Rebalancers and the Cross-Asset Transmission of Expectations Shocks*

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Abstract

We quantify how investors that implement automatic rebalancing transmit return expectations shocks across assets. We estimate a model of country-level asset portfolios, capturing expected returns based on professional forecasts. In the model, rebalancers dampen the impact of a 1 percentage point U.S. equity return expectations shock on U.S. equity prices by 40 basis points and amplify the impact on U.S. long-term debt prices by 52 basis points. Additionally, rebalancers transmitted the 8.3 percentage point observed increase in equity return expectations during 2021 to an 8 basis point decrease in long-term debt yields.

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1 Introduction

A substantial share of U.S. investments are held by funds that automatically rebalance their portfolios to maintain target debt and equity ratios. That is, these investors periodically sell the higher-performing asset class and buy the lower-performing one to prevent their portfolios from drifting away from the targets. Examples of such rebalancers include target date funds (TDFs), balanced funds (BFs), and collective investment trusts (CITs) (Parker, Schoar, and Sun (2023)). Additionally, many defined benefit pension funds closely track their stated asset allocation targets (Harvey, Mazzoleni, and Melone (2025), Gabaix and Koijen (2023)). On the one hand, rebalancers reduce the sensitivity of the stock market to shocks by trading against them. On the other hand, they transmit stock market shocks to debt markets. In this paper, we quantify both of these price effects and the channels that drive them. We then apply these results to quantify the extent to which recent observed changes in expected stock returns have affected the cost of borrowing for the U.S. government.

We implement this analysis using a model of country-level asset portfolios. We estimate the model using forecaster surveys to directly represent equity return expectations. We then use the model to simulate a 1 percentage point U.S. equity return expectations shock in a baseline setting with rebalancers and a counterfactual without them. We find that, in the baseline model relative to the counterfactual, the shock increases the price of U.S. equity by 40 basis points less (from 8.4% to 8.0%) and increases the price of U.S. long-term debt by 52 basis points more (from .29% to .81%). We also apply the model to recent observed yearly changes in U.S. equity return expectations. For example, for the relatively large increase in expected returns by 8.3 percentage points from 2020 to 2021, rebalancers resulted in a 6.6 percentage point greater increase in long-term debt prices (from 3.2% to 9.8%), which corresponds to an approximately 78 basis point greater reduction in yields. However, if a loss of confidence were to lead to a 10 percentage point reduction in future equity return expectations, rebalancers would increase the reduction in U.S. long-term debt prices by 3.45 percentage points (from 2.4% to 5.85%), which corresponds to increasing yields by about 41 basis points.

We begin our analysis by estimating a range for the size of rebalancers of U.S. assets. We rank types of retirement accounts and foreign investments based on their tendency to implement rebalancing strategies. In particular, our baseline estimate associates rebalancing with defined contribution and defined benefit retirement plans, as well as the fraction of individual retirement accounts invested in TDFs. In that case, rebalancers account for around 13% of U.S. investment in equity and debt as of 2023.

We then incorporate these rebalancers into a demand system asset pricing model in the style of Koijen and Yogo (2019). The model includes a set of countries that supply short-term debt, long-term debt, and equity in their local currency. These countries also have a certain level of wealth and invest in the supplied assets, whether domestically or abroad. The portfolio weights for the non-rebalancer investors derive from a nested logit model which separately determines the weights for each asset class and the weights for each issuer country conditional on an asset class. The conditional portfolio weight for an asset depends on its expected return and on characteristics of the issuer country that could affect the variance perceived by the investor, such as its income level, financial stability, and geographic distance from the investor. The asset class weights depend on the preferences for the individual assets available within each class, as well as on overall asset class-level preferences and the degree of substitutability across asset classes.

In equilibrium, the total investment in each asset equals the total market value of supply in U.S. dollars. This market value depends on the amounts supplied, the exchange rates, and the price levels. The price levels correspond to market values relative to face values for both types of debt and to market-to-book ratios for equity. The amount supplied for each asset is exogenous, and the prices for short-term debt are determined independently by the respective monetary authorities. The endogenous prices include the exchange rates, which clear the market for short-term debt, and the prices for equity and long-term debt, which clear their respective markets.

We implement two unique features compared to other papers in the literature that implement a demand system asset pricing model in a cross-country context (e.g. Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming)). First, in addition to the investors whose weights are determined by the nested logit model, we introduce a rebalancer investor that comprises a 13% share of U.S. domestic investment and has fixed portfolio weights.[1] In the baseline model, we assume the rebalancer invests 60% of its portfolio in U.S. equity and 40% in U.S. long-term debt, which is motivated by their empirical share of equity relative to debt.

The second unique feature is that we represent expected returns using forecaster surveys. Specifically, for equity, we divide firm-level 12-month stock price targets by the respective current prices to obtain the implied expected price returns, from which we

[1]We explicitly model rebalancers as a separate investor so that we can vary their size and portfolio to capture their effects on asset prices, as well as simulate potential future changes in the share of rebalancers. In principle, one could alternatively have one representative investor and reflect the impact of rebalancers through changes in the aggregate demand elasticities, but doing so would also imply varying the demand for the non-rebalancer investors.

compute a market-value-weighted average for each country. For exchange rates and debt, we determine the expected return by comparing analyst forecasts of exchange rates or future yields on government bonds to the respective current values. We use analyst forecasts because they are a direct measure of expected returns, which determines demand. The literature instead infers expected returns more indirectly, such as by using the predicted values of realized returns regressed on current prices. However, variation in current prices does not necessarily determine analogous variation in the expected returns that drive investors' portfolio weights, since it could also be correlated with variation in future prices. Examples include persistence or momentum (van Binsbergen, David, and Opp (2025)). Furthermore, we observe that analyst forecasts can differ notably from realized returns over the same horizon. For example, forecasted returns for equity completely fail to predict negative returns. As a result, they have a weaker correlation with current prices. Forecasted returns also have lower volatility and a higher mean than realized returns.

We estimate the model using data on asset prices, forecasted returns, outstanding levels of supply, country characteristics, and bilateral portfolio holdings over the period 2004-2023. We apply the restatement matrices from Coppola et al. (2021) to associate offshore issuances, such as via tax havens, with the original issuers. We estimate the non-rebalancers' demand elasticities using instrumental variables, which accounts for potential endogeneity between expected returns and portfolio weights. For example, an increase in unobserved demand, such as due to changes in risk tolerance, could lead to both higher portfolio weights and higher prices, which could in turn affect expected returns. Our estimation approach is similar to other papers that implement an asset demand system in an international context (Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming)). We construct instruments by first estimating predicted portfolio weights based on a regression restricted to plausibly exogenous regressors, such as the issuer's population, the distance between investors and issuers, and a domestic indicator to capture home bias. We then use the model to determine the predicted asset prices and exchange rates that are implied by the predicted weights. We use these predicted prices and exchange rates as instruments for the expected returns.

We use the model to quantify how rebalancers transmit shocks affecting expected U.S. equity returns to U.S. long-term debt. We allow investor wealth to vary dynamically based on realized returns as portfolios and asset prices shift in response to the shock. A 1 percentage point increase in expected returns to U.S. equity causes the price of U.S. equity to increase by 8.0%, a 40 basis point (or 4.8%) reduction compared to the 8.4% increase in a counterfactual without rebalancers. By trading to restore their predetermined shares, rebalancers effectively reduce aggregate substitution in response to the shock, which drives the reduction in the equity price growth. We also observe that the shock leads to an increase in the price for U.S. long-term debt by about .81%, a 52 basis point (or 180%) increase compared to the approximately .29% increase in a counterfactual without rebalancers. In either scenario, the increase in debt prices is driven by wealth revaluation from realized returns. In particular, U.S. investors experience a relatively large increase in wealth due to their relatively high level of investment in U.S. equity, which they use to buy more long-term debt since they still have relatively high weights on their domestic debt. However, the increase in the U.S. long-term debt price is offset by substitution from debt to equity. Rebalancers naturally reduce this substitution. They also increase the wealth revaluation channel due to their relatively high weights on both U.S. equity, which has a high realized return, and U.S. long-term debt, which absorbs some of the rebalancer's increased wealth. As a result, they lead to a greater increase in the debt price.

Overall, rebalancers dampen the increase in the relative price of equity to long-term debt by 11.8% compared to the counterfactual without rebalancers, which is 43.4% attributable to their effect on equity prices and 56.6% attributable to their effect on debt prices. Changes in substitution across equity and debt contribute to the difference in the price ratio growth at rate of 74.2%, changes in substitution across issuer countries contribute at a rate of 29.9%, and changes in wealth revaluation on net detract at a rate of -4.2%, which is due to rebalancers' relatively high weight on U.S. equity.

We further investigate the mechanisms by deactivating channels in the model. We find that the rebalancer's dampening of the price ratio growth changes only modestly in a variation of the model where wealth remains fixed at the level before the expectations shock. This result affirms that the rebalancer effect is more strongly driven by changes in substitution in response to the expectations shock rather than shifts in wealth from valuation effects. We also observe that the rebalancer effect vanishes if we replace the rebalancer with a passive investor who does not trade, which affirms the essential role of the rebalancer's active trading to maintain fixed weights.

As robustness, we examine the sensitivity of the results to the estimated rebalancer and non-rebalancer characteristics, including the size and composition of rebalancer portfolios as well as the elasticities determining the non-rebalancer portfolios. We show that the effect of the rebalancer on asset prices scales nearly linearly with its size. For example, doubling the size of the rebalancer causes it to dampen the increase in the equity price from 8.4% to 7.62%, about twice the change from 8.4% to 8.0% based on the baseline rebalancer share. It also leads the rebalancer to amplify the increase in U.S. long-term debt prices from .29%

to 1.3%, which is just slightly less than double the change from .29% to .81% when using the baseline rebalancer share. We also observe that the rebalancer effect is largest when the rebalancer's equity share is 50%. On the one hand, a small equity ratio reduces the rebalancer's wealth gain from the shock. On the other hand, a large equity ratio reduces the rebalancer's tendency to invest its wealth gain in long-term debt. If the rebalancer increases the share of short-term debt within total debt, the rebalancer effect on the price of equity relative to long-term debt diminishes, but it results in a greater appreciation of the U.S. dollar. Finally, the rebalancer effect increases, albeit mildly, with non-rebalancers' sensitivity to expected returns and their degree of substitutability across asset classes.

To demonstrate the implications of our results for past or potential future shocks, we show that the 8.3 percentage point change in U.S. equity return expectations from 2020 to 2021 was associated with a 9.8% increase in long-term debt prices, compared to 3.2% in the counterfactual without rebalancers. The 6.6 percentage point difference in the long-term debt price growth corresponds to an approximately 78 basis point greater reduction in yields, assuming a plausible modified duration of 8.5 years for 10-year U.S. Treasury bonds.[2] However, our model also shows that a U.S. stock market crash induced by a 10 percentage point reduction in equity return expectations would reduce long-term debt prices by around 5.85%, compared to just 2.4% in a setting without rebalancers. The difference of 3.45 percentage points corresponds to about a 41 basis point greater increase in yields, again assuming a modified duration of 8.5 years. These examples highlights how rebalancers transmit changes in the stock market to the cost of government borrowing.

Finally, we briefly consider how rebalancers influence the impact of other types of shocks on the relative price of U.S. equity to long-term debt. Rebalancers dampen the effect of a shock to U.S. long-term debt expectations by around 8.3% to 10%. Rebalancers also reduce the negative impact (on U.S. asset prices) of positive equity return expectations shocks for assets issued by other countries by around 7.5% to 9%. These results illustrate the broader effects rebalancers have on the transmission of different types of shocks across assets.

This paper contributes to three major themes in the literature. First, it relates to papers studying the role of rebalancers. Parker, Schoar, and Sun (2023) focus on target date funds and find cross-sectional evidence that they affect returns for stocks that are disproportionately included in their holdings. Harvey, Mazzoleni, and Melone (2025) focus on aggregate

[2] More generally, rebalancers transmitted changes in U.S. equity return expectations during 2020 through 2023 to an average .67% increase in long-term debt prices compared to the counterfactual, which corresponds to an approximately 8 basis point reduction in yields.

indices and find that increases in reduced-form signals of the intensity of rebalancing, such as high recent returns of stocks relative to bonds exceeding target weight deviation thresholds or interacted with month transitions, are associated with reduced subsequent stock returns relative to bonds. Camanho, Hau, and Rey (2022) study determinants and effects of rebalancing between foreign and domestic equities. We contribute to this literature by quantifying the price effects associated with rebalancers transmitting a given shock across asset classes.

Second, this paper builds on papers that use an asset demand system to study international portfolio allocations. Koijen and Yogo (2019) develop a generalized approach for modeling portfolios that vary with asset characteristics. Haddad, Huebner, and Loualiche (2025) use a demand system to show that the increasing role of passive investors has led to increased inelasticity of demand in the stock market. We are specifically related to papers that apply the demand system asset pricing model in the context of international portfolios. For example, Jiang, Richmond, and Zhang (2024) study factors affecting the U.S. net foreign asset position, Jiang, Richmond, and Zhang (2025) quantify various determinants of the U.S. dollar exchange rate, and Koijen and Yogo (Forthcoming) decompose the variation in asset prices and exchange rates. We depart from these papers in two major ways. First, we add a rebalancer investor. Including an explicit rebalancer provides more flexibility for rebalancers to have different target allocations compared to other investors from the same country, allowing a closer correspondence with holdings data. It also more clearly illustrates the effect of rebalancing since the explicit rebalancer maintains strict allocation targets, and we can observe its impact by adjusting its size. Second, we also differ from these papers by measuring return expectations more directly using forecaster estimates rather than the predicted values from regressing realized returns on current prices. As a result, we can verify that our instruments are indeed associated with expected returns. By contrast, this verification is more difficult when using the alternative, as variation in current prices could also be correlated with variation in future prices and therefore does not necessarily imply analogous variation in expected returns. This observation is related to van Binsbergen, David, and Opp (2025), who focus on how dynamics like persistence or momentum could bias estimated demand elasticities with respect to prices.

Third, our study adds to the body of research on forecasts and expectations from surveys. Bordalo et al. (2024) show that increases in forecaster estimates for long-term earnings growth predict future forecast declines as well as lower stocks returns, consistent with overreaction. Checo, Grigoli, and Sandri (2024) use forecasts of policy rate decisions to identify monetary policy shocks. Our paper contributes to this literature by showing that equity returns implied from price target forecasts are inflated on average because they fail to predict declines, and that expected returns tend to be less overly optimistic for the U.S. compared to other countries. We also use analyst forecasts for equity, debt, and exchange rate returns to estimate our model, allowing us to quantify the extent to which rebalancers transmit expectations shocks across assets.

2 Empirical observations

In this section, we first estimate that about 13% of U.S. investment in equity and debt is held by rebalancers. Additionally, 13% of foreign investment in U.S. equity and debt is held by foreign rebalancers. We then describe empirical observations related to forecasted equity returns. We first show that expected returns based on professional forecasts exhibit a higher mean and lower volatility compared to realized returns, which is largely due to failing to predict declines. Additionally, the U.S. has a lower gap between expected and realized returns compared to the majority of countries.

2.1 Size of rebalancers

In this section, we determine a range of estimates for the fraction of U.S. equity and debt held by rebalancers. In our baseline estimate, rebalancers account for 13% of U.S. investment in equity and debt.

Our baseline estimate associates rebalancers with defined contribution and defined benefit retirement plans as well as a fraction of individual retirement accounts (IRAs) that are likely to be invested in target date funds (TDFs). Based on the Federal Reserve Flow of Funds data as of 2023Q4, public and private defined contribution plans account for approximately $8.6 trillion of equity and debt, which we specifically associate with corporate equities, debt securities, and mutual fund shares. Also, defined benefit plans account for $7.0 trillion, and IRAs account for $5.1 trillion. Many employer-sponsored plans implement default selections that allocate contributions to rebalancing funds, such as TDFs, balanced funds, and community investment trusts. By contrast, IRAs do not have defaults and are more likely to be actively managed by investors. As a result, we estimate a lower bound based on a subset of IRAs that invest specifically in TDFs, which comprise about 9% to 23% depending on investor age.[3] For the lower bound estimate, we suppose that 9% of IRA assets are subject to rebalancing. The rebalancing assets based on

[3] See the Investment Company Institute (ICI) "Quick Facts on Target Date Fund Use in Retirement Plans".

this measure then sum to \$16.1 trillion (8.6+7+.09*5.1). Also based on the Federal Reserve Flow of Funds data, we determine that total U.S. investment in the same assets in 2023Q4 totaled \$124 trillion, resulting in a rebalancer ratio of about 13% (≈ 16.1/124). Note that this figure could be an understimate since not all investments subject to rebalancing are within retirement accounts,[4] but it could also be an overestimate since not all retirement assets are subject to rebalancing.[5,6]

Our second estimate is similar to the baseline except that we restrict to the fraction of defined contribution plans that are likely to be held within TDFs within 401(k) accounts. This restriction eliminates potential overestimation due to investors that choose to override plans that select rebalancing funds as a default option. However, it could also exacerbate underestimation since it does not count other types of rebalancers, such as balanced funds and collective investment trusts. It also does not include TDFs held in other types of plans, such as 403(b) plans, 457(b) plans, and the federal Thrift Savings Plan. To estimate the size of TDFs, we observe that, as of 2024Q4, about 72% of defined contribution plans are held in 401(k) plans.[7] Furthermore, TDFs comprise 38% of 401(k) plan assets.[8] Therefore, we estimate that TDFs in 401(k) plans comprise about 27.3% (=.72 *.38) of defined contribution plans. The resulting rebalancer ratio is about 8% (≈ (.72*.38*8.6+7+.09*5.1)/124).

Our third estimate is similar to the second except that, within defined benefit plans, we restrict to those administered by state and local governments. We retain state and local governments in our most restrictive estimate because many explicitly report target ratios, according to the Public Plans Database (PPD) maintained by the Center for Retirement Research at Boston College. Furthermore, they track these targets closely (Harvey, Mazzoleni, and Melone (2025), Gabaix and Koijen (2023)).[9] In this case, the rebalancer ratio is about 6% (≈ (.72*.38*8.6+4.4+.09*5.1)/124).

[4] For example, households can invest in target date funds using brokerage accounts.

[5] For example, even though many 401(k) plans default to rebalancing funds such as target date funds, balanced funds, and community investment trusts, they often allow investors to select other plans if they prefer.

[6] Note that our estimate is similar to the one in Harvey, Mazzoleni, and Melone (2025), who associate rebalancers with the approximately \$20 trillion of equity and debt held in retirements accounts as of the end of 2022. Our estimate is lower because we restrict to a subset of IRAs. Our estimate is also lower than the one in Lu and Wu (2025), who find that rebalancers account for about 20% of the U.S. stock market. However, we include both equity and debt and use different data.

[7] See the ICI "Quarterly Retirement Market Data".

[8] See the ICI "Quick Facts on Target Date Fund Use in Retirement Plans".

[9] Note that the PPD includes about 230 state and local pension plans that cover 95% of state and local pension assets. Additionally, many of target and rebalancing policies are articulated in detail in a list of "Public Retirement System Rebalancing Policies" released by the National Association of State Retirement Administrators (NASRA) in 2020.

2.2 Equity return forecasts

We use analyst forecasts to directly measure expected price returns for equity. By doing so, we sidestep an issue with a common alternative in the literature based on using the predicted values from regressing realized returns on price levels, which is that variation in current prices could also be associated with variation in future prices and therefore does not necessarily imply analogous variation in expected returns.

We use data from the Institutional Brokers' Estimate System (IBES) to compute forecasted and realized equity returns. We use data from IBES since IBES forecasts are indicative of investor behavior (Brav and Lehavy (2003), So (2013)), and they are available for a wide selection of countries. Note that we are interested in using the IBES forecasts to represent the expected returns that affect investors' demand, and we are agnostic regarding their accuracy in predicting realized returns. One potential concern is that the sell-side analysts in IBES could have incentives to strategically manipulate their opinions. However, this strategic manipulation is more likely to affect their recommendations but not their forecasts (Malmendier and Shanthikumar (2014)).

We focus on the median 12-month price target among the analysts for each firm and month. We compute the expected price return as the growth of the median price target relative to the current price, using the actuals data also included in IBES. We compute the corresponding realized return as the growth of the price 12 months later relative to the current price. Note that the expected and realized returns focus on price appreciation and do not include dividends. We restrict to observations for which the instrument code, when defined, is "Security", which filters out many foreign firms represented through depository receipts, foreign listings, or dual listings. We further restrict to observations for which both the price and price targets are reported in domestic currency, and we remove observations where the expected or realized return or price target is implausibly large, specifically greater than 500% or $2000, respectively.[10] We collapse expected and realized returns to the country-month level by taking the mean across firms and weighting by the market capitalization. We restrict to countries with at least 10 firms for each year of the sample period.

In the aggregate time series, Figure 1 shows the median expected and realized returns across firms from all countries in our sample from 2004 to 2023.[11] Expected returns have lower volatility and a higher mean compared to realized returns. The higher mean is largely

[10] Note that the results are similar if we instead winsorize expected and realized returns at 1% and 99%, with or without also removing the filters restricting to domestic firms.

[11] See Table 1 for a list of countries in the sample.

driven by a failure to predict negative returns. For example, the median expected return exceeds realized returns by 2.5% during the full sample period, but it is about 1.3% lower if we restrict to dates where the associated realized return is nonnegative. Table 2 uses the country-year level data and shows that current equity prices, measured using aggregates of market-to-book ratios, predict lower forecasted and realized returns, but the magnitude is about half as large for forecasted returns.

Looking at the cross-section of countries in our sample, Table 1, as well as Figure A.1 in Internet Appendix A, shows the median expected and realized return for our sample of countries over the sample period. The U.S. has higher predicted and realized returns but a lower prediction gap than most countries.

3 Illustrative model

This section uses a simple model with a mean-variance investor and a rebalancer to qualitatively illustrate the effect of rebalancers on the response of equity and debt prices to an equity return expectations shock.

We consider two dates: a date $t = 0$ before return expectations shock, and a date $t = 1$ when the shock occurs. There are two scenarios k: one with just a mean-variance investor ($k = NR$), and one with a mean-variance investor as well as a rebalancer ($k = R$). Denote the investors by $i = MV$ or $i = R$. Each investor has wealth $A^k_{i,t}$. Denote the total wealth of all investors by A_t. The total wealth in period 0 is invariant with respect to the scenario. That is, in the setting with a rebalancer we have $A_0 = A^R_{MV,0} + A^R_{R,0}$, and in the setting without a rebalancer we have $A_0 = A^{NR}_{MV,0}$ and $A^{NR}_{R,0} = 0$.

There are 2 assets l: equity ($l = E$) and long-term debt ($l = L$). The weights for the mean-variance investor $w_{MV,t}$ are determined by solving

$$\max_{w_{MV,t}} \mu_t^T w_{MV,t} - \frac{\gamma}{2} w_{MV,t}^T \Sigma_t w_{MV,t} \qquad \text{s.t. } \mathbf{1}^T w_{MV,t} = 1, \tag{1}$$

where μ_t is a vector of the expected excess returns, Σ_t is the variance-covariance matrix of the excess returns, γ represents the degree of risk aversion, and $\mathbf{1}$ denotes a vector of 1s. This problem yields the known solution

$$w_{MV,t} = \frac{1}{\gamma}\Sigma_t^{-1}\mu_t + \frac{1 - \frac{1}{\gamma}\mathbf{1}^T\Sigma_t^{-1}\mu_t}{\mathbf{1}^T\Sigma_t^{-1}\mathbf{1}}\Sigma_t^{-1}\mathbf{1}, \tag{2}$$

where the weight on an asset increases with its expected return relative to the other asset and decreases with its contribution to portfolio risk, which depends on its variance as well the covariance of the two assets. The rebalancer has time-invariant weights $w_R(l)$.[12]

The supply of each asset class is exogenous and denoted by $Q_t(l)$, which corresponds to face value for debt or book value for equity. The price $P_t^k(l)$ corresponds to the ratio of market value relative to either book or face value, and it is determined by the market clearing condition that equates the market value of supply to the total value of investment:

$$Q_t(l)P_t^k(l) = A_{MV,t}^k w_{MV,t}(l) + A_{R,t}^k w_R(l). \tag{3}$$

We can also allow revaluation of each investor's wealth based on the realized returns of the assets, in which case the post-shock wealth can be expressed as

$$A_{i,1}^k = \sum_{l=E,L} A_{i,0}^k w_{i,0}(l) \frac{P_1^k(l)}{P_0^k(l)}. \tag{4}$$

We consider how prices during the shock in period 1 respond to an equity expectations shock, represented by an increase in $\mu_1(E)$.

Proposition 1. *The price of equity relative to debt $P_1^k(E)/P_1^k(L)$ satisfies the following properties: (i) without wealth revalution, the relative price increases with the expected return of equity $\mu_1(E)$, and (ii) it grows at a slower rate in the scenario with a rebalancer; (iii) in the setting with a rebalancer, wealth revaluation can either amplify or dampen the change in $P_1^k(E)/P_1^k(L)$ depending on if the revaluation favors the investor with the greater equity weight.*

See Appendix B for a proof. The price of equity relative to debt increases as investors substitute to equity due to its higher return. However, the aggregate amount of substitution is less in the setting with a rebalancer since the rebalancer treats the assets as perfect complements. Prices also shift in favor of the asset held disproportionately more by the investor that experiences the greatest increase in wealth due to revaluation.

In the following section, we develop a fuller model to quantitatively estimate the effect of the rebalancer on the price response to the shock, as well as the relative contributions from rebalancers' lack of substitution versus wealth effects.

[12] One option is to assume they are equal to the weights of the mean-variance investor in period 0 so that the aggregate portfolio in period 0 remains unchanged: $w_R(E) = w_{MV,0}(E)$ and $w_R(L) = w_{MV,0}(L)$. However, note that the results in Proposition 1 below do not require this assummption.

4 Model

Our model applies the demand system approach from Koijen and Yogo (2019) in the context of international portfolios and is similar to Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming). We implement two primary innovations compared to those papers. First, we introduce a rebalancer investor to match the estimated fraction of rebalancer holdings. Second, we use our data on expected returns based directly on professional forecasts to estimate investor demand.

4.1 Model description

Section 4.1.1 describes the baseline model, which corresponds to the setting before the equity expectations shock and without the rebalancer. Section 4.1.2 adds the expectations shock. Section 4.1.3 adds the rebalancer.

4.1.1 Baseline model

There are I investor countries denoted by i, N issuer countries denoted by n, and three asset classes denoted by l: equity ($l = E$), long-term debt ($l = L$) such as corporate and government bonds, and short-term debt ($l = S$) such as commercial paper, government bills, and deposits (Kacperczyk and Schnabl (2010)). There is also an outside issuer denoted by $n = 0$, which corresponds to countries excluded from our sample due to lack of data. We index assets by (n, l).

On the demand side, at a given date t each investor has exogenous wealth $A_{i,t}$ in U.S. dollars (USD) and allocates this wealth across the available assets via the portfolio weights $w_{i,t}(n, l)$. The weights are determined as a function of issuer characteristics via a nested logit model. Specifically, each asset has a preference score given by

$$\delta_{i,t}(n,l) = \exp(\lambda_l \mu_{i,t}(n,l) + \Lambda_l' x_{i,t}(n) + \epsilon_{i,t}(n,l)), \tag{5}$$

where $\mu_{i,t}(n, l)$ represents the expected excess return relative to investor i's domestic short-term debt in USD, $x_{i,t}(n)$ represents observable characteristics of the issuer that could affect the variance perceived by investors, and $\epsilon_{i,t}(n, l)$ represents investor-specific latent demand. Note that we measure expected excess returns using the analyst forecasts. The observable characteristics include GDP, population, inflation, stock price volatility, sovereign credit rating, physical distance from the investor, an indicator for whether the issuer coincides with the investor to capture home bias, and a constant term.

The preference scores determine the weights in a given issuer conditional on asset class, or the inner nest, via

$$w_{i,t}(n|l) = \frac{\delta_{i,t}(n,l)}{1 + \sum_{m=1}^{N} \delta_{i,t}(m,l)}, \tag{6}$$

Note that the conditional demand for the outside issuer is given by

$$w_{i,t}(0|l) = \frac{1}{1 + \sum_{m=1}^{N} \delta_{i,t}(m,l)}. \tag{7}$$

Additionally, for the outer nest, we compute the weight for each asset class by

$$w_{i,t}(l) = \frac{\left(1 + \sum_{m=1}^{N} \delta_{i,t}(m,l)\right)^{\rho_l} \exp(\alpha_l + \xi_{i,t}(l))}{\sum_{k \in \{S,L,E\}} \left(1 + \sum_{m=1}^{N} \delta_{i,t}(m,k)\right)^{\rho_k} \exp(\alpha_k + \xi_{i,t}(k))}, \tag{8}$$

where the $\rho_l \in [0,1]$ parameters represent substitutability across asset classes, the α_l parameters represent asset class demand shifters that are common across investors, and the $\xi_{i,t}(l)$ parameters represent investor-specific latent demand. Note that we normalize $\alpha_E = 0$ and $\xi_{i,t}(l) = 0$. The inclusive values $1 + \sum_{m=1}^{N} \delta_{i,t}(m,l)$ represent the overall preferences for each asset class as a function of the characteristics of the associated assets. Their impact on the asset class weights depends on the substitutability parameters ρ_l. If $\rho_l = 0$, then investors treat the asset classes as perfect complements and maintain constant shares regardless of the inclusive values. As discussed further in Section 4.1.3, the rebalancer can be represented as an investor with perfect complements preferences. As the ρ_l increase, the asset classes become more substitutable and investors tilt more towards the assets with higher inclusive values.

Finally, we compute the portfolio weights as

$$w_{i,t}(n,l) = w_{i,t}(n|l) w_{i,t}(l). \tag{9}$$

Note that total investment in outside assets is given by $O_{i,t} = A_{i,t} \sum_{l=S,L,E} w_{i,t}(0,l)$, which can be rearranged to write total wealth in terms of outside assets and the portfolio weights as

$$A_{i,t} = \frac{O_{i,t}}{1 - \sum_{l=S,L,E} \sum_{n=1}^{N} w_{i,t}(n,l)}. \tag{10}$$

On the supply side, each country supplies $Q_t(n,l)$ in local currency, which is expressed as face value for debt and book value for equity. The corresponding price level $P_t(n,l)$ represents the ratio of market value to face value or book value. The price level for short-term debt is determined exogenously by the monetary authority. The remaining price levels $P_t(n,L)$ and $P_t(n,E)$ and the exchange rate $E_t(n)$, which is expressed in units of USD to local currency, are determined by the market clearing conditions for each asset (n,l):

$$P_t(n,l)E_t(n)Q_t(n,l) = \sum_{i=1}^{I} A_{i,t} w_{i,t}(n,l) \tag{11}$$

The left hand side multiplies the outstanding supply $Q_t(n,l)$ by the exchange rate $E_t(n)$ to convert to USD, and it multiplies by the ratio of market value to book value or face value $P_t(n,l)$ to convert to market value. The right hand side sums the amount invested in the asset over the investor countries. Similar to Jiang, Richmond, and Zhang (2024), we assume the U.S. adjusts the supply of short-term debt to satisfy its individual market clearing condition.[13] As a result, (11) specifies 3N equations to determine the 2N asset prices for equity and long-term debt, N-1 exchange rates relative to the U.S. dollar, and the supply of U.S. short-term debt. Note that we modify the system slightly to account for shared currencies and currency pegs (see Internet Appendix C for details).

4.1.2 Return expectations shock

Suppose the baseline equilibrium as described in Section 4.1.1 occurs in period $t = 0$. Then, in period $t = 1$, we consider a shock to the expected returns for U.S. equity. We assume the shock is the same for all investors. We allow investor wealth to vary dynamically with realized returns from $t = 0$ to $t = 1$. We assume there are no net flows that could otherwise affect investor wealth. We also keep outside investment constant. As a result, investor

[13] Note that $Q_t(US,S)$ is determined by the exogenous price $P_t(US,S)$ and investor demand $\sum_{i=1}^{I} A_{i,t} w_{i,t}(US,S)$. This is because the exchange rate for the U.S., $E_t(US)$, must equal 1, since we have chosen to express exchange rates relative to the U.S. dollar.

wealth is determined by

$$A_{i,1} = O_{i,0} + \sum_{l \in \{S,L,E\}} \sum_{n=1}^{N} A_{i,0} w_{i,0}(n,l) \frac{P_1(n,l)E_1(n)}{P_0(n,l)E_0(n)}. \tag{12}$$

4.1.3 Rebalancer investor

We consider an alternative scenario in which a fraction of U.S. domestic investment is associated with a rebalancer in both periods $t = 0$ and $t = 1$. That is, we model the rebalancer as existing throughout the scenario under consideration and not as a dynamic shock like the return expectations shock. In the baseline, the rebalancer accounts for 13% of U.S. domestic investment, based on the estimate from Section 2.1. The portfolio weights consist of 60% U.S. equity and 40% U.S. long-term debt, which aligns with the share of equity relative to debt for the baseline set of rebalancers in the Flow of Funds data.[14,15]

4.2 Data for the model estimation

To observe equity price levels, we use Compustat to compute market-to-book ratios at the firm-year level and then aggregate to the country-year level by taking the median. For countries with missing or unreasonably high values above 100, we impute the value based on the median across other countries in the same year.[16] To observe debt price levels, we use data on yields for 10-year and 3-month government bonds from Bloomberg.[17] We use the yields to infer the market value relative to face value for a zero-coupon bond, namely $price = (1 + yield(maturity))^{-maturity}$. We observe end-of-year exchange rates using data provided by the International Monetary Fund (IMF).

To observe expected returns, we use IBES for equity, as detailed in Section 2.2, and we use analyst forecasts from Bloomberg for debt and the exchange rates. We compute the expected return for an exchange rate as the growth from the current value to the forecast

[14]Note that, in all of the rebalancer weight specifications, the rebalancer effectively sets the substitutability parameters ρ_l equal to zero, which corresponds to treating the asset classes as perfect complements. The fractional allocations can then be achieved by adjusting the latent asset class factors $\xi_{reb,t}$. The rebalancer's investment in the U.S. corresponds to adjusting the latent within-class demand factors $\epsilon_{reb,t}(n,l)$.

[15]We show in Section 4.5 that the results are similar if we suppose the rebalancer occupies 13% of total U.S. investment and invests in assets supplied by foreign issuers at the same rate as the aggregate U.S. investment portfolio.

[16]In 2023, the primary year for which we simulate the model, we impute for 5 countries. The results are not materially affected if we instead drop these countries or impute based on the mean.

[17]For a small set of countries in the sample where 3-month yields are not available, we use overnight rates. For a small set of country-years where either yield is not available from Bloomberg, we substitute using the interest rate data from the International Monetary Fund (IMF) International Financial Statistics (IFS) data.

value. We compute the expected return for long-term debt based on a standard first order approximation for the 1-year holding period return: $yield_t(10) - D[E(yield_{t+1}(10)) - yield_t(10)]$, where we use a modified duration of $D = 8.5$ that is plausible for a typical 10-year U.S. bond. For short-term debt, we assume the forecasted annualized return is the same as the current yield since the security matures in less than one year.

To observe outstanding equity levels, we use the market capitalization data from the World Bank World Development Indicators (WDI) and supplement where needed using outstanding level data from the Organization for Economic Development (OECD). To observe outstanding short-term and long-term debt, we use the debt securities data from the Bank for International Settlements (BIS). Note that amounts in the model are book values in local currency. Series that are reported as market values are converted to book values using our price levels data. Series that are reported in U.S. dollars are converted to local currency using our exchange rate data.

To observe investor portfolios, we obtain U.S. foreign investment positions from Form SHC provided by the Treasury. We obtain foreign holdings for all other countries using the Portfolio Investment Positions by Counterpart Economy dataset provided by the IMF, which was formerly called the Coordinated Portfolio Investment Survey (CPIS). We apply the restatement matrices from the Global Capital Allocation Project (GCAP) (Coppola et al. (2021)) to distribute offshore issuances, such as through tax havens, to the respective original issuers.[18] We infer domestic investment by converting levels to market values in U.S. dollars and subtracting out the total amount of investment by other countries. Note that when estimating the nested logit model for the non-rebalancer investors, we compute the weights for the non-rebalancer investor of each country after subtracting out the positions implied by a rebalancer that comprises 13% of the total value of domestic investment and invests in 60% domestic equity and 40% domestic debt.[19]

We obtain issuer country characteristics from various sources. We obtain data on GDP, population, and inflation from the World Bank WDI. To determine stock price volatility, we first compute the market-capitalization-weighted average 1-year realized return for each country-month using the actual values recorded in IBES, then we compute the standard deviation over months in the corresponding country-year. We obtain data on credit ratings

[18]We use restatement matrices based on the "Enhanced Fund Holdings" methodology when the investor is the U.S. or Norway, we use the "Fund Holdings" methodology when the investor is the United Kingdom, Canada, Switzerland, Australia, Sweden, Denmark, or a member of the European Monetary Union, and we use the "Issuance" methodology for other investors.

[19]Note that the estimated 13% share from Section 2.1 was derived for the U.S., and for this purpose we also use it as an approximation for other countries in our sample.

from Capital IQ. We convert the rating to a probability of default using the relationship described in Koijen and Yogo (Forthcoming) and multiply by -1 so that a higher value corresponds to a lower probability of default.[20] We obtain the distance between countries, computed based on the weighted distance between the most populous cities, using the data associated with Mayer and Zignago (2011).

4.3 Model estimation

We estimate the asset demand parameters in a manner largely similar to Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming), except that we use analyst forecasts for expected returns rather predicted values from a regression of realized returns on current price levels.

4.3.1 Asset demand parameters

To estimate the parameters for the asset demand model, we combine equations (5) and (7) to obtain a relationship involving the observed portfolio weights, expected returns, and issuer characteristics:

$$\log\left(\frac{w_{i,t}(n,l)}{w_{i,t}(0,l)}\right) = \log\left(\delta_{i,t}(n,l)\right) = \lambda_l \mu_{i,t}(n,l) + \Lambda_t' x_{i,t}(n) + \epsilon_{i,t}(n,l). \tag{13}$$

Additionally, we combine equation (8) for different asset classes to obtain a relationship between the asset class weights and the inclusive values:

$$\log\left(\frac{w_{i,t}(l)}{w_{i,t}(E)}\right) = \rho_l \log\left(1 + \sum_{n=1}^{N} \delta_{i,t}(n,l)\right) - \rho_E \log\left(1 + \sum_{n=1}^{N} \delta_{i,t}(n,E)\right) + \alpha_l + \xi_{i,t}(l). \tag{14}$$

Equations (13) and (14) suggest that the parameters can be recovered from linear regressions, conditional on exogeneity of the regressors. However, some characteristics could be correlated with the latent demand shifters. For example, an increase in latent demand, such as a change in risk tolerance, could lead to higher portfolio weights and higher prices, which could also affect expected returns and thereby bias the estimate for λ_l. We therefore instrument expected returns using variation in prices driven by plausibly exogenous factors. This instrument is motivated by the observation that predicted returns are negatively

[20] The relationship between rating and estimated probability of default is as follows: AA- and better is 0%, A+ is 1.98%, A is 2.37%, A- is 2.84%, BBB+ is 3.41%, BBB is 4.09%, BBB- is 4.91%, BB+ is 5.89%, 7.07% is BB, 8.48% is BB-, B+ is 10.17%, B is 12.2%, B- is 14.63%, CCC+ is 17.55%, CCC is 21.06%, CCC- is 25.26%, and CC is 30.3%.

correlated with current prices (see Table 2). We also construct analogous instruments for the inclusive values since they partly depend on the expected returns.

To construct the instruments, we first estimate a version of (13) but only including regressors for plausibly exogenous factors, namely the logarithm of population, the logarithm of distance, and an indicator for domestic ownership. Table 3 shows the estimates: portfolio weights tend to be higher when the issuer is larger and closer to, or especially the same as, the investor.

We then determine the predicted $\hat{\delta}_{i,t}$ from this model and compute the implied inclusive values: $1 + \sum_{n=1}^{N} \hat{\delta}_{i,t}(n,l)$. We use these predicted inclusive values as instruments for the inclusive values to estimate (14). Table 4 shows the first stage, which shows that the instrumented inclusive values positively correlate with the observed inclusive values and have a strong F-statistic above 10 for each asset class. Table 5 shows the estimates for the asset class parameters.

Using the estimated $\hat{\rho}_l$ and $\hat{\alpha}_l$ parameters as well as the $\hat{\delta}_{i,t}$, we compute the predicted portfolio weights $\hat{w}_{i,t}(l)$ using equations (6), (8), and (9), namely:

$$\hat{w}_{i,t}(n,l) = \frac{\hat{\delta}_{i,t}(n,l)}{1 + \sum_{m=1}^{N} \hat{\delta}_{i,t}(m,l)} \frac{\left(1 + \sum_{m=1}^{N} \hat{\delta}_{i,t}(m,l)\right)^{\hat{\rho}_l} \exp(\hat{\alpha}_l)}{\sum_{k \in \{S,L,E\}} \left(1 + \sum_{m=1}^{N} \hat{\delta}_{i,t}(m,k)\right)^{\hat{\rho}_k} \exp(\hat{\alpha}_k)} \tag{15}$$

We also compute the predicted investor total assets using equation (10) but with the predicted portfolio weights:

$$\hat{A}_{i,t} = \frac{O_{i,t}}{1 - \sum_{l=S,L,E} \sum_{m=1}^{N} \hat{w}_{i,t}(m,l)}. \tag{16}$$

We then use the market clearing condition (11) to determine the predicted exchange rate and asset prices. In the market clearing condition for short-term debt, we abstract from the price level since it is exogenously determined by the monetary authority. We then obtain the predicted exchange rate from

$$\hat{E}_t(n) = \frac{1}{Q_t(n,S)} \sum_{i=1}^{I} \hat{A}_{i,t} \hat{w}_{i,t}(n,S). \tag{17}$$

Additionally, the market clearing conditions for long-term debt and equity determine the respective prices

$$\hat{P}_t(n,l) = \frac{1}{\hat{E}_t(n)Q_t(n,l)} \sum_{i=1}^{I} \hat{A}_{i,t}\hat{w}_{i,t}(n,l). \tag{18}$$

Finally, we estimate (13) by instrumenting the USD expected excess return with the predicted price and exchange rate, or just the exchange rate in the case of short-term debt. Table 6 shows the first stage estimates, which show that the instrumented prices negatively correlate with expected returns and have a strong F-statistic above 10 for each asset class. Note that an advantage of using a direct measure of expected returns is that we can verify that expected returns are indeed correlated with the instrumented prices. By contrast, many other demand system asset pricing studies in the literature instead represent expected returns using the predicted values from regressing realized returns on current prices, in which case the first stage effectively shows that the instrumented prices correlate with current prices. However, variation in current prices is not sufficient to determine expected returns, which also depend on expected future prices.

Table 7 shows the within-asset class coefficients. The estimates are largely similar to Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming). We find that a 1 percentage point increase in a country's expected equity return results in a 8.8 percent increase in investment in that country compared to outside equity. We find a similar magnitude for long-term debt and a larger magnitude for short-term debt. The controls indicate that investment in a given issuer in most cases increases with GDP, decreases with population, decreases with inflation, decreases with price volatility, decreases with distance from the investor, and increases for domestic investors.

As robustness, Table D.1 and Table D.2 in Internet Appendix D show that the results are similar if, instead of 12-month exchange rate forecasts, we use annualized 24-month exchange rate forecasts, which more accurately predict 12-month returns (Kremens, Martin, and Varela (2025)).

4.3.2 Latent demand factors

We calibrate the baseline scenario at the initial period $t = 0$ to the observed equilibrium in 2023, the last year in our data. In particular, we determine the values of the latent variables $\epsilon_{i,t}(n,l)$ and $\xi_{i,t}(l)$ that are consistent with the observed portfolio weights $w_{i,t}(n,l)$, issuer characteristics $\mu_{i,t}(n,l)$ and $x_{i,t}(n)$, and estimated demand parameters λ_l and Λ_l. Note that Table D.3 in Internet Appendix D lists the countries included in the model.

4.4 Model results

4.4.1 Overview

As an overview, Figure 2 shows the effect of an equity returns expectations shock on U.S. asset prices in settings with and without rebalancers. In the case without a rebalancer, a positive expectations shock leads to an increase in the price of U.S. equity, a milder increase in the price of U.S. long-term debt, and an increase in the price of equity relative to long-term debt. The figure also shows the effects of the expectations shock for settings in which rebalancers comprise either 10% or 20% of U.S. domestic assets, values that straddle the baseline rebalancer size estimate of 13% from Section 2.1.[21] The rebalancer does not shift its portfolio weights in response to the expectations shock. However, the shock still affects the rebalancer via revaluation effects. In particular, the rebalancer experiences an increase in wealth that is disproportionately driven by equity. To maintain its asset allocation ratio, it reallocates to debt, which dampens the increase in the price of equity, amplifies the increase in the price of long-term debt, and, overall, dampens the increase in the price of equity relative to debt. The magnitude of the dampening of the price ratio varies with the sign and size of the shock as well as the size of rebalancers, ranging from about 8% for a negative 4 percentage point shock in a setting where rebalancers comprise 10% of investment to 20% for a positive 4 percentage point shock in a setting where rebalancers comprise 20% of investment.[22]

4.4.2 Decompositions

In this section, we decompose the effect of the expectations shock on the prices of U.S. equity and U.S. long-term debt, as well as the relative price of U.S. equity to U.S. long-term debt, $P_1^k(US,E)/P_1^k(US,L)$. We implement this decomposition in each scenario k corresponding to whether there is a rebalancer ($k = R$) or no rebalancer ($k = NR$). Henceforth, we focus on the baseline estimated rebalancer share of 13% from Section 2.1. Note that this section focuses on a decomposition in an accounting sense, and Section 4.4.3 offers a complementary

[21] See Figure D.2 in Internet Appendix D for an analogous figure focusing on the 13% estimate and a positive shock.

[22] Note that Figure D.3 in Internet Appendix D shows analogous effects for non-U.S. prices and exchange rates. The prices for non-U.S. equity and long-term debt decrease as countries substitute to U.S. equity, but the existence of the U.S. rebalancer also dampens the reduction for non-U.S. equity relative to non-U.S. long-term debt. The shock also leads to a modest decrease in exchange rates. Since the exchange rate is expressed in dollars per foreign currency, this decline corresponds to an appreciation of the dollar. This comovement of equity prices and exchange rates is consistent with existing empirical observations. For example, Camanho, Hau, and Rey (2022) present evidence that equity inflows strengthen exchange rates for the target country.

analysis of the mechanisms by showing how the rebalancer effect varies if we deactivate specific channels such as wealth revaluation or rebalancer trading. Overall, we find that, in the setting without a rebalancer, the shifting of portfolio weights and wealth revaluation each account for a substantial share of the increase in the U.S. equity price, whereas their effects on the long-term debt price counteract each other. The rebalancer's dampening of the price ratio response to the shock is mostly associated with the decline in the substitution across asset classes rather than shifts in wealth from realized returns.

We focus on the growth of each U.S. asset price in response to the expectations shock and how that is affected by the presence of a rebalancer. For each of the prices, we can rearrange the market clearing condition in equation (11) as

$$P_t(US,l) = \frac{1}{Q_t(l)} \sum_{i=1}^{I} A_{i,t} w_{i,t}(US,l), \tag{19}$$

where we use the normalization $E_t(US) = 1$. Note that the amounts issued for equity and long-term debt do not vary with the shock, and recall that the portfolio weights can be written as a product of the within- and across-asset class components, $w_{i,t}(US,l) = w_{i,t}(l) w_{i,t}(US|l)$. We therefore decompose the change in each price from $t = 0$ to $t = 1$ based on the change in wealth, the change in the across-asset class component, and the change in the within-asset class component:

$$\begin{aligned}
\underbrace{\frac{P_1^k(US,l) - P_0^k(US,l)}{P_0^k(US,l)}}_{\Delta P_l} = & \underbrace{\sum_{i=1}^{I} \frac{[A_{i,1} - A_{i,0}] w_{i,1}(l) w_{i,1}(US|l)}{P_0(US,l) Q_0(US,l)}}_{\Delta P_l \text{ wealth component}} \\
& + \underbrace{\sum_{i=1}^{I} \frac{A_{i,0} [w_{i,1}(l) - w_{i,0}(l)] w_{i,1}(US,l)}{P_0(US,l) Q_0(US,l)}}_{\Delta P_l \text{ across-asset class component}} \\
& + \underbrace{\sum_{i=1}^{I} \frac{A_{i,0} w_{i,0}(l) [w_{i,1}(US|l) - w_{i,0}(US|l)]}{P_0(US,l) Q_0(US,l)}}_{\Delta P_l \text{ within-asset class component}}
\end{aligned} \tag{20}$$

Table 8 shows the decomposition of the U.S. equity price, the U.S. long-term debt price, and the relative price of equity to long-term debt in the scenarios with and without a rebalancer. We focus primarily on the results for a 1 percentage point shock shown in Table

8a. We first consider the U.S. equity price. In the setting with the rebalancer, the equity price increases by 8.0% in response to a 1 percentage point shock. The within-asset class component accounts for about 30.9% of this increase, which reflects the direct effect of the shock on the preference scores via equation (6). The across-asset class component accounts for 28.2%, and wealth effects account for the remaining 40.9%.[23] As greater demand for U.S. equity causes the price to increase, wealth shifts towards U.S. investors, since they disproportionately invest in U.S. assets due to home bias. This revaluation coupled with U.S. investors' home bias further increases the demand for U.S. equity. Compared to the counterfactual without the rebalancer, the rebalancer reduces the growth in the price for U.S. equity by 40 points, which is about 4.8% of the growth in the case without a rebalancer. The across- and within- asset class components of the price change decrease since the rebalancer's contribution to each is equal to zero. By contrast, the wealth component increases since the rebalancer reallocates its wealth gain disproportionately more within U.S. assets.

Moving on to the U.S. long-term debt price, the across-asset class component of the shock is negative since investors substitute from debt to equity. However, the wealth component is positive since wealth revaluation favors U.S. investors, who still have a relatively high weight on their domestic debt. Overall, the long-term debt price increases but only by .81 percentage points. The rebalancer increases the growth in the long-term debt price by .52 percentage points compared to the setting without a rebalancer, which amplifies the price growth by 180%. This effect of the rebalancer is driven by both reducing substitution from debt to equity and increasing U.S. investors' gain in wealth.

As an overall summary measure, we can also consider the effect of the rebalancer on the equity to long-term debt price ratio, which is approximately equal to the growth of the price of equity minus the growth in the price of long-term debt, assuming the respective growth rates are small:[24]

$$\frac{P_1^k(US,E)/P_1^k(US,L)}{P_0^k(US,E)/P_0^k(US,L)} - 1 \approx \left(\frac{P_1^k(US,E)}{P_0^k(US,E)} - 1\right) - \left(\frac{P_1^k(US,L)}{P_0^k(US,L)} - 1\right). \quad (21)$$

[23] Table 8b shows that a similar decomposition holds for a larger 4 percentage point expectations shock: the within-asset class component accounts for 27.5%, the across-asset class component accounts for 27.0%, and revaluation of wealth accounts for 45.6%.

[24] This follows from $\frac{a}{b} - 1 \approx \log\left(\frac{a}{b}\right) = \log(a) - \log(b) \approx (a-1) - (b-1)$, assuming $\frac{a}{b}$, a, and b are all near 1. Note also that the exact relative price growth is equal to the approximate relative price growth divided by $\left(\frac{P_{t+1}^k(US,L)}{P_t^k(US,L)}\right)$.

We can similarly express the overall rebalancer effect on the price ratio growth as:

$$\left[\left(\frac{P_1^R(US,E)}{P_0^R(US,E)}-1\right)-\left(\frac{P_1^{NR}(US,E)}{P_0^{NR}(US,E)}-1\right)\right]-\left[\left(\frac{P_1^R(US,L)}{P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,L)}{P_0^{NR}(US,L)}-1\right)\right]. \quad (22)$$

Based on this additive approximation, the price ratio growth for the setting with a rebalancer minus the growth for the setting without a rebalancer is -.009. This additive approximation is convenient for decompositions. For example, the equity component accounts for 43.4% of the total and the long-term debt component accounts for 56.6%. The approximation is also equal to the respective rebalancer effect for each component. In particular, changes in within-asset class substitution amount to 29.9% of the size of the overall difference, changes in across-asset class component amount 74.2%, and changes in the wealth component detract at a rate of 4.2%.

Finally, we can also compare the rebalancer effect with the price ratio growth in the setting without a rebalancer:[25]

$$\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}. \quad (23)$$

We observe that, for a 1 percentage point shock, the rebalancer dampens the growth in the price ratio by 11.8%.

Table 9 shows a decomposition based on the investor, splitting between the U.S. non-rebalancer, the rebalancer, and foreign investors:

$$\begin{aligned}\frac{P_1(US,l)-P_0(US,l)}{P_0(US,l)} &= \underbrace{\frac{A_{nonreb,1}w_{nonreb,1}(US,l)-A_{nonreb,0}w_{nonreb,0}(US,l)}{P_0(US,l)Q_0(US,1)}}_{\text{U.S. non-rebalancer component}} \\ &\quad+\underbrace{\frac{A_{reb,1}w_{reb,1}(US,l)-A_{reb,0}w_{reb,0}(US,l)}{P_0(US,l)Q_0(US,1)}}_{\text{rebalancer component}} \\ &\quad+\underbrace{\frac{\sum_{\text{foreign } i}(A_{i,1}w_{i,1}(US,l)-A_{i,0}w_{i,0}(US,l))}{P_0(US,l)Q_0(US,1)}}_{\text{foreign component}} \quad (24)\end{aligned}$$

[25]Note that here we use the exact expression since we do not consider further decompositions that rely on the convenience of the additive approximation.

In the setting with the rebalancer, 72.4% of the increase in the equity price is associated with the U.S. non-rebalancer, 8.5% is associated with the U.S. rebalancer, and 19.2% is associated foreign investors. Note that the total share of the price increase associated with U.S. investors (80.9%) is comparable to their share of U.S. equities. By contrast, for long-term debt, the rebalancer corresponds to most (63.7%) of the increase since it experiences an increase in wealth while maintaining fixed weights. The U.S. non-rebalancer corresponds to a modest increase of 38.6% due to the conflicting effects of its increase in wealth and substitution away from debt, while foreign investors correspond to a detraction by -2.2% driven by their substitution. The rebalancer has a modest effect on the foreign component of the price effect for either asset class. Table D.4 in Internet Appendix D shows a more detailed breakdown with each investor country. The foreign investors that contribute most to the increase in the equity price include Canada, Germany, the United Kingdom, and Japan. No foreign investor has a significant impact on U.S. long-term debt prices.

4.4.3 Mechanisms

Whereas Section 4.4.2 focuses on an accounting decomposition of the price changes, in this section we instead manipulate various channels one at a time to shed light on the mechanisms driving the rebalancer effect on the equity to long-term debt price ratio. We find that the rebalancer's dampening effect on the increase in the equity-debt price ratio is more strongly driven by its lack of substitution rather than its reallocation of capital gains.

We first assess the importance of the rebalancer's lack of substitution to the shock, which follows from its strict target weights. We consider a variation of the model in which the rebalancer is replaced by a passive investor that allows its portfolio to drift with changing asset values, which is equivalent to deactivating trade for that investor. Table 10 shows that this variation eliminates the dampening associated with the rebalancer. Table D.5 in Internet Appendix D shows a detailed decomposition for this variation of the model for a 1 percentage point shock. The passive investor results in a larger across-asset shift from long-term debt to equity, compared to the setting where the rebalancer maintains its targets (which corresponds to the decomposition in Table 8). It also results in a greater investment of the rebalancer's wealth gain to equity. Figure D.4 in Internet Appendix D further illustrates how prices respond to variable levels of the expectations shock in the case with a passive investor.

To assess the importance of the rebalancer's capital gain, we consider a variation of the model in which wealth remains constant instead of updating based on valuation effects.

Table 10 shows that the reduction in the price ratio slightly increases in magnitude from -.009 to -.01 when using the approximation in equation (21) for the price ratio growth. In other words, wealth revaluation reduces the magnitude of the rebalancer dampening by around 10%, which is comparable to the -4.2% wealth component from the decomposition analysis (shown in Table 8). Intuitively, wealth revaluation mildly reduces the magnitude of the rebalancer dampening due to the following combination (see part (iii) of Proposition 1): first, the rebalancer experiences a relatively large increase in wealth from the shock because of its high weight on U.S. equity; second, it generally has a higher ratio of U.S. equity to U.S. long-term debt than other investors. Figure D.5 further illustrates how prices respond to variable levels of the expectations shock in the case where wealth is held constant, while Table D.6 shows the decomposition for a 1 percentage point shock in this variation of the model.

4.4.4 Application to observed and potential future shocks

In this section, we quantify how rebalancers have transferred recent equity return expectations shocks to debt prices, as well as how they might impact future shocks.

To compute the impact of rebalancers on rescent shocks, we first calibrate the model for each year from 2020 to 2023, which we do by determining the latent demands that are required to match the observed weights conditional on observable characteristics and estimated demand parameters. We then simulate a U.S. equity return expectations shock based on the difference in expected returns compared to the prior year. We find that long-term debt prices grow on average by .92% in the setting with rebalancers and .25% in the setting without rebalancers, resulting in a difference of .67% associated with rebalancers. Assuming a typical modified duration of around 8.5 years for a typical 10-year U.S. Treasury, this corresponds to about 8 basis point average greater reduction in the yield. Figure 5 shows the growth of the long-term debt price associated with the change in expected returns in each year for each scenario. The largest change occurred in 2021, which exhibted a 8.3 percentage point increase in equity return expectations. We find that long-term debt prices grow by 9.8% in the setting with rebalancers and 3.2% in the setting without rebalancers, resulting in a difference of 6.6%, which corresponds to about a 78 basis point greater reduction in yields.

Rebalancers led to an increase in debt prices during this timeframe since changes in equity expectations were positive on average. However, we can also examine how debt prices would change in response to potential future declines in equity return expectations due to, for example, a loss of confidence in artificial intellgience technology or in U.S. exceptionalism. For example, if equity return expectations decrease by 10 percentage points, then rebalancers would amplify the decline of long-term debt prices from 2.4% to 5.85% (see Figure D.6 in Internet Appendix D), which corresponds to about a 41 basis point greater increase in yields.

4.5 Robustness and extensions

4.5.1 Variations over the model simulation parameters

In this section, we show that the rebalancer's dampening of the equity to long-term debt price ratio in response to equity expectations shocks increases with the non-rebalancers' demand elasticities and the size of the rebalancer. We also show how it varies with the rebalancer portfolio targets and the year used to simulate the shock.

Non-rebalancers' sensitivity to expected returns Figure 3a shows that the magnitude of the dampening associated with the rebalancer increases with the non-rebalancers' sensitivity to the expectations shock, λ_E. As the sensitivity increases, the non-rebalancers shift their weights more in response to shock, which accentuates the contrast from the rebalancer's fixed weights. The rebalancer dampening depends on the sensitivity somewhat mildly. Halving the sensitivity relative to the estimated value reduces the rebalancer effect for a 1 percentage point shock to 11.6% (see Figure D.7 in Internet Appendix D for further details in that setting),[26] while doubling the sensitivity increases the rebalancer effect to about 12.2%.[27]

Non-rebalancers' substitutability of asset classes Figure 3c shows that the magnitude of the rebalancer dampening increases with the sensitivity of equity investment to characteris-

[26]While the absolute magnitude of the shock vanishes as the sensitivity approaches zero (see Figure 3b), the fractional reduction of this effect due to the rebalancer is bounded below by about 11.5%.

[27]The asset demand system approach in the style of Koijen and Yogo (2019) has been subject to some criticisms (He, Kondor, and Li (2025), Fuchs, Fukuda, and Neuhann (2025), van Binsbergen, David, and Opp (2025)). Many of these criticisms argue that the approach under-estimates demand elasticities. However, our result in Figure 3 shows that under-estimating the elasticity would provide a lower bound on the rebalancer effect. In addition to that observation, these critiques are otherwise mitigated in our paper because we do not use residual supply shocks to estimate demand (He, Kondor, and Li (2025)), we focus on assets with relatively limited substitutability (Fuchs, Fukuda, and Neuhann (2025)), and we verify the relationship between our price instruments and a direct measure of expected returns (van Binsbergen, David, and Opp (2025)). Additionally, conditional on using a logit demand model, the identifcation assumptions discussed in Haddad et al. (2025) are satisfied.

tics, ρ_E.[28] On the one hand, the rebalancer effect is stronger in a scenario in which the asset classes are perfect substitutes, which corresponds to setting the ρ_I parameters equal to 1 and is illustrated in more detail in Figure D.8 in Internet Appendix D. In the case of perfect substitutes, the expectations shock causes a greater increase in the demand for U.S. equity since investors tilt their portfolios more towards the equity asset class, which accentuates the rebalancer's lack of substitution. On the other hand, Figure D.9 shows that the effect of the expectations shock becomes weaker in a scenario in which the asset classes are perfect complements, which corresponds to setting the ρ_I parameters equal to 0. Since no investors shift across assets, the part of the rebalancer effect associated with dampening across-asset shifts becomes immaterial. Overall, the rebalancer effect also depends on ρ_E somewhat mildly, decreasing by only about .8 percentage points at half of the estimated value.

Rebalancer size Based on Figure 2, which shows the rebalancer effect for different shock magnitudes when the rebalancer share is 10% or 20%, the rebalancer effect increases in magnitude at a rate varying from .33 percentage points per percentage point increase in the shock for a rebalancer share of 10% to .60 percentage points for a rebalancer share of 20%. Figure D.10 in Internet Appendix D additionally shows the rebalancer effect associated with a 1 percentage point shock for a wider set of rebalancer sizes. The rebalancer effect increases in magnitude at a rate varying from .92 percentage points per percentage point increase in the rebalancer share when the rebalancer share is near zero to .79 percentage points when the rebalancer share is as large as 50%. Specifically focusing on the rebalancer share estimates from Section 2.1, we observe that the rebalancer dampening for a 1 percentage point shock is 11.8% for a rebalancer share of 13%, 7.3% for a rebalancer share of 8% (see Figure D.11 in Internet Appendix D for further details), and 5.5% for a rebalancer share of 6% (see Figure D.12 for further details). Doubling the rebalancer share from the baseline of 13% increases the rebalancer effect on the price ratio by 1.95 (11.8% to 23.1%).

Rebalancer equity share Figure 4a shows that the magnitude of the rebalancer effect is concave in the equity share of the rebalancer's portfolio, with the greatest magnitude occurring at around 50%. On the one hand, if the equity share is low, then the rebalancer experiences a smaller capital gain from the shock to equity return expectations. On the other hand, if the equity share is high, then it does not reallocate as much of its capital gain towards debt. These results are consistent with quadratic expression for the amount of

[28] Note that the rebalancer effect associated with an equity returns expectations shock does not depend on ρ_L or ρ_S since the shock does not affect the inclusive value for either type of debt.

rebalancing as a function of the equity share in Parker, Schoar, and Sun (2023). We further illustrate the effects of the wealth revaluation by showing analogous results for the fixed wealth variation. The small effect from wealth revaluation observed in Section 4.4.3 partly reflects the fact that rebalancers have a similar ratio of U.S. equity to U.S. long-term debt as other investors. However, wealth effects can be greater if there is a larger discrepancy compared to other investors, such as if rebalancers are highly concentrated in either equity or debt.

Rebalancer long-term versus short-term debt share Figure 4b shows that the rebalancer effect decreases in magnitude with the share of short-term debt within total debt. This smaller effect reflects the fact that the rebalancer does not shift as much of its investment gains to long-term debt. The rebalancer also does not affect the price for short-term debt, which is determined independently by the monetary authority. The rebalancer therefore has a smaller effect on the ratio of equity to a value-weighted average price of debt. Instead, it results in a slightly steeper appreciation of the dollar (see Figure 4c).[29] Figure D.13 in Internet Appendix D shows more detail for the case where the rebalancer has a portfolio consisting of 60% equity, 32% long-term debt, and 8% short-term debt. In that case, the rebalancer effect on the equity to long-term debt ratio for a 1 percentage point shock decreases slightly to 10.6%. However, the rebalancer steepens the dollar appreciation by a factor of more than two.

Rebalancer foreign investments In our baseline model, the rebalancer corresponds to a fraction of U.S. domestic investment. Figure D.14 in Internet Appendix D relaxes this assumption by calibrating the rebalancer share as a fraction of total U.S. investment and showing how the rebalancer effect on the price ratio of equity to debt varies with the share of its portfolio consisting of foreign assets. In particular, for each asset class, we compute the conditional distribution of U.S. investments in other countries in the scenario without a rebalancer, then multiply it by the specified foreign share to obtain the rebalancer share in each foreign country. The rebalancer effect with zero foreign share is larger than in the baseline model since the rebalancer is a share of total (rather than domestic) investment. It also diminishes with the foreign share, as the rebalancer exhibits a smaller wealth gain from

[29] The steeper appreciation of the dollar follows from the fact that the rebalancer invests some of its capital gains in U.S. short-term debt, which does not appreciate in value since the price is determined exogenously. As a result, there is overall less increase in wealth from capital gains, which results in less investment in non-U.S. short-term debt, resulting in lower exchange rates compared to the baseline scenario where it does not invest in short-term debt.

the shock to U.S. equity and shifts some of its increased wealth to foreign assets instead of only U.S. long-term debt. Note that in the baseline scenario the U.S. invests about 13% of its portfolio in foreign assets.[30] Figure D.15 shows in more detail how prices vary with the expectations shock in the case where the rebalancer's foreign share is equal to this 13%. In that case, the rebalancer effect for a 1 percentage point expectations shock is about 12.1%, which is close to the effect from the baseline model of 11.8%. Table D.7 shows the associated decomposition table.

Including foreign rebalancers The estimates from Section 2.1 focus on U.S. domestic investors, which likely underestimates the total effect of rebalancers on U.S. issued assets since some of these assets are held by foreign rebalancers. We estimate the fraction of U.S. assets held by foreign rebalancers based on the data collected by Du and Huber (2025). Within foreign holdings of U.S. debt and equity as of 2020, about 6% were held by insurance companies and 7% by pensions (see their Figure 4), which are relatively likely investors to implement rebalancing. As a result, about 13% of foreign-held U.S. equity and debt are estimated to be held by foreign rebalancers.

Figure D.16 in Internet Appendix D shows the rebalancer effects on the prices and price ratio if, in addition to the domestic rebalancer, we associate 13% of each foreign country's investment in the U.S. with a rebalancer that invests 60% in U.S. equity and 40% in U.S. debt. We observe that foreign rebalancers increase the magnitude of the rebalancer dampening for a 1 percentage point shock to about 13.5%.

Simulation year Figure D.17 in Internet Appendix D shows that the rebalancer has a similar effect on the price ratio of equity to debt if we simulate the return expectations shock for years other than 2023. The effect of the expectations shock varies across years due to changes in the supply of the assets, investor wealth, and the observable and unobservable characteristics determining the portfolio weights. However, the parameters mapping the observable characteristics to the weights, including the sensitivity to return expectations λ_l, the asset class preferences α_l, and substitutability parameters ρ_l, are held constant since we estimate them by pooling over multiple years. Note that for this exercise we also hold the rebalancer share constant at 13%.

[30] Using Table D.3, we obtain ((1-.9721)*6819 + (1-.9074)*43694+ (1-.8139)*49293)/(6819 +43694+49293)) = .13.

4.5.2 Variations over alternative shocks

In this section, we show that rebalancers have a similar dampening effect on other types of shocks, such as equity expectations shocks affecting other countries and long-term debt expectations shocks. These results illustrate the broader effects of rebalancers on the transmission of shocks across assets.[31]

Effect of equity expectations shocks of other countries on U.S. prices Figure D.18 in Internet Appendix D illustrates the effect of the U.S. rebalancer on the response of U.S. prices to analogous expected equity return shocks affecting other countries with significant U.S. asset holdings, including Canada, the United Kingdom, Germany, and Japan. In each case, the foreign shock causes a reduction in U.S. equity prices as investors substitute towards the positively affected issuer. However, the presence of a U.S. rebalancer mitigates this substitution, which decreases the change in the equity to debt price ratio by around 7.5% to 9% for a 1 percentage point shock in each of these countries.

Effect of equity expectations shocks of other countries on domestic prices Figure D.19 in Internet Appendix D illustrates the effect of a domestic rebalancer on domestic prices when a return expectations shock occurs for each of the other countries. For example, Figure D.19a shows how Canadian prices vary in response to a positive return expectations shock affecting Canadian equity, with or without a Canadian rebalancer. In each case, we find that the rebalancer dampens the increase in the relative price of equity to long-term debt from a 1 percentage point shock by a similar amount as for the U.S., ranging from 7.5% for Germany to 12.8% for Japan.

Shock to long-term debt expectations Figure D.20 in Internet Appendix D shows how a U.S. rebalancer affects the response of U.S. prices to an expectations shock for U.S. long-term debt, rather than equity. The rebalancer decreases the effect of the shock on long-term debt prices and causes an increase in equity prices, dampening the negative effect of the shock on the price of equity relative to debt by 8.3% to 10% depending on the size of the shock.

[31] Note that we could also simulate combinations of shocks that could be used to represent more complex scenarios or policy instruments, such as monetary policy. For example, Lu and Wu (2025) examine how rebalancers interact with monetary policy based on cross-sectional differences across stocks. Further extensions of the model could also include additional asset classes, such as real estate. For example, Bosshardt et al. (2024) discuss a monetary transmission channel through housing markets, in which changes in house prices and the availability of mortgages could also affect investment in equity and debt securities.

5 Conclusion

We quantify the extent to which rebalancers transmit shocks across assets. We build on the global portfolio allocation models in Jiang, Richmond, and Zhang (2024) and Koijen and Yogo (Forthcoming) by adding a rebalancer that maintains fixed portfolio weights. Portfolio weights for investors other than the rebalancer are determined based on a nested logit model, with the inner component corresponding to investment in an issuer conditional on an asset class and the outer component corresponding to unconditional investment in the asset classes. These components depend on each asset's expected returns and various issuer characteristics that affect the perceived volatility. We estimate the model using expected returns based on analyst forecasts, which, compared to using a projection of realized returns as a function of current prices, sidesteps relying on a generally underdetermined relationship between variation in current prices and expected returns. We show that forecasted returns generally have a higher mean compared to realized returns due failing to predict negative returns. Also, they tend to overestimate less for the U.S. compared to other countries. We estimate the model by instrumenting forecasted returns with predicted price variation generated by plausibly exogenous factors, such as issuer population and the distance between countries.

We use the model to simulate a shock to U.S. equity return expectations. A positive shock increases the price of U.S. equity relative to U.S. long-term debt, but this effect is 12% to 13% smaller compared to a counterfactual setting without a rebalancer. This reduction reflects rebalancers both dampening the effect on equity prices and amplifying the effect on debt prices. Applying the model to observed past shocks, we find that rebalancers transmitted the 8.3 percentage point increase in equity return expectations in 2021 to a 78 basis point greater reduction in yields. By contrast, they would transmit a potential future 10 percentage point reduction in equity return expectations to a 41 basis point greater increase in yields. These price effects scale nearly linearly as the share of rebalancers changes over time. These examples highlights how they translate stock market developments to the cost of government borrowing.

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6 Figures

Figure 1: Expected and realized equity returns

This figure shows the median expected equity return and median realized return for each month in 2004-2023, obtained by taking a USD-market cap weighted average over all firms in the IBES sample.

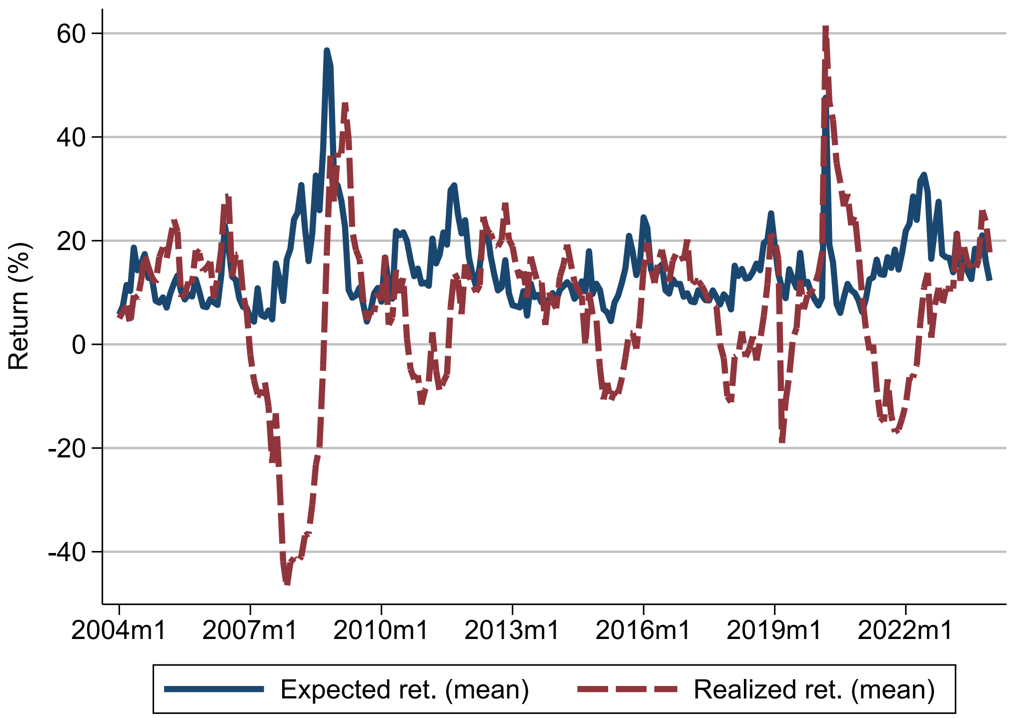


Figure 2: Effect of expectations shock on asset prices with and without a rebalancer

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or

$$\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}.$$

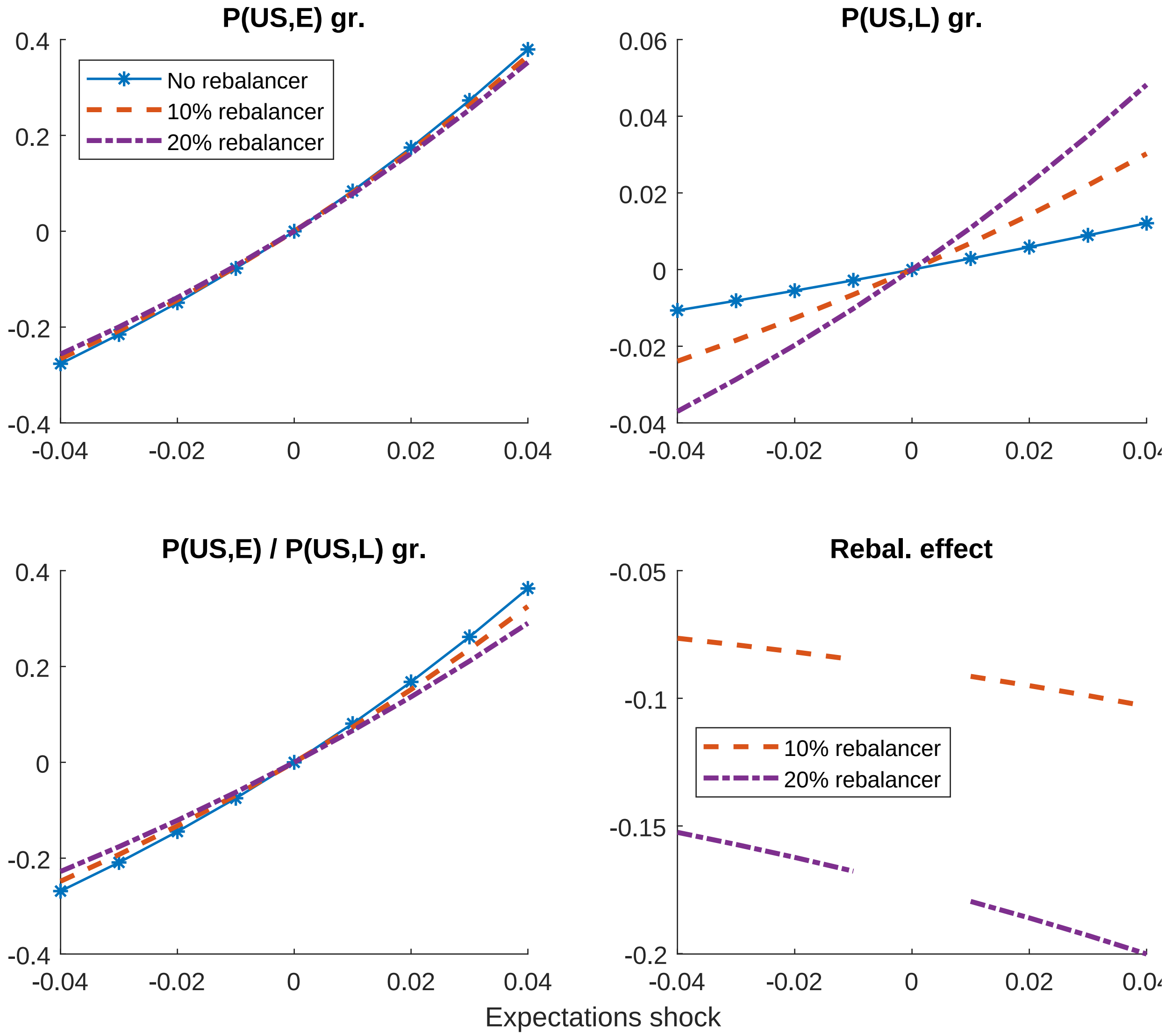
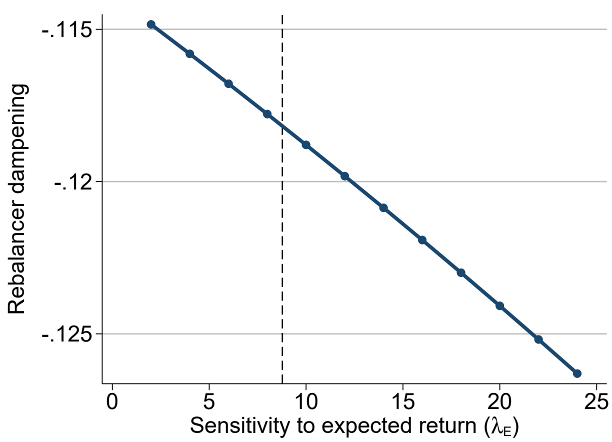


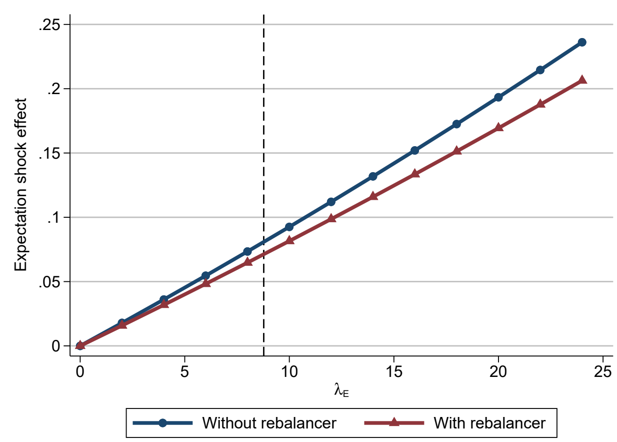
Figure 3: Effect of expectations shock on asset prices with and without a rebalancer: vary non-rebalancer sensitivities

Figure 3a shows how the rebalancer effect for a 1 percentage point U.S. equity return expectations shock varies with the sensitivity to the equity expected return, λ_E. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. The dashed line indicates the estimated λ_E. Figure 3b shows the price ratio growth in each setting separately, or $\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1$ and $\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1$. Figure 3c hows how the rebalancer effect varies with the sensitivity of the asset class weights to characteristics, ρ_E, while Figure 3d shows the price ratio growth in each setting separately.

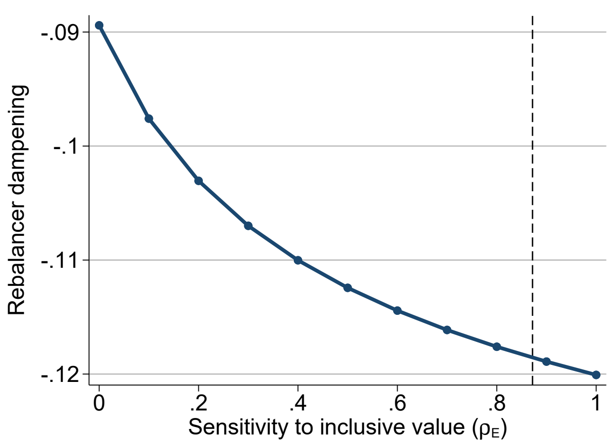
(a) Rebalancer effect on λ_E



(b) Price ratio growth on λ_E



(c) Rebalancer effect on ρ_E



(d) Price ratio growth on ρ_E

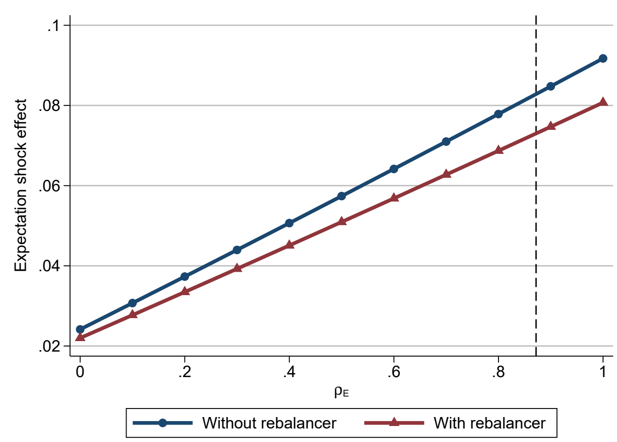
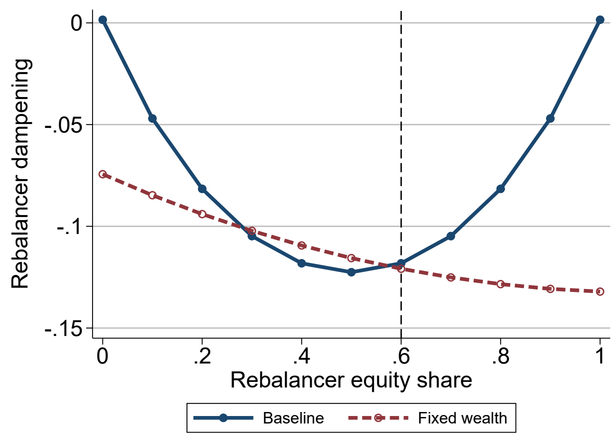


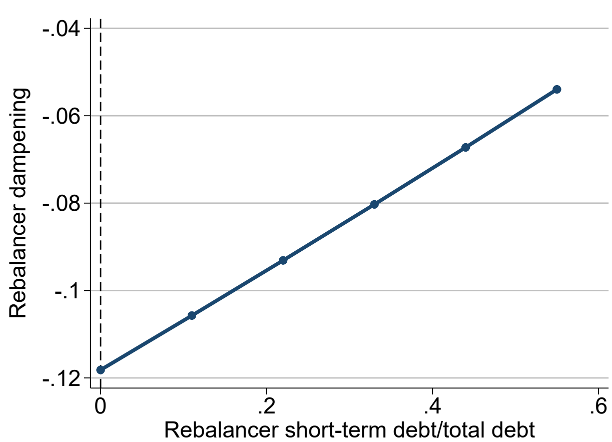
Figure 4: Effect of expectations shock on asset prices with and without a rebalancer: vary rebalancer portfolio weights

Figure 4a shows how the rebalancer effect in response to a 1 percentage point shock varies with the share of equity in the rebalancer's portfolio. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. Figure 4b shows how the rebalancer effect varies with the share of short-term debt within total debt, holding the total debt share fixed at 40%. Figure 4c is similar except focusing on the weighted average exchange rate for non-U.S. countries, expressed in U.S. dollars to local currency and with weights determined by the total value of all outstanding amounts. The dashed lines indicate baseline values.

(a) Rebalancer effect on equity ratio



(b) Rebalancer effect (for equity-debt price ratio) on short-term debt ratio



(c) Rebalancer effect (for exchange rate) on short-term debt ratio

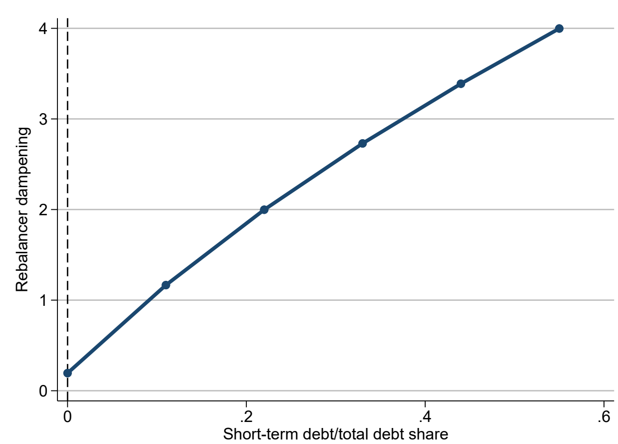
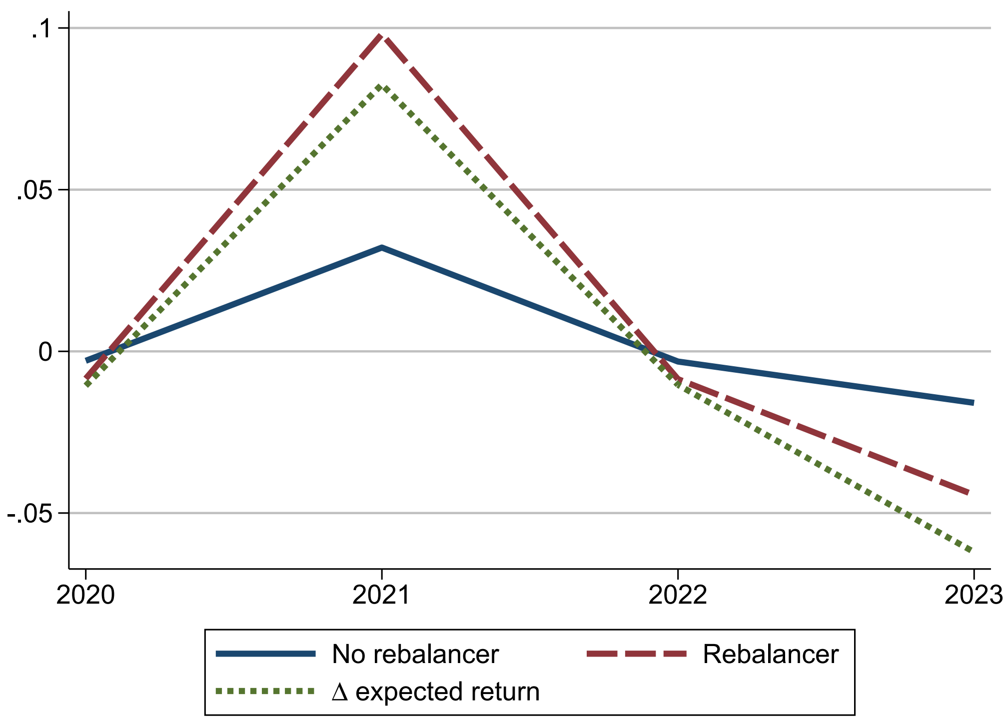


Figure 5: Effect of expectations shock on long-term debt prices with and without a rebalancer

This figure shows the growth in the U.S. long-term debt price induced by a U.S. equity return expectations shock with magnitude corresponding to the yearly difference in observed return expectations, as well as the corresponding difference in return expectations.



7 Tables

Table 1: Expected and realized equity returns

Country	Med. num. firms	Med. exp. ret.	Med. real. ret.	Exp. minus real.
Australia	453	6.47	4.69	1.78
Austria	42	10.33	5.54	4.80
Belgium	72	8.45	7.78	0.66
Brazil	138	20.19	6.96	13.23
Canada	637	13.33	5.85	7.48
China	787	17.55	3.37	14.18
Denmark	55	7.88	16.60	–8.72
Finland	96	7.32	5.86	1.46
France	336	10.32	9.26	1.06
Germany	348	10.98	9.41	1.57
Hong Kong	342	14.00	1.59	12.41
India	486	10.16	11.98	–1.81
Israel	33	12.81	3.91	8.90
Italy	164	11.94	8.57	3.36
Japan	809	13.34	6.18	7.16
Malaysia	237	8.68	1.94	6.74
Mexico	61	10.88	4.80	6.08
Netherlands	86	9.85	9.44	0.41
New Zealand	66	4.81	6.25	–1.44
Norway	136	11.64	5.55	6.09
Philippines	58	11.15	7.41	3.74
Poland	83	5.21	7.45	–2.24
Portugal	20	14.98	4.34	10.64
Singapore	144	11.37	4.32	7.06
South Africa	118	10.08	2.97	7.12
South Korea	282	25.05	4.73	20.32
Spain	93	10.62	5.64	4.99
Sweden	185	6.25	9.05	–2.81
Switzerland	141	9.47	4.14	5.33
Thailand	179	13.28	5.31	7.97
United Kingdom	710	11.26	1.07	10.19
United States	3,272	12.95	10.27	2.68

Note: This table shows the median expected return, the median realized return, and the difference for each country over the period 2004-2023.

Table 2: Expected returns, realized returns, and current asset prices

	(1) Forecast	(2) Realized
Log asset price	-0.053***	-0.116***
	(-5.02)	(-4.74)
Log real exchange rate	-0.089***	-0.379***
	(-3.05)	(-5.56)
Observations	594	594
R^2	0.246	0.113
Country FE	Yes	Yes

Note: This table examines the relationship between current prices and forecasted and realized returns at the country-year level. Column (1) regresses the expected return of equity on the logarithm of the current equity price (which is represented by aggregating market-to-book ratios), the real exchange rate, and country fixed effects. Column (2) is similar except the dependent variable is realized returns. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 3: Portfolio weights and exogenous characteristics

	(1) S	(2) L	(3) E
Log population	0.651***	0.527***	0.679***
	(42.80)	(46.01)	(59.06)
Log distance	-1.304***	-1.136***	-1.146***
	(-50.66)	(-58.46)	(-58.87)
Domestic ownership	5.367***	3.916***	4.572***
	(31.38)	(30.52)	(38.64)
Observations	27,209	27,209	27,357
R^2	0.353	0.393	0.402
Investor FE	Yes	Yes	Yes

Note: This table shows the estimates from regressing equation (13) but restricted to plausibly exogenous regressors. Column (1) regresses the logarithm of the portfolio weight of a given investor in a given issuer's short-term debt in a given year divided by the investor's portfolio weight in outside short-term debt on the logarithm of the issuer's population, the logarithm of the distance between the issuer and investor, and an indicator for when the investor is the same as the issuer. Column (2) is similar except for long-term debt. Column (3) is similar except for equity. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 4: Across asset-class parameters: first stage

	(1) Inc. val(S)	(2) Inc. val(L)	(3) Inc. val(E)
Inc. val(S) instrument	0.400***	-0.060***	-0.321***
	(7.69)	(-4.24)	(-6.00)
Inc. val(L) instrument	0.035**	0.580***	-0.389***
	(2.13)	(7.17)	(-4.25)
Inc. val(E) instrument	-0.061**	0.194***	0.930***
	(-2.15)	(4.45)	(10.35)
1(S)	3.171***	-0.547***	1.848***
	(15.41)	(-4.44)	(8.16)
1(L)	0.148**	0.900***	1.707***
	(2.14)	(2.88)	(4.82)
Observations	1,479	1,479	1,479
R^2	0.730	0.641	0.777
F-statistic	20.01	17.20	39.68

Note: This table shows the estimates from the first stage of regressing equation (14). We arrange the data so that it is investor-year-maturity-level, where maturity refers to the maturity of debt (short or long). Equity characteristics are repeated for both debt maturities. Column (1) regresses the logarithm of the inclusive value of short-term debt on the logarithm of the inclusive value for short-term debt, the inclusive value for long-term debt, the logarithm of the inclusive value for equity instrument, an indicator for short-term debt, and an indicator for long-term debt. Note that there is no constant term. Column (2) is similar except the dependent variable is the logarithm of the inclusive value for long-term debt. Column (3) is similar except the dependent variable is the logarithm of the inclusive value for equity. The F-statistic from testing the joint significance of the instruments is shown below each column. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 5: Across-asset class parameters

Variable	Symbol	Estimate
Log outside portfolio weight:		
Short-term debt	ρ_S	0.62***
		(5.96)
Long-term debt	ρ_L	0.86***
		(17.58)
Equity	ρ_E	0.84***
		(18.13)
Indicator variables:		
Short-term debt	α_S	–2.58***
		(–5.19)
Long-term debt	α_L	0.04
		(0.21)
Observations		1,479

Note: This table shows the estimates from regressing equation (14). We arrange the data so that it is investor-year-maturity-level, where maturity refers to the maturity of debt (short or long). Equity characteristics are repeated for both debt maturities. We regress the logarithm of the asset class weight on the given debt type divided by the asset class weight on equity on a constant (which determines α_S), an indicator for when the debt type is long-term debt (which determines α_L), the logarithm of the inclusive value of the debt type and its interaction with the indicator for long-term debt (which determine ρ_S and ρ_L), and the negative of the inclusive value equity (which determines ρ_E). We instrument the inclusive values using the predicted inclusive values based on plausibly exogenous factors as described in Section 4.3.1. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 6: Within-asset class parameters: first stage

	(1) S	(2) L	(3) E
Log ex. rate instrument	-0.002***	-0.003***	-0.005***
	(-16.03)	(-11.76)	(-15.24)
Log price instrument		-0.006***	-0.009***
		(-10.63)	(-17.90)
Log GDP	-0.012***	0.008***	0.030***
	(-13.04)	(5.88)	(14.71)
Log population	0.014***	-0.005***	-0.020***
	(17.15)	(-4.51)	(-10.99)
Inflation	0.007***	0.010***	-0.003***
	(35.86)	(35.59)	(-7.07)
Volatility	0.038***	0.029***	0.041***
	(9.84)	(5.49)	(4.86)
Rating	0.000*	-0.006***	-0.008***
	(1.94)	(-18.23)	(-15.40)
Log distance	0.004***	0.003***	-0.001
	(10.86)	(5.81)	(-0.75)
Domestic ownership	0.011***	0.008**	0.001
	(4.75)	(2.44)	(0.27)
Observations	20,081	14,844	20,976
R^2	0.436	0.451	0.444
Investor FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
F-statistic	256.81	76.10	170.21

Note: This table shows the estimates from the first stage of regressing equation (13). Column (1) regresses the logarithm of the portfolio weight of a given investor in a given issuer's short-term debt in a given year divided by the investor's portfolio weight in outside short-term debt on expected excess returns and issuer characteristics. Column (2) is similar except for long-term debt. Column (3) is similar except for equity. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 7: Within-asset class parameters

	(1) S	(2) L	(3) E
Expected return	25.055***	15.457***	8.776***
	(5.06)	(4.10)	(6.76)
Log GDP	3.661***	2.593***	2.731***
	(36.18)	(46.78)	(56.20)
Log population	-2.200***	-1.481***	-1.410***
	(-21.12)	(-30.36)	(-35.15)
Inflation	-0.164***	-0.107***	0.119***
	(-4.48)	(-2.89)	(11.43)
Volatility	-1.720***	-0.939***	-0.025
	(-4.88)	(-3.48)	(-0.12)
Rating	-0.120***	-0.000	0.091***
	(-6.28)	(-0.02)	(5.77)
Log distance	-1.347***	-0.985***	-0.947***
	(-35.56)	(-38.39)	(-53.62)
Domestic ownership	4.671***	4.034***	4.491***
	(24.74)	(27.33)	(41.70)
Observations	20,081	14,844	20,976
R^2	0.272	0.360	0.449
Investor FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: This table shows the estimates from regressing equation (13). Column (1) regresses the logarithm of the portfolio weight of a given investor in a given issuer's short-term debt in a given year divided by the investor's portfolio weight in outside short-term debt on expected excess returns and issuer characteristics. Expected excess returns are instrumented with predicted variation in prices and exchange rates due to plausibly exogenous factors as described in Section 4.3.1. Column (2) is similar except for long-term debt. Column (3) is similar except for equity. The F-statistic from testing the joint significance of the instruments is shown below each column. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table 8: Decomposition by channel of expectations shock with and without a rebalancer

(a) Small expectations shock

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.033	0.409	0.030	0.003	0.088	–0.286
ΔP_E across	0.023	0.282	0.026	–0.004	–0.147	0.420
ΔP_E within	0.025	0.309	0.027	–0.003	–0.100	0.299
ΔP_E total	0.080	1.000	0.084	–0.004	–0.048	0.434
ΔP_L wealth	0.032	4.002	0.030	0.002	0.075	–0.244
ΔP_L across	–0.024	–3.002	–0.027	0.003	–0.109	–0.322
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	0.008	1.000	0.003	0.005	1.803	–0.566
$\Delta P_E - \Delta P_L$	0.072		0.081	–0.009	–0.114	1.000
$\Delta(P_E/P_L)$	0.071		0.081	–0.010	–0.118	1.037
ΔP_E - ΔP_L wealth	0.000		–0.000	0.000	0.013	–0.042
ΔP_E - ΔP_L across	0.047		0.054	–0.007	–0.038	0.742
ΔP_E - ΔP_L within	0.025		0.027	–0.003		0.299

(b) Large expectations shock

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.165	0.456	0.155	0.009	0.060	–0.225
ΔP_E across	0.097	0.270	0.114	–0.017	–0.145	0.401
ΔP_E within	0.099	0.275	0.110	–0.011	–0.096	0.255
ΔP_E total	0.362	1.000	0.379	–0.018	–0.047	0.431
ΔP_L wealth	0.135	3.792	0.124	0.011	0.092	–0.276
ΔP_L across	–0.099	–2.792	–0.112	0.012	–0.108	–0.292
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	0.036	1.000	0.012	0.024	1.945	–0.569
$\Delta P_E - \Delta P_L$	0.326		0.367	–0.041	–0.113	1.000
$\Delta(P_E/P_L)$	0.315		0.363	–0.048	–0.133	1.165
ΔP_E - ΔP_L wealth	0.030		0.032	–0.002	–0.033	0.052
ΔP_E - ΔP_L across	0.197		0.226	–0.029	–0.037	0.693
ΔP_E - ΔP_L within	0.099		0.110	–0.011		0.255

Note: Table 8a shows a decomposition, based on equation (20), of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock. The first column refers to the setting with a rebalancer, the second column shows the magnitude of each component relative to the total price growth, the third column refers to the setting with no rebalancer, the fourth column shows the absolute difference of the rebalancer case minus the non-rebalancer case, the fifth column shows the growth compared to the non-rebalancer case, and the sixth column shows the difference of each component relative to the difference in the price growth measured using the approximation $\Delta P_E - \Delta P_L$. Table 8b is similar except for a 4 percentage point shock.

Table 9: Decomposition by investor of expectations shock with and without a rebalancer

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E US non-reb.	0.058	0.724	0.068	–0.010	–0.147	1.082
ΔP_E US reb.	0.007	0.085	0.000	0.007		–0.738
ΔP_E foreign	0.015	0.192	0.016	–0.001	–0.051	0.089
ΔP_E total	0.080	1.000	0.084	–0.004	–0.048	0.434
ΔP_L US non-reb.	0.003	0.386	0.003	0.000	0.022	–0.007
ΔP_L US reb.	0.005	0.637	0.000	0.005		–0.560
ΔP_L foreign	–0.000	–0.022	–0.000	–0.000	0.089	0.002
ΔP_L total	0.008	1.000	0.003	0.005	1.803	–0.566
$\Delta P_E - \Delta P_L$	0.072		0.081	–0.009	–0.114	1.000
$\Delta(P_E/P_L)$	0.071		0.081	–0.010	–0.118	1.037
ΔP_E - ΔP_L non-reb.	0.055		0.065	–0.010	–0.169	1.090
ΔP_E - ΔP_L reb.	0.015		0.016	–0.001	–0.139	0.087
ΔP_E - ΔP_L foreign	0.002		0.000	0.002		–0.177

Note: This table shows a decomposition, based on equation (24), of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock. The first column refers to the setting with a rebalancer, the second column shows the magnitude of each component relative to the total price growth, the third column refers to the setting with no rebalancer, the fourth column shows the absolute difference of the rebalancer case minus the non-rebalancer case, the fifth column shows the growth compared to the non-rebalancer case, and the sixth column shows the difference of each component relative to the difference in the price growth measured using the approximation $\Delta P_E - \Delta P_L$.

Table 10: Mechanisms

(a) Small expectations shock

		R - NR
$\Delta P_E - \Delta P_L$	Baseline	–0.009
$\Delta P_E - \Delta P_L$	Passive investor	0.000
$\Delta P_E - \Delta P_L$	Fixed wealth	–0.010

(b) Large expectations shock

		R - NR
$\Delta P_E - \Delta P_L$	Baseline	–0.041
$\Delta P_E - \Delta P_L$	Passive investor	0.001
$\Delta P_E - \Delta P_L$	Fixed wealth	–0.039

Note: Table 10a shows the dampening effect of the rebalancer associated with a 1 percentage point equity expectations shock in the baseline model, a version where the rebalancer is replaced by a passive investor that drifts with changing asset values, and a version where we keep wealth constant and instead of allowing it to be revalued by changes in prices. Table 10b is similar except for a 4 percentage point equity expectations shock.

Internet appendix

This Internet Appendix contains the following supplemental material:

1. Figure A.1 shows a scatterplot of the median expected return and median realized return for countries in our sample.
2. Table D.1 shows the first stage for the within asset-class parameters except using annualized 24-month exchange rate return expectations instead of 12-month.
3. Table D.2 shows the estimates for the within asset-class parameters except using annualized 24-month exchange rate return expectations instead of 12-month.
4. Table D.3 lists the countries in the sample with information about each country's outstanding amounts and investment for each asset class.
5. Figure D.2 shows the effects of the expectations shock with and without a rebalancer where we focus on just a 13% rebalancer share and restrict to positive shocks.
6. Figure D.3 shows the effects of the expectations shock with and without a rebalancer on non-U.S. prices.
7. Table D.4 decomposes the expectations shock with and without a rebalancer based on the contribution from each investor country.
8. Figure D.4 shows the effects of the expectations shock with and without a rebalancer in a variation where the rebalancer does not actually rebalance.
9. Figure D.5 shows the effects of the expectations shock with and without a rebalancer in a variation where the price for U.S. short-term debt varies and investor wealth is held fixed.
10. Figure D.6 shows the effects of the expectations shock with and without a rebalancer for a large set of expectations shocks.
11. Table D.5 decomposes the expectations shock with and without a rebalancer in a variation where the rebalancer does not actually rebalance.
12. Table D.6 decomposes the expectations shock with and without a rebalancer in a variation where the price for U.S. short-term debt varies and investor wealth is held fixed.
13. Figure D.7 shows the effects of the expectations shock with and without a rebalancer in a variation where we reduce the sensitivity to equity return expectations.
14. Figure D.8 shows the effects of the expectations shock with and without a rebalancer in a variation where investors treat the asset classes as perfect substitutes.
15. Figure D.9 shows the effects of the expectations shock with and without a rebalancer in a variation where the investors treat the asset classes as perfect complements.
16. Figure D.10 shows the dampening associated with the rebalancer when varying the rebalancer size.
17. Figure D.11 shows the effects of the expectations shock with and without a rebalancer in a variation where the rebalancer comprises 8% of U.S. domestic assets.

18. Figure D.12 shows the effects of the expectations shock with and without a rebalancer in a variation where the rebalancer comprises 6% of U.S. domestic assets.

19. Figure D.13 shows the effects of the expectations shock with and without a rebalancer in a variation where the rebalancer has a positive weight on short-term debt.

20. Figure D.14 shows the dampening associated with the rebalancer when varying the rebalancer's foreign asset share.

21. Figure D.15 shows the effects of the expectations shock with and without a rebalancer in a variation where the rebalancer has a positive foreign asset share.

22. Table D.7 decomposes the expectations shock with and without a rebalancer in a variation where the rebalancer has a positive foreign asset share.

23. Figure D.16 shows the effects of the expectations shock with and without a rebalancer in a variation where a fraction of foreign investors in U.S. assets are rebalancers.

24. Figure D.17 shows the dampening associated with the rebalancer when we simulate the model based on different years.

25. Figure D.18 shows the effects of the expectations shock on U.S. prices with and without a U.S. rebalancer in a variation where there is a shock to equity return expectations for a set of non-U.S. countries.

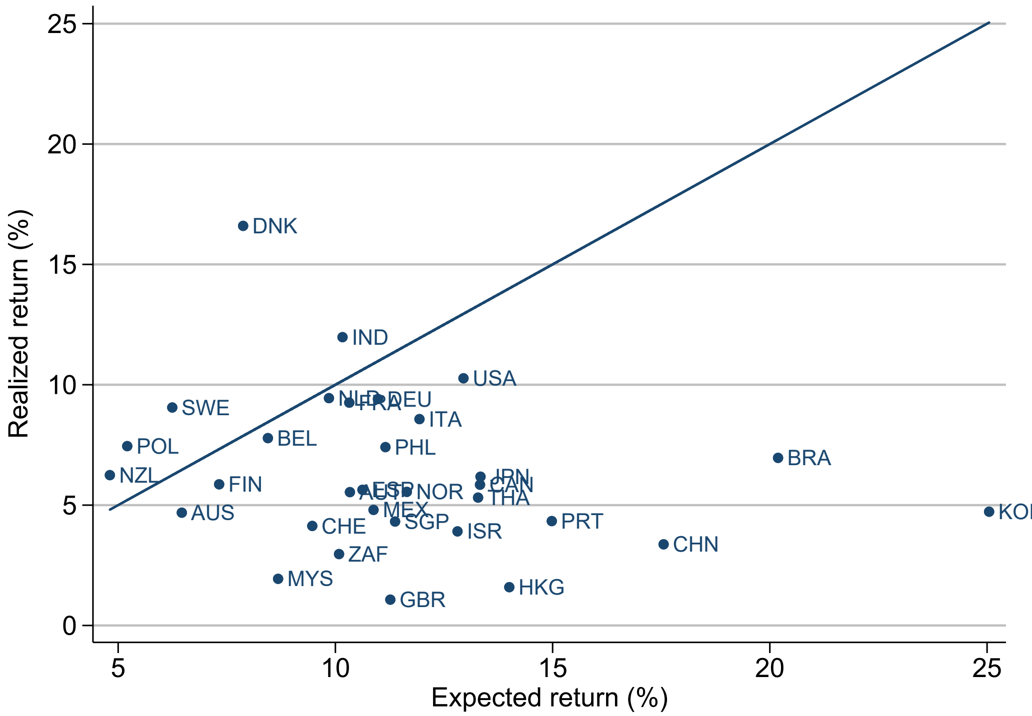
26. Figure D.19 shows the effects of the expectations shock on the shocked country's prices with and without a rebalancer in that country in a variation where there is a shock to equity return expectations for a set of non-U.S. countries.

27. Figure D.20 shows the effects of the expectations shock on U.S. prices with and without a U.S. rebalancer in a variation where there is a shock to U.S. long-term debt return expectations.

A Supplemental material for the empirical observations (Section 2)

Figure A.1: Expected and realized equity returns: median by country

This figure shows the median expected return and the median realized return for each country over the period 2004-2023.



B Proof of Proposition 1

Denote the variance of asset l by $V_t(l)$ and the covariance of the two risky assets by C_t. Then we can express the mean-variance investor's weight in equity based on equation (2) as

$$w_{MV,t}(E) = \frac{V_t(L)\mu_t(E) - C_t\mu_t(L)}{\gamma\left(V_t(E)V_t(L) - C_t^2\right)} + \left(1 - \frac{V_t(L)\mu_t(E) - C_t\mu_t(L) - C_t\mu_t(E) + V_t(E)\mu_t(L)}{\gamma\left(V_t(E)V_t(L) - C_t^2\right)}\right)\frac{V_t(L) - C_t}{V_t(E) + V_t(L) - 2C_t} \tag{25}$$

We can simplify this to

$$w_{MV,t}(E) = \frac{\mu_E - \mu_L + \gamma\left(V_t(L) - C_t\right)}{\gamma\left(V_t(E) + V_t(L) - 2C_t\right)}. \tag{26}$$

Then observe

$$\frac{\partial w_{MV,t}(E)}{\partial \mu_t(E)} = \frac{1}{\gamma\left(V_t(E) + V_t(L) - 2C_t\right)} > 0, \tag{27}$$

where the positive sign follows from $V_t(E) + V_t(L) - 2C_t = Var(E_t - L_t) > 0$, assuming equity and debt do not have identical distributions.

Then, using the market clearing relationship (3) and $w_{i,t}(L) = 1 - w_{i,t}(E)$, we can write

$$P_1^{NR}(E)/P_1^{NR}(L) = \frac{w_{MV,1}(E)}{1 - w_{MV,1}(E)}\frac{Q_1(L)}{Q_1(E)} \tag{28}$$

$$P_1^{R}(E)/P_1^{R}(L) = \frac{A_{MV,1}^R w_{MV,1}(E) + A_{R,1}^R w_R(E)}{A_{MV,1}^R\left(1 - w_{MV,1}(E)\right) + A_{R,1}^R\left(1 - w_R(E)\right)}\frac{Q_1(L)}{Q_1(E)}. \tag{29}$$

To obtain the growth, we differentiate the logarithm of the price ratio with respect to $\mu_1(E)$ evaluated at $\mu_1(E) = \mu_0(E)$, and we assume all other variables stay at their levels as of time $t = 0$. This obtains

$$\frac{\partial \log(P_1^{NR}(E)/P_1^{NR}(L))}{\partial \mu_1(E)} = \underbrace{\frac{1}{w_{MV,0}(E)\left(1 - w_{MV,0}(E)\right)}\frac{\partial w_{MV,1}(E)}{\partial \mu_1(E)}}_{\text{substitution}} \tag{30}$$

Note that the variable levels are equal to the time 0 values since we evaluate at

$\mu_1(E) = \mu_0(E)$. We also have

$$\frac{\partial \log(P_1^R(E)/P_1^R(L))}{\partial \mu_1(E)} = \underbrace{\frac{A_{MV}^R A_0}{\left[A_{MV}^R w_{MV,0}(E) + A_R^R w_R(E)\right]\left[A_{MV}^R (1-w_{MV,0}(E)) + A_R^R(1-w_R(E))\right]} \frac{\partial w_{MV,1}(E)}{\partial \mu_1(E)}}_{\text{substitution}}$$
$$+ \underbrace{\frac{(w_R(E)-w_{MV,0}(E))\, A_{MV,0}^R A_{R,0}^R \left(\frac{\partial A_{R,1}^R}{\partial \mu_1(E)} \frac{1}{A_{R,0}} - \frac{\partial A_{MV,1}^R}{\partial \mu_1(E)} \frac{1}{A_{MV,0}}\right)}{\left[A_{MV}^R w_{MV,0}(E) + A_R^R w_R(E)\right]\left[A_{MV}^R (1-w_{MV,0}(E)) + A_R^R(1-w_R(E))\right]}}_{\text{revaluation}} \tag{31}$$

Without wealth revaluation, the revaluation term in (31) is equal to zero, and we observe that the substitution term in (31) and the one in (30) are positive since $\frac{\partial w_{MV,1}(E)}{\partial \mu_1(E)} > 0$ by (27), which shows statement (i). Note also that the substitution term in (31) is less than the one in (30), which shows statement (ii). To verify this inequality, note that, since $\frac{\partial w_{MV,1}(E)}{\partial \mu_1(E)} > 0$, it holds if and only if

$$\frac{A_{MV}^R A_0}{\left[A_{MV}^R w_{MV,0}(E) + A_R^R w_R(E)\right]\left[A_{MV}^R (1-w_{MV,0}(E)) + A_R^R(1-w_R(E))\right]} < \frac{1}{w_{MV,0}(E)(1-w_{MV,0}(E))}$$
$$\iff 0 < A_R\left[A_{MV}(w_{MV,0}(E) - w_R(E))^2 + A_0 w_R(E)(1-w_R(E))\right], \tag{32}$$

where the second line is clearly true.

With wealth revaluation, the revaluation term in (31) has a variable sign. It is positive if the investor that experiences a greater growth of wealth has a greater share of investment in equity, otherwise it is negative. This shows statement (iii). Note that wealth revaluation does not result in any change in the scenario without a rebalancer.

C Modification of equilibrium for shared and pegged currencies

We modify the equilibrium described in 4.1.1 to account for shared currencies and currency pegs as follows. In the case of the euro, we determine the exchange rate $E_t(euro)$ by using a common short-term debt price $P_t(euro, S)$ and aggregating the market clearing conditions (11) for short-term debt over eurozone countries:

$$P_t(euro, S)E_t(euro) \sum_{n \in \text{eurozone}} Q_t(n, S) = \sum_{n \in \text{eurozone}} \sum_{i=1}^{I} A_{i,t} w_{i,t}(n, S). \tag{33}$$

Our sample also has two currency pegs: the Hong Kong dollar pegs to the U.S. dollar, and the Danish kroner pegs to the euro. In each case, we determine the exchange rate $E_t(n)$ based on the peg multiple times the target exchange rate. Since countries with a shared currency or peg must satisfy both a given short-term debt price and exchange rate, we assume that each of them adjusts the supply of short-term debt to satisfy its individual short-term debt market clearing condition in equation (11). We assume that the total oustanding level of Euro-area short-term debt $\sum_{n \in \text{eurozone}} Q_t(n, S)$ is constant so that the determination of $E_t(euro)$ in (33) is well-defined. Aside from these cases as well as U.S. short-term debt as described in Section 4.1.1, we assume that asset levels are invariant with respect to the comparative statics we focus on. Overall, there are 3N+3 equations corresponding to the market clearing conditions (11), the euro (33), and the two pegs. There are also 3N+3 variables corresponding to the 2N asset prices for equity and long-term debt, N-1-(number of euro countries-1) exchange rates, and the supply of short-term debt for the U.S, each euro country, and each peg country.

D Supplemental material for the model (Section 4)

Table D.1: Within-asset class parameters: first stage, using 24-month exchange rate expectations

	(1) S	(2) L	(3) E
Log ex. rate instrument	-0.002***	-0.003***	-0.005***
	(-20.25)	(-15.46)	(-14.68)
Log price instrument		-0.009***	-0.008***
		(-16.30)	(-16.70)
Log GDP	-0.010***	0.013***	0.030***
	(-14.91)	(11.73)	(15.63)
Log population	0.010***	-0.012***	-0.022***
	(17.33)	(-12.27)	(-12.93)
Inflation	0.006***	0.009***	-0.004***
	(42.95)	(38.57)	(-9.57)
Volatility	0.042***	0.031***	0.050***
	(14.63)	(6.94)	(6.35)
Rating	-0.001***	-0.009***	-0.009***
	(-5.94)	(-29.10)	(-19.62)
Log distance	0.003***	0.001***	-0.002***
	(9.30)	(3.18)	(-2.72)
Domestic ownership	0.006***	0.003	-0.003
	(3.87)	(1.20)	(-0.70)
Observations	19,950	14,754	20,842
R^2	0.530	0.505	0.470
Investor FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
F-statistic	410.09	151.74	151.08

Note: This table shows the estimates from the first stage of regressing equation (13), except using annualized 24-month exchange rate return expectations instead of 12-month. Column (1) regresses the logarithm of the portfolio weight of a given investor in a given issuer's short-term debt in a given year divided by the investor's portfolio weight in outside short-term debt on expected excess returns and issuer characteristics. Column (2) is similar except for long-term debt. Column (3) is similar except for equity. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table D.2: Within-asset class parameters, using 24-month exchange rate expectations

	(1) S	(2) L	(3) E
Expected return	26.706***	11.183***	9.865***
	(5.24)	(3.74)	(6.68)
Log GDP	3.642***	2.549***	2.698***
	(38.46)	(45.29)	(52.74)
Log population	-2.139***	-1.409***	-1.366***
	(-23.48)	(-28.83)	(-32.28)
Inflation	-0.155***	-0.059**	0.131***
	(-4.55)	(-2.12)	(11.64)
Volatility	-1.891***	-0.836***	-0.178
	(-5.24)	(-3.29)	(-0.81)
Rating	-0.080***	0.001	0.115***
	(-4.35)	(0.02)	(6.21)
Log distance	-1.318***	-0.953***	-0.934***
	(-39.75)	(-43.48)	(-52.04)
Domestic ownership	4.760***	4.122***	4.527***
	(26.68)	(29.78)	(41.66)
Observations	19,950	14,754	20,842
R^2	0.312	0.414	0.442
Investor FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: This table shows the estimates from regressing equation (13), except using annualized 24-month exchange rate return expectations instead of 12-month. Column (1) regresses the logarithm of the portfolio weight of a given investor in a given issuer's short-term debt in a given year divided by the investor's portfolio weight in outside short-term debt on expected excess returns and issuer characteristics. Expected excess returns are instrumented with predicted variation in prices and exchange rates due to plausibly exogenous factors as described in Section 4.3.1. Column (2) is similar except for long-term debt. Column (3) is similar except for equity. The F-statistic from testing the joint significance of the instruments is shown below each column. T-statistics computed using robust standard errors are reported in parentheses. * indicates statistical significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.

Table D.3: Investment and outstanding levels by country

(a) Short-term debt

Country	Issuance (B$)	Investment (B$)	% of U.S.	U.S. weight (%)
Australia	356.54	327.68	0.00	0.00
Austria	26.90	28.66	0.01	1.23
Brazil	31.54	28.01	0.01	3.45
Canada	433.17	328.62	0.09	1.84
China	629.63	670.78	0.13	1.30
Denmark	15.49	18.16	0.03	9.97
France	172.12	338.66	0.26	4.97
Germany	261.35	188.91	0.17	5.82
Hungary	19.69	19.58	0.01	3.11
India	80.85	78.65	0.03	2.59
Italy	103.27	105.69	0.13	8.07
Japan	1,240.74	1,091.80	0.16	0.94
Malaysia	13.89	17.62	0.02	5.75
Mexico	59.64	68.23	0.17	15.97
Netherlands	134.16	156.61	0.09	3.97
Norway	58.53	94.61	0.01	0.51
Philippines	17.16	20.06	0.04	13.19
Poland	3.72	10.85	0.01	8.37
Portgual	12.43	19.84	0.00	0.81
Singapore	243.62	276.80	0.29	7.01
South Africa	29.16	29.43	0.01	1.72
South Korea	304.13	293.11	0.08	1.82
Spain	68.48	58.28	0.02	2.35
Sweden	46.15	4.44	0.00	4.41
Switzerland	157.68	223.09	0.29	8.66
Thailand	16.26	20.03	0.02	7.42
United Kingdom	606.58	648.86	0.70	7.13
United States	6,580.48	6,819.27	97.21	93.81

Note: These tables shows a list of the sample countries along with the following as of 2023 for each asset class: total outstanding level (market value in billions of USD), total investment (in billions of USD), percentage of investment within U.S. issued assets, and percentage of U.S. within the given country's investments. Table D.3a corresponds to short-term debt, Table D.3b corresponds to long-term debt, and Table D.3c corresponds to equity.

Table D.3: Investment and outstanding levels by country (continued)

(b) Long-term debt

Country	Issuance (B$)	Investment (B$)	% of U.S.	U.S. weight (%)
Australia	1,999.61	1,844.51	0.00	0.00
Austria	498.35	515.59	0.04	3.48
Brazil	466.61	337.68	0.01	0.70
Canada	3,011.19	2,786.83	0.92	14.68
China	17,696.14	17,744.71	0.28	0.71
Denmark	715.48	782.58	0.09	5.08
France	2,273.54	2,873.93	0.91	14.04
Germany	3,379.24	4,442.70	0.75	7.54
Hungary	155.16	132.77	0.00	0.84
India	975.27	915.15	0.00	0.00
Italy	2,019.19	2,160.42	0.25	5.20
Japan	10,113.76	11,860.98	2.60	9.75
Malaysia	386.58	361.06	0.01	1.44
Mexico	534.78	404.65	0.01	1.44
Netherlands	1,778.42	2,076.58	0.39	8.30
Norway	423.02	831.45	0.45	24.09
Philippines	195.58	188.55	0.01	2.13
Poland	381.48	358.37	0.01	1.24
Portgual	226.75	282.10	0.03	4.12
Singapore	341.21	921.29	0.58	28.03
South Africa	184.31	151.20	0.01	2.69
South Korea	2,262.83	2,346.60	0.24	4.60
Spain	1,200.20	1,094.26	0.13	5.14
Sweden	183.25	139.39	0.05	17.47
Switzerland	717.45	1,131.41	0.42	16.38
Thailand	319.62	316.04	0.01	1.06
United Kingdom	4,757.40	5,017.46	1.06	9.41
United States	44,464.18	43,694.83	90.74	92.33

Note: These tables show a list of the sample countries along with the following as of 2023 for each asset class: total outstanding level (market value in billions of USD), total investment (in billions of USD), percentage of investment within U.S. issued assets, and percentage of U.S. within the given country's investments. Table D.3a corresponds to short-term debt, Table D.3b corresponds to long-term debt, and Table D.3c corresponds to equity.

Table D.3: Investment and outstanding levels by country (continued)

(c) Equity

Country	Issuance (B$)	Investment (B$)	% of U.S.	U.S. weight (%)
Australia	1,761.11	2,059.69	0.91	21.44
Austria	135.37	290.95	0.16	26.14
Brazil	987.74	735.60	0.05	3.13
Canada	3,084.10	3,952.50	2.82	34.49
China	10,289.72	7,554.46	0.29	1.85
Denmark	2,144.58	2,251.33	0.52	11.09
France	12,579.15	12,509.89	0.80	3.10
Germany	2,016.33	2,259.86	1.68	35.98
Hungary	38.47	45.02	0.01	10.77
India	4,334.88	3,712.31	0.02	0.20
Italy	2,444.42	3,382.69	0.87	12.49
Japan	6,100.74	6,677.47	1.93	13.96
Malaysia	376.42	458.63	0.07	7.66
Mexico	575.48	534.30	0.04	4.05
Netherlands	6,822.71	6,593.26	1.26	9.21
Norway	998.77	2,189.37	1.22	27.01
Philippines	236.29	216.86	0.00	0.68
Poland	210.15	201.14	0.02	4.10
Portgual	419.74	442.70	0.05	5.34
Singapore	580.82	1,520.42	0.63	20.01
South Africa	1,024.17	1,146.46	0.12	5.07
South Korea	1,961.23	2,189.10	0.84	18.46
Spain	764.72	992.43	0.36	17.69
Sweden	2,647.64	2,949.85	0.64	10.46
Switzerland	2,028.24	2,122.55	0.86	19.67
Thailand	518.29	511.56	0.04	4.18
United Kingdom	6,430.55	6,890.99	2.39	16.74
United States	48,318.51	49,293.44	81.39	79.78

Note: These tables shows a list of the sample countries along with the following as of 2023 for each asset class: total outstanding level (market value in billions of USD), total investment (in billions of USD), percentage of investment within U.S. issued assets, and percentage of U.S. within the given country's investments. Table D.3a corresponds to short-term debt, Table D.3b corresponds to long-term debt, and Table D.3c corresponds to equity.

Figure D.2: Effect of expectations shock on asset prices with and without a rebalancer (simplified version)

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or

$$\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}.$$

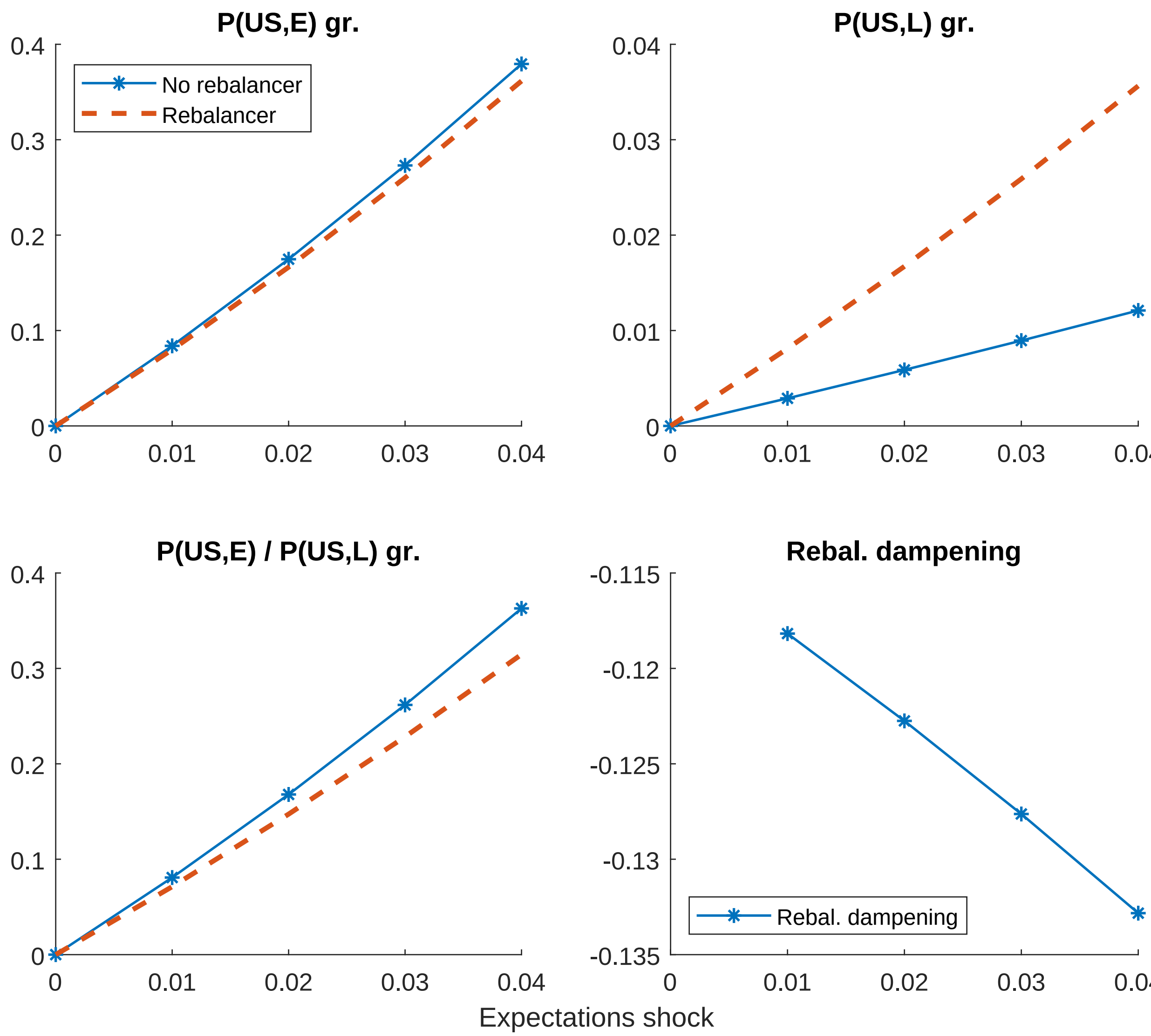


Figure D.3: Effect of expectations shock on asset prices with and without a rebalancer: effect on non-U.S. prices

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the average non-U.S. equity price, the average non-U.S. long-term debt price, the price ratio of equity to long-term debt, the rebalancer effect for the non-U.S. equity to debt price ratio, and the average exchange rate in U.S. dollars per local currency. The average is weighted by the total value of all outstanding levels. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(non-US,E)/P_1^R(non-US,L)}{P_0^R(non-US,E)/P_0^R(non-US,L)}-1\right)-\left(\frac{P_1^{NR}(non-US,E)/P_1^{NR}(non-US,L)}{P_0^{NR}(non-US,E)/P_0^{NR}(non-US,L)}-1\right)}{\frac{P_1^{NR}(non-US,E)/P_1^{NR}(non-US,L)}{P_0^{NR}(non-US,E)/P_0^{NR}(non-US,L)}-1}$.

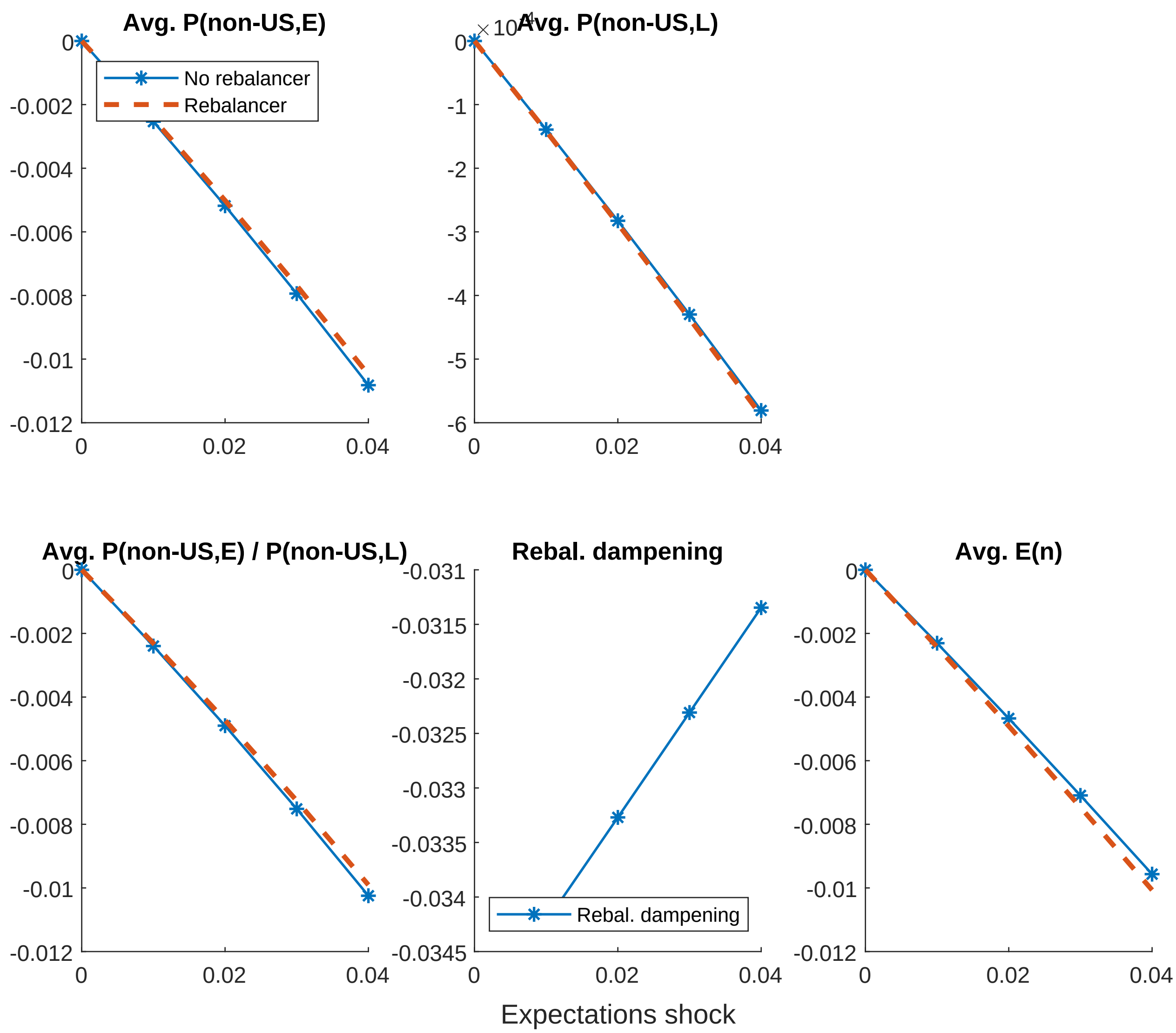


Table D.4: Decomposition by investor of expectations shock with and without a rebalancer: detailed breakdown by country

(a) Equity price

	R (Reb.)	NR (No reb.)	R - NR	(R - NR)/ NR
ΔP_E: USA (non-reb.) component	0.058	0.068	–0.010	–0.147
ΔP_E: USA (reb.) component	0.007	0.000	0.007	
ΔP_E: AUS component	0.001	0.001	–0.000	–0.057
ΔP_E: AUT component	0.000	0.000	–0.000	–0.052
ΔP_E: BRA component	0.000	0.000	–0.000	–0.047
ΔP_E: CAN component	0.002	0.002	–0.000	–0.055
ΔP_E: CHE component	0.001	0.001	–0.000	–0.050
ΔP_E: CHN component	0.000	0.000	–0.000	–0.042
ΔP_E: DEU component	0.001	0.001	–0.000	–0.051
ΔP_E: DNK component	0.000	0.000	–0.000	–0.055
ΔP_E: ESP component	0.000	0.000	–0.000	–0.050
ΔP_E: FRA component	0.001	0.001	–0.000	–0.045
ΔP_E: GBR component	0.002	0.002	–0.000	–0.050
ΔP_E: HUN component	0.000	0.000	–0.000	–0.050
ΔP_E: IND component	0.000	0.000	–0.000	–0.044
ΔP_E: ITA component	0.001	0.001	–0.000	–0.052
ΔP_E: JPN component	0.002	0.002	–0.000	–0.041
ΔP_E: KOR component	0.001	0.001	–0.000	–0.055
ΔP_E: MEX component	0.000	0.000	–0.000	–0.047
ΔP_E: MYS component	0.000	0.000	–0.000	–0.051
ΔP_E: NLD component	0.001	0.001	–0.000	–0.051
ΔP_E: NOR component	0.001	0.001	–0.000	–0.054
ΔP_E: PHL component	0.000	0.000	–0.000	–0.042
ΔP_E: POL component	0.000	0.000	–0.000	–0.048
ΔP_E: PRT component	0.000	0.000	–0.000	–0.049
ΔP_E: SGP component	0.001	0.001	–0.000	–0.045
ΔP_E: SWE component	0.001	0.001	–0.000	–0.058
ΔP_E: THA component	0.000	0.000	–0.000	–0.049
ΔP_E: ZAF component	0.000	0.000	–0.000	–0.054
ΔP_E: total	0.080	0.084	–0.004	–0.048

Note: This table shows a decomposition, based on equation (24) except showing each investor individually, of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock, with and without a rebalancer. It also shows the absolute difference of the rebalancer case minus the non-rebalancer case, as well as the difference relative to the non-rebalancer case.

Table D.4: Decomposition by investor of expectations shock with and without a rebalancer: detailed breakdown by country (continued)

(b) Long-term debt price

	R (Reb.)	NR (No reb.)	R - NR	(R - NR)/ NR
ΔP_L: USA (non-reb.) component	0.003	0.003	0.000	0.022
ΔP_L: USA (reb.) component	0.005	0.000	0.005	
ΔP_L: AUS component	–0.000	–0.000	–0.000	0.503
ΔP_L: AUT component	–0.000	–0.000	–0.000	0.450
ΔP_L: BRA component	–0.000	–0.000	–0.000	0.021
ΔP_L: CAN component	–0.000	–0.000	–0.000	1.213
ΔP_L: CHE component	–0.000	–0.000	–0.000	0.173
ΔP_L: CHN component	–0.000	–0.000	0.000	–0.063
ΔP_L: DEU component	–0.000	–0.000	–0.000	0.822
ΔP_L: DNK component	–0.000	–0.000	–0.000	0.235
ΔP_L: ESP component	–0.000	–0.000	–0.000	0.233
ΔP_L: FRA component	–0.000	–0.000	0.000	–0.005
ΔP_L: GBR component	–0.000	–0.000	–0.000	0.194
ΔP_L: HUN component	–0.000	–0.000	–0.000	0.247
ΔP_L: IND component	–0.000	–0.000	0.000	–0.025
ΔP_L: ITA component	–0.000	–0.000	–0.000	0.236
ΔP_L: JPN component	–0.000	–0.000	0.000	–0.212
ΔP_L: KOR component	–0.000	–0.000	–0.000	0.300
ΔP_L: MEX component	–0.000	–0.000	–0.000	0.046
ΔP_L: MYS component	–0.000	–0.000	–0.000	0.168
ΔP_L: NLD component	–0.000	–0.000	–0.000	0.171
ΔP_L: NOR component	–0.000	–0.000	–0.000	0.604
ΔP_L: PHL component	–0.000	–0.000	0.000	–0.117
ΔP_L: POL component	–0.000	–0.000	–0.000	0.087
ΔP_L: PRT component	–0.000	–0.000	–0.000	0.129
ΔP_L: SGP component	–0.000	–0.000	0.000	–0.048
ΔP_L: SWE component	–0.000	–0.000	–0.000	0.287
ΔP_L: THA component	–0.000	–0.000	–0.000	0.095
ΔP_L: ZAF component	–0.000	–0.000	–0.000	0.187
ΔP_L: total	0.008	0.003	0.005	1.803

(c) Relative price of equity to long-term debt

	R (Reb.)	NR (No reb.)	R - NR	(R - NR)/ NR
$\Delta P_E/P_L$ growth approx.	0.072	0.081	–0.009	–0.114
$\Delta P_E/P_L$ growth error	–0.001	–0.000	–0.000	1.472
$\Delta P_E/P_L$ growth exact	0.071	0.081	–0.010	–0.118

Note: This table shows a decomposition, based on equation (24) except showing each investor individually, of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock, with and without a rebalancer. It also shows the absolute difference of the rebalancer case minus the non-rebalancer case, as well as the difference relative to the non-rebalancer case.

Figure D.4: Effect of expectations shock on asset prices with and without a rebalancer: passive investor

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, we assume the rebalancer's total wealth and portfolio weights drift based on valuation changes, without rebalancing.

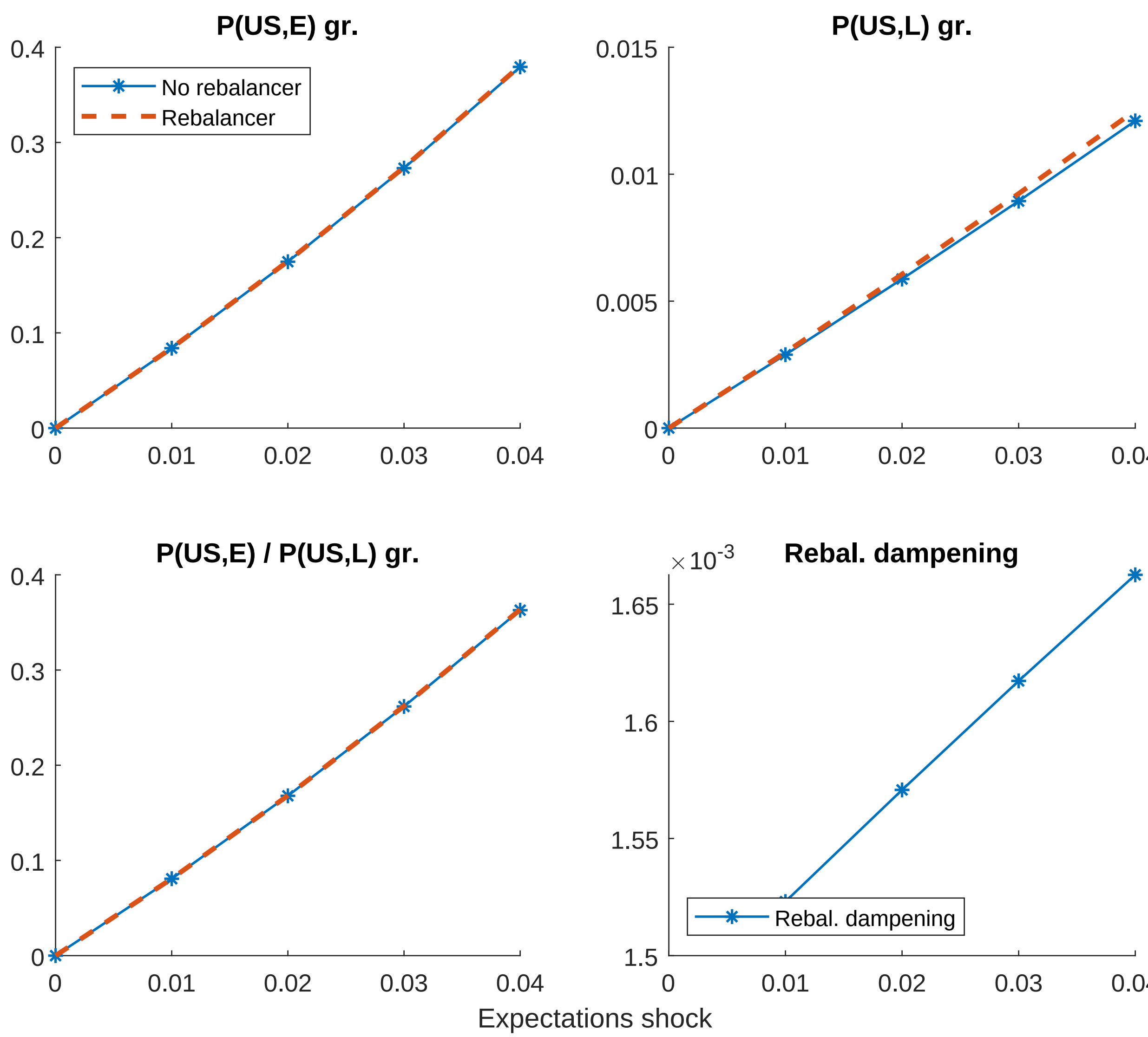


Figure D.5: Effect of expectations shock on asset prices with and without a rebalancer: fixed wealth

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, we fix each investor's wealth to the level before return expectations shock.

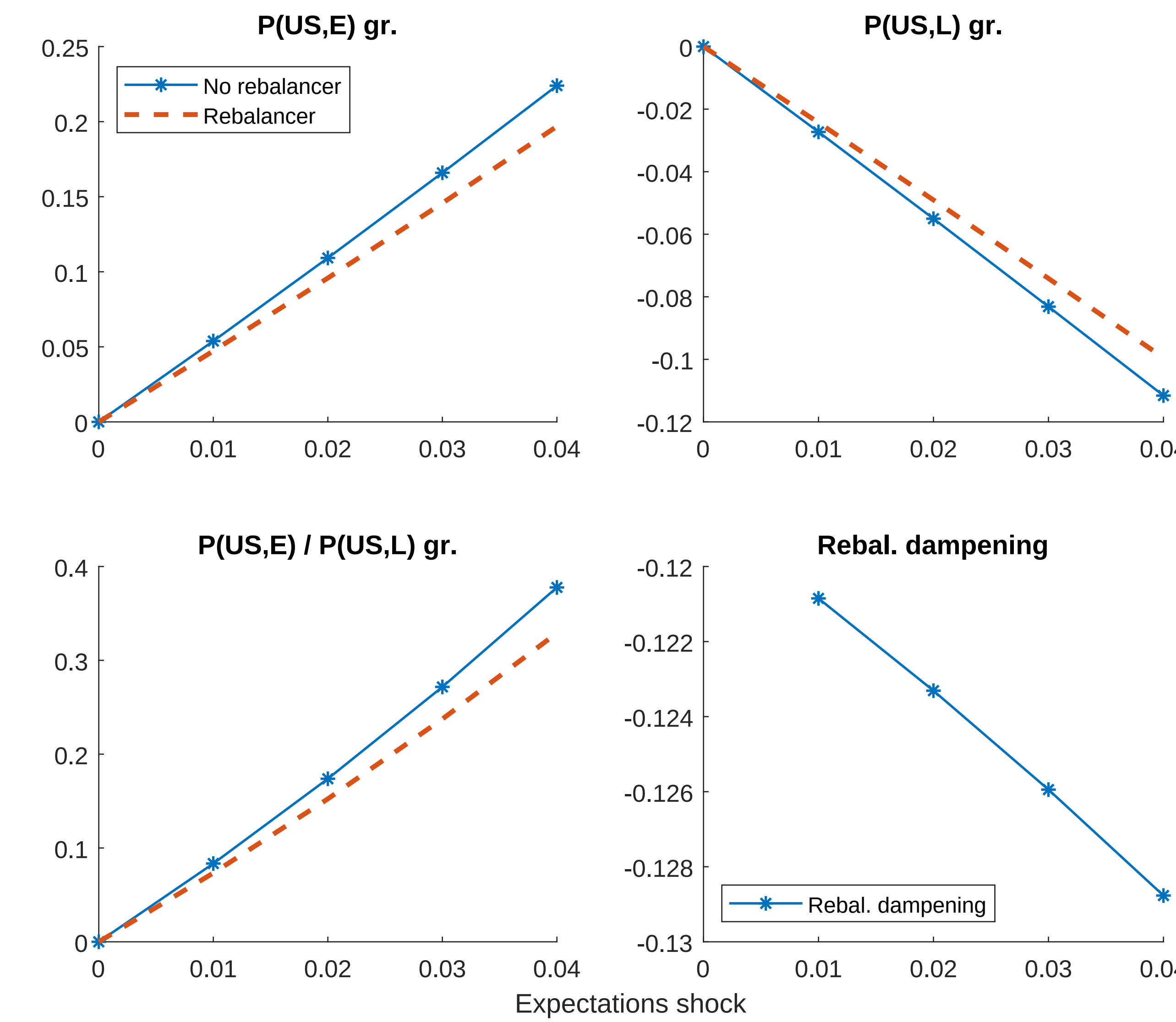


Table D.5: Decomposition by channel of expectations shock with and without a rebalancer: passive investor

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.033	0.343	0.030	0.003	0.092	21.064
ΔP_E across	0.027	0.278	0.026	0.000	0.009	1.717
ΔP_E within	0.025	0.258	0.027	–0.003	–0.100	–21.092
ΔP_E total	0.096	1.000	0.084	0.012	0.140	90.032
ΔP_L wealth	0.032	2.340	0.030	0.002	0.059	13.710
ΔP_L across	–0.029	–2.122	–0.027	–0.002	0.062	–13.022
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	0.014	1.000	0.003	0.011	3.726	82.419
$\Delta P_E - \Delta P_L$	0.081		0.081	0.000	0.002	1.000
$\Delta (P_E/P_L)$	0.081		0.081	0.000	0.002	0.942
ΔP_E - ΔP_L wealth	0.001		–0.000	0.001	0.032	7.354
ΔP_E - ΔP_L across	0.056		0.054	0.002	–0.054	14.739
ΔP_E - ΔP_L within	0.025		0.027	–0.003		–21.092

Note: This table shows a decomposition, based on equation (20), of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock. This table focuses on a variation in which the rebalancer is replaced by a passive investor. The first column refers to the setting with a rebalancer, the second column shows the magnitude of each component relative to the total price growth, the third column refers to the setting with no rebalancer, the fourth column shows the absolute difference of the rebalancer case minus the non-rebalancer case, the fifth column shows the growth compared to the non-rebalancer case, and the sixth column shows the difference of each component relative to the difference in the price growth measured using the approximation $\Delta P_E - \Delta P_L$.

Table D.6: Decomposition by channel of expectations shock with and without a rebalancer: fixed wealth

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.000	0.000	0.000	0.000		0.000
ΔP_E across	0.023	0.476	0.026	–0.004	–0.147	0.403
ΔP_E within	0.025	0.524	0.027	–0.003	–0.100	0.287
ΔP_E total	0.047	1.000	0.054	–0.007	–0.123	0.691
ΔP_L wealth	0.000	0.000	0.000	0.000		0.000
ΔP_L across	–0.024	1.000	–0.027	0.003	–0.109	–0.309
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	–0.024	1.000	–0.027	0.003	–0.109	–0.309
$\Delta P_E - \Delta P_L$	0.072		0.081	–0.010	–0.118	1.000
$\Delta (P_E/P_L)$	0.073		0.083	–0.010	–0.121	1.051
ΔP_E - ΔP_L wealth	0.000		0.000	0.000		0.000
ΔP_E - ΔP_L across	0.047		0.054	–0.007	–0.038	0.713
ΔP_E - ΔP_L within	0.025		0.027	–0.003		0.287

Note: This table shows a decomposition, based on equation (20), of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock. This table focuses on a variation in which we fix each investor's wealth to the level before return expectations shock. The first column refers to the setting with a rebalancer, the second column shows the magnitude of each component relative to the total price growth, the third column refers to the setting with no rebalancer, the fourth column shows the absolute difference of the rebalancer case minus the non-rebalancer case, the fifth column shows the growth compared to the non-rebalancer case, and the sixth column shows the difference of each component relative to the difference in the price growth measured using the approximation $\Delta P_E - \Delta P_L$.

Figure D.6: Effect of expectations shock on asset prices with and without a rebalancer: large shocks

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$.

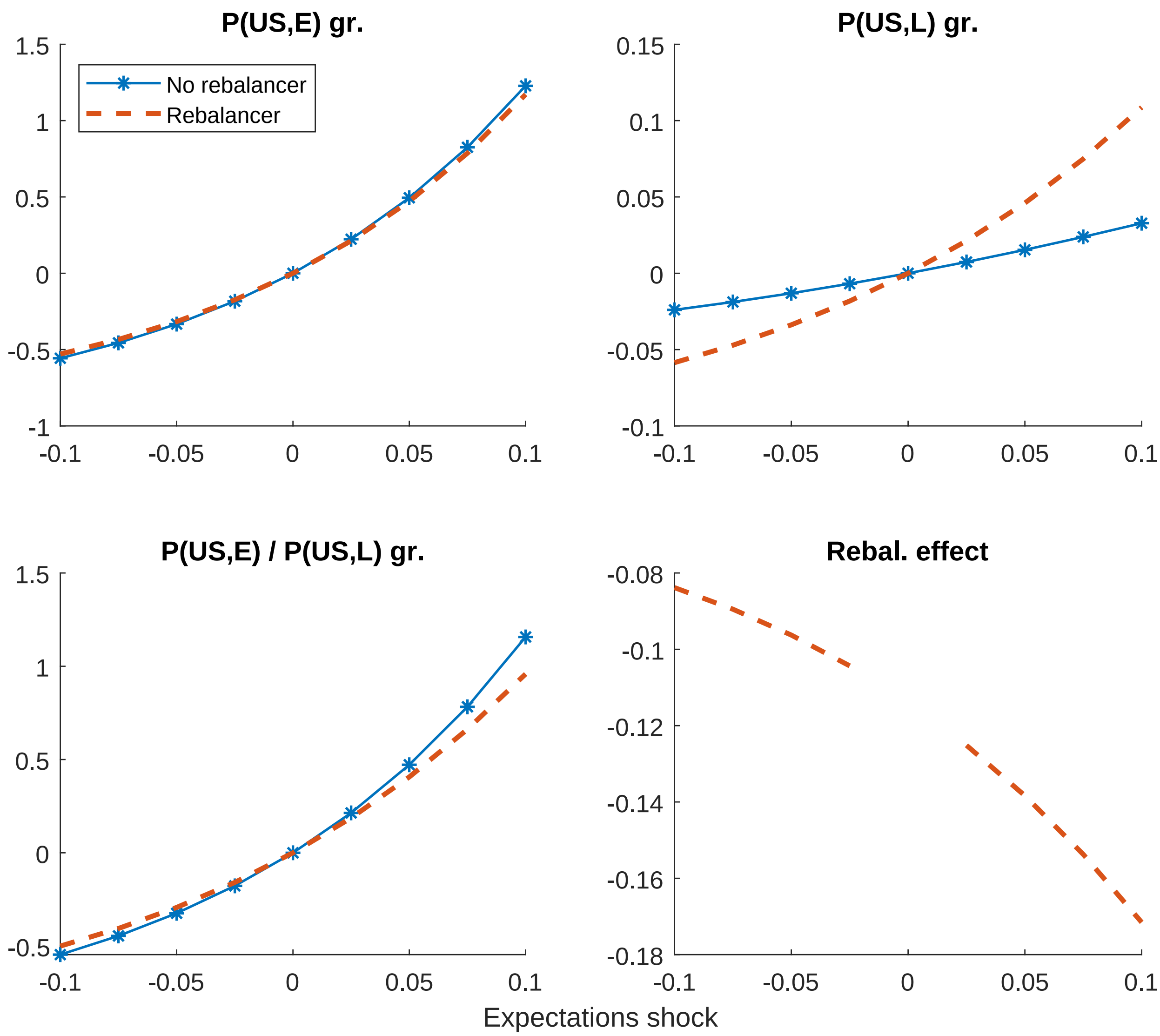


Figure D.7: Effect of expectations shock on asset prices with and without a rebalancer: lower sensitivity to return expectations

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, we reduce the sensitivity of preference scores to excess return expectations (λ_E in equation (5)) to half its estimated value.

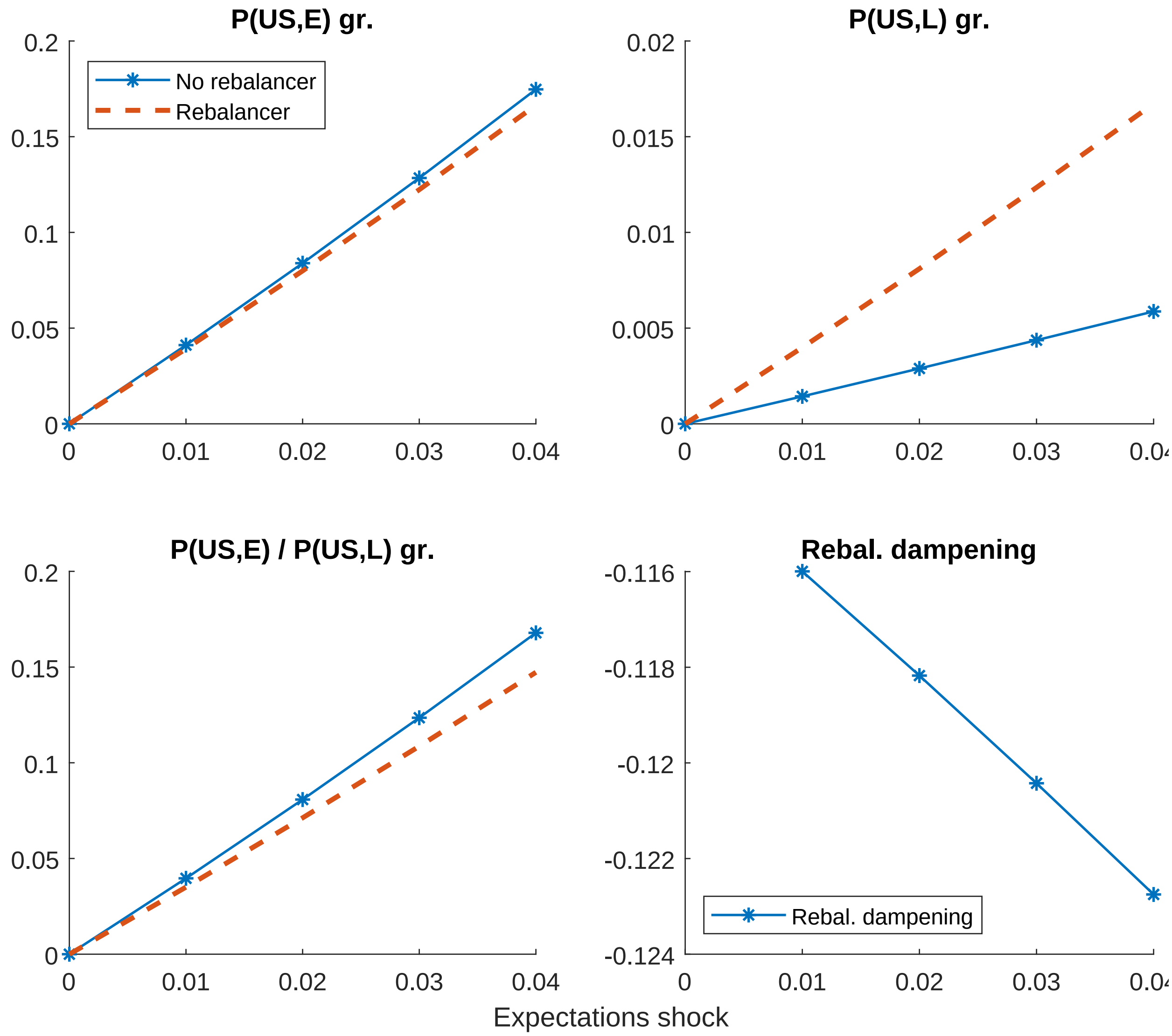


Figure D.8: Effect of expectations shock on asset prices with and without a rebalancer: perfect substitutes

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, we assume investors treat asset classes as perfect substitutes by setting $\rho_l = 1$ for each asset class.

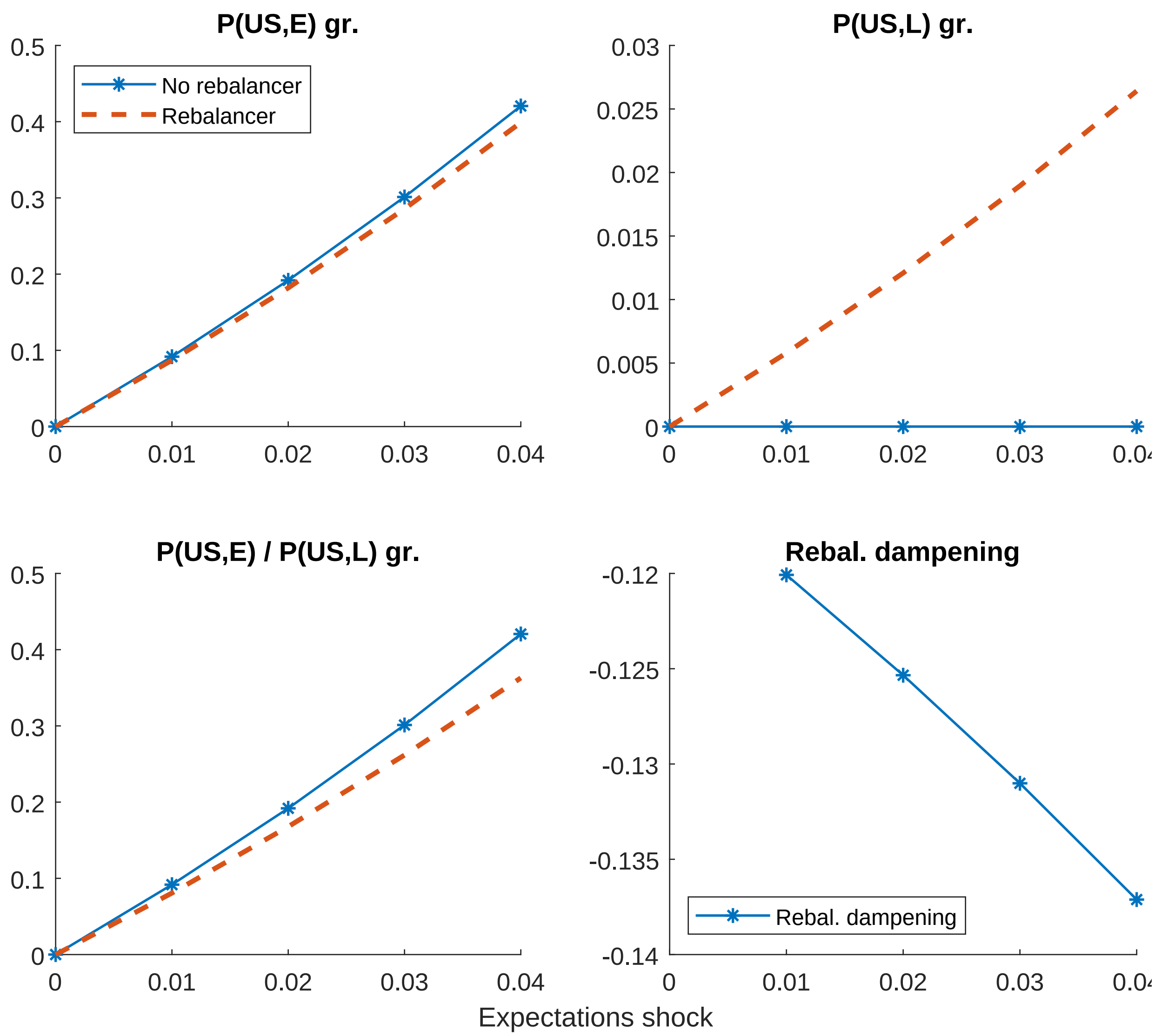


Figure D.9: Effect of expectations shock on asset prices with and without a rebalancer: perfect complements

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, we assume investors treat asset classes as perfect complements by setting $\rho_l = 0$ for each asset class.

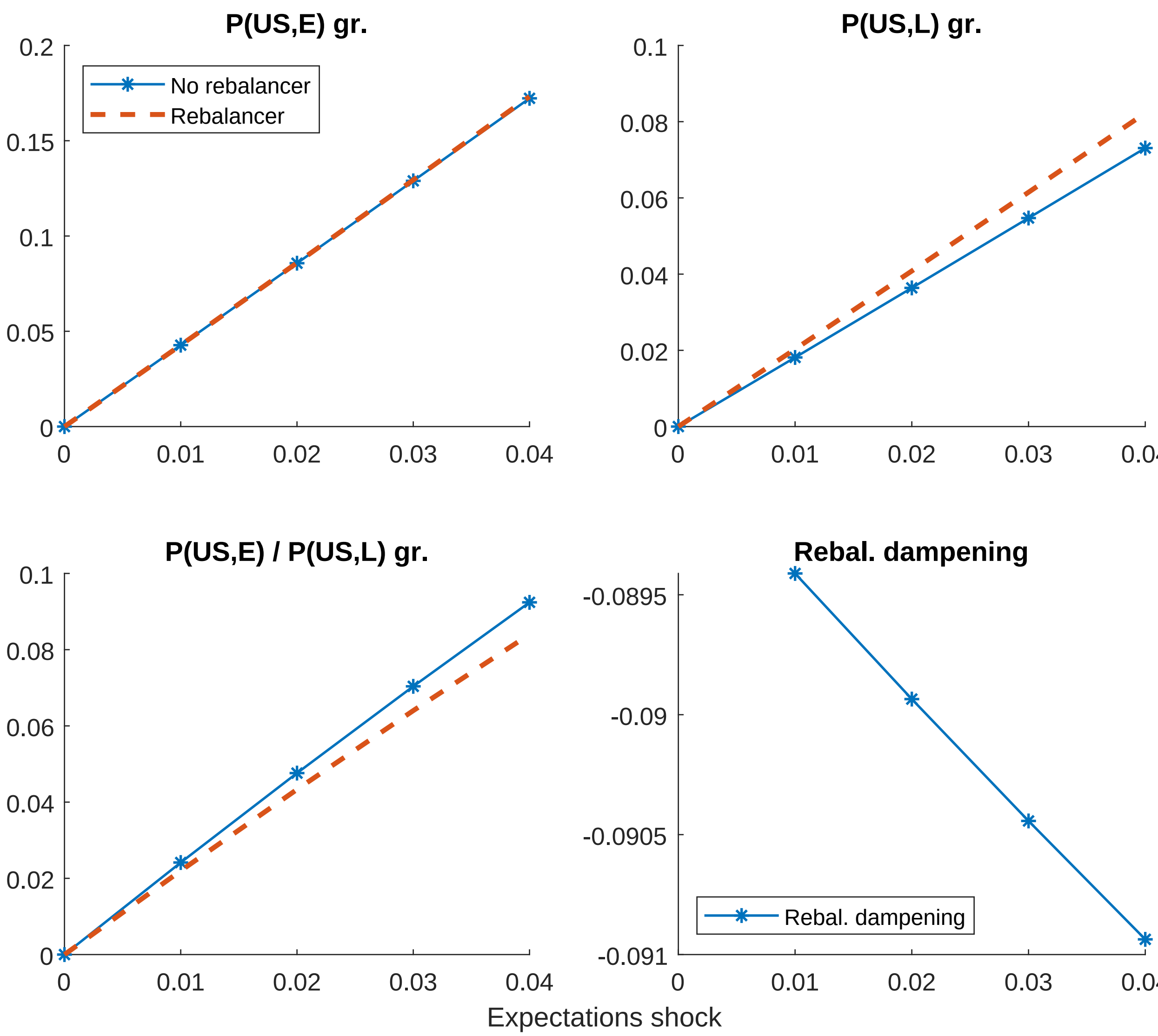


Figure D.10: Effect of expectations shock on asset prices with and without a rebalancer: vary rebalancer size

This figure shows how the rebalancer effect for a 1 percentage point U.S. equity return expectations shocks varies with the rebalancer share of U.S. domestic investment. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. The vertical lines correspond to the estimated rebalancer share of U.S. domestic investment: 13% (primary estimate), 8%, and 6%.

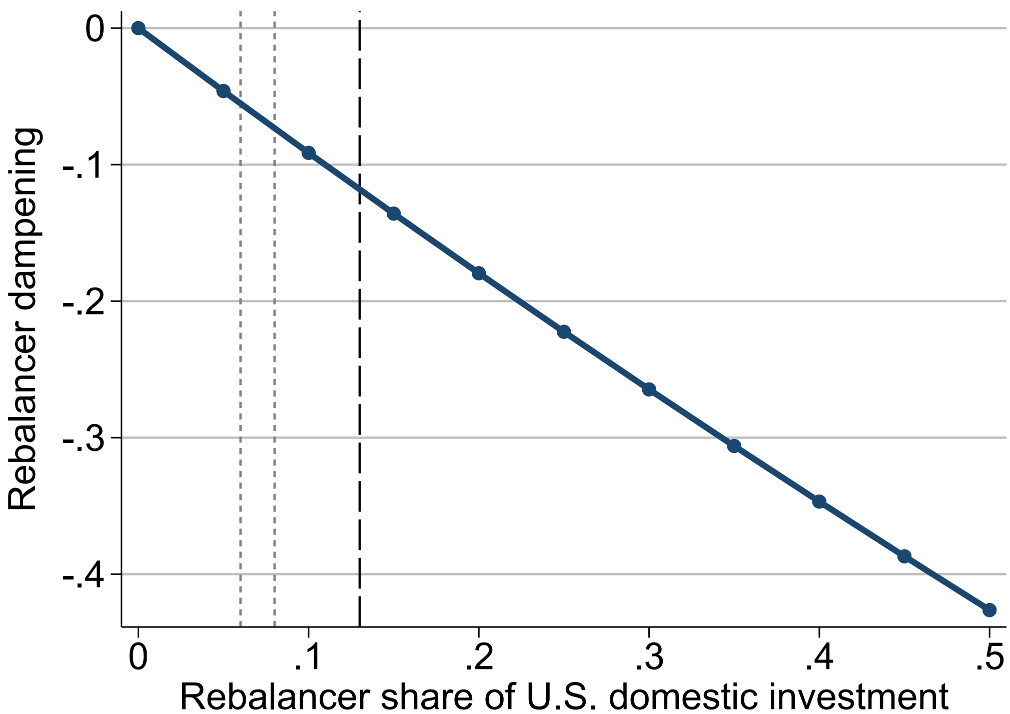


Figure D.11: Effect of expectations shock on asset prices with and without a rebalancer: 8% rebalancer

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the rebalancer comprises 8% of U.S. domestic assets.

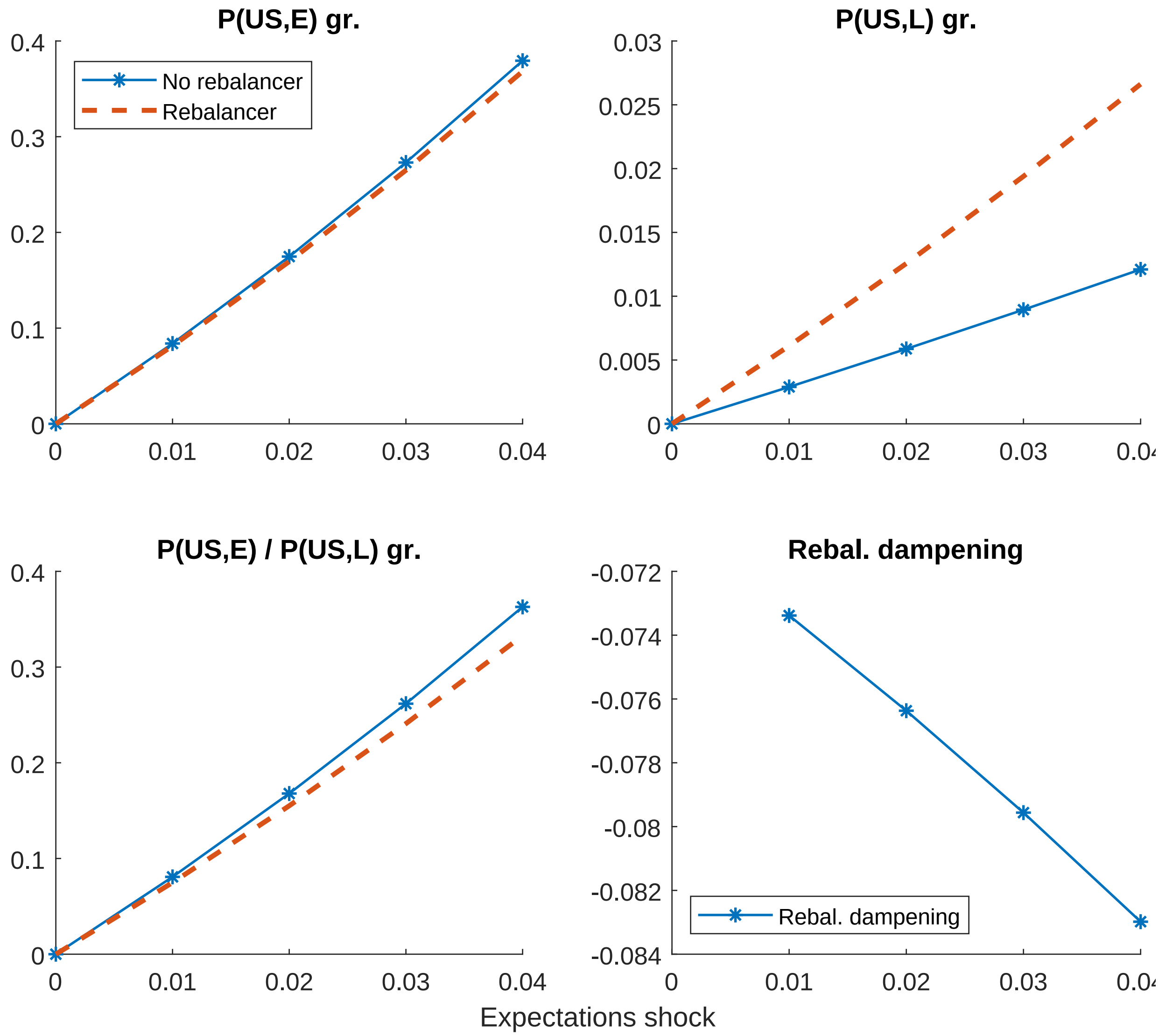


Figure D.12: Effect of expectations shock on asset prices with and without a rebalancer: 6% rebalancer

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the rebalancer comprises 6% of U.S. domestic assets.

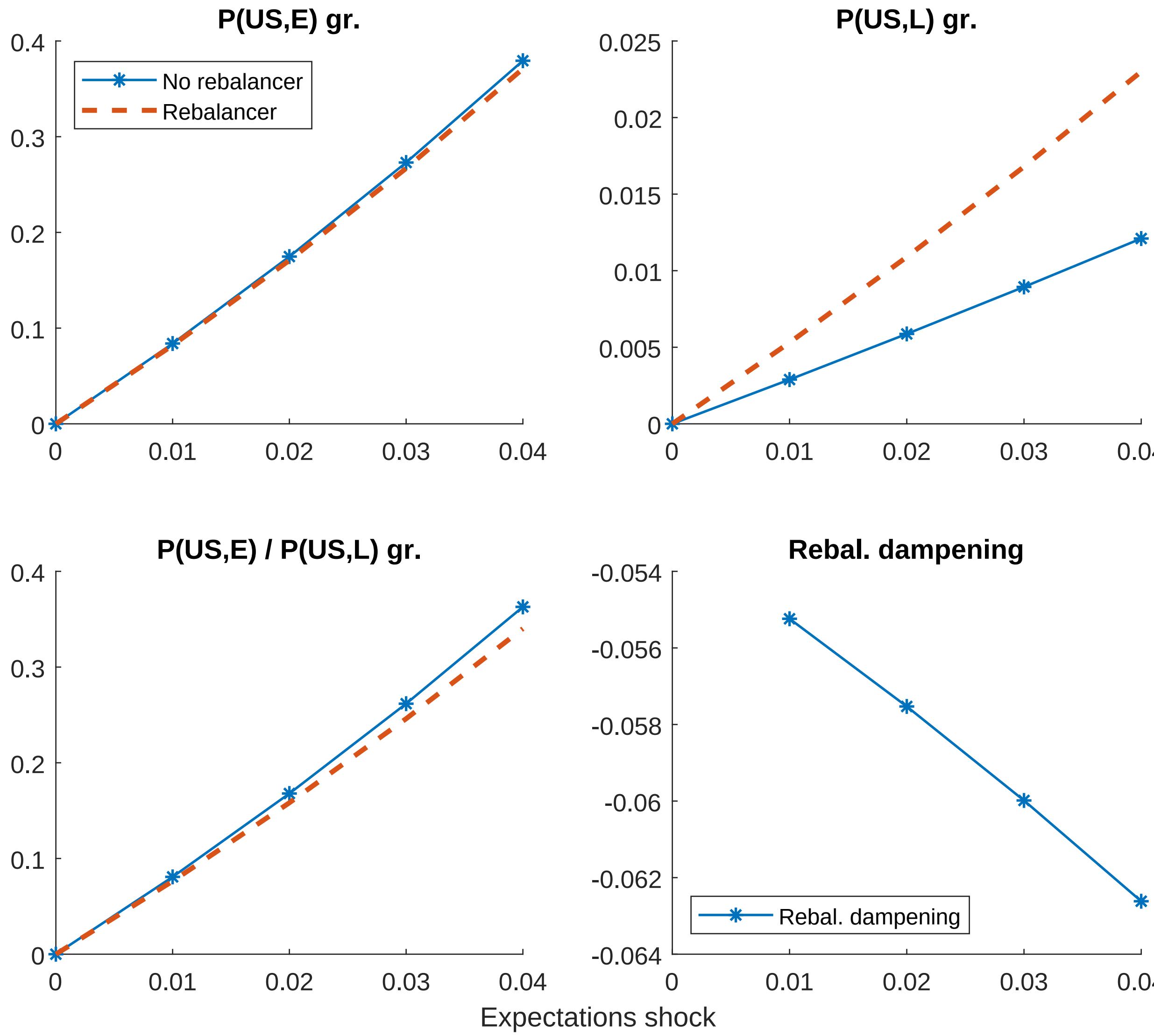


Figure D.13: Effect of expectations shock on asset prices with and without a rebalancer: rebalancer invests in short-term debt

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. *Average E(n)* shows a weighted average exchange rate of USD to local currency over non-U.S. countries, with weights determined by the total value of all outstanding issuances. In this variation of the model, the rebalancer invests in 60% equity, 36% long-term debt, and 4% short-term debt.

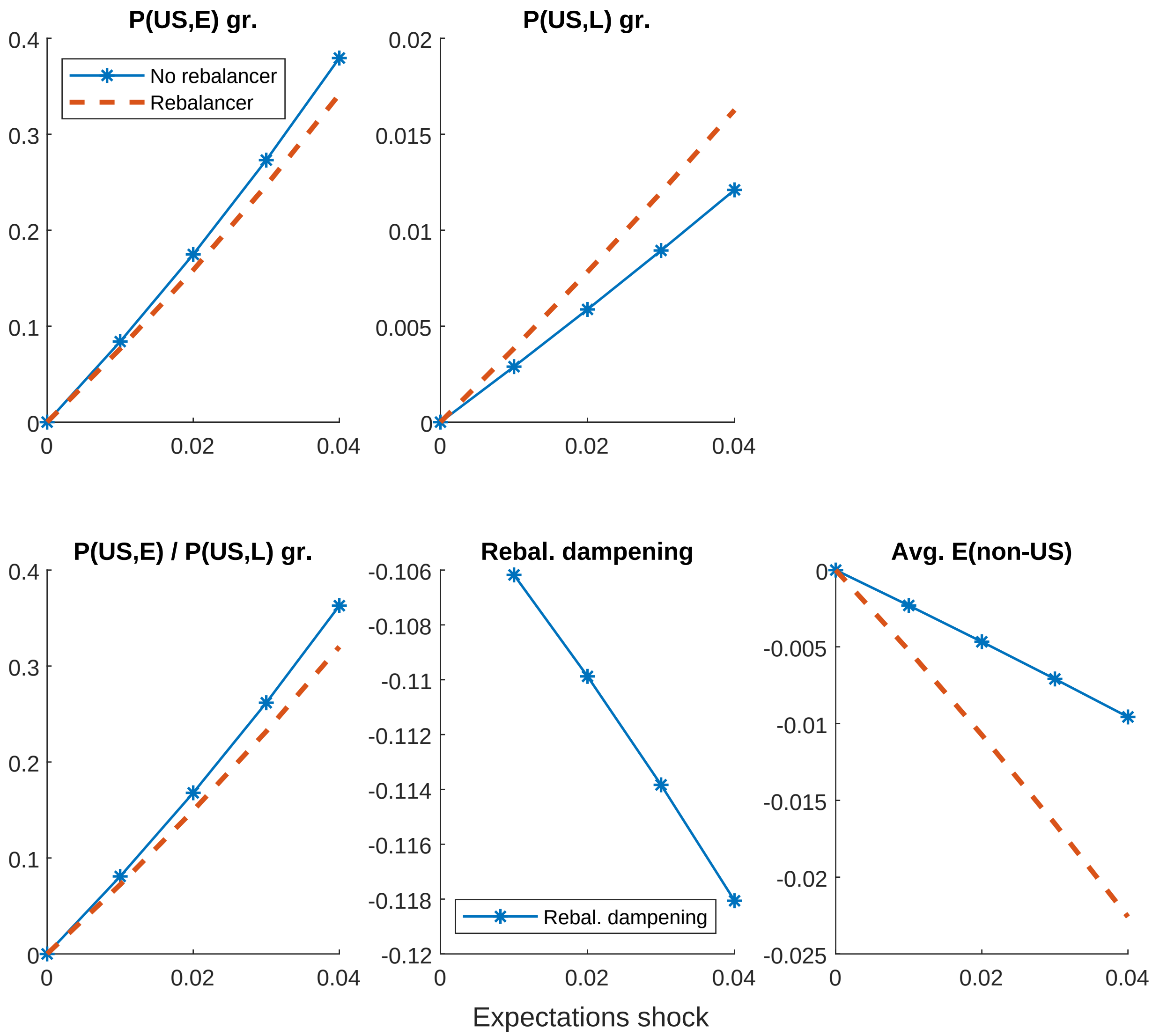


Figure D.14: Effect of expectations shock on asset prices with and without a rebalancer: vary rebalancer foreign asset share

This figure shows how the rebalancer effect for a 1 percentage point U.S. equity return expectations shock varies with the share of the rebalancer's portfolio in foreign investment while also setting the rebalancer size as a fraction of total U.S. investment. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. The dashed vertical line at the x-axis value of 0 represents the foreign share in the baseline model, and the dashed vertical line at 12% represents the foreign share of the U.S. non-rebalancer investor.

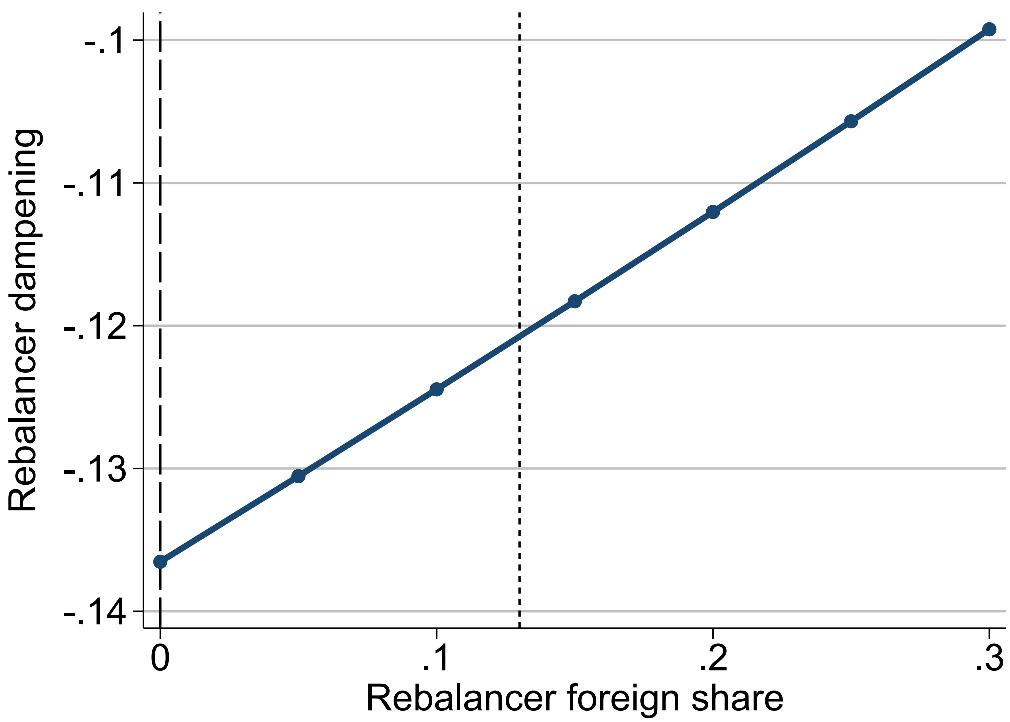


Figure D.15: Effect of expectations shock on asset prices with and without a rebalancer: rebalancer has positive foreign asset share

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the rebalancer comprises a 13% of total U.S. investment and invests 13% of each asset class in foreign assets.

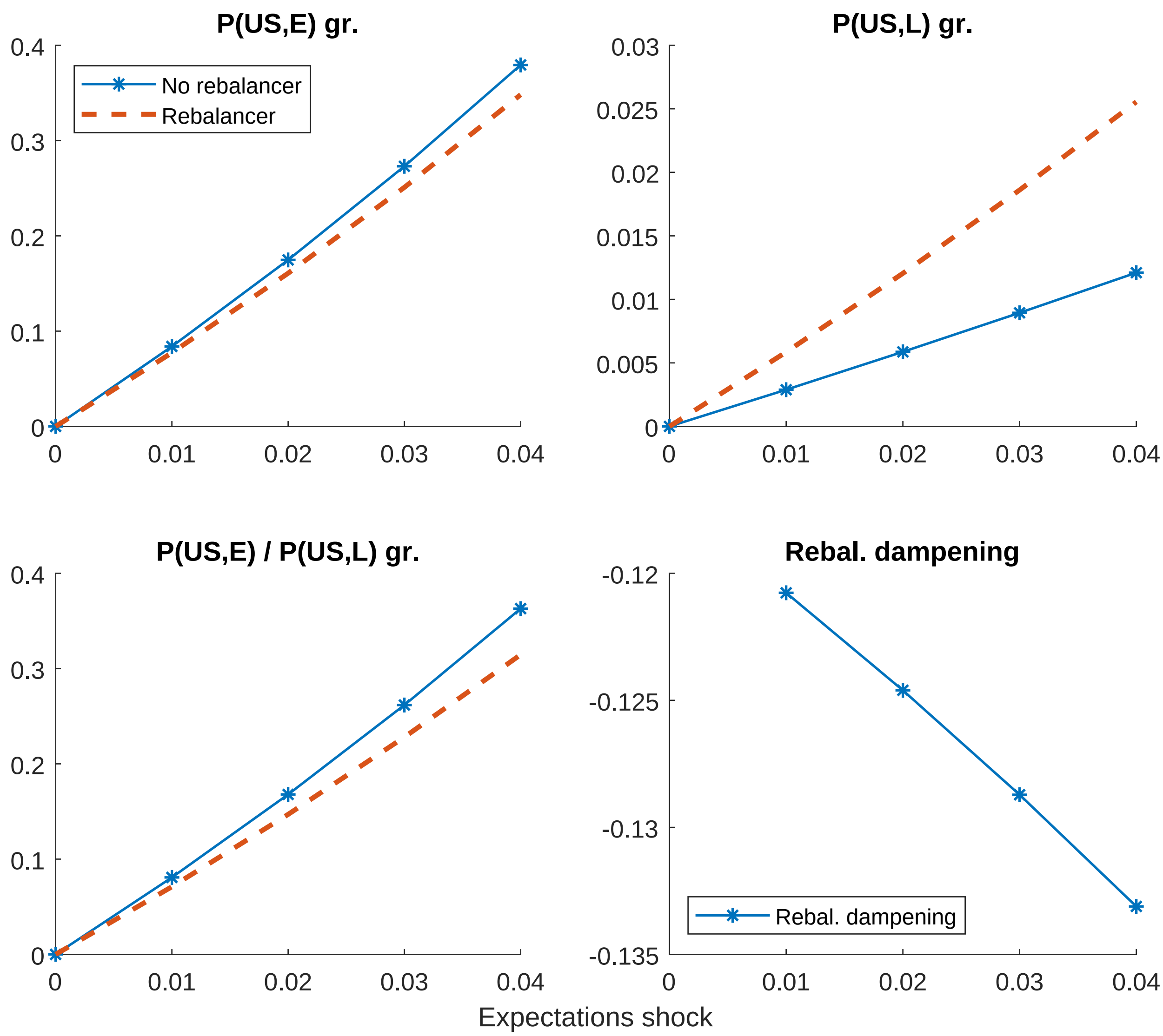


Table D.7: Decomposition by channel of expectations shock with and without a rebalancer: rebalancer has positive foreign asset share

(a) Small expectations shock

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.030	0.390	0.030	0.000	0.003	–0.008
ΔP_E across	0.022	0.289	0.026	–0.004	–0.152	0.419
ΔP_E within	0.025	0.321	0.027	–0.003	–0.098	0.280
ΔP_E total	0.077	1.000	0.084	–0.007	–0.079	0.691
ΔP_L wealth	0.030	5.137	0.030	–0.000	–0.004	0.011
ΔP_L across	–0.024	–4.137	–0.027	0.003	–0.112	–0.321
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	0.006	1.000	0.003	0.003	1.025	–0.309
$\Delta P_E - \Delta P_L$	0.071		0.081	–0.010	–0.118	1.000
$\Delta(P_E/P_L)$	0.071		0.081	–0.010	–0.121	1.019
ΔP_E - ΔP_L wealth	0.000		–0.000	0.000	0.006	–0.019
ΔP_E - ΔP_L across	0.047		0.054	–0.007	–0.040	0.739
ΔP_E - ΔP_L within	0.025		0.027	–0.003		0.280

(b) Large expectations shock

	R (Reb.)	Frac. of ΔP_l	NR (No reb.)	R - NR	(R - NR)/ NR	(R - NR)/ $\Delta P_E - \Delta P_L$
ΔP_E wealth	0.152	0.435	0.155	–0.004	–0.025	0.087
ΔP_E across	0.097	0.278	0.114	–0.017	–0.150	0.384
ΔP_E within	0.100	0.286	0.110	–0.010	–0.092	0.228
ΔP_E total	0.348	1.000	0.379	–0.031	–0.082	0.699
ΔP_L wealth	0.125	4.877	0.124	0.001	0.007	–0.021
ΔP_L across	–0.099	–3.877	–0.112	0.013	–0.112	–0.280
ΔP_L within	0.000	0.000	0.000	0.000		0.000
ΔP_L total	0.026	1.000	0.012	0.013	1.111	–0.301
$\Delta P_E - \Delta P_L$	0.323		0.367	–0.045	–0.122	1.000
$\Delta(P_E/P_L)$	0.315		0.363	–0.048	–0.133	1.082
ΔP_E - ΔP_L wealth	0.027		0.032	–0.005	–0.032	0.107
ΔP_E - ΔP_L across	0.196		0.226	–0.030	–0.038	0.665
ΔP_E - ΔP_L within	0.100		0.110	–0.010		0.228

Note: Table D.7a shows a decomposition, based on equation (20), of the equity price and long-term debt price change in response to a 1 percentage point equity returns expectations shock. In this variation of the model, the rebalancer comprises a 13% of total U.S. investment and invests 13% of each asset class in foreign assets. The first column refers to the setting with a rebalancer, the second column shows the magnitude of each component relative to the total price growth, the third column refers to the setting with no rebalancer, the fourth column shows the absolute difference of the rebalancer case minus the non-rebalancer case, the fifth column shows the growth compared to the non-rebalancer case, and the sixth column shows the difference of each component relative to the difference in the price growth measured using the approximation $\Delta P_E - \Delta P_L$. Table D.7b is similar except for a 4 percentage point shock.

Figure D.16: Effect of expectations shock on asset prices with and without a rebalancer: include foreign rebalancers

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, 13% of each foreign country's investment in the U.S. is treated as a rebalancer.

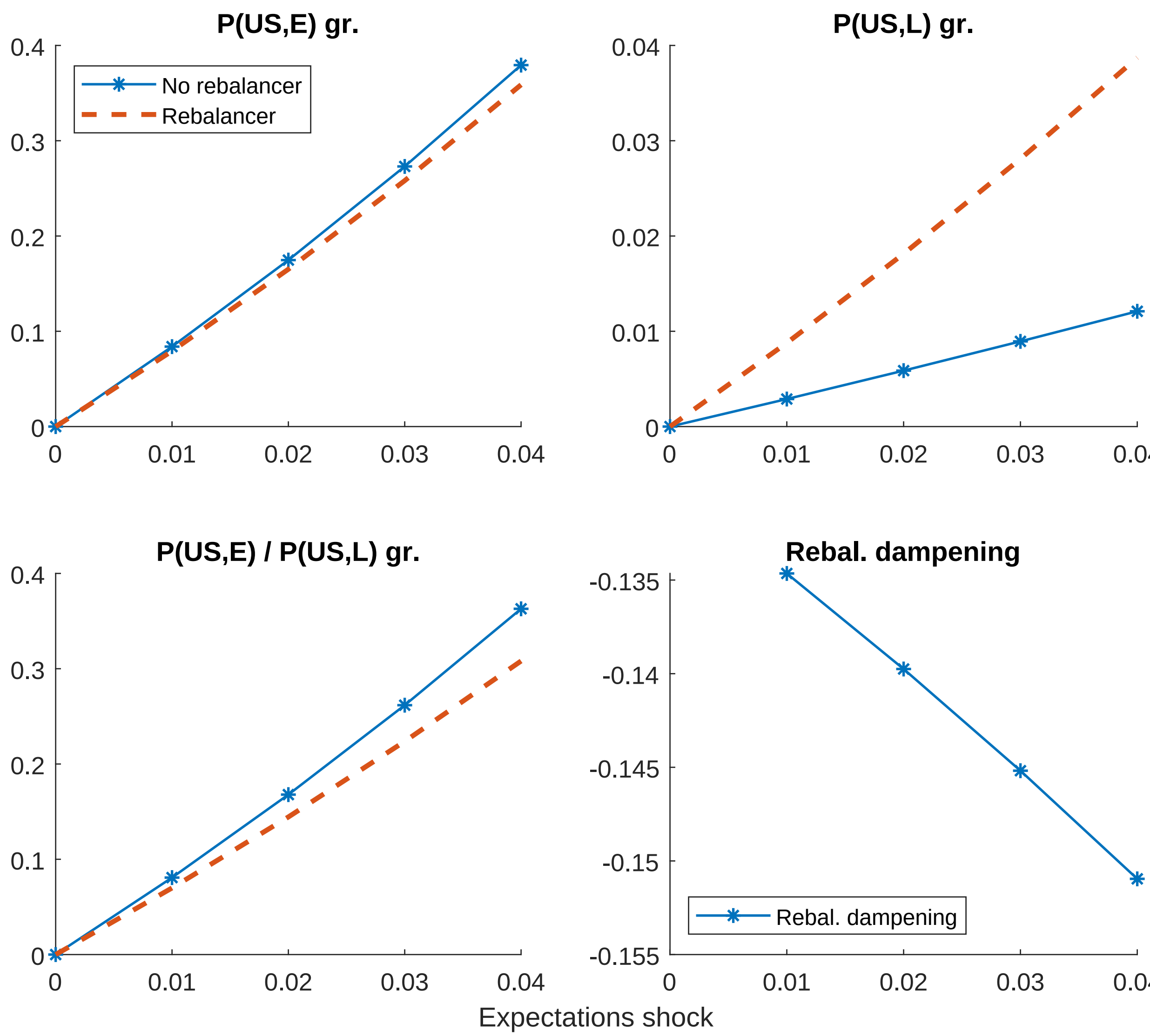


Figure D.17: Effect of expectations shock on asset prices with and without a rebalancer over time

This figure shows how the rebalancer effect for a 1 percentage point U.S. equity return expectations shock varies with the simulation year. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$.

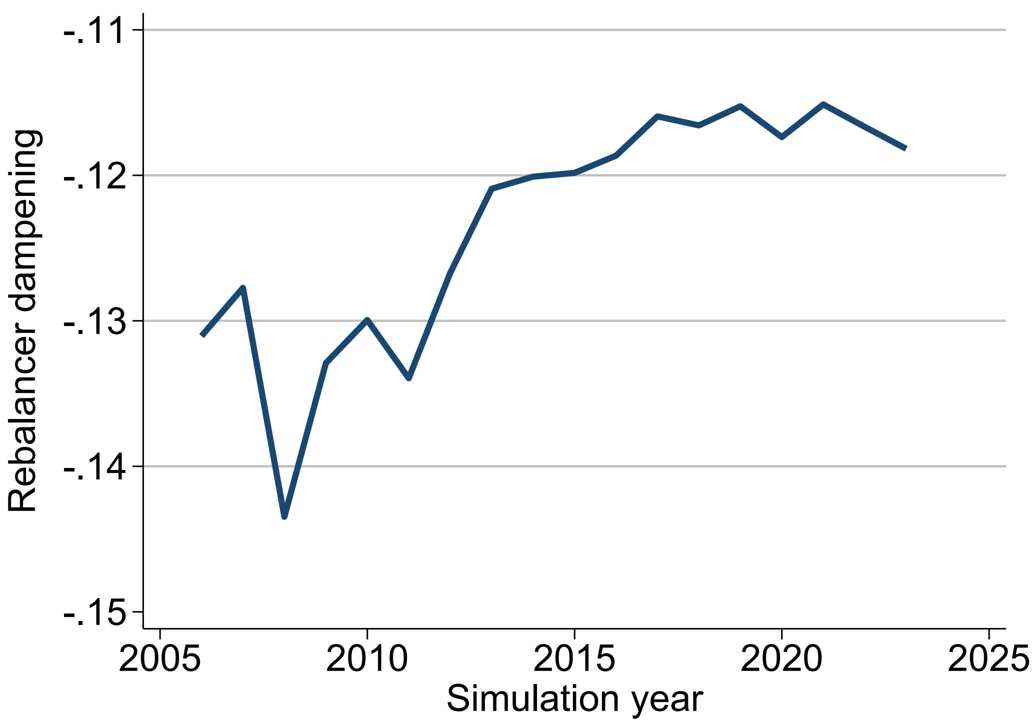
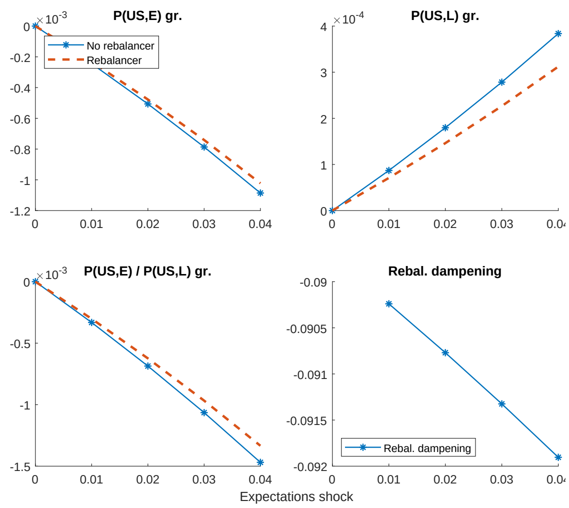


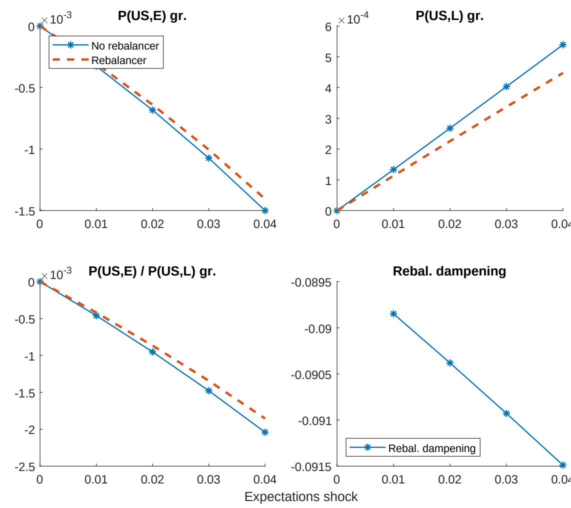
Figure D.18: Effect of expectations shock on asset prices with and without a rebalancer: shock to other country with U.S. rebalancer

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the returns expectations shock applies to equities in Canada (Figure D.18a), the U.K. (Figure D.18b), Germany (Figure D.18c), or Japan (Figure D.18d).

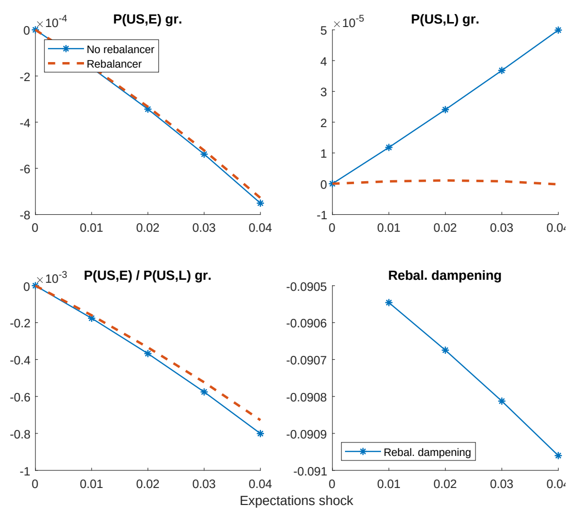
(a) Canada shock



(b) U.K. shock



(c) Germany shock



(d) Japan shock

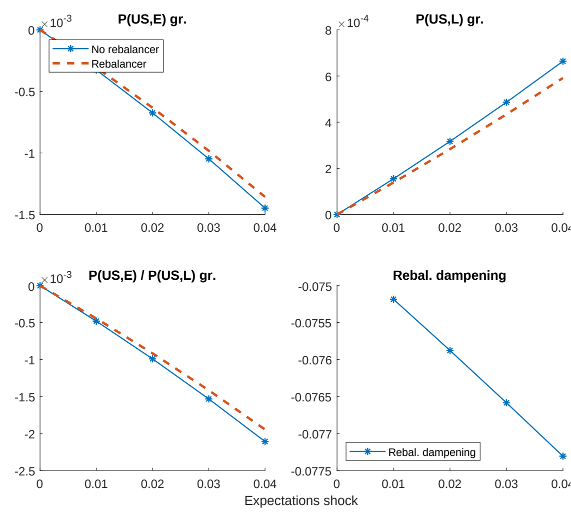
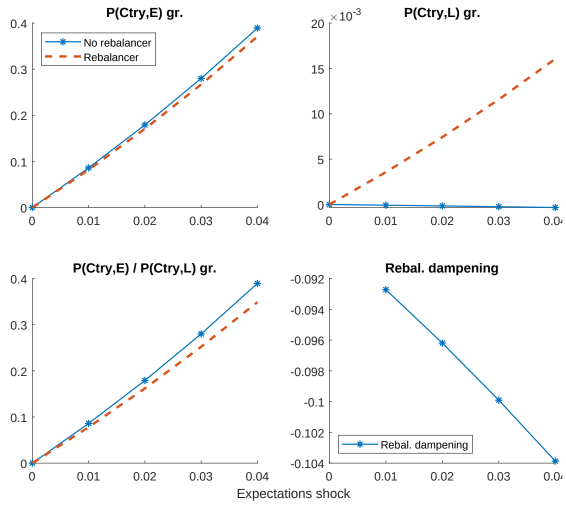


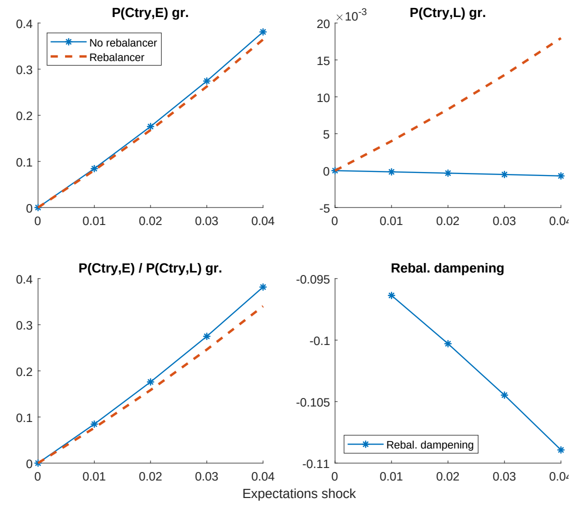
Figure D.19: Effect of expectations shock on asset prices with and without a rebalancer: shock to other country with other country rebalancer

This figure shows how the equity returns expectations shock for a given country and presence of a rebalancer in that country affect that country's equity price, its long-term debt price, its price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the returns expectations shock applies to equities in Canada (Figure D.18a), the U.K. (Figure D.18b), Germany (Figure D.18c), or Japan (Figure D.18d).

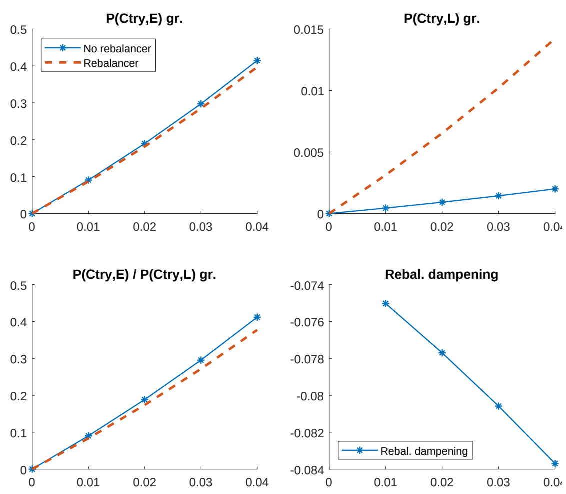
(a) Canada shock



(b) U.K. shock



(c) Germany shock



(d) Japan shock

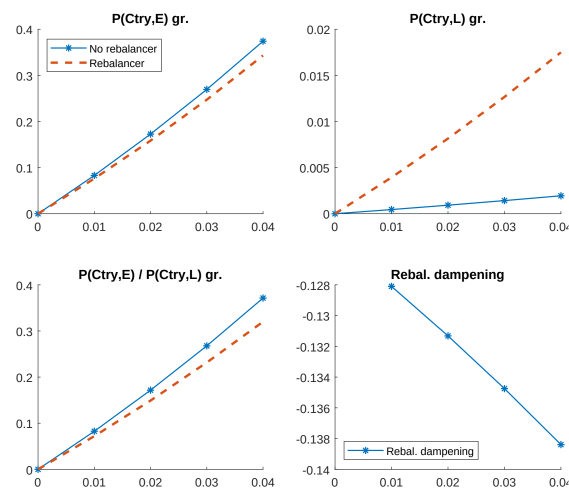


Figure D.20: Effect of expectations shock on asset prices with and without a rebalancer: shock to long-term debt

This figure shows how the equity returns expectations shock and presence of a rebalancer affect the U.S. equity price, the U.S. long-term debt price, the price ratio of equity to long-term debt, and the rebalancer effect. The rebalancer effect refers to the change in the equity to long-term debt price ratio in response to the expectations shock for the scenario with a rebalancer relative to the scenario without a rebalancer, or $\frac{\left(\frac{P_1^R(US,E)/P_1^R(US,L)}{P_0^R(US,E)/P_0^R(US,L)}-1\right)-\left(\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1\right)}{\frac{P_1^{NR}(US,E)/P_1^{NR}(US,L)}{P_0^{NR}(US,E)/P_0^{NR}(US,L)}-1}$. In this variation of the model, the shock applies to long-term debt.