The End of Privilege: A Reexamination of the Net Foreign Asset Position of the United States*

Andrew Atkeson Jonathan Heathcote Fabrizio Perri

UCLA Federal Reserve Bank of Minneapolis

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Abstract

The U.S. net foreign asset position has declined sharply since 2007 and is currently negative 65 percent of U.S. GDP. This deterioration primarily reflects a U.S.-specific rise in corporate asset values that has inflated the value of U.S. equity liabilities to the rest of the world. To interpret these trends we develop an international macro finance model of flows, stocks, asset valuations, the current account, and the net foreign asset position. We find that the welfare impact of rising asset values for a representative U.S. household has been quite negative given extensive foreign ownership of U.S. corporate equity.

JEL Classification Numbers: F30,F40

Key Words: Current account, Equity Markets, Global Imbalances

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1 Introduction

Figure 1 plots the net foreign asset position and current account of the United States from 1990 into 2022. The net foreign asset position (henceforth, NFA) is measured as the market value of the assets U.S. residents hold abroad minus the market value of U.S. assets held by residents of the rest of the world. The figure shows that over the 1990-2007 period, the United States maintained a relatively small negative net position, despite running sustained and substantial current account deficits. As discussed by Gourinchas and Rey (2007) and Gourinchas, Rey, and Govillot (2017), up until 2007, U.S. residents enjoyed the privilege of being able to borrow from the rest of the world without increasing U.S. net debt thanks to ex post favorable market revaluations of cross-border assets and liabilities.

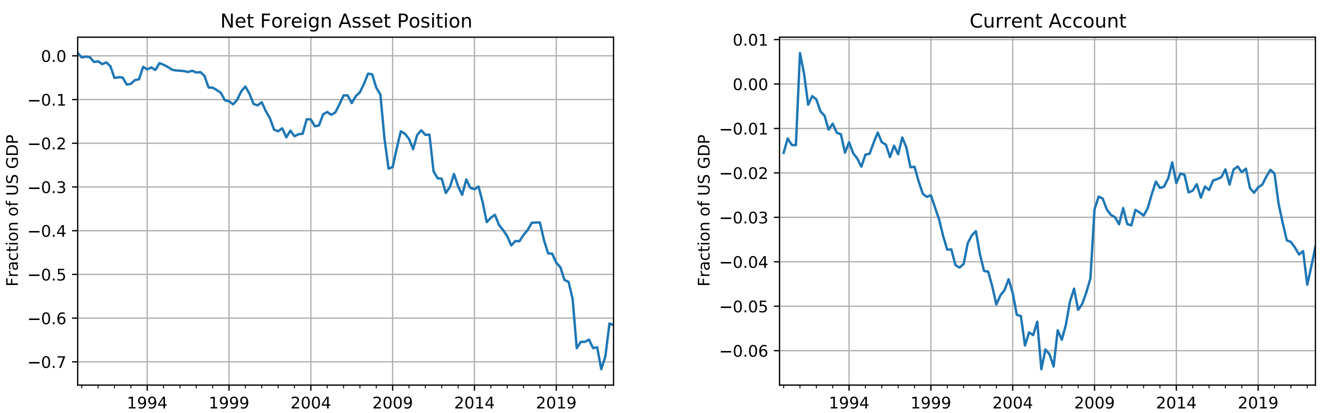


Figure 1: The U.S. Net Foreign Asset Position and Current Account: 1990-2022

In sharp contrast to this prior experience, from 2007 into 2021 the U.S. NFA position declined precipitously — by 60 percentage points of U.S. GDP — before bouncing back somewhat in the first three quarters of 2022. And this has occurred despite the fact that U.S. current account deficits have narrowed relative to the early 2000s.

We document that this unprecedented decline in the U.S. NFA position has been driven by a boom in the market valuation of the non-financial assets in U.S. corporations. Because foreigners' gross holdings of equity in U.S. corporations have grown to be very large, this boom has mechanically increased the market value of U.S. liabilities to the rest of the world (henceforth, ROW). There has not been a similar boom in the valuation of corporations in the ROW over this time period, so U.S. residents have not enjoyed a similar revaluation of their gross foreign equity assets. As a result, the net impact of asset revaluations accounts for a large portion of the deterioration in the U.S. NFA position over the past decade. In fact, as we show below, the negative impact of these revaluations of gross cross-border equity positions has been so large that the U.S. NFA position is now worse than it would have been if no asset revaluations had occurred at all since 1990. In this sense, any ex post "privilege" that U.S. residents might have previously enjoyed has been erased.[1]

Motivated by these observations, we ask two questions. First, what factors underlie this deterioration of the U.S. NFA position and the boom in the market valuation of U.S. corporations over the past decade? Second, what do these developments mean for the welfare of U.S. residents?

To answer these two questions, we develop a unified international macro-finance model of flows, stocks and valuations of the U.S. corporate sector and of the U.S. current account and NFA position. The model builds on Farhi and Gourio (2018) and Crouzet and Eberly (forthcoming) but extends those frameworks to an international setting to include international positions and flows.[2] The approach we take to integrating the current account follows the model of intertemporal trade under incomplete markets of Obstfeld and Rogoff (1995), Engel and Rogers (2006), Corsetti and Konstantinou (2012) and many others. Model households in two regions (the U.S. and ROW) trade domestic and foreign equity and risk-free bonds. Firms in both countries enjoy pricing power that translates to rents payable to their shareholders that Karabarbounis and Neiman (2019) refer to as *factorless income*. The size of this factorless income can vary across countries and over time, generating fluctuations in equity valuations relative to value added. Additional sources of time variation in asset values include fluctuations in the equilibrium discount rate applied to future cash flows, fluctuations in expected future growth rates, fluctuations in the replacement cost of capital, and fluctuations in corporate tax rates.

The model is fully tractable. We exploit its tractability to measure the factors driving observed flows, stocks and valuations of the U.S. corporate sector, together with the evolution of the U.S. current account and NFA position, in quarterly data over the period 1990-2022. Our measurement procedure is similar to that developed in Chari, Kehoe, and McGrattan (2007) in that we saturate the model with interpretable time-varying parameters and compute

[1] Gourinchas and Rey (2014), Gourinchas, Rey, and Govillot (2017), Chen et al. (2022), Choi, Kirpalani, and Perez (2022), Gourinchas (2023) and many others discuss the role of ex-ante return differentials on U.S. foreign assets and liabilities in shaping the U.S. external position. See Curcuru, Thomas, and Warnock (2013) and Bertaut et al. (2023) for critical reviews of the evidence for an ex-ante difference in expected returns on U.S. foreign assets and liabilities. In our analysis, we do not assume any ex-ante return differential on U.S. assets and liabilities. We focus our analysis on the impact of differences in ex-post realized returns. Other authors have also highlighted the large boom in the value of U.S. assets and its impact on the U.S. NFA position; see, for example, Jiang, Richmond, and Zhang (2020) and Milesi-Ferretti (2021).

[2] See also Caballero, Farhi, and Gourinchas (2017), Gutiérrez and Philippon (2017), Eggertsson, Robbins, and Wold (2021), Greenwald, Lettau, and Ludvigson (2021), Corhay, Kung, and Schmid (2021) and others for macrofinance models of the boom in the valuation of U.S. corporations.

parameter values such that the model matches the data period by period. We then simulate counterfactual model scenarios relative to our baseline to study how the factors driving equity values impacted the welfare of U.S. households. We have two main findings.

First, we find that much of the increase in the market valuation of the non-financial assets in U.S. corporations over the past decade has been due a dramatic increase in the free cash flow from operations available to pay to owners of firms. We define this free cash flow to owners of firms as the amount left over from corporate sector value added after deducting payments to labor, taxes (both indirect business taxes and taxes on corporate profits), and investment expenditures on new non-financial assets. As such, free cash flow can be measured from the National Income and Product Accounts (NIPA) with minimal model assumptions. This increase in the free cash flow from U.S. corporations relative to corporate gross value added (henceforth, GVA) is unprecedented in post-WWII data. We find that changes in the valuation multiple applied to those cash flows have played a much smaller role in driving the increased valuation of U.S. corporations. In our accounting, some of this increase in corporate free cash flow is due to changes in taxes and the share of labor in costs, but the lion's share is due to an increase in the wedge between revenue and total cost, resulting in a large increase in the share of factorless income in U.S. corporate GVA. In what follows, we refer to this wedge as the *output wedge*.[3]

Second, when we use our model to simulate counterfactuals, we find that the welfare implications of these developments driving the increase in valuation of U.S. corporations are dramatically impacted by the observed large increase in gross cross-border equity positions. Specifically, we find that had U.S. residents been the sole owners of U.S. corporations, the observed rise in the output wedge would have had only a small impact on the welfare of a representative U.S. household. This welfare impact would have been small because lower wage income would have been largely offset by higher free cash flow to U.S. households as owners of U.S. corporations.[4] In contrast, given the large cross-border equity positions observed in the data, we find that the observed rise in the output wedge has a large negative impact on the consumption of U.S. residents. The reason is simple: much of the increase in

[3]We use the terminology *output wedge,* as this wedge in our model plays the same role as the output distortion in Hsieh and Klenow (2009) and the "markups" in Farhi and Gourio (2018), Baqaee and Farhi (2020), Barkai (2020), and Crouzet and Eberly (2018). That is, this determines the share of revenue that corresponds to factorless income and distorts firms' incentives to accumulate physical capital. It is distinct from the measure of markups of price over marginal variable cost presented by De Loecker, Eeckhout, and Unger (2020). In their paper, they consider capital to be a fixed factor within the period, and thus it is not part of marginal cost, but it is part of total cost and hence must be considered in computing factorless income.

[4]See, for example, Corollary 1 in Baqaee and Farhi (2020) for a theoretical derivation of this result for a small change in the output wedge in a closed economy. This quantitative finding in our model is obtained given a large increase in the output wedge.

free cash flow of U.S. firms is paid to foreign owners.

Could the transfer of resources from U.S. residents to foreign equity owners that follows a rise in the U.S. output wedge be interpreted as part of an ex ante efficient international risk sharing arrangement? In the context of our model exercise, the answer is no: U.S. residents do not benefit from a rise in the output wedge, so risk sharing would not prescribe a transfer of resources abroad in response to this shock.[5]

We make three principal contributions to the literature.

First, we build a model to provide an integrated accounting of flows, stocks and valuations of the U.S. corporate sector and of the U.S. current account and NFA position. It has long been recognized that the current account and net foreign asset position of a country are impacted not only by changes in capital accumulation but also through changes in asset valuations, both directly through revaluations of existing cross-border asset holdings and indirectly through wealth effects impacting the ratio of consumption to income.[6] While all of these effects are present qualitatively in standard international business cycle models, these standard models typically do not account quantitatively for the large changes in valuations of firms at home and abroad observed in the data. Here, we address this shortcoming of standard international business cycle models by extending the recent macro-finance literature that has been developed to account for large observed changes in the valuation of U.S. corporations. We use this model to better understand the links between changes in asset valuations on the one hand, and current account and NFA dynamics on the other.

Second, we bring additional data to bear on the question of whether the observed increase in the market valuation of the U.S. corporate sector is driven by an increase in cash flows to owners of firms or by a change in the valuation multiple of those cash flows. By including data on the current account in our measurement, we are able, through the model, to separately identify the impact on valuation of the cost of capital versus the rate of future expected growth, as these variables have an impact on the current account that is distinct from their impact on the valuation of domestic firms. Our model-based measurement comes down in favor of a stable ratio of expected free cash flow to the market value of non-financial assets in U.S. corporations over the past decade, as the model requires a relatively stable valuation ratio to account for the relative stability of the U.S. current account balance.

Third, and perhaps most important, as we discuss above, we find that conclusions regard-

[5]Such transfers could be part of an efficient risk sharing arrangement if increases in the output wedge were associated with an increase in the relative productivity of U.S. firms. We view exploring this possibility in the context of a version of the model with a wider set of country-specific shocks as an interesting future application of our framework.

[6]See, for example, Lane and Milesi-Ferretti (2001), Lane and Milesi-Ferretti (2007) and subsequent updates of these data by these authors, and the discussion of the literature on the current account and NFA position in Gourinchas and Rey (2014).

ing the welfare costs to U.S. residents of a large increase in the share of corporate value added attributed to factorless income are highly sensitive to the extent of cross-border diversification of equity positions.

One important assumption in our baseline analysis is that the valuation multiple relevant for future factorless income is also the one used to value future labor income. The representative U.S. household in our model can borrow against future labor income, and changes in the discount factor or the long-term expected growth rate therefore impact the current account via their impact on U.S. household human wealth. As discussed in Lustig and Van Nieuwerburgh (2008), the assumption that future factorless income and labor income are valued at the same discount rate may not hold in the data. Moreover, U.S. households may not be able to borrow against future labor income, as in Greenwald, Lettau, and Ludvigson (2021).

To assess the sensitivity of our findings regarding the driving forces behind the boom in U.S. corporate valuation to this assumption, we conduct an array of alternative measurement exercises in which we do not use data on the current account to identify parameter values. Instead we use a measurement procedure similar to that in Farhi and Gourio (2018) and Crouzet and Eberly (forthcoming) to consider a wide range of alternative scenarios for expected future growth rates or for the gap between the discount factor and expected future growth.[7] We find that the conclusion that much of the increase in the market valuation of U.S. corporations over the past decade is due to an increase in the output wedge is robust to this wide range of alternative measurements.

A second important assumption in our analysis is that the extent of international diversification of equity positions is accurately measured in the Integrated Macroeconomic Accounts. Avdjiev et al. (2018) and Lane (2020) provide an excellent overview of the difficulties in measuring corporate activity on a residence basis and in measuring cross-border equity positions.[8] To address concerns about the sensitivity of our results to measurement and valuation of international equity positions, we conduct alternative model exercises with smaller estimates of gross cross border equity positions in Appendix C.3. As expected, with smaller cross-border equity positions, the welfare implications for U.S. households of the boom in the value of U.S. corporations are mitigated, but remain substantial.

The remainder of the paper is organized as follows. In Section 2 and Appendix A, we present the data we use on the evolution of the U.S. NFA position and current account since 1990, and the flows, stocks, and valuation of the U.S. corporate sector. In Section 3, we

[7] We describe how our measurement procedure relates to that used in prior macro-finance papers in greater detail in Appendix E.

[8] In Appendix C, we discuss several important concerns regarding the measurement of gross cross border equity positions and the valuation of cross-border direct investment equity that have been raised in the prior literature. We do not make a contribution to resolving these data concerns.

describe the international macro-finance model we use to interpret this data. In Section 4 and Appendix D, we describe how we use the model to measure the factors driving the flows, stocks, and valuation of the U.S. corporate sector as well as the U.S. current account and NFA position. We present our baseline findings in Section 5. Section 6 contains our counterfactual exercises to evaluate the welfare impact of changing valuations. Sensitivity analysis is in Section 7.

2 The Evolution of the U.S. Current Account, NFA Position and the U.S. Corporate Sector: 1990-2022

In this section, we review the measurement concepts and data we analyze with our model. We begin with a discussion of the evolution of the U.S. NFA position and then turn to the data on flows, stocks, and valuation of the U.S. corporate sector. Details on the data series used are provided in Appendix A.

2.1 The NFA and its components

The starting point of our analysis is accounting identity (1) below, showing that the change in the NFA position between the end of periods $t-1$ and t is the sum of three components. The first, (CA_t), is the balance of the current account during period t; this term captures net U.S. lending abroad measured as the sum of net exports and net income receipts. The second term, (VA_t), captures the net change in the valuations of the existing assets that compose the gross external positions. The third term, (RES_t), is a residual, which reconciles the changes in the NFA position resulting from measured financial transactions and asset positions with the ones resulting from current account transactions.[9] Thus,

$$NFA_t - NFA_{t-1} = \underbrace{CA_t}_{\text{net lending abroad}} + \underbrace{VA_t}_{\text{valuation effects}} + \underbrace{RES_t}_{\text{residual term}} . \tag{1}$$

Summing (1) from period 1 to period t yields

$$NFA_t = NFA_0 + \underbrace{\sum_{j=1}^{t} CA_j}_{\text{cumulated CA}} + \underbrace{\sum_{j=1}^{t} VA_j}_{\text{cumulated valuations}} + \underbrace{\sum_{j=1}^{t} RES_j}_{\text{cumulated residuals}} , \tag{2}$$

[9] See Curcuru, Dvorak, and Warnock (2008), Section 3, for a discussion of these discrepancies arising from differences in the measurement of international financial flows and positions.

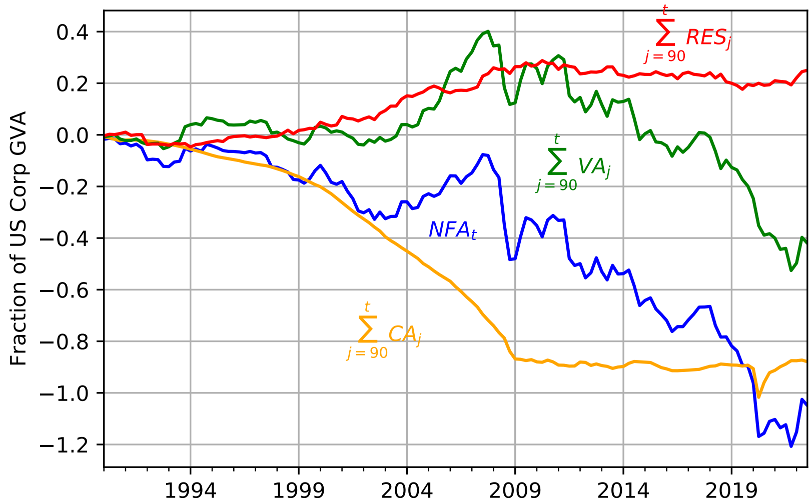


Figure 2: Decomposition of Changes in U.S. NFA over U.S. Corporate Value Added

showing that the NFA position in any period can be expressed as the cumulated sums of the three terms described above.

Figure 2 shows the evolution of the three components in equation (2), each divided by U.S. corporate GVA in each quarter t, from 1990 Q1 until 2022 Q3. The figure shows three different phases in the evolution of the U.S. NFA position. During the first phase (1990–2002), the NFA position closely tracked cumulative current account dynamics. During the second phase (2002–2007), the cumulative current account continued to deteriorate, but the NFA position improved, owing to a combination of positive valuation effects and positive statistical discrepancies. This period was the focus of Gourinchas and Rey (2007) and Gourinchas and Rey (2014), who noticed that valuation effects, which increased the value of foreign assets held by U.S. residents relative to the value of U.S. assets held by foreigners, acted as a stabilizing counterweight to growing current account deficits. In the third and final phase (2007–2022), the U.S. NFA position declined substantially, despite a fairly stable (relative to corporate GVA) cumulated current account deficit. Note that by 2020, the U.S. NFA position was *more* negative than cumulated current accounts over the entire 1990 to 2020 period. As is evident in the figure, a large portion of the decline of the U.S. NFA position in this third phase was driven by negative valuation effects, meaning that during this period, U.S. residents experienced consistently lower capital gains on their foreign asset holdings than those enjoyed by ROW residents on their U.S. assets.

2.1.1 Decomposing valuation effects

Since cumulated valuation effects are an important determinant of the evolution of the U.S. NFA position, we now proceed to analyze in more detail the sources and the impacts of these valuation changes. As a matter of accounting, valuation effects are given by

$$VA_t = FA_{t-1} \times g_t^{P^*} - FL_{t-1} \times g_t^P, \tag{3}$$

where FA_{t-1} and FL_{t-1} are gross U.S. net foreign asset and liability positions at the end of $t-1$, and $g_t^{P^*}$ and g_t^P are the net growth rates in the dollar values of those positions between the end of $t-1$ and the end of period t. It is immediate from this expression that there are two necessary conditions for valuation effects to matter quantitatively: (1) gross positions must be large, and (2) the values of foreign assets and foreign liabilities cannot co-move too closely. We now document that both these conditions have been satisfied in the past decade.

It is useful to divide U.S. foreign positions into two broad categories: equity and non-equity investments. Equity investment includes portfolio investment in corporate equities and the equity component of foreign direct investment (FDI). At the beginning of our sample, when international equity markets were still relatively underdeveloped, FDI was the main component of both inward and outward equity investment, accounting for 80 percent of both positions. Toward the end of our sample, with large and active international equity markets, portfolio and direct equity investment have roughly equal shares. Non-equity assets include debt securities, loans, and currency and deposits. Figure 3 plots the evolutions of these categories of U.S. foreign assets and liabilities as fractions of U.S. corporate GVA.

The first key message from Figure 3 is that by 2007, all the gross positions are large, and thus changes in the prices of the assets composing these positions can potentially generate significant valuation effects. The second key message is that over the past decade, U.S. equity liabilities have been large and now are larger in absolute terms than U.S. equity foreign assets. Thus, changes in the price of U.S. equity that are not matched by identical changes in the price of ROW equity will have much larger effects on the U.S. NFA position than would have been the case in the past.

We now turn to changes in asset valuations. Figure 4a decomposes the cumulated valuation effects plotted in Figure 2 into valuation effects arising from equity and non-equity positions. The figure shows that net valuation changes arise almost exclusively from the equity positions. Although in principle both categories are subject to relative valuation changes (due both to price changes and to exchange rate movements for assets denominated in different currencies), these effects are quantitatively much more important for the equity

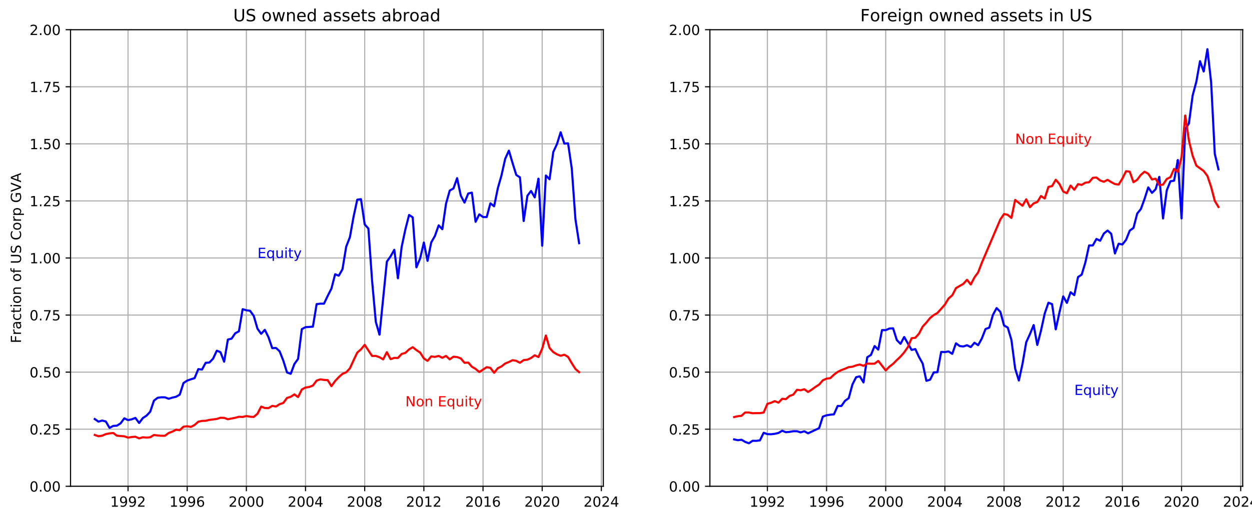


Figure 3: Gross Equity and Non-Equity Positions over U.S. Corporate Value Added

positions.[10]

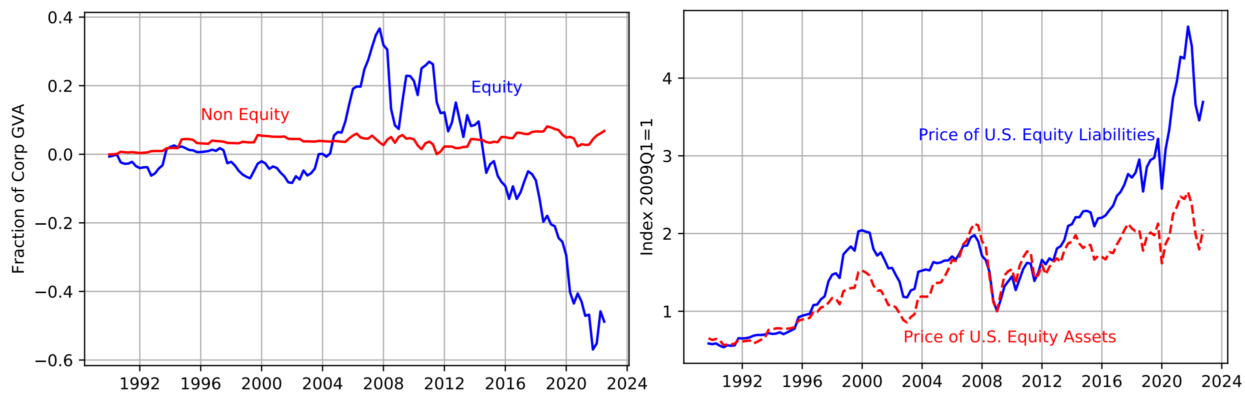
Why are equity valuation effects so large? Figure 4b plots the price indexes, both in dollar terms, that the BEA uses to revalue U.S. equity assets and liabilities. We have normalized the price indexes so that both are equal to one in the first quarter of 2009. Recall that the equity valuation effects in Figure 4a are computed by multiplying the gross equity asset and liability positions plotted in Figure 3 by the growth in these price indexes (equation 3).

In the 1990s, the price of U.S. equity liabilities rose more rapidly than the price of U.S. foreign equity assets. But cumulated valuation effects were small, because gross international equity positions were relatively small in the early part of our sample (Figure 3), so international differentials in equity price dynamics did not translate into large effects on the value of the NFA position.

By the mid 2000s, gross cross-border equity positions were larger, and because equity markets in the ROW outperformed the U.S. during this period, the U.S. NFA position improved.

In the post GFC period, gross equity positions were larger still. A dramatic rise in U.S. equity prices over this period applied to very large gross equity liabilities led to a sharp

[10]One reason why valuation effects for non-equity assets are so small is that foreign bonds owned by Americans tend to be dollar-denominated, as are bond liabilities (see Maggiori, Neiman, and Schreger 2020). Regarding the equity valuation effects, in Appendix C.2, we break down the cumulated valuation changes for equity into those coming from FDI equity versus those from portfolio investment in equity; see Figure C.1. Cumulated valuation effects for equity are roughly equally split between the two components.



(a) Cumulated Valuation Changes: Equity and Non-Equity Positions

(b) Prices of U.S. Equity Positions

Figure 4: Valuation Effects

increase in the value of U.S. equity liabilities. In particular, the dollar price of U.S. equity liabilities peaked in 2021 at over 4.5 times the price at the end of 2008, while the price of U.S. foreign equity assets rose by only a factor of two. Thus, the value of U.S. foreign equity assets rose by much more than the value of equity liabilities, translating into an unprecedented decline in the U.S. NFA position.

To summarize, differential equity price growth matters more for the NFA position when gross international equity positions are large. U.S. equity markets outperformed in the post 2010 period, precisely when it mattered most for the NFA position.

Do equity valuation changes arise from changes in the local currency price of equity or from movements in exchange rates? In Appendix B we show that dollar depreciation was an important factor in explaining the net positive equity valuation effect in the 2002-2007 period. However, dollar appreciation accounts for less than 20 percent of the negative equity valuation effect the U.S. experienced over the period 2010-2022. Over 80 percent of the decline in the net valuation change for equity over this period reflects the fact that U.S. equity prices rose by much more than foreign equity prices in local currency terms.

2.2 Flows, stocks, and valuation of the U.S. corporate sector

We have shown that changes in U.S. equity values play a very important role, in an accounting sense, in explaining changes in the U.S. NFA position. We will build an economic model to interpret the causes and welfare consequences of these valuation effects. That model will incorporate a range of additional data that we now describe. We first define measurement concepts that are consistent across the model and data for flows including value added, taxes, labor compensation, investment, dividends, and earnings. We then discuss our measurement of stocks, including the reproduction value of the stock of capital in the corporate sector, and the value of corporations.

2.2.1 Flows in the U.S. Corporate Sector

We use Tables S.5 and S.6 of the Integrated Macroeconomic Accounts to measure the flows and balance sheets of the U.S. corporate sector. Table S.5 presents data for the non-financial corporate business sector, and Table S.6 presents data for the financial business sector. The overwhelming portion of foreign portfolio and direct investment into the United States is directed toward these two sectors. We combine these two accounts into an aggregated corporate sector. The national accounts follow the residence principle. Thus, the value added of U.S.-resident affiliates of foreign multinationals is counted as part of U.S. value added, while the value added by U.S.-owned businesses abroad is not.

The gross value added (GVA) of these sectors is divided into four categories of income in Tables S.5 and S.6: consumption of fixed capital (depreciation), compensation of employees, taxes on production and imports less subsidies, and net operating surplus. We measure the *earnings* of the corporate sector as net operating surplus less current taxes on income and wealth. We measure the free cash flow or *dividends* of the corporate sector as net operating surplus less current taxes on income and wealth less net capital formation. This measure of free cash flow corresponds to the after-tax cash flow from operations of corporations resident in the United States that is available to be paid out to investors in the debt and equity of those corporations. Note that in the data, only some of this cash flow is actually paid out to investors, while the rest of it is used to acquire, on net, financial assets (as accounted for in Tables S.5 and S.6). Thus, our empirical measures of earnings and dividends correspond to what those objects would be if firms were 100 percent equity financed and maintained no financial assets.

In Figure 5, we examine the ratio of our measure of free cash flow to U.S. corporate sector GVA. We see that this ratio has risen substantially over the past 14 years, compared with the period before 2007. Figure A.3 shows this ratio in annual data from 1929 to 2021. It is clear from these two figures that the recent increase in payouts to firm owners is unprecedented in post-WWII data. This increase in payouts arises from a combination of reductions in taxes, labor compensation, and investment as ratios to corporate gross value added. Note that this measure of payouts to owners of firms is measured directly from national accounts, and does not require any imputations of compensation to physical capital or depreciation of that capital.

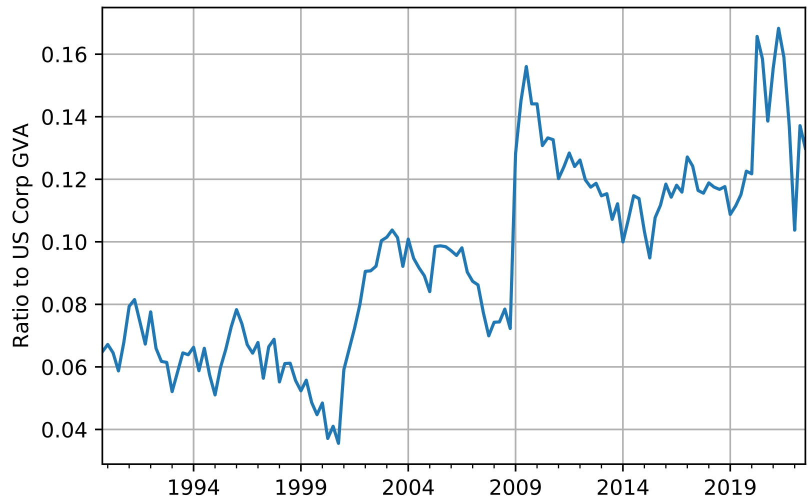


Figure 5: U.S. Corporate Free Cash Flow to Owners, Ratio to U.S. Corp. Value Added

2.2.2 Valuation and capital in the U.S. corporate sector

Our goal in measuring positions is to place a value on these flows of economic activity, which we refer to as earnings and dividends for corporations resident in the United States. Thus, we make several adjustments to the balance sheet data for the corporate sector presented in Tables S.5 and S.6. The following stylized balance sheet for the U.S. corporate sector is useful for organizing our discussion of these adjustments. Recall that this balance sheet is an aggregate of both U.S. firms with overseas subsidiaries (i.e., the parent firm is in the U.S.) and U.S. resident subsidiaries of foreign multinationals.

Corporate Sector Balance Sheet

Assets	Liabilities
Non-financial assets	Equity
(replacement or enterprise value)	(measured at market value)
Financial assets	Financial liabilities
(includes U.S. FDI in ROW)	(debt, bank loans, etc., including ROW FDI in U.S.)

Our specific aim is to value the non-financial assets held by U.S. resident corporations, corresponding to the first entry in the left column of this balance sheet. We consider two measures of this value. The first of these is a measure of the *replacement value* of these non-financial assets. This measure is reported directly in the Integrated Macroeconomic

Accounts.

The second is a measure of what we term the *enterprise value* of these non-financial assets.[11] This measure corresponds to the valuation that financial markets attach to the non-financial assets of U.S. corporations. We measure the value that financial markets attach to corporate non-financial assets located in the United States, both measured and unmeasured, as the sum of the market value of resident corporations' equities plus the value of their financial liabilities (both on the right side of the balance sheet above) less the value of financial assets on the left side of this balance sheet.[12]

The financial assets of these firms, listed as the second entry on the left side of this balance sheet, include the usual financial instruments as well as the debt and equity components of U.S. parent firms' foreign direct investment abroad. The financial liabilities of these firms, listed as the second item on the right side of this balance sheet, include the usual financial instruments plus the debt and equity components of the direct investment of foreign parent firms into their U.S. subsidiaries. Note that excluding U.S. FDI in the rest of the world from enterprise value but including rest of world FDI into the United States aligns our measure of U.S. enterprise value with the residence principle.

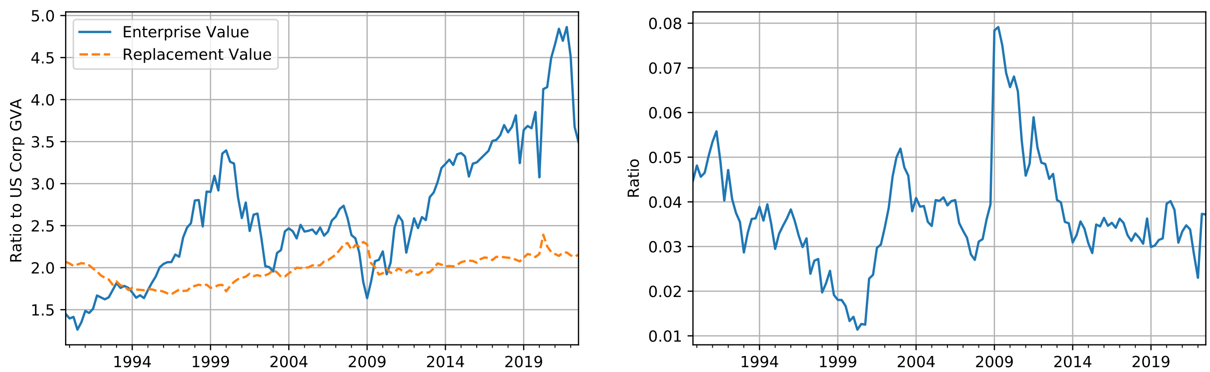
In Figure 6a, we show the ratio of enterprise value to value added for the U.S. corporate sector (blue solid line) and the ratio of the replacement value of the stock of capital in those corporations to value added (orange dashed line).[13] The figure indicates that the capital-output ratio has been quite stable over time, while the enterprise value of U.S. corporations has risen dramatically. A direct implication of the divergence between these two lines is that Tobin's Q for the U.S. corporate sector, measured as the ratio of enterprise value to replacement value of the capital stock, has risen substantially over the past decade.

In Figure 6b, we construct a measure of the dividend or payout yield for the U.S. corporate sector based on the ratio of the free cash flow to firm owners to our measure of the enterprise value of this sector. What is striking about this figure is that the ratio of free cash flow to enterprise value has not changed much for most of the past decade, relative to the period before 2007. Thus, it appears that a substantial portion of the increase in the ratio of the enterprise value of U.S. corporations to GVA can be accounted for by an increase in the ratio

[11] Our measurement concept for the value of corporations is roughly similar to the concept of *enterprise value* used as a valuation benchmark for individual companies and is closely related to that used in Hall (2001). It is also similar to the measures of the market values of the non-financial assets of U.S. non-financial and financial corporations presented in Table B1 of the *Financial Accounts of the United States*. We describe the specific series we use in measuring the enterprise value of the U.S. corporate sector in Appendix A.

[12] Note that it would not be appropriate to equate the value of U.S.-located firms to the value of equity alone, because some fraction of firms' future cash flow is pledged to debt holders and bank lenders, and thus some fraction of firm value is reflected in the value of those liabilities.

[13] We reproduce this figure for the financial business sector and non-financial corporate business sector separately in the Appendix in Figures A.5 and A.4, respectively.



(a) Enterprise and Replacement Values

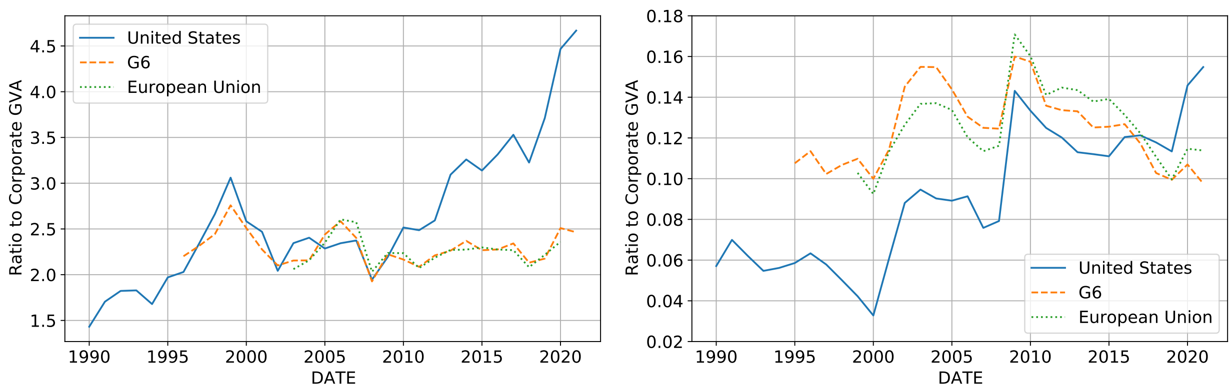
(b) Free Cash Flow to Enterprise Value Ratio

Figure 6: Values and Cash Flow, U.S. Corporate Sector

of free cash flow to GVA.

We now document that the sharp increases in corporate enterprise value and payouts just described are US-specific phenomena and that similar increases have not occurred in the rest of the developed world. In Figure 7a, we plot, for the period 1990–2021, corporate sector enterprise values and free cash flows for the United States, for an aggregate of the other G6 countries, and for the European Union. The figure highlights the divergence between the ratios in the United States and in the rest of the world. Since the Great Recession, the ratio of enterprise value to GVA in the United States rose from 2 to over 4.5, while the ratio abroad was essentially constant over the same time span. Figure 7b shows that the diverging patterns in corporate sector enterprise value are mirrored by diverging paths in free cash flow. From 2007 to 2021, the ratio of free cash flow to GVA in the United States nearly doubled, while abroad this ratio over the same period was largely unchanged. A natural interpretation is that differential dynamics of free cash flow are key to explaining the differential behavior of US and foreign equity markets.[14]

[14]Details on how we constructed data in Figure 7 are in Appendix A.5. This evidence that outside the United States, corporate free cash flow has not risen relative to GVA is consistent with other studies. See, for example, Lequiller and Blades (2014, Chapter 3), Philippon (2019, Chapter 5), and Gutiérrez and Philippon (2020). Gutiérrez and Piton (2020) find evidence of labor's share declining much more in the United States than in other advanced economies. In contrast, De Loecker and Eeckhout (2021), using the Worldscope dataset of firm financial statements, argue that markups and profits have risen in Europe as well as in the United States.



(a) Corporate Enterprise Value

(b) Corporate Cash Flow

Figure 7: Values and Cash Flow, U.S., G6 and European Union

3 Model

We now develop a simple international macro finance model of flows, stocks and valuations of the U.S. corporate sector and of the U.S. current account and NFA position. We use this model to measure the factors driving observed flows, stocks and valuations of the U.S. corporate sector, the U.S. current account, and the U.S. NFA position over the period from 1990 through 2022. Then, we conduct counterfactual exercises relative to this model baseline to consider how these driving factors impacted the welfare of U.S. households.

The model has two regions: a domestic economy we think of as the United States, and a foreign economy that stands in for the rest of the world. Each region is populated by a continuum of identical households. Heterogeneous firms in each economy produce a continuum of non-tradable intermediate varieties. These intermediates are combined to produce a single composite final good that is traded internationally and used for consumption and investment. Intermediates-producing firms enjoy pricing power and hence earn factorless income. Households receive labor income, dividends from holdings of corporate equity both in their region of residence and abroad, and interest income from a risk-free bond that is traded internationally.

In our baseline model specification, we assume that foreign households are risk-neutral and that their rate of time preference determines the cost of capital for firms worldwide. That assumption allows us to characterize equilibrium allocations in closed form and to illustrate the economic mechanisms at work as transparently as possible. We also assume that both countries produce and consume the same final good, so the terms of trade and the real exchange rate in the model will always be equal to one. Recall that exchange rate movements account for only a small portion of the valuation effects in the NFA position between 2010 and 2022. In Appendix G, we discuss a generalization of the model in which domestically and foreign produced goods are imperfect substitutes, in which case shocks to monopoly power and/or productivity have the potential to affect the terms of trade.

3.1 Intermediate-Goods Firms

In each country there is a unit mass of different intermediate varieties indexed by $i \in [0,1]$. Let Y_{it} denote total production of variety i at date t. Domestic output of the final good is given by

$$Y_t = \left(\int_0^1 Y_{it}^{\left(\frac{\varepsilon-1}{\varepsilon}\right)} di \right)^{\frac{\varepsilon}{\varepsilon-1}}, \tag{4}$$

where $\varepsilon > 1$ is the elasticity of substitution in production between different varieties.

Output can be consumed domestically, exported, or transformed into investment. Thus,

$$C_t + G_t + Q_t X_t + NX_t = Y_t,$$

where C_t is private consumption, G_t is public consumption, $Q_t X_t$ is investment expenditure in units of final output, and NX_t is net exports. Investment goods augment the capital stock in the standard way:

$$K_{t+1} = (1 - \delta_t) K_t + X_t,$$

where δ_t is a time-varying depreciation rate. The replacement value of the capital stock at the end of period t in units of final consumption is denoted by $Q_t K_{t+1}$, where this replacement value evolves over time according to

$$Q_t K_{t+1} = Q_{t-1} K_t + (Q_t - Q_{t-1}) K_t - \delta_t Q_t K_t + Q_t X_t, \tag{5}$$

where $Q_{t-1} K_t$ is the replacement value of the capital stock at the end of period $t-1$, $(Q_t - Q_{t-1}) K_t$ is revaluation of installed capital between $t-1$ and t, and the term $\delta_t Q_t K_t$ corresponds to consumption of fixed capital in units of the final consumption good at t.

Both countries produce the same final good. Thus, if we use asterisks to denote foreign variables, the world resource constraint is

$$C_t + C_t^* + G_t + G_t^* + Q_t X_t + Q_t^* X_t^* = Y_t + Y_t^*.$$

Within each country there are two sorts of firms that can produce a given variety of intermediate good: a single leader firm with productivity z_{Ht}, and a fringe of identical follower firms, each with productivity $z_{Lt} \leq z_{Ht}$. An intermediate firm with productivity z_t that rents capital k_t and labor l_t produces output y_t, given by

$$y_t = z_t k_t^{\alpha_t} (Z_t l_t)^{1-\alpha_t} ,$$

where Z_t is aggregate labor productivity common to all firms, and where α_t is a time-varying parameter determining the relative importance of capital versus labor in production costs. The production technologies for leader and follower firms are common across all intermediate varieties in the United States. We denote the corresponding productivities in the ROW by z^*_{Ht}, z^*_{Lt}.

Bertrand price competition between the leader firm and the follower firms for each variety determines the markup of price over marginal cost charged by the leader firm, as in Bernard et al. (2003), Atkeson and Burstein (2007), and Peters (2020). Specifically, let R_t and W_t denote the domestic rental rates for capital and labor in the U.S. These factor prices, together with firm productivity z_t, determine intermediate firms' unit cost. Intermediate firms pay a proportional tax at rate τ_t on sales. Because these firms have no intermediate inputs, this can be interpreted as a value added tax. The leader firms for each variety move first and set a price p_{it}. If these firms did not face any latent competition from follower firms, they would solve the standard monopolistic competition profit maximization problem, with markup of after-tax price over marginal (and average) cost of $\epsilon/(\epsilon-1)$. However, the leader firm also recognizes that if it sets its price above the marginal cost of the firm with productivity z_{Lt}, then latent competitors will be able to profitably enter and will in fact corner the market. Thus, the leader firm effectively faces an additional constraint on pricing, one that ensures that competitors do not enter and the leader retains a 100 percent market share. Given these constraints on pricing, the equilibrium output wedge μ_t between after-tax revenues relative to total costs is given by

$$\mu_t = \frac{(1-\tau_t)p_{it}}{cost_t(z_{Ht})} = \min\left\{\frac{\varepsilon}{\varepsilon-1}, \quad \frac{cost_t(z_{Lt})}{cost_t(z_{Ht})} = \frac{z_{Ht}}{z_{Lt}}\right\}, \tag{6}$$

where $cost_t(z_{Ht})$ is the unit cost of production at t for a leader firm. We assume that $\frac{z_{Ht}}{z_{Lt}} < \frac{\varepsilon}{\varepsilon-1}$ for all t so that the output wedge is always driven by the threat of potential competition, $\mu_t = \frac{z_{Ht}}{z_{Lt}}$.

Note that because all varieties are symmetric, equilibrium prices, output wedges, labor, capital and output are identical across varieties: $p_{it} = P_t$, $k_{it} = K_t$, $l_{it} = L_t$, and

$$y_{it} = Y_{it} = Y_t = z_{Ht} K_t^{\alpha_t} (Z_t L_t)^{1-\alpha_t} . \tag{7}$$

Without loss of generality, we normalize $P_t = 1$ for all t. In our baseline model, we also assume exogenous and fixed labor supply, and normalize $L_t = 1$.

Tax payments by intermediate goods firms fund government purchases: $G_t = \tau_t Y_t$.

Since the production function for final output in equation (4) has constant returns to scale, in equilibrium, final output is equal to the pre-tax revenue of intermediate goods firms. After-tax revenue from intermediate firms is divided between wage payments to labor, rental payments to capital, and factorless income, which we denote by Π_t. The share of pre-tax output accruing as factorless income to owners of intermediate goods firms is

$$\frac{\Pi_t}{Y_t} = \left(\frac{\mu_t - 1}{\mu_t}\right)(1 - \tau_t), \tag{8}$$

while the shares going to labor and capital are

$$\begin{aligned} \frac{W_t L_t}{Y_t} &= \frac{(1-\alpha_t)}{\mu_t}(1-\tau_t), && (9) \\ \frac{R_t K_t}{Y_t} &= \frac{\alpha_t}{\mu_t}(1-\tau_t), && (10) \end{aligned}$$

and the remaining share τ_t goes to taxes.

3.2 Investment Firms

In addition to intermediates-producing firms, a second set of competitive firms holds and rents out capital and makes investment choices. These competitive capital-managing firms choose investment to maximize the expected present value of their dividends. Dividends from these firms are given by

$$D_{Xt} = R_t K_t - Q_t X_t = R_t K_t - Q_t K_{t+1} + Q_t(1-\delta_t)K_t. \tag{11}$$

Investment firms discount cash flow one period ahead at rate r^*_{t+1}. At each date t, given K_t, they choose K_{t+1} to solve

$$\max_{K_{t+1}} \left\{ -Q_t K_{t+1} + \frac{1}{1+r^*_{t+1}} \mathbb{E}_t \left[R_{t+1} K_{t+1} + (1-\delta_{t+1}) Q_{t+1} K_{t+1} \right] \right\}$$

where the interpretation is that purchasing one more unit of new capital at t reduces current dividends by the price of capital Q_t, but generates additional rental income R_{t+1} and a resale value of undepreciated capital $(1-\delta_{t+1})Q_{t+1}$ in the next period.

The first-order condition to this problem is

$$Q_t = \frac{1}{1+r^*_{t+1}}\mathbb{E}_t\left[R_{t+1} + (1-\delta_{t+1})Q_{t+1}\right]. \tag{12}$$

In our model, we assume that all firms are financed entirely by equity and have no financial assets. Thus, the measure of aggregate dividends paid by U.S. firms in the model corresponds to a measure of free cash flow from operations available to be paid to all investors in the firm:

$$D_t = \Pi_t + D_{Xt}, \tag{13}$$

and likewise for foreign dividends. The measure of firm value V_t in the model corresponds to the market valuation of these free cash flows from operations.

We refer to the after-tax net operating surplus of firms in our model as the *earnings* of these firms. These earnings are given by

$$E_t = (1-\tau_t)Y_t - W_tK_t - \delta_tQ_tK_t \tag{14}$$

Note that our measure of aggregate dividends D_t is equal to our measure of earnings E_t less net investment $Q_tX_t - \delta_tQ_tK_t$, as is standard.

The profit maximization problems for foreign firms mirror those for domestic ones. Foreign technology parameters are all identical to domestic ones, with the exceptions of the intermediate firm productivity values, z^*_{Ht} and z^*_{Lt} (and thus the output wedge $\mu^* = z^*_{Ht}/z^*_{Lt}$), and the replacement cost of capital, Q^*_t.

3.3 Households

Lifetime utility for the domestic representative infinitely lived household is given by

$$\mathbb{E}_0\sum_{t=0}^{\infty}\left(\frac{1}{1+\rho}\right)^t \log(C_t), \tag{15}$$

where ρ is the constant rate of time preference.

The assets in this economy are shares in domestic and foreign firms and a one period nominal bond. Domestic households enter period t owning a fraction λ_{t-1} of shares in domestic firms (foreign households own fraction $1-\lambda_t$) and a fraction λ^*_{t-1} of foreign firms. They also enter period t with B_t units of bonds, which pay interest at rate r^*_t. Each period households buy new domestic and foreign shares at prices V_t and V^*_t, and bonds B_{t+1} at a price normalized to one. The interest rate between t and $t+1$, r^*_{t+1}, is known at date t

(bonds are risk-free) and is the same rate used by firms to discount future cash flows. The flow budget constraint for the domestic representative household is

$$C_t + (\lambda_t - \lambda_{t-1})V_t + (\lambda_t^* - \lambda_{t-1}^*)V_t^* + B_{t+1} = W_t L_t + \lambda_{t-1}D_t + \lambda_{t-1}^* D_t^* + (1 + r_t^*)B_t. \quad (16)$$

Foreign households are symmetric to domestic ones, except that we assume they have linear utility ($u^*(C_t^*) = C_t^*$) and a time-varying discount factor ρ_t^*. The foreign discount factor between t and $t+1$, ρ_{t+1}^*, is known at t.

Note that because foreign households have linear utility, the world interest rate is pinned down at

$$r_{t+1}^* = \rho_{t+1}^* \quad (17)$$

for all dates t.

3.4 Expectations

Equilibrium investment in capital and the valuation of the future streams of dividends for U.S. and foreign firms depend on expectations of future realizations of the parameters of the model. We assume that households and firms make decisions taking as given forecasts for the evolution of all model parameter values very similar to those assumed in the transition experiment in Farhi and Gourio (2018). We assume households perceive no uncertainty around these forecasts.

We now describe these forecasts. At each date t, model agents

1. Observe the one-period-ahead discount rate, $r_{t+1}^* = \rho_{t+1}^*$. They expect $r_{t+j}^* = r_{t+1}^*$ for all $j \geq 1$.

2. Perfectly forecast one-period-ahead growth in global labor productivity, g_{t+1}. Thus, $E_t\left[Z_{t+1}/Z_t\right] = Z_{t+1}/Z_t = 1 + g_{t+1}$.

3. Expect global productivity to grow at a constant rate from period $t+1$ onward. We denote the future expected trend growth rate at t by $\bar{g}_{t+1}$. Thus, $E_t\left[Z_{t+j+1}/Z_{t+j}\right] = 1 + \bar{g}_{t+1}$ for all $j \geq 1$. Note that we do not impose $\bar{g}_{t+1} = g_{t+1}$.

4. Perfectly forecast next period values for leader and follower productivities in the two economies, $z_{H,t+1}$ and $z_{L,t+1}$ and $z_{H,t+1}^*$ and $z_{L,t+1}^*$. In addition, we assume that they expect these values to persist $E_t[z_{H,t+j}] = z_{H,t+1}$, $E_t[z_{L,t+j}] = z_{L,t+1}$, $E_t[z_{H,t+j}^*] = z_{H,t+1}^*$ and $E_t[z_{L,t+j}^*] = z_{L,t+1}^*$ for all $j \geq 2$. Thus, agents expect constant output wedges, μ_{t+1} and μ_{t+1}^*, from period $t+1$ on.

5. Perfectly forecast next period values for the technological parameters α_{t+1} and δ_{t+1} and the tax rate τ_{t+1}. In addition, they expect these parameter values to persist: $E_t[\alpha_{t+j}] = \alpha_{t+1}$, $E_t[\delta_{t+j}] = \delta_{t+1}$ and $E_t[\tau_{t+j}] = \tau_{t+1}$ for all $j \geq 2$.

6. Expect no changes in the relative prices of investment goods: $E_t[Q_{t+j}] = Q_t$ and $E_t[Q^*_{t+j}] = Q^*_t$ for all $j \geq 1$.

To summarize, each period t agents receive news about the cost of capital r^*_{t+1} at t and values of other model parameters that will be realized at $t+1$. They treat these parameters as if they followed a random walk. That is, their expectations for the values of these parameters at dates $t+j$ are equal to the value that they expect at $t+1$.

3.5 Asset Pricing

Firm value V_t in the model can be decomposed into the ex-dividend value of claims to investment producing firms, plus the value of claims to profits from intermediate goods firms. As is standard in a model with constant returns to scale and no investment adjustment costs, equation (12) implies that the present value at t of dividends from capital-managing firms from $t+1$ on is equal to the expected replacement value of capital in the next period. That is, $V_{Kt} = Q_t K_{t+1}$.

The ex-dividend price of a share of all domestic intermediate-good-producing firms is the expected present value of the future stream of monopoly profits these firms will earn. Given our assumptions that agents know at t the parameters determining profits Π_{t+1} and agents expect the discount rate r^*_{t+1}, the growth rate of the economy from $t+1$ on $\bar{g}_{t+1}$, and the share of the economy corresponding to after-tax profits of intermediate goods firms all to remain constant from $t+1$, then

$$V_{\Pi t} = \mathbb{E}_t \left[\sum_{j=1}^{\infty} \frac{\Pi_{t+j}}{(1+r^*_{t+1})^j} \right] = \frac{\Pi_{t+1}}{r^*_{t+1} - \bar{g}_{t+1}}.$$

Thus, the market price of all domestic firms is given by

$$V_t = V_{Kt} + V_{\Pi t} = Q_t K_{t+1} + \frac{\Pi_{t+1}}{r^*_{t+1} - \bar{g}_{t+1}}. \tag{18}$$

3.6 Balance of Payments Accounting

We now consider our model's implications for the current account and the U.S. NFA position. The current account is defined as national savings minus investment, where national savings is comprised of household saving plus government saving plus corporate saving. In our model, the government runs a balanced budget period by period, and corporate saving is identical to corporate investment. Thus, the model current account is identical to household saving. The change in the NFA position of the U.S. in the model is the sum of the current account and the revaluations of cross-border asset holdings of households in the United States and in the ROW.

We now solve for the savings of U.S. households. The representative U.S. household at each date t chooses a sequence for consumption to maximize utility (15), subject to a lifetime budget constraint. Given that this household has logarithmic utility, it consumes a constant fraction of its lifetime wealth inclusive of current income. That is, at each date t,

$$C_t = \frac{\rho}{1+\rho} Wealth_t, \tag{19}$$

where household wealth at t inclusive of current income is given by

$$Wealth_t = W_t L_t + H_t + \lambda_{t-1} D_t + \lambda^*_{t-1} D^*_t + \lambda_{t-1} V_t + \lambda^*_{t-1} V^*_t + (1 + r^*_t) B_t, \tag{20}$$

where H_t denotes human wealth excluding current labor earnings and is given by

$$H_t \equiv \frac{W_{t+1} L_{t+1}}{r^*_{t+1} - \bar{g}_{t+1}}. \tag{21}$$

U.S. household saving is the difference between households' current income and consumption. Using the expression for consumption in equation (19), we obtain a formula for the model current account:

$$CA_t = \frac{1}{1+\rho} \left[\left(\frac{D_t}{V_t} - \rho \right) \lambda_{t-1} V_t + \left(\frac{D^*_t}{V^*_t} - \rho \right) \lambda^*_{t-1} V^*_t + (r^*_t - \rho) B_t + \left(\frac{W_t L_t}{H_t} - \rho \right) H_t \right]. \tag{22}$$

This expression is intuitive. It compares the current income yield on each type of asset (both financial and human) owned by the household to the household's rate of time preference and then takes a weighted aggregate of these quantities, where the weights are given by the beginning of period values of each type of asset held by the household. Domestic households will save out of dividend income on domestic and foreign equity if the current income yield on those assets exceeds their rate of time preference ρ. They will save out of bond income if the real interest rate exceeds ρ. And they will save out of labor income if the income yield on human wealth (current earnings relative to the future value of human wealth) exceeds ρ.

This formula (22) reduces to a simple expression on a balanced growth path. Specifically, suppose the economy is on a balanced growth path, with a constant interest rate $\bar{r}^*$ and constant growth rate $\bar{g}$. On that balanced growth path, the ratios D_t/V_t, D^*_t/V^*_t, and $W_t L_t/H_t$

would all be constant and equal to $(\bar{r}^* - \bar{g})/(1+\bar{g})$. It follows that if ρ satisfies $1 = \frac{1}{1+\rho}\frac{1+\bar{r}^*}{1+\bar{g}}$, then the balanced growth path current account will be $CA_t = \frac{1}{1+\rho}(\bar{r}^* - \rho)B_t = \bar{g}B_t$.

Off a balanced growth path, this formula (22) captures the effects of business cycle shocks that lead to fluctuations in investment and corresponding fluctuations in D_t and D_t^*. This formula also captures the effects of changes in the discount rate r_{t+1}^* and expected future growth rate $\bar{g}_{t+1}$, which would also impact equilibrium current income yields on assets. When using our model for measurement, we match observed income yields on financial assets D_t/V_t and D_t^*/V_t^* from the data as described below. We derive how shocks to parameters impact the current account in our model in Appendix F.

In our model, the change in the end of period net foreign asset position between $t-1$ and t is given by the sum of the current account and asset revaluations:

$$NFA_t - NFA_{t-1} = CA_t + \lambda_{t-1}^* \left(V_t^* - V_{t-1}^*\right) - (1-\lambda_{t-1})\left(V_t - V_{t-1}\right), \tag{23}$$

where the final terms capture revaluations of foreign equity assets and liabilities. We refer to the term $\lambda_{t-1}^* \left(V_t^* - V_{t-1}^*\right)$ as the revaluation of U.S. equity assets in the ROW and the term $(1-\lambda_{t-1})\left(V_t - V_{t-1}\right)$ as the revaluation of U.S. equity liabilities to the ROW.

The flow of capital must finance the current account, so we finally have

$$CA_t = B_{t+1} - B_t + (\lambda_t^* - \lambda_{t-1}^*)V_t^* - ((1-\lambda_t) - (1-\lambda_{t-1}))V_t. \tag{24}$$

3.7 Equilibrium

An equilibrium is a set of sequences for the world interest rate $\left\{r_{t+1}^*\right\}_{t=0}^{\infty}$, for stock prices $\{V_t, V_t^*\}_{t=0}^{\infty}$, for investment prices $\{Q_t, Q_t^*\}_{t=0}^{\infty}$, and for domestic and foreign factor prices $\{R_t, W_t\}_{t=0}^{\infty}$ and $\{R_t^*, W_t^*\}_{t=0}^{\infty}$ such that when households and firms take these prices as given and solve their maximization problems with the expectations described above, all markets clear. Because bonds are in zero net supply, bond market clearing requires $B_{t+1} + B_{t+1}^* = 0$.

4 Using the Model for Measurement

We use our model to measure the factors driving flows, stocks, and valuation of the U.S. corporate sector and the U.S. current account and net foreign asset position in two steps.

In the first step, we use data from the Integrated Macroeconomic Accounts (IMA) to construct model-consistent series for flows, stocks, and valuation of the U.S. corporate sector, and for the U.S. current account and net foreign asset position. Specifically, we use the data in IMA Tables S5, S6, and S9 to construct quarterly series from 1990 Q1 through 2022 Q3 for corporate value added Y_t, taxes $\tau_t Y_t$, compensation of labor $W_t L_t$, consumption of fixed capital $\delta_t Q_t K_t$, investment expenditure $Q_t X_t$, end of period reproduction value of capital $Q_t K_{t+1}$, end of period enterprise value V_t, the current account CA_t, the NFA position NFA_t, U.S. gross equity holdings in the ROW $\lambda_t^* V_t^*$, ROW gross holdings of equity in U.S. corporations $(1-\lambda_t)V_t$, as well as the gross flows and revaluations of these equity positions. We obtain data on monetary dividends paid on U.S. equity in the ROW $\lambda_{t-1}^* D_t^*$ from the NIPA. We have reviewed much of these data in Section 2. We provide detailed information on the data sources and construction of these variables in Appendix A.

Note that these data imply measures of Gross and Net Operating Surplus and dividends from operations paid by U.S. resident corporations as in equations (11), (13), and (14). Thus, these data summarize standard valuation metrics, including the ratio of the value of U.S. resident corporations to GDP (the Buffett ratio) V_t/Y_t, the end of period reproduction value of capital to output ratio $Q_t K_{t+1}/Y_t$, Tobin's Q measured as the ratio of the market valuation of the firm to the reproduction value of its capital stock $V_t/Q_t K_{t+1}$, the current dividend yields of U.S. and ROW equity D_t/V_t, D_t^*/V_t^*, and the U.S. earnings yield, E_t/V_t. Thus, when we choose the parameters of our model to match the data listed above, our model will also match all of these standard valuation metrics.

In the second step, we choose sequences of model parameters such that our model exactly reproduces all these data as an equilibrium outcome. Specifically, we fix the rate of time preference for U.S. households, ρ, to a constant value and solve analytically for sequences of parameters so that the model replicates the data items listed in the first step exactly for every quarter from 1990 Q1 through 2022 Q3. The twelve time-varying parameters are: (i) the discount rate for valuing the corporate sector r_{t+1}^*, (ii) the growth rate of aggregate productivity from $t+1$ on that is expected in period t, $\bar{g}_{t+1}$, (iii) the tax rate τ_t, (iv) the depreciation rate δ_t, (v-vi) domestic and foreign output wedges μ_t and μ_t^*, (vii) labor's share of costs $(1-\alpha_t)$, (viii-ix) domestic and foreign replacement costs for capital Q_t and Q_t^*, (x) the growth rate of productivity between t and $t+1$, g_{t+1}, and (xi-xii) the gross cross-border equity positions λ_t^* and $(1-\lambda_t)$.

We summarize the procedure for choosing these parameters here and provide a comprehensive explanation in Appendix D.[15] We describe how our measurement procedure relates to that used in prior macro-finance papers in detail in Appendix E.

Our procedure for solving for model parameters to match the data has a block recursive structure that is usefully described as consisting of three steps.

[15] In particular, for simplicity, in the body of the paper we have described the model in real terms. The data are in fact presented in nominal terms. We discuss the impact of inflation on our procedure for choosing parameters in Appendix D.

In the first step, the evolution of the capital price Q_t, the depreciation rate δ_t, the tax rate τ_t, the productivity growth rate g_{t+1} from t to $t+1$, and gross cross border equity positions as indexed by λ_t^* and $(1-\lambda_t)$ are almost directly pinned down by data. The series for μ_t^* and Q_t^* are set to replicate the time series for rest of world free cash flow D_t^* and enterprise value V_t^*.[16] We set the constant rate of time preference for U.S. households ρ to be consistent, on a balanced growth path, with the sample average of the current dividend yield on U.S. corporations D_t/V_t.

In the second step, we take as given a value for the discount rate r_{t+1}^* – we solve for this discount rate in the third step. Given r_{t+1}^*, we impute a rental rate of capital R_{t+1}/Q_t from the investment first-order condition, equation (12), where we impose our assumption on expectations that $\mathbb{E}_t[Q_{t+1}] = Q_t$ and that the depreciation rate δ_{t+1} is known at t. This ensures that, in equilibrium, model firms find it optimal to choose the observed end of period t reproduction value of the capital stock Q_tK_{t+1}. We then use the factor share expressions (9) and (10) to infer values for α_{t+1} and μ_{t+1}. The model implied value for factorless income Π_{t+1} is then given by equation (8).[17]

In the third step, we set values for the two remaining parameters: the discount rate r_{t+1}^* expected from period t on, and the growth rate of productivity $\bar{g}_{t+1}$ expected from period $t+1$ on. We choose these parameters so that the model matches (i) the observed valuation of the U.S. corporate sector in excess of the replacement cost of capital, $V_t - Q_tK_{t+1}$, and (ii) the observed U.S. current account.

In particular, we first develop one equation in the two unknowns r_{t+1}^* and $\bar{g}_{t+1}$ by combining equation (12) multiplied through by K_{t+1} to solve for $r_{t+1}^*Q_tK_{t+1}$, equation (14) defining earnings E_{t+1}, and equation (18) for the value of U.S. corporations. This equation is given by

$$r_{t+1}^* - \bar{g}_{t+1} = \frac{\mathbb{E}_t[E_{t+1}]}{V_t} - \bar{g}_{t+1}\frac{Q_tK_{t+1}}{V_t}. \tag{25}$$

Note that the term Q_tK_{t+1}/V_t (the inverse of Tobin's Q) in this equation can be taken directly from the data, and given our assumptions that the parameters $\tau_{t+1}, \alpha_{t+1}, \mu_{t+1}$, and δ_{t+1} are known at time t and that $\mathbb{E}_t[Q_{t+1}] = Q_t$, we can also construct the expected earnings yield $\mathbb{E}_t[E_{t+1}]$ from data known at time t. Thus, this equation defines one equation in the two unknown parameters r_{t+1}^* and $\bar{g}_{t+1}$.

[16] Note that domestic households only care about what happens in the rest of the world to the extent that it impacts foreign asset values and cash flow, and these are also the only starred variables (besides r_{t+1}^* and λ_t^*) that enter the current account expression (22).

[17] Note that, in our model, μ_{t+1} is determined by the ratio of the firm-specific productivity of the leader firm to that of the follower firm $z_{H,t+1}/z_{L,t+1}$ for each intermediate good. We set the firm-specific productivity $z_{H,t+1}$ each period so that U.S. output in the model at $t+1$ is equal to $Z_{t+1} = (1+g_{t+1})Z_t$. We will follow the same procedure for the ROW. Thus, the values for model output in the U.S. and the ROW are identical at each date t.

Note that this equation (25) is equivalent to the standard equation from the Gordon growth formula

$$r^*_{t+1} - \bar{g}_{t+1} = \frac{\mathbb{E}_t[D_{t+1}]}{V_t}. \tag{26}$$

This is because, as discussed after equation (14) above, expected dividends in period $t+1$ are equal to expected earnings less net investment in that period, and given our assumptions about agents' expectations, net investment expected in period $t+1$ is given by $\bar{g}_{t+1} Q_t K_{t+1}$. We make use of equation (25) instead of this classic formula (26) because it highlights how estimates of the cost of capital r^*_{t+1} will depend on estimates of expected growth, $\bar{g}_{t+1}$. [18]

Our second equation in the two unknown parameters r^*_{t+1} and $\bar{g}_{t+1}$ is equation (22) for the current account. Given a value for the rate of time preference ρ, all of the terms in equation (22) are directly observed in data except for the value H_t of human wealth from $t+1$ on, which is given in equation (21).[19] This value of human wealth is a simple function of observed labor compensation in period $t+1$ and $r^*_{t+1} - \bar{g}_{t+1}$. Hence equation (22) and equation (25) jointly determine the combination of r^*_{t+1} and $\bar{g}_{t+1}$ needed to have our model match the data on U.S. corporate valuations and the current account.

Note that in our model and measurement exercise, we abstract from value added created in the government sector and in the non-corporate private sector, which is important for residential housing. We have also abstracted from demographic factors relevant to the current account in an overlapping generations framework, as discussed in Auclert et al. (2021). To the extent that these omitted factors impact the U.S. current account, they are implicitly captured in our model measurement in our estimates for $r^*_{t+1} - \bar{g}_{t+1}$, because the valuation multiple for human wealth is the only unknown in our equation (22) for the current account.

To sum up, our parameterized model replicates exactly quarterly series for the following times series of the U.S. corporate sector: value added, gross and net investment, labor earnings, taxes paid, cash flow payable to firm owners (defined as in equation 13), the Buffett ratio, the replacement cost of capital, and the dividend and earnings yields. Figures D.2 and D.3 in Appendix D.7 plot these series.

[18] It is helpful to consider two extreme examples. If Tobin's Q is equal to one, then the expected growth rate $\bar{g}_{t+1}$ cancels out on both sides of equation (25), and this equation becomes a single equation in the single unknown r^*_{t+1}. In this case, given r^*_{t+1}, one can directly use the procedure in our second step above to pin down the model parameters α_{t+1} and μ_{t+1}, independently of assumptions about the value of the expected growth rate $\bar{g}_{t+1}$. Suppose, in contrast, that Tobin's Q is infinite, as would be the case in an endowment economy. Then the expected earnings yield in equation (25) does not pin down r^*_{t+1}, but only identifies $r^*_{t+1} - \bar{g}_{t+1}$.

[19] This equation does involve the lagged value of the cost of capital r^*_t and the stock of bonds carried into the period B_t. We construct series for r^*_t and B_t iteratively, using equations (22) and (24) to determine the stock of bonds carried into the next period, B_{t+1}. See Appendix D for further details.

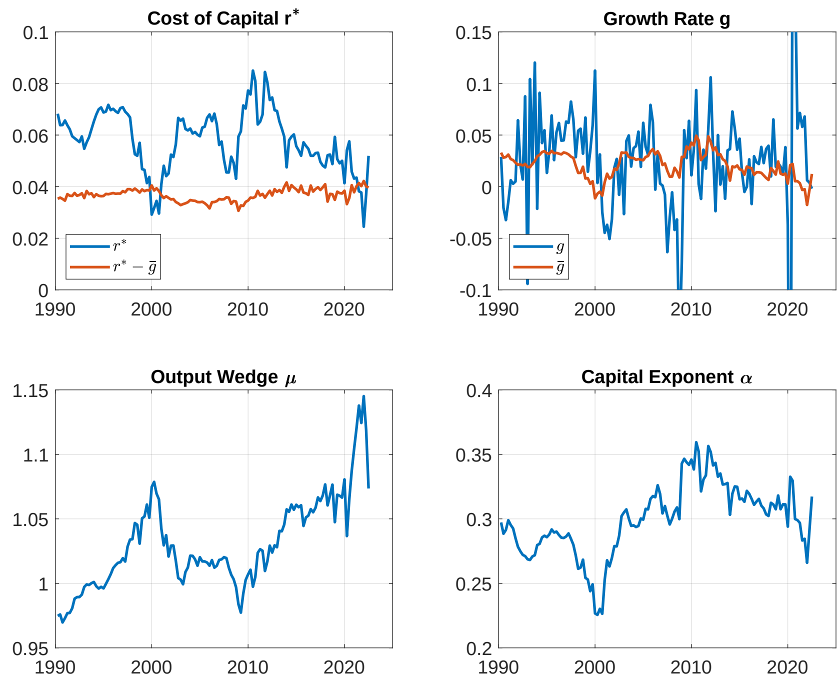


Figure 8: Estimated Times Series for Key Parameters

5 Baseline Results

Figure 8 plots some of the key parameter sequences derived from our measurement procedure.[20] The top left panel plots (in blue) the model-implied sequence for r_t^* (annualized), while the top right panel shows the sequence for trend growth $\bar{g}_t$ alongside actual quarterly growth g_t, both also annualized. The estimated sequence for trend growth is much less volatile than the actual quarterly growth rate series, but some correlation between the two is apparent.

The bottom left panel shows the model-implied time series for the output wedge for the U.S. corporate sector, μ_t; the path for share of factorless income $(1-\tau_t)(\mu_t - 1)/\mu_t$ looks similar. The share of capital in costs, α_t, shown in the bottom right panel, exhibits some fluctuations, but no long-run trend.

The sequence for r_t^* shown in Figure 8 declines substantially over the past decade, but this decline in the discount rate does not account for much of the change in the valuation of U.S. corporations relative to output over this time period. To understand this finding, consider equation 18, which decomposes the value of U.S. corporations into a component due to the reproduction value of their installed capital and a component due to the discounted

[20]Figure D.1 plots time series for all parameter values.

present value of their future factorless income. Now consider the model's implications for each of these two components of firm value.

As discussed above, by construction, the model reproduces the observation that, over the past decade, the replacement value of installed capital in U.S. resident corporations has not risen much relative to corporate value added. As shown in the bottom two panels of Figure 8, it does so through a combination of an increase in the wedge μ_t between revenue and costs and a decline in the share α_t of physical capital in costs. These two forces in the model counteract firms' incentives to otherwise increase the capital-output ratio in the face of a falling cost of capital r_t^*. In this sense, investment has been weaker over the past decade than would have been the case had we seen a decline in the discount rate r_t^* alone.

Now consider the model's implications for changes in the discounted present value of firms' future factorless income. Our measurement procedure implies that the sequence for the discount rate r_t^* tracks the trend growth rate series series closely, so that the difference between the two (the red line in the top left panel of Figure 8) fluctuates very little. Thus, we find that the majority of the increase in this component of firms' valuation is due to an increase in the quantity of factorless income Π_{t+1} rather than to changes in the valuation multiple $1/(r_{t+1}^* - \bar{g}_{t+1})$ applied to that income.

The reason that we find a stable valuation multiple for factorless income is rooted in our requirement that the model also match the observed current account sequence for the United States. The current account is highly sensitive to changes in the ratio of current labor income to human wealth, because the value of human wealth, H_t, is large. Moreover, H_t is inversely proportional to $r_{t+1}^* - \bar{g}_{t+1}$ (see equation 21). Thus, large changes in $r_{t+1}^* - \bar{g}_{t+1}$ would imply large changes in desired U.S. consumption and counterfactually large swings in the current account. Put differently, the observed current account is a data moment that provides sharp identification for expected trend growth.[21]

One interesting observation from valuation data is that while the U.S. corporate dividend yield exhibits no long term trend, there is a downward trend in the earnings yield (see Figure D.3). What explains this difference between these two standard valuation metrics? In our model, the expected forward dividend yield is $(r_{t+1}^* - \bar{g}_{t+1})$ (see equation 26). We define earnings similarly to dividends, except that depreciation is subtracted from gross operating surplus instead of investment. Thus, the expected forward earnings to price ratio is also $(r_{t+1}^* - \bar{g}_{t+1})$ for monopolists, for whom there is no distinction between earnings and dividends. But for investment firms, the expected earnings yield is r_{t+1}^*. The expected earnings yield for the entire economy is a weighted average of the ratios for the two firm types, with weights

[21]This logic is also present in Aguiar and Gopinath (2007) who argue that the current account swings in emerging markets can be used to identify changes in expected growth.

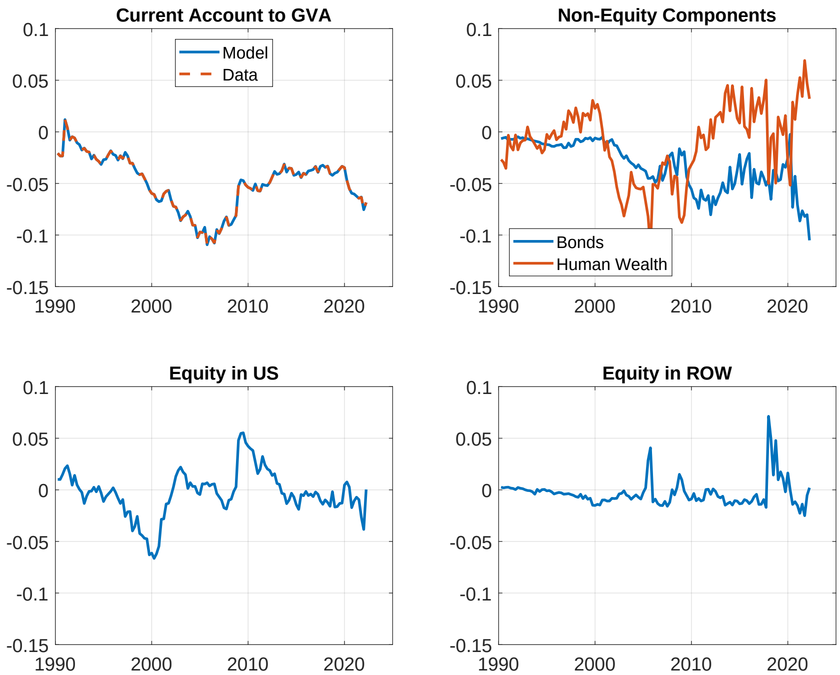


Figure 9: Current Account Decomposition

given by their shares in total enterprise value:

$$\frac{\mathbb{E}_t\left[E_{t+1}\right]}{V_t} = (r^*_{t+1} - \bar{g}_{t+1})\frac{V^{\Pi}_t}{V_t} + r^*_{t+1}\frac{Q_t K_{t+1}}{V_t}.$$

Note that when trend growth is positive, the forward earnings yield will exceed the forward dividend yield (as is evident in Figure D.3). The intuition is that in a growing economy, investment exceeds depreciation, so cash flow payable to investors is less than earnings. This equation also explains why the expected earnings yield in model and data declines over time, even absent trends in r^*_{t+1} or $\bar{g}_{t+1}$. In particular, as the share of monopolist firms in total enterprise value rises over time, the aggregate expected earnings yield puts more weight on the lower value $(r^*_{t+1} - \bar{g}_{t+1})$ for monopolist firms and less weight on the higher value r^*_{t+1} for investment firms.

Figure 9 plots one of the main results in our paper. The top left panel is the U.S. current account relative to corporate sector value added, which the model is calibrated to perfectly replicate. The U.S. current account deficit widened steadily through the 1990s and early 2000s, before moderating during the Great Recession. The other panels of the figure

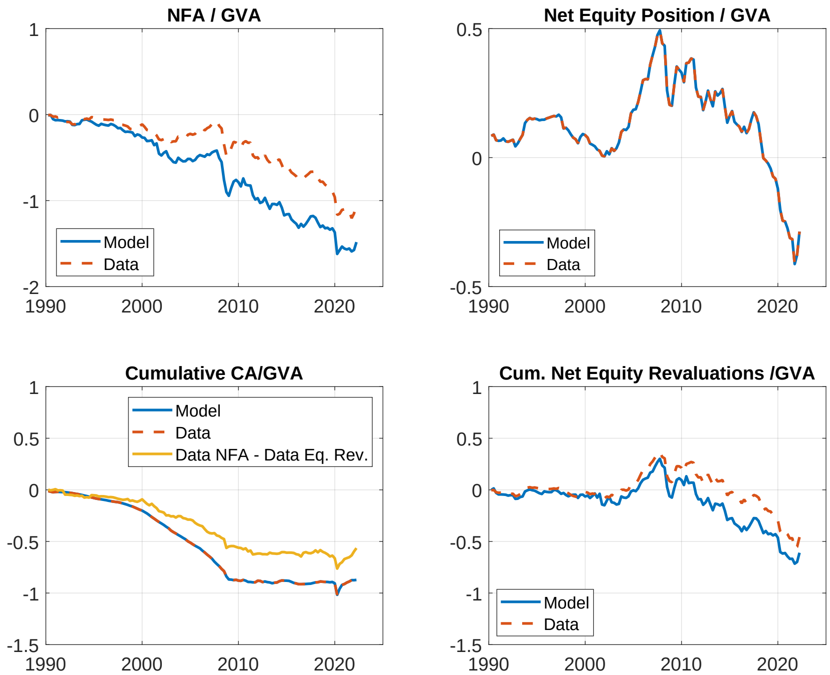


Figure 10: NFA Dynamics

decompose the model current account series following equation (22). The decline in the U.S. current account during the 1990s is primarily attributed to declining dividend yields on U.S. equity, which led U.S. households to borrow from the rest of the world. However, when U.S. asset values fall during the dot-com bust, that dividend yield rises, which, all else equal, would have pushed the current account back toward balance. The model rationalizes the continuing observed decline in the current account via rising expected growth (see Figure 8), which depresses $r^*_{t+1} - \bar{g}_{t+1}$, raising the value of human wealth and stimulating ongoing borrowing. A high dividend yield on U.S. equity during the Great Recession helps explain why the current account narrowed around this time. Thereafter, slowing expected growth reduces the value of human capital, which is why current account deficits remain modest even as the dividend yield on U.S. equity declines.

The top left panel of Figure 10 plots the NFA position predicted by the model against the actual position. The top right panel plots the net equity position, which matches the data by construction. The NFA position in the model reflects cumulative current accounts (bottom left panel) plus cumulative equity revaluations (bottom right panel).

There are three reasons why the model does not perfectly replicate the data path for the NFA position. The first is that the equity liability revaluations in the model are not identical to those reported in Table S9 in the Integrated Macroeconomic Accounts. Recall that we infer our own series for the revaluation of ROW holdings of U.S. equity based on our estimated series for the value of the U.S. corporate sector. Note, however, that the difference between the two revaluation series is small (bottom right panel). The second reason is that the model does not feature any non-equity valuation effects, while there are such effects in the data (see Figure 4a). The third and most important reason is that in the data accounting identity (equation 1), there is a residual term which is not in the model. This residual term, which incorporates the statistical discrepancy between the current account and net foreign asset purchases, contributed to a significant improvement in the U.S. NFA position in the 2000s, which our model cannot replicate (see Figure 2).[22]

5.1 Expected versus unexpected shocks

Our focus is on the impact of changes in asset values and returns on the current account and the NFA position. Some portion of the changes in asset valuations seen in the data are due simply to anticipated factors — as an economy grows and as it invests in more physical capital, the value of its corporations would be expected to grow as well. Other changes in asset valuations are due to the arrival of news that makes realized returns differ from expected returns. We now decompose changes in the U.S. NFA position into anticipated and unanticipated factors.

Given the information available to households in period $t-1$ about model parameters, they expect returns on all assets between $t-1$ and t to be equal to r_t^*. Then, at each date t, these households receive further news about future output wedges, growth, and other parameters, and this news generates dynamics both in the current account and in asset values. Specifically, let e_t and e_t^* denote excess real returns (realized minus expected return) to domestic and foreign equity realized in period t:

$$e_t = \frac{D_t + V_t}{V_{t-1}} - (1 + r_t^*), \qquad e_t^* = \frac{D_t^* + V_t^*}{V_{t-1}^*} - (1 + r_t^*).$$

In the model, these realized excess returns are due to news about parameters from $t+1$ onward that leads agents to expect a different present value of dividend income relative to what they expected at $t-1$.

[22]The combined impact of non-equity revaluations and the residual term can be seen by comparing the cumulative actual current account in the data (which the model perfectly replicates) to the hypothetical current account series that would obtain in the data absent a residual term and absent non-equity revaluations. That hypothetical series is plotted in yellow in the bottom left panel of Figure 10.

In Appendix H, we show that the evolution of the U.S. net foreign asset position in our model can be decomposed as follows:

$$NFA_t - NFA_{t-1} = \underbrace{\frac{r_t^* - \rho}{1+\rho} NFA_{t-1}}_{(1)} + \underbrace{\left(\frac{r_t^* - \rho}{1+\rho} - \bar{g}_t\right) V_{t-1}}_{(2)} + \underbrace{\left(\frac{\frac{W_t L_t}{H_t} - \rho}{1+\rho}\right) H_t}_{(3)} \tag{27}$$
$$-\underbrace{(Q_t X_t - \mathbb{E}_{t-1}[Q_t X_t])}_{(4)} - \underbrace{\frac{\rho}{1+\rho}\lambda_{t-1} e_t V_{t-1}}_{(5)} - \underbrace{\frac{\rho}{1+\rho}\lambda_{t-1}^* e_t^* V_{t-1}^*}_{(6)} - \underbrace{e_t(1-\lambda_{t-1})V_{t-1}}_{(7)} + \underbrace{e_t^* \lambda_{t-1}^* V_{t-1}^*}_{(8)}$$

Terms (1) and (2) capture savings motives that are predictable at $t-1$. Term (1) indicates that the NFA position will tend to grow at rate $(r_t^* - \rho)/(1+\rho)$. Note that on a balanced growth path, this term is equal to the growth rate $\bar{g}$, implying a stable NFA to GDP ratio.[23] The second term is the contribution to the NFA from expected returns to domestic equity. Term (3) is the current account contribution to national saving from a yield on human capital exceeding ρ.

The remaining terms capture the impact of shocks at t to asset values and returns. Term (4) captures deviations of investment at date t from investment expected at $t-1$: if information revealed at t spurs unexpected domestic investment, the U.S. will fund that extra investment by borrowing from abroad. Term (5) captures the impact of excess equity returns at t on desired consumption and the current account. Term (6) captures the direct effect of excess returns on the NFA position: here excess returns to domestic equity reduce the NFA position by inflating U.S. liabilities, while excess returns to foreign equity improve the position. On a balanced growth path, terms (2) through (8) are all zero.

Figure 11 uses equation (27) to decompose the change in the NFA position relative to the start of our sample period (1990) into the cumulative values of each of the eight labeled terms. The cumulative value for each term is plotted relative to value added at date t. The message from the plot is that over the entire sample period, there are three key drivers of the decline in the U.S. NFA position.

Quantitatively, the most important driver is that starting around the end of the Great Recession, positive excess returns on U.S. equities have inflated U.S. equity liabilities (shown in the purple line in the right panel of Figure 11). These excess returns account for a decline in the NFA position of over 100 percent of corporate value added, though some of this effect was unwound in the last few quarters of our sample as U.S. asset values declined. Note that, at high frequency, excess returns to domestic and foreign equity tend to work in opposite

[23] In particular, if $1 = \frac{1}{1+\rho}\frac{1+r^*}{1+\bar{g}}$, then $\frac{r^*-\rho}{1+\rho} = \bar{g}$.

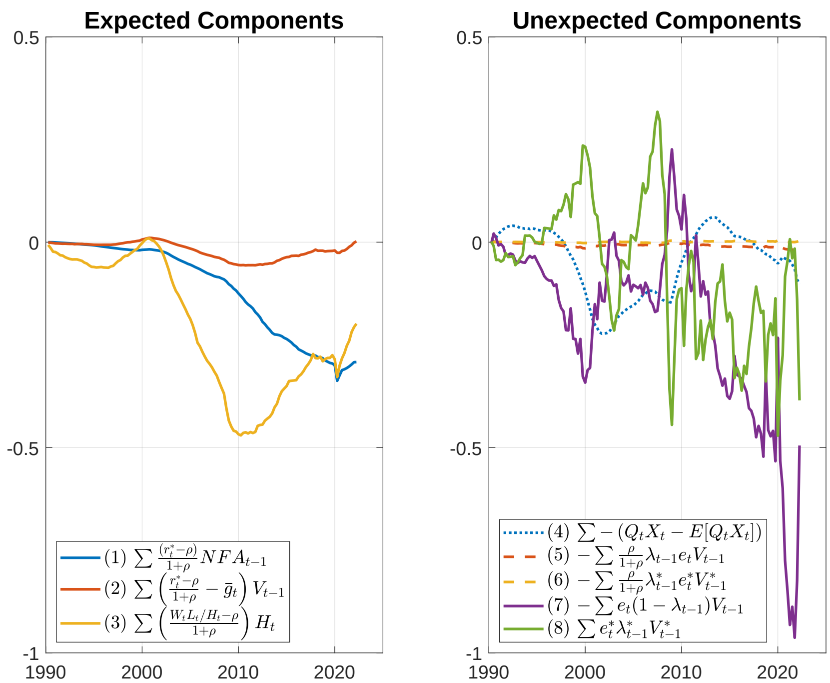


Figure 11: NFA Decomposition

directions, reflecting high frequency co-movement across global equity markets. For example, at the end of our sample period we see that poor U.S. equity market performance reduced U.S. equity liabilities (purple line), but poor ROW market performance simultaneously reduced the value of U.S. foreign equity assets (green line).

The second important driver of the U.S. NFA position is that during the 2000s, a low income yield on human capital fueled current account deficits (shown in the yellow line in the left panel of Figure 11.) The third key driver is that as the NFA position has widened, the fact that the interest rate exceeds the rate of time preference has fueled further borrowing (the blue line in the left panel).

6 Counterfactuals

In Section 4, we used our model to measure the factors driving observed flows, stocks and valuations of the U.S. corporate sector, together with those driving the evolution of the U.S. current account and NFA position in quarterly data over the period 1990 through 2022. This measurement exercise establishes a baseline path for model parameters that accounts for the evolution of this broad collection of data over this three-decade time period. We now use the model to conduct counterfactual exercises relative to this model baseline to consider how these changes in parameters impacted the welfare of U.S. households. Our particular focus is on the question of how the large increase in gross cross-border equity positions observed in recent decades impacts the welfare implications of the large increase in the output wedge μ_t measured in our baseline over the course of the last decade. To address this question, we simulate the model for three specific counterfactual paths for parameters.

In the first, we solve for the counterfactual equilibrium of the model with no cross-border equity positions. To do so, we set the share of U.S. firms owned by U.S. residents to $\lambda_t = 1$ and the share of ROW firms owned by U.S. residents to $\lambda_t^* = 0$, leaving all other parameter values unchanged. In this counterfactual exercise, the paths of output, labor compensation, capital, investment, and the market valuation of the U.S. corporate sector are all the same as in the baseline calibration. That is because, in our model, the distribution of the ownership of firms across U.S. and ROW households does not impact the equilibrium discount rate r_t^* or equilibrium production and investment decisions. In this counterfactual exercise, the paths for U.S. consumption and for the current account are different from those in the baseline because now U.S. households enjoy more of the unexpected capital gains on their now larger holdings of equity in U.S. corporations. Our baseline model, together with this counterfactual exercise, gives us two paths for the consumption of U.S. households with a large increase in μ_t: one with and one without observed gross cross-border equity positions.

In the second counterfactual exercise, we solve for the equilibrium of the model when z_{Lt} is set equal to z_{Ht} for all t, leaving all other parameter values unchanged. In this counterfactual exercise, with this alternative path for the productivity of follower firms, we have $\mu_t = 1$ for all t. This counterfactual exercise gives us predictions for how allocations would have evolved if U.S. leader firms had experienced the same path for productivity but had not enjoyed a large increase in their power to price above cost, all under the assumption that cross-border equity share holdings $(1 - \lambda_t)$ and λ_t^* had evolved as in the baseline.

In the third counterfactual exercise, we solve for the equilibrium path for consumption of U.S. households when we set the share of U.S. firms owned by U.S. residents to $\lambda_t = 1$, the share of ROW firms owned by U.S. residents to $\lambda_t^* = 0$, and $z_{Lt} = z_{Ht}$ for all t so that $\mu_t = 1$ for all t.

With these three counterfactuals, we can compare the paths of output and consumption given the baseline path for the output wedge μ_t against the paths of output and consumption with $\mu_t = 1$. And we can perform this comparison twice: once under the baseline data-consistent paths for gross equity positions $(1 - \lambda_t)$ and λ_t^*, and once for a counterfactual world in which cross-border equity positions are always zero. We use these counterfactual simulations to study how international equity diversification changes the welfare implications

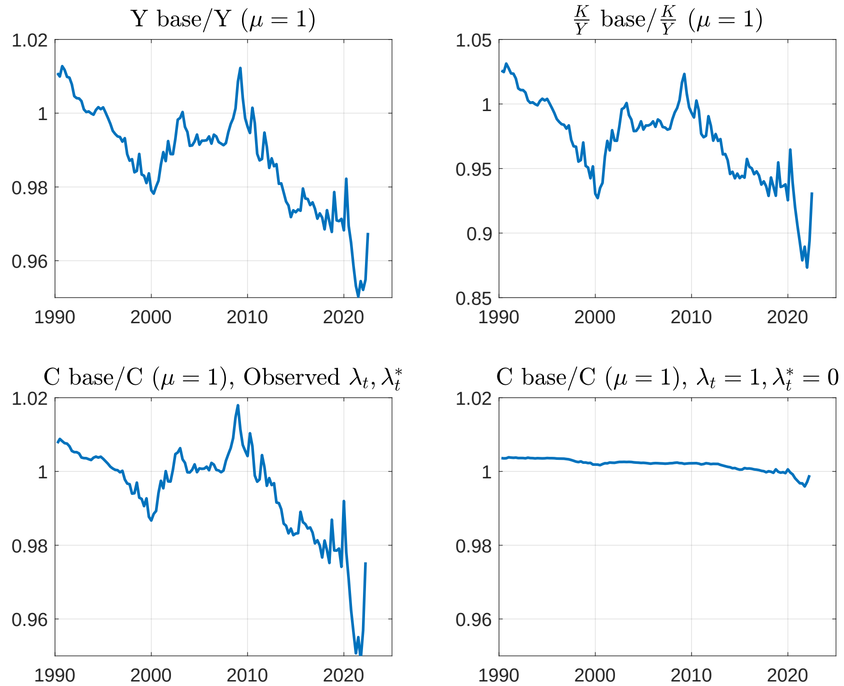


Figure 12: Effect of Output Wedges on Y, K/Y, and C. Effect on C Shown with Actual Path for Diversification, and Zero Diversification Counterfactual.

of a rise in the ratio between revenue and cost μ_t which is the key driver of rising U.S. asset valuations in our analysis.

We show these results in Figure 12. In the top left panel of this figure, we show the ratio of the path of U.S. output in our baseline to that in our counterfactuals with $z_{Lt} = z_{Ht}$ for all t so that $\mu_t = 1$ for all t. As noted above, the path for output implied by our model is not impacted by assumptions about the extent of international diversification of equity holdings $(1 - \lambda_t)$ and λ_t^*. Hence, there is only one line in this top panel. We see in this figure that the increase in μ_t over the past decade has had a large negative impact on the path of output relative to the counterfactual with $\mu_t = 1$ at all dates. In our model, since labor is supplied inelastically and the path for leader firm productivity is the same in the baseline and the counterfactual simulation, this decline in output is entirely due to the impact of increases in μ_t on the accumulation of physical capital; the negative impact on the model capital to output ratio is plotted in the top right panel of the figure. In this regard, we confirm the findings of Gutiérrez and Philippon (2017) that the big increase in the valuation of U.S. firms in our baseline is associated with comparatively weak investment.

In the bottom panels of Figure 12, we show how the impact of a rising output wedge on the consumption (and thus welfare) of U.S. households is mediated by the dynamics of international equity diversification.

First, consider the impact of the large estimated increase in the output wedge μ_t in a world with no cross-border equity holdings (bottom right panel). Here we plot the ratio of the path of U.S. household consumption in our baseline (in which μ_t is generally rising) to consumption in the counterfactual with $z_{Lt} = z_{Ht}$ for all t (so that $\mu_t = 1$ for all t) under the assumption that cross-border equity holdings $(1 - \lambda_t)$ and λ_t^* are always zero in both model simulations. It is clear that a large increase in the output wedge μ_t in the U.S. has only a modest impact on U.S. consumption, notwithstanding the large impact of this increase in the output wedge on U.S. output shown in the top panel. The intuition for this result is straightforward. First, the income that U.S. households lose from lower labor compensation when μ_t goes up is mostly offset by a rise in the factorless income that they receive in dividend payments from firms. Second, the decline in investment that drives down equilibrium output also implies a period of elevated cash flow to shareholders, and that extra income can be invested abroad, and used to replace lower future domestic income. The finding that a rise in μ_t has only a small negative impact on consumption is analogous to the result that an increase in output wedges starting from an efficient equilibrium has no first-order impact on welfare in a closed economy. In Appendix I we prove that if we start from a zero output wedge, the impact on consumption from a marginal shock to μ_t is nil when there is zero foreign ownership of U.S. equity.

Now consider the impact of the same increase in μ_t under our baseline parameterization, in which cross-border equity holdings match those in the data. Specifically, the bottom left panel of Figure 12 plots the path for U.S. household consumption in our baseline relative to that in our counterfactual with $z_{Lt} = z_{Ht}$ for all t (so that $\mu_t = 1$) under the assumption that cross-border equity holdings $(1-\lambda_t)$ and λ_t^* evolve as in our baseline calibration. Now, we see a large negative impact of the increase in μ_t on equilibrium consumption. In fact, the additional decline in consumption relative to a world with a zero output wedge is quantitatively similar to the associated decline in output. The reason is that now the income that U.S. households lose from a decline in the share of labor compensation in output is not largely offset by an increase in dividends that they receive as owners of firms, because foreign households receive a large share of those increased dividends. As a result, U.S. households have less wealth (both in absolute terms and relative to output) than they would have had absent cross-border equity holdings, leading them to reduce consumption. Thus, the negative welfare implications of an increase in market power for U.S. firms for U.S. households are dramatically magnified in the presence of large foreign ownership of U.S. equity.

Is the ex post redistribution to foreign households that occurs when U.S. factorless income increases desirable from an ex ante risk sharing perspective? A large literature in international macroeconomics considers how the optimal extent of international diversification depends on the nature of the shocks hitting the economy (see, for example, Coeurdacier, Kollmann, and Martin, 2007 and Heathcote and Perri, 2013). In Appendix I we show that when fluctuations in macro aggregates and asset values are driven by output wedge shocks associated with fluctuations in follower firm productivity, z_{Lt}, the ex ante optimal portfolio for U.S. households involves U.S. households owning most or all of U.S. equity. The intuition is that shocks to the factorless share of income do not imply large changes in relative lifetime wealth (including human wealth) across countries. Thus, international diversification, which would imply international resource transfers in response to these shocks, is not desirable ex ante. Of course, in a world with additional shocks, this result would likely no longer apply. One interesting scenario is a world in which shocks to the output wedge are correlated with shocks to total factor productivity, as would be the case if shocks to μ_t reflected changes in leader firm productivity, z_{Ht}, rather than changes in follower productivity, z_{Lt}. In such a setting, some portfolio diversification, and the associated transfers, would be desirable.

7 Sensitivity Analysis

We now consider the extent to which our measurement of the discount rate r^*_{t+1} and the parameters μ_{t+1} and α_{t+1} derived from that estimate are sensitive to our use of equation (22) and data on the current account in our measurement procedure.

We do so for two reasons. First, prior papers such as Farhi and Gourio (2018) and Crouzet and Eberly (forthcoming) do not consider the implications of their models for the current account and instead use data on historical growth rates to estimate $\bar{g}_{t+1}$. We consider alternative versions of this procedure in our sensitivity analysis. Second, one might consider an alternative model structure that does not have a representative U.S. household. For example, Greenwald, Lettau, and Ludvigson (2021) consider a model in which there are two types of U.S. households, one that earns labor income and consumes that income every period (living hand-to-mouth), and another that owns all financial assets. If we were to make a similar assumption, our model's implication for the current account would be similar to that in equation (22). The difference would be that the final term involving current labor compensation W_tL_t and the level of human wealth H_t would not be included, since the households earning labor income would contribute nothing to the overall household saving rate and thus the valuation of human wealth would not influence the current account. In this case, we would not be able to use this equation in our measurement of r^*_{t+1} and $\bar{g}_{t+1}$.

To conduct our sensitivity analysis, we consider four alternative measurement procedures in which we replace our use of equation (22) for the current account and use only equation (25) involving the valuation metrics of the earnings yield and Tobin's Q, with alternative auxiliary assumptions about either expected growth $\bar{g}_{t+1}$ or the expected dividend yield $r^*_{t+1} - \bar{g}_{t+1}$ as in equation (26). Specifically, we calculate the model implied paths for r^*_{t+1}, μ_{t+1}, and α_{t+1} under the auxiliary assumptions that

1. $r^*_{t+1} - \bar{g}_{t+1}$ is constant at the average of D_{t+1}/V_t over the 1990-2022 time period;
2. $\bar{g}_{t+1}$ is equal each quarter to the median 10-year GDP growth forecast in the Survey of Professional Forecasters;[24]
3. $\bar{g}_{t+1}$ is set equal to the trend from an HP filtered series of quarterly growth rates of U.S. corporate GVA; and
4. the expected dividend yield $r^*_{t+1} - \bar{g}_{t+1}$ is equal to the realized dividend yield D_{t+1}/V_t each period.

We show the results for $r^*_{t+1}, \bar{g}_{t+1}, \mu_{t+1}$, and α_{t+1} under these four alternative measurement scenarios in Figure 13. We include in this plot (in green) the values of these parameters that we obtain in our baseline measurement exercise in which our model with a representative U.S. household replicates the path for the current account. Note that the series for $r^*_{t+1}, \bar{g}_{t+1}, \mu_{t+1}$, and α_{t+1} that we obtain in our baseline are sufficiently close to those obtained under the assumption that $r^*_{t+1} - \bar{g}_{t+1}$ is constant at the average of D_{t+1}/V_t over the 1990-2022 time period (in blue) that it is difficult to distinguish the two alternative measurements in the figure.

We draw two conclusions from this sensitivity analysis.

First, as is evident in the top left panel of this figure, these alternative measurement procedures produce widely divergent estimates of expected growth $\bar{g}_{t+1}$. Despite this wide array of estimates of expected growth rates $\bar{g}_{t+1}$, these alternative measurement procedures produce very similar estimates of the discount rate r^*_{t+1} over our time period, outside of the years around the peak of the dot-com boom in 2000 and the stock market boom during COVID in 2020 and 2021. As we discussed above, when Tobin's Q is equal to one, the estimate of the discount rate r^*_{t+1} that one obtains from equation (25) is not sensitive to one's estimate of the growth rate $\bar{g}_{t+1}$. We interpret this agreement in estimates of r^*_{t+1} across our five alternative measurement procedures as indicating that in the data, outside of the period around the year 2000, Tobin's Q is close enough to one that the divergence in estimates of future growth $\bar{g}_{t+1}$ does not have a substantial influence on the model-implied discount rate r^*_{t+1}.

[24]We interpolate these data to develop a quarterly series for $\bar{g}_{t+1}$.

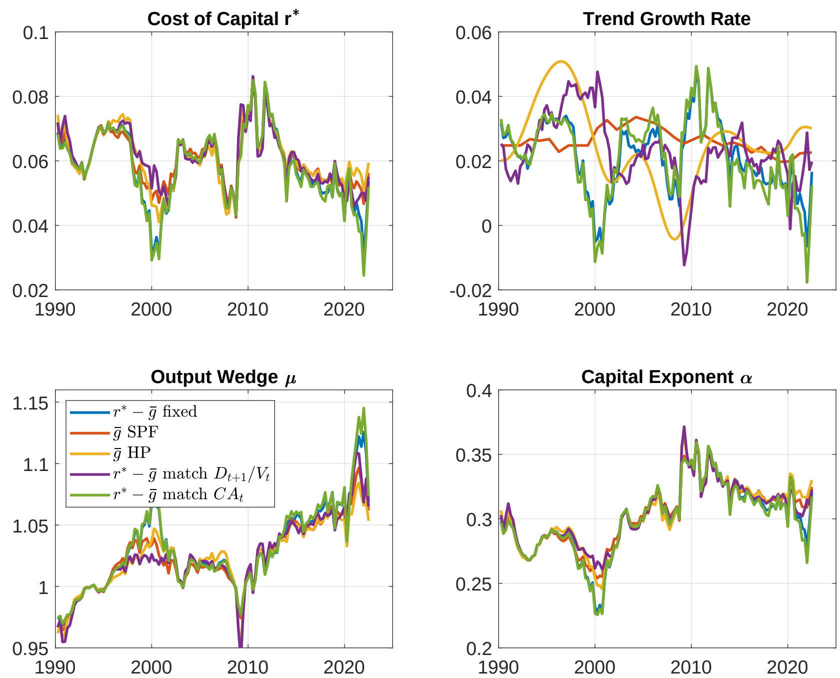


Figure 13: Sensitivity to Trend Growth Model

Second, as is evident in the bottom right panel of this figure, these alternative measurement procedures all imply that the output wedge in the U.S. corporate sector μ_t has increased substantially in the past decade. This finding follows from the observation that given the nearly recursive structure through which the parameters of our model are identified, once these alternative measurement procedures agree on the appropriate discount rate r^*_{t+1}, it is immediate that they will agree on estimates of μ_{t+1} and α_{t+1}.

8 Conclusion

Cross-border asset holdings have grown very large in recent decades. These large gross positions open the door to new channels for shocks to propagate internationally, especially shocks that affect asset values. Gourinchas and Rey (2014) showed that changes in asset values play a quantitatively important role, in an accounting sense, in driving the dynamics of the NFA position. We show that that finding extends with even more force in recent data: the unprecedented decline in U.S. NFA position since the Great Recession is primarily driven by a boom in the value of corporate equity that foreigners own in the United States.

We have presented a simple international macro-finance model to measure and interpret the factors driving changes in value of the U.S. corporate sector and the U.S. current account and NFA position over the period 1990-2022. Our model extends previous macro-finance models used for similar measurement exercises in integrating the evolution of the current account. In doing so, we reinforce previous findings that increases in the cash flows to firm owners, rather than changes in the valuation multiple of those cash flows, account for much of the increase in the value of the U.S. corporate sector over the past decade. Indeed, the share of U.S. corporate GVA available as free cash flow to owners of corporations has reached levels not previously seen in post-WWII data.

Our model extends previous work in international macroeconomics in developing an accounting of observed changes in the U.S. current account and NFA position that incorporates quantitatively realistic fluctuations in asset values. We find that the direct impact of changes in the valuation of the U.S. corporate sector on the U.S. NFA position through its mechanical impact on the valuation of ROW equity holdings in the U.S. has been large over the past decade, while the indirect impact of these developments on the current account through induced changes in the wealth to income ratio for U.S. households has been quite small.

Through the lens of our model, a rising share of factorless income in the United States is a key driver of rising U.S. asset valuations. This rise would not have mattered much for U.S. households absent foreign ownership of U.S. equity. But given high observed ROW ownership of U.S. firms, the rise in U.S. equity values during the 2010s was associated with a large increase in the portion of free cash from U.S. firms accruing to foreign owners, and a large consumption loss for American households.

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Appendix For Online Publication

In this appendix, we discuss the sources and construction of our data in Section A. In Section B we discuss the contribution of exchange rate movements to valuation effects. In Section C we discuss concerns about the international data that have been raised in the literature and present results from a model sensitivity exercise in which we use smaller estimates of gross cross-border equity positions. In Section D we describe how we use our model for measurement in full detail. In Section E we compare our measurement procedure to those used by prior papers in the literature. In Section F we derive our model's implications for how various shocks to model parameters impact the current account. In Section G we present an extended version of our model that includes changes in the terms of trade. In Section H we present details of our decomposition of changes in the current account into those due to anticipated and unanticipated changes. In Section I we consider our model's implications for the ex-ante optimal international diversification of equity positions when shocks to the output wedge are the primary shock driving changes in equity values.

A Data Sources

We use data from the following quarterly version of tables in the Federal Reserve Board of Governors Z1 release *The Financial Accounts of the United States*. We draw most of the data from that website directly, as the versions of the data presented on the FRED website maintained by the Federal Reserve Bank of St. Louis do not have the correct series for the market value of FDI equity as of the time of writing.

We draw most of our data from these tables in Z1 drawing from the *Integrated Macroeconomic Accounts*

- Table S.1 *Selected Aggregates for Total Economy and Sectors* of the Integrated Macroeconomic Accounts
- Table S.5 *Non Financial Corporate Business* sector of the Integrated Macroeconomic Accounts
- Table S.6 *Financial Business* sector of the Integrated Macroeconomic Accounts
- Table S.9 *Rest of World* sector of the Integrated Macroeconomic Accounts

We download data from the Board of Governors Data Download Program. Series identifiers can be found in the "Federal Reserve Statistical Release Z.1. Financial Accounts of the United States." The line numbers reported below refer to the version of that publication dated December 9, 2021, available at https://www.federalreserve.gov/releases/z1/20211209/z1.pdf

The Python code for downloading and constructing our figures is available upon request. We download quarterly nominal GDP and the change in the GDP deflator from one quarter to the next from the FRED database at the Federal Reserve Bank of St. Louis (identifiers "GDP" and "A191RI1Q225SBEA").

We first describe the series we use to measure the levels of the gross and net foreign asset position for the United States and decomposition of changes in those positions into flows and revaluation effects. We then describe our measures of flows for the corporate sector and valuation of the corporate sector. Finally, we present our measure of the extent of foreign ownership of U.S. equities, including the equity for foreign parent firms in their U.S. subsidiaries.

A.1 Gross and Net Foreign Assets, Flows, and Valuations

Gross and net foreign assets: Data on gross and net foreign assets are taken from Table S.9. The total market value of financial claims of the U.S. on the ROW is given in line 134 of Table S.9 in series FL264194005. The total market value of financial claims of the ROW on the United States (U.S.) is given on line 105 of Table S.9 in series FL264090005. These two series constitute the gross foreign asset positions used in our study, with the NFA position of the U.S. shown in Figure 1 being the difference between the market value of U.S. claims on the ROW and ROW claims on the U.S., which corresponds to (the negative of) line 158, series FL262090095, in Table S.9.

We take ratios of these and subsequent series relative to nominal GDP (FRED identifier "GDP") and to nominal Gross Value Added of the Corporate Sector which we construct in quarterly data from Tables S.5 and S.6 as described below. Note that this series for GDP is in billions of dollars, whereas many of the other series are in millions of dollars, so we multiply this series by 1000. Note as well that a data series for gross value added of the U.S. corporate sector and its components is available from BEA NIPA Table 1.14.

The current account, the capital account, and valuation changes: using data from Table S.9 we decompose nominal changes in the U.S. net foreign asset position according to the following accounting identity

$$NFA_t - NFA_{t-1} = \underbrace{CA_t}_{\text{net lending abroad}} + \underbrace{VA_t}_{\text{valuation changes}} + \underbrace{RES_t}_{\text{residual term}} .$$

Table S.9 is presented from the perspective of the rest of the world. We consider flows and net foreign assets from the perspective of the United States. Thus, we typically take the negative of the series noted below. The variables NFA_{t-1} and NFA_t are the end of previous period and end of current period net foreign asset positions of the U.S. computed as Table S.9 line 134 (FL264194005) minus line 105 (FL264090005). The change $NFA_t - NFA_{t-1}$ is reported (with the opposite sign) on line 104 (FC262090095). The current account CA_t corresponding to "net lending abroad" measured from the goods and services flow side is the negative of line 13 (FA265000905). Note that this series is annualized, so we divide the quarterly data by 4. "Valuation changes" VA_t is the negative of line 103 (FR265000005).

What we term the "residual term" RES_t is given by the negative of line 70 (FV268090185). Note that line 70 in Table S.9 is called "total other volume changes" and consists of "other volume changes" in line 71 minus the official "statistical discrepancy" in line 72 between net lending abroad measured from the goods and services flow side and from observed net financial flows.

Note that in Table S.9 the following accounting identity holds

$$\underbrace{NFT_t}_{\text{net financial transactions}} = \underbrace{CA_t}_{\text{net lending abroad}} - \underbrace{SD_t}_{\text{statistical discrepancy}}$$

where the left-hand side is "net lending on the financial account" reported in line 69 (FA265000005) and the right-hand side is the sum of line 13 (FA265000905) minus line 72 (FU267005005). Note that line 69 is annualized in quarterly data, just like line 13, so we divide it by 4.

Thus, an alternative decomposition of the cumulated change in the U.S. NFA position is

$$NFA_t - NFA_{t-1} = \underbrace{NFT_t}_{\text{net financial transactions}} + \underbrace{VA_t}_{\text{valuation changes}} + \underbrace{OV_t}_{\text{other volume changes}},$$

where "other volume changes" (OV_t) is line 71 (FV268090085) in Table S.9. As discussed in Bertaut and Judson (2022), this series for "other volume changes" represents primarily discrepancies arising for separate data sources on gross cross border asset positions and flows. Note that these decompositions of cumulated changes in the U.S. net foreign asset position are invariant to measurement issues in the current account relating to the measurement of U.S. exports and factor income as discussed in Guvenen et al. (2022).

We compare cumulated net financial flows to the cumulated current account here.

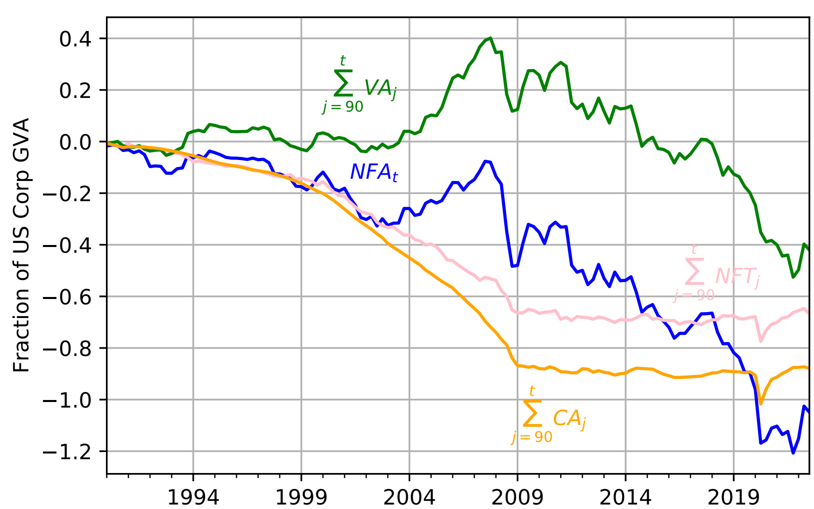

Figure A.1: Decomposition of Changes in U.S. Net Foreign Assets over U.S. Corporate Value Added

The equity component of gross and net foreign assets: We measure the equity component of gross and net foreign assets of the U.S. using the sum of portfolio investments in equity and the equity component of foreign direct investment. The market value of U.S. portfolio equity investment in the ROW is given on line 152 of Table S.9, "corporate equities including foreign investment fund shares" (LM263164100). The market value of ROW portfolio equity investment in the U.S. is given by the sum of lines 125, "corporate equities" (LM263064105), and 126, "mutual fund shares" (LM263064203).

The market value of the equity component of U.S. foreign direct investment in the ROW is given by Table S.9, line 154 (LM263192101), and the market value of the equity component of ROW foreign direct investment in the U.S. is given by Table S.9, line 127 (LM263092101).

We compute market values of non-equity gross and net foreign assets and liabilities as the difference between the the measures of the total positions and the equity component of those positions as described above.

The corresponding valuation changes of the market valuations of the equity component of portfolio investment and of foreign direct investment are as follows. The revaluation of U.S. portfolio equity investment in the ROW is given on line 99 of Table S.9, "corporate equities," (FR263164100). The revaluation of ROW portfolio equity investment in the U.S. is given by the sum of lines 83, "corporate equities," (FR263064105) and 84, "mutual fund shares," (FR263064203). The revaluation of the equity component of U.S. foreign direct investment abroad is line 100, (FR263192101). The revaluation of the equity component of ROW foreign direct investment in the U.S. is line 85, (FR263092101).

We measure the valuation changes for non-equity assets and liabilities as the difference between the total valuation changes and the valuation changes for the equity assets and liabilities discussed above.

We use a measure of the value of the equity component of foreign direct investment at current cost in Figure C.2 below. We use the following series for these alternative plots. A valuation of the equity component of U.S. foreign direct investment abroad at current cost is given in series FL263192161 and the current cost valuation of the equity component of ROW foreign direct investment in the U.S. is given in series FL263092161.

A.2 Measurement of the U.S. Corporate Sector

We now detail exactly which series we use for each entry.

Gross value added The breakdown of gross value added by sector in the Integrated Macroeconomic Accounts is given in Table S.2. Gross value added for the non-financial corporate business sector is given in line 4 of that table (FA106902501) and that for the financial business sector on line 5 (FA796902505). Gross value added for the economy as a whole is given on line 1 of that table in series FA896902505. We compute the fraction of Gross Value Added in the corporate sector as the sum of that in the non-financial corporate business sector and in the financial business sector, all divided by gross value added for the economy as a whole.

The use of the residence principle has a substantial impact on the measurement of economic activity in the corporate sector, relative to what one would get if one were to instead associate the economic activity of affiliates of multinational enterprises with the country in which the multinational is headquartered. For example, the BEA reports that in 2018, majority-owned U.S. affiliates of foreign multinational enterprises contributed \$1.1 trillion, or 7.1 percent of U.S. business sector value added and accounted for 6.0 percent of total private industry employment in the United States. Likewise, in 2018, U.S. multinationals produced \$5.7 trillion of value added, \$4.2 trillion of which was produced by U.S. resident operations with 28.6 million employees, and $1.5 trillion of which was produced by majority-owned affiliates abroad with 14.4 million employees. Using the residence principle, the Integrated Macroeconomic Accounts include the $1.1 trillion of value added by U.S. affiliates of foreign multinationals as a flow attributed to the U.S. corporate sector and do not include the $1.5 trillion produced by foreign affiliates of U.S. multinational enterprises in this category.

In Figure A.2, we show the share of economy-wide gross value added that is produced in the U.S. corporate sector.

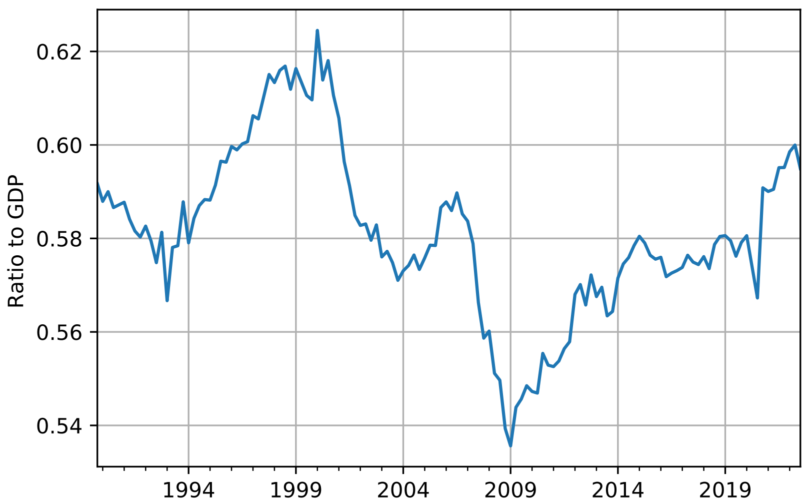

Figure A.2: U.S. Corporate Sector Gross Value Added Share of GDP

Dividends The variable in the model is D_t, which is a comprehensive measure of payouts to investors in the corporate sector from operations. For the non-financial corporate business sector, we measure payouts using the following lines from Table S.5: we take operating surplus, net in line 8 (FA106402101) less current taxes on income, wealth, line 21 (FA106220001) less net capital formation in line 28 (FA105050985). For the financial business sector, we measure payouts from the following lines in Table S.6. We take operating surplus, net in line 8 (FA796402101) less current taxes on income, wealth, line 23 (FA796220001) less capital formation, net in line 30 (FA795015085).

We have also computed an annual series for Dividends from the U.S. corporate sector using data Corporate GVA, consumption of fixed capital, net operating surplus, and taxes on corporate income from Table 1.14 of the BEA NIPA accounts and data on gross investment by the corporate sector from Fixed Assets Table 6.7. We show this series for the ratio of Corporate Dividends relative to Corporate GVA in Figure A.3. As is evident in this figure, the recent elevated level of dividends relative to Corporate GVA is quite unusual in the post WW-II history. Dividends had only previously reached current levels relative to GVA in the Great Depression.

Earnings: The variable E_t in the model is a comprehensive measure of the operating earnings of the U.S. corporate sector. In the model $E_t = D_t + I_t - \delta K_t$. We construct

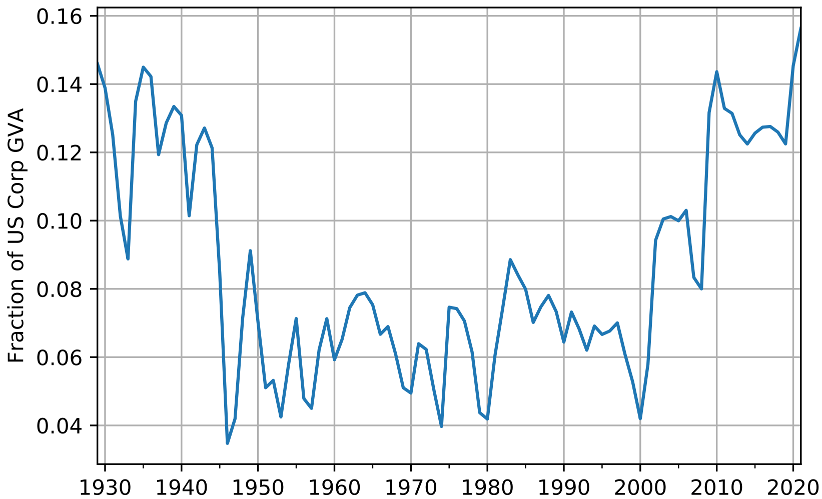

Figure A.3: U.S. Corporate Sector Free Cash Flow 1929-2021, Ratio to U.S. Corp Value Added

this measure using our constructed measure of dividends above, adjusted using the following series from Tables S.5 and S.6. For the non-financial corporate business sector, we add net capital formation, as recorded in line 28 (FA105050985), to our measure of dividends. For the financial sector, we add net capital formation, as recorded in line 30 (FA795015085), to our measure of dividends.

Replacement value of non-financial assets The variable $Q_t K_{t+1}$ in the model is the replacement value of non-financial assets at the end of period t. This is the sum of such values across the non-financial business sector and the financial business sector. We construct this measure as the sum of line 109 (LM102010005) on Table S.5 and line 105 (LM795013865) on Table S.6.

Market or enterprise value of corporate non-financial assets The variable V_t in the model is the market or enterprise value of non-financial assets at the end of period t. This is the sum of such values across the non-financial corporate sector and the financial business sector. We construct this measure for the non-financial corporate business sector as the sum of "Liabilities," line 144 (FL104194005), less "Financial Assets," line 114 (FL104090005) on Table S.5 (note that this series is in billions of dollars). Note as well that line 144 includes both the market value of corporate equities and ROW FDI investment in the U.S. non-financial corporate sector. Line 114 includes the value of U.S. FDI investment by the non-financial corporate sector in the ROW.[25] Finally, note that this measure of the market value of the non-

[25]Given this use of market values to measure the equity entries in the balance sheet of the U.S. corporate sector, the entries on the two sides of this balance sheet do not add up in the standard sense of having the sum of the left side and right side equal. In the Integrated Macroeconomic Accounts, an additional entry called "*Net Worth*" is included as the bottom of this balance sheet to reconcile the two sides (line 166 on Table S.5 and line 153 on Table S.6). This entry does not correspond to the standard accounting notion of net worth

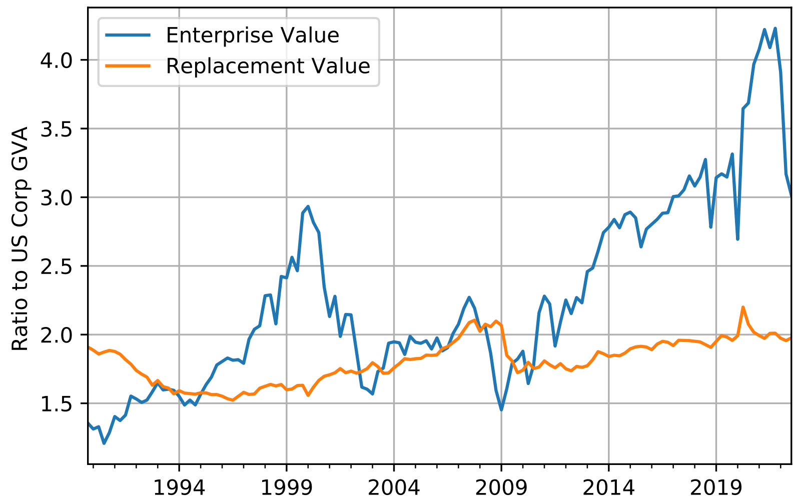

Figure A.4: Enterprise and Replacement Values of U.S. Non-financial Corporate Sector Non-financial Assets

financial assets in the non-financial corporate sector corresponds to the measure presented for that sector in Z1 Table B.1 *Derivation of U.S. Net Wealth* line 14 (LM102010405).

For the financial business sector, we take a different approach than that taken on line 15 in Table B.1. Our aim is to measure the enterprise value of banks, insurance companies, and other financial services firms resident in the United States, but to exclude the value of pure financial intermediaries such as mutual funds, closed end funds, and exchange traded funds (ETFs), as we assume that these pure financial intermediaries by definition have no enterprise value. To construct this measure, we compute the sum of corporate equity issues (LM793164105 from line 143 of Table S.6) and "Foreign Direct Investment in the United States: Equity" (LM793192105 from line 146 on Table S.6) less "U.S. Direct Investment Abroad: Equity" (LM793092105 from Line 126 on Table S.6). We then subtract from this measure the value of corporate equities in closed end funds (LM554090005 line 7 of Table L.123) and exchange traded funds (LM564090005 line 8 of Table L.124). Note that the value of mutual fund shares is already excluded from this measure and reported separately on line 144 of Table S.6.

We construct our measure of V_t as the sum of these measures across these two sectors.

We report on our measures of Enterprise and Replacement values of assets in the non-financial corporate sector and the financial business sector in figures A.4 and A.5.

or to the measure of net worth in Table B.103. This accounting difference occurs because the Integrated Macroeconomic Accounts are compiled under the UN System of National Accounts, which differs in several respects from the U.S. NIPA. See https://www.bea.gov/national/sna-and-nipas for more information.

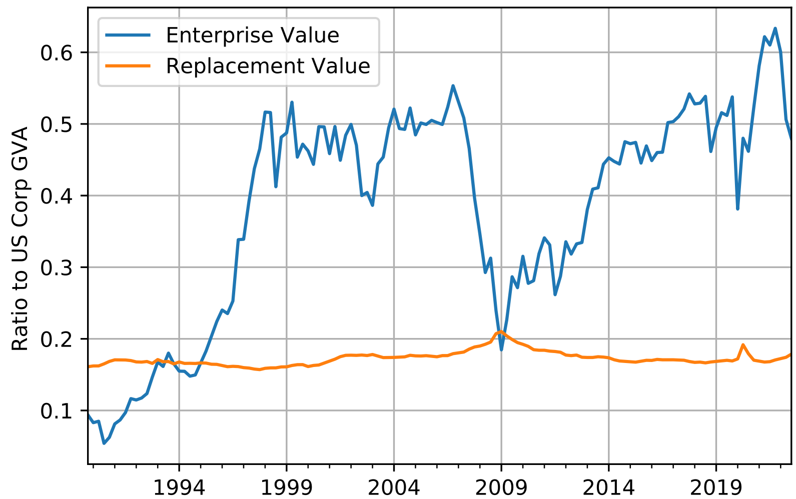

Figure A.5: Enterprise and Replacement Values of U.S. Financial Business Sector Non-financial Assets

A.3 Foreign Ownership of U.S. Equity

Our measure of the share of U.S. equity owned by the ROW at the end of period t $(1 - \lambda_t)$ is a ratio with the numerator equal to a comprehensive measure of ROW ownership of U.S. equity assets and the denominator equal to our measure of the market or enterprise value of corporate non-financial assets, as defined above. Here, the numerator is computed as the gross ROW equity claims on the U.S. described above as the sum of Table S.9 lines 125 "Corporate Equities" (LM263064105), and 126 "Mutual Fund Shares" (LM263064203), and the market value of the equity component of ROW foreign direct investment in the U.S. is given by Table S.9 line 127 (LM263092101).

We show that ratio in Figure A.6

A.4 U.S. Ownership of Foreign Equity

We do not construct a direct measure of the enterprise value of ROW corporations V_t^*. Instead, we measure the U.S. ownership at the end of period t directly as the sum of U.S. portfolio investments in ROW equity and the equity component of U.S. foreign direct investment in ROW. The market value of U.S. portfolio equity investment in the ROW is given on line 152 of Table S.9, "corporate equities including foreign investment fund shares" (LM263164100). The market value of the equity component of U.S. foreign direct investment in the ROW is given by Table S.9, line 154 (LM263192101).

We measure the dividends that U.S. residents receive in period t on their ownership of equity in the ROW (denoted by $\lambda_{t-1}^* D_t^*$ in the model) as monetary dividends paid as reported in BEA NIPA Table 4.1 "Current receipts from the rest of the world: Income receipts on assets: Dividends" which we retrieve from FRED series identifier B3375C1Q027SBEA. Note,

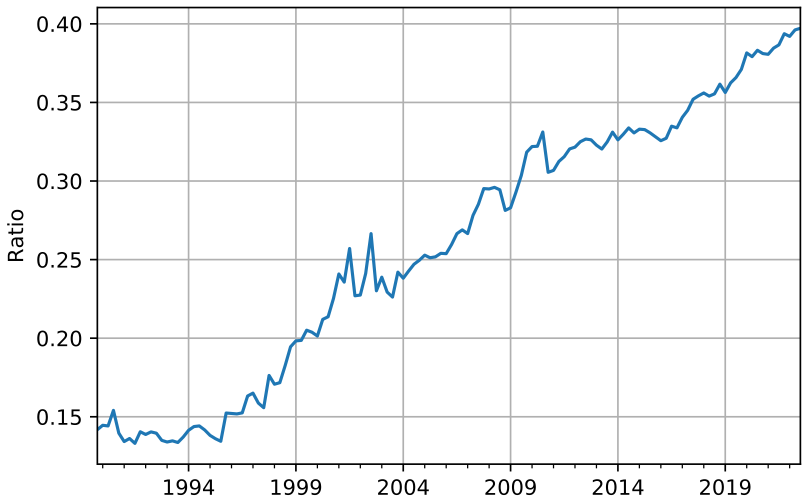

Figure A.6: ROW ownership share of U.S. Corporations

as we discuss below, this series includes only the monetary dividends actually paid on U.S. FDI in the ROW as opposed to the full accounting income reported as part of the current account.

We note that, in contrast to the well-known "income puzzle" on U.S. FDI in the ROW (discussed below), these dividends on U.S. equity in the ROW actually paid are not high relative to the market valuation of U.S. residents holdings of equity in the ROW. We compute that dividend yield as follows. To compute $\lambda^*_{t-1}V^*_t$, we add together the market value of U.S. equity in the ROW at the end of period $t-1$ $(\lambda^*_{t-1}V^*_{t-1})$ as measured above and add to it the revaluation of U.S. equity in the ROW in period t $(\lambda^*_{t-1}(V^*_t - V^*_{t-1}))$. We measure this revaluation as the sum of revaluations of U.S. portfolio and FDI equity in ROW. The revaluation of U.S. portfolio equity investment in the ROW is given on line 99 of Table S.9, "corporate equities," (FR263164100). The revaluation of the equity component of U.S. foreign direct investment abroad is line 100, (FR263192101).

With these data, we compute the current dividend yield on U.S. equity in ROW as the ratio of $\lambda^*_{t-1}D^*_t$ to $\lambda^*_{t-1}V^*_t$ constructed as above giving D^*_t/V^*_t as in Figure A.7. While it is the case that this ratio shows big spikes around changes in U.S. tax law that encourage the repatriation of earnings on U.S. FDI, the long term average for this series is in line with the current dividend yield on U.S. corporations reported in Figure 6b.

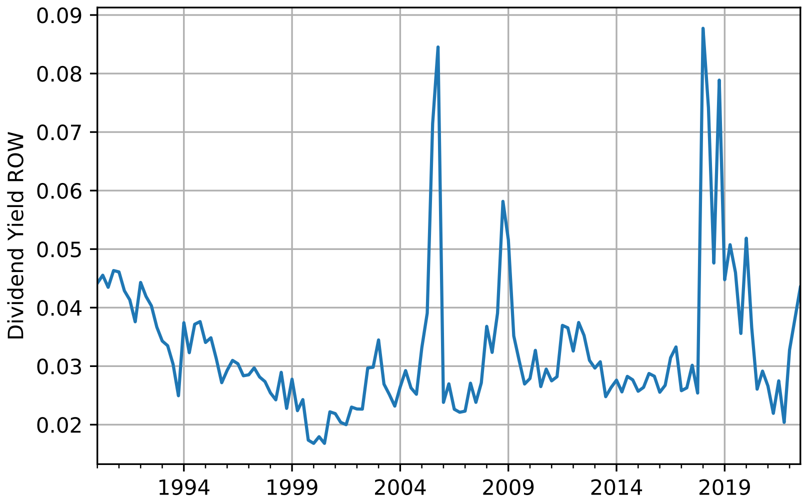

Figure A.7: Current Dividend Yield on U.S. Equity in ROW

A.5 Measurement of the Foreign Corporate Sector

The series in Figure 7a are computed as follows. For the United States the enterprise value of the corporate sector is the net worth of non-financial corporations (from Table S.5.a of the Financial Accounts of the United States) plus the sum of the market value of the equity of monetary financial institutions and of insurance corporations (both from OECD Dataset 720, Non-consolidated Financial Accounts). Note that for the United States, we do not use the OECD Dataset 720 to compute the net worth of non-financial corporations, as figures in that dataset include the net worth of non-financial non-corporate businesses, so the OECD's U.S. figures are not consistent with their analogues for other OECD countries. Gross value added of the corporate sector is also from OECD Dataset 720. For the European Union and each single country in the G6 (Canada, France, Germany, Italy, Japan and United Kingdom) we compute the enterprise value of the corporate sector as the net worth of non-financial corporations plus the sum of the market value of the equity of monetary financial institutions and of insurance corporations. All data for these countries are from OECD Dataset 720.

In Figure 7b, we compute payouts using data from OECD Dataset 13: Simplified Non-financial Accounts. Payouts are measured as net operating surplus minus taxes on income and wealth minus net capital formation for the whole business sector. In both figures the series for the G6 countries are computed aggregating individual countries figures using market exchange rates. We have also experimented using PPP exchange rates and results are quantitatively very similar. Note finally that the U.S. series for enterprise value and payouts in Figures 7a and 7b are the same as the ones plotted in Figures 6a and 5, with the only difference being that the former are annual, whereas the latter are quarterly.

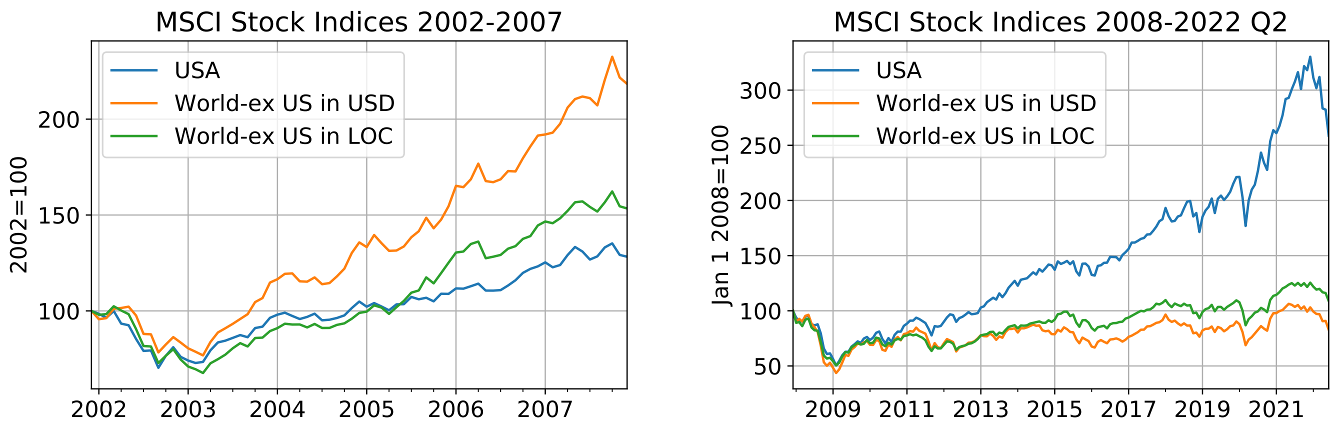

Figure B.1: Two Valuation Episodes

B Valuation effects and exchange rates

In this appendix we assess the contribution of changes in exchange rates to changes in valuations of the net equity position of the United States. To do so we first present stock prices indexes in local currency versus in dollar terms. In Figure B.1 we plot three stock price indexes: the first is a price index for the United States; the second and third are price indexes for foreign stocks in local currency and in dollars.[26] Focus first on the left panel, which describes the earlier valuation episode from 2002 to 2007. This panel shows that foreign equity performed somewhat better than U.S. equity in local currency, but in dollar terms, the foreign equity index substantially outperformed the U.S. index. This suggests that depreciation of the U.S. dollar against the basket of currencies that compose the foreign equity index played an important role in generating the positive valuation effect experienced by the U.S.[27] Moving now to the right panel, we can see that the later valuation episode from 2008 through 2022 was different. During that period, the foreign and U.S. equity indexes diverge dramatically. Comparing the foreign indexes in local currency and in dollars indicates some appreciation of the U.S. dollar, but this appreciation accounts for only a small portion of the differential in dollar returns. Rather, the dominant factor was that the U.S. equity price index more than tripled over the period before falling in 2022.

As an additional check we use information from BEA Table 1.3 (Change in the Year-end U.S. Net International Investment Position). The table provides direct estimates of

[26]For the United States, we use the Morgan Stanley Capital Index (MSCI) U.S. Index. For the rest of the world, we use the MSCI ACWI ex USA Index, which comprises stock market indexes for 22 developed economies and 27 emerging markets, weighted by market capitalization in dollars and in local currency. Bertaut et al. (2023) show that the MSCI indexes closely track the valuation changes reported by the BEA in the International Investment Position tables. The MSCI indices are available from the MSCI website: see `https://www.msci.com/end-of-day-data-search`.

[27]See Bureau Of Economic Analysis (2014) for more discussion of how valuation changes reflect a mix of changes in the prices of the underlying assets, and changes in exchange rates when assets and liabilities are denominated in different currencies. Note that the revaluation of ROW equity in the United States arises solely because of changes in the price of U.S. equity, as these assets are valued in dollars.

Table B.1: Impact of exchange rate on net equity valuation changes

	2002-2007	2010-2022
Δ in value of U.S. equity abroad (% of GDP)	36.2	21.8
due to e	9.2	-9.6
due to p	27.0	31.4
Δ in value of foreign equity in U.S. (% of GDP)	12.5	72.3
Δ in net equity valuation	23.6	-50.4
% of Δ in net equity valuation due to e	38.9	18.9

Source: Authors calculations based on BEA IIP Table 1.3

the equity valuation changes that can attributed to prices or to exchange rates, so we can decompose changes in the net equity valuation effects due to these two factors. Table B.1 below shows that roughly 40 percent of the 2002-2007 positive net U.S. equity valuation effect can be attributed to dollar depreciation. In contrast, only about 20 percent of the 2010-2022 negative net equity valuation change can be explained by exchange rate movements.

C Issues with the International Data

In this paper, we rely on data from the Integrated Macroeconomic Accounts to measure cross border asset positions. As described in Avdjiev et al. (2018) and Lane (2020), several aspects of the the international component of these data as reported in Table S9 have been discussed in detail in the literature. Many of these issues arise due to the difficulties in dividing up the activities of multinational corporations in components attributable to their subsidiaries resident in different countries. Others arise due to the use of offshore financial intermediaries in channeling cross border investments. Moreover, the valuation of closely held foreign direct investment equity is complicated by uncertainty over the appropriate valuation benchmarks using publicly traded equities. We review several of these important concerns here. We then review concerns about the measurement of the income yield on foreign direct investment equity.

C.1 Measurement of Ownership of U.S. Resident Corporations and Cross Border Portfolio Equity

Several factors complicate the measurement of cross border holdings of claims on U.S. resident corporations.

First, as noted in Bertaut, Bressler, and Curcuru (2019), U.S. multinationals have increasingly chosen to incorporate in offshore tax havens in what are called "corporate inversions." As a result, a growing share of what are reported as cross-border equity holdings are, in fact, primarily claims on what are economically U.S. firms held by U.S. equity investors through their claims on the parent firm located in the offshore tax haven. See also Hanson et al. (2015) on how corporate inversions impact the U.S. economic accounts.

Second, again as noted in Bertaut, Bressler, and Curcuru (2019), cross border holdings of assets through mutual funds are classified as equity even if the mutual fund is a bond fund.

These concerns may lead to an overestimate of ROW equity claims on U.S. resident corporations.

Third, as noted in Bertaut, Bressler, and Curcuru (2019), firms are issuing a growing volume of bonds through offshore subsidiaries. Since some U.S. firms follow this practice, a portion of what is recorded as U.S. investors' holdings of foreign corporate bonds is, in fact, a claim on what is economically a U.S. firm. In this regard, we may overestimate U.S. household non-equity claims on ROW corporations. Coppola et al. (2021) and Beck et al. (2023) provide further evidence on the impact of offshore financial centers on the measurement of cross border financial positions.

Fourth, as noted in Bertaut, Bressler, and Curcuru (2020), U.S. households hold portfolio equity in U.S. firms with international operations. In this regard, we underestimate the extend of U.S. residents' holdings of equity claims on corporations resident in the ROW.

Bertaut, Bressler, and Curcuru (2019) estimate that roughly \$2 trillion of the total \$12 trillion U.S. outward investment abroad in 2017, or 16 percent, was actually exposure to the U.S.. It is unclear what the total adjustment of the estimated gross claims by foreigners on the U.S. would be if similar methods were applied to these data.

C.2 Market Valuation of FDI Equity

Milesi-Ferretti (2021) raises concerns with the market valuation of ROW direct investment in U.S. resident corporations and the market valuation of U.S. residents' direct investment in corporations resident in the ROW estimated in Table S.9 and Table L.230. In these tables, the market value of ROW direct investment in U.S. resident corporations is estimated using U.S. stock market indices and the market value of U.S. residents' direct investment in corporations resident in the ROW is estimated using foreign stock market indices. One might argue that it is more appropriate to use foreign stock market indices to value foreign direct investment equity in the United States and U.S. stock market indices to value U.S. direct investment equity in the rest of the world. In Figure C.2, we show the evolution of U.S. net foreign assets with foreign direct investment into and out of the United States valued at current cost, as it was in the *Financial Accounts of the United States* until 2019. This could be viewed as an intermediate case between the current method for valuing FDI and the alternative suggested above. The figure shows that valuating FDI at current cost has an impact on the measured evolution of the U.S. NFA position. In particular, negative valuations no longer apply to FDI, which accounts for about 50 percent of the gross equity positions. So, not surprisingly, the size of the decline of the U.S. NFA position is smaller (40 percent of GDP instead of 60 percent). Nevertheless the main fact we highlight remains: since 2007, the U.S. NFA position has declined primarily because of negative valuation effects.

C.3 Sensitivity of baseline results to size of gross cross-border equity positions

In our baseline measurement exercise, we use data on the size of gross cross-border equity positions as reported in Table S9 of the Integrated Macroeconomic Accounts. The literature

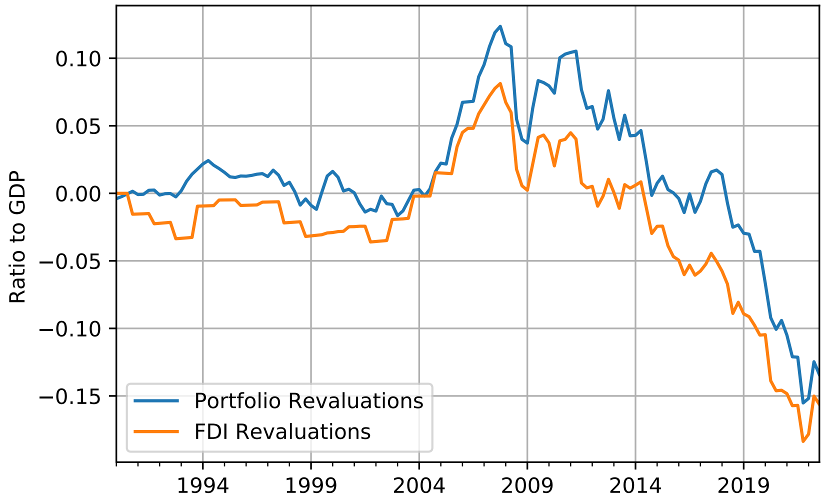

Figure C.1: Cumulated Valuation Effects for Portfolio Equity and FDI Equity over GDP

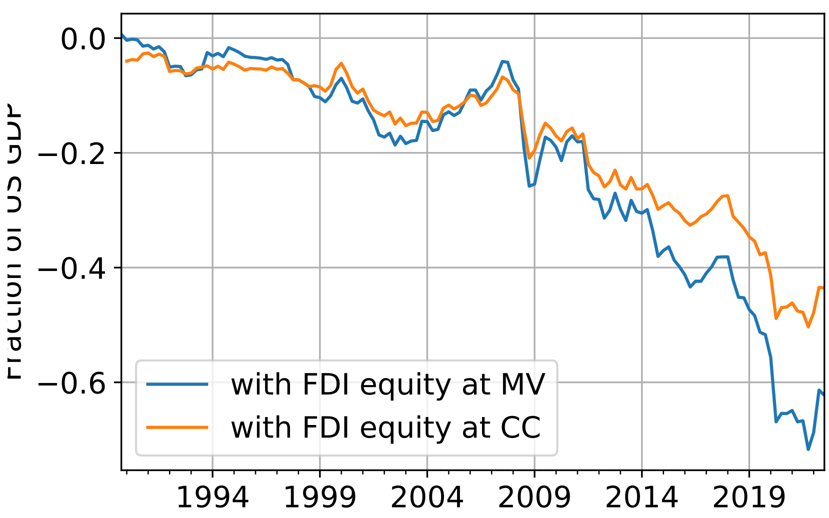

Figure C.2: U.S. NFA over GDP with FDI Equity Valued At Market Value and At Current Cost discussed above points to several reasons that these data may overstate the economically meaningful size of these gross cross-border positions. Here we conduct a sensitivity analysis of our baseline measurement and welfare results to an alternative, and significantly smaller, estimate of the size of these gross positions.

In our baseline analysis, we measured the parameter $(1-\lambda_t)$ representing the share of ROW ownership of U.S. corporations using the ratio of the gross equity claims of the ROW on the U.S. as reported in Table S9 to our measure of U.S. corporations' enterprise value. This procedure produces estimates of this share of U.S. corporate equity owned by the ROW that rise from 15% at the start of 1990 to 40% at the end of our sample in 2022 as shown in Figure A.6. While it is difficult to assess the total impact of all of the factors listed above on the measure of ROW ownership of U.S. corporate equity, to test the sensitivity of our results to this measure, we construct an alternative estimate of the share of U.S. corporate equity owned by the ROW given by

$$(1-\tilde{\lambda}_t) = (1-\lambda_{1990Q1}) + 0.5\left[(1-\lambda_t) - (1-\lambda_{1990Q1})\right]$$

That is, this alternative measure of ROW ownership of U.S. corporate equity rises from 15% at the start of 1990 to close to 27.5% at the end of our sample in 2022. Hence, toward the end of our sample, we reduce our model measure of ROW equity in the U.S. substantially relative to its value reported in Table S9. We also construct an alternative measure of U.S. gross equity abroad $\tilde{\lambda}_t^*$ so that our model's implications for the net equity position of the U.S. remains the same as in the baseline. We then use our model for measurement leaving all other parameters unchanged.

We first report the values of the parameters found in this alternative exercise in Figure C.3. These parameters can be compared to our baseline parameters shown in Figure D.1. We see that changing the size of cross border equity holdings does not impact our parameter estimates much relative to our baseline measurement except for our measures of the size of gross cross border equity portfolios shown in the rightmost panel of the third row of Figures C.3 and D.1.

We next report on our experiment regarding the ex-post welfare impact on U.S. residents of the changes in parameter values of this time period with these alternative estimates of the extent of gross cross-border equity positions in Figure C.4. In this figure, we see in the lower left panel that even with a reduced estimate of cross-border equity positions, the consumption of U.S. households is substantially reduced relative to the alternative with no cross-border equity holdings. These results can be compared to those in our baseline in Figure 12.

C.4 The Income Puzzle

A long-standing puzzle in the international data is that while the U.S. net foreign asset position is large and negative, U.S. primary income from abroad as measured in the current account remains positive. There is a large literature on this topic. Curcuru, Thomas, and Warnock (2013) is an important paper in this literature that points out that a large portion of this discrepancy is due to a gap between the accounting income yields on U.S. direct investment assets and liabilities.

One hypothesis regarding the puzzlingly high accounting income on U.S. FDI equity in

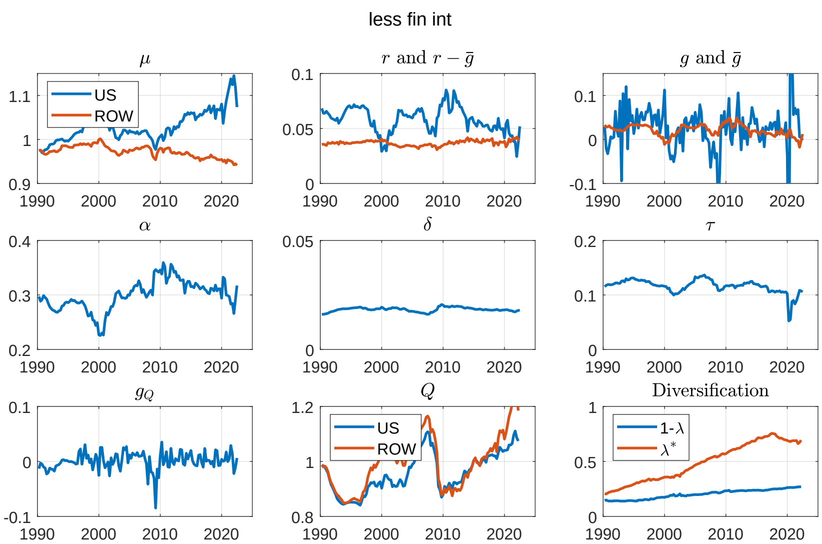

Figure C.3: All Parameter Values with reduced cross border equity holdings

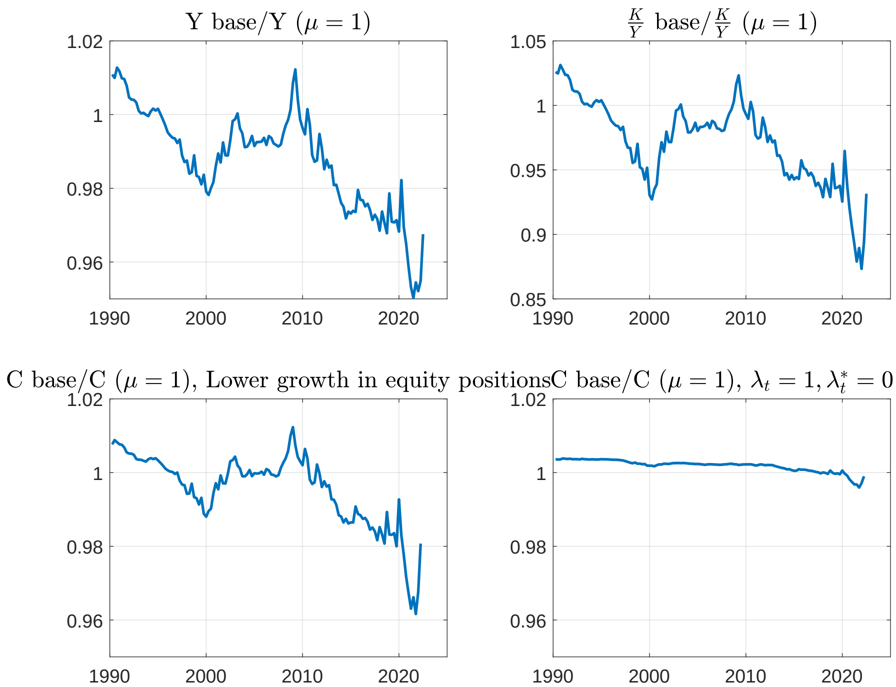

Figure C.4: Effect of Output Wedges on Y, K/Y, and C. Effect on C Shown with Alternative Path for Diversification, and Zero Diversification Counterfactual.

the ROW is that the valuation of U.S. direct investment equity assets recorded in the BEA's International Investment Position tables is too low, thus resulting in a high income yield as a matter of mismeasurement of the denominator of that ratio. This is often referred to as the "Dark Matter" hypothesis. See Hausmann and Sturzenegger (2007). See also Kozlow (2006) and the following discussion from the BEA: `https://www.bea.gov/help/faq/202`.

Another hypothesis regarding this gap in income yields for Direct Investment Equity Assets and Liabilities is that for fiscal reasons, multinational firms tend to over-report income from foreign affiliates and under-report income generated in the United States. See, for example, Bosworth, Collins, and Chodorow-Reich (2007), Curcuru, Thomas, and Warnock (2013), Curcuru and Thomas (2015), Setser (2017), Setser (2019), Torslov, Wier, and Zucman (2020), Guvenen et al. (2022), and Garcia-Bernardo, Jansky, and Zucman (2021). According to this hypothesis, the numerator of the ratio that is the income yield is mismeasured. The upshot of some of these papers is that that these concerns affect the division of the current account between net exports and net foreign income but distort neither the measurement of the U.S. NFA position nor the current account.

One important point to note is that the accounting income yield on U.S. direct investment equity in the ROW is a ratio of corporate income as reported by the ROW subsidiaries of U.S. multinationals to the value of the corporation, not a measure of monetary dividends actually paid. The gap between accounting income on direct investment equity and the monetary dividends actually paid is accounted for as a capital flow titled "Reinvestment of Direct Investment Income". In our measurement, we use only the measure of monetary dividends paid as discussed in subsection A.4 above. We do not use data on accounting income on direct investment equity in our measurement procedure.

D Using the Model for Measurement: Full Detail

We now describe the details of our recursive calibration procedure. The data we use to calibrate our model is nominal. The model we laid out in the text is real. One could introduce fluctuations in the general price level in our model. And one could assume that non-equity assets in the model are nominal; non-equity assets and liabilities in the data are, in fact, mostly nominal. However, if model agents have perfect foresight over the path for the price level, price level fluctuations will have no impact on real allocations. In particular, nominal interest rates will move one-for-one with expected inflation, and the path for the equilibrium real interest rate will be invariant to the path for the price level.

D.1 Nominal Bonds

But there is one aspect where changes in the price level will affect our calibration, which has to do with how changes in the nominal values of gross foreign assets and liabilities due to inflation are divided between net asset purchases on the current account versus valuation changes in the balance of payments accounts. The measurement conventions used can affect the measured current account (see, for example, Box 1.1 in Obstfeld and Rogoff (1996).) We will assume that all changes in the nominal values of equity assets and liabilities, including those reflecting changes in the general price level, are counted as valuation effects. In contrast, we assume that there are no valuation effects for bonds, so that all changes in the nominal bond position show up on the current account. This assumption is consistent with the absence of valuation effects for non-equity liabilities in the national accounts. We measure gross inflation as the growth in the GDP deflator, P^D_{t+1} (in everything that follows, a superscript D denotes a data variable):

$$\pi^D_{t+1} = \frac{P^D_{t+1}}{P^D_t}.$$

Consider a version of the model in which bonds are nominal, and in which the current account includes the change in the nominal bond position. Given perfect foresight regarding the price level, the gross interest rate on the nominal bond between t and $t+1$ is

$$1 + r^{*nom}_{t+1} = (1 + r^*_{t+1})\pi^D_{t+1}$$

so $r^{*nom}_{t+1} = (1 + r^*_{t+1})\pi_{t+1} - 1$. The current account expression in equation 22 now changes in that the term $\frac{1}{1+\rho}(r^*_t - \rho)B_t$ is replaced with $\frac{1}{1+\rho}(r^{*nom}_t - \rho)\frac{B^{nom}_t}{P_t}$. Note that for $\pi_{t+1} > 1$, this increases the measured current account (and the current account to gross value added ratio).

To understand why introducing nominal bonds changes the current account but does not change real consumption or the NFA position in real terms, consider the following simplified version of the model which abstracts from equity and human wealth.

In the "real" version of this simplified model, consumption is

$$C_t = \frac{\rho}{1+\rho}(1 + r^*_t)B_t,$$

the current account is

$$CA_t = r^*_t B_t - C_t = \frac{1}{1+\rho}(r^*_t - \rho)B_t,$$

and the end of period NFA position is

$$B_{t+1} = B_t + CA_t = B_t + \frac{1}{1+\rho}(r^*_t - \rho)B_t = \frac{1 + r^*_t}{1+\rho}B_t.$$

In the "nominal" version of the model, consumption is

$$C_t = \frac{\rho}{1+\rho}(1 + r^{*nom}_t)\frac{B^{nom}_t}{P_t},$$

Substituting in $\frac{B^{nom}_t}{P_{t-1}} = B_t$ and $r^{*nom}_t = (1 + r^*_t)\pi_t - 1$ gives

$$C_t = \frac{\rho}{1+\rho}(1 + r^*_t)\pi^D_t \frac{B_t P_{t-1}}{P_t} = \frac{\rho}{1+\rho}(1 + r^*_t)B_t$$

which is identical to the expression in the "real" version of the model.

The current account is

$$\begin{aligned}
CA_t &= r_t^{*nom}\frac{B_t^{nom}}{P_t} - C_t = r_t^{*nom}\frac{B_t^{nom}}{P_t} - \frac{\rho}{1+\rho}(1+r_t^{*nom})\frac{B_t^{nom}}{P_t} \\
&= \frac{1}{1+\rho}\left(r_t^{*nom}-\rho\right)\frac{B_t^{nom}}{P_t}
\end{aligned}$$

which differs from the expression in the "real" model.

The end of period NFA position is

$$\begin{aligned}
\frac{B_{t+1}^{nom}}{P_t} &= \frac{B_t^{nom}}{P_t} + \frac{CA_t}{P_t} = \frac{P_{t-1}B_t}{P_t} + \frac{1}{1+\rho}\left(r_t^{*nom}-\rho\right)\frac{B_t^{nom}}{P_t} \\
&= \frac{P_{t-1}B_t}{P_t} + \frac{1}{1+\rho}\left((1+r_t^*)\pi_t^D - 1 - \rho\right)\frac{P_{t-1}B_t}{P_t} \\
&= \frac{1+r_t^*}{1+\rho}B_t
\end{aligned}$$

which again is identical to the real version of the model.

D.2 Data Series used

From the data, we have series for (1) corporate taxes paid, (2) wages and salaries, (3) corporate investment, and (4) consumption of fixed capital, all as shares of corporate value added. Denote these

$$\begin{aligned}
&(1)\ \frac{Taxes_t^D}{GVA_t^D} \\
&(2)\ \frac{WL_t^D}{GVA_t^D} \\
&(3)\ \frac{X_t^D}{GVA_t^D} \\
&(4)\ \frac{CFC_t^D}{GVA_t^D}
\end{aligned}$$

We define earnings relative to value added as

$$\frac{E_t^D}{GVA_t^D} = 1 - \frac{WL_t^D}{GVA_t^D} - \frac{Taxes_t^D}{GVA_t^D} - \frac{CFC_t^D}{GVA_t^D}.$$

We measure free cash flow from the corporate sector as

$$\frac{D_t^D}{GVA_t^D} = \frac{E_t^D}{GVA_t^D} + \frac{CFC_t^D}{GVA_t^D} - \frac{X_t^D}{GVA_t^D}$$

We also measure (5) growth in corporate value added, and (6) the replacement value of the capital stock, which is end of period, and whose model counter-part is Q_tK_{t+1}, and (7) U.S.

corporate enterprise value. Denote these

$$(5)\ \frac{GVA_{t+1}^D}{GVA_t^D}$$
$$(6)\ \frac{K_t^D}{GVA_t^D}$$
$$(7)\ \frac{V_t^D}{GVA_t^D}$$

Note that from (3) and (4) we have net investment:

$$\frac{NetX_t^D}{GVA_t^D} = \frac{X_t^D}{GVA_t^D} - \frac{CFC_t^D}{GVA_t^D}$$

and from (3), (4) and (6) we can measure start of period capital (whose model counterpart is $Q_t K_t$) as

$$\frac{KS_t^D}{GVA_t^D} = \frac{K_t^D}{GVA_t^D} - \frac{X_t^D}{GVA_t^D} + \frac{CFC_t^D}{GVA_t^D} \tag{28}$$

We measure (8) the revaluation U.S. foreign equity assets in t in nominal dollar terms, (9) the value of U.S.-owned foreign equity, and (10) the value of foreign-owned equity in the U.S.

$$(8)\ \frac{VAFA_t^D}{GVA_t^D}$$
$$(9)\ \frac{USFA_t^D}{GVA_t^D}$$
$$(10)\ \frac{USFL_t^D}{GVA_t}$$

Finally we have (11) the current account, and (12) a series for foreign corporate dividend income

$$(11)\ \frac{CA_t^D}{GVA_t^D}$$
$$(12)\ \frac{D_t^{*D}}{GVA_t^D}.$$

We use these 12 empirical time series to identify quarterly time series for 12 time-varying model parameters: $\tau_t, g_{t+1}, \delta_t, Q_t, \lambda_t^*, \lambda_t, \bar{g}_{t+1}, r_{t+1}^*, \alpha_{t+1}, \mu_{t+1}, \mu_{t+1}^*, Q_t^*$. To make the notation more compact, we henceforth use lower case letters to denote data ratios relative to value added; e.g., $x_t^D = X_t^D / GVA_t^D$.

D.3 Rate of Time Preference

We set ρ so that the sample average current dividend yield for U.S. corporations (current dividend over end of period enterprise value) is consistent with being on a balanced growth path. Suppose the economy is on a balanced growth path with a constant r^* and a constant growth rate g. For consumption to grow at rate g requires

$$1 = \frac{1}{1+\rho}\frac{1+r^*}{1+g}$$

so

$$\frac{1}{1+\rho} = \frac{1+g}{1+r^*}$$

The balanced growth path dividend yield D/V satisfies

$$1 = \frac{(1+g)}{(r^*-g)}\frac{D}{V},$$

which implies

$$r^* = (1+g)\frac{D}{V} + g$$

Substituting that expression into the discount factor expression gives

$$\frac{1}{1+\rho} = \frac{1+g}{(1+g)\frac{D}{V} + (1+g)} = \frac{1}{\frac{D}{V}+1}$$

so the discount rate consistent with consumption growth at rate g is

$$\rho = \frac{D}{V}$$

Thus, we set ρ equal to the average dividend yield over our sample period:

$$\rho = \mathbb{E}\left[\frac{d_t^D}{v_t^D}\right]$$

D.4 Time-Varying Parameters

We now describe how we recursively identify all 12 of our time-varying parameters.

1. τ_t : Our model assumes that taxes are proportional to value added. Thus, to ensure the model replicates the observed path for taxes paid we set

$$\tau_t = \frac{Taxes_t^D}{GVA_t^D}.$$

2. g_{t+1} : In our model, both Z_t and z_{Ht} impact the level of equilibrium output. At each date t, we specify z_{Ht} and z_{Ht}^* as parametric functions of other model parameters, where

the functions have the property that in equilibrium $Y_t = Y_t^* = Z_t$. We describe those functions at the end of the calibration description. We can then identify g_{t+1} from

$$1 + g_{t+1} = \frac{Z_{t+1}}{Z_t} = \frac{GVA_{t+1}^D}{GVA_t^D} \frac{1}{\pi_{t+1}^D}$$

which ensures that model real value added tracks U.S. corporate real value added. We normalize $Z_0 = 1$.

3. δ_t : Model depreciation is proportional to the start of period capital stock. Thus,

$$\delta_t = \frac{cfc_t^D}{ks_t^D}$$

where start-of-period capital ks_t^D is given by equation 28.

4. Q_t : We can measure the growth rate for Q_t as follows. The perpetual inventory equation in units of capital is a model identity

$$K_{t+1} = (1 - \delta_t)K_t + X_t$$

Thus

$$\begin{aligned} Q_t K_{t+1} &= Q_t K_t - \delta_t Q_t K_t + Q_t X_t \\ &= \frac{Q_t}{Q_{t-1}} Q_{t-1} K_t - \delta_t Q_t K_t + Q_t X_t \end{aligned}$$

which implies

$$\frac{Q_t}{Q_{t-1}} = \frac{Q_t K_{t+1} + \delta_t Q_t K_t - Q_t X_t}{Q_{t-1} K_t}$$

Recognizing that our data is nominal, we implement this as

$$\begin{aligned} \frac{Q_t}{Q_{t-1}} &= \frac{K_t^D - NetX_t^D}{\pi_t^D K_{t-1}^D} \\ &= \frac{(1 + g_t)\left(k_t^D - netx_t^D\right)}{k_{t-1}^D} \end{aligned}$$

We normalize the initial $Q_0 = 1$.

5. λ_t^* : We measure the growth in the foreign enterprise value using equity asset revaluation data and the foreign equity position as follows.

   (a) Let V_t^{*D} denote the nominal data value of the foreign corporate sector at t. We have

$$VAFA_{t+1}^D = \lambda_t^* (V_{t+1}^{*D} - V_t^{*D})$$

The value of U.S. owned foreign equity at the end of t is

$$USFA_t^D = \lambda_t^* V_t^{*D}$$

Thus.we can identify the nominal growth rate of foreign enterprise value, V_{t+1}^{*D}/V_t^{*D}, by taking the ratio of valuation effects to the value of the stock at the end of the previous period:

$$\frac{GVA_{t+1}^D}{GVA_t^D}\frac{vafa_{t+1}^D}{usfa_t^D} = \frac{\lambda_t^*(V_{t+1}^{*D} - V_t^{*D})}{\lambda_t^* V_t^{*D}} = \frac{V_{t+1}^{*D}}{V_t^{*D}} - 1$$

(b) To pin down the *level* of foreign enterprise value we assume that the foreign Buffett ratio is initially equal to the U.S. value:

$$v_0^{*D} = v_0^D$$

(c) Given the assumption that foreign nominal value added grows at the value added in the U.S., the growth rate in the foreign Buffett ratio is then identified as

$$\frac{v_{t+1}^{*D}}{v_t^{*D}} = \frac{\frac{V_{t+1}^{*D}}{V_t^{*D}}}{(1+g_{t+1})\pi_{t+1}^D} = \frac{\frac{GVA_{t+1}^D}{GVA_t^D}\frac{vafa_{t+1}^D}{usfa_t^D} + 1}{(1+g_{t+1})\pi_{t+1}^D} = \frac{vafa_{t+1}^D}{usfa_t^D} + \frac{1}{(1+g_{t+1})\pi_{t+1}^D}$$

which gives U.S. the level of v_t^{*D} for each date t.

(d) Then we identify λ_t^* from

$$\lambda_t^* = \frac{usfa_t^D}{v_t^{*D}}$$

6. λ_t : We identify this from U.S. equity liabilities and U.S. enterprise value:

$$(1-\lambda_t) = \frac{usfl_t^D}{v_t^D}$$

7. $\bar{g}_{t+1}$: We identify $\bar{g}_{t+1}$ using (1) a valuation equation, and (2) the current account. The value of firms in the model is given by

$$V_t = \frac{\mathbb{E}_t\left[D_{t+1}\right]}{r_{t+1}^* - \bar{g}_{t+1}}$$

where expected dividends are given by expected earnings minus expected net investment:

$$\begin{aligned}\mathbb{E}_t\left[D_{t+1}\right] &= \mathbb{E}_t\left[E_{t+1}\right] - \mathbb{E}_t\left[X_{t+1} - \delta_{t+1}Q_{t+1}K_{t+1}\right] \\ &= E_{t+1} + \delta_{t+1}Q_{t+1}K_{t+1}\left(1 - \frac{Q_t}{Q_{t+1}}\right) - \bar{g}_{t+1}Q_tK_{t+1}\end{aligned}$$

(note that realized earnings differ from expected earnings because unexpected changes in the replacement cost of capital at $t+1$ affect realized consumption of fixed capital). Thus,

$$\left(r^*_{t+1} - \bar{g}_{t+1}\right) V_t = E_{t+1} + \delta_{t+1} Q_{t+1} K_{t+1} \left(1 - \frac{Q_t}{Q_{t+1}}\right) - \bar{g}_{t+1} Q_t K_{t+1} \tag{29}$$

This equation has two unknowns: r^*_{t+1} and $\bar{g}_{t+1}$. Thus we need another equation to identify $\bar{g}_{t+1}$. In our baseline calibration, we use the model expression for the current account. Recall that the equilibrium model current account is very sensitive to $\bar{g}_{t+1}$: all else equal, a higher value for expected trend growth implies a higher value for human capital, $H_t = \frac{W_{t+!} L_{t+1}}{r^*_{t+1} - \bar{g}_{t+1}}$, translating to higher desired consumption, and a larger current account deficit. The current account expression, in the version of the model with nominal bonds explained above, is

$$CA_t = \frac{1}{1+\rho} \left[\left(\frac{D_t}{V_t} - \rho \right) \lambda_{t-1} V_t + \left(\frac{D^*_t}{V^*_t} - \rho \right) \lambda^*_{t-1} V^*_t + (r^{*nom}_t - \rho) \frac{B^{nom}_t}{P_t} + (W_t L_t - \rho H_t) \right] \tag{30}$$

where $H_t = \frac{W_{t+1} L_{t+1}}{r^*_{t+1} - \bar{g}_{t+1}}$ and $r^{*nom}_t = \left((1+r^*_t)\pi^D_t - 1\right)$. Given equation 29, the denominator of the H_t term can be expressed as

$$r^*_{t+1} - \bar{g}_{t+1} = \frac{\mathbb{E}_t \left[E_{t+1}\right]}{V_t} - \bar{g}_{t+1} \frac{Q_t K_{t+1}}{V_t}$$

Substituting that into the current account expression, we can solve for $\bar{g}_{t+1}$ as

$$\begin{aligned} \bar{g}_{t+1} = & \frac{\mathbb{E}_t \left[E_{t+1}\right]}{Q_t K_{t+1}} - \frac{V_t}{Q_t K_{t+1}} \rho W_{t+1} L_{t+1} \\ & \times \left[\left(\frac{D_t}{V_t} - \rho \right) \lambda_{t-1} V_t + \left(\frac{D^*_t}{V^*_t} - \rho \right) \lambda^*_{t-1} V^*_t + \right. \\ & \left. \left[\left((1+r^*_t)\pi^D_t - 1 \right) - \rho \right] \frac{B^{nom}_t}{P_t} + W_t L_t - (1+\rho) CA_t \right]^{-1} \end{aligned}$$

The data analogue is (dividing date t nominal data variables by P_t and date $t+1$ variables by P_{t+1})

$$\begin{aligned} \bar{g}_{t+1} = & \frac{\mathbb{E}_t \left[E^D_{t+1}\right]}{\pi_{t+1} K^D_t} - \frac{V^D_t}{K^D_t} \rho \frac{W L^D_{t+1}}{P^D_{t+1}} \\ & \times \left[\left(\frac{D^D_t}{V^D_t} - \rho \right) \lambda_{t-1} \frac{V^D_t}{P^D_t} + \left(\frac{D^{*D}_t}{V^{*D}_t} - \rho \right) \lambda^*_{t-1} \frac{V^{*D}_t}{P^D_t} + \right. \\ & \left. \left[\left((1+r^*_t)\pi^D_t - 1 \right) - \rho \right] \frac{B^{nom}_t}{P^D_t} + \frac{W L^D_t}{P^D_t} - (1+\rho) \frac{CA^D_t}{P^D_t} \right]^{-1} \end{aligned}$$

Expressing data values relative to data value added gives

$$\bar{g}_{t+1} = (1+g_{t+1})\frac{\mathbb{E}_t\left[e^D_{t+1}\right]}{k^D_t} - (1+g_{t+1})\frac{v^D_t}{k^D_t}\rho w l^D_{t+1}$$
$$\times\left[\left(\frac{d^D_t}{v^D_t}-\rho\right)\lambda_{t-1}v^D_t + \left(\frac{d^{*D}_t}{v^{*D}_t}-\rho\right)\lambda^*_{t-1}v^{*D}_t + \left[\left((1+r^*_t)\pi^D_t - 1\right)-\rho\right]b^{nom}_t + \right.$$
$$\left. w l^D_t - (1+\rho)ca^D_t\right]^{-1}$$

There are two variables on the right-hand side of this equation that are neither data objects nor parameters that we have recovered in previous steps. Those are r^*_t and b^{nom}_t (the non-equity position relative to value added carried into period t.) But we can recover these parameters sequentially through time: given r^*_t and b^{nom}_t, we can solve for $\bar{g}_{t+1}$ using the equation above, then for r^*_{t+1} (following step 8 below) and other date $t+1$ parameters, and finally for the equilibrium value for b^{nom}_{t+1}.

Alternatives

(a) We might have an external estimate for $\bar{g}_{t+1}$.

(b) We might have an external estimate for $\left(r^*_{t+1} - \bar{g}_{t+1}\right)$ – for example, $r^*_{t+1} - \bar{g}_{t+1} = average\left(\frac{D^D_{t+1}}{V^D_t}\right)$. We then immediately obtain $\bar{g}_{t+1}$ from equation 29

$$\begin{aligned}\bar{g}_{t+1} &= \frac{\mathbb{E}_t\left[E_{t+1}\right]}{Q_t K_{t+1}} - \left(r^*_{t+1} - \bar{g}_{t+1}\right)\frac{V_t}{Q_t K_{t+1}} \\ &= \frac{\mathbb{E}_t\left[E_{t+1}\right]}{Q_t K_{t+1}} - average\left(\frac{D^D_{t+1}}{V^D_t}\right)\frac{V_t}{Q_t K_{t+1}}\end{aligned}$$

In the data, that is identified as

$$\begin{aligned}\bar{g}_{t+1} &= \frac{\mathbb{E}_t\left[E^D_{t+1}\right]}{\pi^D_{t+1}K^D_t} - average\left(\frac{D^D_{t+1}}{V^D_t}\right)\frac{V^D_t}{K^D_t} \\ &= (1+g_{t+1})\frac{\mathbb{E}_t\left[e^D_{t+1}\right]}{k^D_t} - average\left(\frac{D^D_{t+1}}{V^D_t}\right)\frac{v^D_t}{k^D_t}\end{aligned}$$

(c) Suppose we want to identify $\bar{g}_{t+1}$ from an equation assuming perfect foresight about future dividends (note that this is NOT strictly consistent with our baseline expectations model – here we think of it as a separate auxiliary model which informs the parameter vector for $\{\bar{g}_{t+1}\}$.)

$$V_t = \frac{D_{t+1}}{r_{t+1} - \bar{g}_{t+1}}$$

Then we can replace $(r_{t+1} - \bar{g}_{t+1})$ in our model valuation equation (29) with $\frac{D_{t+1}}{V_t}$

$$\begin{aligned}\left(r_{t+1} - \bar{g}_{t+1}\right)V_t &= \mathbb{E}_t\left[E_{t+1}\right] - \bar{g}_{t+1}Q_t K_{t+1} \\ D_{t+1} &= \mathbb{E}_t\left[E_{t+1}\right] - \bar{g}_{t+1}Q_t K_{t+1}\end{aligned}$$

which we can operationalize empirically as

$$
\begin{aligned}
\bar{g}_{t+1} &= \frac{\mathbb{E}_t\left[E^D_{t+1}\right] - D^D_{t+1}}{\pi_{t+1}K^D_t} \\
&= (1+g_{t+1})\frac{\left(\mathbb{E}_t\left[e^D_{t+1}\right] - d^D_{t+1}\right)}{k^D_t}
\end{aligned}
$$

8. r^*_{t+1} : Given $\bar{g}_{t+1}$ we next identify r_{t+1}. The key valuation equation can rearranged as

$$
r^*_{t+1} = \frac{\mathbb{E}_t[E_{t+1}]}{V_t} + \bar{g}_{t+1}\left(\frac{V_t - Q_t K_{t+1}}{V_t}\right)
$$

But note that we are working with nominal data, and $\mathbb{E}_t[E_{t+1}]$ is dated one period later than the other variables. Thus we implement this as

$$
\begin{aligned}
r_{t+1} &= \frac{\mathbb{E}_t[E^D_{t+1}]}{\pi_{t+1}V^D_t} + \bar{g}_{t+1}\left(1 - \frac{K^D_t}{V^D_t}\right) \\
&= (1+g_{t+1})\frac{\mathbb{E}_t[e^D_{t+1}]}{v^D_t} + \bar{g}_{t+1}\left(1 - \frac{k^D_t}{v^D_t}\right)
\end{aligned}
$$

9. α_{t+1} : Given r_{t+1}, the expression for the labor share and the FOC for investment identify μ_{t+1} and α_{t+1}. The former can be expressed as

$$
\frac{W_{t+1}L_{t+1}}{Y_{t+1}}\frac{1}{(1-\tau_{t+1})(1-\alpha_{t+1})} = \frac{1}{\mu_{t+1}}
$$

The second is

$$
\begin{aligned}
Q_t(1+r^*_{t+1}) &= \mathbb{E}_t[(1-\tau_{t+1})\frac{\alpha_{t+1}}{\mu_{t+1}}\frac{Y_{t+1}}{K_{t+1}} + (1-\delta_{t+1})Q_{t+1}] \\
&= (1-\tau_{t+1})\frac{\alpha_{t+1}}{\mu_{t+1}}\frac{Y_{t+1}}{K_{t+1}} + (1-\delta_{t+1})Q_t]
\end{aligned}
$$

which implies

$$
\frac{r^*_{t+1} + \delta_{t+1}}{\alpha_{t+1}(1-\tau_{t+1})}\frac{Q_t K_{t+1}}{Y_{t+1}} = \frac{1}{\mu_{t+1}} \tag{31}
$$

Combining those two expressions gives

$$
\alpha_{t+1} = \frac{\left(r^*_{t+1} + \delta_{t+1}\right)Q_t K_{t+1}}{W_{t+1}L_{t+1} + \left(r^*_{t+1} + \delta_{t+1}\right)Q_t K_{t+1}}
$$

which we implement as

$$\begin{aligned}\alpha_{t+1} &= \frac{\left(r^*_{t+1}+\delta_{t+1}\right)K^D_t/P^D_t}{WL^D_{t+1}/P^D_{t+1}+\left(r^*_{t+1}+\delta_{t+1}\right)K^D_t/P^D_t} \\ &= \frac{\left(r^*_{t+1}+\delta_{t+1}\right)k^D_t}{(1+g_{t+1})wl^D_{t+1}+\left(r^*_{t+1}+\delta_{t+1}\right)k^D_t}\end{aligned}$$

10. μ_{t+1} : We can plug the solution for α_{t+1} into the labor's share expression for solve for μ_{t+1}.

$$\mu_{t+1} = \frac{(1-\tau_{t+1})(1-\alpha_{t+1})}{wl^D_{t+1}}$$

Given μ_{t+1} and $z_{H,t+1}$ from equation 32 we have $z_{L,t+1} = z_{H,t+1}/\mu_{t+1}$.

11. μ^*_{t+1} : We use the valuation formula to infer μ^*_{t+1}. Recall that we assume the rest of the world shares the U.S. tax rate and the U.S. growth rate. Recall that we have a series for V^{*D}_t/GVA^D_t. We know that

$$V^*_t = Q^*_t K^*_{t+1} + \frac{\Pi^*_{t+1}}{r^*_{t+1}-\bar{g}_{t+1}}$$

and

$$\begin{aligned}Q^*_t K^*_{t+1} &= \frac{(1-\tau_{t+1})\alpha_{t+1}}{(r^*_{t+1}+\delta_{t+1})\mu^*_{t+1}}Y_{t+1} \\ \Pi^*_{t+1} &= \frac{(1-\tau_{t+1})(\mu^*_{t+1}-1)}{\mu^*_{t+1}}Y_{t+1}\end{aligned}$$

Thus

$$\mu^*_{t+1} = \frac{(1-\tau_{t+1})(1+g_{t+1})\left(\frac{\alpha_{t+1}}{(r^*_{t+1}+\delta_{t+1})} - \frac{1}{\left(r^*_{t+1}-\bar{g}_{t+1}\right)}\right)}{v^{*D}_t - \frac{(1-\tau_{t+1})(1+g_{t+1})}{\left(r^*_{t+1}-\bar{g}_{t+1}\right)}}$$

(One might wonder why Q^*_t does not show up in the expression for $Q^*_t K^*_{t+1}$. The logic is that equilibrium K^*_{t+1} is proportional to Q^{*-1}_t; when Q^*_t is high, investment is low)

12. Q^*_t : We assume $Q^*_0 = Q_0 = 1$. Foreign dividends at date t are given by

$$D^*_t = (1-\tau_t)Y^*_t - W^*_t L^*_t - Q^*_t(K^*_{t+1} - (1-\delta_t)K^*_t)$$

That can be rearranged to give

$$Q^*_t = \frac{D^*_t - (1-\tau_t)Y^*_t + W^*_t L^*_t + Q^*_t K^*_{t+1}}{(1-\delta_t)K^*_t}$$

At each date t (initially for $t=0$) we can solve for K^*_{t+1} from the foreign FOC for investment (recall that agents expect $Q^*_{t+1} = Q^*_t$). In particular, the rest of world version of equation 31 gives

$$K_{t+1}^{*}=\frac{\alpha_{t+1}(1-\tau_{t+1})Z_{t+1}}{Q_t^{*}(r_{t+1}^{*}+\delta_{t+1})\mu_{t+1}^{*}}$$

Substituting that expression into the previous one, and dividing through by output (recall $Y_t = Y_t^*$) gives

$$Q_t^{*}=\frac{\frac{D_t^{*}}{Y_t}-(1-\tau_t)+\frac{W_t^{*}L_t^{*}}{Y_t^{*}}+\frac{\alpha_{t+1}(1-\tau_{t+1})}{(r_{t+1}^{*}+\delta_{t+1})\mu_{t+1}^{*}}(1+g_{t+1})}{(1-\delta_t)\frac{K_t^{*}}{Y_t^{*}}}$$

We have model expressions for $\frac{W_t^{*}L_t^{*}}{Y_t^{*}}$ and $\frac{K_t^{*}}{Y_t^{*}}$ and a data series for $\frac{D_t^{*D}}{GVA_t^{D}}$ which identify Q_t^* given Q_{t-1}^* :

$$Q_t^{*}=\frac{\frac{D_t^{*D}}{GVA_t^{D}}-(1-\tau_t)+\frac{(1-\tau_t)(1-\alpha_t)}{\mu_t^{*}}+\frac{\alpha_{t+1}(1-\tau_{t+1})}{(r_{t+1}^{*}+\delta_{t+1})\mu_{t+1}^{*}}(1+g_{t+1})}{(1-\delta_t)\frac{(1-\tau_t)\alpha_t}{(r_{t+1}^{*}+\delta_t)\mu_t^{*}}\frac{1}{Q_{t-1}^{*}}}.$$

Thus we can iteratively construct a sequence for Q_t^*.

D.5 Functions for $z_{H,t+1}$ and $z_{H,t+1}^*$

The functions for $z_{H,t+1}$ and $z_{H,t+1}^*$ are derived as follows.

1. (a) The optimality condition for investment, equation 12 simplifies, given $E[Q_{t+1}] = Q_t$, to

$$r_{t+1}^{*}=\frac{R_{t+1}}{Q_t}-\delta_{t+1}$$

which pins down R_{t+1} given r_{t+1}^* (which is known at t).

(b) The first-order condition for capital 10 in conjunction with the production function 7 then pins down K_{t+1} as

$$K_{t+1}=Z_{t+1}\left(z_{H,t+1}\right)^{\frac{1}{1-\alpha_{t+1}}}\left(\frac{\left(r_{t+1}^{*}+\delta_{t+1}\right)\mu_{t+1}Q_t}{(1-\tau_{t+1})\alpha_{t+1}}\right)^{\frac{1}{\alpha_{t+1}-1}}$$

so output is given by

$$\begin{aligned}Y_{t+1} &= z_{H,t+1}K_{t+1}^{\alpha_{t+1}}Z_{t+1}^{1-\alpha_{t+1}}\\ &= Z_{t+1}\left(z_{H,t+1}\right)^{\frac{1}{1-\alpha_{t+1}}}\left(\frac{\left(r_{t+1}^{*}+\delta_{t+1}\right)\mu_{t+1}Q_t}{(1-\tau_{t+1})\alpha_{t+1}}\right)^{\frac{\alpha_{t+1}}{\alpha_{t+1}-1}}\end{aligned}$$

Note, from the expressions for capital and output, that Z_{t+1} and $z_{H,t+1}$ affect inputs and output symmetrically.

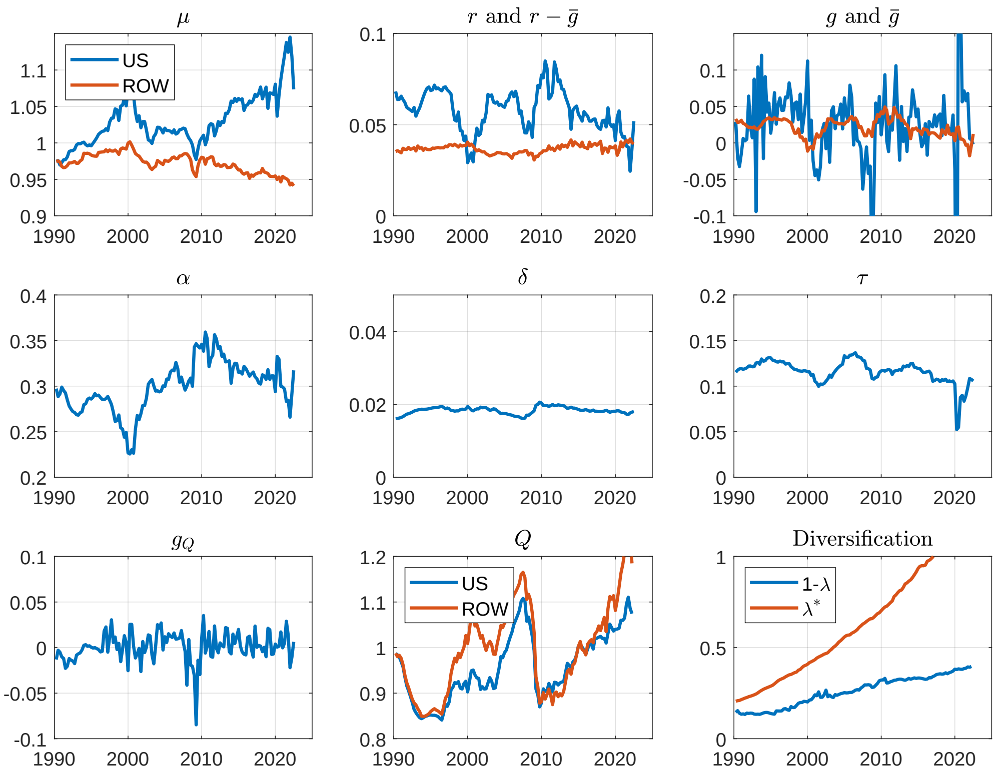

Figure D.1: All Parameter Values

(c) It follows that $Y_{t+1} = Y^*_{t+1} = Z_{t+1}$ when

$$
\begin{aligned}
z_{H,t+1} &= \left(\frac{\left(r^*_{t+1} + \delta_{t+1}\right) \mu_{t+1} Q_t}{(1 - \tau_{t+1})\alpha_{t+1}} \right)^{\alpha_{t+1}} \\
z^*_{H,t+1} &= \left(\frac{\left(r^*_{t+1} + \delta_{t+1}\right) \mu^*_{t+1} Q^*_t}{(1 - \tau_{t+1})\alpha_{t+1}} \right)^{\alpha_{t+1}}
\end{aligned}
\qquad (32)
$$

D.6 All Parameter Values

We plot the full set of parameter values in our baseline analysis in Figure D.1.

D.7 Model fit

Figure D.2 illustrates the model's ability to replicate key macroeconomic time series for the U.S. corporate sector: value added, gross investment, labor earnings, and cash flow payable

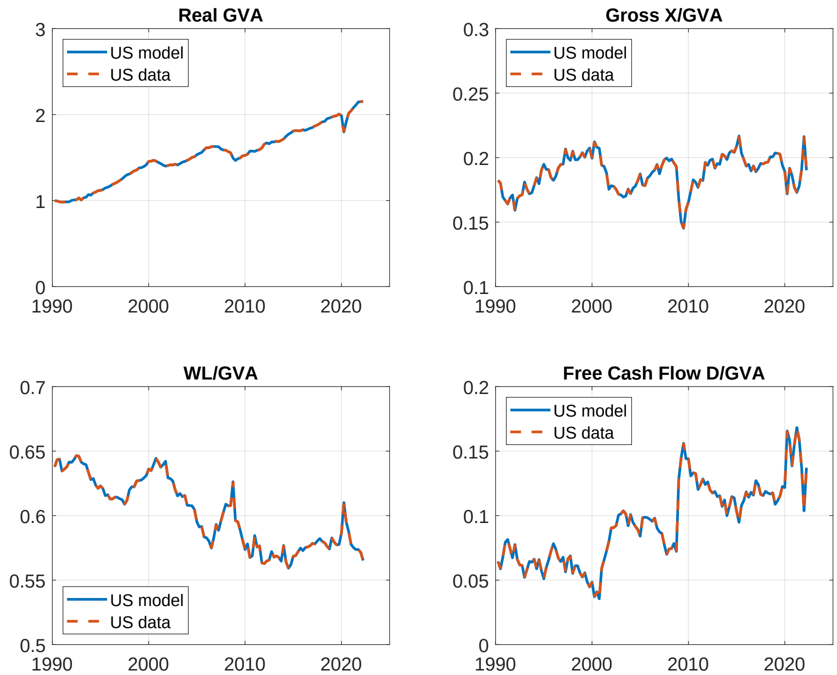

Figure D.2: National Income Accounts for the Corporate Sector

to firm owners (defined as in equation 13). By construction, this fit is exact. The model replicates the decline in the 2000s in labor's share of value added, $(1-\tau_t)(1-\alpha_t)/\mu_t$, via a mix of changes in the share of labor in costs determined by $1-\alpha_t$ and changes in the output wedge μ_t. The rise in free cash flow to firm owners is due in part to lower payments to labor, and in part to lower taxes; investment is a fairly stable share of value added.

Figure D.3 illustrates the model's replication of key valuation metrics: the Buffett ratio, the replacement cost of capital, and the dividend and earnings yields. Again, by construction, this fit is exact.

E Comparison of our Measurement Procedure to that in Prior Papers

Our use of a simple macro finance model to measure factors driving the change in the division of income in the U.S. corporate sector into compensation for labor and physical capital and profits and the valuation of that sector has several antecedents in the literature. Here we describe how our work extends and refines this prior work.

Barkai (2020) and Karabarbounis and Neiman (2019) focus on measuring the division of income in the U.S. corporate sector into compensation for labor and physical capital and profits. These papers do not use data on the market valuation of the sector. Specifically,

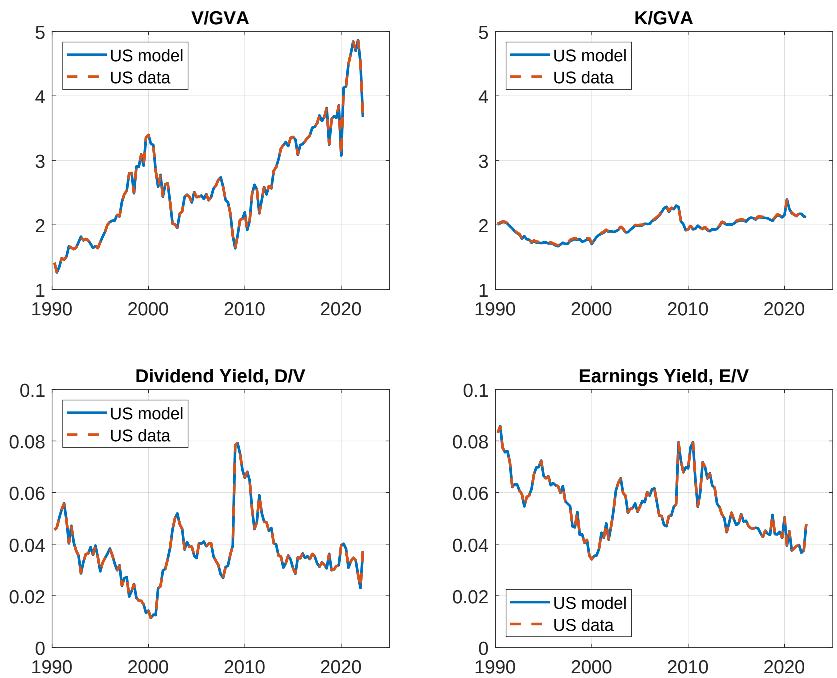

Figure D.3: Key Asset Pricing Metrics

these papers start with estimates of the cost of capital r^*_{t+1} and then follow procedures analogous to those that we follow in steps 1 and 2 above to arrive at analogs of our estimates of the share of labor in costs $1 - \alpha_t$ and the share of corporate income left over to pay investors after deducting compensation of physical capital Π_t/Y_t. Karabarbounis and Neiman (2019) highlight that estimates of the "factorless income" share Π_t/Y_t derived using this procedure are very sensitive to the estimate of the cost of capital r^*_{t+1} used as an input into the measurement procedure. The principal measurement issue here is that it is difficult to arrive directly at an estimate of the appropriate cost of capital for the corporate sector r^*_{t+1} as it is difficult to measure the equilibrium gap between this cost of capital and the observed yields on government bonds due to considerations of risk and any liquidity or convenience yields on government bonds.

Our measurement procedure is more closely related to that in Farhi and Gourio (2018), Eggertsson, Robbins, and Wold (2021), and in the baseline case with no adjustment costs for investment studied in Crouzet and Eberly (forthcoming).[28] Farhi and Gourio (2018) in particular argue that one need not build up an estimate of the cost of capital r^*_{t+1} from data on government bond yields and estimates of the equity premium and any convenience yield on those bonds. Instead, all three of these papers argue that one can proceed as we do in the third step of our measurement procedure by including measures of firm valuation V_t as well as the replacement value of the capital stock $Q_t K_{t+1}$ in the analysis. These papers arrive at estimates of the cost of capital r^*_{t+1} using analogs of equation (25) or (26) by making assumptions about the relationship between expected growth from $t+1$ on, $\bar{g}_{t+1}$, and observed historical growth rates.

We extend the measurement done in these papers in two respects.

First, we bring in the current account in equation (22) as an additional data series that can be used to measure both the cost of capital r^*_{t+1} and expected growth $\bar{g}_{t+1}$ when used in conjunction with equation (25). In proceeding in this way, our model gives an accounting of the factors driving the joint dynamics of flows, stocks, and market valuation of the U.S. corporate sector as well as the U.S. current account.

Second, we conduct a sensitivity analysis of our measurement of r^*_{t+1} to alternative assumptions regarding the expected growth rate $\bar{g}_{t+1}$. Specically, in subsection XX, we present measures of r^*_{t+1} using only U.S. corporate data and equation (25) where we make alternative assumptions about either expected growth $\bar{g}_{t+1}$ or the valuation multiple for profits given by $1/(r^*_{t+1} - \bar{g}_{t+1}$. We consider four cases. In the first, expected growth $\bar{g}_{t+1}$ is set equal to the trend of growth rates of value added for the Corporate Sector from an HP filter of that time series. In the second, expected growth $\bar{g}_{t+1}$ is set equal to ten-year forecasts of GDP growth from the Survey of Professional Forecasters. In the third, we set the valuation multiple for profits equal to a constant $1/(r^*_{t+1} - \bar{g}_{t+1}$. In the fourth, we set the valuation multiple for profits $1/(r^*_{t+1} - \bar{g}_{t+1}$ equal to the realized value of dividends at $t+1$ over firm value at t (D_{t+1}/V_t). In this last case, we are assuming that agents' expectations for dividends realized at t are equal to the realized value of these dividends each period. In this way, we

[28] Greenwald, Lettau, and Ludvigson (2021) conduct a related measurement exercise that develops a richer model of the dynamics that agents in the model expect but that does not use data on measures of the reproduction value of the stock of physical capital or investment. They conclude, as do these other papers, that a large portion of the increase in the market valuation of U.S. corporations is due to an increase in the share of value added paid to the owners of these firms.

examine the sensitivity of the measurement procedure followed in Farhi and Gourio (2018), Eggertsson, Robbins, and Wold (2021), and in the baseline case with no adjustment costs for investment studied in Crouzet and Eberly (forthcoming) to alternative assumptions about expected growth.

As shown in subsection 7 above, we find that the values of r^*_{t+1} obtained from equation (25) under these four alternative assumptions are remarkably similar outside of the period around the peak of the Tech boom in stocks in 2000. Accordingly, we find from this sensitivity exercise that the conclusion that profits or factorless income in the U.S. corporate sector have risen substantially over the past 10 years is robust to alternative assumptions about growth rates that agents expect going forward. As discussed above, the intuition for this finding is that in the data, the last term for the inverse of Tobin's Q in equation (25) is close enough to one that the value of r^*_{t+1} that satisfies this equation is not very sensitive to alternative assumptions about growth $\bar{g}_{t+1}$. At the same time, as pointed out by Aguiar and Gopinath (2007), the implications of the model for the current account are highly sensitive to these four alternative assumptions for the expected growth rate $\bar{g}_{t+1}$ because the value of human wealth is highly sensitive to alternative assumptions for $r^*_{t+1} - \bar{g}_{t+1}$. Thus, in our baseline measurement in which we include the current account, we find a very stable value of $r^*_{t+1} - \bar{g}_{t+1}$.[29]

In our measurement, we have abstracted from the role of unmeasured intangible capital in accounting for the increase in value of the U.S. corporate sector.[30] While we recognize that firms do make many investment that are not currently included in the measures that we use of the reproduction value of firm capital stocks and that firms' likely generate substantial quasi-rents from these past investments, we abstract from unmeasured capital for two reasons.

First, in the aggregate data on capital stocks not measured by the BEA cited in Corrado et al. (2022), there is no trend in the stock of such capital relative to value added over the past decade or more. Hence, incorporating these estimates of unmeasured capital would not serve to explain much of the rise in the market valuation of U.S. corporations over the past decade.[31]

Second, if one were to postulate that the observed increase in the valuation of U.S. corporations was accounted for by a large increase in investment in and accumulation of forms of capital that are not measured in the National Income and Product Accounts, then one would also have to postulate that U.S. corporations had simultaneously experienced a very large increase in productivity that allowed them to maintain measured value added growing along a smooth trend and large free cash flow as observed in the data. This would

[29]The intuition for this finding is close to that in Lustig and Van Nieuwerburgh (2008) regarding the observed insensitivity of consumption to changes in financial wealth and the lack of correlation of innovations to consumption with innovations to financial wealth.

[30]Hall (2001) argued that unmeasured intangible capital played an important role in accounting for the boom in the valuation of U.S. firms in the late 1990's. Eisfeldt and Papanikolaou (2014), Belo et al. (2022), Eisfeldt, Kim, and Papanikolaou (2022) and the papers cited therein argue that measured of intangible capital drawn from firms' accounting statements that is not included in the National Income and Product Accounts help account for the valuation of firms in the cross section.

[31]This statement must be qualified in that we do not consider adjustment costs together with unmeasured forms of capital. Crouzet and Eberly (forthcoming) argue that considering the interaction of these two model assumptions may have a significant impact on the conclusions drawn regarding the drivers of firm value in the aggregate.

be required because, absent such an increase in productivity, and increase in investment in unmeasured capital would decrease measured output and measured free cash flow. Thus, while one could conduct a measurement exercise such as ours that matched observed flows, stocks, and market valuations of U.S. corporations and that attributed the large increase in the valuation and payouts from this sector to an increase in accumulated unmeasured capital rather than to profits (rents), such an exercise would require what seem like implausibly large increases in productivity to allow the U.S. corporate sector to maintain a steadily growing path of measured output while simultaneously dramatically increasing investment in forms of unmeasured capital. In the context of our model, these increases in productivity would be unexpected shocks from the perspective the agents in our model and thus the model would still attribute a large portion of the increase in the valuation of U.S. corporations to unexpected capital gains to owners of firms rather than as an anticipated reward for previous investments.

F The Impact of Shocks on the Current Account in the Model

In this appendix we derive an expression for the current account in terms of the underlying parameters of our model.

We present the following equation for the current account

$$CA_t = \frac{1}{1+\rho}\left[\left(\frac{D_t}{V_t} - \rho\right)\lambda_{t-1}V_t + \left(\frac{D_t^*}{V_t^*} - \rho\right)\lambda_{t-1}^* V_t^* + (r_t^* - \rho)B_t + \left(\frac{W_t L_t}{H_t} - \rho\right)H_t\right] \tag{33}$$

with Human Wealth H_t given by

$$H_t \equiv \frac{W_{t+1}L_{t+1}}{r_{t+1}^* - \bar{g}_{t+1}}. \tag{34}$$

Note that in the formula 22, the terms r_t^* and B_t are predetermined (set at $t-1$), so that we take them as given.

In taking the equation 33 to data, we combine the dividends from the intermediate goods firms and the firm that manages the capital stock into a single dividend D_t and computed enterprise value of these two types of firms into a single value V_t. To get intuition for how changes in model parameters impact the current account, it is more transparent to divide this dividend up into the component coming from intermediate goods firms, denoted by Π_t, and that coming from the firm that manages the capital stock, denoted by D_{Xt} in the paper, and to divide that enterprise value of US firms into the component due to intermediate goods firms, denoted by $V_{\Pi t}$ and the component coming from the end of period replacement cost of capital $Q_t K_{t+1}$. Thus, we study the following version of our equation for the current account

$$(1+\rho)CA_t = \left(\frac{\Pi_t}{V_{\Pi t}} - \rho\right)\lambda_{t-1}V_{\Pi t} + \left(\frac{D_{Xt}}{Q_t K_{t+1}} - \rho\right)\lambda_{t-1}Q_t K_{t+1} + \tag{35}$$

$$\left(\frac{D_t^*}{V_t^*} - \rho\right) \lambda_{t-1}^* V_t^* + (r_t^* - \rho) B_t + \left(\frac{W_t L_t}{H_t} - \rho\right) H_t$$

We make use of the following additional equations of the model.
Firm Valuation Equations:

$$V_{\Pi t} = \frac{\Pi_{t+1}}{r_{t+1}^* - \bar{g}_{t+1}} \tag{36}$$

$$V_t^* = Q_t^* K_{t+1}^* + V_{\Pi t}^* \tag{37}$$

Definitions of Dividends and Investment

$$D_{Xt} = R_t K_t - X_t \tag{38}$$

$$X_t = Q_t K_{t+1} - (1 - \delta_t) Q_t K_t \tag{39}$$

$$D_t^* = \Pi_t^* + R_t^* K_t^* - X_t^* \tag{40}$$

$$X_t^* = Q_t^* K_{t+1}^* - (1 - \delta_t^*) Q_t^* K_t^* \tag{41}$$

Note that the terms $\delta_t, \delta_t^*, K_t, K_t^*$ are all determined at $t-1$ and that Q_t and Q_t^* are exogenous shocks realized in period t. Thus, the terms $Q_t(1-\delta_t)K_t$ and $Q_t^*(1-\delta_t^*)K_t^*$ for the replacement value of the capital stock remaining after depreciation are taken as given at time t.

Note as well that we define $1 + g_{t+1} = Y_{t+1}/Y_t$ and $1 + g_{t+1}^* = Y_{t+1}^*/Y_t^*$ and assume that these growth rates are known at t.

Factor Shares

$$\frac{\Pi_t}{Y_t} = \left(\frac{\mu_t - 1}{\mu_t}\right)(1 - \tau_t), \tag{42}$$

$$\frac{W_t L_t}{Y_t} = \frac{(1-\alpha_t)}{\mu_t}(1 - \tau_t), \tag{43}$$

$$\frac{R_t K_t}{Y_t} = \frac{\alpha_t}{\mu_t}(1 - \tau_t), \tag{44}$$

and likewise for the factor shares in ROW.

Euler equations for Physical capital (with the assumptions that the parameters at $t+1$ other than Q_{t+1} and Q_{t+1}^* are known at t)

$$(1 + r_{t+1}^*) Q_t K_{t+1} = R_{t+1} K_{t+1} + (1 - \delta_{t+1}) \mathbb{E}_t Q_{t+1} K_{t+1} \tag{45}$$

$$(1 + r_{t+1}^*) Q_t^* K_{t+1}^* = R_{t+1}^* K_{t+1}^* + (1 - \delta_{t+1}^*) \mathbb{E}_t Q_{t+1}^* K_{t+1}^* \tag{46}$$

Adding our assumption that $\mathbb{E}_t Q_{t+1} = Q_t$ and likewise for Q^*, we then have the following two equations for the replacement value of the capital stock

$$(r_{t+1}^* + \delta_{t+1}) Q_t K_{t+1} = R_{t+1} K_{t+1} \tag{47}$$

$$(r_{t+1}^* + \delta_{t+1}^*) Q_t^* K_{t+1}^* = R_{t+1}^* K_{t+1}^* \tag{48}$$

F.1 Step 1: Current Account Relative to Output

The first step in terms of solving for the current account in terms of model parameters is to state the equations relative to output. If we divide all the equations above except the factor share equations by output and then use the factor share equations to get variables in terms of parameters, we have

$$(1+\rho)\frac{CA_t}{Y_t} = \left(\frac{\Pi_t}{V_{\Pi t}} - \rho\right)\lambda_{t-1}\frac{V_{\Pi t}}{Y_t} + \left(\frac{D_{Xt}}{Q_t K_{t+1}} - \rho\right)\lambda_{t-1}\frac{Q_t K_{t+1}}{Y_t} + \left(\frac{D_t^*}{V_t^*} - \rho\right)\lambda_{t-1}^*\frac{V_t^*}{Y_t^*}\frac{Y_t^*}{Y_t} + (r_t^* - \rho)\frac{B_t}{Y_t} + \left(\frac{W_t L_t}{H_t} - \rho\right)\frac{H_t}{Y_t} \tag{49}$$

The ratio of Human Wealth to output is given by

$$\frac{H_t}{Y_t} \equiv \frac{(1-\alpha_{t+1})}{\mu_{t+1}}(1-\tau_{t+1})\frac{(1+g_{t+1})}{r_{t+1}^* - \bar{g}_{t+1}}. \tag{50}$$

and the income yield on human wealth is given by

$$\frac{W_t L_t}{H_t} = \frac{(1-\alpha_t)}{(1-\alpha_{t+1})}\frac{\mu_{t+1}}{\mu_t}\frac{(1-\tau_t)}{(1-\tau_{t+1})}\frac{(r_{t+1}^* - \bar{g}_{t+1})}{(1+g_{t+1})} \tag{51}$$

The ratio of the value of intermediate goods firms to output is given by

$$\frac{V_{\Pi t}}{Y_t} = \frac{(\mu_{t+1}-1)}{\mu_{t+1}}(1-\tau_{t+1})\frac{(1+g_{t+1})}{(r_{t+1}^* - \bar{g}_{t+1})} \tag{52}$$

and the income yield on these firms is given by

$$\frac{\Pi_t}{V_{\Pi t}} = \frac{(\mu_t - 1)}{\mu_t}\frac{\mu_{t+1}}{(\mu_{t+1}-1)}\frac{(1-\tau_t)}{(1-\tau_{t+1})}\frac{(r_{t+1}^* - \bar{g}_{t+1})}{(1+g_{t+1})} \tag{53}$$

The ratio of end of period capital to output is given using equations 10, and 12 by

$$\frac{Q_t K_{t+1}}{Y_t} = \frac{(1+g_{t+1})}{(r_{t+1}^* + \delta_{t+1})}\frac{\alpha_{t+1}}{\mu_{t+1}}(1-\tau_{t+1}) \tag{54}$$

The ratio of dividends from the firms that manage the capital stock to output is given by

$$\frac{D_{Xt}}{Y_t} = \frac{\alpha_t}{\mu_t}(1-\tau_t) - \frac{X_t}{Y_t}$$

The ratio of investment to output is given by

$$\frac{X_t}{Y_t} = \frac{(1+g_{t+1})}{(r_{t+1}^* + \delta_{t+1})}\frac{\alpha_{t+1}}{\mu_{t+1}}(1-\tau_{t+1}) - (1-\delta_t)\frac{(Q_t - Q_{t-1})K_t}{Y_t} - (1-\delta_t)\frac{Q_{t-1}K_t}{Y_t}$$

so

$$\frac{X_t}{Y_t} = \frac{(1+g_{t+1})}{(r^*_{t+1}+\delta_{t+1})}\frac{\alpha_{t+1}}{\mu_{t+1}}(1-\tau_{t+1}) - \frac{(1-\delta_t)}{(r^*_t+\delta_t)}\frac{\alpha_t}{\mu_t}(1-\tau_t) - (1-\delta_t)\frac{(Q_t-Q_{t-1})K_t}{Y_t} \tag{55}$$

These equations imply

$$\frac{D_{Xt}}{Y_t} = \frac{(1+r^*_t)}{(r^*_t+\delta_t)}\frac{\alpha_t}{\mu_t}(1-\tau_t) - \frac{(1+g_{t+1})}{(r^*_{t+1}+\delta_{t+1})}\frac{\alpha_{t+1}}{\mu_{t+1}}(1-\tau_{t+1}) + \tag{56}$$

$$(1-\delta_t)\frac{(Q_t-Q_{t-1})K_t}{Y_t}$$

Direct analogs of these equations hold for the ROW (D^* and V^*) as well.

F.2 Step 2: Solving for Balanced Growth Paths

In the second step of solving for the response of the model current account to changes in model parameters is to solve for a balanced growth path in the model. We assume that parameters are constant on a balanced growth path. Thus, we have $\tau_t = \tau_{t+1}$, $\mu_t = \mu_{t+1}$, $\alpha_t = \alpha_{t+1}$, $\delta_t = \delta_{t+1}$, $Q_t = Q_{t+1}$, $r^*_t = r^*_{t+1}$, and we assume that growth from t to $t+1$ is equal to long term growth so $g_{t+1} = \bar{g}_{t+1}$. We also assume that equity shares λ_t and λ^*_t are constant as well. We denote all of these variables with a bar over the top.

With these assumptions, we have the ratio of human wealth to output given by the labor share times its valuation multiple

$$\overline{\frac{H}{Y}} = \frac{(1-\bar{\alpha})}{\bar{\mu}}(1-\bar{\tau})\frac{(1+\bar{g})}{\bar{r}^*-\bar{g}}. \tag{57}$$

and the income yield on human wealth is given by

$$\overline{\frac{WL}{H}} = \frac{(\bar{r}^*-\bar{g})}{(1+\bar{g})} \tag{58}$$

For the intermediate goods firms, the ratio of their value to GDP is equal to the share of factorless income times its valuation multiple

$$\overline{\frac{V_\Pi}{Y}} = \frac{(\bar{\mu}-1)}{\bar{\mu}}(1-\bar{\tau})\frac{(1+\bar{g})}{\bar{r}^*-\bar{g}} \tag{59}$$

and the associated income yield is given by

$$\overline{\frac{\Pi}{V_\Pi}} = \frac{(\bar{r}^*-\bar{g})}{(1+\bar{g})} \tag{60}$$

The value of the firms managing the capital stock is given by the ratio of BGP capital at the end of the period to output

$$\frac{\overline{QK'}}{Y} = \frac{(1+\bar{g})}{(\bar{r}^* + \bar{\delta})} \frac{\bar{\alpha}}{\bar{\mu}}(1-\bar{\tau}) \tag{61}$$

The ratio of the dividends from these firms managing the capital stock to output is given by

$$\frac{\overline{D_X}}{Y} = \frac{(\bar{r}^* - \bar{g})}{\bar{r}^* + \bar{\delta}} \frac{\bar{\alpha}}{\bar{\mu}}(1-\bar{\tau})$$

Thus income yield on this capital is given by

$$\frac{\overline{D_X}}{QK'} = \frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} \tag{62}$$

Note that on a BGP, the ROW has the same cost of capital and growth rate, so the income yield on the corporate sector in the ROW is given by

$$\frac{\overline{D^*}}{V^*} = \frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} \tag{63}$$

These equations imply that on a balanced growth path, the ratio of the current account to output taking as given the outstanding stock of bonds maturing relative to output B_t/Y_t is given by

$$\frac{CA_t}{Y_t} = \frac{1}{1+\rho}\left[\left(\frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} - \rho\right)\left(\frac{\overline{H}}{Y} + \bar{\lambda}\frac{\overline{V_\pi}}{Y} + \bar{\lambda}\frac{\overline{QK'}}{Y} + \bar{\lambda}^*\frac{\overline{V^*}}{Y}\right) + (\bar{r}^* - \rho)\frac{B_t}{Y_t}\right] \tag{64}$$

The change in the stock of bonds coming due is then equal to the current account, or

$$(1+\bar{g})\frac{B_{t+1}}{Y_{t+1}} - \frac{B_t}{Y_t} = \frac{CA_t}{Y_t} \tag{65}$$

F.3 Alternative BGP's

In the event that the income yield on human wealth and equity assets equals the rate of time preference, so

$$\frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} = \rho$$

then the term

$$\left(1 - \rho\frac{(1+\bar{g})}{(\bar{r}^* - \bar{g})}\right) = 0$$

and

$$\frac{(\bar{r}^* - \rho)}{(1+\rho)} = \bar{g}$$

so $CA_t/Y_t = \bar{g}B_t/Y_t$ and thus the ratio of net non-equity assets to output remains constant $(B'/Y' = B/Y)$. In this case, the ratio of the current account to output remains constant over time at a level indexed by $B_t/Y_t = \overline{B/Y}$.

In the event that the income yield on human wealth and equity assets exceeds the rate of time preference, so

$$\frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} > \rho$$

then

$$\bar{r}^* - \rho > \bar{g}(1+\rho)$$

and, since the sum of human and equity assets must be non-negative, we have that

$$\frac{CA}{Y} > \bar{g}\frac{B}{Y}$$

and thus

$$\frac{B'}{Y'} > \frac{B}{Y}$$

That is, the US economy steadily acquires net non-equity claims on the ROW. If the income yield on human wealth and equity assets is smaller than the rate of time preference, then these inequalities are reversed and the US economy steadily depletes non-equity claims on the ROW. This process of trend accumulation or decumulation of net non-equity claims on the ROW would be very slow given the narrow range of fluctuations in the gap between the income yield on equity and the rate of time preference allowed in the model. A more complete model would specify a force to prevent the net non-equity position from growing without bound. One approach in the literature to address this issue is to include a quadratic cost to holding a large net non-equity position. Alternatively, if one models uncertainty explicitly, a full non-linear solution has a consumption rule out of wealth that varies with the level of wealth due to changes in the strength of the precautionary motive for saving as the level of wealth rises.

F.3.1 Magnitudes

To get a sense of magnitudes, consider the case in which $B/Y = 0$ and

$$\frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} = \rho$$

In this case, the current account balance on this BGP is zero and the terms

$$\frac{(1-\bar{\alpha})}{\bar{\mu}}(1-\bar{\tau}) + \lambda\frac{(\bar{\mu}-1)}{\bar{\mu}}(1-\bar{\tau}) + \lambda\frac{(\bar{r}^* - \bar{g})}{\bar{r}^* + \bar{\delta}}\frac{\bar{\alpha}}{\bar{\mu}}(1-\bar{\tau}) + \lambda^*\frac{D^*}{Y}$$

in total are equal to the ratio of consumption to output. If we consider changes in the term comparing the rate of time preference to the income yield on human wealth and equity assets

$$\left(1 - \rho\frac{(1+\bar{g})}{(\bar{r}^* - \bar{g})}\right)$$

we see that the ratio of the current account to GDP is quite sensitive to such changes. For example, if the baseline value of ρ on an annual basis is 3.3% and the income yield on human wealth and equity assets drops to 3%, then the current account to output becomes

$$\frac{CA}{Y} = -0.1 * \frac{C}{Y} \approx -8\%$$

F.4 Responses of the Current Account to Shocks

In our model, at time t, a shock is the arrival of news that any of the parameters of the model dated $t+1$ have changed and will have that new value from $t+1$ on. These parameters include $\alpha_{t+1}, \delta_{t+1}, \mu_{t+1}, \tau_{t+1}, r^*_{t+1}$. We also consider permanent shocks to the expected growth rate $\bar{g}_{t+1}$ relevant for growth from $t+1$ on and transitory shocks to the growth rate from t to $t+1$ denoted by g_{t+1}. The only exception to this rule is that at time t, it is possible that the current value of the price Q_t is shocked relative to its prior value Q_{t-1} which is also the expectation of Q_t at time $t-1$. We do not shock the parameters λ and λ^*.

For shocks to $\alpha_{t+1}, \delta_{t+1}, \mu_{t+1}, \tau_{t+1}, r^*_{t+1}$ and $\bar{g}_{t+1}$, the response of the current account has two steps. At t, there is a transitory response of the current account as detailed below. From period $t+1$ on, the ratio of the current account to output is given by equations 64 with parameters held constant at their levels at $t+1$ and the ratio of net non-equity claims on the ROW evolves according to equation 65.

In the algebra below, we use ratios without dates (such as $\overline{H/Y}$) to denote the values of these ratios on the original BGP up to time t.

For the impact of such a shock on the current account in period t, we use equations 49, 50, 51, 52, 53, 54, and 56. We illustrate the application of these equations for several types of shocks next. In each case, we assume that the economy starts on a BGP with $B_t/Y_t = 0$ and with

$$\frac{(\bar{r}^* - \bar{g})}{(1+\bar{g})} = \rho,$$

F.4.1 A transitory growth shock

Consider the impact of a shock to the growth rate from t to $t+1$ denoted by g_{t+1}. We assume that this shock hits both countries (we mention where this matters below). Assume that the economy starts on a BGP as described above and that from $t+1$ on, the parameters continue on this original path. Thus, this corresponds to a one-time permanent shock to the level of productivity.

In this case, income levels W_tL_t, Π_t, and D^*_t are not impacted by the shock. The dividend from the firms managing the physical capital stock does fall because investment rises. Specifically, from equation 55, the ratio of investment to output rises by the shock to the growth rate times the capital output ratio

$$\frac{X_t}{Y_t} = \overline{\frac{X}{Y}} + \frac{(g_{t+1} - \bar{g})}{1+\bar{g}} \overline{\frac{QK'}{Y}}$$

Thus, as an example, with a capital to output ratio of 2, a $50bp$ transitory shock to the growth rate leads to a jump in the ratio of investment to output of 1 percentage point. Plugging in this result for investment, we have that

$$\frac{D_{Xt}}{Y_t} = \frac{\overline{D_X}}{Y} - \frac{(g_{t+1} - \bar{g})}{1 + \bar{g}} \frac{\overline{QK'}}{Y}$$

Using equation 54 for the end of period t capital stock to output ratio, we have

$$\frac{Q_t K_{t+1}}{Y_t} = \frac{1 + g_{t+1}}{1 + \bar{g}} \frac{\overline{QK'}}{Y}$$

and the income yield on physical capital in period t becomes

$$\frac{D_{Xt}}{Q_t K_{t+1}} = \frac{1 + \bar{g}}{1 + g_{t+1}} \left(\rho - \frac{(g_{t+1} - \bar{g})}{1 + \bar{g}} \right)$$

Putting this together, the contribution of the impact of this shock on physical capital to the current account is given by

$$\frac{1}{1+\rho} \left(\frac{D_{Xt}}{Q_t K_{t+1}} - \rho \right) \lambda_{t-1} \frac{Q_t K_{t+1}}{Y_t} = \frac{1}{1+\rho} \left(\left(\rho - \frac{(g_{t+1} - \bar{g})}{1 + \bar{g}} \right) - \rho \frac{1 + g_{t+1}}{1 + \bar{g}} \right) \bar{\lambda} \frac{\overline{QK'}}{Y} =$$

$$- \left(\frac{g_{t+1} - \bar{g}}{1 + \bar{g}} \right) \bar{\lambda} \frac{\overline{QK'}}{Y}$$

That is, the increment to investment induced by this transitory shock to the growth rate is financed by a current account deficit in proportion to the US households' share of US equity $\bar{\lambda}$.

If we assume that the shock hits the ROW as well, then we have the equivalent term for the impact on the US current account

$$- \left(\frac{g_{t+1} - \bar{g}}{1 + \bar{g}} \right) \bar{\lambda}^* \frac{\overline{Q^* K^{*\prime}}}{Y}$$

If the shock does not hit the ROW, then this term would be zero.

From equations 50, 52 the ratios of values of domestic assets $H_t, V_{\Pi t}$ relative to output at t all rise by the ratio

$$\frac{1 + g_{t+1}}{1 + \bar{g}}$$

relative to their BGP values. If the shock hits the ROW as well, then the same is true for $V^*_{\Pi t}/Y_t$ while Π^*_t/Y_t is unchanged.

As a result, the impact of changes in the terms involving human capital on the current account are given by

$$- \frac{\rho}{1+\rho} \left(\frac{g_{t+1} - \bar{g}}{1 + \bar{g}} \right) \frac{\overline{H}}{Y}$$

and those involving US factorless income are given by

$$-\frac{\rho}{1+\rho}\left(\frac{g_{t+1}-\bar{g}}{1+\bar{g}}\right)\bar{\lambda}\frac{\overline{V_\Pi}}{Y}$$

while the terms involving factorless income in the ROW are given by

$$-\frac{\rho}{1+\rho}\left(\frac{g_{t+1}-\bar{g}}{1+\bar{g}}\right)\bar{\lambda}^*\frac{\overline{V_\Pi^*}}{Y}$$

If the shock did not hit the ROW, this term would be zero.

Putting these results together, we have that if the transitory growth shock is common to both countries, then

$$\frac{CA_t}{Y_t}-\frac{\overline{CA}}{Y}=\frac{\rho}{1+\rho}\left(\frac{\bar{g}-g_{t+1}}{1+\bar{g}}\right)\left[\frac{\overline{H}}{Y}+\bar{\lambda}\frac{\overline{V_\pi}}{Y}+\bar{\lambda}^*\frac{\overline{V_\Pi^*}}{Y}\right]-\frac{(g_{t+1}-\bar{g})}{1+\bar{g}}\left[\bar{\lambda}\frac{\overline{QK'}}{Y}+\bar{\lambda}^*\frac{\overline{Q^*K^{*\prime}}}{Y}\right]$$

where the last term represents the negative impact on the current account of increased investment in physical capital in both the US and ROW. We see here that for reasonable values of the rate of time preference ρ, the dominant impact of this shock on the current account is through its impact on the ratio of investment to output (the second term) rather than through its impact on the ratio of human wealth and the value of factorless income to output.

Note that this shock feeds into the net bond position B_{t+1} and from $t+1$ on, the economy is on a BGP with the current account equal to $\bar{g}B_{t+1}/Y_{t+1}$.

F.4.2 A permanent growth shock

Now consider a shock to $\bar{g}_{t+1}$. Let $\bar{g}$ denote the long term growth rate expected on the initial BGP and $\bar{g}_{t+1}$ denote the new growth rate expected from period $t+1$ on. This shock is common to both countries. By definition, this shock only impact the growth in productivity from period $t+1$ on. Hence, it does not impact any flow variables at time t. Moreover, it does not impact the end of period t capital stock in either the US Q_tK_{t+1} or ROW $Q_t^*K_{t+1}^*$ and hence does not impact investment at time t. The shock does, however, impact the end of period t valuation of human wealth H_t and the end of period t valuations of US and ROW factorless income $V_{\Pi t}$ and $V_{\Pi t}^*$. In particular

$$\frac{H_t}{Y_t}=\frac{\bar{r}^*-\bar{g}}{\bar{r}^*-\bar{g}_{t+1}}\frac{\overline{H}}{Y}$$

$$\frac{V_{\Pi t}}{Y_t}=\frac{\bar{r}^*-\bar{g}}{\bar{r}^*-\bar{g}_{t+1}}\frac{\overline{V_\Pi}}{Y}$$

$$\frac{V_{\Pi t}^*}{Y_t}=\frac{\bar{r}^*-\bar{g}}{\bar{r}^*-\bar{g}_{t+1}}\frac{\overline{V_\Pi^*}}{Y}$$

Thus, the impact of this shock on the current account at time t is given by

$$\frac{CA_t}{Y_t} - \frac{\overline{CA}}{Y} = \frac{\rho}{1+\rho}\left(\frac{\bar{g} - g_{t+1}}{\bar{r} - \bar{g}_{t+1}}\right)\left[\frac{\overline{H}}{Y} + \bar{\lambda}\frac{\overline{V_\Pi}}{Y} + \bar{\lambda}^*\frac{\overline{V_\Pi^*}}{Y}\right]$$

Note that this shock feeds into the net bond position B_{t+1} and that from period $t+1$, since $\bar{r}^* - \bar{g}_{t+1}$ differs from its level in the initial balanced growth path, the current account rise (or fall) relative to output depending on whether the new income yield $\frac{(\bar{r}^* - \bar{g}_{t+1})}{(1+\bar{g}_{t+1})}$ is larger or smaller than the rate of time preference ρ.

Note as well that the impact of this shock on the current account can be quite large as the ratio of human wealth to output is large and the term $\bar{r} - \bar{g}_{t+1}$ is on the order of ρ. Thus, the impact of such a shock on the ratio of the current account to output is of opposite sign and at least an order of magnitude larger than the magnitude of the shock itself $(g_{t+1} - \bar{g})$.

F.4.3 A shock to the discount rate r^*_{t+1}

Now consider a shock to the discount rate r^*_{t+1}. This shock arrives at t and impacts the discount rate between t and $t+1$ and all subsequent periods in the same way. Thus, this shock impacts the equilibrium capital to output ratio at the end of period t, and hence investment at t, in both the US and the ROW. It also impacts the valuation of future labor and factorless income as in the case of a permanent growth shock.

We have that this shock impacts the ratio of capital to output at the end of period t by

$$\frac{Q_t K_{t+1}}{Y_t} = \frac{\bar{r}^* + \bar{\delta}}{r^*_{t+1} + \bar{\delta}}\frac{\overline{QK'}}{Y}$$

Thus, the ratio of investment to output at t is given by

$$\frac{X_t}{Y_t} = \frac{\overline{X}}{Y} + \left(\frac{\bar{r}^* - r^*_{t+1}}{r^*_{t+1} + \bar{\delta}}\right)\frac{\overline{QK'}}{Y}$$

and the ratio of dividends from the firm managing the capital stock to output at t is given by

$$\frac{D_{Xt}}{Y_t} = \frac{\overline{D_X}}{Y} - \left(\frac{\bar{r}^* - r^*_{t+1}}{r^*_{t+1} + \bar{\delta}}\right)\frac{\overline{QK'}}{Y}$$

Thus, the impact on the current account at t due to the terms corresponding to physical capital are given by

$$\frac{1}{1+\rho}\left(\rho\frac{r^*_{t+1} + \bar{\delta}}{\bar{r}^* + \bar{\delta}} - \frac{\bar{r}^* - r^*_{t+1}}{\bar{r}^* + \bar{\delta}} - \rho\right)\bar{\lambda}\frac{\bar{r}^* + \bar{\delta}}{r^*_{t+1} + \bar{\delta}}\frac{\overline{QK'}}{Y} =$$

$$-\left(\frac{\bar{r}^* - r^*_{t+1}}{r^*_{t+1} + \bar{\delta}}\right)\frac{\overline{QK'}}{Y}$$

That is, these terms are equal to minus the increase in investment.

While current labor compensation and factorless income do not change, the end of period valuations of these income streams do change and are given by

$$\frac{H_t}{Y_t} = \frac{\bar{r}^* - \bar{g}}{r^*_{t+1} - \bar{g}} \frac{\overline{H}}{Y}$$

$$\frac{V_{\Pi t}}{Y_t} = \frac{\bar{r}^* - \bar{g}}{r^*_{t+1} - \bar{g}} \frac{\overline{V_\Pi}}{Y}$$

$$\frac{V^*_{\Pi t}}{Y_t} = \frac{\bar{r}^* - \bar{g}}{r^*_{t+1} - \bar{g}} \frac{\overline{V^*_\Pi}}{Y}$$

Thus, the impact on the current account from these terms is given by

$$\frac{\rho}{1+\rho} \left(\frac{r^*_{t+1} - \bar{r}^*}{r^*_{t+1} - \bar{g}} \right) \left[\frac{\overline{H}}{Y} + \bar{\lambda} \frac{\overline{V_\Pi}}{Y} + \bar{\lambda}^* \frac{\overline{V^*_\Pi}}{Y} \right]$$

Putting these together, the overall impact on the ratio of the current account to output at time t is given by

$$\frac{CA_t}{Y_t} - \frac{\overline{CA}}{Y} = -\left(\frac{\bar{r}^* - r^*_{t+1}}{r^*_{t+1} + \bar{\delta}} \right) \frac{\overline{QK'}}{Y} + \frac{\rho}{1+\rho} \left(\frac{r^*_{t+1} - \bar{r}^*}{r^*_{t+1} - \bar{g}} \right) \left[\frac{\overline{H}}{Y} + \bar{\lambda} \frac{\overline{V_\Pi}}{Y} + \bar{\lambda}^* \frac{\overline{V^*_\Pi}}{Y} \right]$$

The first term captures in the impact of the discount rate shock on investment at t while the second term captures the revaluation of future labor income and factorless income. Again, since human wealth is quite large and ρ and $r^*_{t+1} - \bar{g}$ are similar in magnitude, the impact of this shock on the current account through the second term is quite large.

Note also that this shock feeds into the net bond position B_{t+1} and that from period $t+1$, since $\bar{r}^* - \bar{g}_{t+1}$ differs from its level in the initial balanced growth path, the current account rise (or fall) relative to output depending on whether the new income yield $\frac{(\bar{r}^* - \bar{g}_{t+1})}{(1+\bar{g}_{t+1})}$ is larger or smaller than the rate of time preference ρ.

F.4.4 A shock to factorless income

We now consider a shock to the allocation of income due to an increase in μ_{t+1} in the U.S. News regarding this change in parameters arrives in period t. Households and firms perceive that $\mu_{t+k} = \mu_{t+1}$ for all periods $t+k$ for $k \geq 1$.

This shock has no impact in time t on wages $W_t L_t$ or factorless income Π_t, output Y_t, or dividends received from the ROW, D^*_t. The shock does alter dividends paid by the US firm that manages the capital stock D_{Xt}. From equation 56, we have

$$\frac{D_{Xt}}{Y_t} = \frac{\overline{D_X}}{Y} + \left(1 - \frac{\bar{\mu}}{\mu_{t+1}}\right) \frac{\overline{QK'}}{Y}$$

Moreover, the ratio of end of period capital to output in period t is given by

$$\frac{Q_t K_{t+1}}{Y_t} = \frac{\bar{\mu}}{\mu_{t+1}} \frac{\overline{QK'}}{Y}$$

Thus, the impact on the current account at t from the terms associated with investment in physical capital is given by

$$\frac{1}{1+\rho}\left(\rho\frac{\mu_{t+1}}{\bar{\mu}}+(\frac{\mu_{t+1}}{\bar{\mu}}-1)-\rho\right)\bar{\lambda}\frac{\bar{\mu}}{\mu_{t+1}}\frac{\overline{QK'}}{Y}=$$

$$\left(\frac{\mu_{t+1}-\bar{\mu}}{\mu_{t+1}}\right)\frac{\overline{QK'}}{Y}$$

That is, the impact of this shock on the current account at t coming through terms having to do with physical capital in the US is equal to the the drop in investment at t.

The change in μ_{t+1} also alters the value of human wealth and factorless income. We have

$$\frac{H_t}{Y_t}=\frac{\bar{\mu}}{\mu_{t+1}}\frac{\overline{H}}{Y}$$

and the income yield on this human wealth from equation 51 is given by

$$\frac{W_tL_t}{H_t}=\frac{\mu_{t+1}}{\bar{\mu}}\frac{\overline{WL}}{H}$$

so the impact on the current account at t from the terms associated with human wealth is given by

$$\frac{\rho}{1+\rho}\left(\frac{\mu_{t+1}-\bar{\mu}}{\mu_{t+1}}\right)\frac{\overline{H}}{Y}$$

Likewise, for factorless income, we have

$$\frac{V_{\Pi t}}{Y_t}=\frac{\mu_{t+1}-1}{\mu_{t+1}}\frac{\bar{\mu}}{\bar{\mu}-1}\frac{\overline{V_{\Pi}}}{Y}.$$

This gives an income yield on the claim to factorless income of

$$\frac{\Pi_t}{V_{\Pi t}}=\frac{\mu_{t+1}}{\mu_{t+1}-1}\frac{\bar{\mu}-1}{\bar{\mu}}\frac{\overline{\Pi}}{V_{\Pi}}$$

and the impact on the current account at t from the terms associated with factorless income given by

$$\frac{\rho}{1+\rho}\left(1-\frac{\mu_{t+1}-1}{\mu_{t+1}}\frac{\bar{\mu}}{\bar{\mu}-1}\right)\bar{\lambda}\frac{\overline{V_{\Pi}}}{Y}=\frac{\rho}{1+\rho}\left(\frac{\bar{\mu}-\mu_{t+1}}{\mu_{t+1}}\right)\frac{\bar{\lambda}}{\bar{\mu}-1}\frac{\overline{V_{\Pi}}}{Y}$$

From equations 57 and 59, we have

$$\frac{\overline{V_{\Pi}}}{Y}=\frac{\bar{\mu}-1}{1-\alpha}\frac{\overline{H}}{Y}$$

Thus, we can write this impact on the current account at t from the sum of the terms associated with factorless income and human wealth as

$$\frac{\rho}{1+\rho}\left(\frac{\bar{\mu}-\mu_{t+1}}{\mu_{t+1}}\right)\left(1-\frac{\bar{\lambda}}{1-\alpha}\right)\frac{H}{Y}$$

This gives the overall impact on the current account at t from this shock as

$$\frac{CA_t}{Y_t}-\frac{\overline{CA}}{Y}=\left(\frac{\mu_{t+1}-\bar{\mu}}{\mu_{t+1}}\right)\frac{\overline{QK'}}{Y}+\frac{\rho}{1+\rho}\left(\frac{\mu_{t+1}-\bar{\mu}}{\mu_{t+1}}\right)\left(1-\frac{\bar{\lambda}}{1-\alpha}\right)\frac{\overline{H}}{Y}$$

Note that this shock feeds into the net bond position B_{t+1} and from $t+1$ on, the economy is on a BGP with the current account equal to $\bar{g}B_{t+1}/Y_{t+1}$.

This formula for the response of the current account on impact (at t) to a shock to μ_{t+1} is the sum of the impact of this shock on investment in physical capital as captured in the first term and the impact of this shock on the combined value of the claims held by US Households on labor income and factorless income as captured in the second term. The first term positive when $\mu_{t+1} > \bar{\mu}$ because the capital to output ratio and thus investment falls. While this second term in theory can be large because the baseline value of human wealth relative to output is large, this effect is mitigated to the extent to which US residents hold claims to US firms (as indexed by $\bar{\lambda}$). If the share of equity US residents hold in US firms exceeds the share of labor in production costs, then this second term is negative. If this equity share is less than the share of labor in costs, then it is positive. These offsetting effects arise as this shock to μ_{t+1} reallocates income from labor compensation to factorless income.

G Extended Model with Terms of Trade Effects

In our simple baseline model, all domestic intermediate varieties have the same price, and because domestic and foreign final output are the same good, the prices of domestic and foreign intermediates are identical. Thus, in that model, a rise in output wedges for U.S. firms does not change the price that consumers pay for U.S.-produced relative to foreign-produced goods.

We now briefly consider an extended version of the model, in which domestically produced intermediates produce a composite domestic good A, while foreign intermediates are combined to produce a composite foreign final good B. Goods A and B are traded and used symmetrically in each country as imperfectly substitutable inputs in the production of final consumption and investment goods. In this extended model, the equilibrium price of good B relative to good A – the terms of trade – will depend on how much of good B is produced relative to good A. Thus, whether a rise in U.S. output wedges improves or worsens the terms of trade will depend on whether the rise in U.S. output wedges is associated with an expansion or a contraction in U.S. production.

A pure output wedge shock – one in which output wedges go up because follower firms become less productive and z_L falls – will be associated with a decline in U.S. output and an increase in the price of U.S.-produced goods relative to foreign ones. This terms of trade effect will ameliorate the negative welfare consequences of a pure output wedge shock for U.S.

consumers. This is an optimal tariff argument: just like a tax on exports, a pure increase in domestic output wedges reduces the supply of U.S.-produced goods and increases their relative price. However, note that an increase in U.S. output wedges may be associated with either a decline or a rise in the production of U.S. goods, depending on whether the rise in output wedges reflects a decline in z_L (which reduces U.S. output) or a rise in z_H (which boosts U.S. output). In our baseline calibration of our baseline model, we constructed a combination of changes to z_L and z_H with the property that the rise in U.S. output wedges neither expands nor reduces U.S. output. We now show that if we were to follow the same strategy in the extended model in which goods A and B are imperfect substitutes, there would be no change in the equilibrium terms of trade. And in the absence of such a change, all the positive and normative implications of the increase in output wedges would be identical to those in the baseline model described in the main text.

In particular, consider an extension of the baseline model in which domestically produced varieties are combined to produce a composite domestic intermediate A and a composite foreign intermediate B, where the quantites of these composites are denoted by Y_A and Y_B. Thus,

$$\begin{aligned} Y_A &= \left[\int_0^1 Y_i^{(\theta-1)/\theta} di\right]^{\theta/(\theta-1)} \\ Y_B &= \left[\int_0^1 Y_i^{*(\theta-1)/\theta} di\right]^{\theta/(\theta-1)} \end{aligned}$$

These two composites are combined to produced the final consumption and investment goods using a CES aggregator function G. Let A and A^* and B and B^* denote the quantities of the two composite goods used in producing the final consumption and investment goods in the two countries. Thus,

$$\begin{aligned} C + K' - (1-\delta)K &= G(A, B) \\ C^* + K^{*\prime} - (1-\delta)K^* &= G^*(A^*, B^*). \end{aligned}$$

Assume the aggregators for producing final goods are identical in the two economies:

$$\begin{aligned} G(A, B) &= 2^{\frac{1}{1-\varepsilon}} \left[A^{(\varepsilon-1)/\varepsilon} + B^{(\varepsilon-1)/\varepsilon}\right]^{\frac{\varepsilon}{\varepsilon-1}} \\ G^*(A^*, B^*) &= 2^{\frac{1}{1-\varepsilon}} \left[A^{*(\varepsilon-1)/\varepsilon} + B^{*(\varepsilon-1)/\varepsilon}\right]^{\frac{\varepsilon}{\varepsilon-1}}. \end{aligned}$$

Here, the parameter ε defines the elasticity of substitution between locally produced intermediates and foreign-produced ones.

Market clearing requires

$$\begin{aligned} Y_A &= A + A^* \\ Y_B &= B + B^*. \end{aligned}$$

Let P_A and P_B denote the prices of good A and B relative to the domestic final consumption good and similarly for P_A^* and P_B^*. Given that all intermediate varieties are symmetric, in equilibrium $Y_A = Y_i$, $Y_B = Y_i^*$, $P_A = P_i$ and $P_B^* = P_i^*$.

Note that because the aggregators for producing domestic and foreign consumption goods are identical, the relative price of foreign to domestic consumption (the real exchange rate) in this model is one, and thus $P_A = P_A^*$ and $P_B = P_B^*$.

The first order conditions for intermediate-good-producing firms in this economy are identical to those in the baseline model. But we cannot immediately equate the prices P_A and P_B to the price of the final consumption good, which is normalized to one. Rather, these prices are pinned down by two conditions. First, the first-order conditions for final-good-producing firms ties the relative price of B to A to the relative quantities produced:

$$\frac{Y_B}{Y_A} = \frac{B}{A} = \frac{B^*}{A^*} = \left(\frac{P_B}{P_A}\right)^{-\varepsilon}. \tag{66}$$

Second, final-good-producing firms are competitive, so that the price of producing one unit of final consumption must equal the price of one unit of consumption (which is normalized to one). If domestic firms are producing one unit of output, then the quantities A and B must satisfy

$$\begin{aligned} G(A,B) &= 1 = 2^{\frac{1}{1-\varepsilon}}\left[A^{(\varepsilon-1)/\varepsilon} + B^{(\varepsilon-1)/\varepsilon}\right]^{\frac{\varepsilon}{\varepsilon-1}} \\ 1 &= 2^{\frac{1}{1-\varepsilon}} A\left[1 + \left(\frac{B}{A}\right)^{(\varepsilon-1)/\varepsilon}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \end{aligned}$$

which, given (66), implies

$$A = 2^{\frac{-1}{1-\varepsilon}}\left[1 + \left(\frac{P_B}{P_A}\right)^{1-\varepsilon}\right]^{\frac{-\varepsilon}{\varepsilon-1}}.$$

So the cost of producing one unit of the final consumption good is

$$\begin{aligned} & P_A 2^{\frac{-1}{1-\varepsilon}}\left[1 + \left(\frac{P_B}{P_A}\right)^{1-\varepsilon}\right]^{\frac{-\varepsilon}{\varepsilon-1}} + P_i^* 2^{\frac{-1}{1-\varepsilon}}\left[1 + \left(\frac{P_B}{P_A}\right)^{1-\varepsilon}\right]^{\frac{-\varepsilon}{\varepsilon-1}}\left(\frac{P_B}{P_A}\right)^{-\varepsilon} \\ = \;& 2^{\frac{-1}{1-\varepsilon}}\left(P_A^{1-\varepsilon} + P_B^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}. \end{aligned}$$

If this cost is to equal to the price of consumption, which is one, then

$$P_A^{1-\varepsilon} + P_B^{1-\varepsilon} = 2. \tag{67}$$

Proposition 1 *If*

$$\frac{z_H^*}{z_H} = \left(\frac{\mu^*}{\mu}\right)^{\alpha + \frac{1-\alpha}{1+\sigma}}, \tag{68}$$

then $P_A = P_B = 1$ and allocations are independent of ε and are identical to those in the one good model in the main text.

Proof:

Bertrand competition among intermediate-good-producing firms gives the same price expressions as in the one-good model, which we reproduce here:

$$
\begin{aligned}
P_A &= \frac{\mu}{z_H}\left(\frac{W}{Z(1-\alpha)}\right)^{1-\alpha}\left(\frac{R}{\alpha}\right)^{\alpha} \\
P_B &= \frac{\mu^*}{z_H^*}\left(\frac{W^*}{Z(1-\alpha)}\right)^{1-\alpha}\left(\frac{R^*}{\alpha}\right)^{\alpha}.
\end{aligned}
$$

Taking the ratio of these two prices (and recalling that $R = R^*$), we get

$$
\frac{P_B}{P_A} = \frac{\mu^*}{\mu}\left(\frac{z_H^*}{z_H}\right)^{-1}\left(\frac{W^*}{W}\right)^{(1-\alpha)}. \tag{69}
$$

From the two FOCs for labor supply, we have

$$
\frac{L^*}{L} = \left(\frac{W^*}{W}\right)^{1/\sigma}.
$$

Thus, the ratio of foreign to domestic output is

$$
\frac{Y_B}{Y_A} = \frac{z_H^*}{z_H}\left(\frac{K^*}{K}\right)^{\alpha}\left(\frac{L^*}{L}\right)^{1-\alpha} = \frac{z_H^*}{z_H}\left(\frac{K^*}{K}\right)^{\alpha}\left(\frac{W^*}{W}\right)^{(1-\alpha)/\sigma}. \tag{70}
$$

Multiplying together expressions (69) and (70), we get

$$
\frac{P_B}{P_A}\times\frac{Y_B}{Y_A} = \frac{\mu^*}{\mu}\left(\frac{K^*}{K}\right)^{\alpha}\left(\frac{W^*}{W}\right)^{(1-\alpha)(1+\sigma)/\sigma}. \tag{71}
$$

From equation (10 at home and abroad, with a common value of $R = R^*$, we have

$$
\frac{K^*}{K} = \frac{\mu}{\mu^*}\frac{P_B}{P_A}\frac{Y_B}{Y_A} = \left(\frac{K^*}{K}\right)^{\alpha}\left(\frac{W^*}{W}\right)^{(1-\alpha)(1+\sigma)/\sigma}.
$$

or

$$
\frac{K^*}{K} = \left(\frac{W^*}{W}\right)^{(1+\sigma)/\sigma}
$$

Substituting this into (71) gives

$$
\frac{P_B}{P_A}\frac{Y_B}{Y_A} = \frac{\mu^*}{\mu}\left(\frac{W^*}{W}\right)^{(1+\sigma)/\sigma}
$$

or, using equation (66) to substitute out Y_B/Y_A,

$$
\left(\frac{P_B}{P_A}\right)^{1-\varepsilon} = \frac{\mu^*}{\mu}\left(\frac{W^*}{W}\right)^{(1+\sigma)/\sigma}. \tag{72}
$$

Now we can combine eqs. (69) and (72) to solve for $\frac{W^*}{W}$ as a function of exogenous parameters:

$$\frac{W^*}{W} = \left(\left(\frac{z_H^*}{z_H}\right)^{-(1-\varepsilon)}\left(\frac{\mu^*}{\mu}\right)^{-\varepsilon}\right)^{\frac{1}{\frac{(1+\sigma)}{\sigma}-(1-\alpha)(1-\varepsilon)}} \tag{73}$$

Now recall equation (67),

$$P_A^{1-\varepsilon} + P_B^{1-\varepsilon} = 2,$$

which can be written as

$$P_A^{1-\varepsilon}\left(1+\left(\frac{P_B}{P_A}\right)^{1-\varepsilon}\right) = 2.$$

using eq: (72) again and then substituting in eq: (73) gives

$$\begin{aligned} P_A^{1-\varepsilon}\left(1+\frac{\mu^*}{\mu}\left(\frac{W^*}{W}\right)^{(1+\sigma)/\sigma}\right) &= 2 \\ P_A^{1-\varepsilon}\left(1+\frac{\mu^*}{\mu}\left(\left(\frac{z_H^*}{z_H}\right)^{-(1-\varepsilon)}\left(\frac{\mu^*}{\mu}\right)^{-\varepsilon}\right)^{\frac{\frac{1+\sigma}{\sigma}}{\frac{(1+\sigma)}{\sigma}-(1-\alpha)(1-\varepsilon)}}\right) &= 2. \end{aligned}$$

Now substitute in the expression for $\frac{z_H^*}{z_H}$ in the statement of the Proposition, equation (68), which gives

$$P_A^{1-\varepsilon}(2) = 2,$$

which implies $P_A = 1$. equation (67) then implies $P_B = 1$.

Given $P_B = P_A = 1$, it is immediate that the budget constraints for domestic and foreign households are identical to the baseline one-good model and thus that all equilibrium allocations are identical.

H Extended Current Account Decomposition

The current account contribution from domestic equity in equation (22) can be expressed as

$$\begin{aligned} \frac{\lambda_{t-1}}{1+\rho}(D_t - \rho V_t) &= \frac{\lambda_{t-1}}{1+\rho}\left[D_t - \rho\left(\left(e_t + (1+r_t^*)\right)V_{t-1} - D_t\right)\right] \\ &= \lambda_{t-1}\left(\mathbb{E}_{t-1}[D_t] - (Q_tX_t - \mathbb{E}_{t-1}[Q_tX_t]) - \frac{\rho}{1+\rho}e_tV_{t-1} - \frac{\rho}{1+\rho}(1+r_t^*)V_{t-1}\right) \\ &= \lambda_{t-1}\left(\frac{r_t^*-\rho}{1+\rho}V_{t-1} - \bar{g}_tV_{t-1} - \frac{\rho}{1+\rho}e_tV_{t-1} - (Q_tX_t - \mathbb{E}_{t-1}[Q_tX_t])\right) \end{aligned}$$

The first two terms here relate to predictable factors. If domestic equity pays the expected return r_t^*, desired net saving is given by $\frac{r_t^*-\rho}{1+\rho}V_{t-1}$. Fo this desired saving to boost foreign asset purchases, desired saving must exceed expected growth in the value of domestic assets, $\bar{g}_tV_{t-1}$. Thus higher (expected) returns or lower expected growth will both translate into a more positive current account.

The next two terms show the impact on the current account of news shocks at t. If domestic assets pay an unexpected positive excess return between $t-1$ and t ($e_t > 0$) then there is a wealth effect on desired consumption, which reduces desired saving by $-\frac{\rho}{1+\rho} e_t V_{t-1}$. In addition, if news at t leads to more investment than was expected at $t-1$, U.S. households will finance that difference by borrowing.

The contributions from all these effects are proportional to domestic ownership of domestic equity, λ_{t-1}. An analogous decomposition applies to the foreign equity term.

Thus, the model current account can be expressed as

$$\begin{aligned} CA_t \;=\; & \left(\frac{r_t^* - \rho}{1+\rho} - \bar{g}_t\right)\left(\lambda_{t-1} V_{t-1} + \lambda_{t-1}^* V_{t-1}^*\right) \\ & - \frac{\rho}{1+\rho}\left(\lambda_{t-1} e_t V_{t-1} + \lambda_{t-1}^* e_t^* V_{t-1}^*\right) \\ & - \lambda_{t-1}(Q_t X_t - \mathbb{E}_{t-1}[Q_t X_t]) - \lambda_{t-1}^*(Q_t^* X_t^* - \mathbb{E}_{t-1}[Q_t^* X_t^*]) \\ & + \frac{r_t^* - \rho}{1+\rho} B_t + \frac{1}{1+\rho}\left(\frac{W_t L_t}{H_t} - \rho\right) H_t \end{aligned} \tag{74}$$

Figure H.1 plots the novel terms in the current account decomposition according to 74. It shows that the low income yield on U.S. equity in the 1990s reflected unexpectedly strong U.S. investment (see also Figure D.2), and widening current account deficits during this period reflect Americans borrowing from abroad to finance that investment. Conversely, unexpectedly weak U.S. investment explains some of the high income yield on U.S. equity around the Great Recession, and the associated narrowing of the U.S. current account.

We can similarly decompose valuation effects into a predictable component versus the impact of shocks. Note that the excess return to domestic equity between $t-1$ and t can be expressed as

$$\begin{aligned} e_t &= \frac{D_t + V_t}{V_{t-1}} - (1 + r_t^*) \\ &= \frac{D_t + V_t}{V_{t-1}} - \frac{\mathbb{E}_{t-1}[D_t] + (1 + \bar{g}_{t-1}) V_{t-1}}{V_{t-1}} \end{aligned}$$

Thus, the equity liability revaluation term can be expressed as

$$\begin{aligned} -(1-\lambda_{t-1})(V_t - V_{t-1}) &= -(1-\lambda_{t-1})\left(\bar{g}_{t-1} V_{t-1} + e_t V_{t-1} - D_t + \mathbb{E}_{t-1}[D_t]\right) \\ &= -(1-\lambda_{t-1})\left(\bar{g}_{t-1} V_{t-1} + e_t V_{t-1} + Q_t X_t - \mathbb{E}_{t-1}[Q_t X_t]\right) \end{aligned}$$

A similar expression applies for the revaluation of U.S. foreign equity assets. In this expression $\bar{g}_{t-1} V_{t-1}$ captures the expected change in asset values due to trend growth, while the other terms reflect surprise components: a positive excess return on U.S. equity inflates U.S. liabilities, as does unexpected U.S. investment.[32]

[32] For example, if households learn at t that the cost of capital moving forward r_{t+1}^* will be lower, domestic investment and the value of domestic firms will increase. And this unexpected revaluation will occur even in an economy with no output wedges ($\mu = 1$), and thus no excess returns ($e_t = 0$).

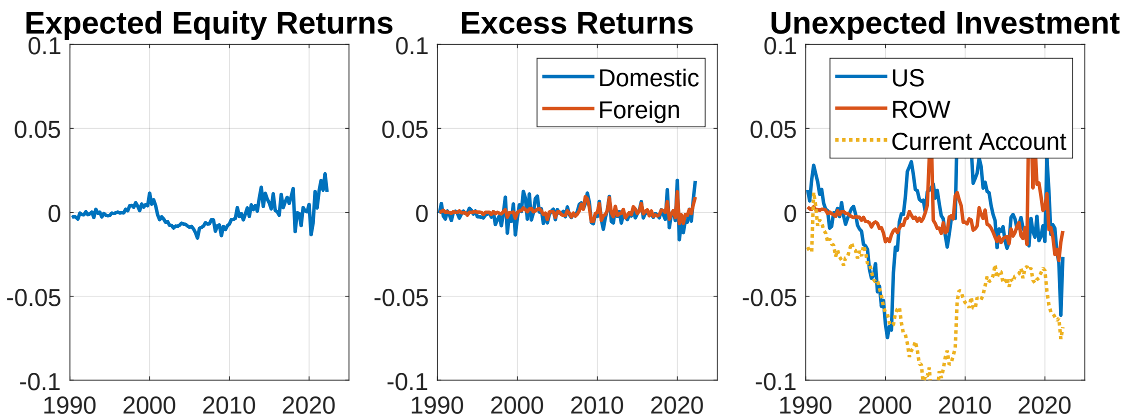

Figure H.1: Alternative Current Account Decomposition. These panels plot the following components of equation 74: left panel plots the first line, middle panel plots the terms in the second line, right panel plots the terms in the third line.

Note that the expected equity return term plotted in Figure H.1 is almost perfectly correlated with the return to human wealth term plotted in Figure 9: both are approximately proportional to $r_t^* - \bar{g}_t - \rho$. However, human wealth, on average, is 6.8 times larger than the value of U.S. corporations, and thus fluctuations in $r_t^* - \bar{g}_t$ impact the current account primarily through that channel. Note also that the wealth effects associated with excess returns to equity also have only a modest impact on the current account.

I Ex-Ante Risk Sharing

In this paper, we have focused on the ex-post welfare implications of the recent boom in the value of U.S. Corporations and how those ex-post welfare implications are impacted by the extent of gross cross-border equity positions. There is a large literature in international macroeconomics that considers ex-ante optimal cross-border equity holdings and how the extent of ex-ante optimal international diversification depends on the nature of the shocks hitting the economy and the structure of international trade in goods. See, for example, Baxter and Jermann (1997) and Heathcote and Perri (2013). Coeurdacier, Kollmann, and Martin (2007) is perhaps most relevant for our study in that they consider shocks that reallocate the distribution of income between workers and owners of firms. One main result in their study is that, in the face of such shocks, rather limited cross-border equity positions are ex-ante optimal. We next derive that result in our model.

I.1 Portfolio That Delivers Perfect Insurance against Output Wedge Shocks

We now show that if changes to the output wedge are the main driver of changes in equity values, then the ex-ante optimal portfolio for U.S. households in our model has little to no cross border equity claims.

Consider news shocks at t about the value for $z_{L,t+1}$ that impact next period's output wedge, $\mu_{t+1} = \frac{z_H}{z_{L.t+1}}$. Assume constant productivity z_H for leader domestic firms. We abstract here from taxation and from all other shocks. Bonds and foreign equity pay a constant return r^* and global productivity grows at a constant rate $\bar{g}$. The assumption that shocks to z_L are revealed one period in advance means that the domestic capital stock can be adjusted in response to those shocks to ensure that the rental rate net of depreciation is always equal to r^*. Thus, in this economy there are effectively two assets: (1) shares in domestic intermediate firms (whose return is risky and varies with news shocks to $z_{L,t+1}$) and (2) all other forms of saving, which pay a safe return r^*.

Suppose $z_{L,t+1} = z_{L,t} + \varepsilon_{t+1}$ where ε_{t+1} is a mean zero shock. Agents choose portfolios at $t-1$, and at t they learn about ε_{t+1}. Asset values reset at t, as does the expected present value of human wealth. In the model in the text, we assumed agents perceived zero variance for the ε_{t+1} shock, so they were indifferent about portfolios. If agents perceive a positive variance for ε_{t+1}, foreign risk-neutral agents will remain indifferent about their portfolio, as long as all assets pay the same expected return. Domestic risk averse agents will now want a portfolio such that shocks to ε_{t+1} have zero impact on total wealth at t and thus on consumption on t. We now characterize the impact of a shock to ε_{t+1} on consumption, and solve for the portfolio that provides perfect insurance.

Proposition: If $\lambda_{t-1} = \frac{1-\alpha}{1-\mu_t\alpha}$, where $\mu_t = \frac{z_H}{z_{L,t}}$, then domestic households achieve perfect insurance against pure output wedge shocks, in that small news shocks at date t about the value of $z_{L,t+1}$ do not impact consumption at date t.

Special case. If $\mu_{t+1} = 1$, then $\lambda_t = 1$ (zero diversification) delivers perfect insurance.

Proof: Recall that equilibrium consumption with logarithmic utility is given by

$$C_t = \rho Wealth_t$$

where

$$\begin{aligned} Wealth_t &= W_tL_t + \frac{W_{t+1}L_{t+1}}{r^*-\bar{g}} + \lambda_{t-1}\left(\Pi_t + \frac{\Pi_{t+1}}{r^*-\bar{g}}\right) \\ &\quad + \lambda_{t-1}\left(R_tK_t + (1-\delta)Q_tK_t\right) + \lambda^*_{t-1}\left(D^*_t + V^*_t\right) + (1+r^*)B_t \end{aligned} \tag{75}$$

Imagine a shock to $z_{L,t+1}$ that households learn about at t. The shock has no impact on W_tL_t, Π_t, or any of the terms in the second line of equation 75. How does it affect $W_{t+1}L_{t+1} + \lambda_{t-1}\Pi_{t+1}$?

Equilibrium allocations at $t+1$ (given $L_{t+1}=1$) are given by

$$\begin{aligned} K_{t+1} &= \left(\frac{r^*+\delta}{\alpha z_{L,t+1}}\right)^{\frac{1}{(\alpha-1)}}, \\ Y_{t+1} &= z_H\left(\frac{r^*+\delta}{\alpha z_{L,t+1}}\right)^{\frac{\alpha}{(\alpha-1)}}, \end{aligned}$$

$$\begin{aligned} W_{t+1}L_{t+1} &= \frac{1-\alpha}{\mu_{t+1}}Y_{t+1} = z_{L,t+1}(1-\alpha)\left(\frac{r^*+\delta}{\alpha z_{L,t+1}}\right)^{\frac{\alpha}{(\alpha-1)}}, \\ \Pi_{t+1} &= \frac{\mu_{t+1}-1}{\mu_{t+1}}Y_{t+1} = (z_H - z_{L,t+1})\left(\frac{r^*+\delta}{\alpha z_{L,t+1}}\right)^{\frac{\alpha}{(\alpha-1)}}. \end{aligned}$$

Thus

$$W_{t+1}L_{t+1} + \lambda_{t-1}\Pi_{t+1} = \left(z_{L,t+1}(1-\alpha) + \lambda_{t-1}\left(z_H - z_{L,t+1}\right)\right)\left(\frac{r^*+\delta}{\alpha z_{L,t+1}}\right)^{\frac{\alpha}{(\alpha-1)}}$$

Now consider shocks to $z_{L,t+1}$. For a generic value for λ_{t-1}, the impact of a marginal shock to ε_{t+1}, evaluated at $\varepsilon_{t+1}=0$, is given by

$$\frac{\partial\left(W_{t+1}L_{t+1} + \lambda_{t-1}\Pi_{t+1}\right)}{\partial\varepsilon_{t+1}}|_{\varepsilon_{t+1}=0} = \frac{1}{1-\alpha}\left(\frac{r^*+\delta}{z_{L,t}\alpha}\right)^{\frac{\alpha}{(\alpha-1)}}\left((1-\alpha) - \lambda_{t-1} + \frac{z_H}{z_{L,t}}\alpha\lambda_{t-1}\right)$$

This is equal to zero at

$$\lambda_{t-1} = \frac{1-\alpha}{1-\frac{z_H}{z_{L,t}}\alpha} = \frac{1-\alpha}{1-\mu_t\alpha}.$$

Appendix

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