US Multinational Companies' Productivity Growth and the Current Account

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This paper re-evaluates the US external deficit which widened markedly over the 1990s. We identify a critical role for technology shocks originating in US multinational companies (MNCs) that have a strong foreign direct investment (FDI) presence. We show that technology shocks that increase the market value of FDI assets are loosening the sustainability constraint on the trade balance and therefore generate persistent trade balance deficits. Our analysis suggests that this channel can explain why the US tech-boom in the 1990s contributed significantly to the increase of the US current account deficit and its duration. We show that our enhanced model – covering both trade and FDI – not only matches well the dynamics of the US external balance but can also account for the observed evolution of FDI related components of the external balance. In particular, MNC-technology shocks can match the increase in net FDI income and a rising FDI capital balance.

Keywords: foreign direct investment, external imbalance, USA, open economy model, technology shocks, safe asset shocks

JEL: F21, F23, F32, F41, O3, O41

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1. Introduction

An important stylized fact is the persistent US current account and trade deficit, which both widened significantly during the 1990s. While the current account has reverted to values in the mid-90s, the trade balance remains more persistently negative. The dominant explanation for this phenomenon is the demand for US safe assets by the Rest of the World (henceforth, RoW) especially from emerging economies – a phenomenon we will refer to as "flight to safety" (henceforth, FtS) in this paper. This has been emphasized by Krishnamurthy et al. (2019) and by Jiang et al. (2021). Complementary to this hypothesis is the observation of a worldwide decline in interest rates on safe assets, for example, documented by Farhi and Gourio (2018) as well as Marx et al. (2021). Since the required return on equity has not declined this phenomenon is interpreted as a global increase of the risk premium (GRP). This development is relevant for the US current account insofar as it has been shown by Gourinchas and Rey (2007), Caballero et al. (2008), Gopinath and Stein (2021), and Gourinchas et al. (2019) that US foreign assets consist largely of bank loans, equity, and foreign direct investment (henceforth, FDI), with a shift towards equity and FDI since the 1990s, while foreign investors are holding liquid dollar assets, in particular US government bonds. Gagnon et al. (2017) have contributed an interesting insight into foreign liquid asset holdings by arguing that some governments intervene in foreign exchange markets in order to manipulate their currencies. The demand for US safe assets is also an important contributory factor which partly explains the US exception in many empirical studies of current account imbalances as regularly conducted by international institutions (see, e.g., Chinn (2017) for a recent review of this literature). However, there remains an under-prediction of the US current account deficit in the period after 1995. In a recent paper Atkinson et al. (2025) show that the US external balance position was also driven by a boom in equity prices of US corporations which mechanically increased US liabilities to the RoW because of RoW holdings of US equities. The focus of our paper differs from this paper since we are interested in the current account and its components and how they have been affected by technology and safe assets shocks prior to 2007.

These explanations are – in principle – consistent with predictions made by standard open economy models. These models generate persistent external imbalances primarily from persistent demand and portfolio shocks (see, e.g., Kollmann et al. (2015)), while standard random walk technology shocks can only generate temporary imbalances, as shown by Ghironi and Melitz (2005). Attempts in the literature to account for the technology dimension of the US external deficit after the strong decline in the 1990s[1] generate persistence via persistent growth rate shocks and learning mechanisms, such as Hunt and Rebucci (2005) and Hoffmann et al. (2017). The latter paper is especially concerned with the persistence issue. They find that with their technology growth expectations US current account deficit begins to shrink after 2003, i.e. at the end of the US tech boom. In addition, their model predicts a return of the current account to pre-1995 levels already by 2008. This suggests that there is room for additional mechanisms for generating persistence of the current account and the trade balance.

This paper explores the extent to which technology shocks originating in US multinational companies (MNC) that conduct international transactions via FDI increase the persistence of external imbalances. It is demonstrated that such shocks generate more prolonged trade balance deficits because the rise in the market value of FDI capital loosens the sustainability constraint on the trade balance. TFP shocks occurring in firms conducting FDI can therefore especially explain why the trade balance has been more persistently negative compared to the current account.

While the authors do not deny the relevance of the safe asset hypotheses (which include FtS and GRP developments), this paper stresses that MNC technology shocks have contributed significantly to the observed strong increase in the US external deficit over the technology boom period from 1995 to 2005 and is also a major reason for its persistence to date. Furthermore, it is argued that MNC technology shocks are also better able to match the evolution of the US net FDI position in recent decades.

Empirical studies support an unequal TFP acceleration, particularly among US MNCs engaged in FDI. Corrado et al. (2009) show that the productivity gains in the late 1990s came almost entirely from US multinationals, while firms that only operated domestically did not contribute much. Moreover, Bloom et al. (2012) find that US MNCs achieved significantly higher TFP growth compared to non-US multinationals in the same industries, highlighting the organizational and technological advantages of

[1] Kollmann (1998) shows that the widening of the US current account deficit in the 80s can be well matched by US TFP shocks.

US MNCs. Other work by Stiroh (2002) and Oliner and Sichel (2003) confirms that firms in ICT-heavy sectors – often dominated by MNCs – had faster TFP growth during this period. These findings support our claim that TFP shocks in US MNCs were particularly large and explain part of the persistent trade balance deficit.

There is only a small literature on dynamic open economy models with FDI. McGrattan and Prescott (2010) construct a two-region general equilibrium model with an FDI decision with the goal of explaining statistically the reported positive return differentials between foreign subsidiaries of US multinational companies and US subsidiaries of foreign MNCs. They find that the model with international production accounts well for the trends in the components of the US current account over the period 1960-2005, but they do not address the persistence issue. Caballero et al. (2008) add intermediation rents from exogenous US FDI in a model where emerging economy households shift their portfolio towards US assets because of insufficient reliable domestic stores of value. FDI returns reduce the trade surplus necessary for financing the portfolio shift towards US assets. Wei Li et al. (2020) use a multi-country dynamic general equilibrium model with trade and FDI to study the impact of trade and FDI liberalization on current account imbalances and find that reduced barriers for US outward FDI was an important driver of global imbalances.

This paper augments a standard two-country model with an FDI decision in the two countries and asks which implications this has for the international transmission of shocks. We regard our model as an extension of a standard one sector open economy model. There are two types of firms, namely those that supply foreign markets by exporting (type 1 firms) and those firms that supply foreign markets via FDI (type 2 firms) – see Figure 1. Thus, type 2 firms closely resemble MNCs that serve foreign customers through foreign affiliates, whereas type 1 firms mirrors predominantly domestic companies whose foreign sales rely on traditional exports. The two types of firms compete with each other on the domestic market and in the foreign market and they compete with the two foreign types of firms both on the domestic and foreign market. Subsidiaries of foreign type 2 firms constitute a third type of firm in each country. While type 1 and type 2 firms have identical technologies, in particular an identical share of imported investment goods and intermediate inputs with a home bias, subsidiaries of foreign type 2 firms use the foreign technology and therefore have a foreign bias in their capital composition and structure of intermediate inputs.

To study the long-term effects of permanent demand and supply shocks, we choose an OLG model (following Blanchard (1985)) and we assume incomplete asset markets with a dollar-denominated, internationally traded bond. The OLG structure allows for a determination of net foreign assets which does not depend on initial conditions. As shown by Schmitt-Grohe and Uribe, (2003) the OLG assumption greatly simplifies the endogenous determination of the net foreign asset position.

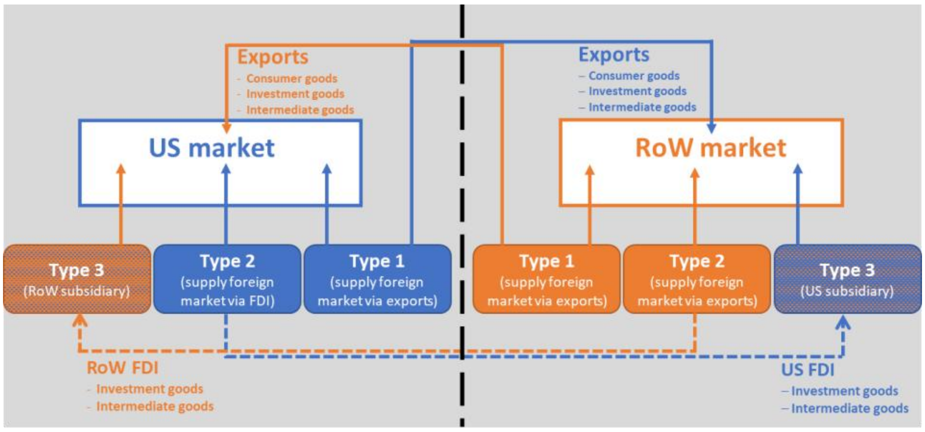

Figure 1: Overview of Firm Types and Trade Patterns

Source: Own illustration

The remainder of the paper is structured as follows: Section 2 provides major stylized facts concerning the US current account and its components and some evidence on the nature of the US technology shock in the late 1990s and early 2000s. In Section 3 the two-country model is presented with an emphasis on explaining the FDI extensions and discussing the implications of FDI on current account sustainability. In Section 4 a simplified small open economy version is used to show how interest rates, technology, and foreign income shocks affect current account dynamics. Section 5 provides information about calibration. In Section 6, the ability of our model to match important stylized facts of the US external balance since 1995 from safe asset (FtS and GRP shock) vs technology shocks is examined. Section 7 concludes.

2. The US External Imbalance

The US current account and trade balance, which show a strong co-movement, fluctuated closely around zero throughout the 1960s and 1970s with a temporary decline in the mid-1980s. After 1995, the balances declined significantly and persistently (see Figure 2). The primary income balance for the US has always been positive with mild fluctuations.

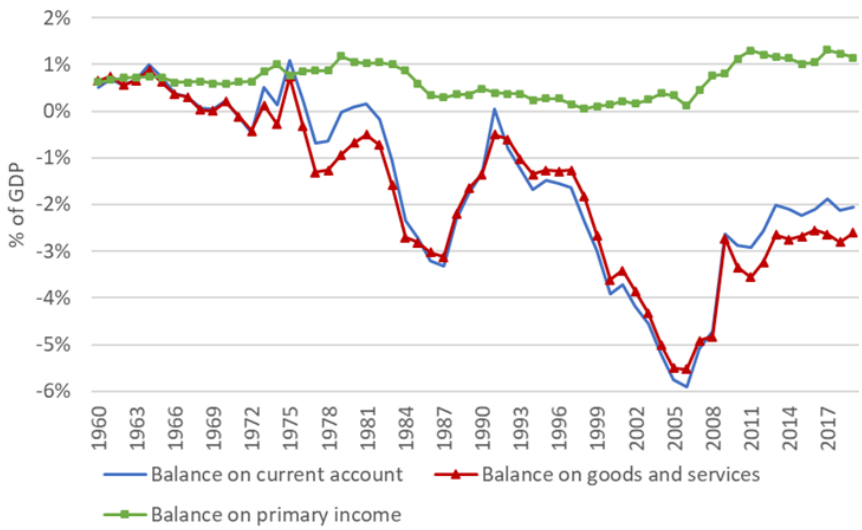

Figure 2. US Current Account Balance, Primary Income Balance, and Balance on Goods and Services, 1960-2019 (Annual Data)

Source: Own representation of data available from the Bureau of Economic Analysis (BEA).

Unfortunately, information about net FDI income is only available since 1999. As shown in Figure 3, the US receives positive net income from FDI activities and pays interest to the rest of the world (RoW) from other financial activities. Notably, the net FDI income of the US increased in the second half of the 2000s.

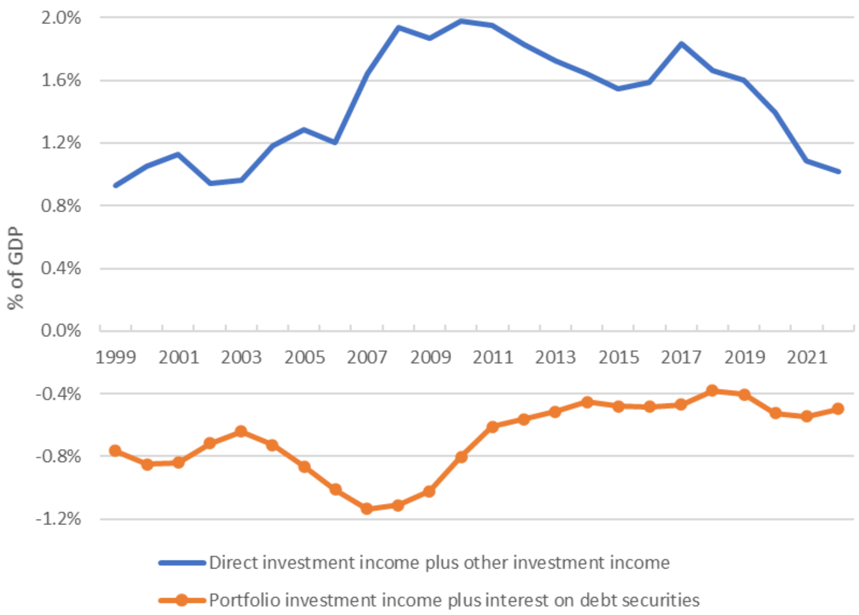

Figure 3. Components of the US Primary Income Balance, 1999-2021

Note: Direct investment income include reinvested earnings.

Source: Own representation of data available from the Bureau of Economic Analysis (BEA).

2.1. Some Evidence Supporting the Safe Asset View

The demand for US safe assets (FtS development) is a prominent hypothesis for explaining the rising US external deficit. It is noteworthy that the strong decline after 1997 coincides with the Asian Financial Crisis starting in 1997. As shown by Barsky and Easton (2021), the period from 1995 to 2005 is characterized by an increase in foreign holdings of US government bonds which are generally regarded as safe assets. Additional evidence in support of the FtS hypothesis is provided by the evolution of the US Treasury premium, which shows a marked increase between 1995 and 2005 as documented by Krishnamurthy and Lustig (2019) and Jiang et al. (2021). As can be seen from Figure 4, a gap opens up between the yield on US government bonds and currency-hedged foreign government bonds in times of economic and financial turmoil. It appears, however, that the return differential is not of a permanent nature.

As shown by Farhi and Gourio (2018), interest rates for government bonds have been declining, starting around the turn of the century (see Figure 5). Marx et al. (2021) show that similar trends have occurred in Europe and Japan.

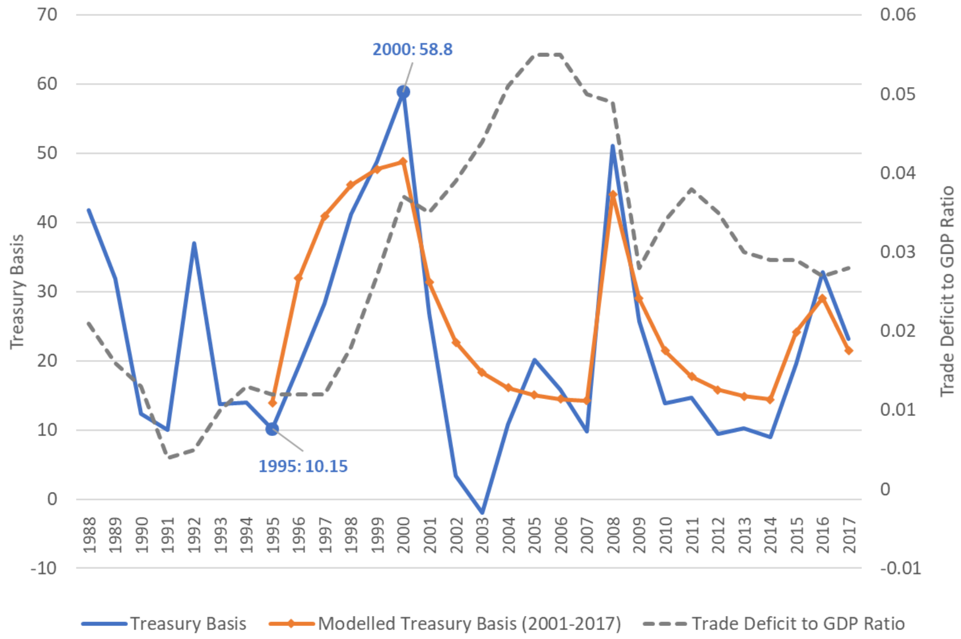

Figure 4. Treasury Basis (Yield Gap between US Government and Currency-Hedged Foreign Government Bonds) and the Trade Deficit (1988 – 2017)

Note: The "Modelled Treasury Basis" (see Jiang et al. (2021) for derivation) is used for the FtS shock scenario applied in Section 5.

Source: Jiang et al. (2021), Bureau of Economic Analysis, own calculations.

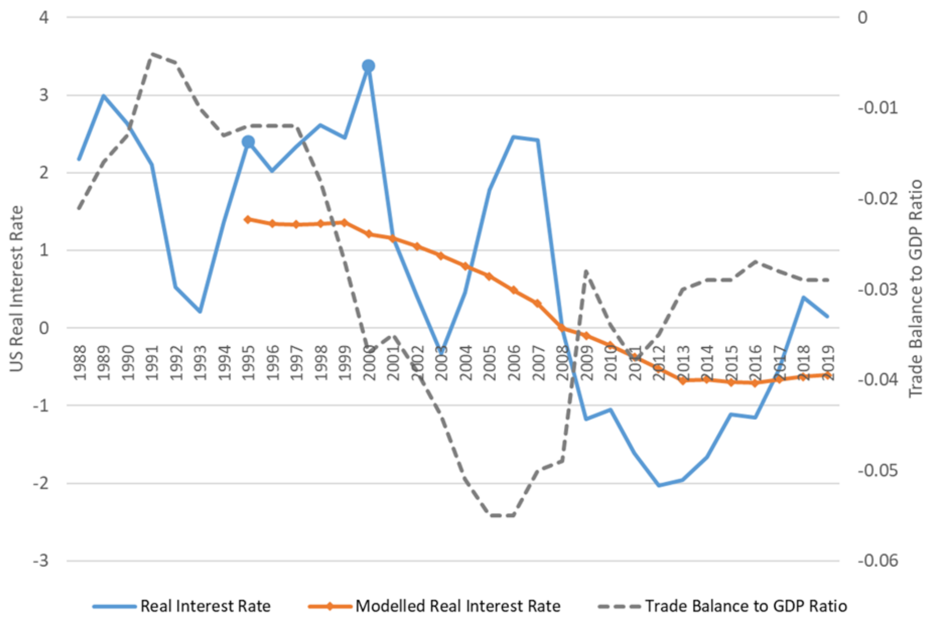

Figure 5. US Real Interest Rate and the Trade Deficit (1988 – 2019)

Note: Real interest rate data come from the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters, specifically the annualized three-month Treasury bill rate minus the headline CPI inflation forecast for the next year. The "Modelled Real Interest Rate" represents the outcome derived from the simulation conducted under the GRP scenario as described in Section 5.

Source: Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters, Bureau of Economic Analysis, own calculations

2.2. Some Evidence Supporting the Technology/FDI View

Despite rising US foreign liabilities, the value of net FDI assets of the US has increased persistently (measured at current cost), starting in the late 90s. As will be argued below, an increase in net foreign liabilities accompanied by an increase in the net FDI asset position is consistent with the prediction made by the model presented herein, namely that a positive technology shock of type 2 firms leads to both an increase in foreign liabilities (of financial assets) and an increase in the net FDI stock (see Figure 6).[2]

It is interesting to observe that the strong increase in the US current account deficit coincides well with the tech boom in the US emerging in the mid-1990s, which in turn coincides with a significant increase in the growth rate of utilization rate adjusted TFP growth (see Figure 7).

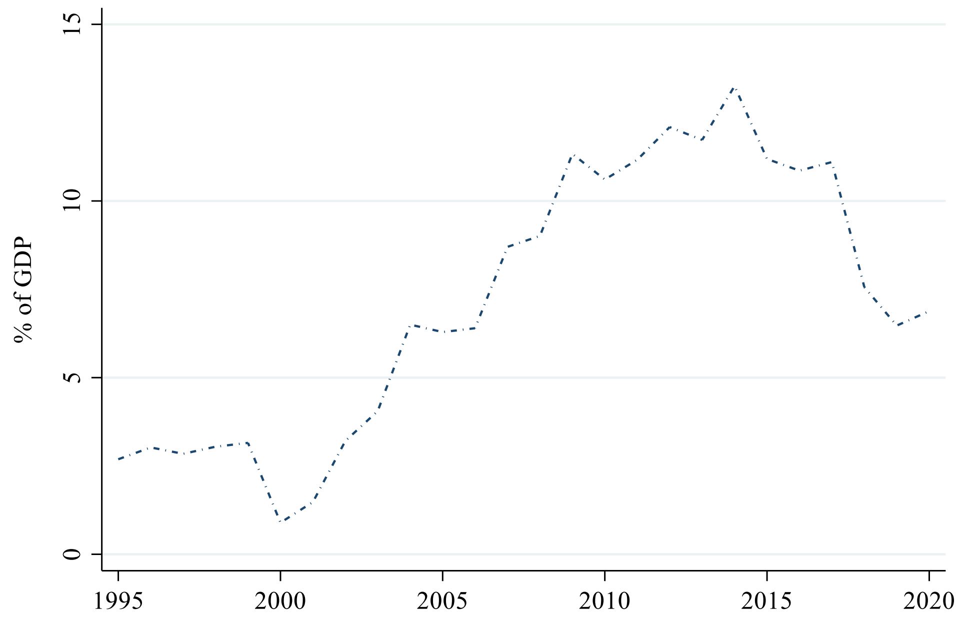

Figure 6. US Net FDI Stock (at Current Cost) as Percentage of GDP

Note: Net FDI stock represents the difference between outward and inward FDI stock at current cost.

Source: Own representation of data available from the Bureau of Economic Analysis.

[2] Note that here, FDI net asset is reported at current cost and not market value. As argued in Brookings (2021), the BEA measure of the market value of US FDI assets and liabilities is rather unreliable, since the BEA uses the (aggregate country) stock market index of the location where the FDI is booked. Thus, liabilities are evaluated by the US stock market index while US FDI assets are measured by the index of the host country. Therefore, the market value of FDI assets and liabilities is strongly influenced by (host) country factors.

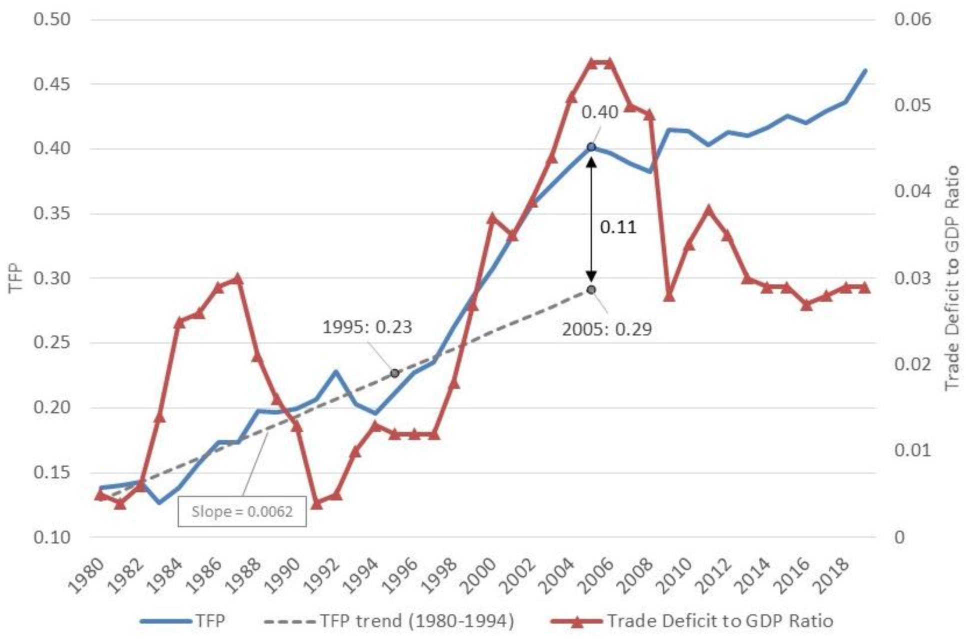

Figure 7. The US Tech Boom and the Trade Deficit (1980 – 2019)

Note: TFP represents the cumulated US cyclically adjusted TFP growth rate as measured by Fernald (2014).

Source: Fernald (2014), Bureau of Economic Analysis, own calculations.

The period between 1995 and 2005 is not only interesting because it is a period of high growth, but it has also been largely driven by digital sector TFP growth and has affected service sectors such as retail (e.g., Amazon) and information and communication (Google, Apple, Microsoft, and Facebook, amongst others). The services provided by these firms are supplied to international customers less via exports but rather through the establishment of foreign subsidiaries which are supplied with the intellectual capital produced in the US, i.e., whose international transactions are provided by foreign direct investment and subsidiaries abroad, respectively, rather than by exports. Van Ark et al. (2008) show an acceleration of productivity growth in market services between 1995-04 and 1980-94 from 1.5% to 3.2%. Inklaar et al. (2020) find, however, that higher growth rates were not sustained in later years. It is also important to note that the US technology boom had a rather limited international diffusion. Van Ark et al. (2008) show that 1995 marks a watershed moment in terms of EU productivity convergence with the US, namely the end of EU technology convergence with the US, followed by a decade of faster productivity growth in the US. This pattern is confirmed by Gordon and Sayed (2020). They also locate the US tech boom to 1995-05, while Europe was hardly positively affected by it. They attribute most of the US growth revival over that period to ICT-intensive industries in the services sector. As shown in Figure 8, this international productivity growth pattern is not restricted to a US-EU comparison, but applies to the OECD as a whole.[3]

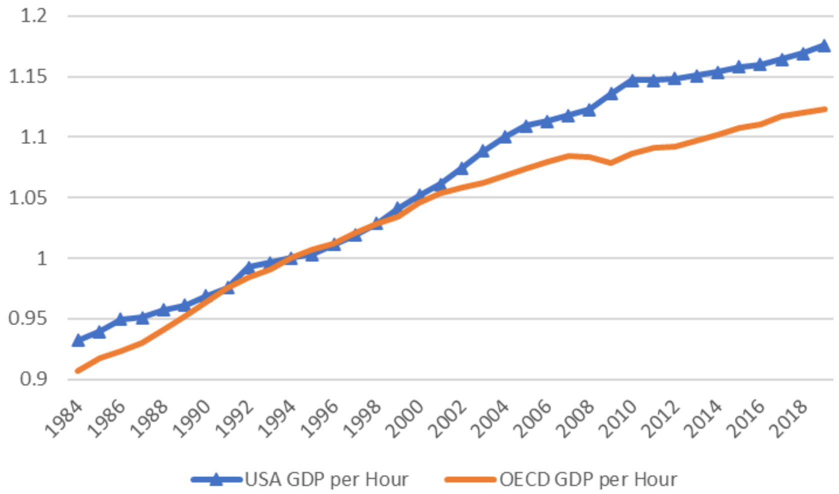

Figure 8. Gross Domestic Product (GDP) per Hour: United States vs OECD (excluding US), 1985 – 2019

Note: Natural logarithm, index 1994=1

Source: Own representation of data available from the Penn World Table (version 10.01). For the OECD (excluding the US), we consider the GDP-weighted GDP per hour worked of all OECD countries except for the following countries: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

3. The Trade and FDI Model

In this section, we add an FDI decision to a two-region model of the world economy consisting of the US and the rest of the world ($c = (US, RoW)$[4]). The model distinguishes between (type 1) firms that conduct international sales via exports and (type 2) firms that sell internationally via foreign subsidiaries, i.e. type 2 firms conduct international transactions with the RoW via FDI. Instead of export revenues, the domestic type 2 firm receives rental income and profits/monopoly rents from its foreign operations. Thus, type 2 firms are dominated by multinational companies which produce internationally. The only trade of type 2 firms is intra-firm trade. The multinational company exports capital and intermediate goods produced in the headquarters to its foreign affiliates.

[3] The recession in 2009 is associated with a further widening of productivity between the US and the rest of the OECD. In our analysis we disregard this productivity shock in order to show more clearly the duration of the external balance effects of the previous US TFP boom.

[4] In our model discussion, superscript c generally refers to the RoW, while the superscript $c*$ refers to the US.

We assume that households use a final consumption good C_t and firms (type 1 and type 2 firms plus subsidiaries of type 2 firms abroad) use a final investment good $I^c_{k,t}, k = (1,2,f)$ and a final intermediate production input $Z^c_{k,t}$, which is produced from domestic type 1 and type 2 firms as well as from imports of foreign type 1 firms and goods produced from subsidiaries of foreign type 2 firms. Final consumption and investment goods producers are perfectly competitive. Let $X^c_t \epsilon \{C^c_t, I^c_{k,t}, Z^c_{k,t}\}, k = 1,2,f$ denote consumption in country *c* as well as investment and intermediate production inputs of the three types of firms from country *c*. *Final c*onsumption as well as investment goods and intermediate production input producers use the following nested CES technology:

(1) $$X^c_t = \left[{s^D}^{\frac{1}{\sigma}} {X^{c,D}_t}^{\frac{\sigma-1}{\sigma}} + {s^F}^{\frac{1}{\sigma}} {X^{c,F}_t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

(1a) $$X^{c,D}_t = \left[{s^1}^{\frac{1}{\sigma^d}} {X^{c,1}_t}^{\frac{\sigma^d-1}{\sigma^d}} + {s^2}^{\frac{1}{\sigma^d}} {X^{c,2}_t}^{\frac{\sigma^d-1}{\sigma^d}} \right]^{\frac{\sigma^d}{\sigma^d-1}}$$

(1b) $$X^{c,F}_t = \left[{s^M}^{\frac{1}{\sigma^f}} {X^{c,M}_t}^{\frac{\sigma^f-1}{\sigma^f}} + {s^{FDI}}^{\frac{1}{f}} {X^{c,FDI}_t}^{\frac{\sigma^f-1}{\sigma^f}} \right]^{\frac{\sigma^f}{\sigma^f-1}}$$

with $$X^c_t \epsilon \{C^c_t, I^c_{k,t}, Z^c_{k,t}\}, k = 1,2,f;$$

with $$X^{c,l}_t \epsilon \{C^{c,l}_t, I^{c,l}_{k,t}, Z^{c,l}_{k,t}\}, \quad k = 1,2,f; \quad l = D, F, 1,2, M, FDI.$$

According to our nesting structure the final good X^c_t is produced with a composite of domestic and foreign inputs ($X^{c,D}_t, X^{c,F}_t$) using a CES technology with elasticity of substitution (henceforth, EoS) σ. The domestic input is a CES aggregates from domestic type 1 and type 2 firms ($X^{c,1}_t, X^{c,2}_t$) with EOS σ^d and the foreign input is a CES aggregate of imports from foreign type 1 firms and inputs from subsidiaries of foreign type 2 firms ($X^{c,M}_t, X^{c,FDI}_t$) with EoS σ^f. In contrast to models without FDI we have to determine not only the EoS between domestically produced goods and imports (σ), but also the EoS between type 1 and type 2 goods (σ^d) and the EoS between imports of type 1 goods and goods produced by subsidiaries of type 2 MNCs (σ^f). For σ^d and σ^f we set identical values since we assume symmetry across domestic and foreign type 1 and type 2 firms. The choice of the parameter values is discussed in the calibration section.

3.1. Households

We use a discrete-time version of Blanchard's (1985) model of perpetual youth as a tractable OLG model. The economy is populated by different age cohorts of unitary size (born in period s) which face a constant probability of death ($p = 1 - \gamma$). Given our interest in the effects of permanent shocks and longer-term trends of the current account, we abstract from aggregate uncertainty. Each household in country c maximizes an intertemporal utility function over a final consumption good $C_{s,t}^{c}$.

The household receives labor income from employment $L_{1,s,t}^{c}$ and $L_{2,s,t}^{c}$ in type 1 and 2 firms as well as from employment by the subsidiary of the foreign type 2 firm $L_{f,s,t}^{c}$ at a common wage rate W_t^c. Asset markets are incomplete[5] and financial transactions in each country are restricted to four assets, namely a domestically traded bond $B_{s,t}^{c}$ in zero net supply each period, which pays one period interest rate i_t^c and (end of period) a number of shares $S_{i,s,t}^{c}$ from domestic type i firms, valued at price $q_{i,t}^{c}$, respectively. Firms pay their net cash flow as dividends $div_{i,t}^{c}$ per share to the representative cohort member. International financial transactions are conducted via an internationally traded bond $B_{s,t}^{W,c}$, which is denominated in US dollars and which pays interest at rate i_t^{US}, and where E_t is the exchange rate (expressed in units of RoW currency, per unit of Dollars ($\Delta E_t > 0$: depreciation of RoW currency).

$$F_{s,t}^{c} = B_{s,t}^{W,c} E_t + B_{s,t}^{c} + q_{1,t}^{c} S_{s,t}^{c,1} + q_{2,t}^{c} S_{s,t}^{c,2}. \quad (2)$$

In order to distinguish between safe and risky assets in household portfolios, we follow Krishnamurthy and Vissing-Jorgensen (2012) and introduce preferences for domestic bonds in both regions and the dollar denominated bond for RoW households. Similarly, for generating an equity premium we allow for a disutility of holding physical capital,

[5] It is difficult to conceptualize complete financial contracts with as yet unborn future cohorts.

(3) $U(.) = \frac{1}{1-\sigma^c} {C_{s,t}^c}^{\sigma^c} + \xi_t^{W,c} \lambda_{s,t}^c V^{B,W}\left(B_{s,t}^{W,c} E_t\right) + \xi_t^c \lambda_{s,t}^c V^B\left(B_{s,t}^c\right) - \zeta_t^c \lambda_{s,t}^c V^S\left(q_{1,t}^c S_{s,t}^{c,1} + q_{2,t}^c S_{s,t}^{c,2}\right)$

Utility from consumption is an isoelastic function with an elasticity of substitution $\frac{1}{\sigma^c}$. Household preferences for internationally traded bonds $V^{B,W}(\cdot)$, domestic bonds $V^B(\cdot)$ and equity $V^S(.)$ are increasing and concave in their respective arguments. Asset preferences are multiplied with the Lagrange multiplier of the budget constraint $\lambda_{s,t}^c$ and $\xi_t^{W,c} \geq 0$, $\xi_t^c \geq 0$, $\zeta_t^c \geq 0$, denote exogenous asset demand shifters. We follow Fisher (2014) who provides conditions under which only $\xi_t^{W,c}$, ξ_t^c, ζ_t^c appear in the first order condition for the respective assets. Because the international tradable bond is denominated in dollars, US households only have access to the US bond as a safe asset, while RoW households can diversify their portfolio over domestic and US bonds. Within our model a flight to safety shock is represented by $\xi_t^{W,RoW} \geq 0$, while a global risk premium shock is characterized by $\xi_t^c \geq 0, c = US, ROW$. An equity premium shock[6] is given by $\zeta_t^c \geq 0, c = US, RoW$.

Households write a contract with an insurance company which pays them a premium equal to $pF_{s,t}$ each period, with the proviso that the insurance company receives the total financial wealth of the household in the case of death. Due to the positive probability of death, the effective discount rate exceeds the rate of time preference

(4) $U_{s,0}^c = \sum_{t=0}^{\infty} (\beta\gamma)^t \, U\left(C_{s,t}^c, B_{s,t}^{W,c} E_t, B_{s,t}^c, \; q_{1,t}^c S_{s,t}^{c,1} + q_{1,t}^c S_{s,t}^{c,2}\right).$

The cohort budget constraint is given by:

(5) $B_{s,t}^{W,c} E_t + B_{s,t}^c + q_{1,t}^c S_{s,t}^{c,1} + q_{2,t}^c S_{s,t}^{c,2} = \left(1 + i_{t-1}^{c^*}\right) B_{s,t-1}^{W,c} E_t + (1 + i_{t-1}^c) B_{s,t-1}^c + S_{s,t-1}^{c,1} div_{1,s,t-1}^c + q_{1,t}^c S_{s,t-1}^{c,1} + S_{s,t-1}^{c,2} div_{2,s,t-1}^c + q_{2,t}^c S_{s,t-1}^{c,2} + pF_{s,t}^c - PI_t^c C_{s,t}^c + W_t^c (L_{1,s,t}^c + L_{2,s,t}^c + L_{f,s,t}^c)$

where PI_t^c is the CES price deflator.

[6] We use the equity premium shock only to generate a constant return differential between the return of stocks and bonds.

The first order conditions w. r. t. financial assets are given by:

(6a) $$\frac{\partial \mathcal{L}}{\partial C_{s,t}^{c}} = {C_{s,t}^{c}}^{-\sigma^{c}} - \lambda_{s,t}^{c} PI_{t}^{c} = 0$$

(6b) $$\frac{\partial \mathcal{L}}{\partial B_{s,t}^{c}} = -\lambda_{s,t}^{c}(1 - \xi_{t}^{c} V_{B_{s,t}^{c}}) + \beta \lambda_{s,t+1}^{c}(1 + i_{t}^{c}) = 0$$

(6c) $$\frac{\partial \mathcal{L}}{\partial S_{s,t}^{c,i}} = -\lambda_{s,t}^{c} q_{i,t}^{c}(1 + \zeta_{t}^{c} V_{S_{i,t}}^{S}) + \beta \lambda_{s,t+1}^{c}(div_{i,t}^{c,i} + q_{i,t+1}^{c}) = 0$$

(6d) $$\frac{\partial \mathcal{L}}{\partial B_{s,t}^{W,c}} = -\lambda_{s,t}^{c} E_{t}(1 - \xi_{t}^{W,c} V_{B_{s,t}^{W,c}}) + \beta \lambda_{s,t+1}^{c}\left(1 + i_{t}^{c^{*}}\right) E_{t+1} = 0.$$

The first order conditions determine wedges in rates of return between different types of assets. For example, $\xi_{t}^{c} = \xi_{t}^{W,c} = 0$, $\zeta_{t}^{c} > 0$ generates an equity premium.

(7a) $$(1 + i_{t}^{c})(1 + \zeta_{t}^{c} V_{S_{i,t}}^{S}) = \frac{div_{i,t}^{c,i} + q_{i,t+1}^{c}}{q_{i,t}^{c}}$$

No-arbitrage between the internationally-tradable bond and the domestically-tradable bond determines the interest parity condition between the US and the RoW

(7b) $$(1 + i_{t}^{RoW})(1 - \xi_{t}^{W,RoW} V_{B_{s,t}^{W,RoW}}) = (1 + i_{t}^{US})\left(\frac{E_{t+1}}{E_{t}}\right).$$

Preference for the dollar-denominated financial asset of RoW households ($\xi_{t}^{W,RoW} > 0$) drives a wedge between the interest rate of the domestic tradable bond and the internationally traded bond in the RoW. Given the medium-term focus of our analysis and to simplify the discussion of transmission channels of the diverse shocks we assume inelastic labor supply.

3.2. Corporate Sector

There are two types of firms in each country, distinguished by the way firms conduct international operations. Type 1 firms sell internationally by exporting and type 2 firms supply the foreign market via foreign subsidiaries, i.e. type 2 firms conduct international transactions with the RoW via FDI.

Type 1 Firms

The representative type 1 firm produces output $Y_{1,\mathrm{t}}^{c}$ which is a CES aggregate of value added $VA_{1,t}^{c}$ and an intermediate production input $Z_{1,t}^{c}$

(8a) $$Y_{1,\mathrm{t}}^{c} = \left({VA_{1,t}^{c}}^{\frac{\omega-1}{\omega}} + {Z_{1,t}^{c}}^{\frac{\omega-1}{\omega}} \right)^{\frac{\omega}{\omega-1}}$$

Value added is itself a Cobb Douglas production function with capital $K_{1,\mathrm{t}}^{c}$ and labor $L_{1,\mathrm{t}}^{c}$ and a labor augmenting technology term $A_{1,\mathrm{t}}^{c}$ which we specify as a random walk with drift; a more detailed discussion will be provided in Section 5:

(8b) $$VA_{1,\mathrm{t}}^{c} = (A_{1,\mathrm{t}}^{c} L_{1,\mathrm{t}}^{c})^{\alpha} {K_{1,\mathrm{t}}^{c}}^{1-\alpha}.$$

The representative type 1 firm is monopolistically competitive and faces price elasticity ε_1^{c} in the domestic market and $\varepsilon_1^{c^*}$ in the foreign market. In order to simplify, we assume that the firm faces the same price elasticity in domestic and foreign markets, i.e., the firm charges the same markup at home and abroad. Firms conduct domestic cost pricing in export markets. All type 1 firms pay the country-specific wage, i.e., we assume homogenous labor in each country and full mobility of labor across firm types.

The representative type 1 firm seeks to maximize the discounted value of dividends, consistent with household no-arbitrage conditions:

(9) $$Max\ V_{1,\mathrm{t}}^{c} = \sum_{j=0}^{\infty} \prod_{k=0}^{j} \left(\frac{1}{(1+i_{t+k}^{c})(1+\zeta_{t+k}^{c} V_{S_{1,t}}^{S})} \right)^{k} div_{1,t+j}^{c}$$

where

$$(10)\qquad div_{1,t}^{c} = P_{1,t}^{c}\left(Y_{1,t}^{D,c}; \varepsilon_1^{c}\right)Y_{1,t}^{D,c} + P_{1,t}^{c}\left(X_{1,t}^{c}; \varepsilon_1^{c}\right)EX_{1,t}^{c} - W_t^{c}L_{1,t}^{c} - P_{1,t}^{C^c}I_{1,t}^{c}. - P_{1,t}^{C^c}Z_{1,t}^{c}$$

Dividends are revenues from domestic sales $Y_{1,t}^{D,c}$ and exports $EX_{1,t}^{c}$ minus wage costs, expenditure for current investment $I_{1,t}^{c}$ and intermediate production inputs $Z_{1,t}^{c}$. This objective is consistent with the no-arbitrage conditions of households for type 1 stocks and implies maximizing the value of the households' type 1 equity. Dividends are distributed to individual cohorts in proportion to their stock holdings, and maximization is subject to the technology and capital accumulation constraint as well as the domestic and foreign demand function.

Type 2 Firms

The representative type 2 firm produces output in the domestic and foreign location $j = 2, f$ $Y_{\mathrm{j,t}}^{c}$ using an identical technology across locations. Output is a CES aggregate of value added $VA_{j,t}^{c}$ and an aggregate of intermediate inputs $Z_{j,t}^{c}$

$$(11\text{a})\qquad Y_{\mathrm{j,t}}^{c} = \left(VA_{j,t}^{c}{}^{\frac{\omega-1}{\omega}} + Z_{j,t}^{c}{}^{\frac{\omega-1}{\omega}}\right)^{\frac{\omega}{\omega-1}}, j = 2, f$$

Value added is a Cobb Douglas production function with capital $K_{\mathrm{j,t}}^{c}$ and labor $L_{\mathrm{j,t}}^{c}$ and a labor augmenting technology term $A_{\mathrm{j,t}}^{c}$ which is also specified as a random walk with drift:

$$(11\text{b})\qquad VA_{\mathrm{j,t}}^{c} = (A_{\mathrm{j,t}}^{c}L_{\mathrm{2,t}}^{c})^{\alpha}K_{\mathrm{j,t}}^{c}{}^{1-\alpha}.$$

The MNCs are monopolistically competitive in home and foreign markets and face price elasticity ε_2^{c} and ε_f^{c} respectively. Here, elasticities are also assumed to be identical. The MNC maximizes the present discounted value (PDV) of current and future expected cash flows using the discount factor of the domestic owner. In this case, the multinational corporation decides about domestic and foreign production, domestic and foreign investment, and domestic and foreign employment. The optimization is subject to a technological constraint and a capital accumulation constraint. As with type 1 firms, investment is financed from retained earnings.

The representative type 2 firm seeks to maximize the discounted value of dividends.

$$(12)\quad Max\ PDV_{2,0}^{c} = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{(1+i_{t+k}^{c})(1+\zeta_{t+k}^{c} V_{S_{2,t}}^{S})} \right)^{k} (\, div_{2,t}^{c,D} + div_{2,t}^{c,S} E_t)$$

where $div_{2,t}^{c,D}$ and $div_{2,t}^{c,S}$ denote dividends of the representative type 2 MNC in the home and foreign market respectively

$$(13a)\qquad div_{2,t}^{c,D} = P_{2,t}^{c}\left(Y_{2,t}^{c}; \varepsilon_2^{c}\right) Y_{2,t}^{c} - W_t^{c} L_{2,t}^{c} - P_{2,t}^{C^c} I_{2,t}^{c} - P_{2,t}^{C^c} Z_{2,t}^{c}$$

$$(13b)\qquad div_{2,t}^{c,S} = \left(P_{f,t}^{c^*}\left(Y_{f,t}^{c^*}; \varepsilon_f^{c}\right) Y_{f,t}^{c^*} - W_t^{c^*} L_{f,t}^{c^*} - P_{f,t}^{C,FDI^{c^*}} I_{f,t}^{c^*} - P_{f,t}^{C,FDI^{c^*}} Z_{f,t}^{c^*} \right) E_t.$$

Total dividends $div_{2,t}^{c} = div_{2,t}^{c,D} + div_{2,t}^{c,S} E_t$ are distributed to individual cohorts in proportion to their stock holdings.

3.3. Equilibrium

Equilibrium is characterized by a sequence of prices and quantities that satisfy the equilibrium conditions for goods traded by the three firm types and the labor market in each region and the optimality conditions of households and firms.

Goods market

Type 1 firms:

$$(14)\qquad Y_{1,t}^{c} = C_t^{c,1} + C_t^{c^*,M} + \sum_{j\epsilon(1,2,f)} I_{\mathrm{j},t}^{c,1} + \sum_{j\epsilon(1,2,f)} I_{\mathrm{j},t}^{c^*,M} + \sum_{j\epsilon(1,2,f)} Z_{1,\mathrm{j},t}^{c,1} + \sum_{j\epsilon(1,2,f)} Z_{\mathrm{j},t}^{c^*,M}$$

Type 2 firms:

$$(15)\qquad Y_{2,t}^{c} = C_t^{c,2} + \sum_{j\epsilon(1,2,f)} I_{\mathrm{j},t}^{c,2} + I_t^{c^*,FDI} + \sum_{j\epsilon(1,2,f)} Z_{2,,\mathrm{j}t}^{c,2} + Z_t^{c^*,FDI}$$

FDI firms:

$$Y_{f,t}^{c^*} = C_{f,t}^{c^*,FDI} + \sum_{j\epsilon(1,2)} I_{\mathrm{j},t}^{c^*,FDI} + \sum_{j\epsilon(1,2)} Z_{\mathrm{j},t}^{c^*,FDI} \tag{16}$$

Labor market (domestic economy):

$$L_t^c = L_{1,t}^c + L_{2,t}^c + L_{f,t}^c. \tag{17}$$

D. Current Account Sustainability

We show in this section how the presence of foreign subsidiaries of multi-national companies affects current account sustainability. The current account CA_t^c consists of the trade balance of goods and services TB_t^c, and the primary income balance

$$CA_t^c = TB_t^c + PRB_t^c, \tag{18}$$

with the trade balance

$$TB_t^c = (P_{1,t}^c M_{1,t}^{c^*} - P_{1,t}^{c^*} E_t M_{1,t}^c) + (P_{2,t}^c (I_{2,f,t}^{c^*} + Z_{2,f,t}^{c^*}) - P_{2,t}^{c^*} E_t (I_{2,f,t}^c + Z_{2,f,t}^c)), \tag{19}$$

and the primary income balance PRB_t^c consist of the interest income balance from the holding of internationally tradable bonds

$$IntY_t^c = i_{t-1}^{c^*} B_{t-1}^{W,c} E_t, \tag{20}$$

and the FDI income balance[7]

$$FDIB_t^c = (div_{2,t}^{c,S} E_t - div_{2,t}^{c^*,S}). \tag{21}$$

[7] Note, FDI income balance as defined here differs from the balance of payments definition of the primary income balance by not including invested earnings. In the empirical section we show results which are consistent with the BOP definition.

Foreign assets evolve according to

(22a) $B_t^{W,c}E_t + V_{ft}^c - V_{ft}^{c^*} = \left(1 + i_{t-1}^{c^*}\right)B_{t-1}^{W,c}E_t + TB_t^c + div_{2,t}^{c,S}E_t + V_{f,t-1}^c - div_{2,t}^{c^*,S} - V_{f,t-1}^{c^*}$.

We simplify the derivation of the current account sustainability constraint by assuming that the number of shares for all firms (in particular shares of foreign subsidiaries) remain constant. Thus, we can write the market value of foreign subsidiaries as $V_{f,t}^c = q_{f,t}^c S_f^c$ where $q_{f,t}^c$ is the stock price and S_f^c is the number of shares. The stock of existing assets in period *t* and the stock of assets from the previous period are valued at the current stock price, which implies that:

(23) $V_{f,t}^c = q_{f,t}^c S_{f,t}$ and $V_{f,t-1}^c = q_{f,t}^c S_{f,t-1}$ and $S_{f,t} = S_{f,t-1} \quad \rightarrow \quad V_{f,t}^c = V_{f,t-1}^c$.

This simplifies the net foreign asset accumulation equation

(22b) $B_t^{W,c}E_t = \left(1 + i_{t-1}^{c^*}\right)B_{t-1}^{W,c}E_t + TB_t^c + div_{2,t}^{c,S}E_t - div_{2,t}^{c^*,S}$.

Iterating forward Equation 22b and imposing a no Ponzi game condition on net foreign assets

(24) $$\lim_{T\to\infty}\left(\prod_{k=0}^{T-1}\left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k\right)B_{T+1}^{W,c}E_{T+1} = 0$$

reveals that sustainability requires that the value of net foreign assets plus the PDV of net FDI income is equal to the PDV of the trade deficit, with the trade deficit and net FDI income discounted with the interest rate of the internationally traded bond.

(25) $$\left(1 + i_{t-1}^{c^*}\right)B_{-1}^{W,c}E_0 + \sum_{t=0}^{\infty}\prod_{k=0}^{t}\left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k div_{2,t}^{c,S}E_t - \sum_{t=0}^{\infty}\prod_{k=0}^{t}\left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k div_{2,t}^{c^*,S} = -\sum_{t=0}^{\infty}\prod_{k=0}^{t}\left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k TB_t^c,$$

We denote the PDV of current and future (distributed) profits, using the interest rate of the internationally traded bond with $V_{f,0}^{c,B^W}$ and $V_{f,0}^{c^*,B^W}$

(26) $$V_{f,0}^{c,B^W} = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k div_{2,t}^{c,S} E_t,$$

(27) $$V_{f,0}^{c^*,B^W} = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k div_{2,t}^{c^*,S},$$

in order to distinguish it from the market value of foreign subsidiaries with risk adjusted discount factors $V_{f,0}^{c}, V_{f,0}^{c^*}$. We can now express the sustainability condition as equality between the value of net foreign financial wealth plus the PDV of dividends from outward and inward FDI with the PDV of the trade deficit:

(28) $$\left(1 + i_{t-1}^{c^*}\right) B_{-1}^{W,c} E_0 + V_{f,0}^{c,B^W} - V_{f,0}^{c^*,B^W} = -\sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}^{c^*}}\right)^k TB_t^c \,.$$

To the extent to which a technology shock affects current and expected (net) dividend streams of foreign subsidiaries of MNCs positively, the PDV of the trade deficit becomes larger. Since $V_{f,0}^{c,B^W}, V_{f,0}^{c^*,B^W}$ exceeds the market value of foreign subsidiaries to the extent in which there is an equity premium, a one percent of GDP increase of the net valuation of US MNC assets abroad increases the PDV of the US trade deficit as % of GDP by more than one per cent. Note, there is also a valuation effect on the initial value of internationally traded bonds, insofar as they are denominated in foreign currency.

4. Demand and Supply Shocks and Current Account Persistence

In this section, a simplified version of the proposed model without capital is used to illustrate the persistence of the current account to demand/risk premia and supply/technology shocks and to show that technology shocks affecting foreign operations (and dividend income) generate persistence of the current account. Firstly, it is shown that in the standard model without foreign operations of domestic firms, a (permanent) technology shock does not generate a persistent movement of the current account or a significant change in the net foreign (NFA) position.

To keep the analysis tractable, a small open economy is considered. A homogeneous good Y is produced in the domestic economy and the RoW (with the price normalized to one). Output in the domestic economy is produced with decreasing returns to scale technology. Domestic labor is supplied inelastically, while

technology

(29) $$Y_t = A_t L_t^{\alpha}, \ \ \alpha < 1,$$

wage income

(30) $$\alpha Y_t = W_t L_t,$$

and profit income

(31) $$\Pi_{\mathrm{t}} = (1 - \alpha) Y_t$$

are given.

Domestic households can borrow/lend at the world interest rate r_t. The aggregate consumption of life-cycle households can be represented by a consumption rule which is a linear function of net foreign wealth and human capital where future income is discounted by $r_t + p$ (where p is the probability of death).

Life Cycle Consumption is given by

(32) $$C_t = (\rho + p)\left(F_{t-1} + \frac{Y_t}{r_t + p}\right),$$

where ρ is the rate of time preference and p the probability of death. The household budget constraint and the goods market equilibrium condition imply the following net foreign asset equation.

Net Foreign Assets are given by

(33) $$CA_t = \Delta F_t = r_t F_{t-1} - C_t + Y_t.$$

Equilibrium can be characterized by the following phase diagram (Figure 9) which shows the relationship between consumption (C) and the net foreign assets (F) as determined by the consumption schedule and the same relationship as determined long-run current account balance.

It can now be shown how demand/safe asset shocks, supply/technology shocks and foreign income shocks affect the NFA position. As the change in the net foreign asset stock is equal to the cumulated current account balance

(34) $$F_T - F_0 = \sum_{t=0}^{T} CA_t,$$

a permanent change in the NFA position between period T and period 0 reflects the sum of current account imbalances over the same period.

Safe Asset Shock:

Households in the domestic economy face a permanent reduction of the interest rate. This shifts up the domestic consumption schedule since domestic households' discount future income at a lower interest rate (see Figure 10). There is a downward rotation of the consumption schedule implied by the net foreign asset equation. A lower borrowing rate yields less return from foreign assets and therefore lowers consumption possibilities.

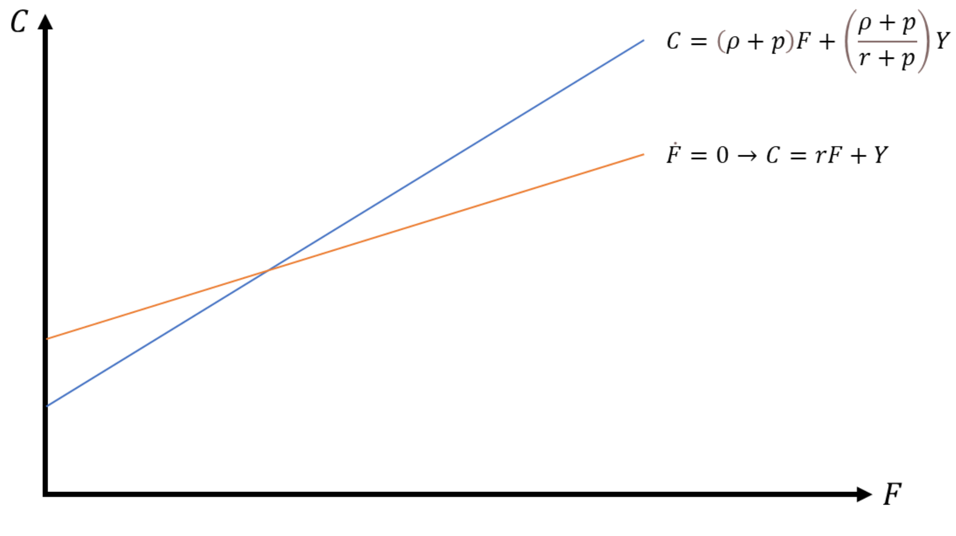

Figure 9. Phase Diagram for Consumption (C) and Net Foreign Assets (F)

Source: Own representation.

Dynamic adjustment: The economy always operates on the consumption schedule. Thus, consumption immediately jumps upwards to the new level of consumption (B) and the economy runs a trade deficit, since at point B, consumption exceeds GDP. The trade deficit reduces net foreign assets (negative current account position), generating a negative wealth effect which gradually reduces consumption. This process will continue until consumption has reached a level which is consistent with $\Delta F_t = CA_t = 0$ (point C).

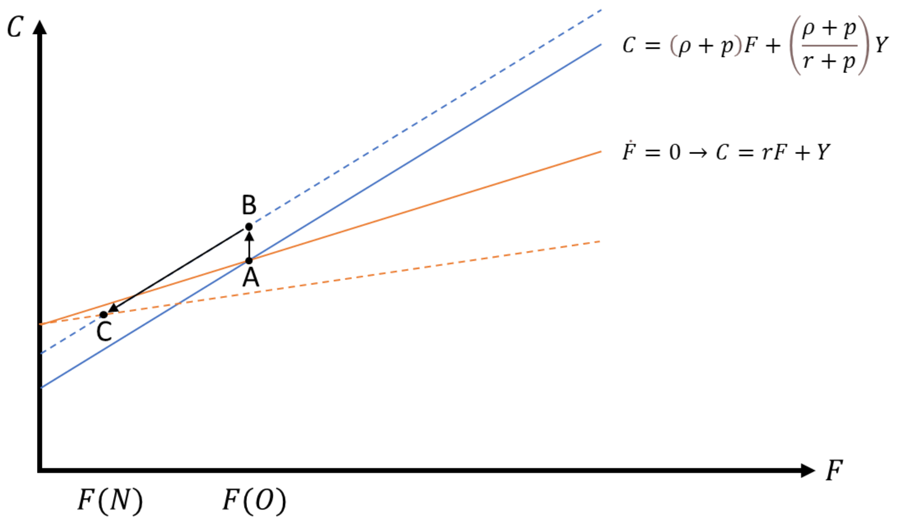

Figure 10. Interest Rate/Safe Asset Shock, Δr<0

Source: Own representation.

Permanent Technology Shock:

Unlike with the demand/safe asset shock, a technology shock shifts the demand schedule and the consumption constraint in the same direction and approximately at the same magnitude $\left(\left(\frac{\rho+p}{r+p}\right) \approx 1\right)$ – see Figure 11. That is, households can realize their new permanent level of consumption without significantly changing their net foreign position. Thus, permanent technology shocks are not associated with longer lasting current account imbalances. This explains why standard DSGE models do not generate persistent current account imbalances related to technology shocks.

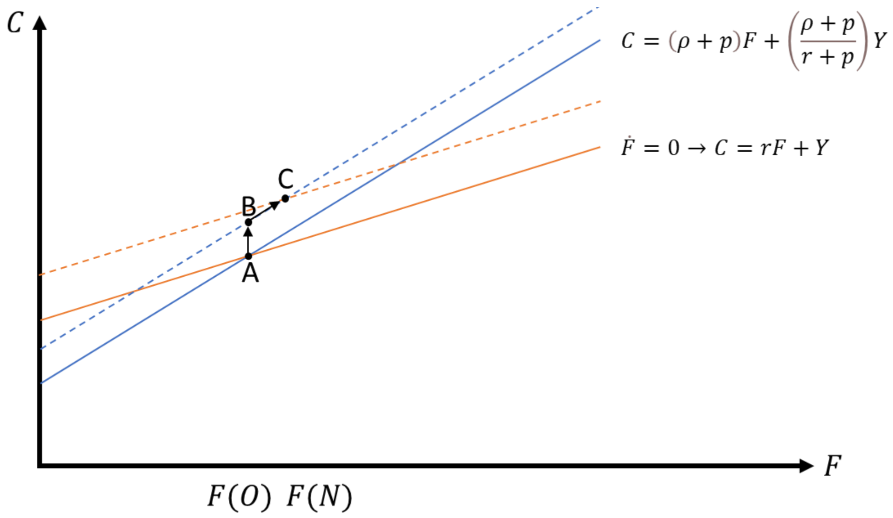

Figure 11. Technology Shock, ΔY>0

Source: Own representation.

A Shock to a Foreign Source of Income:

A slight extension of the model now allows for a foreign source of income D, which is regarded as income from foreign operations of domestic firms. Due to decreasing returns, the foreign affiliates earn positive profits. The market value of this foreign income flow is given by

(35) $$V_t = D_t + \frac{1}{1+r_t} V_{t+1}.$$

Since only constant flows and a constant interest rate are considered, one gets $D = rV$. Life-cycle consumption is now given by

(36) $$C_t = (\rho + p)\left(F_{t-1} + V_t + \frac{Y_t}{r_t+p}\right) = (\rho + p)\left(F_{t-1} + \frac{D_t}{r_t} + \frac{Y_t}{r_t+p}\right).$$

Note, since V is a financial asset for which the household signs a life insurance contract, the aggregate discount rate is given by r instead of $r_t + p$ (as for human capital). The household budget constraint and the goods market equilibrium condition imply the following net foreign asset equation

(37) $$CA_t = \Delta F_t = r_t F_{t-1} - C_t + Y_t + D_t.$$

Since $\left(\frac{\rho+p}{r}\right) > 1$, the C schedule shifts up more compared to the long-run current account balance condition, there is initially a larger upward shift of the consumption schedule, leading to a larger trade deficit compared to the domestic income shock (see Figure 12). The trade deficit persists until the wealth effect from rising foreign liabilities reduces consumption sufficiently to be consistent with a zero current account balance. Comparing scenario 3 with scenario 2, one can see that similar current account dynamics would emerge with a simultaneous increase of domestic and foreign income if the source of the shock is an MNC technology shock.

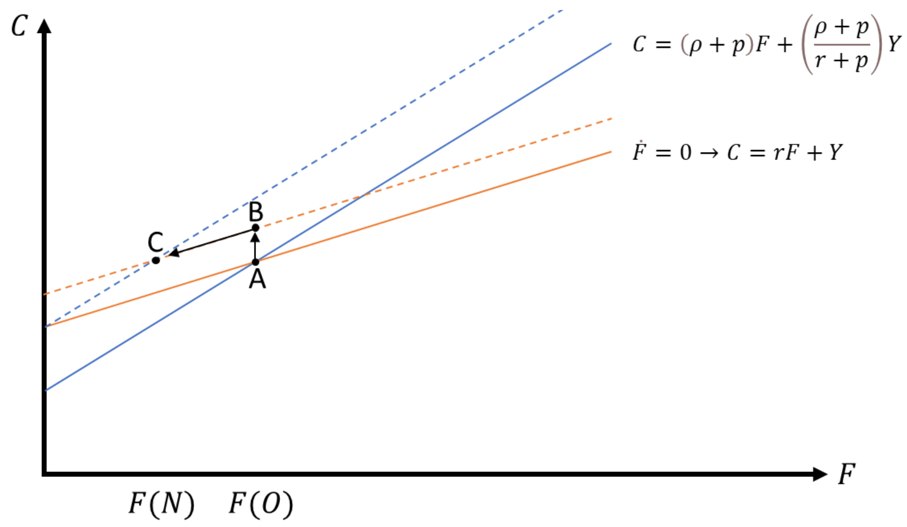

Figure 12. Foreign Wealth Shock, ∆D>0

Source: Own representation.

5. Data and Calibration

We consider a highly stylized, two-country US-RoW model of the world economy. The two countries are identical concerning preference and technology parameters. The US produces 25% of World GDP. The economy is initially (prior to 1995) in a steady state with zero external balances. To be realistic we allow for home bias, i.e. the share parameters in CES aggregates for consumption, and investment are consistent with a US import share of 11.8 % of GDP (of 1995). The share parameters in the CES aggregate for imports and FDI production are consistent with a share of US outward FDI stock of 9.2 % of US GDP in 1995. This calibration also provides a good match with the US outward FDI-US capital stock ratio of 3.3 % in 1995. The calibrated values and their corresponding references are detailed in Table 1.

The rate of time preference is set to 0.03 in order to match the average real rate on safe assets before 1995. The household planning horizon is assumed to be 40 years. Consistent with empirical evidence as surveyed by Thimme (2017), we set the intertemporal elasticity of substitution to 0.5.[8] We assume a constant equity premium of 4% (see Caballero et al. (2017)) prior to 1995. All firm types use a nested CES production function with value added and intermediates using an elasticity of substitution of 0.5. Based on EU KLEMS we set the share of intermediates to capital output to 0.5. Value added is a Cobb-Douglas production function with output elasticity for capital and labor of 0.4 and 0.6, respectively. The depreciation rate on capital is set to 5% p.a.. We set the adjustment cost parameter to 2 which ensures that investment is between 2 and 3 times as volatile as GDP. There is monopolistic competition with a mark-up of 10 %. This is consistent with estimates for the US provided by Barkai (2020) using a similar production technology.

We assume uniform preferences across the 4 types of goods consumed and invested, with an elasticity of substitution equal to 2 between domestic and foreign varieties. This calibration aligns with empirical estimates of EoS between domestic and foreign goods reported in the literature (see, e. g. Boehm et al. (2023) and Francois and Woerz (2009)) and has also been used by Klein and Linnemann (2021) as well as Benigno and Thoenissen (2008). In addition, we distinguish between goods imported versus those supplied via FDI, as well as between different product types within each category. For both substitution dimensions – the EoS between imports and FDI-supplied goods, and the EoS between type 1 and type 2 products – we calibrate the elasticity at 6. This choice is based on the analysis in Helpman et al. (2004), who provide empirical estimates of the substitution between trade and FDI sales. We assume that the EoS of 6 between imports and inward FDI sales (which corresponds to the EoS between

[8] Annex 2 of the Online Appendix shows a sensitivity analysis with the intertemporal elasticity of substitution set to 1, 0.5 and 0.33 respectively.

purchases of foreign type 1 goods and foreign type 2 goods) is identical to the EoS between domestic type 1 and type 2 goods.[9]

Table 1. Parameters and References for Model Calibration

Parameter	Calibrated Value	References
US GDP Share	25%	Based on World Bank World Development Indicators data, 1995.
US Import Share of GDP	11.3%	Based on BEA, 1995.
US Outward FDI Stock at Historical Cost to Capital Stock Ratio	3.6%	Based on BEA, 1995, using current-cost net stock of fixed assets.
US Outward FDI Stock at Historical Cost as a Share of US GDP	10.6%	Based on BEA, 1995.
Rate of Time Preference	0.03	Matches the average real rate on safe assets before 1995, see Farhi and Gourio (2018).
Household Planning Horizon	40 years	Consistent with standard overlapping generations models.
Intertemporal Elasticity of Substitution	0.5	Consistent with empirical evidence (Thimme, 2017).
Equity Premium	4%	Constant equity premium, see Caballero et al. (2017).
Intermediate Share of Production	0.5	Based on EU KLEMS
Elasticity of Substitution between Intermediates and Value Added	0.5	Based on Atalay (2017)
Output Elasticity of Labor	0.6	Based on US non-farm business sector.
Output Elasticity of Capital	0.4	Implied by constant returns to scale assumption.
Depreciation Rate	5% p.a.	Standard value in the literature.
Adjustment Cost Parameter	2	Ensures investment volatility is 2-3 times GDP volatility.
Mark-up	10%	Consistent with Barkai (2020) for US data.
Elasticity of Substitution (Domestic vs Foreign)	2	Matches EoS between domestic and foreign goods, as reported by Boehm et al. (2023), Francois and Woerz (2009).
Elasticity of Substitution (Imports vs FDI-Products)	6	Helpman et al (2004)
Elasticity of Substitution (Type 1 vs Type 2)	6	Helpman et al (2004)
TFP growth autocorrelation	0.6	Hoffmann et al. (2017), prior estimate

5.1. How to Match the Period from 1995 to 2004 (and Beyond)?

To shed more light on the ability of the various hypotheses to match the stylized facts of the US current account and its components, we conduct the following experiment: We calculate the trend evolution of the current account balance and its components via a Hodrick-Prescott (HP) filter and we determine the smoothing parameter such that the trend and actual data roughly coincide at the end of

[9] Annex 1 of the Online Appendix presents a sensitivity analysis of the elasticity of substitution between imports and inward FDI sales as well as domestic type 1 and type 2 goods with elasticity parameters 2.5, 6, and 9.5.

the sample[10]. We focus on trends since we concentrate on the impact of TFP and safe asset shocks and abstract from shocks that can account for short-term fluctuations, such as demand and policy shocks as well as financial market shocks which played a crucial role in generating the dot com bubble. With our parametrization (see Figure 13), the trend of the current account and the trade balance to GDP ratio declines by more than 3 percentage points between 1995 and 2005. The current account balance has gradually recovered to the 1995 level by 2019, while the trade balance to GDP ratio remains persistently negative and is more than one percentage point lower at the end of our sample.

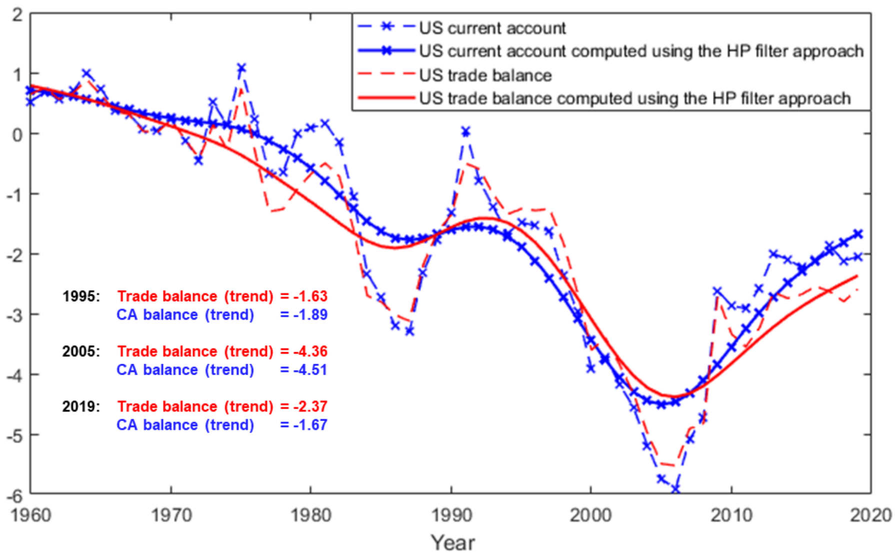

Figure 13. US Current Account and Trade Balance in % of GDP (Actual vs. Trend)

Note: The trends in the current account- and trade balance-to-GDP ratios are calculated using the HP filter with λ=100.

Source: Bureau of Economic Analysis and authors' own calculation.

We use the information about the size of the US productivity acceleration between 1995 and 2005 in the two sectors (see Figure 7) for measuring productivity growth differentials between the US and the RoW. Concerning financial shocks, we distinguish between preference shifts towards US save assets of RoW households (FtS shock) and a worldwide shift towards safe assets (GRP shock). For the FtS shock we use the US Treasury basis over the same period (see Figure 4), while for the GRP shock we update the expected real interest rate for US Treasuries as calculated by Farhi and Gourio and assume that the same shock has occurred in the RoW. Concerning model implementation, we assume that TFP

[10] Figure 19 in the Appendix provides information about trends and actual series.

innovations, flight to safety shocks and global risk premium shocks constitute a sequence of unanticipated shocks, however with different degrees of persistence.

TFP:

To replicate the US TFP shock, we use the cyclically adjusted TFP data from Fernald (2014). As illustrated in Figure 7, we take the aggregate trend growth rate between 1980 and 1994 and subtract it from the actual aggregate TFP growth rate, resulting in a trend-adjusted TFP level of around 11% in 2005, which we hold fixed in subsequent years. Based on the discussion in the empirical growth literature, which points towards higher TFP gains in ICT-engaged and higher-internationalized firms, we implement this shock by assuming that TFP acceleration of type 2 firms exceeded TFP acceleration of type 1 firms. Corrado et al. (2009) report that labor productivity growth in US MNCs jumped from 2.7 % p.a. in 1989-95 to 5.6 % p.a. in 1995-2000, implying an excess of roughly 2.9 percentage points, whereas domestically oriented firms registered virtually no pickup. Bloom et al. (2012) find a four-to-one gap at the plant level: doubling the IT-capital stock raises productivity by 4.9 % in a US-owned multinational but by only 1.2 % in domestic or non-US multinationals. Bergeaud (2024) confirms the pattern, showing that firms in the top half of the ICT-intensity distribution enjoyed TFP gains about five times those of the bottom half over 1995-2005. Guided by this evidence, we match the empirical pattern of the trend TFP acceleration in the baseline simulation by incorporating TFP shocks 1.33% per year on average for type 2 firms.[11] In line with our data we assume that US TFP acceleration comes to an end after 2005, i.e., there are no further TFP innovations after 2005. This allows us to study the persistence of TFP innovations for the US current account and its components until 2019[12]. The TFP process is specified as a random walk for the logarithm of TFP ($a_{kt} = \ln{(A_{kt})}$). It follows $a_{kt} = \mu_{kt} + a_{kt-1} + \varepsilon_{kt}^{a}$ with drift μ_{kt} specified as an AR(1) process $\mu_{kt} = (1-\alpha^{\mu})\mu_k + \alpha^{\mu}\mu_{kt-1} + \varepsilon_{kt}^{\mu},\ \ \alpha^{\mu} < 1$. This specification is taken from Hoffman et al. (2017) and Edge et al. (2007). We choose a value for

[11] Further details on the baseline and alternative TFP shock simulations are described in the next section.
[12] Our projection ends in 2019, the last year before the emergence of the COVID-19 shock.

α^{μ} which is equal to 0.6 and close to the prior adopted by Hoffmann et al. (2017), which appears more consistent with the rapid slowdown of TFP growth in the US after 2005.

Flight to Safety Shock:

Our safe asset innovations related to the FtS shock are chosen to mimic the sequence of shocks that underlies the observed movements in the Treasury basis. In particular, we reproduce the sharp increase between 1996 and 2000 (see Jiang et al., 2021) and the subsequent positive innovations that raise the post-1996 average level by about 37 basis points relative to the pre-1996 mean. Visual inspection and time series analysis reveal that the Treasury basis is not permanently increased but has been hit by a sequence of positive shocks. To give the FtS hypothesis a good chance of generating persistence we choose a value of the autocorrelation of the Treasury basis trend of 0.5, which is in line with the estimated autocorrelation of the Treasury basis (see Table A1, Annex 3 of the Online Appendix)[13]. To account for the increase between 1996 and 2000 we assume a sequence of positive innovations that raises the trend component of the Treasury basis from 0 in 1995 to 26 basis points by 2000 in a linear fashion. In addition, we introduce further positive innovations in 2008 (35 basis points), in 2016 (18 basis points), and in 2018 and 2019 (0.4 basis points in each year). The FtS shock is implemented as a portfolio preference shock to the demand for the internationally traded US bond (denominated in US dollars) in the utility function of households in the RoW.

Global Risk Premium (GRP) Shock:

Farhi and Gourio (2018) as well as Marx et al. (2021) interpret the decline of government bond yields and the constancy of the return on capital as an increase of the risk premium and they date the beginning of this trend to the Asian crisis, the LTCM crisis and the bursting of the tech bubble in 2001. Their estimate of the real safe rate, as measures by the real return of 1-year Treasury bills and the median 1-year ahead CPI inflation expectations from the Survey of Professional Forecasters (SPF), suggests a

[13] Annex 3 of the Online Appendix includes simulations of the FtS shock (+10 BP annually) with varying degrees of persistence.

decline of nearly 3% before and after 2003. Obstfeld (2025) shows that this decline is not confined to the US. In the model, we capture this development through a sequence of permanent global risk premium (GRP) shocks that shift down the equilibrium real interest rate and are chosen to mimic the trend component of the observed US real safe rate series used by Farhi and Gourio (2018). Specifically, we introduce annual innovations of -28 basis points from 2000 to 2009, -20 basis points from 2010 to 2013, and 20 basis points from 2016 to 2019. These GRP shocks are implemented as permanent changes in the risk premium in favor of US and RoW government bonds in the portfolio choice of households.

6. Matching the US Current Account: Technology vs Safe Assets

In this section, the impact of technology and safe asset shocks on the US current account and its components are analyzed through the lens of the proposed model. In the first part of this section, we show impulse responses for standardized TFP and safe asset shocks. In the second part, we analyze how well our model can match the US current account dynamics for realistic sequences of these shocks.

6.1. Impulse Response Analysis

Figure 14 compares the effect of a permanent technology shock to US type 1 and type 2 firms ($\varepsilon_{1t}^{a}, \varepsilon_{2t}^{a}$). To make the shocks comparable we normalize them such they affect aggregate TFP equally (+???%). There are several noteworthy differences. First, the trade balance stays negative more persistently if the shock originates in type 2 firms. This is due to a loosening of the sustainability constraint, resulting from an increase in the market value of US net FDI assets. A type 1 TFP shock leaves the value of net US FDI assets nearly unaffected. Therefore, a temporary negative trade balance must be followed by a trade surplus. Since the market value of FDI assets is difficult to assess empirically due to measurement issues, we also report the net FDI capital stock at current cost which rises more gradually in the case of shocks hitting type 2 firms. Secondly, and also more consistent with US evidence, a TFP shock originating from US type 2 firms increases the primary income balance, while a shock to type 1 firms leaves the primary income balance largely unaffected. Thirdly, net interest income from US financial assets declines more strongly because of rising US financial liabilities, due to the loosening of the sustainability constraint. It is, however, interesting to observe that the current account balance is less persistent negative with a TFP shock in type 2 firms since in the BOP definition of the current account balance invested earnings increase the current account balance.

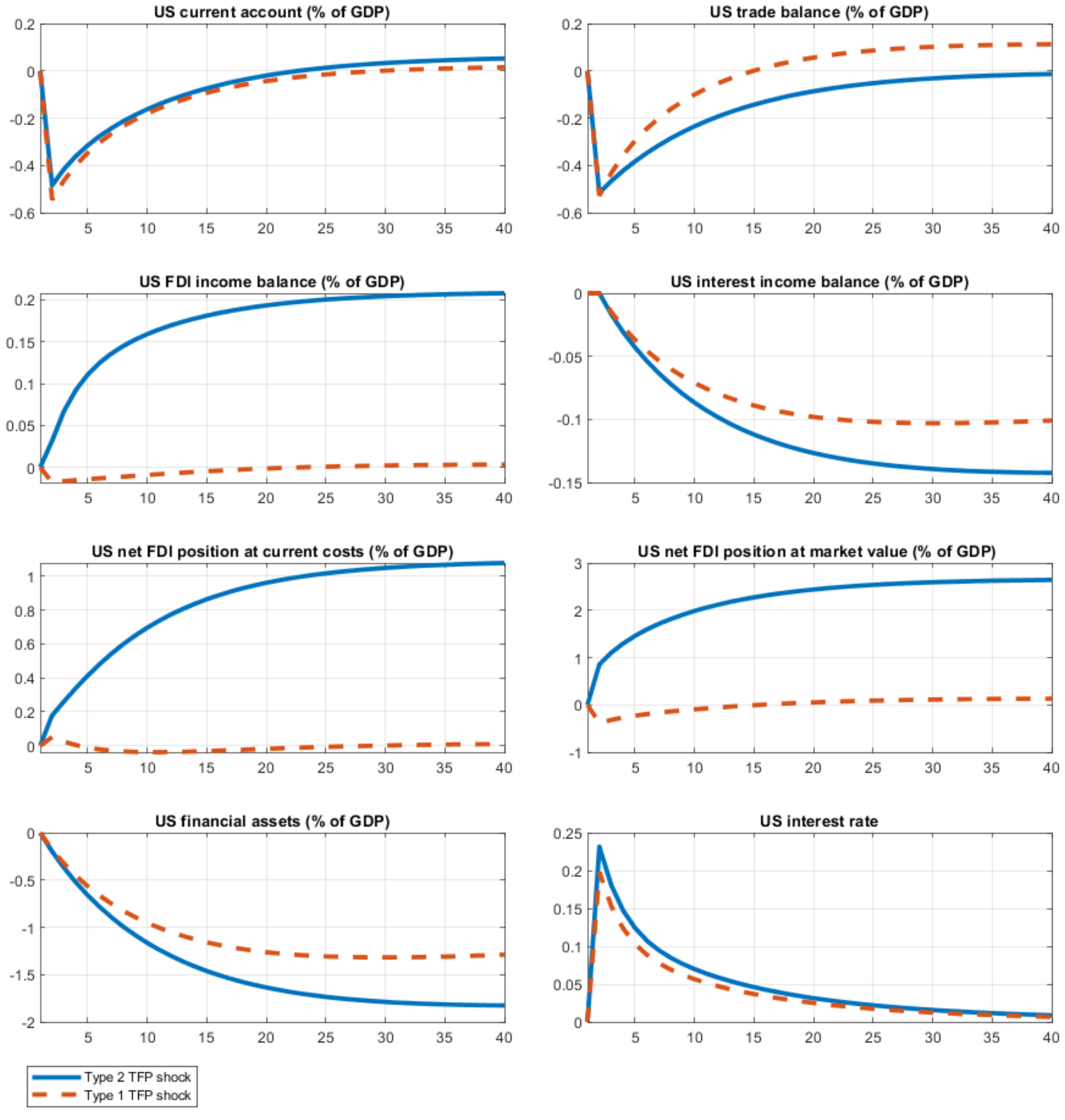

Figure 14. US TFP Drift Shock Type 1 vs. Type 2 Firms

Note: Both TFP drift shocks are adjusted to generate the same aggregate TFP effect. The current account and net FDI income balance are based on the Balance of Payments (BOP) definition. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP.

Source: Own representation.

Because the TFP shock is permanent there is frontloading of domestic demand in the country from which the technology shocks originates this leads to an increase in the trade deficit which temporarily exceeds the increase in the net FDI balance. To illustrate this mechanism we also show (see Figure 15) the dynamics of the two balances in case of a TFP growth rate shock (ε_{2t}^{μ}) of the same size as the TFP level shock ($\varepsilon_{2t}^{\mu} = \varepsilon_{2t}^{a}$). Initially the TFP effect is identical but the growth rate shock generates a higher long run TFP level effect. This shows up in a higher initial trade deficit because the higher long term income expectation increases domestic demand in the short run more strongly.

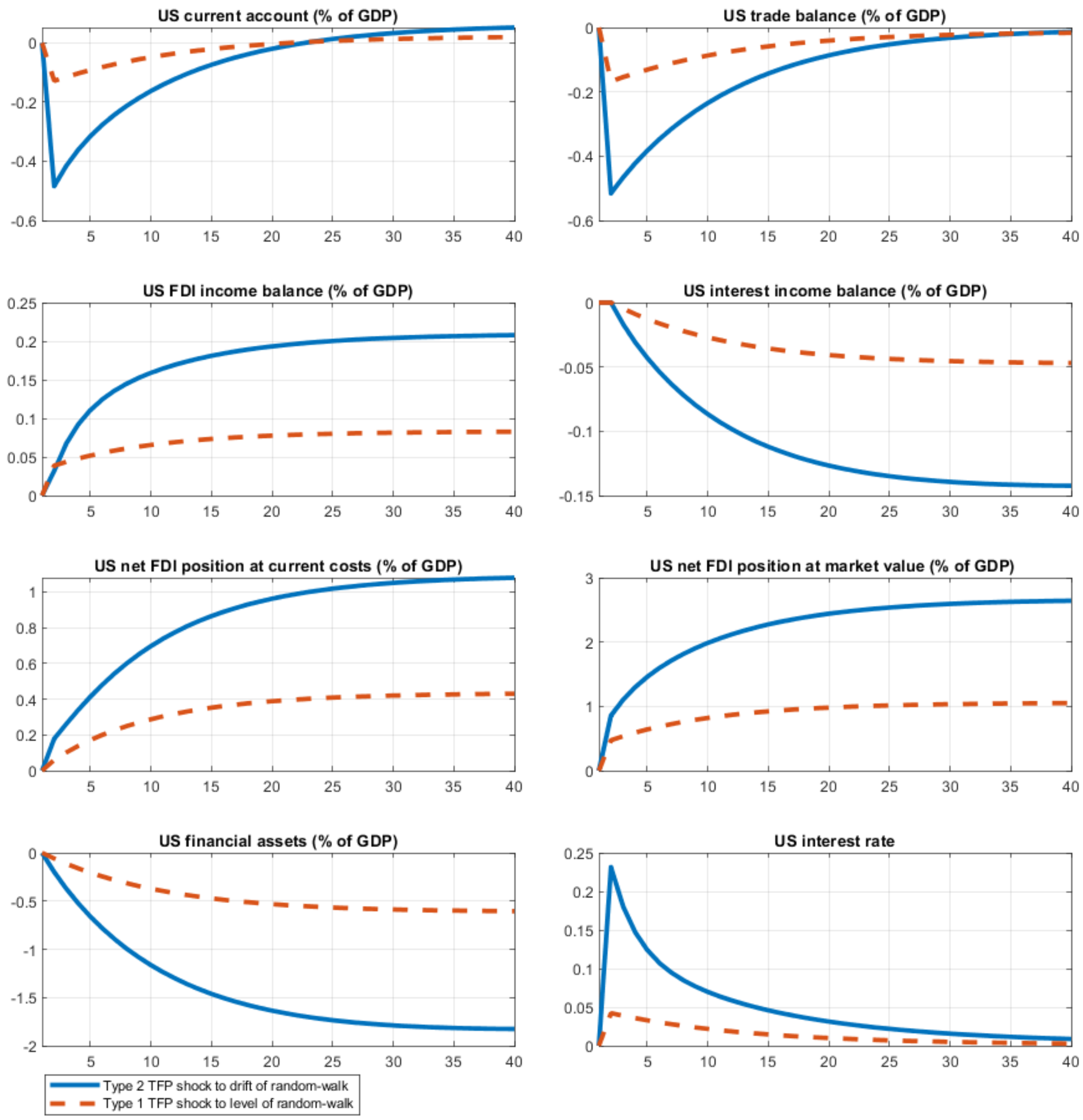

Figure 15. US Type 2 TFP Shock to Drift and Level of Random-Walk (1% Each Case)

Note: Shocks to drift and level are identical to generate the same first period TFP effect. The current account and net FDI income balance are based on the Balance of Payments (BOP) definition. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP.

Source: Own representation.

We consider a permanent 100 BPS reduction of the global risk premium where the US is a net debtor country – see Figure 16. This shock reduces current and expected interest payments to the RoW and loosens the sustainability constraint for the US trade balance. Because of lower interest payments, there are opposite effects on the current account and trade balance. Since the global risk premium shock improves international borrowing conditions of US households this creates an inflow of FDI capital into the US and reduces the net FDI capital stock of the US. This financial shock can therefore not account for the evolution of the US net FDI income balance and net FDI position in the US.

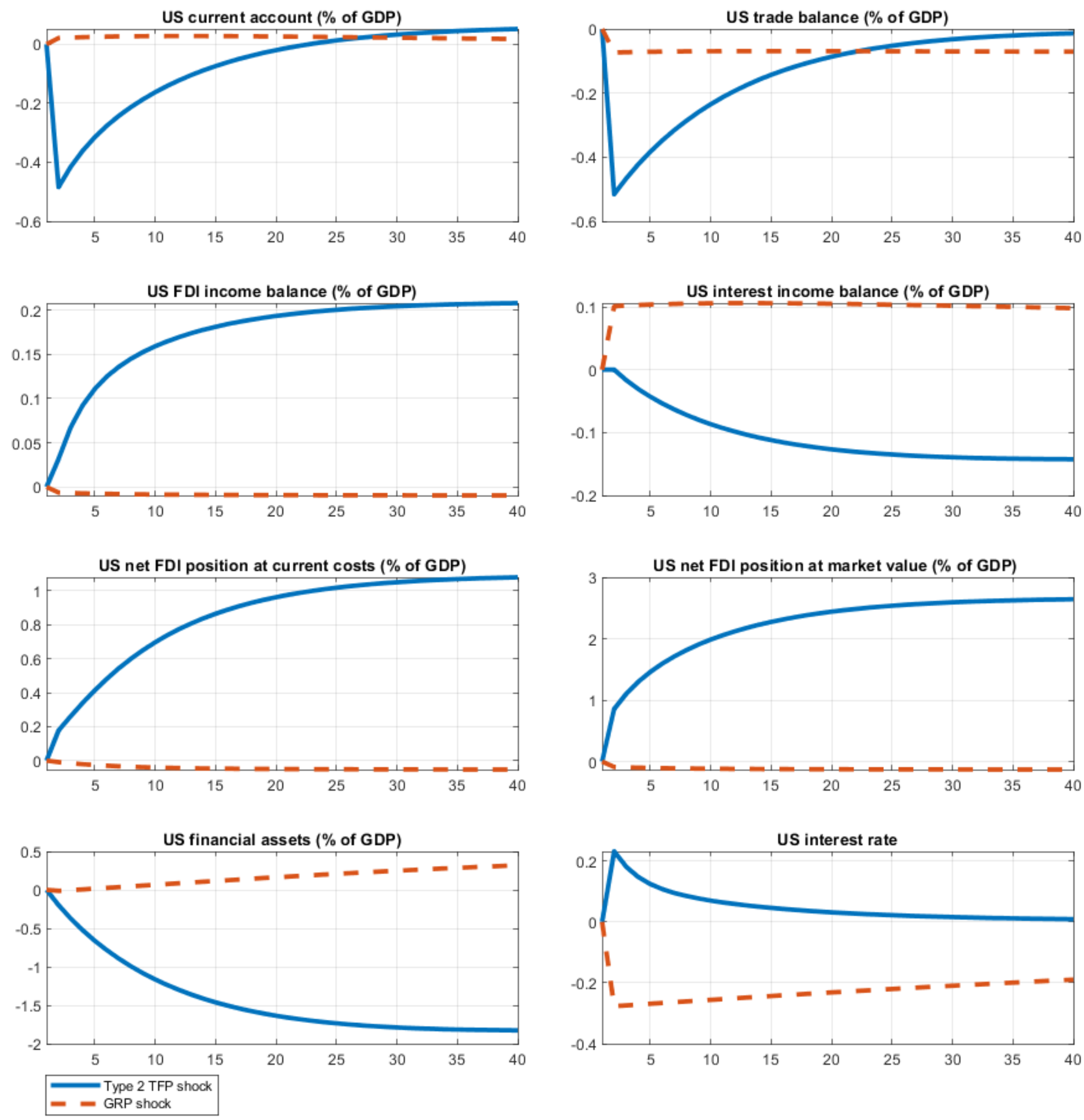

Figure 16. Type 2 TFP Drift vs GRP Shock

Note: TFP drift and GRP shocks are based on their respective standard average errors. The current account and net FDI income balance are based on the Balance of Payments (BOP) definition. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP.

Source: Own representation.

Figure 17 shows that temporary FtS shocks, corresponding to the dynamics of the Treasury basis increase, can only generate temporary external deficits, and also cannot account for the observed FDI income flow and FDI position in the US.

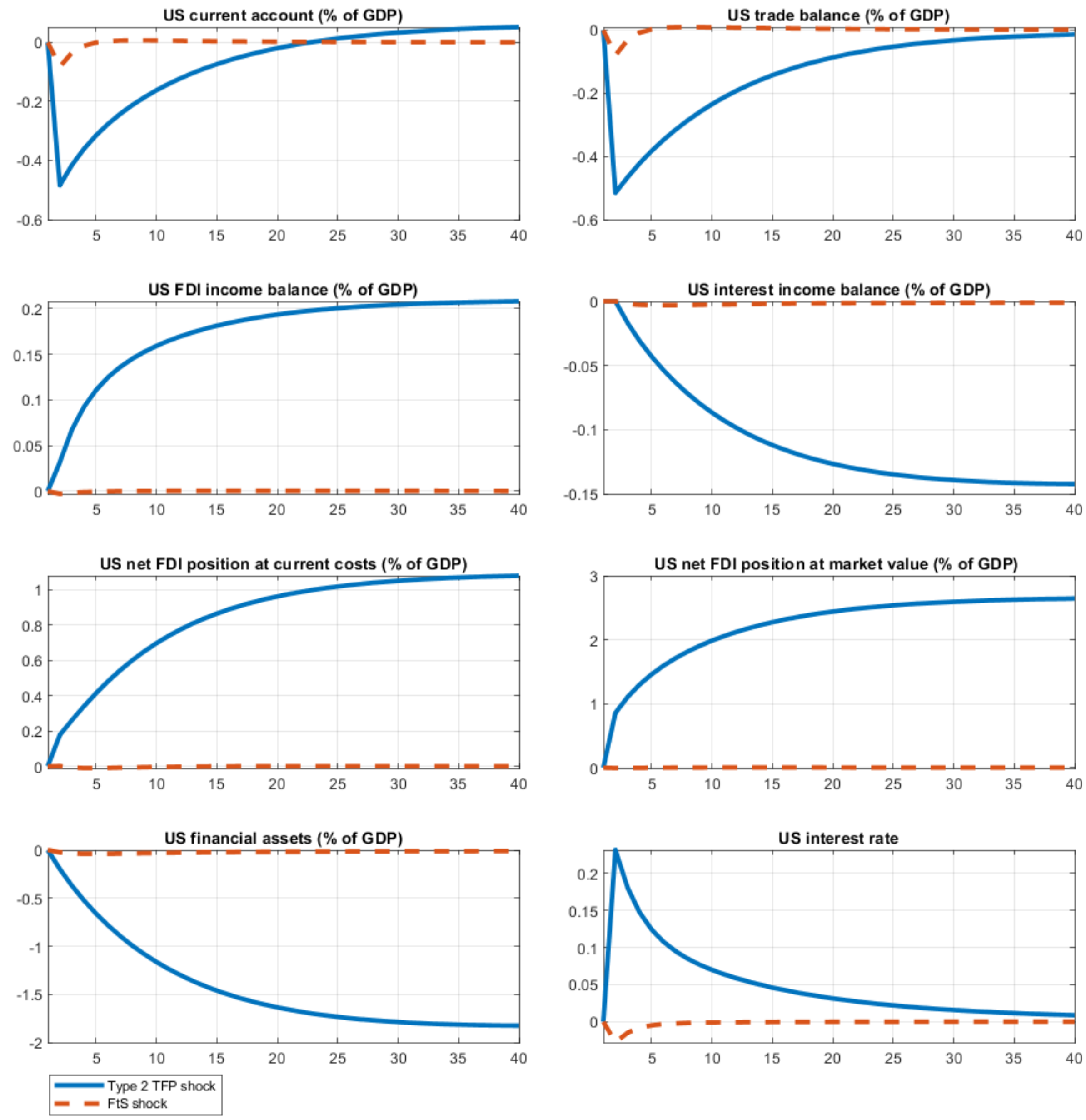

Figure 17. Type 2 TFP Drift vs FtS Shock

Note: TFP drift and FtS shocks are based on their respective standard average errors. The current account and primary income balance are based on the Balance of Payments (BOP) definition. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP.

Source: Own representation.

6.2. Matching the Data

In the following, we analyze how well the shocks using our model can depict the US economy between 1995 and 2019. First, we take a closer look at the TFP shock and elaborate how the results change when the same aggregate innovation is distributed differently across the two firm types in the model. This exercise should reveal whether the data (US external accounts and FDI data) are better matched when the shock falls mainly on the FDI-active type 2 firms or when it is shared more evenly. In the second exercise, we start with the TFP shock and add, step by step, the flight-to-safety and the global risk-premium shocks. The simulations are carried out as a sequence of perfect foresight simulations of the non-linear model from 1995 to 2019. Consistent with the temporary US TFP growth acceleration from 1995 to 2005, there are no additional TFP innovations after 2005, while we allow for FTS and GRP shocks after 2005. Comparing the simulated paths from these scenarios with HP-trend-adjusted data reveals how much explanatory power each shock contributes[14].

Varying the TFP Shock across Firm Types

Figure 18 reports three simulations that differ only in how the same aggregate TFP innovation between 1995 and 2005 is allocated across the two firm types in the model. In all cases we impose a smooth TFP profile that matches the trend increase in US TFP and the long-run evolution of US GDP relative to the RoW. For the baseline run, we specify a TFP shock for US type 2 firms that starts at 1.9% in 1995, declines linearly to 1.1% in 2000, and then remains at 1.1% until 2005, implying an average annual TFP gain of about 1.33% for US type 2 firms over 1995-2005. For the RoW, type 2 firms receive an analogous but smaller shock that falls from 0.8% in 1995 to 0.3% in 2000 and stays constant thereafter. These choices ensure that the simulated aggregate TFP series and the ratio of US to rest-of-the-world GDP track the observed trends, as shown in the subpanels of the figure.[15] In the baseline, the TFP trend of type 1 firms is kept at its pre-1995 growth rate, so that the entire additional US TFP improvement above trend is attributed to type 2 firms (FDI-active MNCs). In the second simulation, we allow US type 1 firms to share in the TFP gain by assigning them one quarter of the average baseline type 2 shock (about 0.33%), and we reduce the type 2 shock so that the implied aggregate US TFP path remains unchanged. At the same time, we adjust the TFP of type 1 firms in the RoW to keep the simulated US-to-RoW GDP ratio on its observed trend; this step is necessary due to the spillover of productivity gains of type 2 firms to foreign affiliates (type 3 firms) in the model. The third simulation

[14] No HP filter is used to display the Treasury basis actual data.

[15] We target the smooth trend in relative GDP, not cyclical fluctuations. Short-run movements in the relative GDP series, such as those around the dot-com boom, are not captured by this calibration and are outside the scope of our long-run exercise.

mirrors this experiment in the opposite direction: type 1 firms receive a negative one-quarter share of the average baseline type 2 shock (about -0.33%), and type 2 firms absorb a correspondingly larger share so that the implied aggregate US TFP path remains unchanged. As in the second simulation, we then adjust the TFP of type 1 firms in the RoW to keep the simulated US-to-RoW GDP ratio on its observed trend.

As can be seen from Figure 18, the three specifications mostly differ concerning the fit of the net FDI income balance and net FDI position. The baseline specification provides the best match over the period 1995-2019. Increasing relative TFP growth of MNC firms overshoots in particular the net FDI income balance, while lowering TFP growth underpredicts the net FDI position.

As the results reveal, shifting a larger share to the FDI-oriented firms deepens the trade balance deficit and makes it more persistent. Moreover, the higher shock allocation for type 2 firms more accurately reflects the evolution of the net FDI position, but at the same time the FDI income balance is overshot and the current account deficit is underestimated more strongly than in the baseline. Notably, the trade balance and FDI income flow have same order of magnitude but different dynamics.

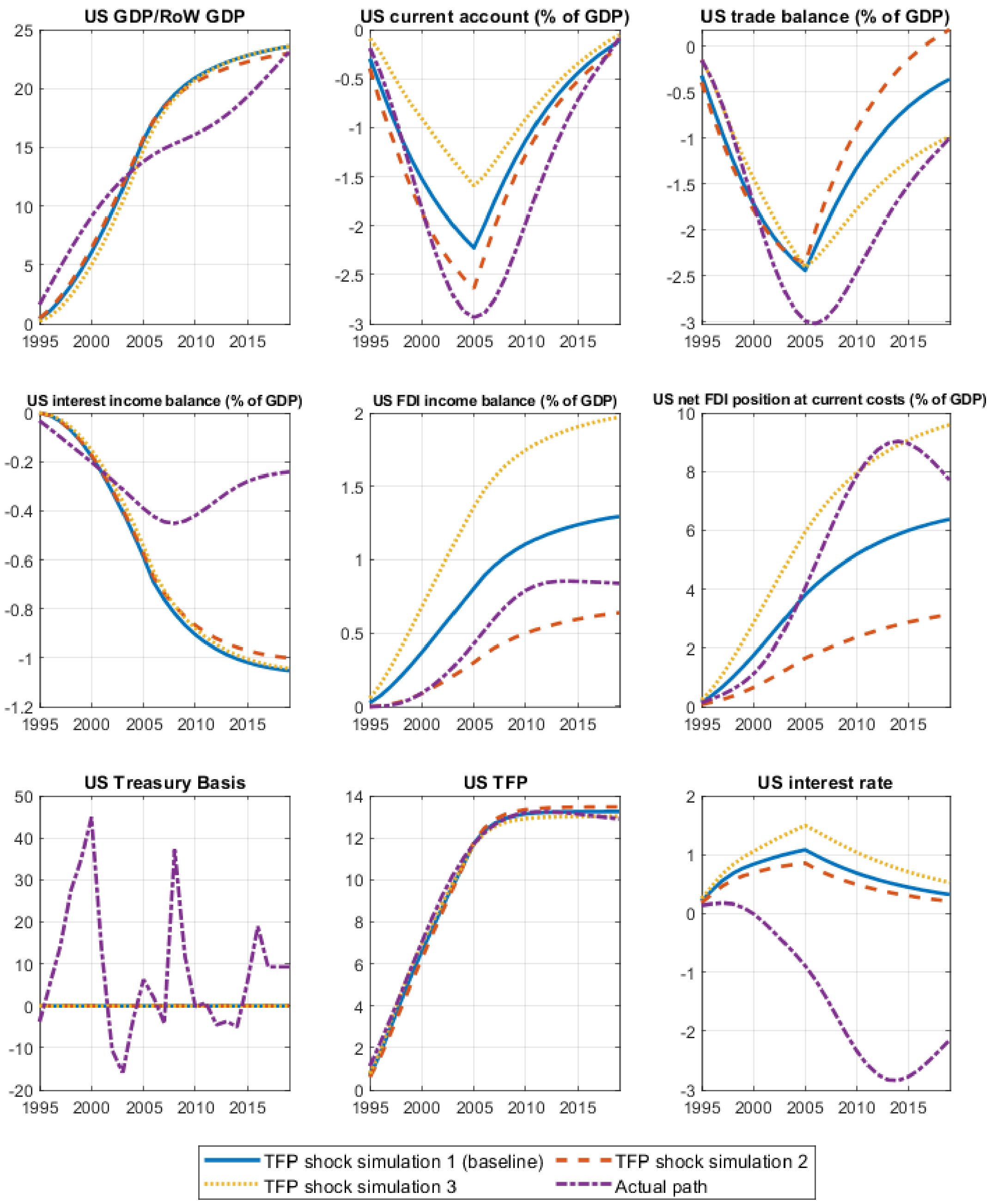

Figure 18: TFP Shock Simulations with Various Shock Combinations

Note: TFP drift shocks are calibrated to match the trend in US TFP between 1995 and 2005. In the baseline simulation, US type 2 firms receive a TFP shock that starts at 1.9% in 1995, declines linearly to 1.1% in 2000, and then remains at 1.1% until 2005 (average 1.33% p.a.), while type 1 firms stay at their pre-1995 trend. In the second simulation, type 1 firms receive an additional constant 0.33% p.a. and the type 2 shock is reduced so that the aggregate US TFP path is unchanged. In the third simulation, type 1 firms receive -0.33% p.a., and the type 2 shock is increased symmetrically, again keeping aggregate US TFP unchanged. FDI income balance include reinvested earnings. US net FDI position at current costs represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost, expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in the Appendix.

Adding Safe Asset Shocks

Figure 19 shows the results when the baseline TFP setup from the previous simulation 1 (baseline) is retained and the two safe asset shocks are added progressively. The TFP shock provides a good explanation for the long-term evolution of both the current account and the trade balance, including the congruence between the turning points of the modeled and actual trajectories. While the exact magnitude of the negative shift in the actual current account may not be precisely modeled, the TFP shock captures the long-term trend of the US current account. The model with the TFP shock can explain around 71.8% and 70.1% of the actual US current account and trade deficits, respectively[16]. The root mean squared error (RMSE) between the actual and simulated values is 0.57 percentage points for the current account and 0.74 percentage points for the trade balance. Furthermore, the TFP shock captures the interest balance dynamics up to the outbreak of the financial crisis. However, it fails to capture the long-term trend, most likely due to safe asset shocks implemented subsequently, as well as additional shocks after 2008. Notably, the model's prediction is broadly consistent with the dynamic and long-term behavior of the US net FDI asset stock as observed in the actual data; the model matches the dynamic pattern of the US FDI income balance well, but overstates its level.

The simultaneous application of both TFP and FtS shocks results in a slightly improved dynamic description of the current account up to 2000 – see Figure 19. The explained proportion of the actual US current account and trade balance deficits rises to 74.3% and 71.2%, respectively, while the RMSE increases slightly to 0.58 and 0.77 percentage points. However, the accuracy of the model with simultaneous TFP and FtS shocks in describing the actual paths of the trade balance, interest income balance, FDI income balance, net FDI asset stock, and the GDP ratio between the US and the RoW is roughly equivalent to that of the TFP shock alone, which reveals the limited additional contribution of the FtS shock in this context.

[16] To calculate the proportion of current account and trade balance explained, we have taken the cumulative value generated by the model relative to the cumulative actual HP filtered data.

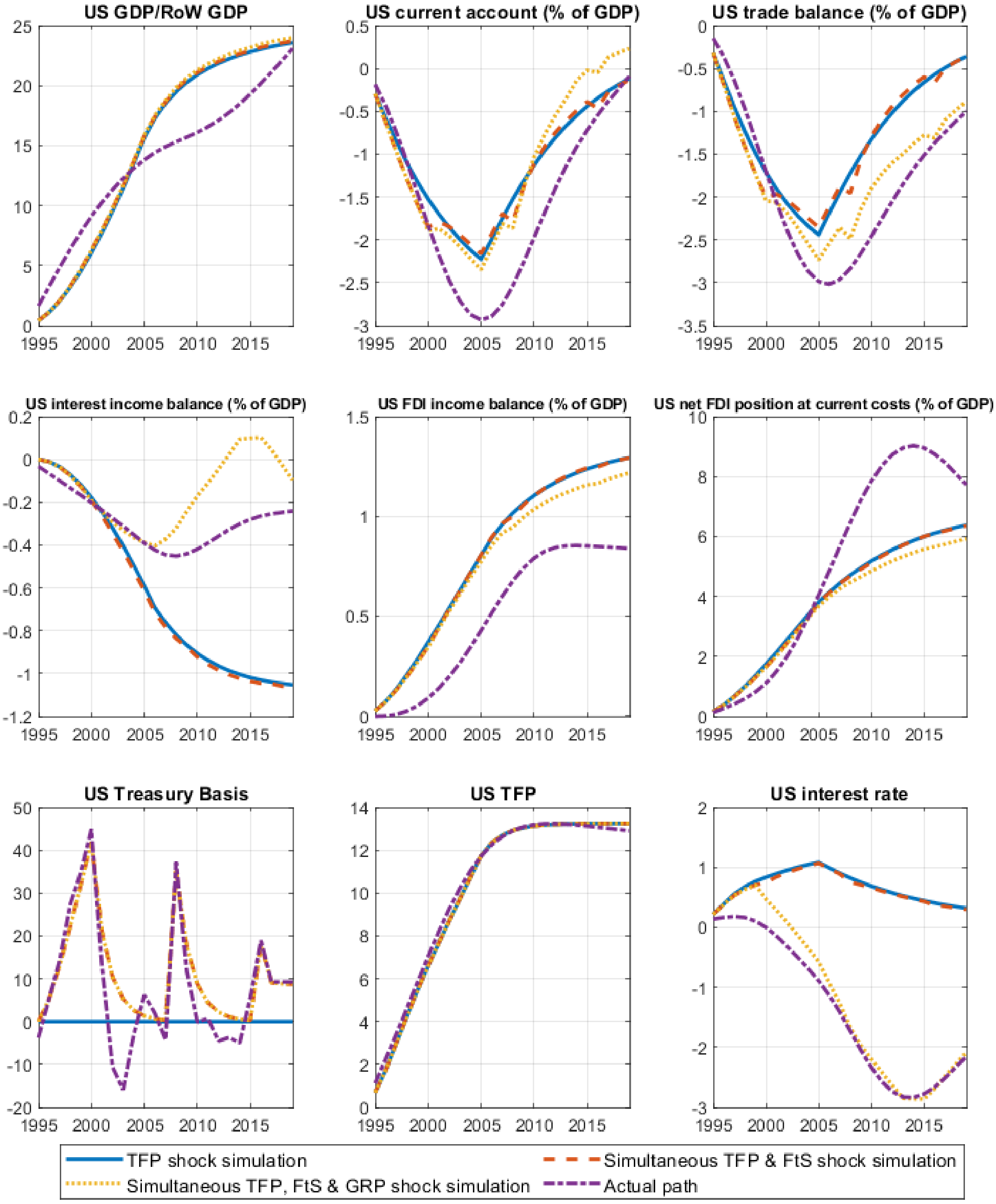

Figure 19. Simulation Results Using the TFP, FtS & GRP Shock – Simulated and Actual Trends

Note: The following shocks are used in the simulations: TFP drift (US type 2: 1.9% in 1995, declining linearly to 1.1% in 2000 and remaining at 1.1% until 2005; RoW type 2: 0.8% in 1995, declining to 0.3% in 2000 and then flat), FtS (trend Treasury basis rising linearly from 0 to 26 basis points between 1995 and 2000, with additional positive innovations of 35 basis points in 2008, 18 basis points in 2016, and 0.4 basis points in both 2018 and 2019), and GRP shocks (2000–2009: -28 basis points annually; 2010–2013: -20 basis points annually; 2016–2019: +20 basis points annually). In the simulations, three scenarios were analyzed sequentially: First, a TFP shock was simulated alone. Second, the FtS shock was added to the TFP shock. Finally, all three shocks, including the GRP shock, were simulated simultaneously. FDI income balance include reinvested earnings. US net FDI position at current costs represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost, expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in the Appendix.

Adding the GRP shock to the TFP and FtS shocks improves the trade balance's matching performance in terms of magnitude and long-run matching, while worsens the long-run matching of the current account – see Figure 19. Compared with the FtS shock, the GRP shock generally has a stronger effect on both external balance measures. Most strikingly, the persistence of the trade balance deficit is better captured once the GRP shock is included. The explained proportion of the actual US current account declines to 69.3%, while that of the trade balance rises markedly to 91.8%. This pattern is also reflected in the RMSE values: the RMSE for the current account increases slightly to 0.61 percentage points, whereas the RMSE for the trade balance improves substantially to 0.36 percentage points. With the inclusion of the GRP shock, the interest balance is now matched better in both its short-run dynamics and long-run evolution, improving on the previous simulations. This fit appears to rely on the joint presence of TFP and GRP shocks. By contrast, the dynamics and long-term evolution of the remaining variables change only marginally when the GRP shock is added.

7. Conclusions

This paper re-evaluates the US current account deficit which widened considerably during the 1990s. It is suggested that apart from the standard safe asset hypotheses, there is an important role for technology shocks originating in US MNCs which have a strong FDI presence. It is shown that technology shocks that increase the market value of FDI assets loosen the sustainability constraint for the trade balance and can therefore generate persistent trade imbalances. This is a novel transmission channel that has been widely neglected in the international macro literature, which is characterized by pessimism concerning the ability of technology shocks to generate persistent external imbalance effects. It is also demonstrated that our model can match several important stylized facts of the US current account and its components over the last three decades. Using the TFP, FtS, and GRP shocks, our model can explain about 69% and 92% of the HP trend in the US current account and trade deficits between 1995 and 2019, respectively. Compared with the FtS shock, the TFP shock showed significantly better performance in matching the current account and its components. The global risk premium shock also contributes to explaining trade balance persistence and improves the fit of the interest income balance. From a broader perspective, this model provides a useful framework for deepening the understanding of structural current account imbalances and can support more targeted, evidence-based policy responses, particularly in economies with substantial trade and foreign direct investment linkages. In future research, we intend to use this framework to evaluate the quantitative importance of other possible explanations, such as tariffs, export subsidies, and the role of reciprocal market access conditions.

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Appendix

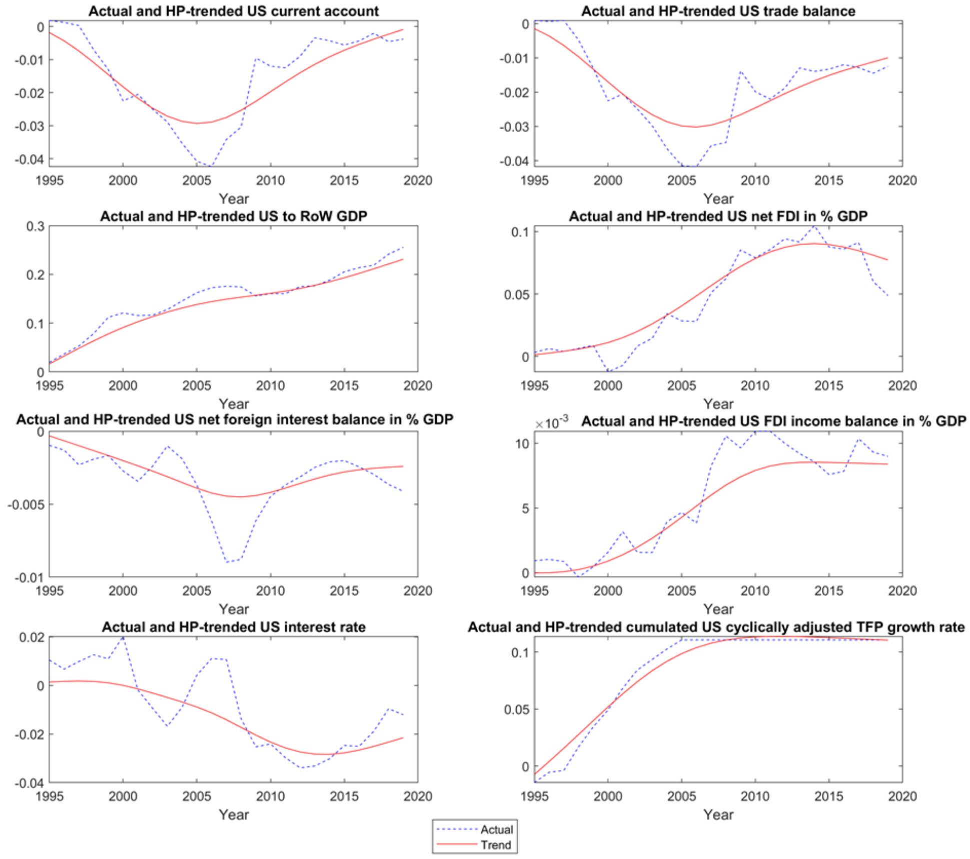

Figure 20. Actual and HP-Filtered US Variables between 1995 and 2019

Note: The HP filter was applied to yearly data available from 1985 to 2019, using a smoothing parameter of λ=100 to capture long-term trends. Since simulations begin in 1995, the trend data have been adjusted by subtracting the trend value from 1994, setting 1994 as the baseline year with a value of zero. The cumulative US cyclically adjusted TFP growth rate, isolating the TFP shock between 1995 and 2005, was calculated by subtracting the trend of cumulative TFP observed from 1980 to 1994 from cumulative TFP growth. The data for the current account, trade balance, net FDI, net foreign interest balance, and FDI income balance are sourced from the Bureau of Economic Analysis (BEA). Net FDI stock represents the difference between outward and inward FDI stock at current cost. TFP data are taken from the cyclically adjusted US TFP series by Fernald (2014). Real interest rate data come from the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters, specifically the annualized three-month Treasury bill rate minus the headline CPI inflation forecast for the next year. The Penn World Table (version 10.01) database was used to calculate the US-to-RoW GDP ratio, based on the cumulative GDP per hour growth differential between the US and the OECD (excluding the US), starting from 1985. From 1995 onwards, the trend from 1985 to 1994 was subtracted from this cumulative difference to normalize values. The OECD data, weighted by GDP, includes all OECD countries except Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia.

Online Appendix of "Persistent US Current Account Deficit: The Role of Foreign Direct Investment"

By KAAN CELEBI AND WERNER ROEGER

Annex 1: Sensitivity Analysis Using Alternative Elasticities in Household and Firm Preferences across Different Types of Goods ($\sigma = \{2.5,\ 6,\ 9.5\}$)

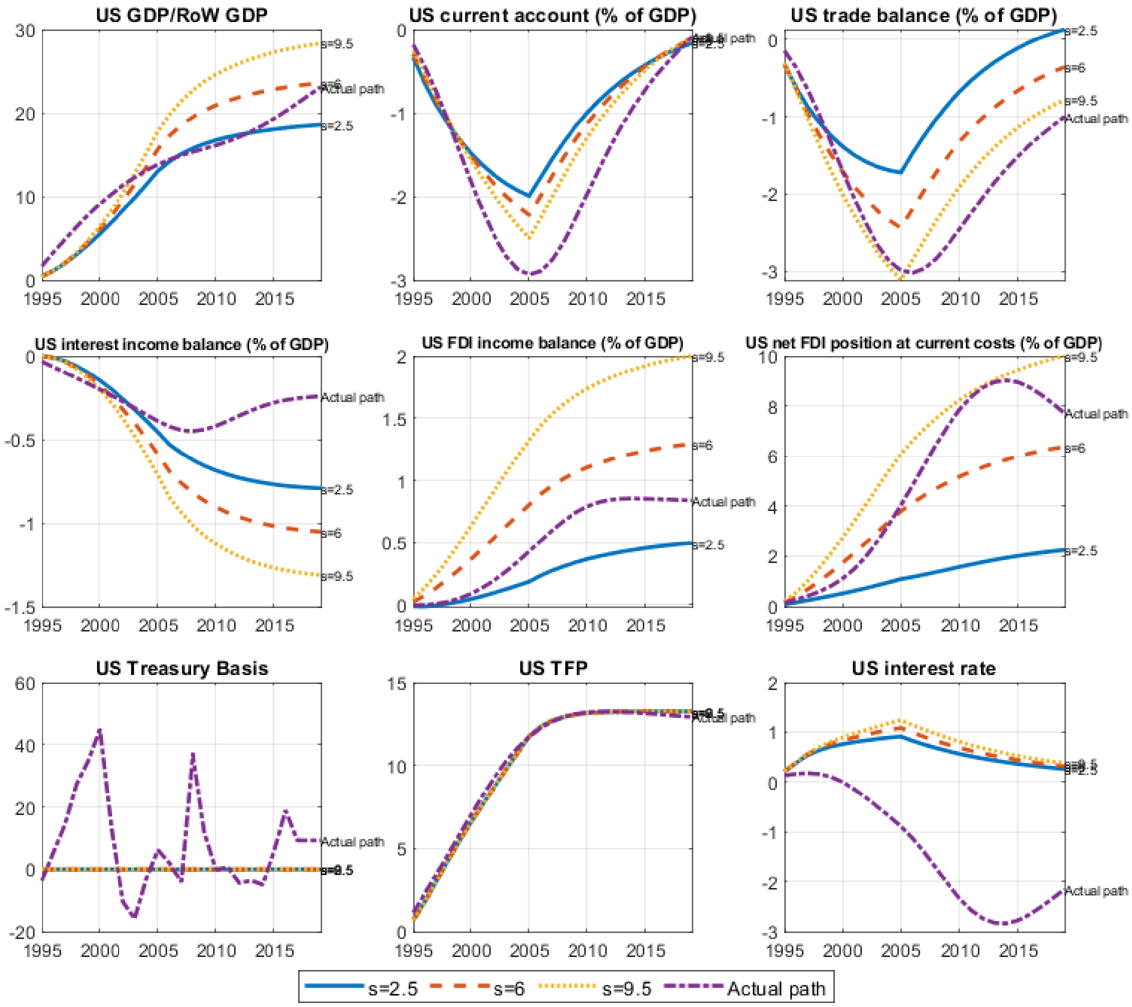

FIGURE 1. SIMULATIONS OF THE TFP SHOCK USING MODIFIED ELASTICITY OF SUBSTITUTION

Note: The baseline TFP shock (1995–2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend) is used for the simulations with varying elasticities of substitution. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

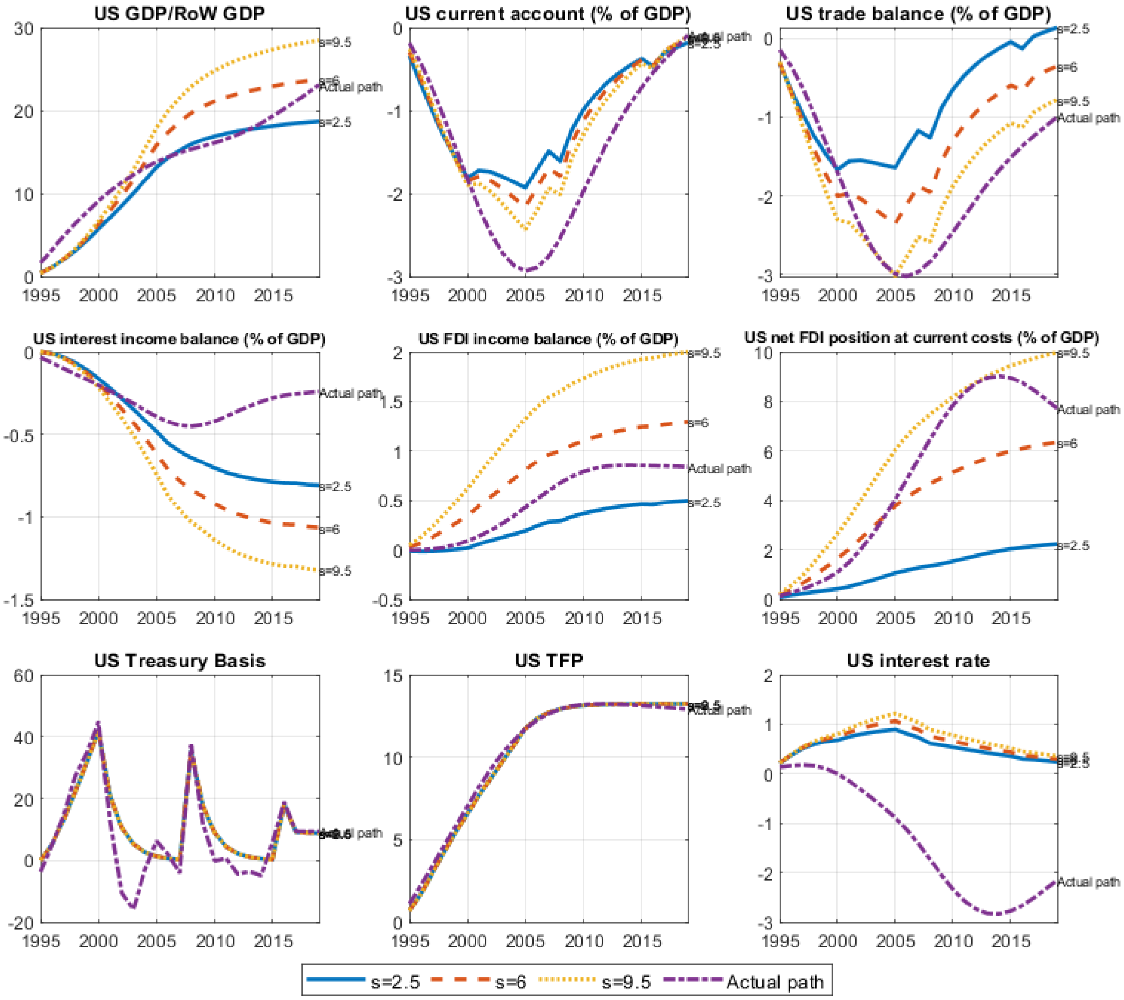

FIGURE 2. SIMULTANEOUS TFP & FTS SHOCK SIMULATIONS USING MODIFIED ELASTICITY OF SUBSTITUTION

Note: The baseline TFP shock (1995–2005: 1995–2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend) and the FtS shock (Treasury Basis rising linearly from 0 to 26 basis points between 1995 and 2000, with additional positive innovations of 35 basis points in 2008, 18 basis points in 2016, and 0.4 basis points in both 2018 and 2019) are used simultaneously for the simulations with varying elasticities of substitution. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

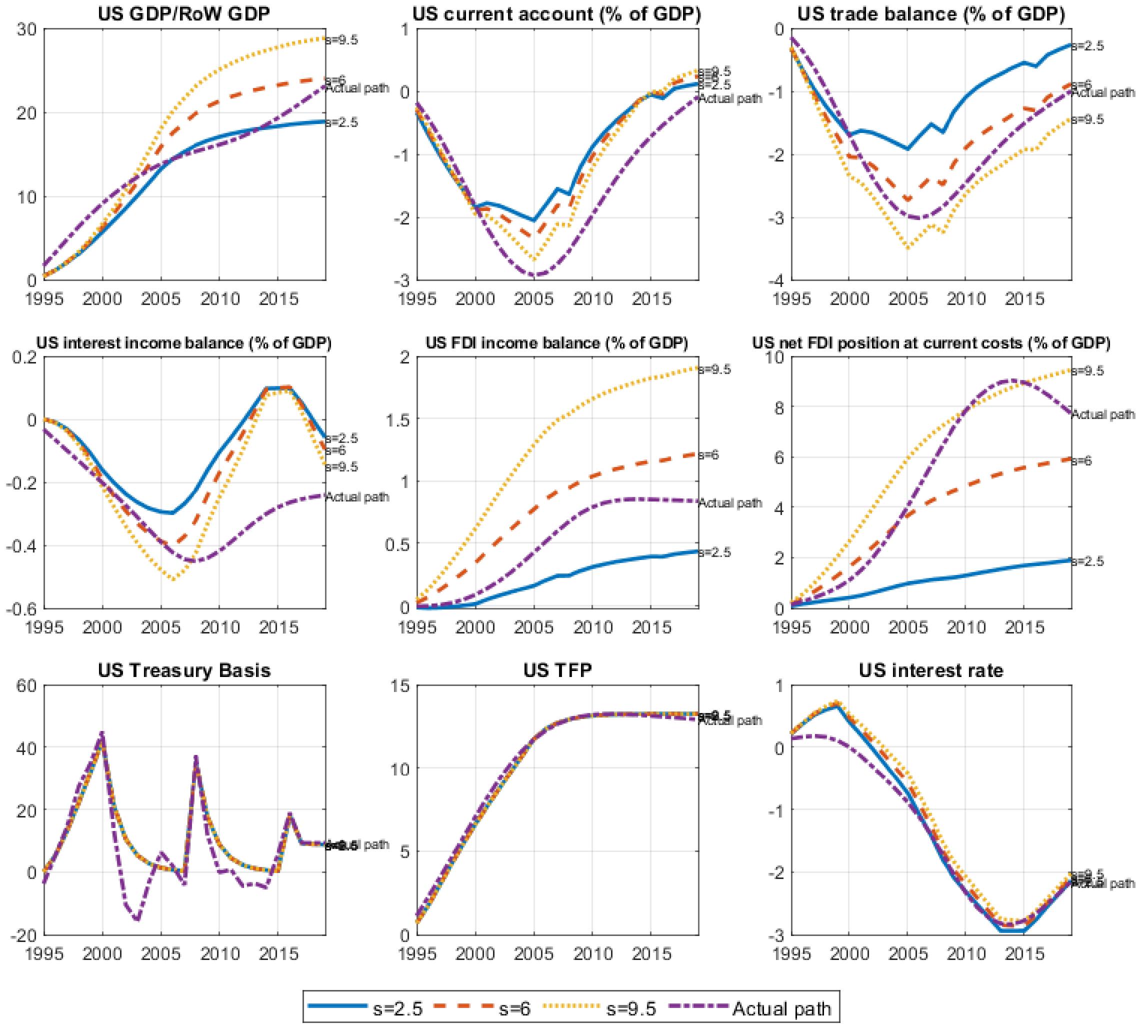

FIGURE 3. SIMULTANEOUS TFP, FTS & GRP SHOCK SIMULATIONS USING MODIFIED ELASTICITY OF SUBSTITUTION

Note: The baseline TFP shock (1995–2005: 1995–2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend) and the FtS shock (Treasury Basis rising linearly from 0 to 26 basis points between 1995 and 2000, with additional positive innovations of 35 basis points in 2008, 18 basis points in 2016, and 0.4 basis points in both 2018 and 2019), and the and GRP shock (2000-2009: -28 basis points annually; 2010-2013: -20 basis points annually; 2016-2019: +20 basis points annually) are used simultaneously for the simulations with varying elasticities of substitution. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

Annex 2: Sensitivity Analysis Using Modified Intertemporal Elasticity of Substitution of Consumption $\left(1/_{\sigma^C} = \{1, 2, 3\}\right)$

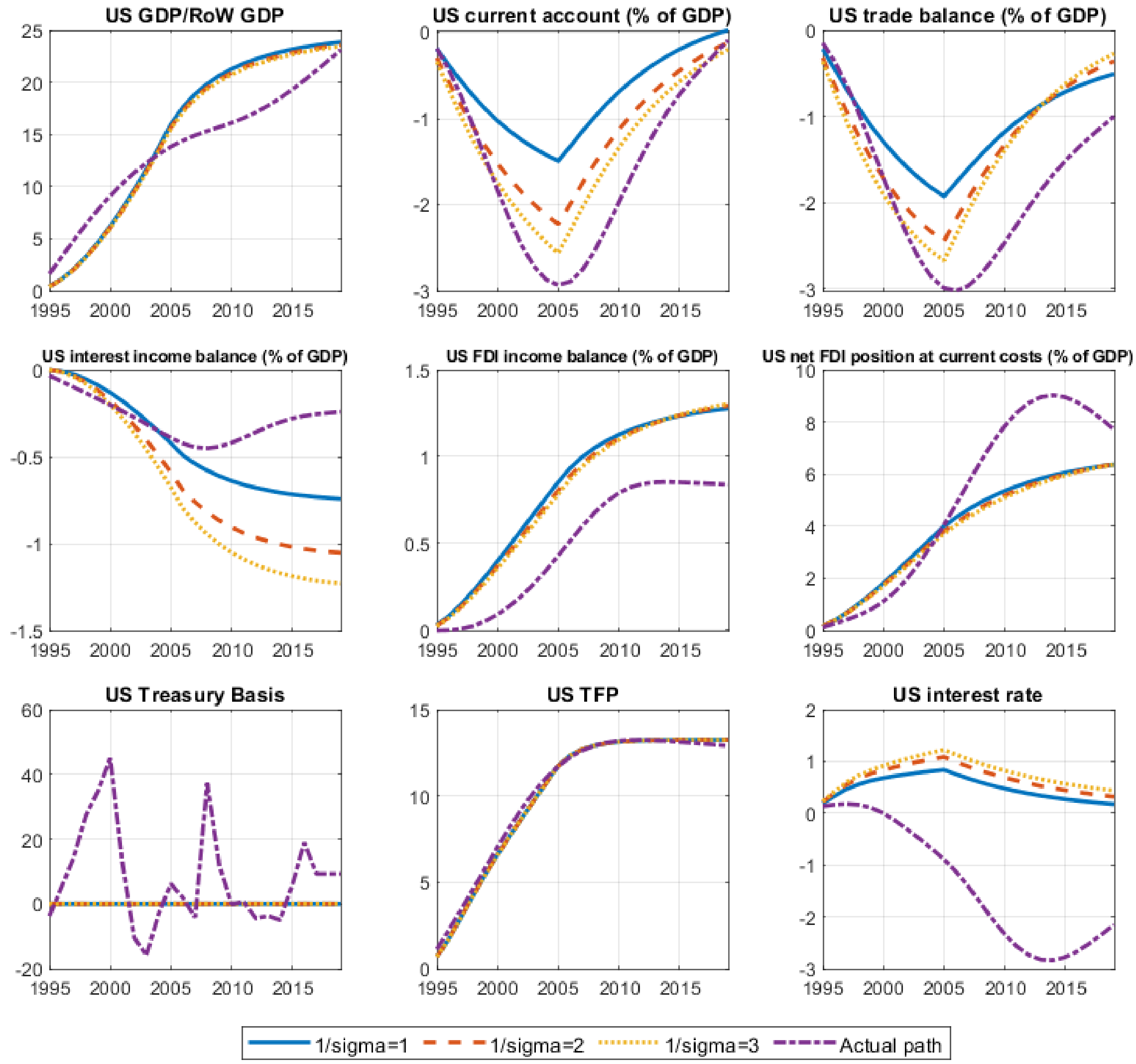

FIGURE 4. SIMULATIONS OF THE TFP SHOCK USING MODIFIED INTERTEMPORAL ELASTICITY OF SUBSTITUTION OF CONSUMPTION

Note: The baseline TFP shock (1995–2005: 1995–2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend) is used for the simulations with varying intertemporal elasticities of substitution of consumption. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

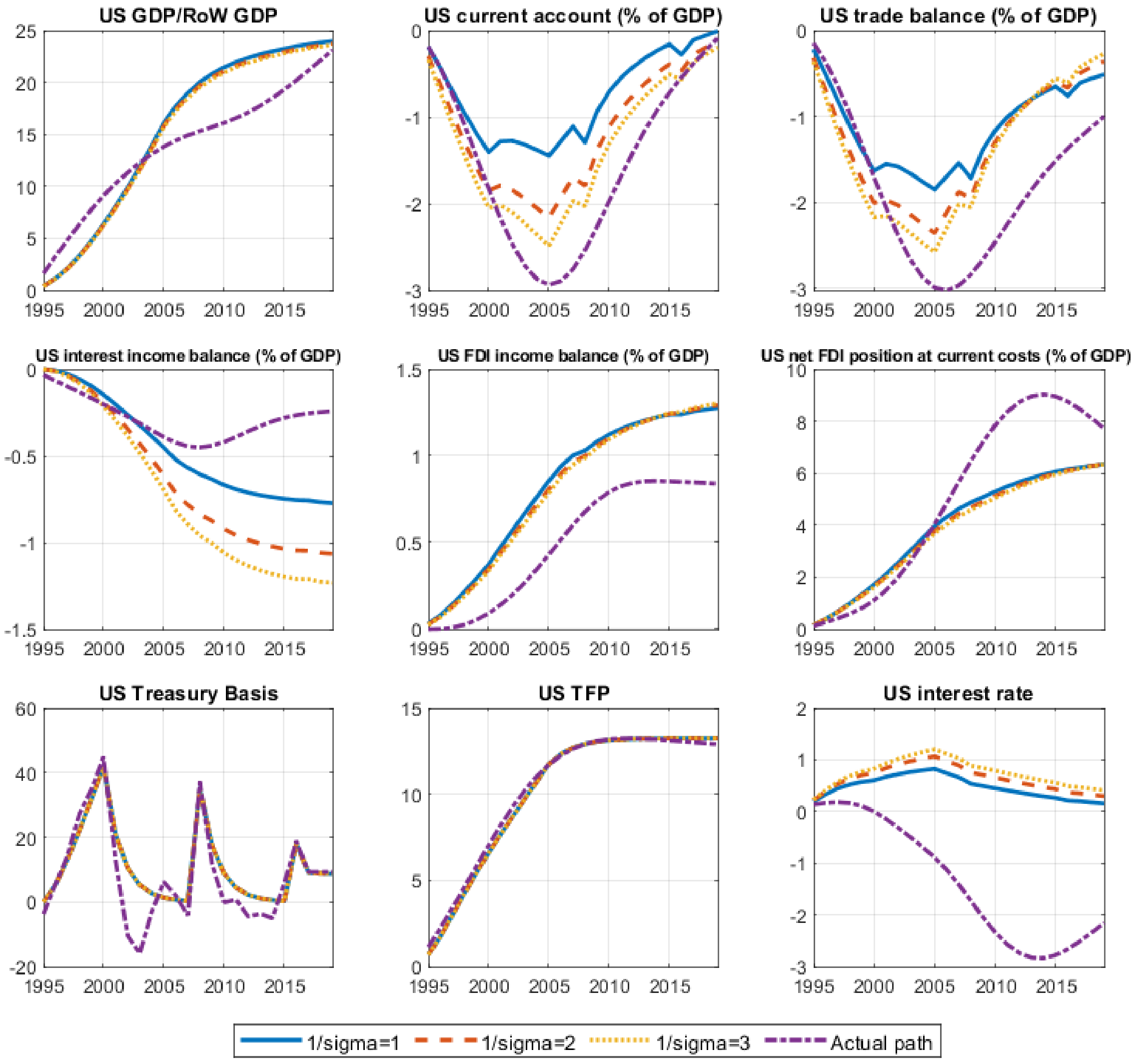

FIGURE 5. SIMULTANEOUS TFP & FTS SHOCK SIMULATIONS USING MODIFIED INTERTEMPORAL ELASTICITY OF SUBSTITUTION OF CONSUMPTION

Note: The baseline TFP shock (1995-2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend) and the FtS shock (trend Treasury basis rising linearly from 0 to 26 basis points between 1995 and 2000, with additional positive innovations of 35 basis points in 2008, 18 basis points in 2016, and 0.4 basis points in both 2018 and 2019) are used simultaneously for the simulations with varying intertemporal elasticities of substitution of consumption. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

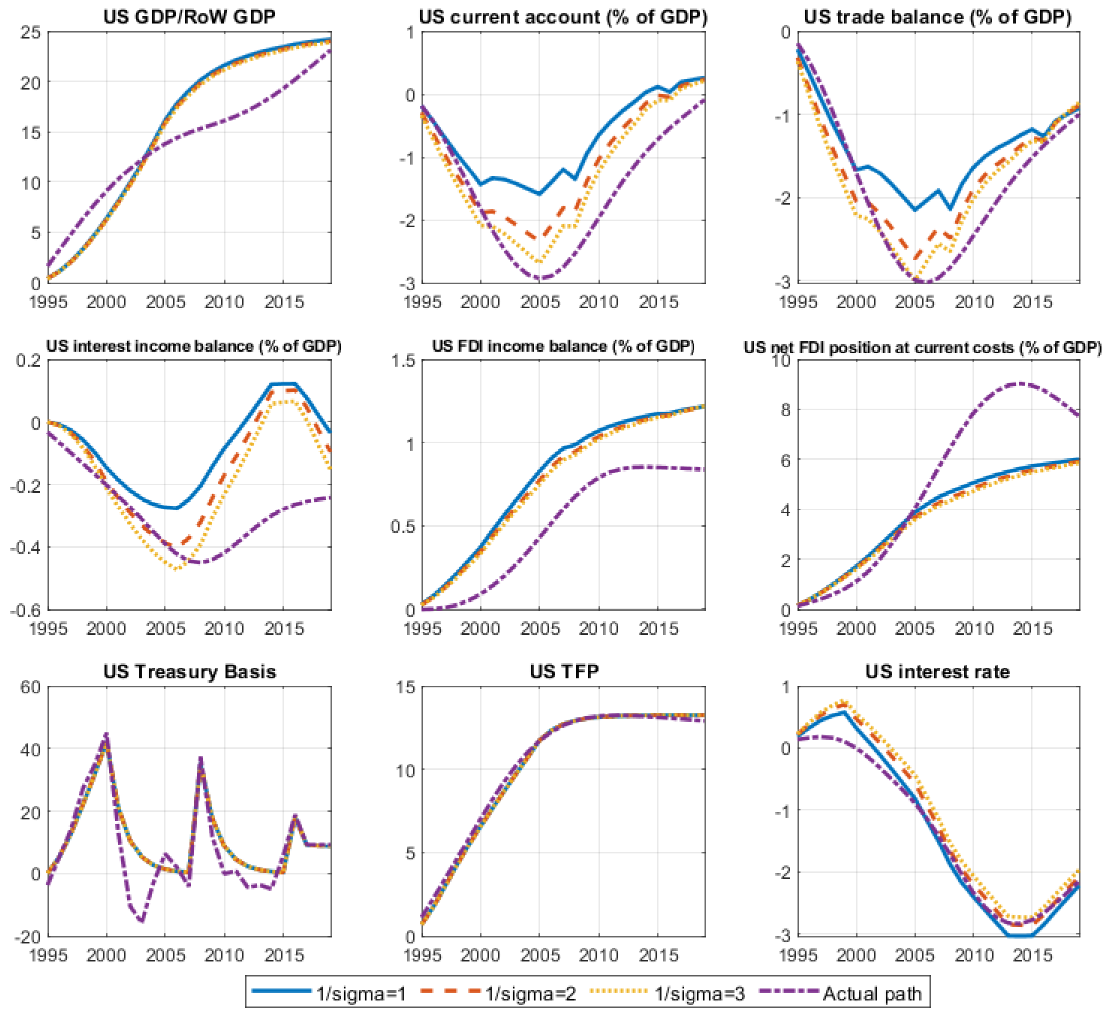

FIGURE 6. SIMULTANEOUS TFP, FTS & GRP SHOCK SIMULATIONS USING MODIFIED INTERTEMPORAL ELASTICITY OF SUBSTITUTION OF CONSUMPTION

Note: The baseline TFP shock (1995-2005: US type 2 from 1.9% in 1995, declining linearly to 1.1% in 2000 and then flat; RoW type 2 from 0.8% to 0.3% and then flat, with type 1 firms at their pre-1995 trend), the FtS shock (trend Treasury basis rising linearly from 0 to 26 basis points between 1995 and 2000, with additional positive innovations of 35 basis points in 2008, 18 basis points in 2016, and 0.4 basis points in both 2018 and 2019), and the GRP shock (2000-2009: -28 basis points annually; 2010-2013: -20 basis points annually; 2016-2019: +20 basis points annually) are used simultaneously for the simulations with varying intertemporal elasticities of substitution of consumption. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP. An HP filter with lambda=100 was performed for all actual data except the US Treasury basis. The annual values of the Treasury basis are derived from the reported quarterly data provided by Jiang et al. (2021) by calculating annual averages. Further details on the data sources and calculations are provided in Appendix A.

Annex 3: Autoregression in the Treasury Basis and Simulation with Varying Degree of Persistence

TABLE 1. AR(1) REGRESSION ON THE TREASURY BASIS (YIELD GAP BETWEEN US GOVERNMENT AND CURRENCY-HEDGED FOREIGN GOVERNMENT BONDS)

	Sample			
	1989-2017	1989-1994	1995-2005	1995-2017
Constant	11.914***	19.562**	8.261**	10.810**
	(3.972)	(4.365)	(3.492)	(4.545)
AR(1)	0.430**	0.011	0.674***	0.513**
	(0.180)	(0.181)	(0.180)	(0.207)
R-squared	0.197	0.000	0.465	0.266
Observations	29	6	11	23

Note: Heteroskedasticity and autocorrelation consistent standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

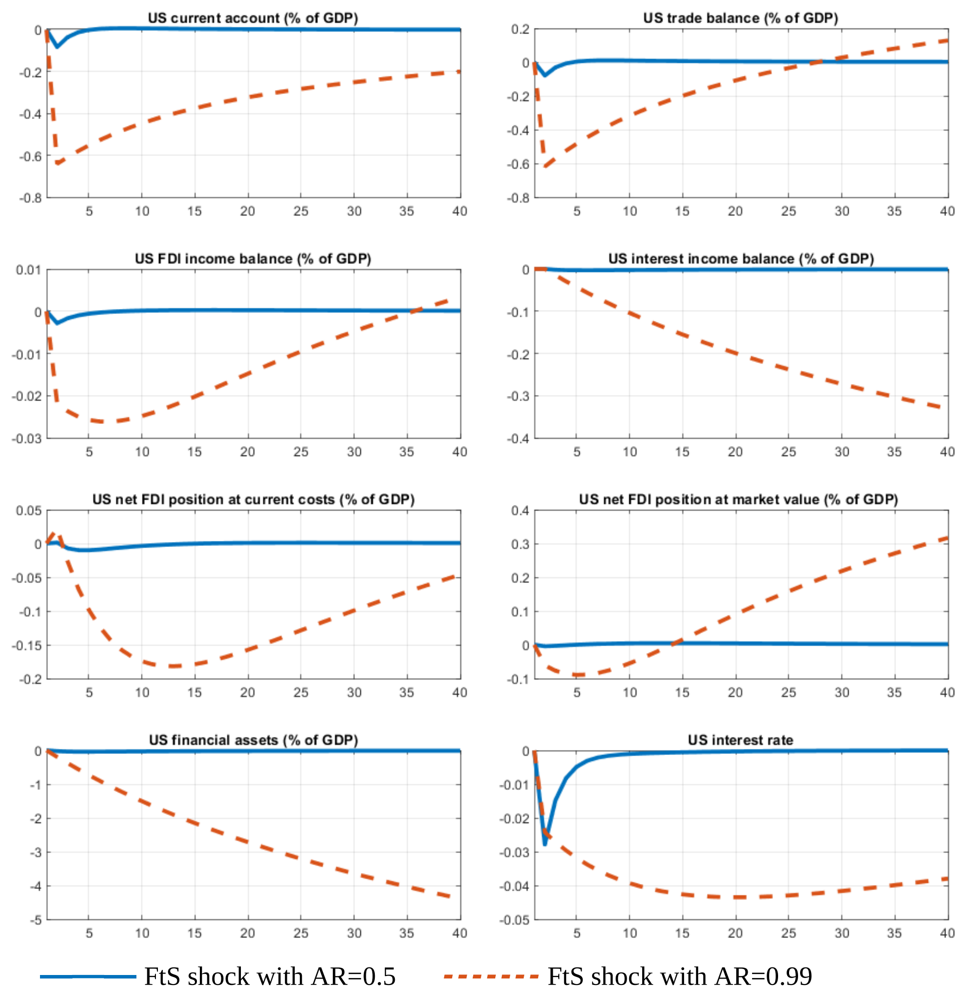

FIGURE 7. SIMULATIONS OF THE FTS SHOCK (+10BP ANNUAL) WITH VARYING DEGREES OF PERSISTENCE (AR= {0.5, 0.99})

Note: The current account and primary income balance are based on the Balance of Payments (BOP) definition. US net FDI position at current costs (at market value) represents FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost (at market value), expressed as a percentage of GDP.