output distribution, separately for each generation in each country. We show that, if agents are born with the same priors about domestic and foreign output, experience-based learning does not imply home bias. However, if agents have more precise priors about domestic output, experience-based learning implies home bias. Moreover, the EBL framework implies that home bias decreases in global output and that we will observe fickleness (outflow of foreign funds) and retrenchment (inflow of domestic funds) after recessions. The opposite is the case after booms.

Finally, we turn to the role of market composition. A key feature of experience-based learning models is that they capture the systematic cross-sectional differences in updating behavior. We extend this insight to capture differences in the differences between the older and younger generations of investors across countries. For simplicity we return to the setting of equal priors. Specifically, we show that, if the H country has a larger fraction of young generations who are participating in the market, then home biases increase current excess output, relative to the other country, but decrease in last period's excess

output. We also predict outflows of domestic funds and inflows of foreign funds after recessions in country H . For both statements, the opposite holds if H has fewer young investors than F .

We analyze home bias, fickleness, and retrenchment in the data. We use data from the IMF and the World Federation of Exchanges. We translate our theoretical comparison between countries H and F into an empirical comparison of the US and the rest of the world (ROW). First we confirm positive US home bias in every period of our 1980-2017 sample. We then provide evidence that, as output increases in both the US and the ROW, domestic funds leave the US, i.e., home bias decreases. This is consistent with our predictions. We also observe fickleness (outflow of foreign funds) and retrenchment (inflow of domestic funds) after recessions, and that both phenomena are exacerbated when there are more young agents in the ROW relative to the US (using U.N. population data).

Overall our findings suggest that international macro analyses might benefit from incorporating more modern approaches to belief formation and, in particular, acknowledge the longlasting effects of prior experiences in domestic and foreign markets on investors willingness to invest in the respective markets.

Related Literature. We have already referenced much of the literature on experience effects and its theoretical underpinning, models of experience-based learning. A discussion of the broader literature on learning in explaining asset pricing puzzles, extrapolation, departures from the rational beliefs in asset pricing, and learning in OLG models can be found in [Malmendier, Pouzo, and Vanasco \(2018\)](#).

Our paper connects to a large literature on equity home bias, which originated with [French and Poterba \(1991\)](#) and [Tesar and Werner \(1995\)](#). [Cooper, Sercu, and Vanpée \(2013\)](#) provide a survey of this literature and summarize the leading explanations, which include theories that rely on hedging motives, barriers to entering foreign stock markets,

information asymmetries, correlation with trade, strong governance reducing disadvantages to foreigners, and alternative behavioral approaches. The correlation with trade can be driven by companies receipts of foreign currency during trade, reduced moral hazard due to leverage induced by trading relationships, or greater knowledge of trading partners' industries. Past behavioral explanations include, but are not limited to, overconfidence, over-optimism, familiarity bias, and patriotism. The literature relying on informational asymmetries documents the roles of distance, language, and culture in generating home (Grinblatt and Keloharju 2001), but also points to home bias even at the local level, for example towards local companies (Coval and Moskowitz 2001).⁵ Bae, Stulz, and Tan (2008) find that US investors underweight foreign countries more when local analysts in a country have a greater advantage. This evidence is consistent with informational asymmetries explaining US underinvestment in foreign countries due to asymmetric information. Similar to Guidolin (2005), we model asymmetric information by allowing for agents to have a more precise prior about their domestic output. Our model resembles Guidolin (2005) and others in its OLG set-up (see also Carmichael and Coën (2003)) and use of learning dynamics (see also Balduzzi and Liu (2001)), but differs in that we introduce experienced-based learning which allows for additional demographic heterogeneity to be exploited.

Our paper also connects to the growing literature surrounding fickleness and retrenchment. We aim to explain two of the stylized facts presented in Broner, Didier, Erce, and Schmukler (2013), specifically that inflows and outflows are pro-cyclical and that retrenchments, and ergo fickleness, occurs during both domestic and global crises. Further, we also explain some of the results of Forbes and Warnock (2012) who note a strong correlation between periods of retrenchment and fickleness.⁶ Our paper relates to Caballero

⁵ Relatedly, Malloy (2005) document that geographically proximate analysts are more accurate and influential. The literature is mixed on the return implications of home bias (Ardalan 2019).

⁶ Forbes and Warnock (2012) use a narrower definition of fickleness and retrenchment. They consider “gross capital flows” by type of investor (domestic versus foreign) rather than differentiating between net

and Simsek (2018) who explain these capital flow patterns in a model which assumes fickleness. Our model explains the empirical facts with investors’ belief formation process, and our empirical results extend those of Caballero and Simsek (2018), who also document a positive correlation between inflows and outflows. Our estimations highlight periods in which the correlation between inflows and outflows is stronger, and the role of countries’ demographic composition. Finally, our paper relates to research using asymmetric information to explain global capital flows include Tille and Van Wincoop (2008) and Dvořák (2003).

The remainder of the paper is organized as follows. First, we present the model setup, the notion of experience-based learning, and the equilibrium concept in Section 2. Section 3 characterizes equilibrium demand and prices, and extends the model to allow for heterogeneity in prior beliefs about foreign and domestic assets. Section 4 introduces heterogeneity in market participations, i.e., the demographic structures in markets, across countries. In Section 5 we test the predictions of the model. Section 6 concludes. All proofs are relegated to the Appendix.

2 Model Setup

Our model describes the decisions of different generations of domestic and foreign investors to invest in domestic and foreign assets. We will generally use superindices for the investor’s country of origin i and generation n , and subindices for country j in whose asset the investor is investing, and for the current time t . In a few instances we will simplify to distinguish between “the young” and “the old” with subindices 0 and 1 (more generally *age*), and a star to indicate foreign country. These are instances when the

inflows and outflows. In their paper, retrenchment refers to a period with strongly negative outflows, i.e., domestic investors reducing their investments abroad, and a stop refers to a period with strongly negative gross inflows, i.e., foreigners reducing their domestic investment and thus generating outflows.

context does not require keeping track of all the information in the indices, and when it is useful to highlight cross-country symmetries.

2.1 The Maximization Problem

Consider two countries H and F , each populated with overlapping generations of a continuum of risk-averse agents. Time is infinite and indexed by t . At each point in time $t \in \mathbb{Z}$, a new generation is born in each country and lives for two periods. Hence, there are three generations alive at any t : the young, the adult, and the old. The generation born at $t = n$ is called the generation n , and each generation has a mass of $\frac{1}{4}$ identical agents.

Preferences. All agents have CARA preferences with risk aversion γ , and they maximize per-period utility, i. e., are myopic.⁷ Generation n in country $i \in \{H, F\}$ is born with an endowment of $\mathcal{W}^{i,n}$ consumption goods, and can transfer resources across time by investing in financial markets. Trading takes place at the beginning of each period. At the end of the last period of their lives, old agents consume the wealth they have accumulated. Figure 1 illustrates the time line of this economy.

Financial Markets. All agents have access to a storage technology, which has a gross return of R , and there is a risk-free asset that all agents can trade. There are also two risky assets in unit net supply, each being a claim to a stream of future risky outputs of country i , $\{y_{i,t}\}$. That is, the dividend paid on country i 's risky asset corresponds to country i 's output. We assume outputs to be independent across countries and time and identically distributed, $y_{i,t} \sim N(\theta_i, \sigma_i^2)$ at time t for $i \in \{H, F\}$. To keep the model tractable, we assume that agents' endowments are sufficiently large so that the risk-free

⁷ This assumption simplifies the maximization problem considerably and highlights the main determinants of portfolio choice generated by experience-based learning. For the same reason it is commonly used in finance (see Vives 2010). We show that our results do not depend on the myopic assumption in Appendix B.

asset pays a return of R every period in equilibrium.⁸

Agents from generation $n \in \mathbb{Z}$ in country i that participate in financial markets have the following budget constraint at any time $t \in \{n, n+1\}$

$$\mathcal{W}_t^{i,n} = x_{H,t}^{i,n} \cdot p_{H,t} + x_{F,t}^{i,n} \cdot p_{F,t} + a_t^{i,n}, \quad (1)$$

where $\mathcal{W}_t^{i,n}$ denotes the wealth of generation n of country i at time t , $x_{j,t}^{i,n}$ and $a_t^{i,n}$ are the investments of generation n of country i in the risky asset of country $j \in \{H, F\}$ and in the risk-free asset, respectively, and $p_{j,t}$ is the price of one unit of the risky asset of country j at time t . As a result, wealth next period is

$$\mathcal{W}_{t+1}^{i,n} = x_{H,t}^{i,n} \cdot (p_{H,t+1} + y_{H,t+1}) + x_{F,t}^{i,n} \cdot (p_{F,t+1} + y_{F,t+1}) + a_t^{i,n} R \quad (2)$$

$$= \sum_{j \in \{H, F\}} x_{j,t}^{i,n} (p_{j,t+1} + y_{j,t+1} - p_{j,t} R) + \mathcal{W}_t^{i,n} R. \quad (3)$$

We denote the excess payoff received in $t+1$ from investing at time t in one unit of the risky asset of country j , relative to the risk-free asset, as $s_{j,t+1} \equiv p_{j,t+1} + y_{j,t+1} - p_{j,t} R$. In our framework with CARA preferences, this is analogous to the equity premium. Using this notation, $\mathcal{W}_{t+1}^{i,n} = \sum_{j \in \{H, F\}} x_{j,t}^{i,n} s_{j,t+1} + \mathcal{W}_t^{i,n} R$.

To model uncertainty about fundamentals, we assume that agents do not know the mean of output processes, θ_H and θ_F , but that they can use past output realizations to learn about them. To keep the model tractable, we assume that the variance of output is σ^2 for both countries, and that it is known by all agents at all times.

For a given wealth level $\mathcal{W}_t^{i,n}$, the problem of a generation n at each time $t \in \{n, n+1\}$

⁸ One way to ensure this would be to set $\mathcal{W}_t^i = \mathcal{W} + v y_{i,t}$ where v is chosen to ensure, that for all $y_{i,t}$, endowments are greater than the aggregate demand for the risky asset of country i .

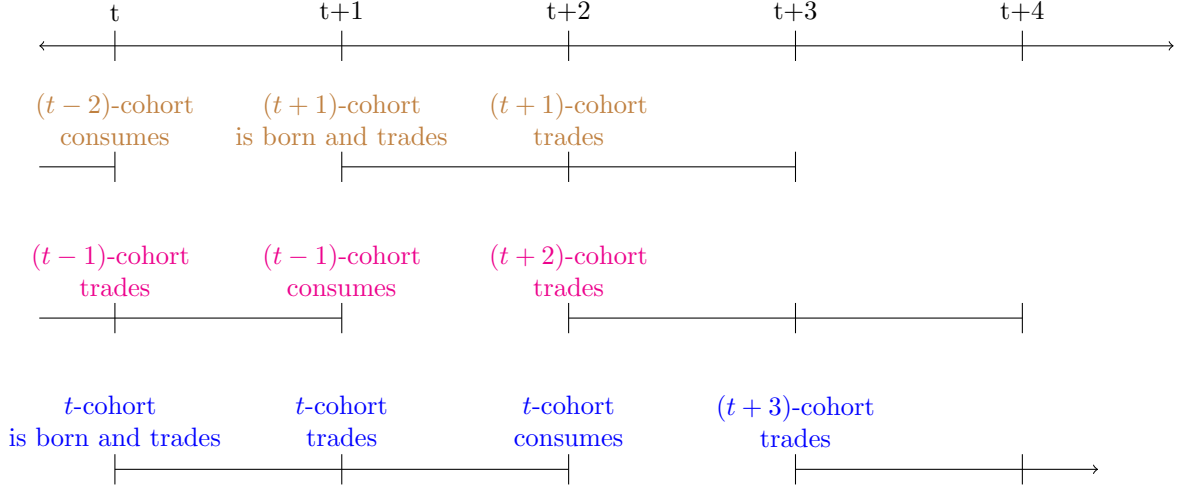


Figure 1: Timeline.

is to choose $\{x_{j,t}^{i,n}\}_{j \in \{H,F\}}$ to maximize $E_t^{i,n}[-\exp(-\gamma \mathcal{W}_{t+1}^{i,n})]$, i. e.,

$$\max_{\{x_H, x_F\} \in \mathbb{R}^2} E_t^{i,n}[-\exp(-\gamma(x_H s_{H,t+1} + x_F s_{F,t+1}))], \quad (4)$$

where $E_t^{i,n}[\cdot]$ is the (subjective) expectation with respect to a joint Gaussian distribution that we will define below. Note that, when $x_{j,t}^{i,n}$ is negative, generation n of country i is short-selling the risky asset of country j at time t .

2.2 Agents' Belief Formation

In this framework, experienced-based learning (EBL) means that agents over-weigh realizations observed during their lifetimes when forecasting dividends, i. e., output, and that they tilt the excess weights towards the most recent observations, as in [Malmendier, Pouzo, and Vanasco \(2018\)](#). For simplicity, we assume that agents *only* use observations realized during their lifetimes.⁹ That is, even though all agents observe the entire history of output realizations in both countries, they choose to disregard observations they have

⁹ We only need agents to discount pre-lifetime relative to lifetime observations for our results to hold.

not *experienced*. Finally, as in our setting information is available to all agents, prices do not add new information, which greatly simplifies the analysis.

We assume that all agents know the shape of the distribution of outputs for both countries, including their variance, but are uncertain about output means θ_H and θ_F . Let m_j^i denote the prior belief about the mean of output in country j that agents in country i are born with, where we restrict m_j^i to be Gaussian with mean θ_j . With this, we construct the subjective mean of dividends of generation n at time t following the empirical evidence on Malmendier and Nagel (2011) as follows

$$\theta_{j,t}^{i,n} \equiv (1 - \omega_{j,age}^i) \cdot m_j^i + \omega_{j,age}^i \cdot \sum_{k=0}^{age} w(k, \lambda, age) y_{j,t-k}, \quad (5)$$

where $age = t - n$, and where, for all $k \leq age$,

$$w(k, \lambda, age) = \frac{(age + 1 - k)^\lambda}{\sum_{k'=0}^{age} (age + 1 - k')^\lambda} \quad (6)$$

denotes the weight an agent aged age assigns to the output on country j observed k periods earlier, and $w(k, \lambda, age) \equiv 0$ for all $k > age$. The denominator in (6) is a normalizing constant that depends only on age and on the parameter that regulates the recency bias, λ . For $\lambda > 0$, more recent observations receive relatively more weight, whereas for $\lambda < 0$ the opposite holds. Finally, $\omega_{j,age}^i \equiv \frac{age+1}{\tau_j^i+age+1}$ denotes the weight that agents assign to their experience beliefs (with $1 - \omega_{j,age}^i$ being the weight they assign to their prior belief m_j^i), which increases with age and decreases with the relative importance agents assign to their prior beliefs, regulated by parameter $\tau_j^i \in [0, \infty)$. Thus, after observing history of output realizations $\{y_{H,0}, \dots, y_{H,t}, y_{F,0}, \dots, y_{F,t}\}$, the posterior belief of

generation $n \in \{t-1, t\}$ in country $i \in \{H, F\}$ at time t are

$$y_{H,t} \sim N(\theta_{H,t}^{i,n}, (\sigma_{H,t}^{i,n})^2) \quad (7)$$

$$y_{F,t} \sim N(\theta_{F,t}^{i,n}, (\sigma_{F,t}^{i,n})^2) \quad (8)$$

where $\theta_{j,t}^{i,n}$ is given by (5) and $\sigma_{j,t}^{i,n}$ by

$$\sigma_{j,t}^{i,n} \equiv \left((1 - \omega_{j,age}^i)^2 (\tau_j^i)^{-1} + (\omega_{j,age}^i)^2 \sum_{k=0}^{age} w(k, \lambda, age)^2 \right) \sigma^2, \quad (9)$$

We make two observations about the variance of posterior beliefs. First, the posterior variance decreases with age, as agents incorporate more observations into their belief formation process. Thus, old agents in country i have more precise posteriors than younger agents in the same country. Second, the posterior variance decreases in the precision of prior beliefs and increases in the variance of output.

2.3 Equilibrium Definition

We now proceed to define the equilibrium of the economy with EBL agents.

Definition 2.1 (Equilibrium). *An equilibrium is a demand profile for the risky assets $\{x_{j,t}^{i,n}\}$, a demand profile for the risk-free asset $\{a_t^{i,n}\}$, and price schedules $\{p_{j,t}\}$ such that:*

1. *Given the price schedule, $\{(a_t^{i,n}, x_{H,t}^{i,n}, x_{F,t}^{i,n}) : t \in \{n, n+1\}\}$ solve the maximization problem (4) of generation n in country $i \in \{H, F\}$.*
2. *Markets clear in all $t \in \mathbb{Z}$:*

$$1 = \frac{1}{4} \left(x_{H,t}^{H,t} + x_{H,t}^{H,t-1} + x_{H,t}^{F,t} + x_{H,t}^{F,t-1} \right), \quad (10)$$

$$1 = \frac{1}{4} \left(x_{F,t}^{H,t} + x_{F,t}^{H,t-1} + x_{F,t}^{F,t} + x_{F,t}^{F,t-1} \right). \quad (11)$$

We focus the analysis on the class of linear equilibria, i. e., equilibria with affine prices:

Definition 2.2 (Linear Equilibrium). *A linear equilibrium is an equilibrium wherein prices are an affine function of output realizations. That is, there exists a $K \in \mathbb{N}$, $\alpha_j \in \mathbb{R}$, and $\beta_{j,k} \in \mathbb{R}$ for all $k \in \{0, \dots, K\}$ such that*

$$p_{j,t} = \alpha_j + \sum_{k=0}^K \beta_{j,k} \cdot y_{j,t-k}. \quad (12)$$

3 Equilibrium Characterization

3.1 Benchmark

Before we analyze the equilibrium portfolio choices under learning, we derive the demand for risky assets in the benchmark case of known mean output θ_H and θ_F . Consider an economy where the mean of outputs are known by all agents, i. e., $E_{j,t}^{i,n}[y_{j,t}] = \theta_j \forall n, t$. In this scenario, there are no disagreements across cohorts nor across countries, and the demands of any cohort trading at time t is

$$x_{j,t}^{i,n} \in \arg \max_{x \in \mathbb{R}} E[-\exp(-\gamma x s_{j,t+1})]. \quad (13)$$

The solution to this problem is standard and given by

$$x_{j,t}^{i,n} = \frac{E[s_{t+1}]}{\gamma V[s_{t+1}]} \quad (14)$$

for all $n \in \{t-1, t\}$, and zero otherwise. Since there is no heterogeneity in cohorts' demands and there is a unit supply of each risky asset, in any equilibrium, $x_{j,t}^{i,n} = 1$ for all $n \in \{t-1, t\}$, and zero otherwise. Furthermore, there exists a unique equilibrium with prices $p_j = P_j = \frac{\theta_j - \gamma \sigma^2}{R-1}$ for all t .¹⁰

¹⁰ Our analysis focuses on Fundamental Equilibria, as we rule out the presence of price bubbles.

3.2 Equilibrium Demand Under EBL

We begin by analyzing the demands of generation n in country $i \in \{H, F\}$ at time t , given prices $p_{j,t}$, by solving problem (4).

Proposition 3.1. *The demand of generation $n \in \{t, t-1\}$ in country $i \in \{H, F\}$ for the risky asset of country $j \in \{H, F\}$ at time t is*

$$x_{j,t}^{i,n} = \frac{E_t^{i,n} [y_{j,t+1} + p_{j,t+1}] - Rp_{j,t}}{\gamma V_{j,t}^{i,n} [y_{j,t+1} + p_{j,t+1}]}, \quad (15)$$

and the demand for the risk-free asset of cohort n in country i at time t is

$$a_t^{i,n} = w_t^{i,n} - x_{H,t}^{i,n} p_{H,t} - x_{F,t}^{i,n} p_{F,t}. \quad (16)$$

With these demands, we can impose market clearing to solve for market prices. We make the following guess for prices of the risky-free asset in country j at time t

$$p_{j,t} = \alpha_j + \beta_{j,0} y_{j,t} + \beta_{j,1} y_{j,t-1}, \quad (17)$$

and use the method of undetermined coefficients to verify our guess and obtain price coefficients $\{\alpha_j, \beta_{j,0}, \beta_{j,1}\}$,

$$\sum_{n \in \{t, t-1\}} \left(\frac{1}{4} \frac{E_t^{H,n} [y_{j,t+1} + p_{j,t+1}] - Rp_{j,t}}{\gamma V_{j,t}^{H,n} [y_{j,t+1} + p_{j,t+1}]} + \frac{1}{4} \frac{E_t^{F,n} [y_{j,t+1} + p_{j,t+1}] - Rp_{j,t}}{\gamma V_{j,t}^{F,n} [y_{j,t+1} + p_{j,t+1}]} \right) = 1 \quad (18)$$

As we have assumed that countries are symmetric and that the variance of output is known by all agents, it suffices to keep track of the posterior belief volatilities of the

young ($age = 0$) and the adult ($age = 1$) generations at time t :

$$\sigma_{age}^2 = V_{i,t}^{i,n} [y_{i,t}], \quad i \in \{H, F\} \quad (19)$$

$$\sigma_{age}^{*2} = V_{j,t}^{i,n} [y_{j,t}], \quad j \in \{H, F\}, j \neq i. \quad (20)$$

for domestic and foreign output, respectively, and where $age = t - n$. In addition, posterior means can be stated as follows

$$E_t^{i,t} [y_{i,t+1}] = (1 - w_0) m + w_0 y_{i,t} \quad (21)$$

$$E_t^{i,t-1} [y_{i,t+1}] = (1 - w_1) m + w_1 [\omega y_{i,t} + (1 - \omega) y_{i,t-1}], \quad (22)$$

$$E_t^{i,t} [y_{j,t+1}] = (1 - w_0^*) m + w_0^* y_{j,t} \quad (23)$$

$$E_t^{i,t-1} [y_{j,t+1}] = (1 - w_1^*) m + w_1^* [\omega y_{j,t} + (1 - \omega) y_{j,t-1}]. \quad (24)$$

for $i, j \in \{H, F\}$ and $j \neq i$. In our model, agents' posterior beliefs may differ for two reasons. First, older agents have more “experience” than younger agents, and thus have a more precise posterior belief for a given country's output: $\sigma_0 > \sigma_1$ and $\sigma_0^* > \sigma_1^*$. Second, when agents have more precise prior beliefs about their own country's output than about the foreign country's output, as typically assumed in the literature, the same will hold for their posterior beliefs. Thus, for a given cohort, posterior volatilities for the foreign country's output will be higher than for domestic output: $\sigma_{age} < \sigma_{age}^*$ for $age \in \{0, 1\}$. As a result, the weight that an agent assigns to the output realization $y_{j,t}$ for $j \in \{H, F\}$ when forming her beliefs varies with the agents' age, $age \in \{0, 1\}$ and her country of origin, $i \in \{H, F\}$.

we will suppose that agents have more precise prior beliefs about their own country's output.

By using our linear guess for prices, plugging in the posterior means and variances into

equation (18), and using the method of undetermined coefficients we obtain the following expressions that fully characterize prices for the asset of country $i \in \{H, F\}$,

$$\begin{aligned}
\beta_{i,0} &= \frac{\Sigma R}{\Sigma R - \frac{1}{4} \left\{ \frac{w_0}{\sigma_0^2} + \frac{w_1 \omega}{\sigma_1^2} + \frac{w_0^*}{\sigma_0^{*2}} + \frac{w_1^* \omega}{\sigma_1^{*2}} + \frac{1}{R} \left(\frac{w_1(1-\omega)}{\sigma_1^2} + \frac{w_1^*(1-\omega)}{\sigma_1^{*2}} \right) \right\}} - 1 \\
\beta_{i,1} &= \frac{(1 + \beta_{i,0})(1 - \omega)}{4\Sigma R} \left\{ \frac{w_1}{\sigma_1^2} + \frac{w_1^*}{\sigma_1^{*2}} \right\} \\
\alpha_i &= \frac{(1 + \beta_0^i)}{\Sigma(R - 1)} \left(\frac{1 - w_0}{\sigma_0^2} + \frac{1 - w_1}{\sigma_1^2} + \frac{1 - w_0^*}{\sigma_0^{*2}} + \frac{1 - w_1^*}{\sigma_1^{*2}} \right) m - \frac{\gamma(1 + \beta_0^i)^2}{\Sigma(R - 1)}
\end{aligned} \tag{25}$$

where $\Sigma \equiv \frac{1}{4} \left(\frac{1}{\sigma_0^2} + \frac{1}{\sigma_1^2} + \frac{1}{\sigma_0^{*2}} + \frac{1}{\sigma_1^{*2}} \right)$. With this, we can compute the holdings of both risky assets for each cohort in each country as a function of past output realizations, and analyze the effect of output shocks on cross-country flows. At time t , the holdings of cohort $n \in \{t, t-1\}$ in country i of assets from country i and $j \neq i$ are

$$\begin{aligned}
x_{i,t}^{i,t} &= \frac{\tilde{\alpha}_i + (1 + \beta_{0,i})(1 - w_0)m}{\gamma(1 + \beta_{0,i})^2 \sigma_0^2} + \frac{w_0(1 + \beta_{0,i}) + \beta_{1,i} - R\beta_{0,i}}{\gamma(1 + \beta_{0,i})^2 \sigma_0^2} y_{i,t} - \frac{R\beta_{1,i}}{\gamma(1 + \beta_{0,i})^2 \sigma_0^2} y_{i,t-1} \\
x_{i,t}^{i,t-1} &= \frac{\tilde{\alpha}_i + (1 + \beta_{0,i})(1 - w_1)m}{\gamma(1 + \beta_{0,i})^2 \sigma_1^2} + \frac{w_1(1 + \beta_{0,i})\omega + \beta_{1,i} - R\beta_{0,i}}{\gamma(1 + \beta_{0,i})^2 \sigma_1^2} y_{i,t} + \frac{w_1(1 + \beta_{0,i})(1 - \omega) - R\beta_{1,i}}{\gamma(1 + \beta_{0,i})^2 \sigma_1^2} y_{i,t-1} \\
x_{j,t}^{j,t} &= \frac{\tilde{\alpha}_j + (1 + \beta_{0,j})(1 - w_0^*)m}{\gamma(1 + \beta_{0,j})^2 \sigma_0^{*2}} + \frac{w_0^*(1 + \beta_{0,j}) + \beta_{1,j} - R\beta_{0,j}}{\gamma(1 + \beta_{0,j})^2 \sigma_0^{*2}} y_{j,t} - \frac{R\beta_{1,j}}{\gamma(1 + \beta_{0,j})^2 \sigma_0^{*2}} y_{j,t-1} \\
x_{j,t}^{j,t-1} &= \frac{\tilde{\alpha}_j + (1 + \beta_{0,j})(1 - w_1^*)m}{\gamma(1 + \beta_{0,j})^2 \sigma_1^{*2}} + \frac{w_1^*(1 + \beta_{0,j})\omega + \beta_{1,j} - R\beta_{0,j}}{\gamma(1 + \beta_{0,j})^2 \sigma_1^{*2}} y_{j,t} + \frac{w_1^*(1 + \beta_{0,j})(1 - \omega) - R\beta_{1,j}}{\gamma(1 + \beta_{0,j})^2 \sigma_1^{*2}} y_{j,t-1}
\end{aligned}$$

where $\tilde{\alpha}_i = \alpha_i(1 - R)$. The following definitions will be useful for our analysis. First, let $X_{j,t}^i \equiv \frac{1}{4} (x_{j,t}^{i,t} + x_{j,t}^{i,t-1})$ denote the aggregate demand in country i of the asset of country j ; and let $\bar{X}_t^i \equiv \{X_{H,t}^i, X_{F,t}^i\}$ denote the portfolio of risky assets of country i at time t . With this, we introduce the notion of home bias in portfolio holdings for our two-country economy.

Definition 3.1 (Home Bias). *We say that there is home bias in portfolio holdings at time t when*

$$HB_t \equiv X_{H,t}^H - X_{F,t}^H > 0.$$

Due to the symmetry across countries embedded in the model, it is sufficient to compare a country's holdings of domestic vs. foreign assets to assess the presence of home bias in portfolio holdings. As the world portfolio is given by one unit of the domestic asset and one unit of the foreign asset, no home bias in portfolio holdings would imply that $X_{H,t}^H = X_{F,t}^H = X_{H,t}^F = X_{F,t}^F$; that is, all countries hold the same fraction of assets of the H and F country, and thus $HB_t = 0$. Finally, due to market clearing, $HB_t > 0$ implies that $X_{F,t}^F - X_{H,t}^F > 0$ as well, so it is WLOG to focus on the holdings of the H country.

Finally, it is useful to define booms and recessions of individual countries as periods in which positive or negative macro-shocks follow a period of output stability in both countries.

Definition 3.2 (Booms and Recessions). *We say there is a recession in country i at time t when $y_{i,t-1} = y_{j,t} = y_{j,t-1} = \bar{y}$ and $y_{i,t} < \bar{y}$. Analogously, we say there is a boom in country i at time t when $y_{i,t-1} = y_{j,t} = y_{j,t-1} = \bar{y}$ and $y_{i,t} > \bar{y}$.*

We begin by characterizing the portfolio choice of each country in an economy with no heterogeneity across countries.

Lemma 3.1. *If all agents are born with the same prior belief about domestic and foreign output, then all countries hold the same fraction of the world portfolio. As a result, aggregate holdings of domestic and foreign assets are*

$$X_{H,t}^H = X_{H,t}^F = X_{F,t}^H = X_{F,t}^F = 1,$$

and thus do not vary during domestic or foreign booms or recessions.

When countries share prior beliefs, $\tau = \tau^*$, the efficient portfolio theory holds, as both countries hold a fraction of the world portfolio, which implies there is no home bias in portfolio holdings. This is true even though agents form beliefs by using their lifetime

experiences. It is important to highlight, however, that within a country individual cohorts need not be holding the world portfolio. In particular, deviations in the portfolio holdings of young agents from the world portfolio are off-set by deviations in the portfolio holdings of adult agents in that same country, so that in aggregate the efficient portfolio result holds. The results in Lemma 3.1 have important implications for international flows, as they suggest that domestic, foreign, or local booms or recessions should have no impact on a country's aggregate portfolio holdings, and thus international flows.

In what follows, we show how these predictions change when we allow for different prior beliefs or degrees of market participation across countries. In particular, we will show heterogeneity across countries can generate deviations from the efficient portfolio benchmark which are consistent with the data, such as home bias, and capital fickleness and retrenchment during domestic and global crisis.

3.3 Heterogeneity in Prior Beliefs

We suppose that agents have more precise prior distributions about their own country's output than the foreigner's; that is, $\tau > \tau^*$. There are many reasons why agents may have more precise prior beliefs about their own country's output, such as early lifetime experiences that foreigners have not had, or inter-generational information transmission. Even though we do not model this explicitly, we believe that a more precise prior distribution is a good way to capture the notion that agents are more confident about their knowledge of their own country than foreigners.

Proposition 3.2. *If agents have more precise prior beliefs about domestic than foreign output, $\tau > \tau^*$, then we should expect home bias in portfolio holdings:*

$$\mathbb{E} [X_{H,t}^H - X_{F,t}^H] > 0,$$

where $\mathbb{E}[\cdot]$ is the unconditional expectations operator over the true distribution of outputs. Furthermore, home bias at time t decreases in global output, $Y_t \equiv y_{H,t} + y_{F,t}$.

The assumption that domestic agents have a more precise prior belief about their own country's output has important implications for portfolio holdings and countries' reactions to macro-shocks. First, a more precise domestic prior belief implies that domestic agents perceive less risk when investing in the domestic asset than in the foreign asset: $\sigma_{age}^2 < \sigma_{age}^{*2}$, where $age \in \{0, 1\}$. As a result, all else equal, they are more willing than foreigners to hold the domestic asset than the foreign asset, driving home bias in portfolio holdings. Second, a more precise domestic prior belief implies that domestic agents put more weight on their prior belief about domestic output than foreign agents do when computing their posterior mean, i.e., $1 - w_{age} > 1 - w_{age}^*$. From inspection of posterior means (21)-(24), it follows that domestic agents underreact to domestic shocks relative to foreign agents, $w_{age} < w_{age}^*$, when forming their beliefs. As a result, as global output increases, domestic agents under-react to the boom in domestic output (or equivalently, they over-react to the boom in foreign output), and an outflow of domestic funds from the domestic country occurs, decreasing home bias in portfolio holdings.

Corollary 3.1. *If agents have more precise prior beliefs about domestic than foreign output, $\tau > \tau^*$, after a recession in country i there is an outflow of foreign funds (fickleness) and an inflow of domestic funds (retrenchment). The opposite flow pattern follows a boom in country i .*

The results in Corollary 3.1 suggest that the model can rationalize two patterns of international flows that have been identified in the literature and that are hard to explain with standard models that rationalize home bias (Forbes and Warnock 2012). First, that during domestic crisis, there is an inflow of domestic funds – a behavior usually referred to as *retrenchment*. Second, that during domestic crisis there is an outflow of foreign funds – a pattern usually referred to as *fickleness*.

4 Heterogeneity in Market Participation

We now suppose that agents have the same prior beliefs, but differ in the demographics of market participation. To be able to do so in our OLG setting, we assume that a fraction of agents in country i participate in this market; in particular, we denote by $\phi^{i,age} \in (0, 1)$ the mass of agents with $age \in 0, 1$ of country i that participate in the market for risky assets, where $\phi^{i,0} + \phi^{i,1} = \Phi^i$ is assumed to be constant over time.¹¹ This allows us to study the effect of heterogeneous market demographics across countries, which could be due to cultural differences or constraints that affect the age at which agents enter or exit financial markets, and that are outside the scope of this paper. Agents that do not participate in the market for risky claims invest all of their wealth in the risk-free asset.

Our equilibrium definition needs to be adjusted, as the new market clearing condition states that in all $t \in \mathbb{Z}$:

$$1 = \phi^{H,0} x_{H,t}^{H,t} + \phi^{H,1} x_{H,t}^{H,t-1} + \phi^{F,0} x_{H,t}^{F,t} + \phi^{F,1} x_{H,t}^{F,t-1}, \quad (26)$$

$$1 = \phi^{H,0} x_{F,t}^{H,t} + \phi^{H,1} x_{F,t}^{H,t-1} + \phi^{F,0} x_{F,t}^{F,t} + \phi^{F,1} x_{F,t}^{F,t-1}. \quad (27)$$

By using our linear guess for prices, plugging in the posterior means and variances into equation (18), and using the method of undetermined coefficients we obtain the following adjusted expressions that fully characterize prices for the asset of country $i \in \{H, F\}$

¹¹ The assumption that the total fraction of agents that participate in the market is constant over time is done to reduce notation and simplify exposition, but varying the mass of market participants can be simply incorporated into our framework.

when market participations differ across countries,

$$\begin{aligned}
\beta_{i,0} &= \frac{\Sigma R}{\Sigma R - \left\{ \frac{\phi^{i,t}}{\sigma_0^2} w_0 + \frac{\phi^{i,t-1}}{\sigma_1^2} w_1 \omega + \frac{\phi^{j,t}}{\sigma_0^{*2}} w_0^* + \frac{\phi^{j,t-1}}{\sigma_1^{*2}} w_1^* \omega + \frac{(1-\omega)}{R} \left(\frac{\phi^{i,t-1}}{\sigma_1^2} w_1 + \frac{\phi^{j,t-1}}{\sigma_1^{*2}} w_1^* \right) \right\}} - 1 \\
\beta_{i,1} &= \frac{(1 + \beta_{i,0})(1 - \omega)}{\Sigma R} \left\{ \frac{\phi^{i,t-1}}{\sigma_1^2} w_1 + \frac{\phi^{j,t-1}}{\sigma_1^{*2}} w_1^* \right\} \\
\alpha_i &= \frac{(1 + \beta_0^i)}{\Sigma(R - 1)} \left(\frac{\phi^{i,t}}{\sigma_0^2} (1 - w_0) + \frac{\phi^{i,t-1}}{\sigma_1^2} (1 - w_1) + \frac{\phi^{j,t}}{\sigma_0^{*2}} (1 - w_0^*) + \frac{\phi^{j,t-1}}{\sigma_1^{*2}} (1 - w_1^*) \right) m - \frac{\gamma(1 + \beta_0^i)^2}{\Sigma(R - 1)}
\end{aligned} \tag{28}$$

where $\Sigma \equiv \frac{\phi^{i,t}}{\sigma_0^2} + \frac{\phi^{i,t-1}}{\sigma_1^2} + \frac{\phi^{j,t}}{\sigma_0^{*2}} + \frac{\phi^{j,t-1}}{\sigma_1^{*2}}$.

Without loss of generality, we analyze the case in which $\phi_{H,t} > \phi_{F,t}$, that is, there is a relatively larger mass of young market participants in the H country. There are many reasons why different countries may have different demographics of market participation. First, the difference could be simply driven by differences in the country's overall demographics due to different natality and mortality rates (which in our model are constant over time). Second, differences could be driven by cultural reasons or market frictions that induce different generations to participate or exit the market at a different points in their life. Our simple model is not able to capture all the exogenous and endogenous reasons why a country's market demographics may differ, but we believe that our reduced-form approach captures some of the forces at play when demographics do differ across countries.

Proposition 4.1. *If both countries have the same prior belief, home bias at time t increases in $y_{H,t} - y_{F,t}$ and decreases in $y_{H,t-1} - y_{F,t-1}$ if and only if country H has a larger fraction of young market participants, $\phi_{H,t} > \phi_{F,t}$.*

Corollary 4.1. *If both countries have the same prior belief, after a recession in country H , there is an outflow of domestic funds and an inflow of foreign funds from country H if and only if country H has a larger fraction of young market participants, $\phi_{H,t} > \phi_{F,t}$.*

5 Empirical Implications

This section explores empirical regularities of capital flows in terms of the home bias, macroeconomic cycles, as well as fickleness and retrenchment. We interpret the empirical evidence in light of our model predictions.

Our stylized model is based on two countries, H and F , and focuses on investment in the risky assets, that capture each country’s output, we will contrast the US and the “rest of the world” (ROW), and focus on all listed equity data.

We analyze equity home bias by testing the prediction of Proposition 4.1 and presenting empirically consistent results. We then turn our focus to our predictions on fickleness and retrenchment. We replicate the results of Broner, Didier, Erce, and Schmukler (2013) and Caballero and Simsek (2018) by documenting the correlation between changes in US foreign investment (outflows) and foreign investment in the US (inflows) with a focus on US equity data. We confirm that this correlation intensifies during recessions and is also directionally consistent with Corollary 3.1. Next, we focus on demographics and find that when the percent of young people in the ROW is higher the correlation between inflows and outflows is stronger, providing evidence for Corollary 4.1. Last, since Corollary 3.1 and Corollary 4.1 are based on different sets of assumptions, we focus on both demographics and recessions finding that during recession years and years with a higher percent ROW young population the correlation between inflows and outflows remain strongly statistically significant which provides evidence that the insights of our model are jointly valid empirically.

5.1 Home Bias

To measure equity home bias we use data on foreign asset holdings from the International Investment Positions (IIP) data set published by the International Monetary Fund (IMF)

Table 1: Summary Statistics

Home Bias, Home Bias Measure, and Home Investment Measure are based on data from 1980-2017. Relative Output Measure, Foreign Output Measure, Outflows, Inflows, and US Recessions use data from 1970-2017. ROW Percent Young uses data from 1970-2015.

Variable	N	Mean	SD	Min	Max
Home Bias Measure	38	3.09	0.45	2.30	3.95
Home Investment Measure	38	2.20	1.09	0.96	4.36
Relative Output Measure	48	-0.58	0.18	-0.88	-0.13
Foreign Output Measure	48	30.54	0.54	29.39	31.29
Outflows	48	0	1	-1.22	3.94
Inflows	48	0	1	-2.48	2.6
US Recessions	48	0.17	0.33	0	1
ROW Percent Young	46	0.65	0.02	0.60	0.68

and the US listed market capitalization from the World Federation of Exchanges (via World Bank) for the years 1980-2017 based on the the availability of non-US IIP data used as a benchmark. Consistent with [Mishra \(2015\)](#) and [Cooper, Sercu, and Vanpée \(2013\)](#), we consider equity portfolio investment to be roughly equal to listed equity investment in a country. Equity portfolio investment is defined by the IMF to comprise all liquid equity investments. The IIP provide data on foreign holdings in a given country and a given country's foreign investment. Thus total holdings of foreigners in the US and total holdings of the US in foreign countries are given for equity portfolio investment. To calculate US domestic holdings of listed equity, we subtract the total foreign equity portfolio investment in the US for a given year (from the IIP data) from the market capitalization of listed stocks in that year. To calculate total foreign investment in foreign countries, we sum the foreign investments in all countries with available data.¹² GDP data is provided by the World Bank. The ROW GDP is the sum of GDP for a set of countries defined in [Appendix B](#). All data is in US dollars inflation adjusted using the US

¹² One concern with this approach is that as more countries enter they create an artificially downward trend in home bias. Thus, it is important to note that we use the home investment measure, which does not use this data series, for our regression results as well.

GDP deflator. Summary statistics are in Table 1 and more details on data construction can be found in Appendix B.

We define the home investment measure as the log of the ratio between US domestic and US foreign investment. A traditional benchmark, as described in Cooper, Sercu, and Vanpée (2013), is to use the world investment as a benchmark. Similarly, our home bias measure equals home investment net of the log of the ratio between foreign investment in the US and foreign investment in foreign countries.

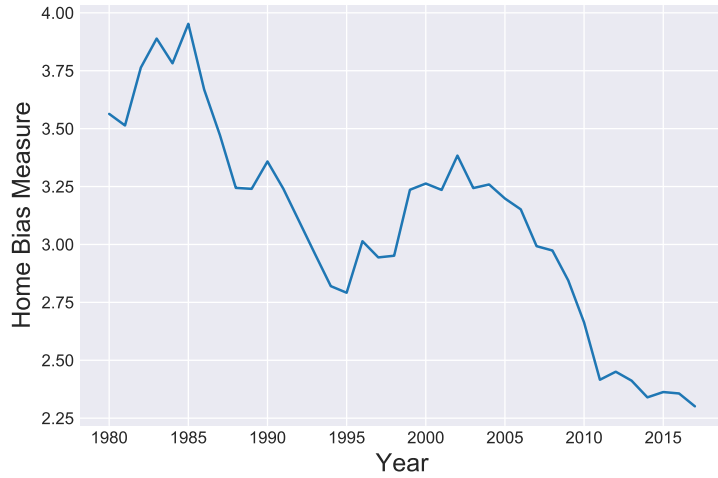


Figure 2: US Home Bias by Year

In view of Proposition 4.1, we explore the relationship between our measure of home bias and outputs of both the US and the rest of the world (ROW).

Table 2 presents the outcome of two regressions, one using home investment as dependent variable and another one using home bias as dependent variable. In both regressions, the explanatory variables are lags of the relative output measure — the log of US GDP divided by ROW GDP — and lags of the foreign output measure — the log of ROW GDP. See Appendix B for Summary statistics and details on the variables construction.

The first result we would like to highlight is that the coefficients of the contemporary relative output measure take negative values and are non-significant and significant respectively. On the other hand, the coefficient of past relative output measures are either

positive and significant or non-significant. For the home bias measure regression all coefficients for the foreign output measure are non-significant at 5% level and only one is significant at 10%. Even though the F -test rejects the hypothesis of all these coefficients being naught, the current and first-lag ones are both non-significant. In view of the fact that for our data the proportion of young in the US is always below the proportion of young in ROW, these results are broadly aligned with the predictions of Proposition 4.1 that predicts a negative impact of the current relative output measure and a positive impact of the first-lag.

For the investment measure regression, however, the results are somewhat different. In this case the current foreign output measure has a highly significant coefficient. This result suggests that the behavior of the home bias measure is different to the one for the investment measure and, unsurprisingly, our results do not seem to apply.

5.2 Fickleness and Retrenchment

We now shift our focus to fickleness and retrenchment, which requires different data series. We use data from the Balance of Payments (BOP) and International Investment Position Statistics (IIP) published by the International Monetary Fund (IMF) for the years 1970-2017. As before, we focus on equity portfolio investment. We define outflows as the change in US equity portfolio investment in foreign countries. We define inflows as the change in foreign equity portfolio investment in the US. We standardize both inflows and outflows to have a mean of 0 and a standard deviation of 1. For international demographic data, we use country level population data from the United Nations'(UN) World Population Prospects 2017 data.¹³ This data ends in 2015 so for regressions using demographic data our panel runs from 1970-2015. The ROW population is the aggregate population of a set of countries with the most important financial markets, as defined in

¹³The version of this data set is available here: <https://population.un.org/wpp/Download/Standard/Population/> under Annual Population by Age Groups - Both Sexes.

Table 2: Home Bias

Variable descriptions are in Appendix-Section B. Newey-West robust standard errors with a maximum of three lags are used to calculate the t -statistics. The F -statistic tests if the coefficient on Foreign Output Measure and all five of its lags are equal to 0.

	(1)	(2)
	Home Bias Measure	Home Investement Measure
Relative Output Measure in t	-0.354 (-0.31)	-4.472** (-2.15)
Relative Output Measure in $t-1$	0.677 (0.59)	0.729 (0.49)
Relative Output Measure in $t-2$	2.514* (1.98)	1.680 (0.71)
Relative Output Measure in $t-3$	-1.302 (-0.70)	1.213 (0.93)
Relative Output Measure in $t-4$	0.216 (0.12)	-1.705 (-0.78)
Relative Output Measure in $t-5$	0.200 (0.18)	0.918 (0.67)
Foreign Output Measure in t	-1.844 (-1.64)	-6.325** (-2.67)
Foreign Output Measure in $t-1$	0.575 (0.51)	1.146 (0.69)
Foreign Output Measure in $t-2$	2.382* (2.00)	1.568 (0.62)
Foreign Output Measure in $t-3$	-2.038 (-1.14)	0.848 (0.64)
Foreign Output Measure in $t-4$	1.182 (0.65)	-1.410 (-0.72)
Foreign Output Measure in $t-5$	-0.780 (-0.76)	1.075 (0.94)
Constant	20.38*** (6.42)	96.55*** (15.06)
F -statistic	6.206***	54.33***
R^2	0.9470	0.9810
N	38	38

Newey-West robust t statistics using three lags in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B. Following [Malmendier, Pouzo, and Vanasco \(2018\)](#), we focus on investors aged 25-75, and refer to the younger generations as those up to 50 years of age, and to the older population as those more than 50 years old. Our measure of US recessions is the proportion of a given year in recession according to the quarterly NBER recession variable. All relevant data is in US dollars and inflation adjusted using the US GDP deflator. Summary statistics are in Table 1 and more details on data construction can be found in Appendix B.

To document fickleness and retrenchment, we use the approach of [Caballero and Simsek \(2018\)](#). In our benchmark model with same prior beliefs and demographics, any change in US or ROW output should have no impact in the investment decisions of both the US and the ROW, as prices would adjust accordingly (Lemma 3.1). When we consider the case of more precise prior beliefs about domestic output, however, we predict opposite patterns of investment by the US and the ROW in response to changes in output (Proposition 3.2). In particular, there should be an inflow of domestic funds (retrenchment) and an outflow of foreign funds (fickleness) after a negative domestic or global shock.

Consistent with our model, [Forbes and Warnock \(2012\)](#) find evidence of fickleness and retrenchment increasing during global recessions, and after domestic negative GDP growth news. For our empirical strategy, we follow [Caballero and Simsek \(2018\)](#), who demonstrate that capital inflows are strongly correlated with capital outflows, as predicted by our model. They find that such correlations are especially strong for OECD countries, which includes the US. In this subsection, using the approach of [Caballero and Simsek \(2018\)](#), we extend their results to US equity data, examine the importance of recessions for these results, and then examine the importance of demographics. Our data diverges from [Caballero and Simsek \(2018\)](#) in that we use only US data and focus exclusively on equity portfolio investment.¹⁴

¹⁴ [Caballero and Simsek \(2018\)](#) consider total direct investment, portfolio investment, other investments, and, in the case of outflows, also reserve assets. This, for example, also includes the debt

In column 1 of Table 3, we replicate the result of Caballero and Simsek (2018) with our data and find that US inflows and outflows are correlated at the 10% level. This feature is aligned with Proposition 3.1 which relies on the assumption that agents’ priors are less precise about foreign countries.

One potential concern with this regression is that the coefficient estimates could be generated by the opposite patterns of retrenchment and fickleness. Instead of following a pattern of flows consistent with Corollary 3.1, US investors might invest less in the US and foreigners might invest more during US recessions. Even though such a reverse pattern would be at odds with the literature, we address this concern in column 2 of Table 3. There, we test directly for retrenchment during recessions. We find a strong correlation, statistically significant at the 5% level, between an inflow of domestic funds, i.e., negative outflows, and recessions.¹⁵ This result serves to provide evidence that outflows and recessions are correlated in the direction predicted by our model.

Our baseline regression, column 1 of Table 3, presents a stylized fact that alone is enough to warrant further study; however, it largely leaves the questions of what drives fickleness and retrenchment unanswered. Recessions (and booms) are difficult to define and so, rather than using an ad hoc definition, we rely on the recessions as defined by NBER. We then split the data into years where the US was and wasn’t in a recession. We find that if we look at the 13 years where the US was in a recession for at least one quarter, the coefficient on outflows increases, the statistical significance raises to the 5%

component of portfolio investment.

¹⁵ We do not find statistically significant evidence for or against fickleness using this simple regression approach. We suggest that these results are likely more muted for fickleness than retrenchment, possibly because of the US’ strong economic reputation although that is normally applies to primarily to US treasuries. Given our other results and the broader literature, we suggest that US fickleness still deserves strong consideration. For example, Caballero and Simsek (2018) note that Obstfeld (2012) document fickleness and retrenchment during the 2008-2009 financial crisis. In Forbes and Warnock (2012), they document that growth shocks are positively correlated with both retrenchment and fickleness, although they refer to instances large negative inflows as stops. Thus, during a recession, a severe negative growth shock, a country is much more likely to experience retrenchment and fickleness which is consistent with our theoretical and empirical findings.

level, and the R^2 increases about fivefold. In contrast, in the sample of years where the US was not in a recession the results are not statistically significant even at the 10% level despite having more than double the sample size. These results are consistent with the results of our model which suggest that fickleness and retrenchment primarily occur during macro-shocks such as recessions.

Table 3: Recessions and Capital Flows

Outflows correspond to changes US portfolio investment in foreign countries. Inflows correspond to changes in foreign portfolio investment in the US. Recession years are when the US was in a recession for at least one quarter. US recessions correspond to the proportion of the year (in quarters) when the US was defined to be in a recession by NBER. Constants included but not tabulated.

	(1)	(2)	(3)	(4)
	Outflows	Outflows	Outflows	Outflows
Inflows	0.313* (1.69)		0.296 (1.16)	0.437** (2.75)
US Recession		-0.795** (-2.17)		
R^2	0.098	0.069	0.072	0.539
N	48	48	35	13
Sample	Full	Full	Non-Recession	Recession

Jackknife robust t statistics in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Next, to analyze Corollary 4.1, we explore whether fickleness and retrenchment are exacerbated when there are more young agents in the ROW. We define a variable which measures the percentage of the population that is young outside the US.¹⁶ We then split this variable into terciles and define the years in the top tercile as the years with more young.¹⁷ Terciles are used to best parallel the recession years sample size. In column 2

¹⁶ Our model highlights the relative difference in young population between the two countries. In practice, the US always has a lower fraction of young people than the ROW in this time period. Further, in contrast to the model the size of the US population is dwarfed by the ROW population. Thus we zoom in on the ROW demographics which carry the most weight.

¹⁷ Our results are also robust to using the above median sample or the top quartile as the subsample

of Table 4, we find that in the years with a higher percentage of young agents' outside the US the correlation between outflows and inflows is statistically significant at the 5% level. In the sample with a lower percentage of young agents' we find the same coefficient to be statistically insignificant despite having double the sample size.

The next step is to examine whether or not the years with more young people outside the US happen to coincide with the years of recessions in the US whether by reason or by chance. We find, however, that this is not the case: of the 13 recession years and 15 years with more young only 3 years overlap. As a logical next step and to ensure the relationships aren't mutually exclusive somehow, we define two more samples, one for recession years or years with more young and the converse. This splits the sample approximately in half. In column 4 of Table 4, we find that in the sample of recession years or years with more young the correlation is statistically significant at the 0.01% level despite having only 25 observations. This suggests the results from our model, even though they relied on different assumptions, can be combined to deliver stronger, more robust insights on the presence of fickleness and retrenchment.

6 Conclusion

To be completed.

with more young.

Table 4: Recessions and Capital Flows

Outflows correspond to changes US portfolio investment in foreign countries. Inflows correspond to changes in foreign portfolio investment in the US. US recessions correspond to the percent of the year (in quarters) when the US was defined to be in a recession by NBER. Constants included but not tabulated. Recession years are when the US was in a recession for at least one quarter. More young years infer the percent of young in the ROW population was in the top tercile. Fewer young is the converse.

	(1) Outflows	(2) Outflows	(3) Outflows	(4) Outflows
Inflows	0.252 (0.92)	0.478** (2.80)	0.220 (0.51)	0.409**** (4.01)
R^2	0.0509	0.476	0.0278	0.349
N	31	15	21	25
Sample	More Young	Fewer Young	Fewer Young and Non-Recession	More Young or Recession

Jackknife robust t statistics in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

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*** WORK IN PROGRESS ***

Appendix A Proofs for Results

Proof of Lemma 3.1. As $\tau_j^i = \tau_i^i$, we have that $w_{t-n} = w_{t-n}^*$ and that $\sigma_{t-n}^2 = \sigma_{t-n}^{*2}$, same demographics implies that $\phi^{i,n} = \phi^{j,n}$ and that overall market participation is the same across countries $\phi^i = \phi^j = \phi$. With this, the aggregate demand of the *Home* country for the *Foreign* country's asset is given by

$$X_{F,t}^H = \phi^{H,0} \frac{\mathbb{E}_t^{H,t}[s_{F,t}]}{\mathbb{V}_t^{H,t}[s_{F,t}]} + \phi^{H,1} \frac{\mathbb{E}_t^{H,t-1}[s_{F,t}]}{\mathbb{V}_t^{H,t-1}[s_{F,t}]} \quad (29)$$

while the aggregate demand of the *Foreign* country for the *Foreign* country's asset is

$$X_{H,t}^F = \phi^{F,0} \frac{\mathbb{E}_t^{F,t}[s_{F,t}]}{\mathbb{V}_t^{F,t}[s_{F,t}]} + \phi^{F,1} \frac{\mathbb{E}_t^{F,t-1}[s_{F,t}]}{\mathbb{V}_t^{F,t-1}[s_{F,t}]} \quad (30)$$

As both country's have the same prior beliefs about output in country *F* and all agents in a given cohort observe the same output realizations, it follows that agents in both countries in a given cohort have the same posterior beliefs. Additionally, as both countries have the same market demographics, it follows that $X_{F,t}^H = X_{F,t}^F$. Market clearing implies that

$$X_{F,t}^H X_{F,t}^H + \phi^F X_{F,t}^F = 1.$$

It follows that $X_{F,t}^H = X_{F,t}^F = \frac{1}{2\phi}$. The proof for $X_{H,t}^H = X_{H,t}^F = \frac{1}{2\phi}$ is isomorphic. \square

Proof of Proposition 3.2. To show that a decrease in the prior precision about a foreign country induces a home bias in the domestic country, it suffices to show that $\frac{\partial \mathbb{E}[HB_{H,t}]}{\partial \tau^*} \Big|_{\tau^*=\tau} < 0$, which would imply that $HB_{H,t} > 0$ if $\tau^* < \tau$. As τ^* decreases, everything else equal, the aggregate demand in country *H* of domestic assets, $X_{H,t}^H$, remains unchanged. Thus, we focus on the effect of a decrease in the prior precision about the foreign asset on the demand of the domestic country for the foreign asset. We thus highlight the terms in the demand that are directly affected by the prior precision τ^* :

$$X_{F,t}^H = \phi^t \left[\frac{\tilde{\alpha} + (1 + \beta_{F,0})(1 - w_0^*)m}{\gamma(1 + \beta_{F,0})^2 \sigma_0^{*2}} + \frac{w_0^*(1 + \beta_{F,0}) + \beta_{F,1} - R\beta_{F,0}}{\gamma(1 + \beta_{F,0})^2 \sigma_0^{*2}} y_{F,t} - \frac{R\beta_{F,1}}{\gamma(1 + \beta_{F,0})^2 \sigma_0^{*2}} y_{F,t-1} \right] + \dots$$

$$\phi^{t-1} \left[\frac{\tilde{\alpha} + (1 + \beta_{F,0})(1 - w_1^*)m}{\gamma(1 + \beta_{F,0})^2 \sigma_1^{*2}} + \frac{w_1^*(1 + \beta_{F,0})\omega + \beta_{F,1} - R\beta_{F,0}}{\gamma(1 + \beta_{F,0})^2 \sigma_1^{*2}} y_{F,t} + \frac{w_1^*(1 + \beta_{F,0})(1 - \omega) - R\beta_{F,1}}{\gamma(1 + \beta_{F,0})^2 \sigma_1^{*2}} y_{F,t-1} \right].$$

where the terms indexed by $*$ are a function of τ^* . We can then compute $\frac{\partial X_{F,t}^H(\tau^*)}{\partial \tau^*}$ as

follows

$$= \phi^t \frac{(y_{F,t} - m) \frac{\partial w_0^*}{\partial \tau^*}}{\gamma(1 + \beta_{F,0}) \sigma_0^{*2}} + \phi^{t-1} \frac{(\omega y_{F,t} + (1 - \omega) y_{F,t-1} - m) \frac{\partial w_1^*}{\partial \tau^*}}{\gamma(1 + \beta_{F,0}) \sigma_1^{*2}} + \phi^t \frac{\partial x_{F,t}^{t,H}}{\partial \sigma_0^{*2}} \frac{\partial \sigma_0^{*2}}{\partial \tau^*} + \phi^{t-1} \frac{\partial x_{F,t}^{t-1,H}}{\partial \sigma_1^{*2}} \frac{\partial \sigma_1^{*2}}{\partial \tau^*}$$

As $\mathbb{E}[y_{F,t}] = m$ for all t , it follows that

$$\mathbb{E} \left[\frac{\partial X_{F,t}^H(\tau^*)}{\partial \tau^*} \right] = \phi^t \frac{\partial x_{F,t}^{t,H}}{\partial \sigma_0^{*2}} \frac{\partial \sigma_0^{*2}}{\partial \tau^*} + \phi^{t-1} \frac{\partial x_{F,t}^{t-1,H}}{\partial \sigma_1^{*2}} \frac{\partial \sigma_1^{*2}}{\partial \tau^*} < 0$$

□

Proof of Proposition 4.1. Let $\tau + \tau^*$, all agents share the same prior belief. Then, we have that $\sigma_a^2 = \sigma_a^{*2}$ and thus $w_a = w_a^*$ for $a \in \{0, 1\}$, which implies that $\beta_{0,F} = \beta_{0,H} = \beta_0$ due to symmetry. Thus, we have that

$$1 + HB_t \propto \frac{1}{\sigma_0^2 \sigma_1^2} [(\phi^{F,1} \phi^{H,0} - \phi^{F,0} \phi^{H,1}) w_0 + (\phi^{F,0} \phi^{H,1} - \phi^{H,0} \phi^{F,1}) \omega w_1] y_{H,t} \quad (31)$$

$$+ [\phi^{F,0} \phi^{H,1} - \phi^{H,0} \phi^{F,1}] w_1 \Sigma(1 - \omega) y_{H,t-1} \quad (32)$$

$$+ [(\phi^{H,1} \phi^{F,0} - \phi^{F,1} \phi^{H,0}) w_0 + (\phi^{H,0} \phi^{F,1} - \phi^{F,0} \phi^{H,1}) \omega w_1] y_{F,t} \quad (33)$$

$$+ [\phi^{H,0} \phi^{F,1} - \phi^{F,0} \phi^{H,1}] w_1 \Sigma(1 - \omega) y_{F,t-1} \quad (34)$$

$$1 + HB_t \propto \frac{(\phi^{H,0} \phi^{F,1} - \phi^{H,1} \phi^{F,0})}{\sigma_0^2 \sigma_1^2} ((w_0 - \omega w_1) (y_{H,t} - y_{F,t}) - w_1 \Sigma(1 - \omega) (y_{H,t-1} - y_{F,t-1})) \quad (35)$$

Thus, a country's HB is a function of the differential output realizations in the domestic relative to the foreign country. The intuition is as follows: as young agents (in both countries), overreact to more recent observations relative to older cohorts, then the HB depends on the current realizations in each country and the number of young relative to old in each country:

$$\frac{\partial HB_t}{y_{H,t} - y_{F,t}} = \frac{(1 + \beta_0)}{\sigma_0^2 \sigma_1^2} (\phi^{H,0} \phi^{F,1} - \phi^{H,1} \phi^{F,0}) (w_0 - \omega w_1) \quad (36)$$

$$\frac{\partial HB_t}{y_{H,t-1} - y_{F,t-1}} = - \frac{(1 + \beta_0)}{\sigma_0^2 \sigma_1^2} (\phi^{H,0} \phi^{F,1} - \phi^{H,1} \phi^{F,0}) w_1 \Sigma(1 - \omega) \quad (37)$$

Thus, HB increases in $y_{H,t} - y_{F,t}$ and decreases in $y_{H,t-1} - y_{F,t-1}$ if and only if

$$\phi^{H,0} \phi^{F,1} - \phi^{H,1} \phi^{F,0} > 0$$

$$\frac{\phi^{H,0}}{\phi^{H,1}} > \frac{\phi^{F,0}}{\phi^{F,1}}$$

As we have assume the total mass of market participants is the same, we have that

$$\frac{\phi^{H,0}}{\phi^{H,1}} > \frac{\phi^{F,0}}{\phi^{F,1}} \iff \frac{\phi^{H,0}}{\Phi - \phi^{H,0}} > \frac{\phi^{F,0}}{\Phi - \phi^{F,0}} \iff \boxed{\phi^{H,0} > \phi^{F,0}}.$$

□

Appendix B Data

All monetary data are in US\$ and inflation adjusted using the GDP deflator. Our sample for the home bias data runs from 1980-2017 to allow for 6 countries other than the US to have foreign equity portfolio investment data available. Our inflows and outflows sample in Table 1 runs from 1970-2017 for due to the availability of the Balance of Payments (BOP) series we use. However, the sample used in Table 2 runs from 1970-2015 as the UN population data ends in 2015. Summary statistics are in Table 1.

B.1 Home Bias

In general, the data construction we use to calculate our home bias measure is constructed following on [Mishra \(2015\)](#) and [Cooper, Sercu, and Vanpée \(2013\)](#). Places where our calculations diverge from both are noted. A key assumption of [Mishra \(2015\)](#) and [Cooper et al. \(2013\)](#) in calculating home bias is that equity portfolio investment, as defined by the the International Monetary Fund (IMF), is approximately equal to investment in listed equities.¹⁸

We focus primarily on home bias in listed equities. Investors exhibit home bias if the fraction of their equity holdings that is invested in domestic equity exceeds the optimal percentage. A common benchmark for the optimal percentage is the percent of domestic assets held in the global portfolio. There is no publicly available data on total domestic listed equity holdings of US investors. As an approximation of this amount, we subtract the total equity portfolio investment of foreign investors in the US from the market capitalization of all US listed stock. In addition to foreign equity portfolio investment in the US, we also obtain US investment in foreign equity portfolio investment from the International Investment Positions (IIP) data from the IMF, which provides a longer time series than the IMF's Current Portfolio Investment Survey (CPIS) used by [Mishra \(2015\)](#) and [Cooper et al. \(2013\)](#).¹⁹ Foreign investment in foreign countries is defined as the sum of foreign equity portfolio investment in all countries outside of the US. Due to data availability, the number of countries in this sum varies; to ensure our results are not

¹⁸Portfolio investment is defined by the IMF to comprise liquid investment assets, such as listed equities; however, investments of less than 10% in venture capital firms will be included in equity portfolio investment and investments greater than 10% in a listed company are denoted as direct investment instead of portfolio investment.

¹⁹The IIP data can be found at <http://data.imf.org/BOP>.

biased by this, we use only years where we have this data for 6 countries other than the US and also consider our home investment measure which does not use this data series.

For the worldwide market capitalization of all listed stock we use data from the World Federation of Exchanges, available from the World Bank in the World Development Indicators.²⁰

We use GDP data provided by the World Bank in the World Development Indicators from 1970-2017.

The measures used in Table 2 are defined in Table 5 Rest of world (ROW) is defined using the same countries/regions listed below. X-Y Inv is meant to mean the amount X has invested in Y. These measures as above apply to publicly listed stocks/portfolio investment.

Table 5: Variable Definitions

Variable Name	Formula
Output Measure	$\log(\text{US GDP}) - \log(\text{ROW GDP})$
Foreign Output Measure	$\log(\text{ROW GDP})$
Home Bias Measure	$[\log(\text{US-US Inv}) - \log(\text{US-ROW Inv})] - [\log(\text{ROW-US Inv}) - \log(\text{ROW-ROW Inv})]$
Home Investment Measure	$\log(\text{US-US Inv}) - \log(\text{US-ROW Inv})$

B.2 Fickleness and Retrenchment

Outflows are the changes from the IMF Balance of Payments data for the for US portfolio investment in foreign countries (variable BFP AE_BP6_USD). Inflows are the changes from the IMF Balance of Payments data for the for foreign portfolio investment in the US (variable BFP LE_BP6_USD).²¹ We standardize both inflows and outflows to have a mean of 0 and a standard deviation of 1.

US recession data comes from NBER’s Business Cycle Dating Committee. The recession sample are years where for at least one quarter the US is in a recession. The US Recession variable is the proportion of the year, in quarters, where the US is in a recession. For example, if the US is in a recession one quarter in a given year the variable will have the value .25 in that year.

World population data comes from the UN. Following Malmendier, Pouzo, and Vanasco (2018), we consider people aged 25 to 75, and define young people as those below 50. For computational simplicity we limit our definition of the rest of world (ROW) population to the combined population of a panel of 20 countries/regions (based on UN names and divisions). These countries/regions are Canada, Mexico, Brazil, Chile, Argentina, Peru,

²⁰The World Development Indicators is located here: <https://datacatalog.worldbank.org/dataset/world-development-indicators>.

²¹The BOP data can be found at <http://data.imf.org/BOP>.

United Kingdom, France, Germany, Spain, Italy, Switzerland, Luxembourg, China (Mainland), Hong Kong, Japan, Singapore, Republic of Korea, Australia, and New Zealand.

To define the “more young” panel, we calculate the ROW percentage young and take the top tercile of observations. The “fewer young” panel is the converse.

The “more recession” years are 1970, 1973, 1974, 1975, 1980, 1981, 1982, 1990, 1991, 2001, 2007, 2008, and 2009.

The “more young” years are 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, and 2002.