# PERSISTENT US CURRENT ACCOUNT DEFICIT: THE ROLE OF FOREIGN DIRECT INVESTMENT

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**February 2024**

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**Abstract:** This paper re-evaluates the US external deficit which has considerably widened over the 1990s. US safe asset provision to the rest of the world is the dominant explanation for the persistent nature of the US external deficit. We suggest that apart from the safe asset hypothesis, there is an important role for technology shocks originating in US multinational companies that have a strong foreign direct investment presence. It is shown 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 has contributed significantly to the increase of the US current account deficit and its duration. Technology shocks have been neglected as a reason for longer lasting current account deficits since for these shocks, standard open economy DSGE models can only generate temporary external deficits. We show that our enhanced DSGE-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, US technology shocks can match the increase in net FDI income and a rising FDI capital balance. Our analysis suggests that FDI flows and their determinants should play a more important role in monitoring external imbalances by international organizations.

**Keywords:** foreign direct investment, current account imbalance, USA, DSGE, technology shocks

**JEL Classification:** D5, F21, F23, F32, O3

**Acknowledgments:** We are grateful for comments received from Zeno Enders, Thomas Gries, Robert Kollmann, and seminar participants from the Swiss National Bank, the IMF and University of Bayreuth. Research assistance from Tian Xiong and editorial support by David Hanrahan (EIIW) are appreciated. The usual disclaimer applies.

† Paul Welfens passed away on the 11th of November 2022. He was the main initiator of this project and contributed strongly to the first versions of this paper.

## 1. Introduction

An important stylized fact is the persistent US current account and trade balance 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 (RoW) especially from emerging economies. 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 (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. Apart from return differentials between US liabilities and US assets, it is argued that there has been rising demand for US safe assets (see, e.g., Caballero et al. (2008)). 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. There is also literature that links inequality with current account deficits (see, for example, Ranciere et al. (2012) or Ferra et al. (2021)). This literature emphasizes that countries with high levels of inequality develop deeper financial markets which allows for higher borrowing rates. Thus, this literature stresses the link between savings and the current account.

These explanations are - in principle - consistent with predictions made by standard open economy (DSGE) models concerning the determinants of persistent trade and current account (referred to hereafter as TB and CA) imbalances. As will be shown below, these models generate persistent external imbalances primarily from persistent demand and portfolio shocks (see, e.g., Kollmann et al. (2015)), while persistent technology shocks can only generate temporary imbalances, as shown by Ghironi and Melitz (2005). Enders and Müller (2009) show that the standard 2 country business cycle model cannot match the VAR evidence concerning the duration and size of the trade balance response to a technology shock in one country.

This paper questions the received wisdom that the US external deficit is predominantly a demand/portfolio shift phenomenon and presents a new supply-side perspective on the rising deficit in the 1990s. While the authors do not deny the relevance of the safe asset contribution, this paper stresses that technology has contributed significantly to the observed strong increase over the period from 1995 to 2005 and is also a major reason why it has continued until today. Furthermore, it is argued that technology shocks are also better able to match the evolution of the US net FDI position in recent decades. The reason why – in contrast to standard open economy DSGE models - technology shocks have persistent effects in the model presented herein is due to the fact that it allows for an FDI channel (besides the standard trade channel) for the transmission of technology shocks. In this paper, it is demonstrated that technology shocks originating with firms that engage in FDI generate more persistent external imbalances because the rise of the market value of FDI capital loosens the sustainability constraint on the trade balance. We show in this paper that this aspect is relevant quantitatively.

We find that the 1995-2005 technology boom shares two essential features that fit the analysis presented very well. Firstly, during this period the US experienced a technology shock that was only partially diffused to the rest of the world, i.e., it led to a permanent level shift of US technology vis-à-vis major trading partners. Secondly, the technology shock was not only confined to the US manufacturing sector but also affected various service sectors (see Van Ark et al. (2008), Lewis et al. (2001))[1]. Over this period, major US technology giants were created, which revolutionized information and communication services (such as Apple or Google) but also other services such as retail (Amazon). 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 trade.

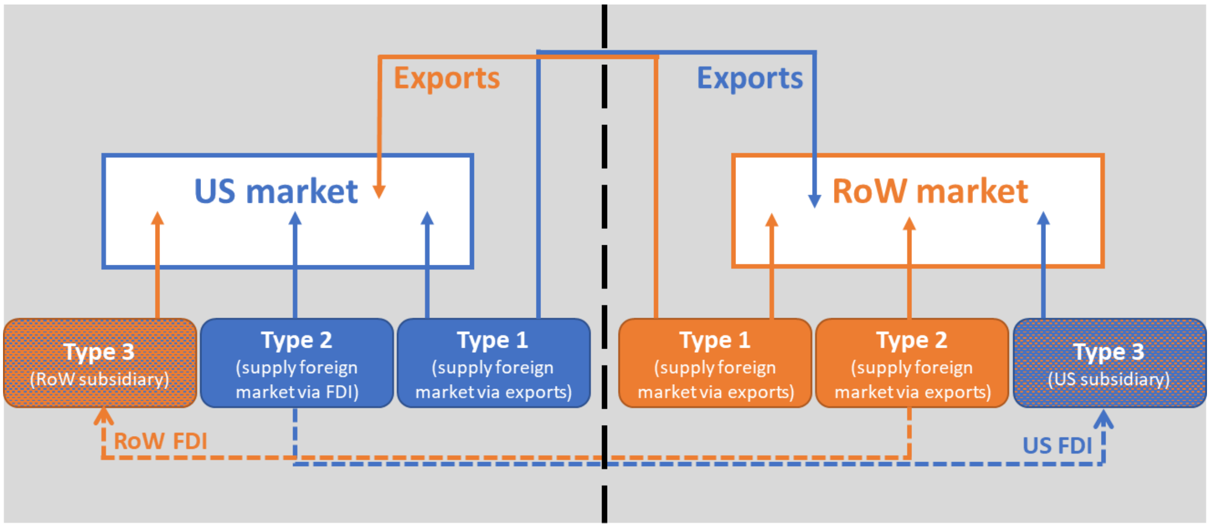
There have been attempts in the literature to account for the technology dimension of the US CA deficit after the strong decline in the 1990s. Hunt and Rebucci (2005) partly attribute this to positive US total factor productivity (TFP) shocks, however, they remain within the standard paradigm and argue that TFP shocks have difficulty generating persistence of the current account. Obstfeld and Rogoff (2007) have used a two-sector model (tradable vs non-tradable) to analyze the US current account deficit and find a role for US productivity growth in the non-tradable sector. However, they neglect FDI as a factor regarding a loosening of the sustainability constraint for the current account. 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 (MNCs) 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. However, to the best of the authors' knowledge, no attempt has been made to attribute a persistent high US current account deficit in the aftermath of the US tech boom to technology.

To analyze this channel, this paper augments a standard two-country DSGE model with an FDI decision in the two countries and raises the question of which implications this has for the international transmission of shocks. In this paper, the focus is on the persistence of the trade and current account and its components. We regard our model as an extension of a standard one sector open economy macro 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. 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

[1] Rodrik (2012) provides empirical evidence that the international diffusion of technology is confined to manufacturing.

a third type of firm in each country alongside types 1 and 2. While type 1 and 2 firms have similar technologies, in particular an identical share of imported investment goods with a home bias, subsidiaries of foreign type 2 firms use the foreign technology and therefore have a foreign bias in their capital composition. The technology of the foreign subsidiary is thus similar to the technology used for exports.

**Figure 1: Overview of Firm Types and Trade Patterns**




*Source: Own illustration*

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

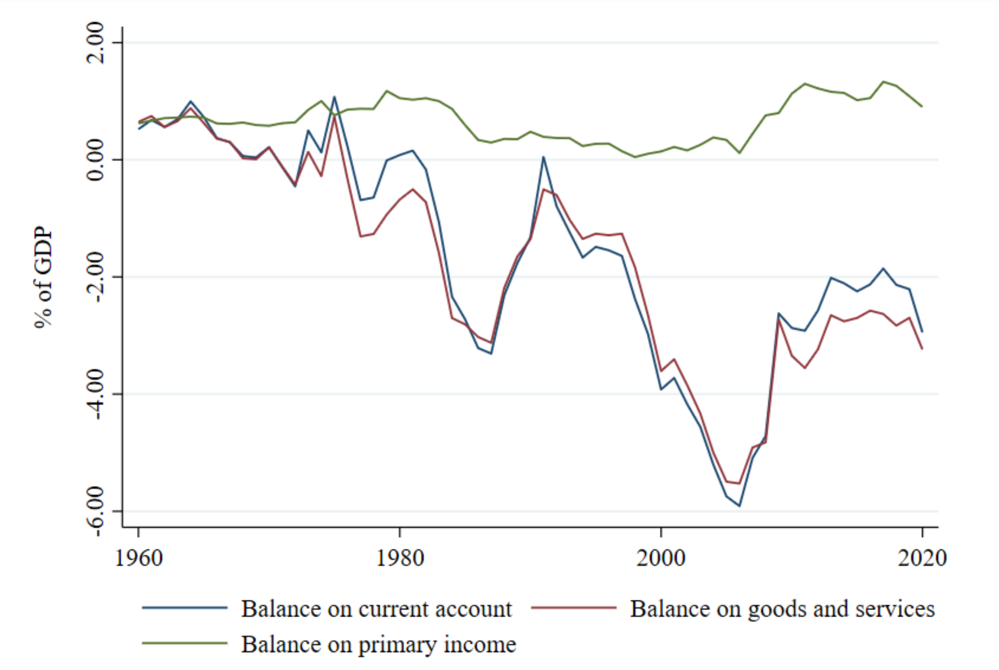
In this paper, it is shown that a permanent technology shock transmitted to the RoW via FDI generates degrees of persistence for the external deficit which are similar to the persistence generated by safe asset shocks. Moreover, it is also shown that this type of technology shock can match other features of the US external balance since 1995 such as the evolution of the primary income balance and the net FDI capital stock.

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 vs technology shocks is examined. Section 7 concludes.

## 2. The US External Imbalance

The US current account fluctuated closely around zero throughout the 1960s and 1970s with a temporary decline in the mid-1980s. After 1995, the balance declined significantly and persistently (see Figure 2). While the CA balance is mostly driven by the trade balance, it is however interesting to note that the primary income balance for the US has always been positive with only mild fluctuations.

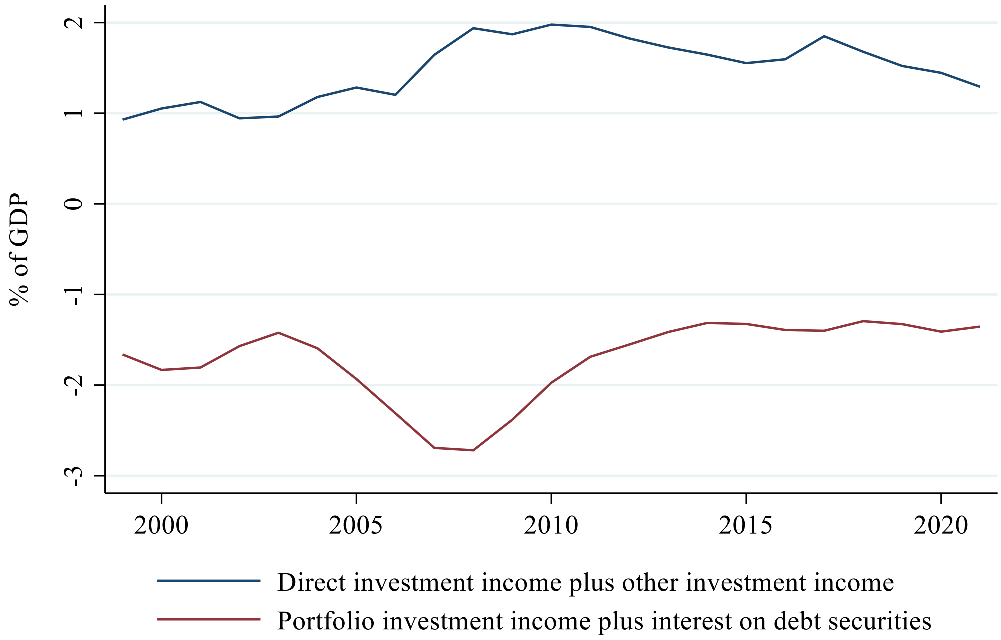
**Figure 2: US Current Account Balance, Primary Income Balance, and Balance on Goods and Services, 1960-2021 (annual data)**




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

Unfortunately, information about the primary balance 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.

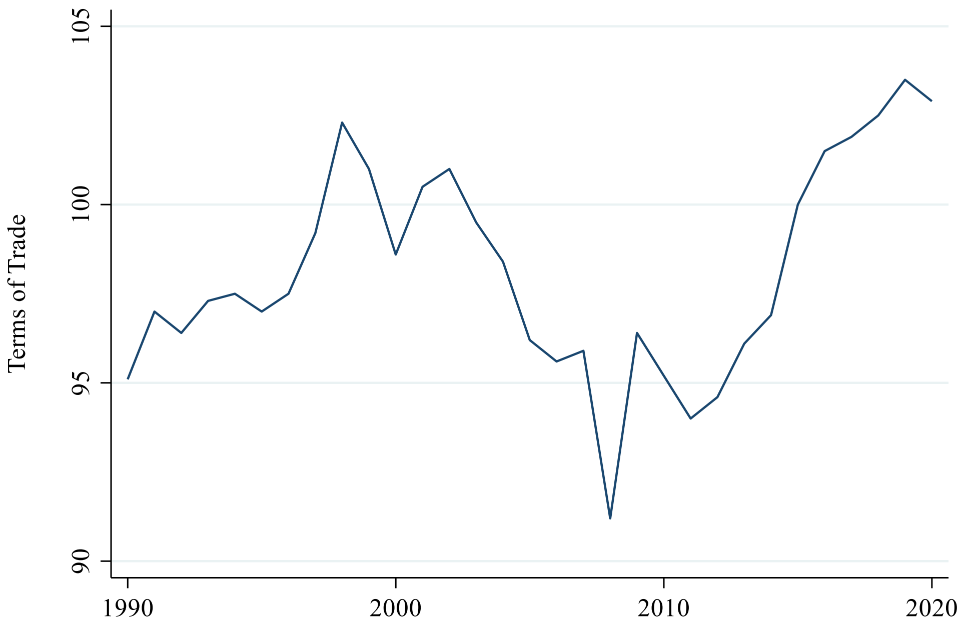
**Figure 3: Components of the US Primary Balance, 1999-2021**




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

It is also interesting to report US terms of trade dynamics, which show that the technology boom after the mid-1990s was associated with an increase in the terms of trade (see Figure 4). This supports the view that the technology shock was not only linked to traditional US exporting industries.

**Figure 4: United States Terms of Trade, 1990-2018**

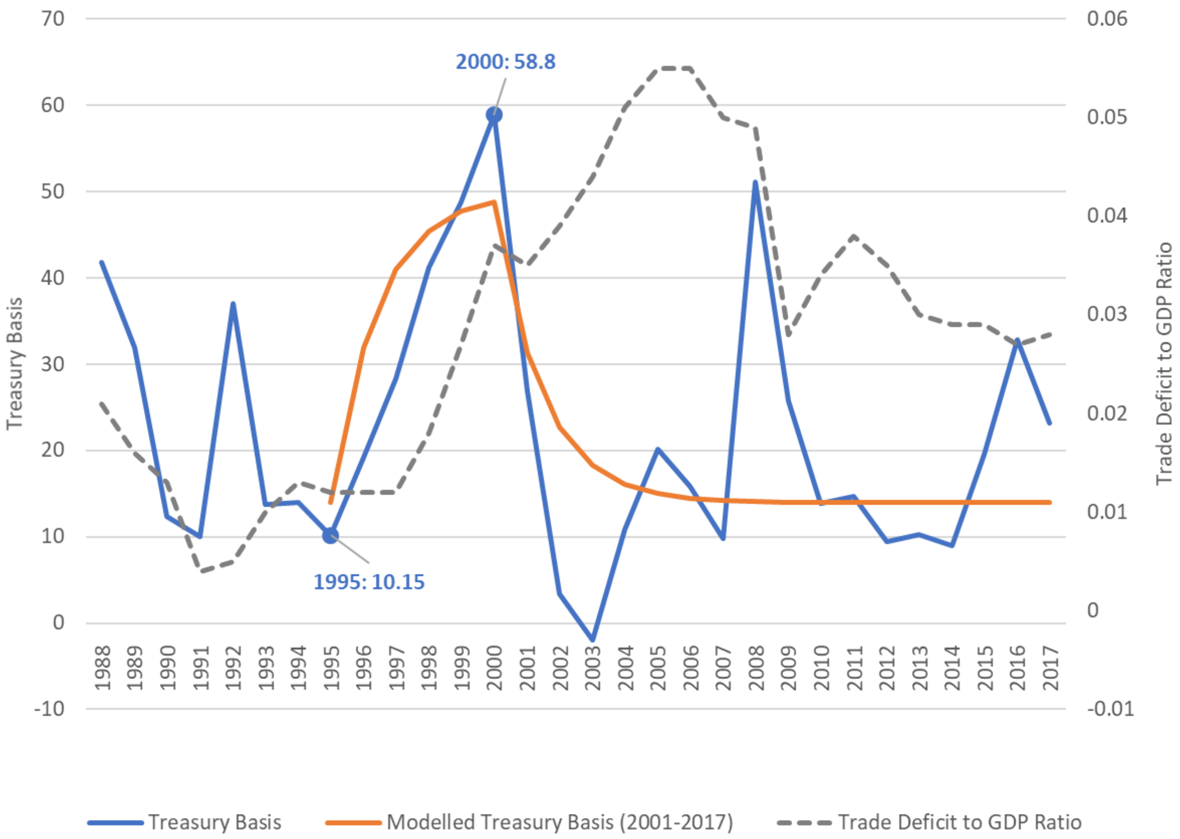



*Source: Own representation of data available from the AMECO database.*

Some Evidence Supporting the Safe Asset View

The demand for US safe assets is a prominent hypothesis for explaining the rising US CA 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 safe asset 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 5, 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.

**Figure 5: Treasury Basis (yield gap between U.S. government and currency-hedged foreign government bonds) and the Trade Deficit (1988 – 2017)**

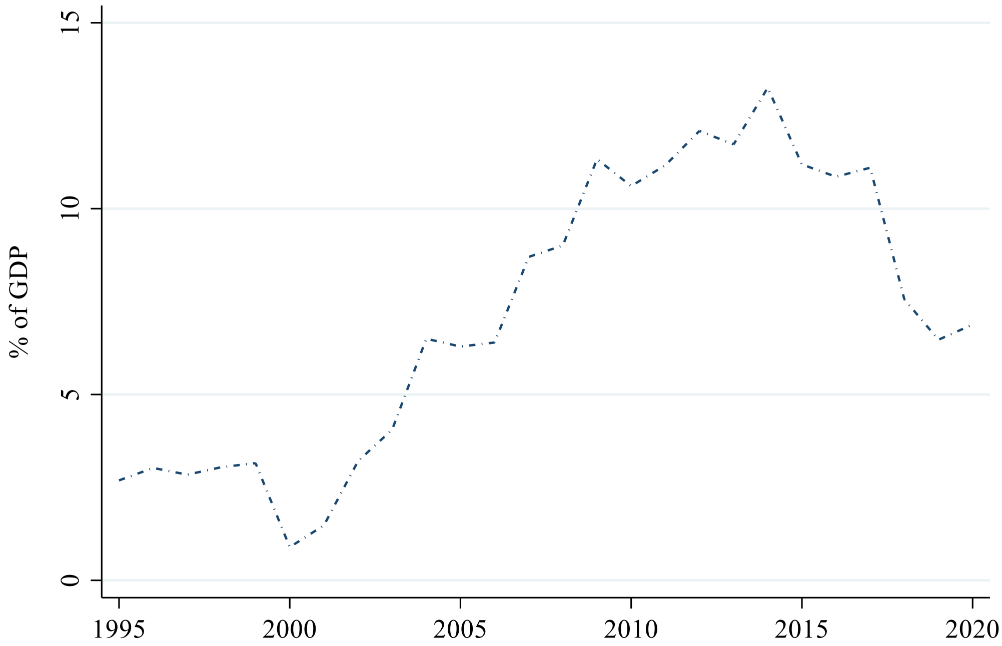



*Note: The average of the Treasury Basis between 2001 and 2017 is 17.3 basis points, while the average of the modelled Treasury Basis in Section 6 is 16.0 basis points.*
*Source: Jiang et al (2021), Bureau of Economic Analysis, own calculations*

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]

**Figure 6: US Net FDI Stock (at current cost) as Percentage of GDP**

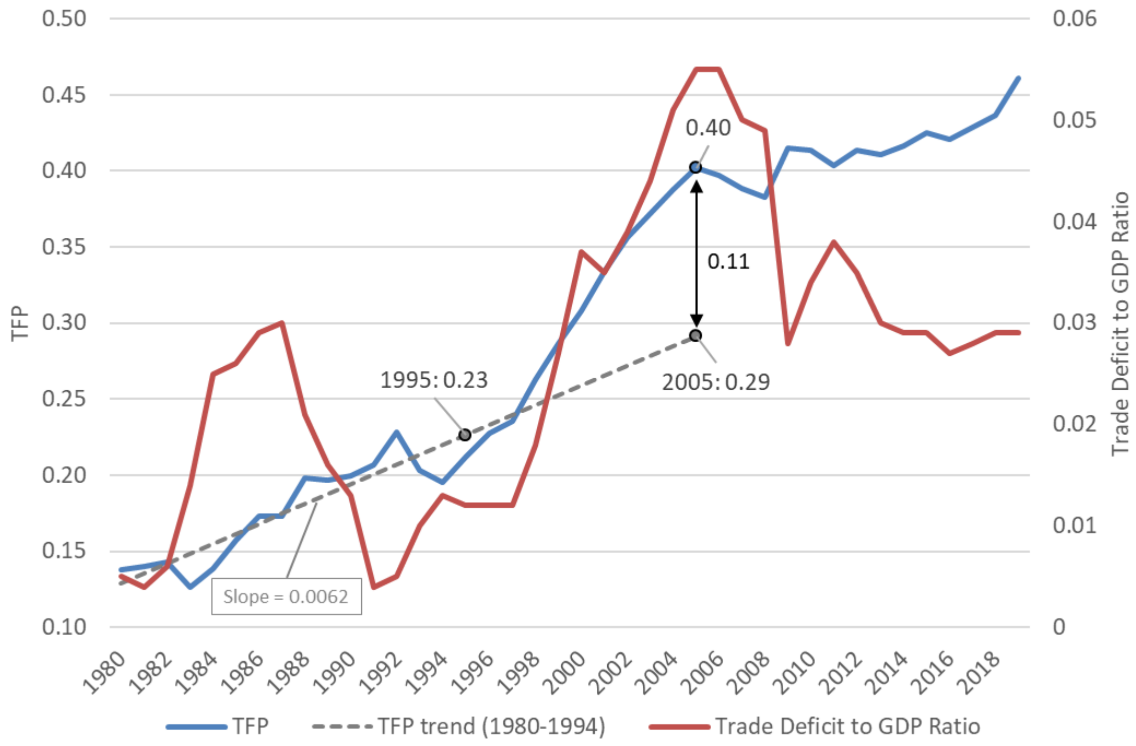



*Source: Own representation of data available from the Bureau of Economic Analysis.*

It is interesting to observe that the strong increase in the US CA 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).

[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)**

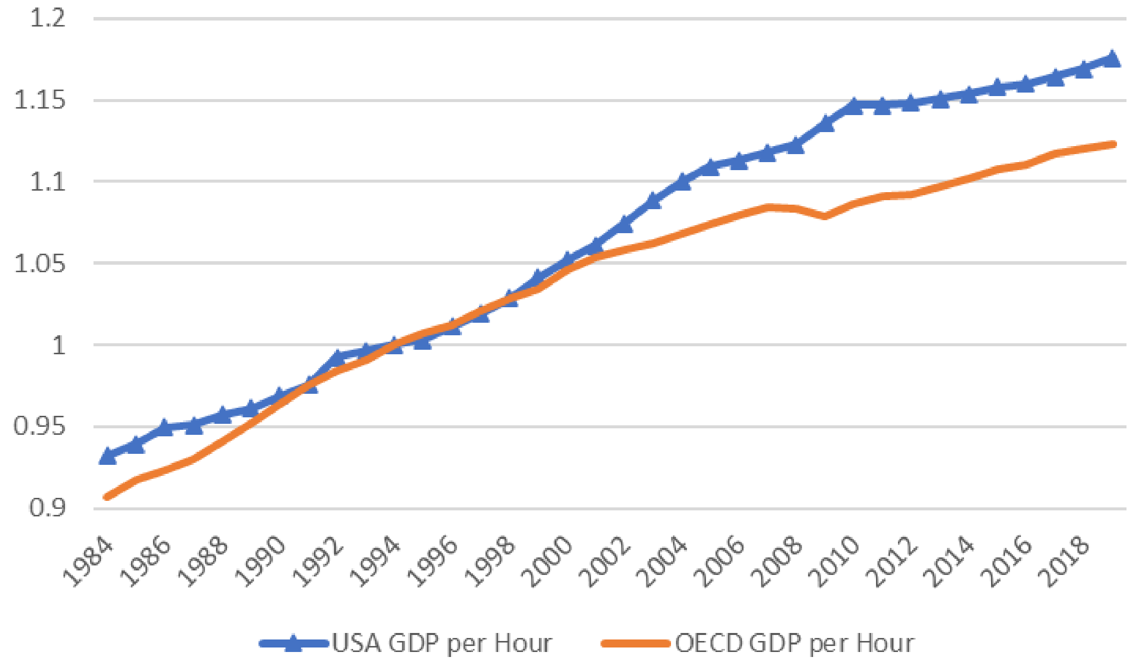



*Note: Cumulated US cyclically adjusted TFP growth rate as measured by Fernald (2014)*
*Source: Fernald (2014), Bureau of Economic Analysis, own calculations.*

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) which conduct their international transactions mostly via FDI. 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% while 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[3] in the US. As shown in Figure 8, this is not restricted to the EU but applies to the OECD as a whole.

[3] The recession in 2009 is associated with a one-off jump in terms of productivity in the US relative to the EU. This is unlikely related to a technology shock but rather reflects different labor market adjustment measures between the US and EU during the recession.

**Figure 8: Gross Domestic Product (GDP) per Hour: United States vs OECD (1985 – 2019)**




*Note: Natural logarithm, index 1994=1*
*Source: Own representation of data available from the World Penn Table (version 10.01). For the OECD, 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 FDI-Based DSGE 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 produced in the headquarters to its foreign affiliates.

### 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 domestic consumption goods produced by type $i$ domestic firms ($i = 1,2$) ($C_{i,s,t}$), as well as

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

imported goods and goods produced by the subsidiary of the foreign type 2 firm, which are denoted by subscripts $m$ and $f$ respectively ($C_{m,s,t}, C_{f,s,t}$). Preferences over all four categories of goods are characterized by a CES utility function

$$C_{s,t}^{c} = \left[\sum_k s^{k\frac{1}{\sigma}} C_{k,s,t}^{c}{}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

with an elasticity of substitution equal to $\sigma$ and share parameters $s^k$ (with $k = (1,2,m,f)$). We assume home bias $s^{k^d} > s^{k^f}, k^d = (1,2), k^f = (m,f)$. $C_{k,s,t}^{c}$ is itself a CES aggregate across goods produced by a continuum of monopolistically competitive firms, indexed by $l\epsilon[0,1]$

$$C_{k,s,t}^{c} = \left[\int_0^1 C_{k,s,t}^{c}(j,l)^{\frac{\varepsilon-1}{\varepsilon}} dl\right]^{\frac{\varepsilon}{\varepsilon-1}}. \tag{2}$$

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 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 nominal exchange rate (expressed in units of RoW currency, per unit of Dollars ($\Delta E_t > 0$: depreciation of RoW currency).

$$F_{s,t}^{c} = B_{s,t}^{W,c} E_t + B_{s,t}^{c} + q_{1,t}^{c} S_{s,t}^{c,1} + q_{2,t}^{c} S_{s,t}^{c,2}. \tag{3}$$

To allow for a safe asset, we follow Fisher (2014) and Krishnamurthy and Vissing-Jorgensen (2012) and introduce a preference for the dollar denominated bond for RoW households. Similarly, for generating an equity premium we allow for a disutility of holding physical capital,

$$U\left(C_{s,t}^{c}, \frac{B_{s,t}^{W,c} E_t}{C_{s,t}^{c}}\right) = \frac{1}{1-\sigma^c} C_{s,t}^{c}{}^{\sigma^c} + \xi_t^{RoW} V^B\left(\frac{B_{s,t}^{W,c} E_t}{C_{s,t}^{c}}\right) - \zeta_t^c V^S\left(\frac{S_{s,t}^{c,1} + S_{s,t}^{c,2}}{C_{s,t}^{c}}\right) \tag{4}$$

where $V^B(\cdot)$ and $V^S(.)$ is increasing and concave and $\xi_t^{RoW} \geq 0, \zeta_t^c \geq 0$, denote exogenous demand shifters, whereas $\sigma^c$ denotes the inverse of the intertemporal elasticity of substitution of consumption. 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

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

$$U_{s,0}^{c} = \sum_{t=0}^{\infty} (\beta\gamma)^{t}\, U\left(C_{s,t}^{c}, \frac{B_{s,t}^{W,c} E_{t}}{C_{s,t}^{c}}, \frac{S_{s,t}^{c,1} + S_{s,t}^{c,2}}{C_{s,t}^{c}}\right). \quad (5)$$

The cohort budget constraint is given by:

$$B_{s,t}^{W,c} E_{t} + B_{s,t}^{c} + q_{1,t}^{c} S_{s,t}^{c,1} + q_{2,t}^{c} S_{s,t}^{c,2} = \left(1 + i_{t-1}^{c^{*}}\right) B_{s,t-1}^{W,c} E_{t} + (1 + i_{t-1}^{c}) B_{s,t-1}^{c} + S_{s,t}^{c,1} div_{1,s,t}^{c} + q_{1,t}^{c} S_{s,t-1}^{c,1} + S_{s,t}^{c,2} div_{2,s,t}^{c} + q_{2,t}^{c} S_{s,t-1}^{c,2} + pF_{s,t}^{c} - PI_{t}^{c} C_{s,t}^{c} + W_{t}^{c} (L_{1,s,t}^{c} + L_{2,s,t}^{c} + L_{f,s,t}^{c}) \quad (6)$$

where $PI_{t}^{c}$ is the ideal CES price deflator.

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

$$\frac{\partial \mathcal{L}}{\partial C_{s,t}^{c}} = {C_{s,t}^{c}}^{-\sigma^{c}} - \lambda_{s,t}^{c} PI_{t}^{c} = 0 \quad (7a)$$

$$\frac{\partial \mathcal{L}}{\partial B_{s,t}^{c}} = -\lambda_{s,t}^{c} = \beta \lambda_{s,t+1}^{c} (1 + i_{t}^{c}) = 0 \quad (7b)$$

$$\frac{\partial \mathcal{L}}{\partial S_{s,t}^{c,i}} = -\lambda_{s,t}^{c}\left(q_{i,t}^{c} + div_{i,t}^{c,i}\right) - \zeta_{t}^{c} V_{S_{i,t}}^{S} = \beta \lambda_{s,t+1}^{c} q_{i,t+1}^{c} = 0 \quad (7c)$$

$$\frac{\partial \mathcal{L}}{\partial B_{s,t}^{W,c}} = -\lambda_{s,t}^{c} E_{t} + \xi_{t}^{c} U_{B_{s,t}^{W,c}} E_{t} + \beta \lambda_{s,t+1}^{c} \left(1 + i_{t}^{c^{*}}\right) E_{t+1} = 0. \quad (7d)$$

The first order conditions for the bond tradable amongst all domestic cohorts $B_{s,t}^{c}$ determines the riskless rate and the no-arbitrage condition for stocks of the representative type *i* firm

$$q_{i,t}^{c} = div_{i,s,t}^{c} + \frac{1}{1 + i_{t}^{c}} q_{i,t+1}^{c}. \quad (8)$$

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

$$1 + i_{t}^{RoW} = \frac{1 + i_{t}^{US}}{1 - \xi_{t}^{RoW} U_{B_{s,t}^{W,RoW}}} \left(\frac{E_{t+1}}{E_{t}}\right). \quad (9)$$

Preference for the dollar denominated financial asset of RoW households 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 an inelastic labor supply.

**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 1 firms conduct international transactions with the RoW via FDI.

Type 1 firms:

The representative type 1 firm produces output $Y_{1,\mathrm{t}}^{c}$ with a capital aggregate $K_{1,\mathrm{t}}^{c}$ and labor $L_{1,\mathrm{t}}^{c}$, using a Cobb-Douglas production function with technology index $A_1^c$

$$Y_{1,\mathrm{t}}^{c} = (A_1^c L_{1,\mathrm{t}}^{c})^{\alpha} K_{1,\mathrm{t}}^{c}{}^{1-\alpha}. \tag{10}$$

The capital aggregate is itself a CES composite of domestic and foreign capital and we assume identical elasticity of substitution and share parameters as for consumption

$$K_{1,t}^{c} = \left[\sum_k s_1^{k\frac{1}{\sigma}} K_{1,k,t}^{c}{}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}. \qquad \ldots\ldots(11)$$

Type 1 firms face domestic demand

$$Y_{1,t}^{D,c} = s^1 \left(\frac{PI_t^c}{P_{1,t}^c}\right)^{\sigma} (C_t^c + I_{1,t}^c + I_{2,t}^c) \tag{12a}$$

and foreign demand

$$X_{1,t}^{c} = s^m \left(\frac{PI_t^{c^*} E_t}{P_{1,t}^c}\right)^{\sigma} \left(C_t^{c^*} + I_{1,t}^{c^*} + I_{2,t}^{c^*}\right) \tag{12b}$$

where $PI_t^c$ and $PI_t^{c^*}$ is the ideal price index in c and $c^*$.

The representative type 1 firm is monopolistically competitive and faces price elasticity $\varepsilon_1^c$ 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 mark up 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.

$$Max\ V_{1,\mathrm{t}}^{c} = \sum_{j=0}^{\infty} \prod_{k=0}^{j} \left(\frac{1}{1+i_{t+k}^c}\right)^{k} div_{1,t+j}^{c} \tag{13}$$

where

$$div_{1,t}^{c} = P_{1,t}^{c}\left(Y_{1,t}^{D,c}; \varepsilon_1^c\right) Y_{1,t}^{D,c} + P_{1,t}^{c}\left(X_{1,t}^{c}; \varepsilon_1^c\right) X_{1,t}^{c} - W_t^c L_{1,t}^{c} - P_{1,t}^{C^c} I_{1,t}^{c}. \tag{14}$$

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:

Type 2 firms produce output $Y^c_{2t}$ for the domestic market and via a subsidiary for the foreign market $Y^{c^*}_{ft}$ using an identical technology

$$Y^c_{j,t} = (A^c_2 L^c_{j,t})^{\alpha} {K^c_{j,t}}^{1-\alpha} \quad , j = 2, f. \tag{15}$$

The capital aggregate is itself a CES composite of domestic and foreign capital

$$K^c_{j,t} = \left[\sum_k {s_j^{j}}^{\frac{1}{\sigma}} {K^c_{j,k,t}}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \; j = 2, f \;. \tag{16}$$

Aggregate domestic demand for type 2 is given by

$$Y^{D,c}_{2,t} = s^2 \left(\frac{PI^c_t}{P^c_{2,t}}\right)^{\sigma} (C^c_t + I^c_{1,t} + I^c_{2,t} + I^{c^*}_{f,t}) \tag{17a}$$

and their subsidiaries face the following aggregate demand schedule from foreign consumers and foreign firms

$$Y^{D,c^*}_{f,t} = s^2 \left(\frac{PI^{c^*}_t}{P^{c^*}_{f,t}}\right)^{\sigma} \left(C^{c^*}_t + I^{c^*}_{1,t} + I^{c^*}_{2,t}\right). \tag{17b}$$

The MNCs are monopolistically competitive in home and foreign markets and face price elasticity $\varepsilon^c_2$ and $\varepsilon^c_f$ 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.

$$Max\; PDV^c_{2,0} = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}}\right)^{k} (\, div^{c,D}_{2,t} + div^{c,S}_{2,t} E_t) \tag{18}$$

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

$$div^{c,D}_{2,t} = P^c_{2,t}\left(Y^c_{2,t}; \varepsilon^c_2\right) Y^c_{2,t} - W^c_t L^c_{2,t} - P^{C^c}_{2,t} I^c_{2,t} \tag{19a}$$

$$div^{c,S}_{2,t} = \left(P^{c^*}_{f,t}\left(Y^{c^*}_{f,t}; \varepsilon^c_f\right) Y^{c^*}_{f,t} - W^{c^*}_t L^{c^*}_{f,t} - P^{C,FDI^{c^*}}_{f,t} I^{c^*}_{f,t}\right) E_t. \tag{19b}$$

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

### 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.

<u>Goods market</u>

Type 1 firms

$$Y_{1,t}^{c} = C_{1,t}^{c} + C_{1,t}^{c^*} + I_{1,1,t}^{c} + I_{1,2,t}^{c} + I_{1,f,t}^{c} + I_{1,1,t}^{c^*} + I_{1,2,t}^{c^*} + I_{1,f,t}^{c^*}. \tag{20}$$

Type 2 firms

$$Y_{2,t}^{c} = C_{2,t}^{c} + I_{2,1,t}^{c} + I_{2,2,t}^{c} + I_{2,f,t}^{c} + I_{2,f,t}^{c^*}. \tag{21}$$

FDI firms

$$Y_{f,t}^{c^*} = C_{f,t}^{c^*} + I_{f,1,t}^{c^*} + I_{f,2,t}^{c^*}. \tag{22}$$

Labor market (domestic economy)

$$L_{t}^{c} = L_{1,t}^{c} + L_{2,t}^{c} + L_{f,t}^{c}. \tag{23}$$

### Current account sustainability

The current account $CA_t^c$ consists of the trade balance of goods and services $TB_t^c$, interest income balance from the holding of internationally tradable bonds $IntY_t^c$ , and the FDI profit balance $PRB_t^c$

$$CA_t^c = TB_t^c + IntY_t^c + PRB_t^c. \tag{24}$$

With the trade balance

$$TB_t^c = (P_{1,t}^{c} X_{1,t}^{c} - P_{1,t}^{c^*} E_t X_{1,t}^{c^*}) + (P_{t,2}^{c} X_{2,t}^{c} - P_{t,2}^{c^*} E_t X_{2,t}^{c^*}) \tag{25}$$

the interest income balance

$$IntY_t^c = i_{t-1}^{c^*} B_{t-1}^{W,c} E_t \tag{26}$$

and the FDI income balance[6]

[6] Note, the 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 BOP definitions.

$$PRB_t^c = (div_{2,t}^{c,S} E_t - div_{2,t}^{c^*,S}). \tag{27}$$

In this section, it will be shown that with FDI, the sustainability condition for the external balance is affected by the market value of foreign investment. Since technology shocks originating with domestic and foreign MNCs affect the market value of FDI positions, there is a link between technology shocks and the persistence of the current account.

Foreign assets evolve according to

$$B_t^{W,c} E_t + V_{ft}^c - V_{ft}^{c^*} = \left(1 + i_{t-1}^{c^*}\right) B_{t-1}^{W,c} E_t + \left(P_{1,t}^c X_{1,t}^c - P_{1,t}^{c^*} E_t X_{1,t}^{c^*}\right) +$$

$$\left(P_{t,2}^c X_{2,t}^c - P_{t,2}^{c^*} E_t X_{2,t}^{c^*}\right) + div_{2,t}^{c,S} E_t + V_{f,t-1}^c - div_{2,t}^{c^*,S} - V_{f,t-1}^{c^*}. \tag{28}$$

However, in each period the stock of existing assets in period t and the stock of assets from the previous period are valued at the current stock price (and the number of shares remains constant), thus we have:

$$V_{f,t}^c = q_{f,t}^c S_{f,t} \text{ and } V_{f,t-1}^c = q_{f,t}^c S_{f,t-1} \text{ and } S_{f,t} = S_{f,t-1} \;\; \rightarrow \;\; V_{f,t}^c = V_{f,t-1}^c. \tag{29}$$

Iterating forward equation 28 and imposing a no Ponzi game condition on net foreign debt

$$\lim_{T\to\infty} \left(\prod_{k=0}^{T-1} \left(\frac{1}{1+i_{t+k}}\right)^k\right) B_{T+1}^{W,c} E_{T+1} = 0 \tag{30}$$

reveals that sustainability requires that the value of net foreign debt is equal to the PDV of the trade surplus and net FDI income.

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

$$\sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}}\right)^k div_{2,t}^{c^*,S}, \tag{31}$$

since the PDV of current and future (distributed) profits is equal to the market value of FDI capital

$$V_{f,0}^c = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}}\right)^k div_{2,t}^{c,S} E_t \tag{32}$$

$$V_{f,0}^{c^*} = \sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}}\right)^k div_{2,t}^{c^*,S}. \tag{33}$$

We can also express the sustainability condition as equality between the value of net foreign financial wealth plus the net market value of FDI assets (where FDI assets are evaluated at their current market price) and the PDV of future trade deficits:

$$\left(1 + i_{t-1}^{c^*}\right) B_{-1}^{W,c} E_0 + V_{f,0}^c - V_{f,0}^{c^*} = -\sum_{t=0}^{\infty} \prod_{k=0}^{t} \left(\frac{1}{1+i_{t+k}}\right)^k TB_t^c. \tag{34}$$

To the extent to which a technology shock affects the (net) market value of foreign subsidiaries of MNCs positively, the PDV of the trade balance becomes more negative. 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 CA to demand/risk premia and supply/technology shocks and to show that technology shocks affecting foreign operations (and dividend income) generate persistence of the CA. 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.

Technology

$$Y_t = A_t L_t^{\alpha}, \;\; \alpha < 1 \tag{35}$$

Wage income

$$\alpha Y_t = W_t L_t \tag{36}$$

Profit income

$$\Pi_t = (1-\alpha) Y_t. \tag{37}$$

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).

<u>Life Cycle Consumption</u>

$$C_t = (\rho + p)\left(F_{t-1} + \frac{Y_t}{r_t + p}\right) \tag{38}$$

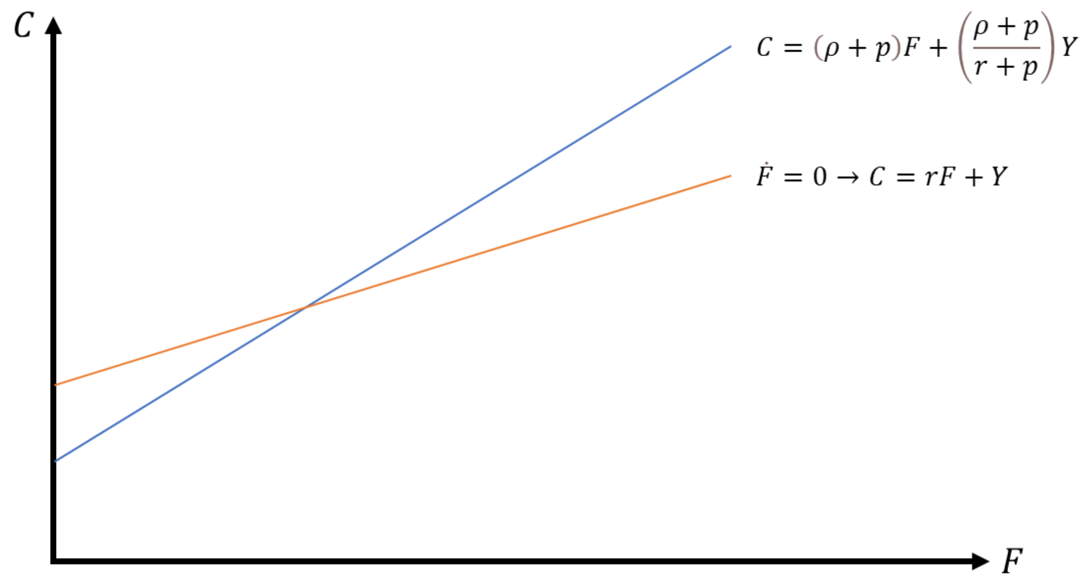
where $\rho$ is the rate of time preference and $p$ the probability of death. The household budget constraint and the goods market equilibrium condition imply the following net foreign asset equation.

<u>Net Foreign Assets</u>

$$CA_t = \Delta F_t = r_t F_{t-1} - C_t + Y_t. \tag{40}$$

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.

**Figure 9: Phase diagram for C and F**




*Source: Own representation.*

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 CA balance

$$F_T - F_0 = \sum_{t=0}^{T} CA_t, \tag{41}$$

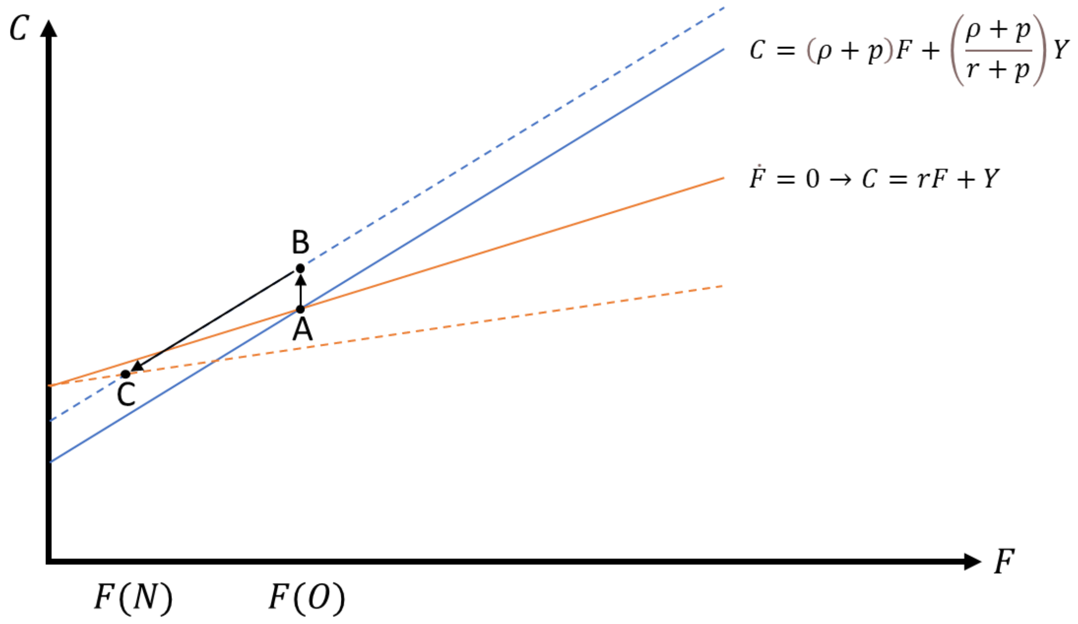
a permanent change in the NFA position between period T and period 0 reflects the sum of CA imbalances over the same period.

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.

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 CA 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, $\Delta r < 0$**

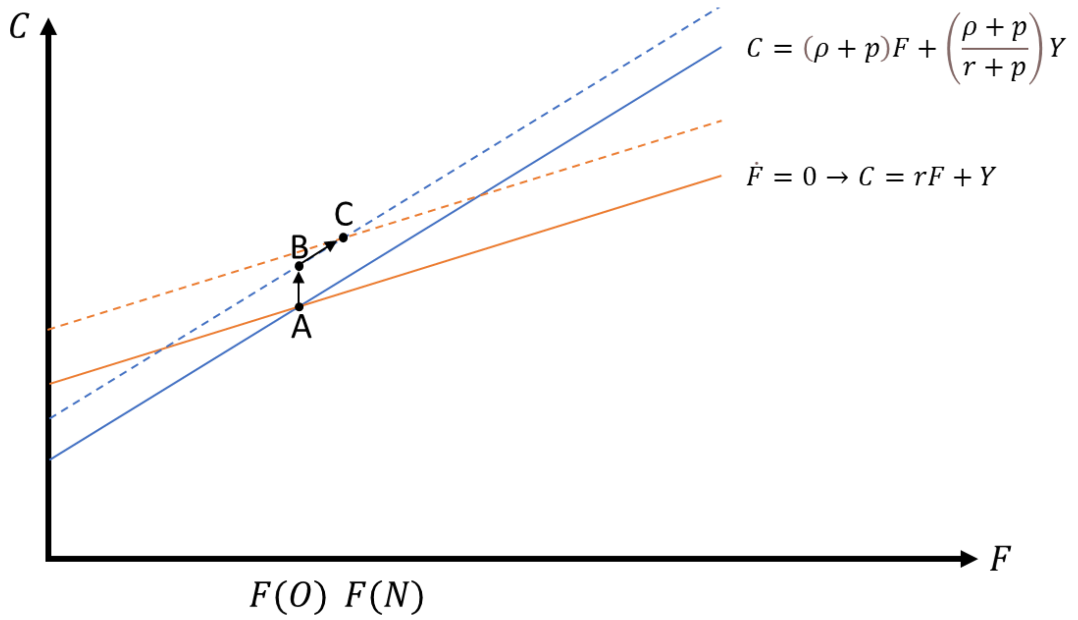



*Source: Own representation.*

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 CA imbalances related to technology shocks

**Figure 11: Technology Shock, $\Delta Y > 0$**




*Source: Own representation.*

<u>A shock to a foreign source of income:</u>

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

$$V_t = D_t + \frac{1}{1+r_t} V_{t+1}. \tag{42}$$

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

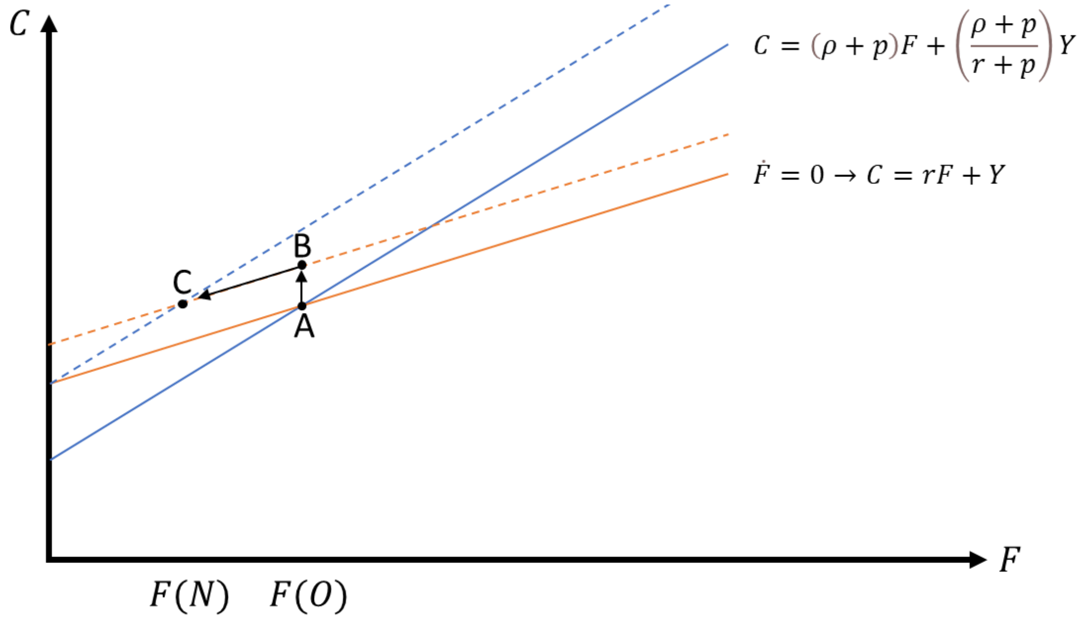
$$C_t = (\rho + p)\left(F_{t-1} + V_t + \frac{Y_t}{r_t+p}\right) = (\rho + p)\left(F_{t-1} + \frac{D_t}{r_t} + \frac{Y_t}{r_t+p}\right). \tag{43}$$

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

$$CA_t = \Delta F_t = r_t F_{t-1} - C_t + Y_t + D_t. \tag{44}$$

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 CA balance. Comparing scenario 3 with scenario 2, one can see that similar CA 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, $\Delta D > 0$**




*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 the World GDP. The economy is initially in a steady state with zero external balances. To be realistic, a home bias is included, i.e. the share parameters in CES aggregates for C and I are consistent with a US import share of 15 percent. The share parameters in the CES aggregate for imports and FDI production are consistent with a share of FDI production of 12 percent. This order of magnitude roughly corresponds to the recent US outward FDI-US capital stock ratio (UNCTAD, 2021).

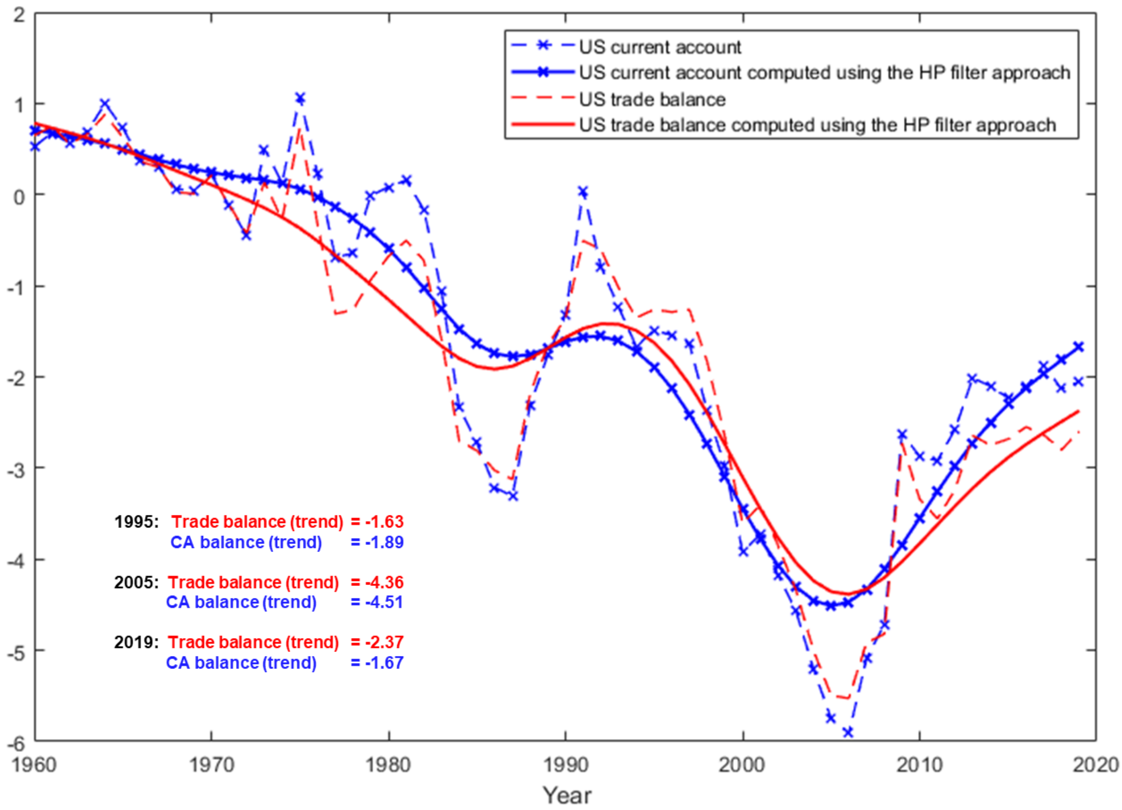
Concerning savings, the rate of time preference is set to 0.01, and the household planning horizon to 40 years. We assume a constant equity premium of 4% (see Caballero et al (2017)) All firm types use a Cobb-Douglas technology with output elasticity for capital and labor of 0.4 and 0.6, respectively. The depreciation rate on capital is set to 5 percent p.a.. We set the adjustment cost parameter to 2.5 which ensures that investment is between 2 and 3 times as volatile as GDP. There is monopolistic competition with a mark up of 10 percent. 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. This also makes sure that we are matching the EoS between domestic and foreign goods as reported in empirical studies. (see e. g. Boehm et al. (2023) and Francois and Woerz (2009)). These values have also been used by Klein and Linnemann (2021) and Benigno and Thoenissen (2008). Annex 2 shows a sensitivity analysis with elasticity parameters 1, 2, and 3.

**How to match the period from 1995 to 2004 (and beyond)?**

To shed more light on the ability of both hypotheses to match the stylized facts of the US CA and TB, we conduct the following experiment: We calculate their trend evolution 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 the sample. 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 (Actual vs. Trend)**




*Note: CA/GDP Trend: HP Filter ($\lambda = 100$).*
*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) as well as information about the US Treasury Basis over the same period (see Figure 5) to identify technology and safe asset innovations. We assume that both types of innovations constitute a sequence of unanticipated TFP and safe asset shocks over the period 1995 to 2005.

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. This shock is implemented by assuming that US type 1 and type 2 firms have been hit uniformly[7].

Treasury Basis:

Our safe asset innovations are intended to match the sharp increase of the Treasury Basis between 1996 and 2000 (see Jiang et al 2021) and an average value that has exceeded the pre 1996 mean by about 37 basis points. Visual inspection and time series analysis of the Treasury Basis reveals that the Treasury Basis is not permanently increased but has been hit by a sequence of positive shocks. To give the safe asset 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 2 in the appendix). To account for the increase between 1995 and 2000 we assume a sequence of positive innovations in the first five years of 7 BPS p. a and followed by smaller positive innovations between 2001 and 2005 (2 BPS p.a.). Following Fisher (2014), and Krishnamurthy and Vissing-Jorgensen (2012), the safe asset shock is implemented as a portfolio preference shock to the demand for the internationally traded bond (denominated in US dollars) in the utility function of households in the RoW.

In a second step, conditional on the state of the economy in 2005 we project the evolution of the current account and its components until 2019. This allows us to address the following two dimensions of the US current account since 1995, namely first, how well can our sequence of shocks match the unprecedented increase of the CA and TB deficit until its peak in 2005, and second, we can test how well the two alternative shock realizations can account for the persistence of the external balance over the period 2005/19[8].

## 6. Matching the US Current Account: Technology vs Safe Asset

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. We proceed in two steps. First, we analyze how our model economy responds to a typical TFP and safe asset shock. Since the economy responds differently to TFP shocks originating with type 1 and type 2 firms

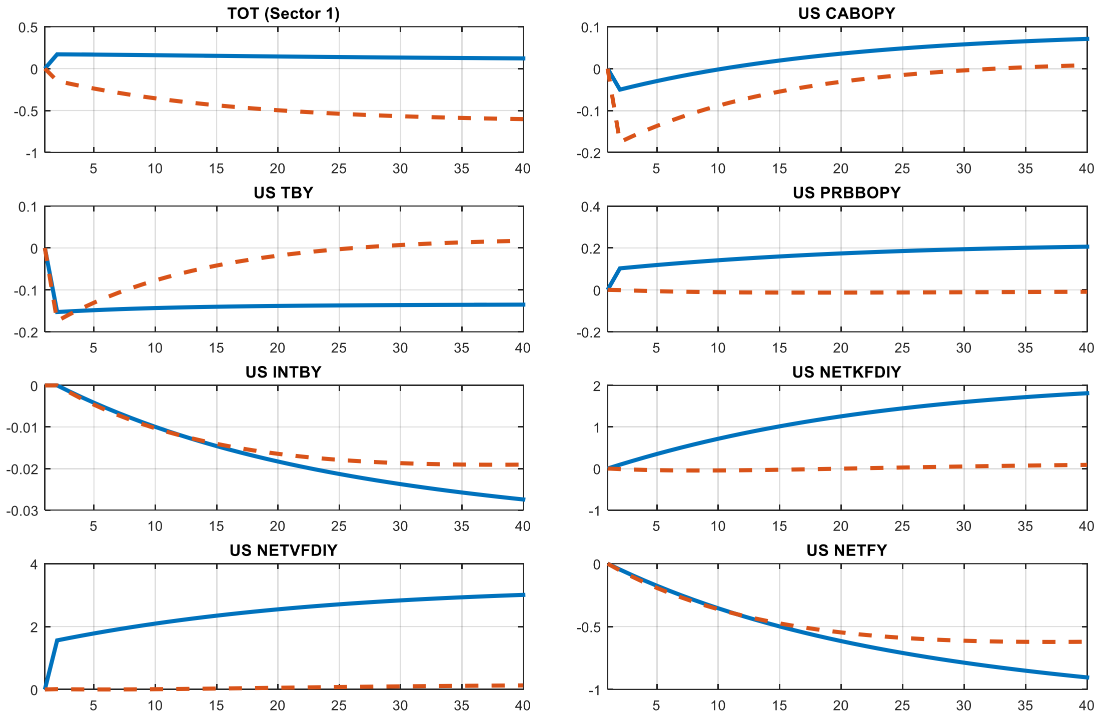
[7] We give a TFP shock of 1.3% p.a. for US type 1 and type 2 firms but no TFP shock for subsidiaries of RoW MNCs operating in the US.
[8] Our projection ends in 2019, one year before the emergence of the COVID-19 shock.

we also highlight these differences. In a second step, we show how well TFP and safe asset shocks can match the trend evolution of the US current account and its components.

### Impulse response analysis

Figure 14 compares the effect of a 1.3 percent shock to the level of TFP of US type 1 and type 2 firms. There are several noteworthy differences.

**Figure 14: US TFP Shock Type 1 vs. Type 2 Firms (1.3%)**

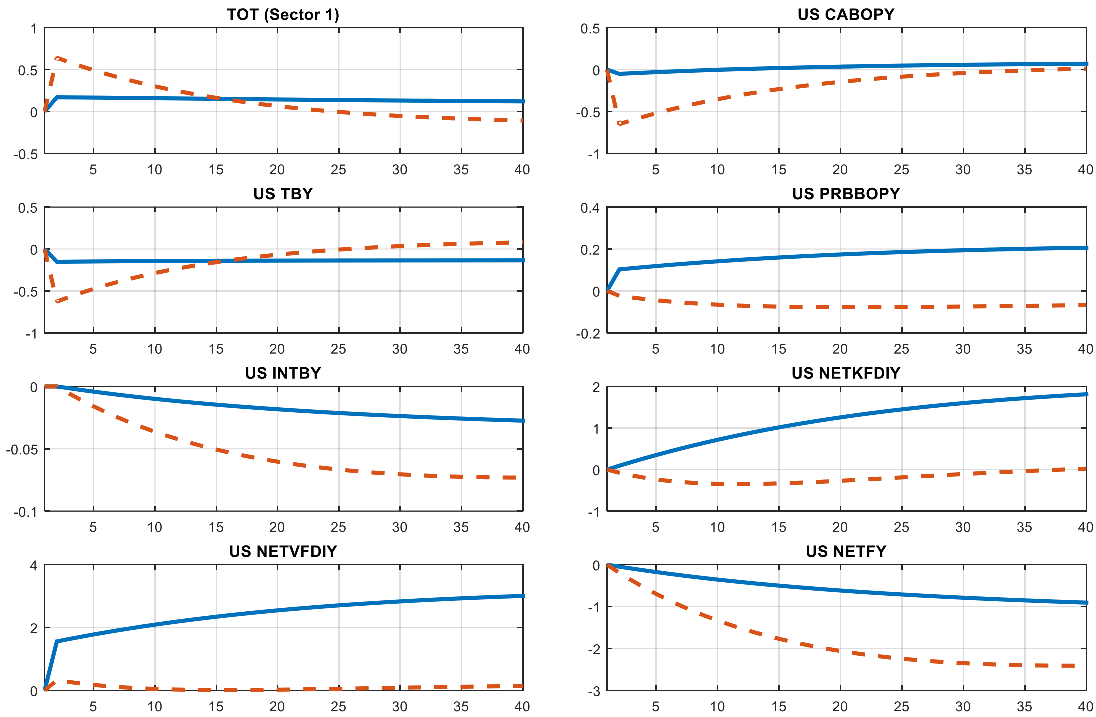



*———: Type 2 TFP shock --------: Type 1 TFP shock*

*Note: TOT: Terms of trade (type 1); CAY: Current account (% of GDP); TBY trade balance (% of GDP); PRBY: Primary income balance (% of GDP, BOP Definition); INTBY: Interest income balance (% of GDP); NETKFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in the US at current cost, (% of GDP); NETVFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in US at market value, (% of GDP); NETFY: US (safe) financial asset (% of GDP).*
*Source: Own representation.*

Firstly, 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 net US FDI assets (US NETVFDI). A type 1 TFP shock leaves the value of net US FDI assets nearly unaffected. 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 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 FDI 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 CA balance invested earnings increase the CA balance. Finally, the type 1 and 2 TFP shocks have opposite effects on the terms of trade, where the terms of trade is defined as the relative price of type 1 firms in the US and RoW. We loosely refer to goods of type 1 firms as tradables. The difference in the terms of trade adjustment can be explained via a Balassa-Samuelson type of effect. A type 1 TFP shock reduces the prices of domestic tradables relative to imports, while a type 2 TFP shock increases the prices of tradables because of an increase in labor cost of type 1 firms.

**Figure 15: Type 2 TFP (+1.3%) vs Safe Asset Shock (+10BP annual)**



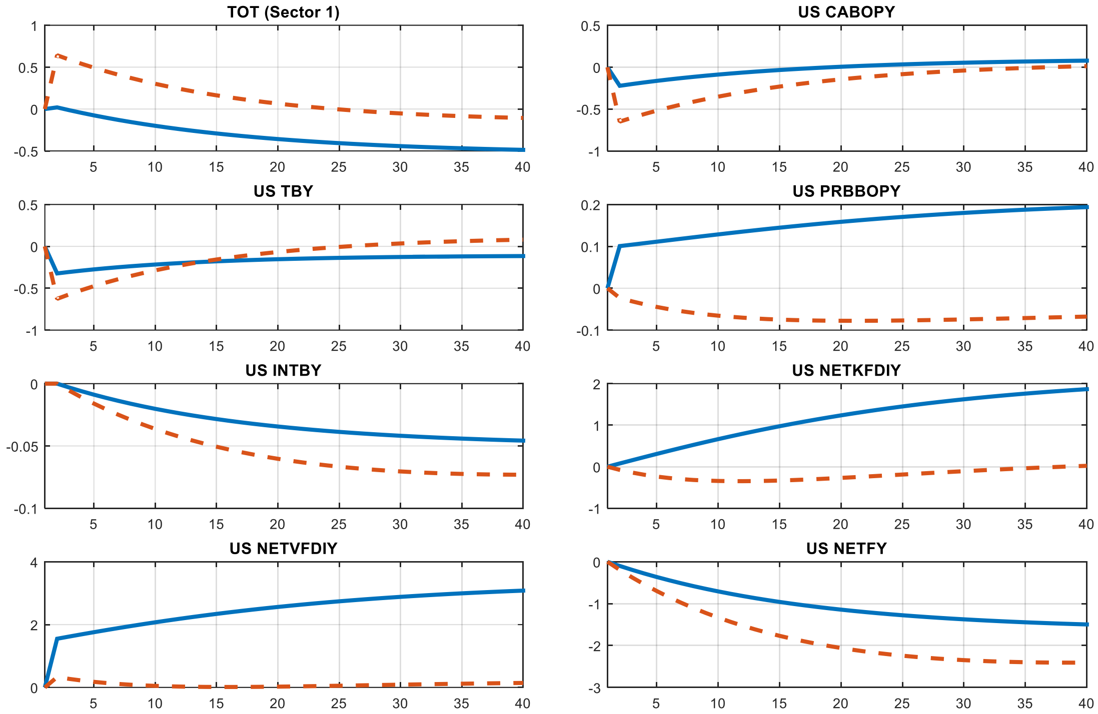

--------: *Safe Asset shock* ————: *Type 2 TFP shock*

*Note: TOT: Terms of trade (type 1); CAY: Current account (% of GDP); TBY trade balance (% of GDP); PRBY: Primary income balance (% of GDP, BoP definition); INTBY: Interest income balance (% of GDP); NETKFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in US at current cost, (% of GDP); NETVFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in US at market value, (% of GDP); NETFY: US safe asset (% of GDP).*
*Source: Own representation.*

Figure 15 shows that both the safe asset shock and the type 2 TFP shock can generate persistent external deficits. The trade balance responds more persistently to the TFP shock in type 2 firms while the safe asset shock can generate quite a persistent current account deficit. The technology shock better matches the primary income balance and can generate a positive FDI asset balance (both at market value and current cost), while the safe asset hypothesis generates a slightly negative FDI balance. This suggests that the technology shock will be better able to match the composition of US net foreign assets over the last three decades.

Figure 16 shows that the two TFP shocks increase the external deficit in the short run and also and the trade balance remains negative persistently.

**Figure 16: Type 1 and Type 2 TFP (+1.3%) vs Safe Asset Shock (+10BP annual)**




--------*: Safe Asset shock* ——————*: Type 1 and 2 TFP shock*

*Note: TOT: Terms of trade (type 1); CAY: Current account (% of GDP); TBY trade balance (% of GDP); PRBY: Primary income balance (% of GDP, BoP definition); INTBY: Interest income balance (% of GDP); NETKFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in US at current cost, (% of GDP); NETVFDIY: FDI assets of US MNCs minus FDI assets of foreign MNCs in US at market value, (% of GDP); NETFY: US safe asset (% of GDP).*
*Source: Own representation.*

## Matching the data

In the following, we analyze how well the shocks using our model can depict the US economy between 1995 and 2019. For this purpose, we run the SA shock and the TFP shock separately and simultaneously in the third run and compare the simulated variables with the HP trend-adjusted actual data.[9] As Figure 17 shows, the SA shock has a negative impact on the external balance. However, the extent of the shock remains relatively small, so it cannot accurately reflect both the dynamics and the long-term development of the current account and the balance – including the turning point in 2005 – in the actual data. The model with the SA shock can

[9] No HP filter is used to display the Treasury Basis actual data.

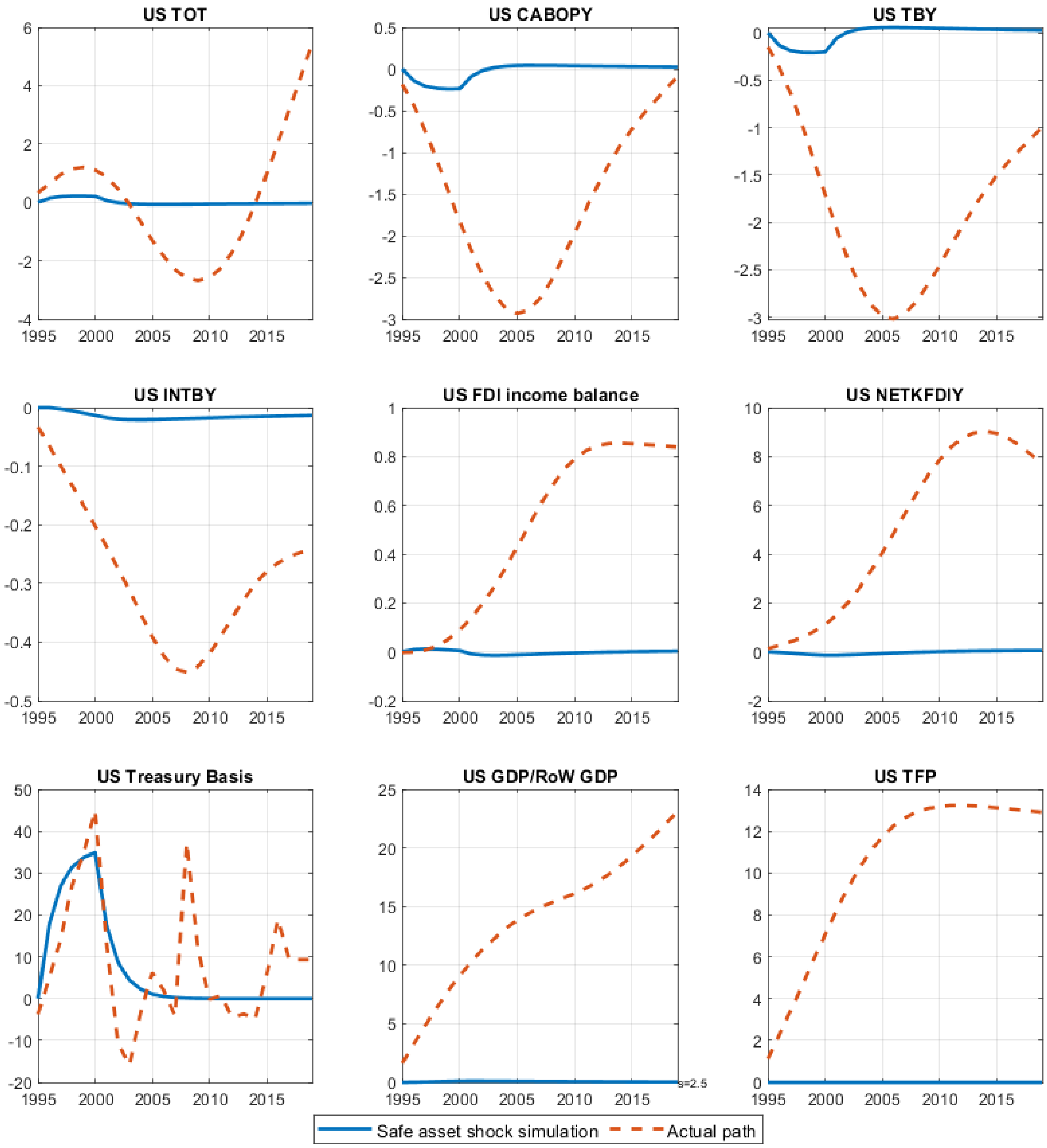
explain around 1.6 % and 0.4 % of the actual US current account and trade deficits, respectively.[10] Even if the SA shock implies a negative trend in the interest balance corresponding to the actual direction, the magnitude of the effect is also relatively small. It is also noticeable that the SA shock can partially describe the dynamics of the actual terms of trade: The modeled and actual development is initially positive and shows a negative trend after around five years. It is also noteworthy that the SA shock can partially account for the dynamics of the actual terms of trade: the modeled and actual evolution initially show a positive trend but exhibit a negative trend after around 2000. However, the magnitude of the impact of the SA shock on the terms of trade is limited, and it does not explain the long-term evolution of the terms of trade. Besides that, the actual path of the FDI income balance, the net FDI asset stock, and the development of the GDP ratio of the USA to the RoW cannot be properly matched by the SA shock.

The TFP shock offers a more precise explanation for the long-term evolution of both the current account and the trade balance, as illustrated in Figure 18. Notably, the trade balance is accurately explained across both dynamic and long-term perspectives. While the exact magnitude of the negative shift in the actual current account may not be precisely modeled, the TFP shock effectively captures the long-term trend of the US current account. A notable distinction from the SA shock is the congruence between the turning points of the modeled and actual current account and trade balance in the case of the TFP shock. Moreover, the TFP shock outperforms the SA shock in terms of explanatory power: it accounts for 69.7% of the actual US current account deficit and 86.2% of the trade balance deficit. It should be noted that the TFP shock improves the simulation of the trade balance and better reflects the empirical evidence that the trade balance falls more sharply than the current account, as shown in Figure 13. The TFP shock provides a relatively accurate description of the interest balance up to the outbreak of the financial crisis. However, it falls short of capturing the long-term trend, likely due to the influence of additional shocks after 2008. Notably, both the dynamic and long-run behavior of the US FDI income balance and net FDI asset stock are accurately explained. In addition, the TFP shock provides a relatively precise description of the dynamics of the GDP ratio between the USA and RoW up to around 2010. The simulated and actual GDP ratios may drift apart at the end of the calculation due to further shocks between 2010 and 2019. Although there are some similarities between the modeled and actual terms of trade in the initial years, the TFP shock is less accurate in capturing the dynamics and long-term evolution of the terms of trade.

The simultaneous application of both 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 slightly to 71.4% and 86.7%, respectively. It is also evident that the modeling of the dynamics of the terms of trade (up to around 2000) has improved somewhat compared with the previous modeling. However, the accuracy of the simultaneous shock to describe the actual course of the interest rate balance, FDI income balance, net FDI asset stock, and the GDP ratio between the USA and RoW is roughly equivalent to that of the TFP shock.

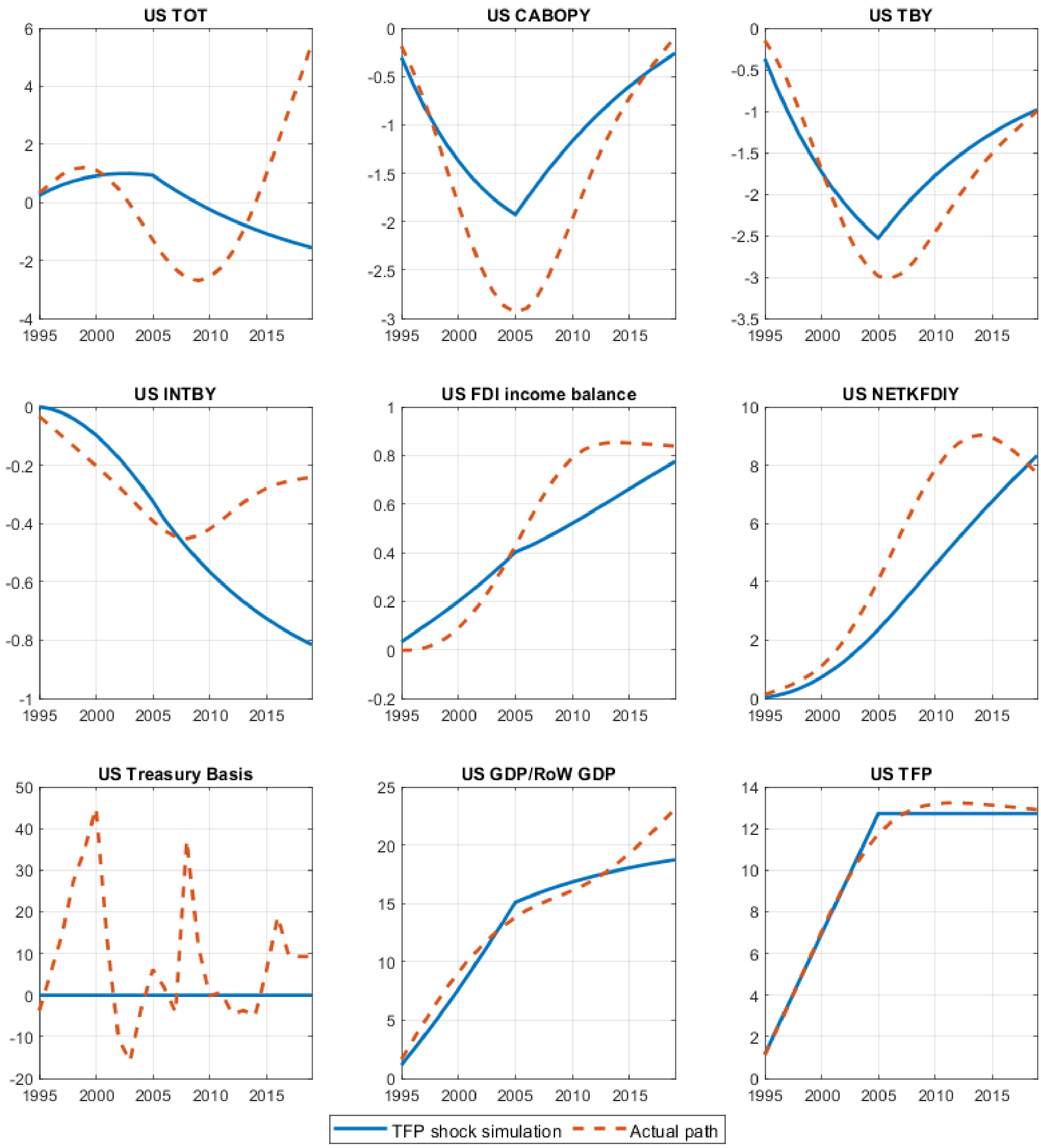
[10] To calculate the proportion of CA and trade balance explained, we have taken the cumulative value generated by the model relative to the cumulative actual HP filtered data.

**Figure 17: Safe Asset Shock (1996-2000: +18BP annual): Simulated and Actual Trends**



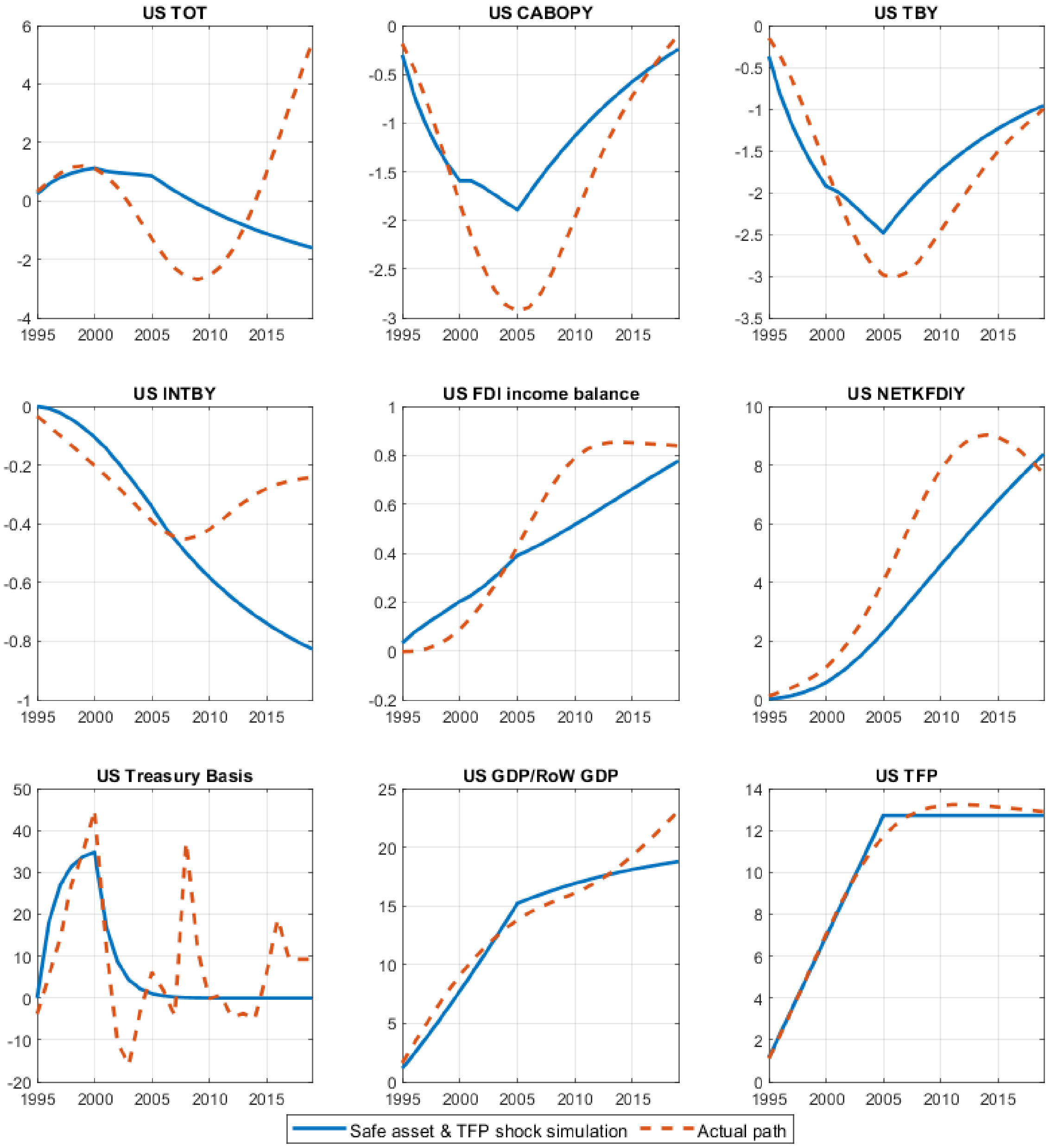

*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Figure 18: TFP Shock (1.3% both types): Simulated and Actual Trends**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Figure 19: Simultaneous Safe Asset (1996-2000: +18BP annual): & TFP Shock (1.3% both types): Simulated and Actual Trends**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

## 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 hypothesis, 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 are loosening 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. In particular, the dynamic effects of MNC technology shocks on the external balance and especially the trade balance are very persistent, reflecting the empirical pattern observed in the USA. Using both shocks, our model can explain about 71.4 % and 86.7 % of the HP trend in the US current account and trade deficits between 1995 and 2019, respectively. As compared to the SA shock, the TFP shock showed a higher proportion of explanation of the actual US CA (69.7% vs. 1.6%) and trade balance (86.2% vs. 0.4%). Furthermore, MNC technology shocks better match the evolution of the FDI income balance and the net FDI capital balance for the US since the mid-1990s.

Our results suggest that a richer set of shocks is relevant for explaining persistent external balance dynamics in the US. Our model results should also be useful to better understand external imbalances in other industrialized countries. With more multinationals emerging in Asian Newly Industrialized Countries, macroeconomic developments – for example, in leading ASEAN countries – could also be better understood than traditional DSGE models thus far allow. As regards economic policy monitoring by the International Monetary Fund, the new approach presented here should be generally useful to understand structural current account imbalances and to consider adequate policy remedies in the case of open economies with both major trade and foreign direct investment links.

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# Appendix

## Annex 1: Exports of Goods and Services and Affiliates Value-Added for Selected Countries, 1990-2018

### Table 1: Exports of Goods and Services and Affiliates Value-Added for the US, Germany, the UK, Canada, France, Italy, and Japan in a Transatlantic and US-Japan Perspective, 1990-2018

| | Exports in Goods and Services by Partners in the percentage of GDP (GE is Germany) | | | | Value Added of Affiliates to GDP[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | | **(5)** | **(6)** | **(7)** | **(8)** |
| | **US EX to UK / UK GDP** | ***US EX to GE / GE GDP*** | *UK EX to US / US GDP* | GE EX to US / US GDP | | **US Affiliates in the UK / UK GDP** | ***US Affiliates in the GE / GE GDP*** | *UK Affiliates in the US / US GDP* | GE Affiliates in the US / US GDP |
| **1991** | **1.93%** | ***1.14%*** | *0.30%* | 0.42% | **1991** | - | - | - | - |
| **2000** | **4.46%** | ***2.34%*** | *0.69%* | 0.74% | **2000** | **6.69%** | ***3.10%*** | *0.54%* | 1.06% |
| **2010** | **4.24%** | ***2.21%*** | *0.64%* | 0.77% | **2010** | **6.19%** | ***2.52%*** | *0.78%* | 0.51% |
| **2019** | **5.22%** | ***2.50%*** | *0.59%* | 0.76% | **2018** | **5.92%** | ***2.14%*** | *0.82%* | 0.62% |

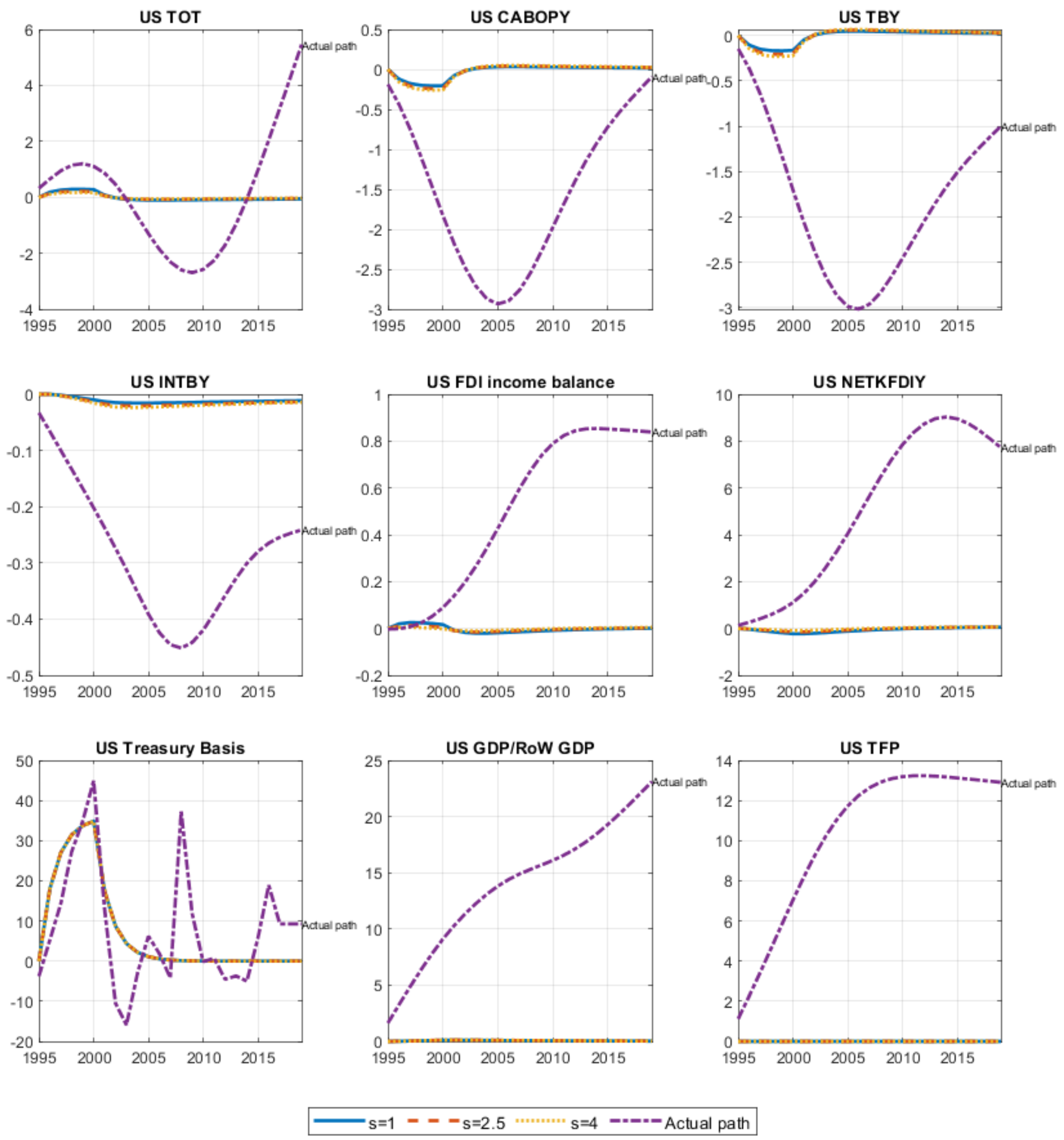
| | **US EX to CA / CA GDP** | ***US EX to FR / FR GDP*** | *CA EX to US / US GDP* | FR EX to US / US GDP | | **US Affiliates in CA / CA GDP** | ***US Affiliates in FR / FR GDP*** | *CA Affiliates in US / US GDP* | FR Affiliates in the US / US GDP |
|---|---|---|---|---|---|---|---|---|---|
| **1991** | **13.95%** | ***1.21%*** | *1.48%* | 0.22% | **1991** | - | - | - | - |
| **2000** | **27.51%** | ***2.26%*** | *2.47%* | 0.40% | **2000** | **9.90%** | ***2.64%*** | *0.36%* | 0.38% |
| **2010** | **19.06%** | ***1.71%*** | *2.07%* | 0.38% | **2010** | **8.09%** | ***1.90%*** | *0.38%* | 0.40% |
| **2019** | **20.80%** | ***2.22%*** | *1.70%* | 0.37% | **2018** | **7.84%** | ***1.88%*** | *0.60%* | 0.44% |

| | **US EX to JP / JP GDP** | ***US EX to IT / IT GDP*** | *JP EX to US / US GDP* | IT EX to US / US GDP | | **US Affiliates in JP / JP GDP** | ***US Affiliates in IT / IT GDP*** | *JP Affiliates in the US / US GDP* | IT Affiliates in the US / US GDP |
|---|---|---|---|---|---|---|---|---|---|
| **1991** | **1.34%** | ***0.69%*** | *1.49%* | 0.19% | **1991** | - | - | - | - |
| **2000** | **2.08%** | ***1.46%*** | *1.61%* | 0.31% | **2000** | **0.74%** | ***1.82%*** | *0.62%* | 0.05% |
| **2010** | **1.84%** | ***1.07%*** | *0.99%* | 0.25% | **2010** | **0.84%** | ***1.33%*** | *0.54%* | 0.06% |
| **2019** | **2.46%** | ***1.67%*** | *0.84%* | 0.32% | **2018** | **1.02%** | ***1.57%*** | *0.78%* | 0.05% |

*Note: [1] Value added (Gross product), All Majority-owned Foreign Affiliates (2010-2018), Majority-owned Nonbank Foreign Affiliates (2000)*
*Source: Own calculations and representation of data available from the BEA, US Census, WDI*

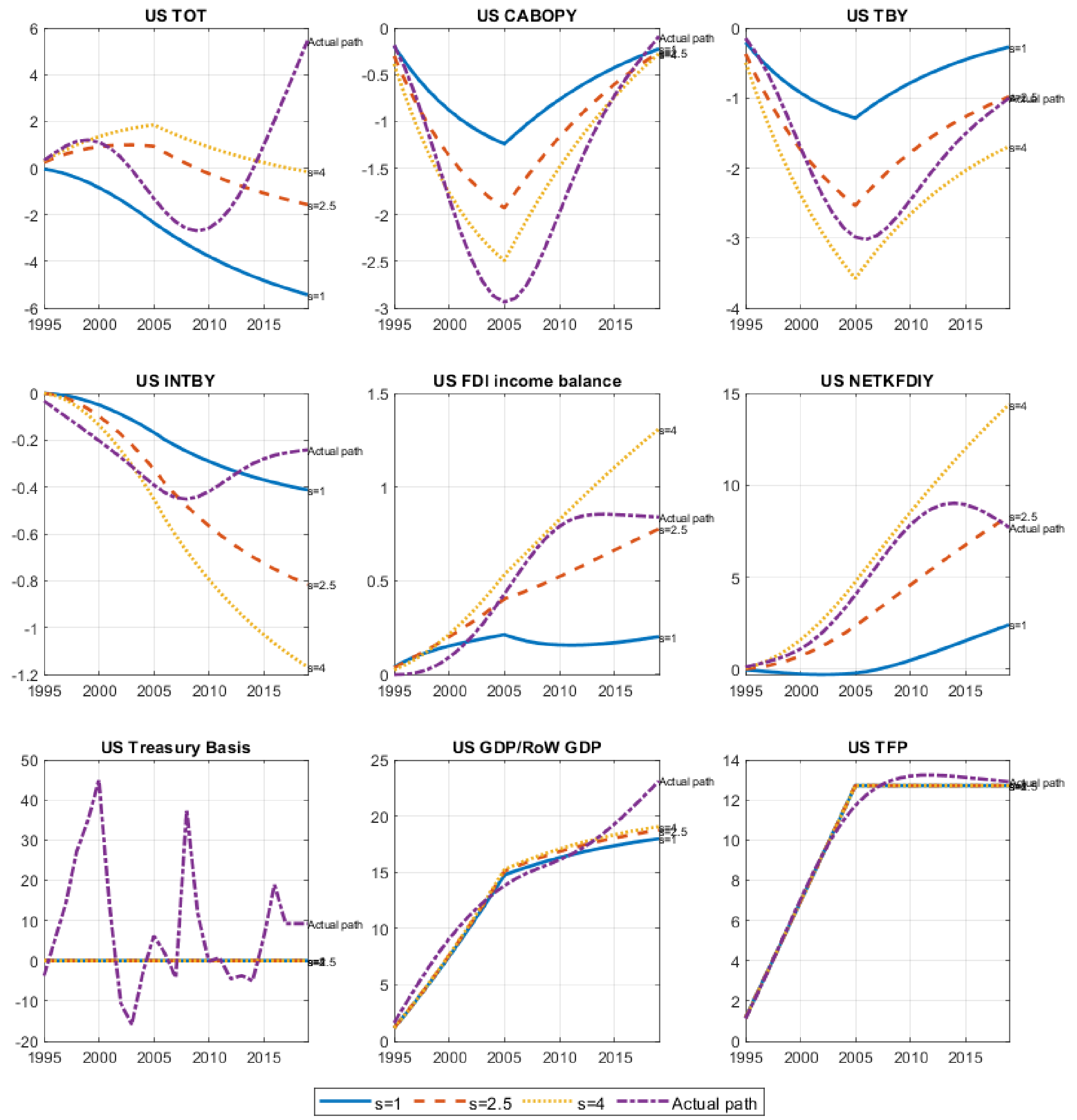
**Annex 2: Sensitivity analysis using alternative elasticities in household and firm preferences across different types of goods ($\boldsymbol{\sigma = \{1,\ 2.5,\ 4\}}$)**

**Figure 20: Safe Asset Shock (1996-2000: +18BP annual): Simulated and Actual Trends**



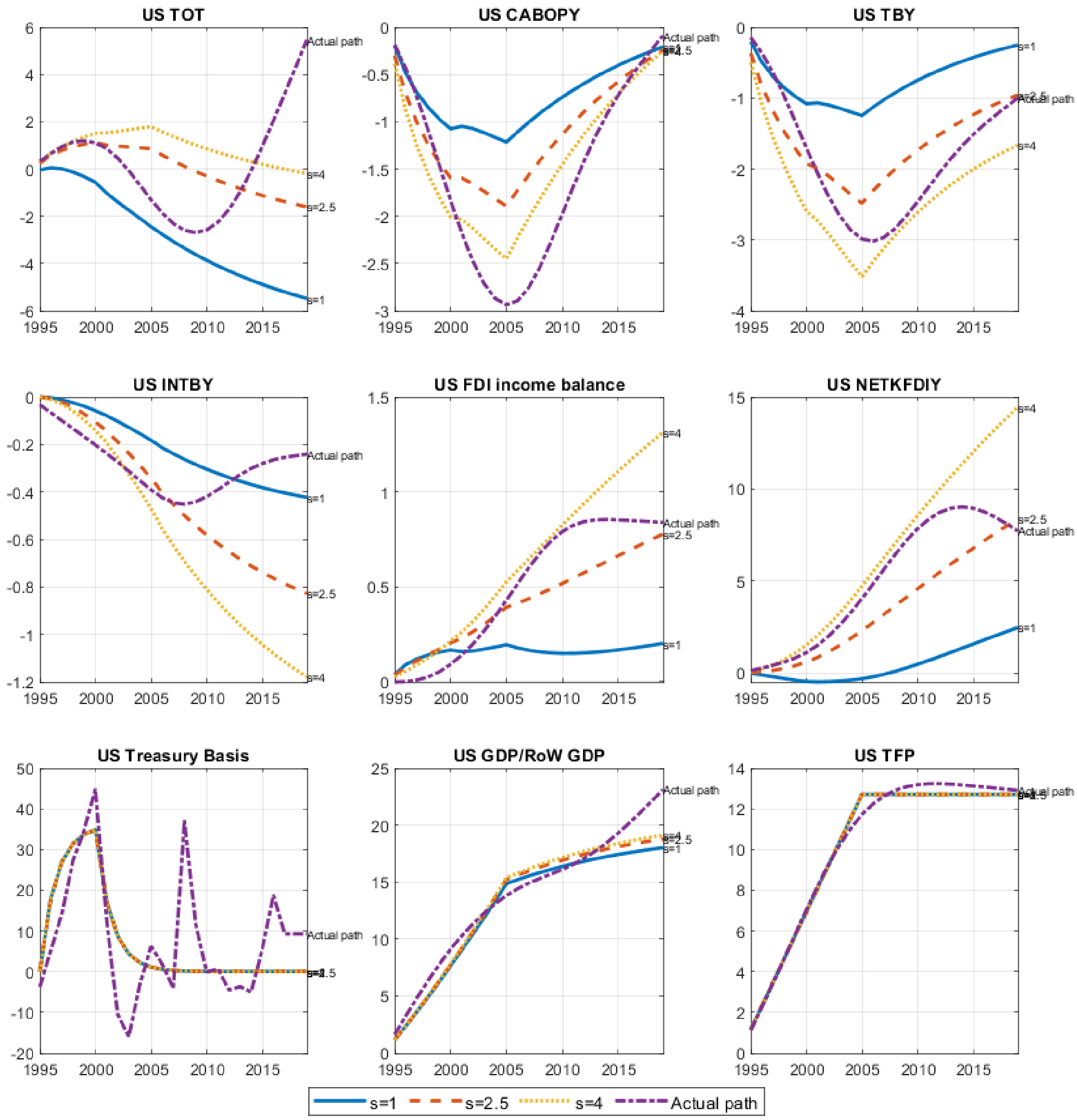

*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Figure 21: TFP Shock (1.3% both types) using modified elasticity of substitution($\boldsymbol{\sigma} = \{\mathbf{1},\ \mathbf{2.5},\ \mathbf{4}\}$)**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

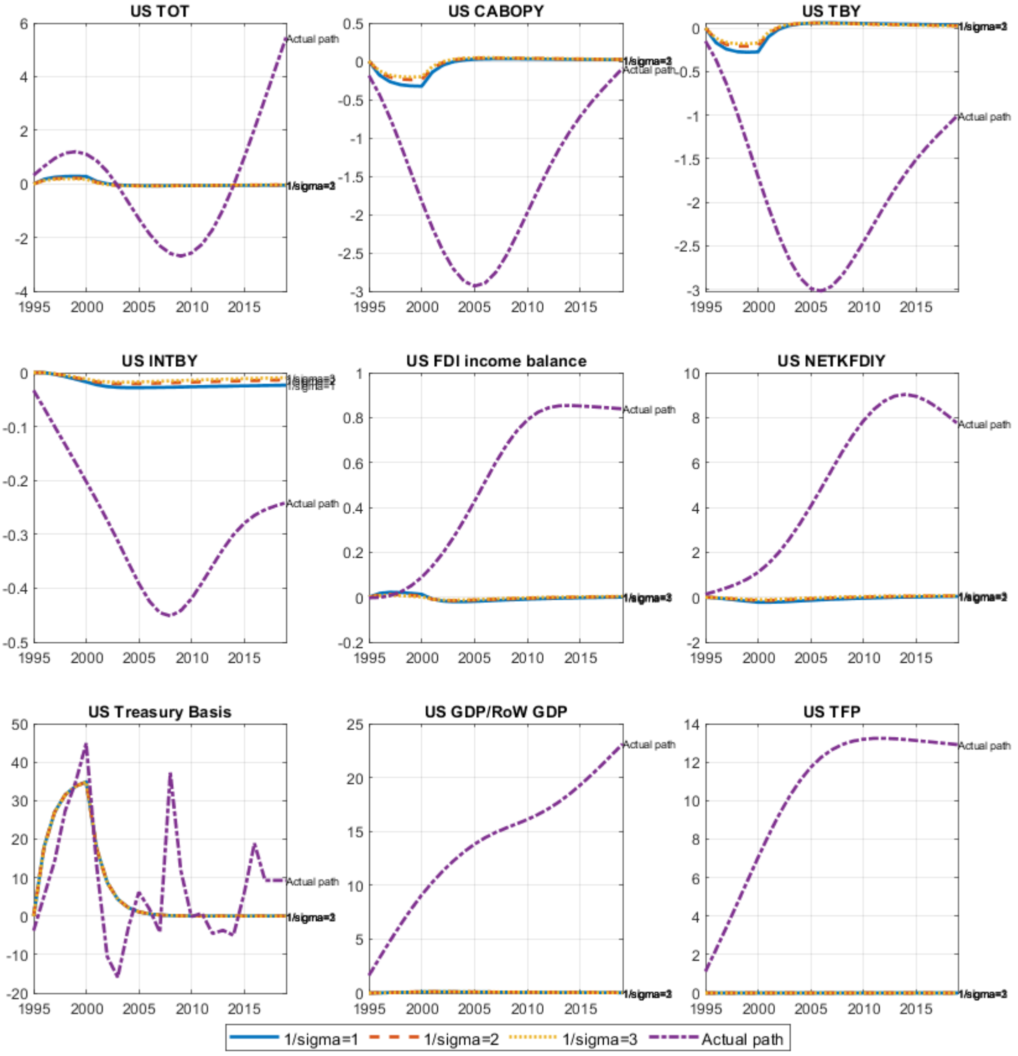
**Figure 22: Simultaneous Safe Asset (1996-2000: +18BP annual): & TFP Shock (1.3% both types) using modified elasticity of substitution ($\sigma = \{1,\ 2.5,\ 4\}$)**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

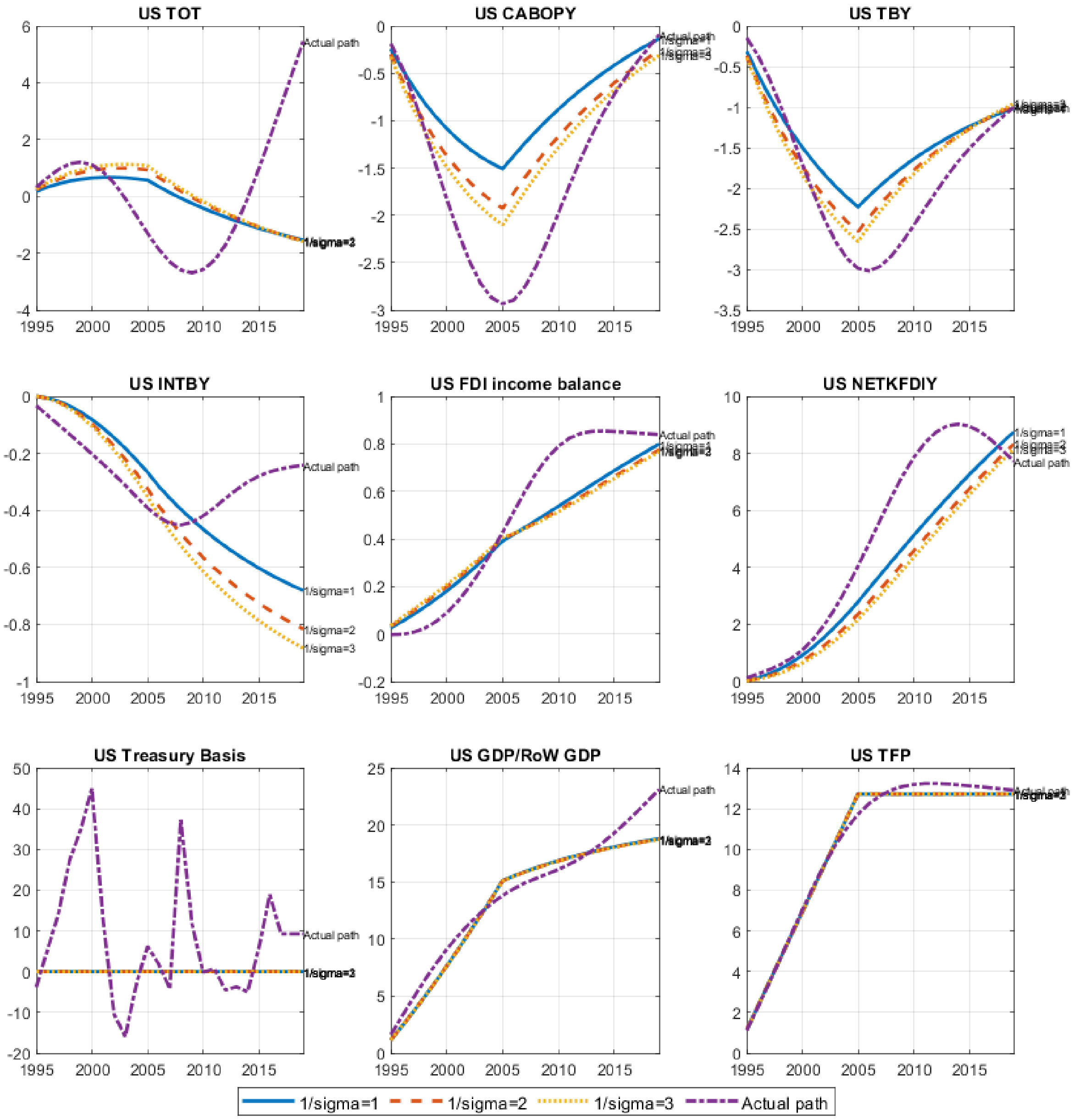
**Annex 3: Sensitivity analysis using modified intertemporal elasticity of substitution of consumption $\left({}^{1}/_{\sigma^{c}} = \{1, 2, 3\}\right)$**

**Figure 23: Safe Asset Shock (1996-2000: +18BP annual) using modified intertemporal elasticity of substitution of consumption $\left({}^{1}/_{\sigma^{c}} = \{1, 2, 3\}\right)$**



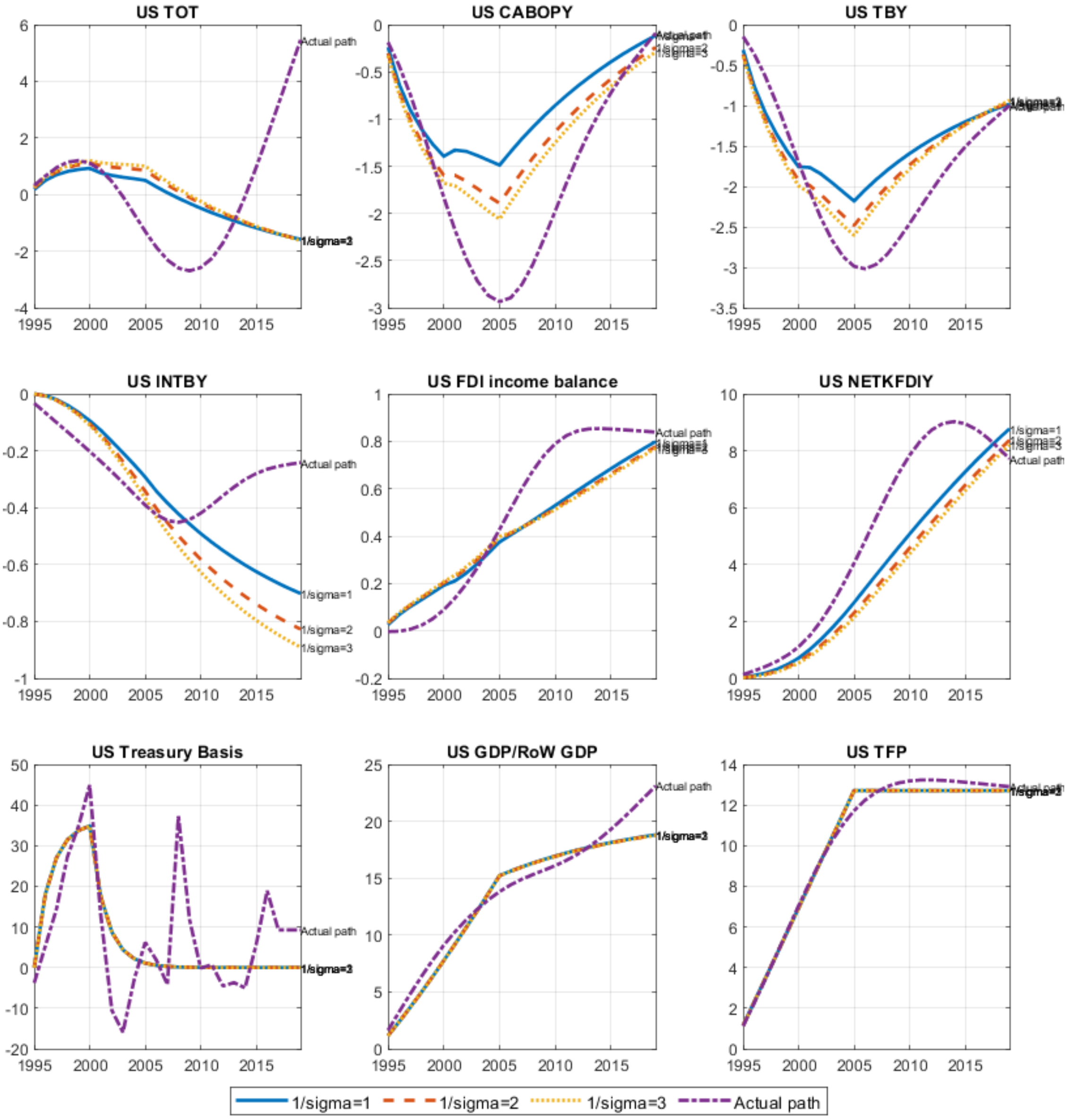

*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Figure 24: TFP Shock (1.3% both types) using modified intertemporal elasticity of substitution of consumption $\left(1/_{\sigma^{C}} = \{1, 2, 3\}\right)$**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Figure 25: Simultaneous Safe Asset (1996-2000: +18BP annual): & TFP Shock (1.3% both types) using modified intertemporal elasticity of substitution of consumption $\left(1/_{\sigma^C} = \{1, 2, 3\}\right)$**




*Note: TOT: Terms of trade (sector 1); CAY Current account (% of GDP); TBY Trade balance (% of GDP); INTBY: Interest income balance (% of GDP); NETKFDIY: Net FDI asset stock at current cost (% of GDP). An HP filter with lambda=100 was performed for all actual data except the US Treasury Basis. The TOT data was retrieved from FRED, Federal Reserve Bank of St. Louis (W369RG3Q066SBEA). The annual values of the Treasury Basis are derived from the reported quarterly data provided by Jiang et al (2021) by calculating annual averages. The actual US-TFP time series is calculated using the cyclically adjusted TFP data from Fernald (2014). The Penn World Table (version 10.01) database was used to calculate the US RoW GDP ratio. For this purpose, the GDP per hour growth difference between the US and OECD (ex USA) was calculated and cumulated from 1985 onwards. From 1995 onwards, the trend between 1985 and 1994 was subtracted from this value. The data for the OECD was calculated using GDP weights and includes all OECD countries except the following: Chile, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All other data is retrieved from the BEA.*

**Table 2: AR(1) Regression on the Treasury Basis (yield gap between U.S. 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.*