News, Sentiment and Capital Flows

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Legal Issues

News, Sentiment and Capital Flows *[†]

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Abstract

We examine empirically the effect of two types of expectations-related shocks – "news" (increases in expected future productivity) and "sentiment" (surges in optimism unrelated to future productivity) – on gross capital flows. We find that news shocks lead to a decrease in both gross capital inflows and outflows, while sentiment shocks lead to an increase in both gross inflows and outflows. Both these shocks drive a positive correlation between gross inflows and outflows but only sentiments shocks generate procyclical gross flows. These effects are not driven by global shocks or financial shocks. They are consistent with the existence of asymmetric information between domestic and foreign investors about the country's fundamentals.

JEL-Classification: D82, E32, F32.

Keywords: Capital flows, SVAR, Asymmetric information.

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1   Introduction

Gross capital inflows and outflows have been shown to be procyclical, volatile and positively correlated (Broner et al., 2013; Forbes and Warnock, 2012; Davis and Van Wincoop, 2018; Avdjiev et al., 2017). The positive correlation between inflows and outflows is particularly puzzling. Studying the conditional behavior of capital flows offers information on the mechanisms driving capital flows and is a step towards understanding them. This paper moves in that direction by disentangling the reaction of domestic gross capital flows to technology and nontechnology expectation-related shocks. Indeed, capital flows are driven by expected excess returns. These expected excess returns are related to expected future productivity, but they can also be driven by excessive optimism.

A key contribution of the paper is to study the reaction of gross capital flows to "news" shocks (increases in future productivity) and nontechnological expectation shocks (surges in optimism that are orthogonal to future productivity), which we call "sentiment" shocks, following Levchenko and Pandalai-Nayar (2018). We find that news shocks lead to a decrease in both gross capital inflows and outflows (an increase in home bias), while sentiment shocks lead to an increase in both gross inflows and outflows (a decrease in home bias). This implies that while only sentiment shocks generate procyclical flows, both shocks generate positively correlated inflows and outflows. The fact that expectation-related shocks generate positively correlated gross inflows and outflows gives credence to the hypothesis of a prominent role of heterogenous information, as emphasized by Broner et al. (2013): If foreigners buy domestic assets when domestic agents buy foreign assets, they must have differing expectations. A simple model where domestic investors have an informational advantage can rationalize our results. Home investors are better able to identify future improvements in technology than foreign investors, which explains the increased home bias in the case of news and the decreased home bias in the case of sentiment shocks, where the latter are interpreted as "noise" shocks (unwarranted optimism).

We use a recursive structural VAR approach to identify three shocks: a total factor productivity (TFP) surprise shock, a news shock about future TFP and a "sentiment" shock. Our specification includes TFP, GDP per capita, an expectation variable and gross capital inflows or outflows in the last position. Formally, we follow Levchenko and Pandalai-

Nayar (2018), who build on Barsky and Sims (2011), and define the TFP surprise shock as the TFP's own innovation. The news shock is identified as the structural shock that best explains future variations in TFP not accounted for by the TFP surprise shock. Finally, the sentiment shock is the shock that best explains short-run variations in expectations, accounted for by neither the TFP surprise shock nor the news shock. The sentiment shock captures any shock that affects expectations while unrelated to technology.

Using US data, we find that a positive news shock triggers an immediate, short-lived and negative response of capital flows, while a positive sentiment shock has positive effects on capital flows on impact with medium-lasting effects. TFP surprise shocks do not induce significant responses of capital flows. Quantitatively, news and sentiment shocks contribute up to 85% of the forecast error variance decomposition (FEVD) of capital flows. Using a panel of 17 OECD economies, we find results similar to those of the US. Overall, two main conclusions can be drawn. First, nontechnology shocks are an important driver of capital flows. They are at least as important as technology shocks. Second, contemporaneous technology shocks play a negligible role but anticipated technology (i.e., news) shocks are important. This shows that expectations play a key role in driving capital flows.

Before interpreting our results further, we address two issues. First, as the sentiment shock is identified as a residual, it is important to rule out potential known drivers of capital flows. We thus account for the following: financial shocks (Broner et al., 2013), uncertainty shocks, shocks to monetary policy (Rey, 2015), and shocks to international prices. In all cases, the responses of capital flows to the three shocks remain unchanged. Second, the conditional positive correlation of capital inflows and outflows can be explained by the global nature of shocks (Davis and Van Wincoop, 2018; Tille and van Wincoop, 2014). Indeed, the capital outflows of a given country are the inflows of the rest of the world. Global shocks that drive a positive response of capital inflows worldwide necessarily drive a positive response of outflows. The role of global factors in driving capital flows has also been emphasized in the literature (Forbes and Warnock, 2012; Fratzscher, 2012; Passari and Rey, 2015). We account for this issue by introducing global variables in our baseline VAR and identify global shocks before the local TFP surprise, news and sentiment shocks. The impact of the three local shocks on capital flows remains unchanged and they still explain a large part of the FEVD of capital flows.

Given that our results are not exclusively driven by the global nature of shocks or by "usual suspects", we illustrate how information frictions can explain them. We lay out a two-country model with asymmetric information between domestic and foreign investors about the country's fundamentals. All agents share a noisy public signal that can be driven by "news" (i.e., by actual future improvements in the fundamentals) or by "noise" (i.e., by excessive optimism), but home agents have additional private information. Following a news shock, domestic investors, who are better informed about their domestic productivity, increase their demand for domestic assets relatively more than foreign investors do. In equilibrium, domestic investors sell foreign assets - decreasing capital outflows - and buy domestic assets from foreign investors - decreasing capital inflows, which is in line with our empirical results. Following a noise shock, domestic investors, who are better informed about their domestic productivity, increase their demand for domestic assets relatively less than foreign investors do. In equilibrium, domestic investors sell domestic assets - increasing capital inflows - and buy more foreign assets - increasing capital outflows, which is in line with the empirical effects of the sentiment shock. Interestingly, demand shocks (i.e., shocks that decrease home savings) generate net inflows and negatively correlated gross inflows and outflows. In the data, sentiments shocks, on the contrary, generate positively correlated gross flows and no significant net inflows.

The empirical reaction of domestic stock prices to news and sentiment shocks is consistent with a key role of information frictions and especially with a "noise" interpretation of sentiment shocks. We indeed show that the stock price reacts positively to both news and sentiment shocks, but while the reaction to news is persistent, the reaction to noise is short-lived. This echoes the finding of the financial literature empirically exploring the effect of international market "sentiment" on domestic asset prices.[1] Particularly appealing are the findings of Ben-Rephael et al. (2019). Their measure of foreign sentiment, which is based on flow shifts towards international mutual funds, predicts return reversals in local markets. These effects are driven by an overreaction to local public news and become more important with cultural distance, which suggests a key role for information asymmetries.

This paper is related to the literature on expectation-driven business cycles. There is increasing empirical evidence that expectations are key drivers of macroeconomic fluctua-

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[1]See for instance Hwang (2011), Gao et al. (2016) and Fraiberger et al. (2018).

tions.[2] Yet, little has been done to analyze the impact of expectations on capital flows. One exception is the paper by Milesi-Ferretti and Tille (2011) showing that countries with worse outlooks suffered larger capital retrenchments. Cordonier (2017) shows that the forward-looking component of the consumer sentiment index is significantly related to capital flows. This paper extends on this idea by using a more structural approach and distinguishing the technology-related part of expectations from their nontechnology-related part.[3]

Our model is related to Albuquerque et al. (2007, 2009) and Brennan (1997), who study the role of information asymmetries on capital flows. It is especially close to that of Tille and van Wincoop (2014), as it is a general equilibrium model, but unlike them, we do not consider endogenous responses of saving and investment. Indeed, our focus is on portfolio shifts due to changes in expected returns, so we abstract from portfolio growth effects and time-varying risk. They consider shocks to future productivity and noise trading shocks, that is, iceberg cost shocks that shift the demand for home and foreign assets, and show that these shocks generate gross capital flows only in the presence of private information. While the former correspond to what we call news shocks, the latter are close, but not quite similar to what we call noise shocks. Their noise shock is a financial shock, ours is an expectation shock. While noise trading ends up affecting expectations through its effect on asset prices, it is hard to disentangle the effect due to expectations from the effect due to the underlying shock.

The rest of the paper is structured as follow: Section 2 describes our methodology, Section 3 defines the data gathered for the empirical analysis, Section 4 presents the main findings of this paper and Section 5 performs robustness checks. Section 6 presents a two-country model with information asymmetry. Section 7 concludes.

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[2]See for instance Beaudry and Portier (2006) or Barsky and Sims (2011).

[3]The empirical literature on capital flows, more generally, explores "push" and "pull" factors of capital flows. Calvo et al. (1993), Calvo et al. (1996), Fernandez-Arias (1996) and Chuhan et al. (1998) first referred to the "push" external forces and the "pull" domestic factors influencing the capital flows toward an economy. More recently, Fratzscher (2012), Forbes and Warnock (2012) or Adler et al. (2016) in a dynamic set-up, among others, have underlined the importance of global factors, the VIX in particular.

2 Empirical methodology

This section describes the identification strategy for TFP surprise, news and sentiment shocks in a structural VAR model. This recursive approach is based on Levchenko and Pandalai-Nayar (2018) and Barsky and Sims (2011) and aims at identifying the following structural shocks: a TFP surprise shock, a news shock on TFP and a sentiment shock. Like Barsky and Sims (2011), we identify news shocks by maximizing the forecast error of TFP at horizons greater than 1. Following Levchenko and Pandalai-Nayar (2018), we then identify sentiment shocks as the shock, uncorrelated to TFP, that maximizes the residual forecast error variance of an expectation variable (here consumer confidence). This methodology allows us to distinguish between shocks to expectations that are related to the country's TFP ("news") from those that are unrelated ("sentiment").[4]

Formally, assume that TFP is driven both by the usual surprise TFP shock, but also by a news shock. The latter is a shock about future productivity. The process of TFP can be represented as a moving-average, with the restriction that the news shock has no contemporaneous effect on the level of TFP. With A_t denoting TFP, one example for this particular representation is given by:

$$ln(A_t) = ln(A_{t-1}) + \lambda_1 \epsilon_t^{sur} + \lambda_2 \epsilon_{t-s}^{news}$$

where ϵ_t^{sur} is the surprise TFP shock that contemporaneously affects the level of TFP, and ϵ_{t-s}^{news} is the news shock, i.e., the change in productivity that agents expect $s > 0$ periods before it materializes.

Assume then that agents' expectations about the state of the economy can also be represented as a moving average process. Both the surprise TFP shock and the news shock can affect the level of expectations, but also a sentiment shock. The latter captures variations in expectations not related to current or future changes in TFP. With the expectations

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[4]Beaudry and Portier (2006) were the first to provide a method to identify news. A news shock is identified in a VAR with TFP and stock prices where TFP is placed first. A news shock is then the shock that explains contemporaneous stock price movements that are uncorrelated to the innovation in TFP. This methodology, however, does not allow us to distinguish between movements in stock prices that are correlated to future TFP from those that are not.

denoted as F_t, a possible representation is given by:

$$F_t = F_{t-1} + \lambda_1^F \epsilon_t^{sur} + \lambda_2^F \epsilon_t^{news} + \lambda_3^F \epsilon_t^{sent} + \eta_t$$

where ϵ_t^{sent} is the sentiment shock.

As noted by Levchenko and Pandalai-Nayar (2018), identifying the three shocks based on only TFP and an expectation variable would not be possible. We thus include GDP as an additional forward-looking variable, as well as gross capital flows.[5] Let us denote by y_t the M-dimensional state vector. In our specification, we have $y_t = [TFP_t, GDP_t, E12m_t, KF_t]'$ where TFP is the log of TFP, GDP is the log of real GDP, $E12m$ is the consumer confidence measure (our expectation variable) and KF are capital inflows or outflows. Consider the case where y_t follows a VAR whose MA representation is:

$$y_t = B(L)u_t,$$

with $B(0)$ being an identity matrix. We assume that the linear mapping between the residuals (or innovations) and structural shocks is given by:

$$u_t = A_0 \epsilon_t.$$

where $Var(\epsilon_t) = I$. The vector of innovations of the VAR corresponds to $A_0 \epsilon_t$. Its variance-covariance matrix of innovations is given by $A_0 A_0' = \Sigma$. The VAR estimation provides us with a consistent estimate of Σ. This is however not sufficient to get an estimate of A_0. Indeed, there is an infinity of A_0 matrices satisfying $A_0 A_0' = \Sigma$. They are all of the form $\tilde{A}_0 D$, where D is a $M \times M$ orthonormal matrix ($DD' = I$) and $\tilde{A}_0$ results from the Cholesky decomposition of Σ.

The h step ahead forecast error is given by:

$$y_{t+h} - E_{t-1} y_{t+h} = \sum_{\tau=0}^{h} B_\tau \tilde{A}_0 D \epsilon_{t+h-\tau}$$

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[5]Please note that we also have a specification including consumption and hours variables. As discussed later in the paper, the results are similar.

Define the share of the forecast error variance of variable i attributable to shock j at horizon h by $\Omega_{i,j}(h)$. The first structural shock, ϵ^{sur} is identified as the reduced-form innovation of the VAR with the TFP measure ordered first. This implies that the first row of D is of the form $[1, 0, .., 0]$.[6] Hence, the share of the forecast error variance of the first variable, the TFP measure, attributable to the surprise TFP shock is now determined. Formally, it means that $\Omega_{1,1}(h) \ \forall h$ is fixed.

Given that only the surprise TFP shock and the news shock move the level of TFP, they have to account for all the forecast error variance of TFP. Formally, it means that the sum of the shares of the forecast error variance of TFP attributable to the first and second structural shocks - the surprise TFP shock and the news shock - should be as close as possible to 1 at all horizons:

$$\Omega_{1,1}(h) + \Omega_{1,2}(h) \approx 1 \ \forall h$$

where $\Omega_{i,j}(h)$ is given by:

$$\Omega_{i,j}(h) = \frac{e_i'(\sum_{\tau=0}^h B_\tau \tilde{A}_0 D e_j e_j' D' \tilde{A}_0' B_\tau')e_i}{e_i'(\sum_{\tau=0}^h B_\tau \Sigma B_\tau')e_i} = \frac{\sum_{\tau=0}^h B_{i,\tau} \tilde{A}_0 \gamma_j \gamma_j' \tilde{A}_0' B_{i,\tau}'}{(\sum_{\tau=0}^h B_{i,\tau} \Sigma B_{i,\tau}')} = \frac{\gamma_j' Z \gamma_j}{(\sum_{\tau=0}^h B_{i,\tau} \Sigma B_{i,\tau}')}$$

with $Z = \sum_{\tau=0}^h \tilde{A}_0' B_{i,\tau}' B_{i,\tau} \tilde{A}_0$ and $\gamma_j = D e_j$ selecting the jth column of the D matrix. e_j is the selection vector that contains zero everywhere except at the jth position and $B_{i,\tau} = e_i' B_\tau$ denotes the ith row of the matrix of moving average coefficients. As stated earlier, all the forecast error variance of TFP must be attributed to the surprise TFP and the news shocks only. As $\Omega_{1,1}(h)$ is fixed, the strategy to identify the second structural shock consists of maximizing its contribution to the forecast error variance of TFP, not attributable to the first structural shock.

Let us denote by γ^{news} the second column of D. The impact of the second structural shock on the variables is $\tilde{A}_0 \gamma^{news}$. Since D is orthonormal, we must have $\gamma^{news}(1) = 0$ an

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[6]This also implies that the first column is $[1, 0, ..., 0]'$ because D is orthonormal.

$\gamma^{news'}\gamma^{news} = 1$. As a result, γ^{news} is obtained by solving the following problem:[7]

$$\gamma^{news} = argmax_\gamma \sum_{h=0}^{H}(H-h)\Omega_{1,2}(h) = \sum_{h=0}^{H}(H-h)\frac{\sum_{\tau=0}^{h} B_{1,\tau}\tilde{A}_0\gamma\gamma\tilde{A}_0'B_{1,\tau}'}{(\sum_{\tau=0}^{h} B_{1,\tau}\Sigma B_{1,\tau}')}$$
$$= \sum_{h=0}^{H}(H-h)\frac{\gamma'N\gamma}{(\sum_{\tau=0}^{h} B_{1,\tau}\Sigma B_{1,\tau}')}$$

s.t

$$\gamma(1) = 0, \quad \gamma'\gamma = 1$$

with, $N = \sum_{\tau=0}^{h} \tilde{A}_0'B_{1,\tau}'B_{1,\tau}\tilde{A}_0$ The restrictions ensure that the news shock has no contemporaneous effect on TFP.[8] To summarize, we identify the news shock as the linear combination of the $M-1$ reduced form innovations - excepting the first one - that best explain TFP at long horizons.

The last structural shock to be identified is the sentiment shock. As seen earlier, this third structural shock is not related to TFP, but rather to changes in expectations not explained by any of the TFP shocks. We assume that it is a short-run shock, i.e., its impacts on the expectations' variable only last a few quarters. Hence, following Levchenko and Pandalai-Nayar (2018), the sentiment shock is identified so as to maximise its contribution to the remaining short-run forecast error variance of the expectation variables. Assume the expectations' variable, F_t, is ordered third in the VAR. The two first structural shocks have been identified, meaning that $\Omega_{3,1}(h)$ and $\Omega_{3,2}(h)$ are fixed at all horizons h. Using the same strategy as for the news shocks, identifying the third structural shock is equivalent to choosing γ^{sent} (the third column of D), such that the sentiment shock is orthogonal to the other two shocks and contributes the most to the remaining forecast error variance of F_t.

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[7]Notice that in Barsky and Sims (2011) do not explicitly include the time-weights, i.e., denoted by $(H-h)$, in their presentation of the optimisation problem, although they write about them.

[8]As pointed out by Barsky and Sims (2011) and based on the paper by Uhlig (2003), this strategy is equivalent to the identification of news shock as the first principal component of TFP orthogonalized with respect to its own innovation. Formally, γ^{news} is the eigenvector associated with the maximum eigenvalue of a weighted sum, using time-weights, of the lower $(M-1) \times (M-1)$ submatrices of $(B_{1,\tau}\tilde{A}_0)'(B_{1,\tau}\tilde{A}_0)$ over τ.

Formally,

$$\gamma^{sent} = argmax_\gamma \sum_{h=0}^{H^{sent}} \Omega_{3,3}(h) = \sum_{h=0}^{H^{sent}} (H^{sent} - h) \frac{\sum_{\tau=0}^{h} B_{3,\tau} \tilde{A}_0 \gamma \gamma \tilde{A}_0' B_{3,\tau}'}{(\sum_{\tau=0}^{h} B_{3,\tau} \Sigma B_{3,\tau}')}$$
$$= \sum_{h=0}^{H^{sent}} (H^{sent} - h) \frac{\gamma' S \gamma}{(\sum_{\tau=0}^{h} B_{3,\tau} \Sigma B_{3,\tau}')}$$

s.t

$$\gamma(1) = 0, \quad \gamma'\gamma = 1, \quad \gamma'\gamma^{news} = 0$$

with $S = \sum_{\tau=0}^{h} \tilde{A}_0' B_{3,\tau}' B_{3,\tau} \tilde{A}_0$. Note that as the sentiment shock is assumed to be a short-run shock, the horizon H^{sent} is set to two quarters.

To sum up, the TFP surprise shock is identified as the TFP's own innovation. The news shock is identified as the structural shock that best explains future variations in TFP not accounted for by the TFP surprise shock. Finally, the sentiment shock is the shock that best explains short-run variations in expectations, accounted for by neither the TFP surprise shock, nor the news shock.

3   Data

For this analysis, we gather data on TFP, GDP, consumer confidence and capital flows for the U.S. The baseline vector y_{USt} used to estimate U.S. shocks includes four variables: TFP - as a measure of technology, the log of real GDP per capita, an expectation variable and capital flows. For TFP, we use the utilization-adjusted TFP series from Fernald (2014), where adjustments for variable utilization are based on the methodology by Basu et al. (2006). Then, as measure of output, we use the chain-weighted real GDP variable from the BEA (NIPA table 1.1.6). To obtain per capita terms, we divide by the civilian noninstitutionalized population aged 16 and over (BLS).

The main measure of expectations is from the survey of consumers produced by the University of Michigan. In particular, we use the standardized forward-looking component asking about expected changes in business conditions in a year, which is part of the main consumer sentiment index. More specifically, the survey asks the following: "Now turning to the business conditions in the country as a whole: do you think that during the next twelve

months we will have good times financially, or bad times, or what?". There are 6 possible answers: good times, good with qualifications, pro-con, bad with qualifications, bad times or do not know. From these answers are computed relative scores, i.e., the percentage of favorable replies minus the percentage of unfavorable replies, plus 100. Similarly to Barsky and Sims (2012), we label this variable "E12M". Notice that there are two main reasons, why our baseline uses consumer confidence rather than the expectations obtained from the Survey of Professional Forecasters (SPF). First, it allows us to link this paper to the literature on news and sentiment shocks using the same variable. Second, Cordonier (2017) has found that this specific "E12M" variable relates significantly to capital flows (while controlling for other key factors).

The data on gross capital inflows and outflows are obtained from the Balance of Payment Statistics Database (IFS/IMF), based on the BPM6 methodology. Gross inflows are the country's net incurrence of liabilities, while gross outflows represent the net acquisitions of foreign assets by domestic agents. As in Forbes and Warnock (2012), official reserves are excluded from the gross capital outflows. Following the literature (see Broner et al. (2013) or Adler et al. (2016)), we express capital flows in terms of GDP trend (trend extracted using a Hodrick-Prescott filter).[9]

4   Baseline results

In this section, we estimate the effects of TFP surprise, news and sentiment shocks on capital flows. We show that news shocks typically generate a decrease in both gross capital inflows and outflows, while sentiment shocks generate an increase in both gross capital inflows and outflows.

We start by presenting the orthogonalized response functions obtained from the SVAR analysis for the United States. The identification of the shocks follows the methodology described earlier. We set the baseline number of lags to $p = 4$ and we use bias-corrected confidence intervals from 2000 bootstraps based on Kilian (1998). We start with a SVAR containing TFP, GDP, E12M and gross capital inflows as described in the data section.

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[9]Indeed, the GDP trend reacts to shocks much less strongly than current GDP. Using current GDP would make it much harder to attribute the impact of the shock mostly on capital flows as GDP would react as well.

Figure 1 shows the impulse response functions (IRF) of all variables to the three shocks: TFP surprise, news and sentiment shocks. We then replace gross inflows with gross outflows and show in Figure 2 the responses of gross capital outflows only.

News and sentiment shocks are fairly well identified. The news shock has a slow-building persistent impact on TFP, while overall, TPF does not react significantly to a sentiment shock. Thus, the sentiment shock does not relate to technology. Moreover, responses of GDP are as expected: TFP generates an immediate positive response and the news shock has a persistent positive impact. The consumer sentiment index reacts strongly to the sentiment shock by construction, but also to the news shocks, while it reacts less to the TFP surprise shock. News and sentiment shocks are thus the main drivers of expectations.
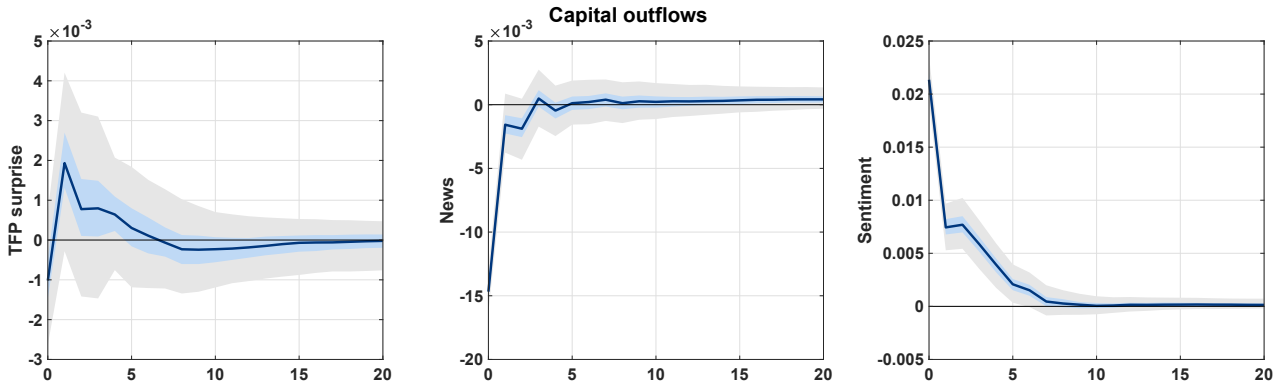
Figure 1: IRFs to TFP surprise, news and sentiment shocks
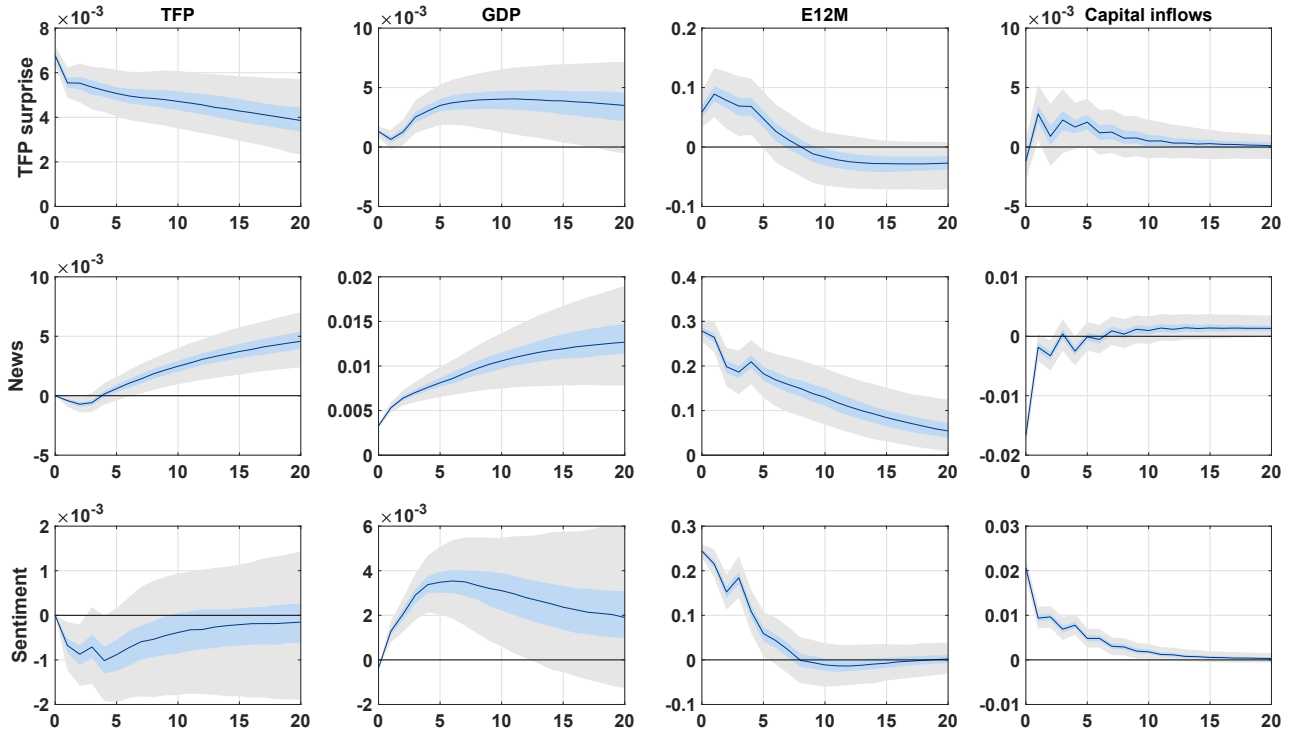
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Regarding the impact of shocks on gross capital inflows, we see in Figure 1 that a news shock has an immediate negative impact that is short-lived (1-2 quarters), followed by a positive response after 4 quarter. Figure 2 shows that the response of gross capital outflows is similar. On the other hand, a sentiment shock triggers an immediate positive response of

Figure 2: IRFs of capital outflows to TFP surprise, news and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

gross capital inflows and outflows that lasts for approximately 7 to 10 quarters.[10] Hence, optimism that is related to fundamentals (here measured by TFP) generates an increased home bias, while optimism that is unrelated to fundamentals generates a decrease in home bias.

Note that the responses of gross capital flows to a surprise TFP shock are positive, but nonsignificant. Overall, capital flows are found to react not to current changes in fundamentals, but to expectations about the country's future performance. In terms of magnitude, capital flows are mainly driven by expectation-related shocks (news and sentiment). This is confirmed by the forecast error variance decomposition of both inflows and outflows, presented in the Appendix (Figure A.3). The sentiment shock alone can explain up to 60% of the FEVD of gross capital flows. News shocks explain approximately 25% of capital flows, while TFP surprise shocks have a negligible contribution.

The response of capital flows, especially the impact response, might seem puzzling. However, as we illustrate in Section 6, this can be explained by the informational advantage of domestic investors. Home investors have private information on domestic technology and are thus better able to identify future improvements in fundamentals. Since news shocks are actually followed by an improvement in fundamentals, while sentiment shocks are not,

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[10]Our results remain similar when we use the same variables as Levchenko and Pandalai-Nayar (2018) in our specification, i.e., including consumption and hours in third and fourth position. However, the response of capital inflows to a TFP surprise shock becomes significantly positive, and the news shocks has a more significant and persistent effect on capital flows in the medium/long-run. The impulse responses functions are presented in Appendix A Figure A.1.

this explains the increased home bias in the case of news shocks and the decreased home bias in the case of sentiment shocks.

Interestingly, as shown in Figures A.5 to A.8 in the Appendix, the effects of shocks varies across different categories of flows. In particular, the negative reaction of inflows to news shocks holds for the categories of assets for which private information is key (namely, FDI and Other flows, which include loans, currency and deposits or trade credit and advances), but not for equities, about which information is less asymmetric. Indeed, listed companies are also subject to public disclosure, and equity markets are more liquid, which implies that prices better reflect fundamentals.

The reaction of the stock prices can also be informative on the nature of shocks. We thus introduce the log of the S&P500 index as a fourth variable in the SVAR, before capital flows. The IRFs of the stock price are shown in Figure A.4 in the Appendix. The stock price increases for all shocks. This increase persists over time in the case of news shocks, which is consistent with the literature. In the case of sentiment shocks, the increase is not persistent and is quickly reversed, which suggests that sentiment shocks generate noise trading. This echoes the finding of the financial literature empirically exploring the effect of international market "sentiment" on domestic asset prices.[11]

Finally, as a comparison, Figure A.2 in the Appendix provides the IRFs of net inflows. The magnitude of the response to news and sentiment shocks is small in comparison to gross flows, especially for sentiment shocks, whose response is nonsignificant. This reflects the positive comovement in gross flows. In the case of news shocks, the initial response is also insignificant, but it is followed in subsequent quarters by a significantly positive response.

5 Robustness

Before interpreting our results, we need to address two issues. First, the conditional positive correlation of capital inflows and outflows can be explained by the global nature of shocks. Indeed, the capital outflows of a given country are the inflows of the rest of the world. Global shocks that drive a positive response of capital inflows worldwide then necessarily

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[11]See for instance Ben-Rephael et al. (2019) and Fraiberger et al. (2018). The former identify sentiment shocks as portfolio shifts to international mutual funds. The latter identify them through international media coverage.

drive a positive response of outflows. Second, a sentiment shock is identified as a residual, it is especially important to rule out known potential drivers of capital flows. We address these issues as follows. First, we extend our SVAR to control for global shocks. We then assess whether sentiment shocks can be accounted for by other shocks, such as uncertainty, financial, monetary policy or international shocks. Finally, we run more standard robustness checks.

5.1 Accounting for global shocks

We assess the global dimension of our shocks by including global variables and accounting for global shocks. To do so, we add a global GDP per capita variable, a global TFP and a global E12M variable in the first positions of our vector. We then obtain a 7-variable VAR with $y_t = [TFPGlobal_t, GDPGlobal_t, E12MGlobal_t, TFP_t, GDP_t, E12M_t, KF_t]$. Using the same approach as in the baseline, we first identify three global shocks: global TFP surprise, news and sentiment shocks. Local TFP surprise, news and sentiment shocks are then identified by imposing orthogonality with the global shocks. For this 7-variable VAR, we use a balanced panel of 10 countries over the 1996Q1-2018Q3 time period. The selected countries are those for which a consumer sentiment index and data to build a measure of TFP are available (see Appendix B for details on the data of the 9 extra countries and Appendix D for a description of the TFP variable construction).[12] We then build the TFP, GDP per capita and E12M as the weighted-mean of the countries' variables, using real GDP as weights. Altogether, our sample averages to approximately a third of world real GDP, PPP-adjusted, over the covered time period.[13]

The IRFs of capital flows to these shocks are presented in Figure 3. Note that to limit the number of parameters to be estimated, we use VAR specification with 2 lags. In this set-up, the responses of capital flows to the three local shocks remain very similar to those from the baseline, i.e., without identifying global shocks first. Interestingly, the responses to global shocks are qualitatively similar to the local ones. Looking at FEVD in Figure A.9 in the Appendix, we see that an important part remains explained by local shocks.

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[12]The included countries are Australia, Denmark, France, Germany, Italy, Portugal, Spain, Sweden and the United Kingdom. Note that we do not include the US, because it is too large a country. The risk, in that case, is that what we will identify as global shocks would be actually US-specific shocks.

[13]To get this ratio, we use the World Bank annual GDP constant 2011 USD, PPP-adjusted data.

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Figure 3: IRFs of capital flows to both global and local shocks
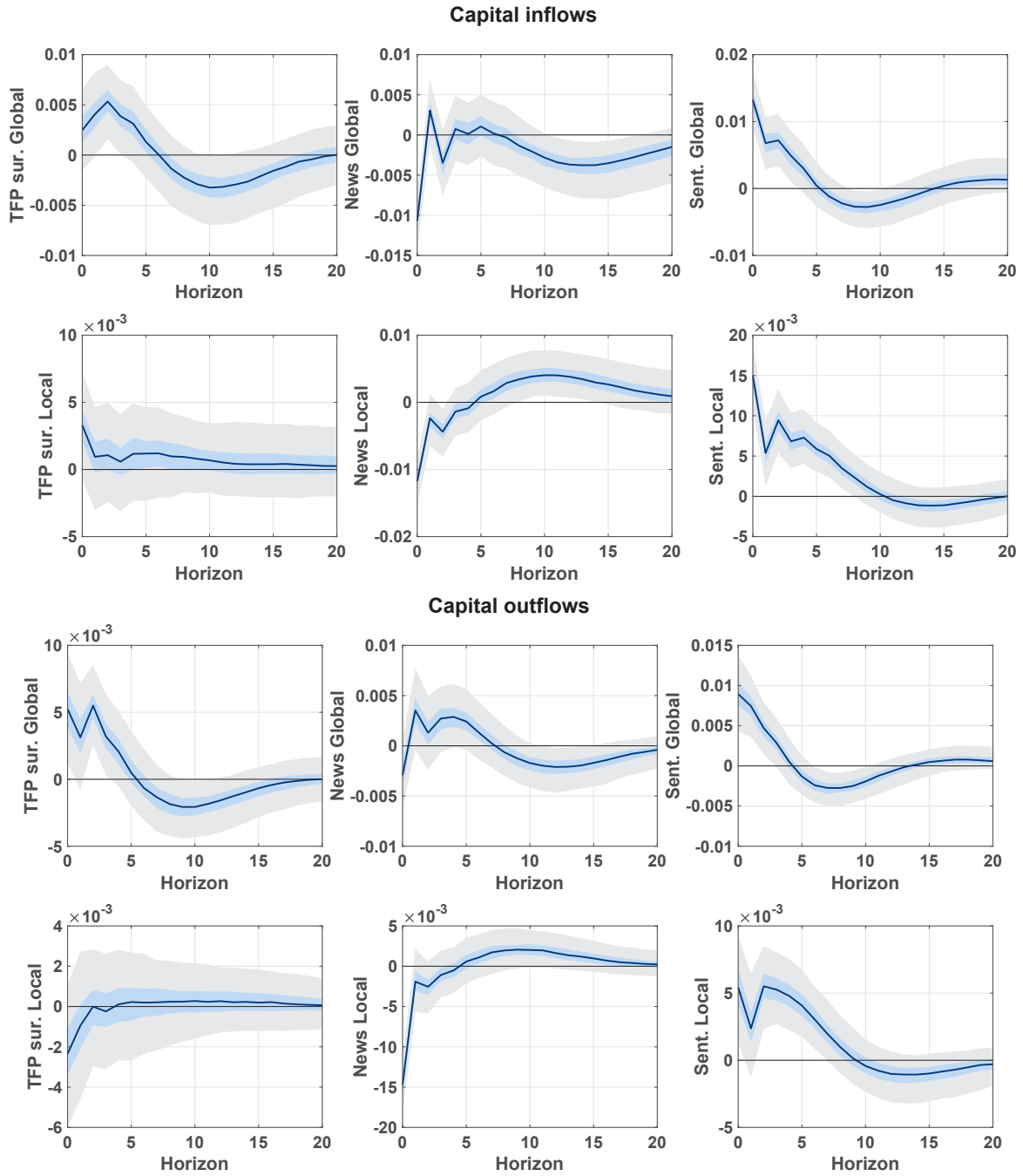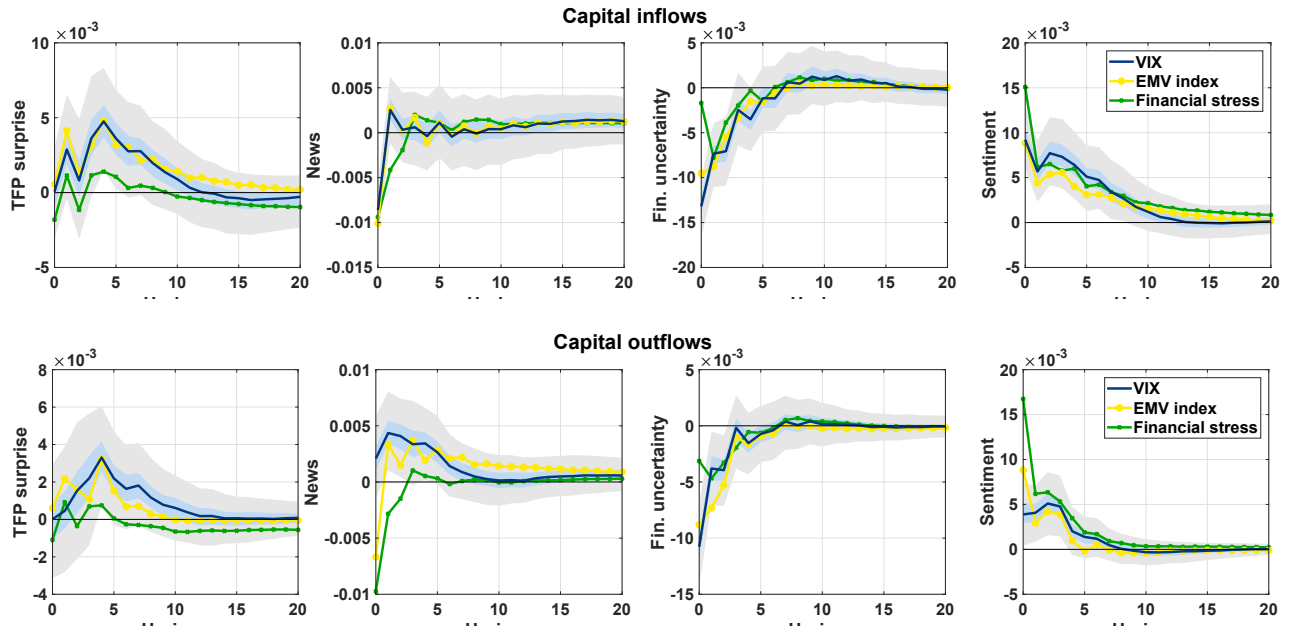
Capital inflows

Capital outflows

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors.

5.2 Accounting for other shocks

One could argue that our sentiment shocks merely reflect variations in uncertainty or in financial conditions. Thus, we repeat the empirical exercise but sequentially include various variables that measure economic and financial markets uncertainty, as well as financial and

international conditions. First, to account for financial markets' uncertainty, we include the VIX, the equity market volatility (EMV) index built by Baker et al. (2019) and a financial stress indicator from Püttmann (2018). To give maximum weight to this additional shock, we identify it before the sentiment shock. Formally, we add this extra variable in the third position, $y_t = [TFP_t, GDP_t, Extra_t, E12M_t, KF_t]$, where $Extra_t$ stands for the financial uncertainty variable. Then, we identify the additional shock after the TFP surprise and news shocks, in a similar way as for our sentiment shock. The financial uncertainty shock is the structural shock that best explains short-run future variations (2 quarters) of the additional variable that are unexplained by the first two shocks.

Figure 4: U.S. IRFs for capital flows to TFP surprise, news, financial uncertainty and sentiment shocks
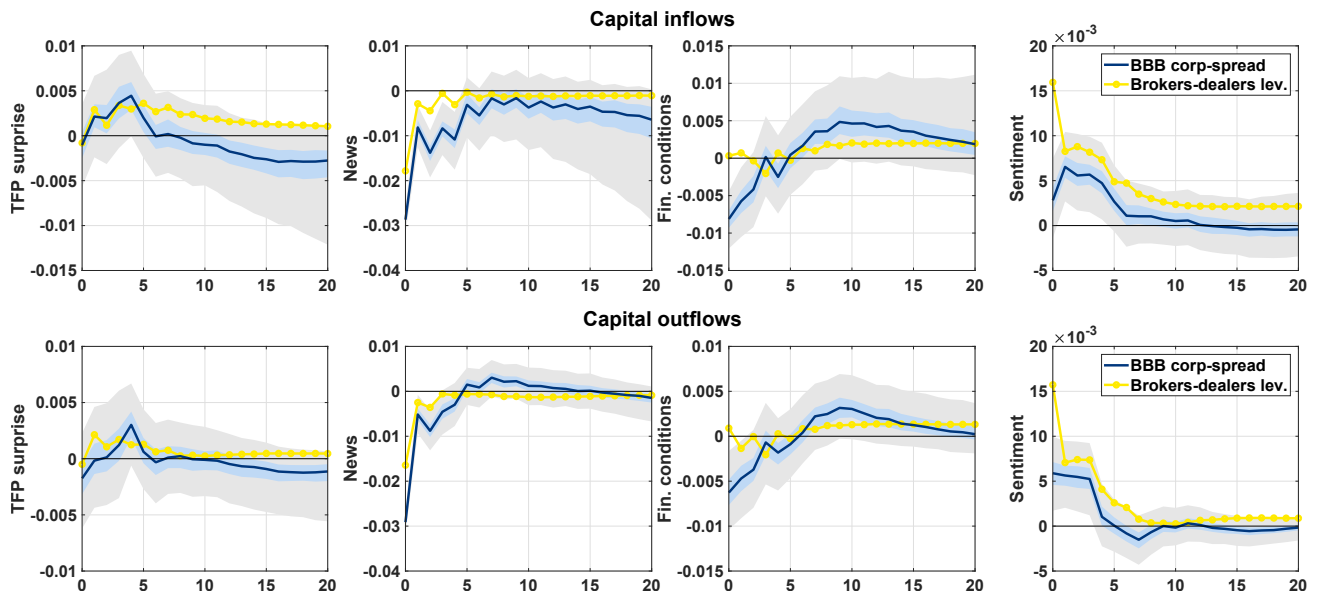

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors. Confidence intervals are built for the model with VIX as financial uncertainty variable.

Figure 4 shows the responses of inflows and outflows when identifying a financial uncertainty shocks. Consistent with the literature's findings, an increase in financial uncertainty, triggers an immediate short-lived negative responses of capital flows. This is true whatever the proxy variable we are using. The responses to the news and sentiment shocks remain qualitatively similar, although the response of capital outflows to news shock with VIX is slightly positive. Their sizes are, however, reduced, although we should keep in mind that

the weight given to the financial uncertainty shock was maximized. In other words, the impact of the sentiment shocks could be interpreted as a lower band.

Second, we wish to identify the so-called financial shocks. One could argue that these shocks are strongly related to financial uncertainty shocks described above (for instance the VIX). Nevertheless, we deepen our analysis by including two additional indicators of a potential tightening in the financial conditions. We first include the U.S. corporate BBB option-adjusted spread (from Bank of America Merrill Lynch). This variable has an even shorter timespan than the VIX and starts only in 1997. Second, we use the U.S. security brokers and dealers leverage variable. Adrian and Shin (2010) show that global market liquidity relates to the leverage of security brokers and dealers. We define leverage as they do, i.e., the ratio of total assets over equities, which is the difference between total assets and liabilities. The IRFs of capital flows to all four shocks, including a tightening in financial conditions, are presented in Figure 5. Again, the responses of capital flows to TFP surprise, news and sentiment shocks are similar to those from the baseline. The responses to a tightening in financial conditions (mostly for corporate BBB spread) appear to be meaningful: capital flows contract as financial conditions tighten.
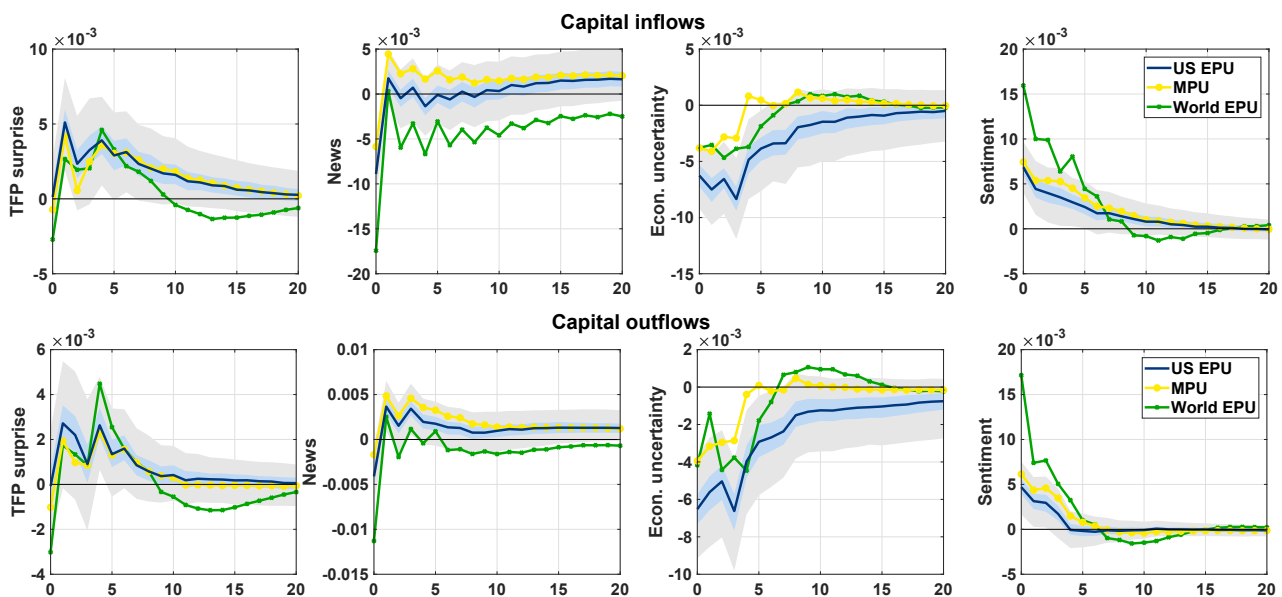
Figure 5: U.S. IRFs for capital flows to TFP surprise, news, financial conditions and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors. Confidence intervals are built for the model with corporate BBB spread as financial conditions variable.

As a third option, we account for policy uncertainty. We use the economic policy uncertainty (EPU) index for the U.S., as well as the Monetary Policy Uncertainty (MPU) index for the U.S. from Bloom et al. (2016) and the World Uncertainty Index (WUI) from Ahir et al. (2018).[14] The IRFs of capital flows to the shocks are presented in Figure 4. Here as well, an increase in any type of policy uncertainty shock negatively and immediately impacts capital flows, but the responses to the other shocks remain similar although somewhat dampened.

Figure 6: U.S. IRFs for capital flows to TFP surprise, news, economic uncertainty and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors. Confidence intervals are built for the model with U.S. EPU as economic uncertainty variable.

To conclude, uncertainty or financial conditions shocks appear to matter for capital flows, in line with the literature. However, sentiment shocks are not mere reflections of these, as they remain significant in driving capital flows after accounting for these other shocks.

One alternative hypothesis is that sentiment shocks are reflecting monetary policy shocks. Hence, we identify here a monetary policy shock, again before the sentiment shock to give it maximum weight. Then, we analyze capital flows responses to the sentiment shock. We thus include the Fed funds interest rate in third position in our SVAR, i.e., $y_t = [TFP_t, GDP_t, FFR_t, E12M_t, KF_t]$ and we identify the monetary policy shock after the TFP

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[14]For the WUI, we use the index built as a GDP-weighted average of the local index.

surprise and news shocks. As before, the monetary policy shock is defined as the structural shock that best explains short-run future variations (2-quarters) of the interest rate, unexplained by the first two shocks. The IRFs of capital flows are shown in Figure 7. Interestingly, a local monetary policy shock has a positive lagged impact on capital flows. Here as well the impact of other shocks on capital flows remain similar to the baseline. Overall, we can conclude that sentiments shocks are not a mere reflection of monetary policy shocks.

Figure 7: U.S. IRFs to TFP surprise, news, monetary and sentiment shocks
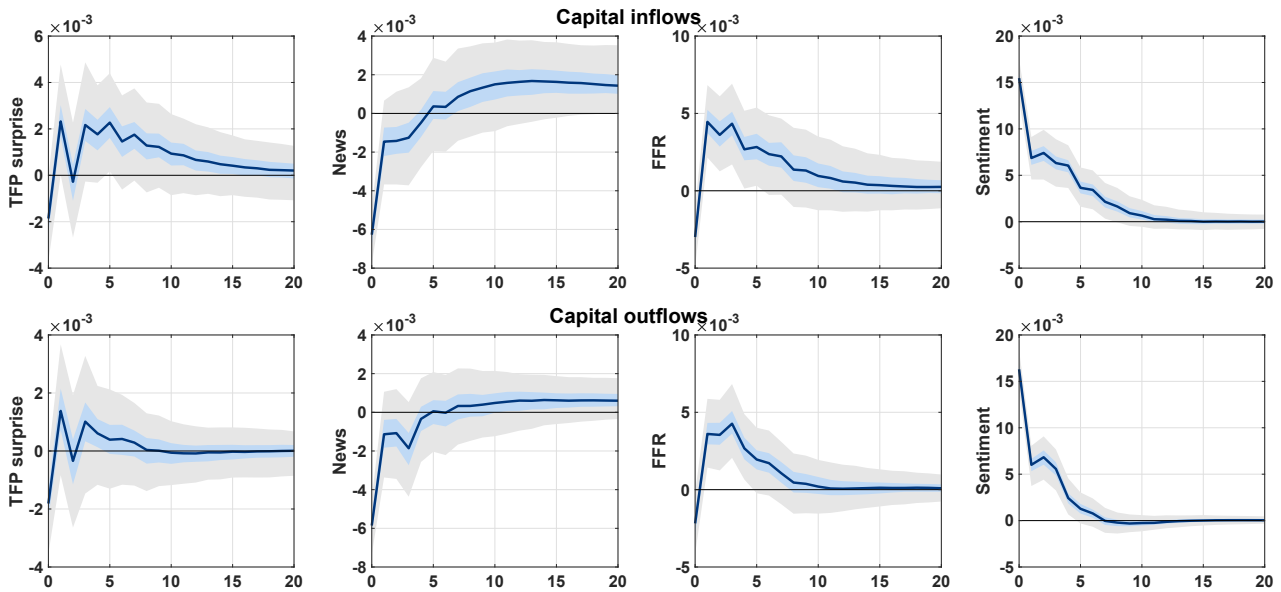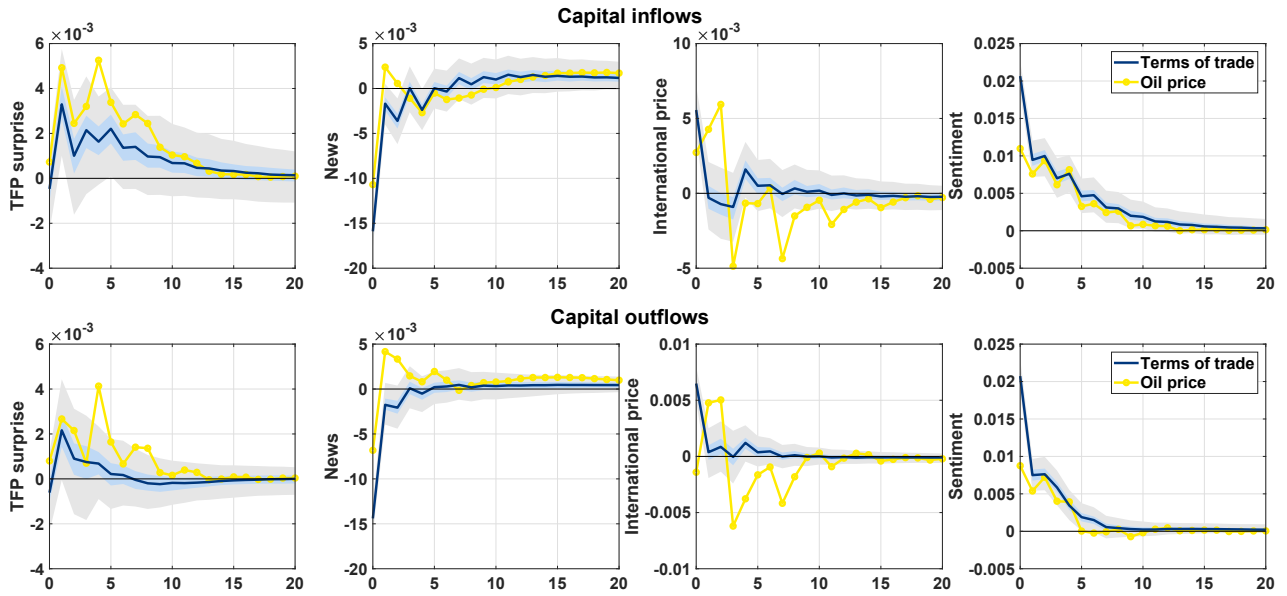

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors.

Finally, we account for shocks to international prices. We use the U.S. terms of trade from the Bureau of Economic Analysis, as well as the oil price (Global price of Brent Crude). The oil price is deflated by the CPI. IRFs of capital flows to the shocks are presented in Figure 8. A terms-of-trade amelioration and an increase in oil prices generate an increase in capital inflows and outflows (though it is subsequently reversed for the oil price shock), but the responses to the other shocks remain similar.

5.3 Further robustness checks and external validity

Can we interpret capital flows as reflecting changes in the desired cross border assets and liabilities? Gross capital flows are measures of the transactions between the US and the rest of the world. The evolution of cross-border assets and liabilities result from these

Figure 8: U.S. IRFs to TFP surprise, news, international prices and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors. Confidence intervals are built for the model with terms of trade.

transactions, but also from valuation effects. For instance, if there is an exchange rate appreciation, the foreign-currency value of US assets increases. Foreign investors might want to offset this valuation gain by selling US assets. Capital flows can then be due to "passive" portfolio rebalancing and not necessarily to a change in the desired portfolio. Figure A.10 in the Appendix shows that the news shock produces an exchange rate appreciation, whereas the sentiment shock produces a depreciation. The observed effect of these shocks on capital outflows would not be consistent with pure portfolio rebalancing, but the observed effect on inflows could be. To check this, we add the log-change in US liabilities and assets in the baseline SVAR.[15] Figure A.11 in the Appendix shows that the changes in liabilities and the change in assets, as a response to both news and sentiment shocks, go in the same direction as, respectively, capital inflows and capital outflows, with the qualification that the responses are lagged. This shows that capital flows do not simply offset valuation effects, but reflect desired changes in cross-border positions.

Our baseline specification uses four lags. Here, we repeat the analysis and plot the

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[15]The stock data come from the IMF's International Investment Position Statistics and are expressed in US dollars. In this specification, the sample reduces to 50 observations. We thus reduce the lag length from 4 to 2.

response functions using different lag lengths ($p = 1, 2, 3$). We present the IRFs in Appendix Figure A.12. The impulse responses computed using different lag specifications are very close to the ones of the baseline using two lags. Regarding the FEVD, adding more lags increases the contribution of our news and sentiment shocks to the variance of capital flows, and the share of unexplained FEVD diminishes.

Then, instead of including either inflows or outflows in the VAR specification, we add both inflows and outflows in our variables' vector y_t. Figure A.13 in Appendix A shows the responses of capital inflows and outflows when added together in the VAR. The responses are almost unchanged compared to a case where we identify the impact of TFP surprise, news and sentiment shocks including only inflows or outflows in the identification procedure.

We next extend our analysis to a panel of countries, thereby assessing our findings' external validity. Hence, we use the same identification strategy but include 17 additional OECD economies.[16] Again, the selected countries are those for which data are available (especially the TFP, see Appendix D). More details about the data is available in Appendix B. Our methodology for the panel is as follow: First, we run a SVAR identification including TFP, GDP, E12M and capital flows at the country level and compute the individual impulse response functions.[17] Then, the aggregate response function is obtained as the median across individual responses at all horizons.

The median responses of both capital inflows and outflows to all three shocks are presented in Figure 9. Both inflows and outflows react immediately and negatively to news shocks and positively to sentiment shocks. In other words, the panel findings are similar to those for the United States alone, confirming the importance of sentiment shocks in driving capital flows. Computing the aggregate responses as a median rather than a mean gives less weight to extreme values. Nevertheless, the mean responses, presented in Figure A.14 in Appendix A, lead to similar responses. Regarding the panel forecast error variance decomposition, we see in Figure A.15 in the Appendix that both news and sentiment shocks can explain close to 50% of the FEVD, with roughly equal contributions of the two shocks. In constrast, TFP surprise shock plays no role in driving capital flows as pointed out by the

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[16]We use a VAR specification with only 2 lags because of the more limited timespan of data availability for most countries. Selecting more lags or specific lags for each country does not change our conclusions, but render the IRFs less smooth.

[17]Notice that we use demeaned data to account for country-specific effects and that we use a horizon of 20 quarters for the news identification.

impulse response functions and the FEVD.

Figure 9: Panel median IRFs to TFP surprise, news and sentiment shocks
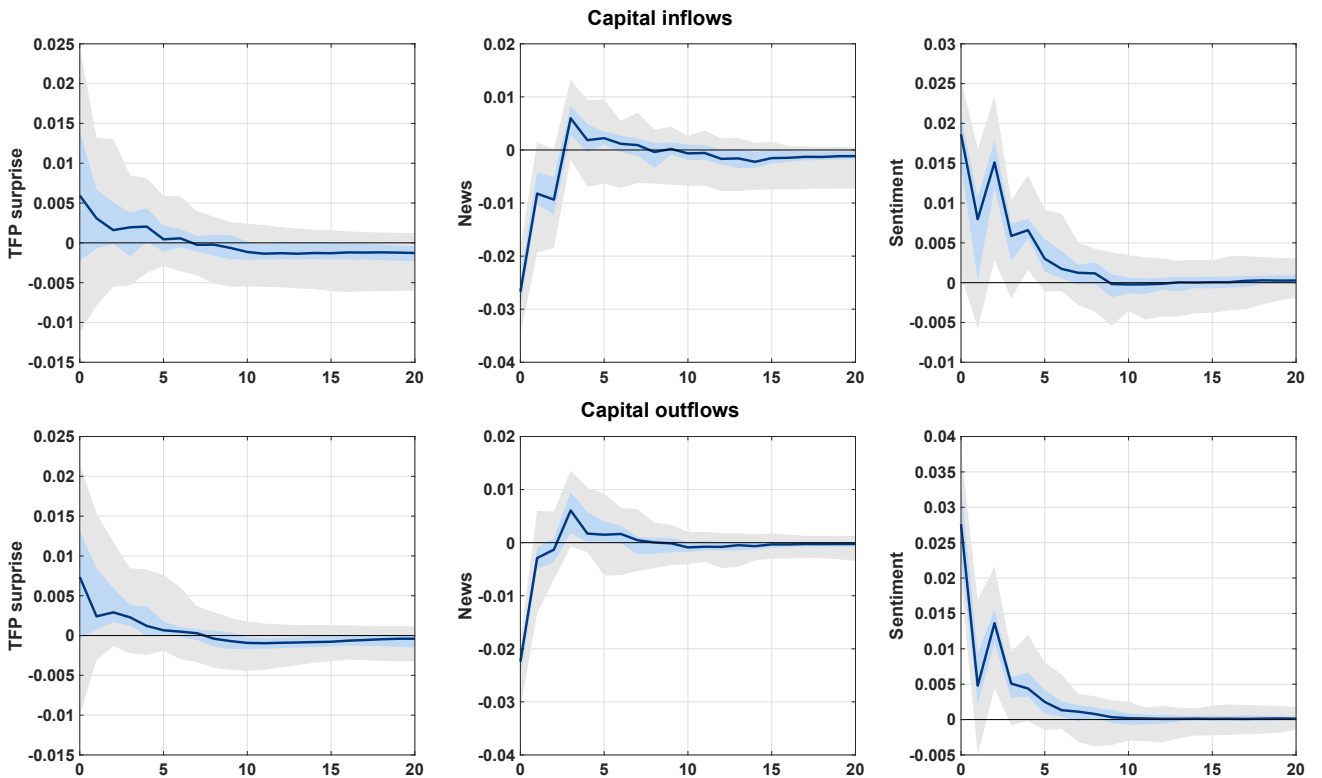
Dark and light shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

6 A stylized model of gross capital flows with asymmetric information

We develop a two-country model of gross capital flows to understand the effects of our empirically identified shocks. We consider a simple two-period model with two assets (home and foreign), equally-sized countries and a simple information structure. Technology shocks increase the return of domestic assets, while demand shocks reduce savings in the domestic economy. Domestic and foreign agents have asymmetric information about domestic shocks. While domestic agents obtain a private signal about future productivity shocks, foreign agents only observe a common noisy signal. We will be able to analyze three types of shocks: fundamental shocks (shocks to future technology), noise shocks (shocks to the public signal, which will influence expectations about future technology) and demand shocks. The

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fundamental shock in the model can be interpreted as the empirically identified news shock, as it generates a wave of optimism followed by an improvement in the country's fundamentals. The noise shock can be interpreted as the empirically identified sentiment shock, as it generates a wave of optimism with no actual improvement in the fundamentals. We find that the effect of news and sentiment shocks on capital flows documented in the data are consistent with the effects of fundamental and noise in the model, when domestic investors have an informational advantage, while we rule out demand shocks as an explanation for sentiment shocks.

The home country is indexed by H and the foreign country is indexed by F. There is a unit measure of asset suppliers and of investors in each country. In period 1, each domestic investor is endowed with $1/\beta$ units of good. They can either consume it or invest it in period 1, to consume their dividends in period 2. In period 1, the asset suppliers of the home country are endowed with a domestic tree, which yields dividend e^δ in period 2, and the asset suppliers of the foreign country are endowed with a foreign tree, which yields dividend e^{δ^*} in period 2, with $\delta \sim \mathcal{N}(0, \sigma_\delta)$ and $\delta^* \sim \mathcal{N}(0, \sigma_\delta)$. δ and δ^* are respectively the domestic and foreign fundamental (technology) shocks. Asset suppliers sell their tree in period 1 to investors of both countries, at price Q for the home tree and Q^* for the foreign tree, in order to consume.

Savings and portfolio choices An investor $j \in [0,1]$ of country H maximizes the following expected utility:

$$U_j^H = (1 - \beta e^{-\gamma^H}) \log(C_{j1}^H) + \beta e^{-\gamma^H} E_j^H \left\{ \log(C_{j2}^H) \right\} \tag{6.1}$$

E_j^H is the expectation conditional on home investor j's information in period 1. C_{j1}^H is j's consumption during period 1 and C_{j2}^H is her consumption during period 2. γ^H is a preference shock that increases the investors' demand for goods, with $\gamma^H \sim \mathcal{N}(0, \sigma_\gamma)$.

The agent is subject to the followings budget constraints:

$$\begin{aligned}
C_{j1}^H + Q K_j^H + Q^* K_j^{H*} &= \tfrac{1}{\beta} \\
e^\delta K_j^H + e^{\delta^*} K_j^{H*} &= C_{j2}^H
\end{aligned} \tag{6.2}$$

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K_j^H is j's investment in the domestic asset and K_j^{H*} is her investment in the foreign asset.

Denote by $S_j^H = QK_j^H + Q^*K_j^{H*}$ the total savings of home investor j and $X_j^{H*} = Q^*K_j^{H*}/S_j^H$ the share of savings invested in the foreign asset. $1 - X_j^{H*}$ is then the share invested at home. With log-utility, savings have a simple expression:

$$S_j^H = e^{-\gamma^H} \tag{6.3}$$

Then, assuming that returns are log-normally distributed, we obtain portfolio shares:

$$X_j^{H*} = \frac{E_j^H\{r^*-r\}}{Var_j^H\{r^*-r\}} + \frac{1}{2} \tag{6.4}$$

where $r = \log(R) = \delta - q$ is the log of the return on the home asset, $r^* = \log(R^*) = \delta^* - q^*$ is the log of the return on the foreign asset, with $q = \log(Q)$ and $q^* = \log(Q^*)$ the log of the domestic and foreign prices. $E_j^H(.)$ $(Var_j^H(.))$ is the expectation (variance) conditional on the information of investor j of country H in period 1.

Symmetric relations hold for investor $j \in [0,1]$ in the foreign country:

$$\begin{aligned} S_j^F &= e^{-\gamma^F} \\ X_j^F &= \frac{E_j^F\{r-r^*\}}{Var_j^F\{r-r^*\}} + \frac{1}{2} \end{aligned} \tag{6.5}$$

where S_j^F are j's savings, $X_j^F = QK_j^F/S_j^F$ is the share of savings invested in the home country's asset. γ^F is the foreign demand shock, with $\gamma^F \sim \mathcal{N}(0, \sigma_\gamma)$. $E_j^F(.)$ $(Var_j^F(.))$ is the expectation (variance) conditional on the information of investor j of country F in period 1.

We assume that asset suppliers get utility from consuming in period 1, so that the home asset suppliers sell the home asset in period 1 and consume Q, while the foreign asset suppliers sell the foreign asset and consume Q^*.

Gross capital inflows in the home country are changes in the foreign holdings of domestic assets $KI^H = K^F$, and gross capital outflows are changes in the domestic holdings of foreign assets $KO^H = K^{H*}$, with $K^F = \int_0^1 K_j^F dj$, $K^{H*} = \int_0^1 K_j^{H*} dj$. Note that $KI^F = KO^H$ and $KO^F = KI^H$. Combining savings and portfolio shares as described in (6.3)-(6.5), we can determine cross border asset holdings K^F and K^{H*}, which correspond to gross capital flows.

Equilibrium on the world's asset markets implies that the asset supply should be equal to the asset demand:

$$
\begin{aligned}
Q &= (1 - X^{H*})S^H + X^F S^F \\
Q^* &= X^{H*}S^H + (1 - X^F)S^F
\end{aligned}
\tag{6.6}
$$

with $X^{H*} = \int_0^1 X_j^{H*}dj$ and $X^F = \int_1^1 X_k^F dk$ being the average portfolio shares. We used here the fact that savings are equal across investors in a given country ($S_j^H = S^H$ and $S_j^F = S^F$ for all j).

Asymmetric information As assets demand, and hence capital flows, depends on expected returns, it is crucial to specify the information structure. We assume that there are public signals on home and foreign future productivity that are observed both by both home and foreign investors. We denote these signals $s = \delta + e$ and $s^* = \delta^* + e^*$, where e and e^* are i.i.d. noise shocks with mean zero and standard error σ_e. s and s^* summarizes the publicly available information.

The asymmetry in information goes as follows. Each home investor $j \in [0, 1]$ additionally observes a private signal on home productivity $x_j = \delta + \lambda_j$, with $\lambda_j \sim \mathcal{N}(0, \sigma_\lambda)$ and $\int_0^1 \lambda_j dj = 0$. Similarly, each foreign investor $j \in [0, 1]$ observes a private signal on foreign productivity $x_j^* = \delta^* + \lambda_j^*$, with $\lambda_j^* \sim \mathcal{N}(0, \sigma_\lambda)$ and $\int_0^1 \lambda_j^* dj = 0$. In addition, home investors observe their own demand shock γ^H, while foreign investors observe their own demand shock γ^F.

Finally, all investors observe assets prices q and q^*. However, we assume, for simplicity, that asset prices are not used as a source of information on the fundamental shocks. Namely, investors do not extract any information from q and q^* regarding the state of the productivity shocks δ and δ^*, i.e., they neglect the reasons why asset prices change. In other words, investors are cursed in the sense of Eyster and Rabin (2005). This assumption is without loss of generality. Indeed, in our setup, prices are imperfect signals of the fundamentals, because they are also driven by demand shocks.[18] As a consequence, allowing investors to extract information on fundamentals from prices would not dramatically change our results.

With this information structure, domestic and foreign investors form the following ex-

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[18]This is similar to the finance literature, where "noise traders" make asset prices noisy signals of the fundamentals.

pectations about fundamentals:

$$E_j^F(\delta) = \alpha_0 s$$
$$E_j^H(\delta) = (1-\kappa)\alpha_0 s + \kappa x_j$$

where $\alpha_0 = \sigma_e^{-2}/(\sigma_\delta^{-2} + \sigma_e^{-2})$ and $\kappa = \sigma_\lambda^{-2}/(\sigma_\delta^{-2} + \sigma_e^{-2} + \sigma_\lambda^{-2})$ are Bayesian weights.

We denote by $\bar{E}^H(\delta) = \int_0^1 E_j^H(\delta)dj$ and $\bar{E}^F(\delta) = \int_0^1 E_j^F(\delta)dj$ the average expectations of home and foreign investors about home fundamentals. We obtain:

$$\bar{E}^F(\delta) = \alpha_0\delta + \alpha_0 e$$
$$\bar{E}^H(\delta) = \alpha_1\delta + \alpha_2 e \tag{6.7}$$

where $\alpha_1 = [\alpha_0 + \kappa(1-\alpha_0)]$ and $\alpha_2 = (1-\kappa)\alpha_0$. δ and e are both increasing the expectations about δ, but only δ materializes later in the country's technology. We therefore interpret δ as a "news" shock and e as a "sentiment" shock.

We can see that, when $\kappa > 0$, we have $\alpha_2 < \alpha_0 < \alpha_1$: domestic expectations about the domestic fundamentals react more to the fundamental (δ) and less to the aggregate noise (e) than foreign expectations. Domestic investors thus have more precise expectations than foreign investors. κ, which is increasing in the precision of the domestic private signal σ_λ^{-2}, is a measure of the degree of asymmetry in information between home and foreign agents.

Log-linearized equilibrium We have assumed, for simplicity, that all shocks are i.i.d. As a result, log-linearizing around the nonstochastic equilibrium yields the following equilibrium home expected return, from the point of view of a home and a foreign investors:

$$E_j^H(r) = E_j^H(\delta) - q$$
$$E_j^F(r) = E_j^F(\delta) - q \tag{6.8}$$

where lower-case letters denote log-deviations from the nonstochastic equilibrium.

Now consider capital inflows and outflows. They are equal to cross-border asset holdings:

$$k^F = s^F + x^F - q$$
$$k^{H*} = s^H + x^{H*} - q* \tag{6.9}$$

Cross-border asset holdings depend on savings, average portfolio shares $x^F = \int_0^1 x_j^F dk$ and $x^{H*} = \int_0^1 x_j^{H*} dj$ and valuation effects.

Savings are a function of the preference shocks:

$$
\begin{aligned}
s^F &= -\gamma^F \\
s^H &= -\gamma^H
\end{aligned}
\tag{6.10}
$$

and average portfolio shares are then simple functions of the average expected excess returns:

$$
\begin{aligned}
x^F &= 2\phi[\bar{E}^F(\delta - \delta^*) - (q - q^*)] \\
x^{H*} &= 2\phi[\bar{E}^H(\delta^* - \delta) - (q^* - q)]
\end{aligned}
\tag{6.11}
$$

where $\phi = Var^H(r - r^*)^{-2} = Var^F(r - r^*)^{-2}$ is the inverse of the conditional variances.

Taking asset prices as given, higher expected home productivity (higher $\bar{E}^H(\delta)$ and $\bar{E}^F(\delta)$) increases the portfolio shares, and should lead to more capital inflows (higher k^F) and less capital outflows (lower k^{H*}), as both home and foreign investors increase the share of home assets in their portfolio. However, the home asset is in limited supply, so an increase in the demand for the home asset leads to a price increase, which reduces the expected return of the home asset. Another effect of the asset price comes from valuation. An increase in the home asset price, by mechanically increasing the share of home assets in portfolios, reduces the need to acquire new home assets.

Taking into account Equations (6.10), (6.11), and the equilibrium asset prices, we show (see details in Appendix C) that equilibrium cross-border asset holdings are:

$$
\begin{aligned}
k^F &= \phi\left[E^F(\delta - \delta^*) - E^H(\delta - \delta^*)\right] + \tfrac{\gamma^H - \gamma^F}{2} \\
k^{H*} &= \phi\left[E^H(\delta^* - \delta) - E^F(\delta^* - \delta)\right] + \tfrac{\gamma^F - \gamma^H}{2}
\end{aligned}
\tag{6.12}
$$

Consider k^F, the foreign holdings of the home asset. Foreign expectations about the relative productivity of the home country have a positive effect on these foreign holdings. On the other hand, home investors' expectations about the relative productivity of the home asset have a negative effect on the foreign holdings of the home asset. This comes from the fact that a higher domestic demand for the home asset increases its price. This price increase

limits the excess return of the home asset and lowers the demand of foreign investors, and it mechanically increases the share of home assets in the foreign investors' portfolios, which pushes foreign investors to sell the home asset to rebalance their portfolios.

As a result, capital flows are not affected by absolute optimism about fundamentals but by relative optimism $(\bar{E}^F(.) - \bar{E}^H(.))$. To understand, consider a shock (either fundamental or noise) that generates a positive public signal on home fundamentals δ while holding everything else constant. As both home and foreign investors receive the public signal, they both become more optimistic about those fundamentals. Holding the home asset price constant, this leads both home and foreign investors to demand more of the home asset. However, in equilibrium, home (foreign) investors can hold more home assets only if foreign (home) investors hold fewer home assets. Therefore, optimism about home productivity changes asset holdings only to the extent that the beliefs of home and foreign are affected in an asymmetric way $(\bar{E}^F(\delta) - \bar{E}^H(\delta) \neq 0)$. The adjustment then takes place through the increase in the home asset price. In equilibrium, this adjustment is large enough to keep away the agents with a relatively lower demand for the home asset.

The effect of shocks on capital flows We are now able to derive the aggregate effect of fundamental shocks (δ), noise shocks (e) and demand shocks (γ^H) on capital flows.

The results are summarized in the following Proposition:

Proposition 1 (Capital inflows and outflows) *If $\kappa > 0$, a positive fundamental shock at home $(\delta > 0)$ generates a decrease in capital inflows and outflows, and a positive noise shock $(e > 0)$ generates an increase in capital inflows and outflows. If $\kappa = 0$, fundamental and noise shocks do not generate any capital flows.*

A positive demand shock at home (γ^H) generates a decrease in capital outflows and an increase in capital inflows.

A positive demand shock at home decreases capital outflows and increases capital inflows, generating net inflows. Indeed, an increase in the demand for goods reduces savings. This means that domestic agents invest less in both home and foreign assets. This implies that demand shocks not only generate net inflows, but also cannot drive a positive correlation between inflows and outflows. This is at odds with our identified sentiment shock, which generates positively correlated flows and no net flows.

A positive correlation between inflows and outflows arises only in the presence of expectation-related shocks, when there is asymmetric information ($\kappa > 0$), with a retrenchment in capital flows following a fundamental shock and an expansion following a noise shock. Indeed, expectation-related shocks do not change total savings, so larger holdings of home assets (in the case of a fundamental shock for instance) have to come with a reduction in foreign asset holdings.[19] This mechanically generates a positive correlation of flows.

Consider now, more specifically the effect of fundamental and noise shocks on capital flows. Remember that, as illustrated by (6.12), capital flows respond only to asymmetric demand shifts. One parameter is especially crucial to generate asymmetric demand shifts: the relative precision of home investors' information about the home asset, which is reflected in $\kappa > 0$. In the case of a positive fundamental shock, domestic agents are more confident about the fundamental nature of the shock. Hence, they are relatively more optimistic than foreign agents about domestic excess returns, and relatively more pessimistic about foreign excess returns. This generates a decrease in both capital inflows and outflows, as domestic agents prefer to sell foreign assets and buy back domestic assets from foreigners. In the case of a positive noise shock, foreign agents are more easily confused by the optimistic public signal. As a result, they are relatively more optimistic than home agents about domestic excess returns, and relatively more pessimistic about foreign excess returns. This generates an increase in both capital inflows and outflows, as home agents sell foreign assets and buy domestic assets from domestic agents. The effects of news and sentiment shocks identified in the data are therefore consistent with the effects of fundamental and noise shocks in our model with information asymmetries.

Discussion of assumptions Here, we discuss the effects of some assumptions on our results. First, once could note that noise shocks, as opposed to sentiment shocks, have no "real effects". This is because we consider a model with endowment. With endogenous production, noise shocks would also prove to have short-term real effects, similarly to Lorenzoni (2009).

Second, it is assumed that investors do no carry over any assets from a prior period. If we

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[19]The independence of the saving rate from expected returns comes from log-utility, which is characterized by a unitary elasticity of intertemporal substitution, and might not hold with a more general utility function. However, the elasticity of intertemporal substitution is consistently estimated to be close to one in the data.

relaxed this assumption, then valuation effects could generate wealth effects that lead agents to change their saving plans, as with demand shocks. As shown in the model, this generates net inflows and a negative correlation between inflows and outflows. This mechanism will reduce the comovement between capital inflows and outflows resulting from expectation-related shocks. It is reasonable to argue that with enough information asymmetries between domestic and foreign investors, our predictions would survive.

Finally, we do not have investment in the model. Introducing investment would amount to having an elastic supply of assets. As a result, fundamental and noise shock would generate net capital inflows or outflows. This mechanism would thus also reduce the comovement between capital inflows and outflows. Here, as well, we can expect our predictions to survive with enough information asymmetries. Note also that with investment, global demand shocks could potentially lead inflows and outflows to move in the same direction, as a rise in global saving would raise inflows and outflows associated with portfolio growth. However, this prediction does not apply to local sentiment shocks, and it is hard to reconcile it with the empirical fact that sentiment shocks generate a positive comovement between consumption and gross capital flows (see Figure A.1).

7   Conclusion

Overall, our findings show that domestic surges in optimism either related to future productivity - news shocks - or not - sentiment shocks - are important drivers of gross capital flows at the country level. Together they can explain up to 80% of the FEVD of capital flows for the United States and approximately 50% for a panel of 17 OECD economies. While sentiment shocks trigger positive inflows and outflows, news shocks have a negative impact on gross capital flows. This suggests that the increase in cross-border capital positions is not related to better fundamentals, but rather driven by surges in optimism unrelated to future productivity. These sentiment shocks are also found to be distinct from global, financial or economic uncertainty and monetary policy shocks. The fact that capital inflows rise following optimism shocks disconnected from fundamentals can raise concerns from a policy perspective, even though forces driving these flows are not necessarily global.

These results are consistent with a model where domestic agents have an informational

advantage over foreigners about domestic fundamentals. A relatively higher optimism among domestic agents explains the typical increase in home bias triggered by a news shock, while a relatively higher optimism among foreign agents explains the typical capital flows expansions observed in the case of a sentiment shock.

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A   Additional results

Figure A.1: U.S. IRFs to TFP surprise, news and sentiment shocks - with consumption and hours
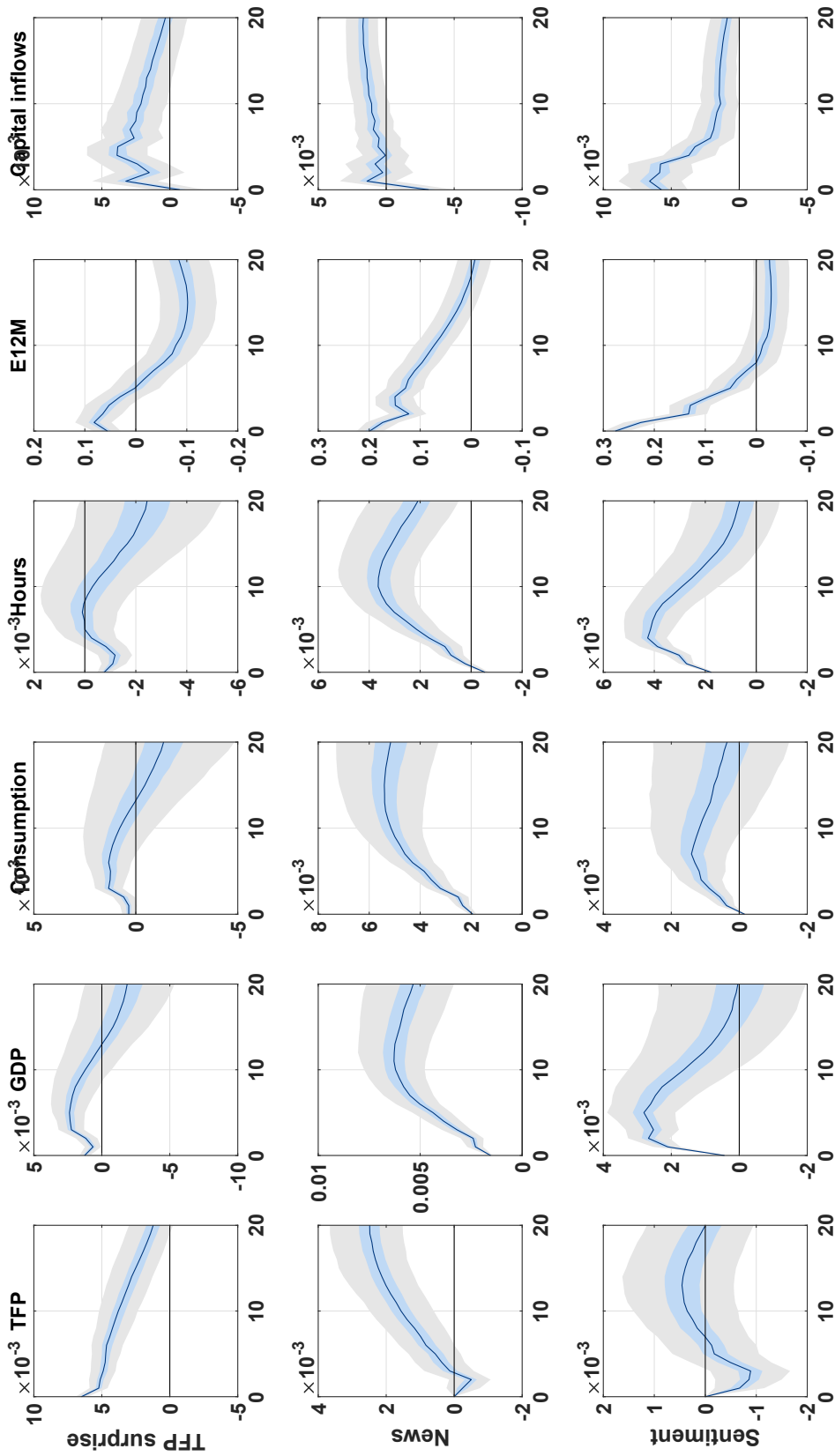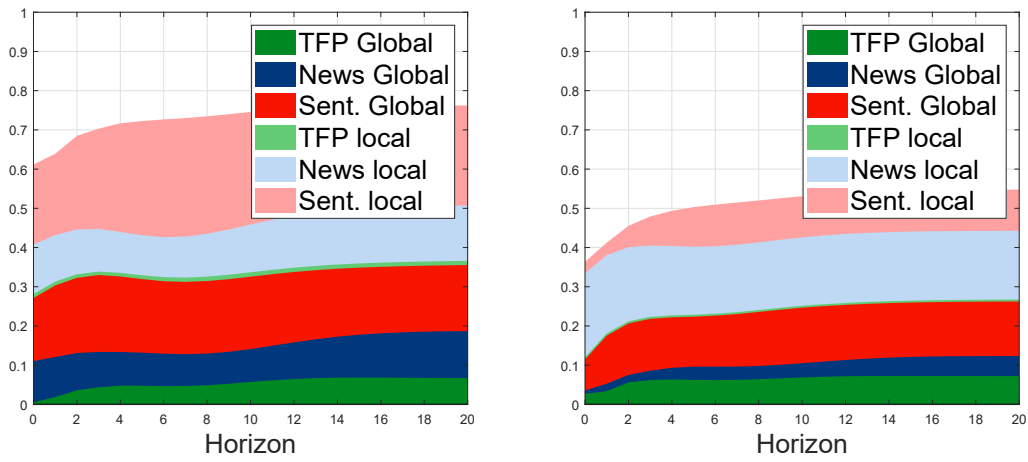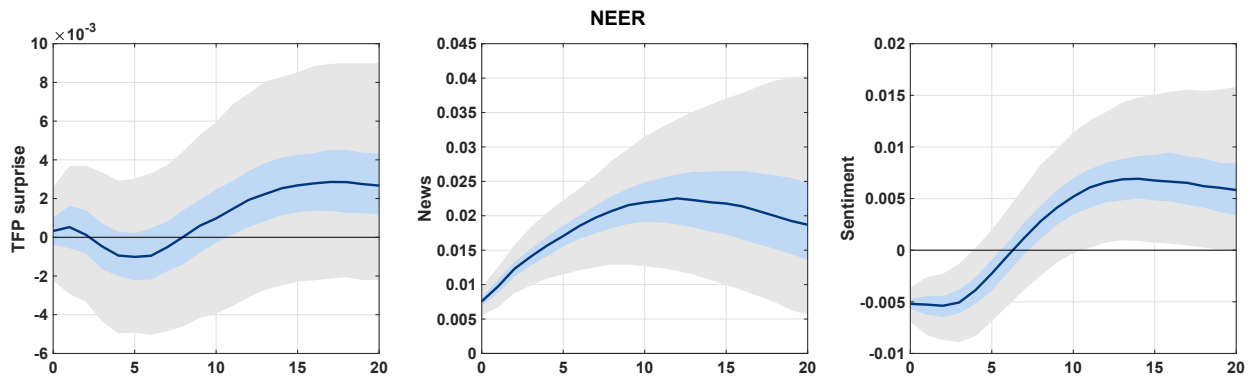
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors
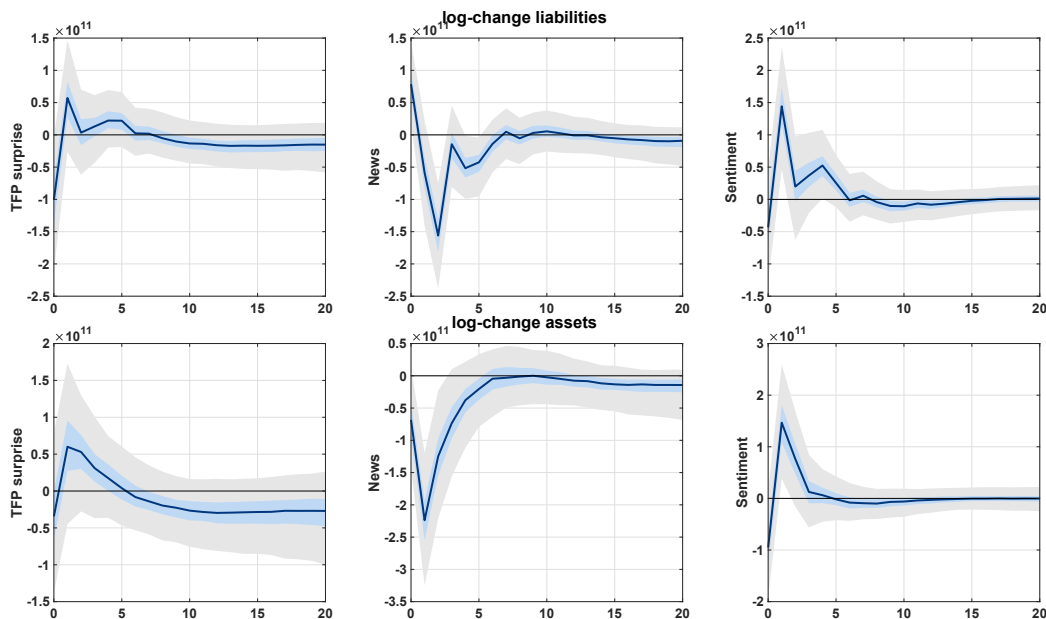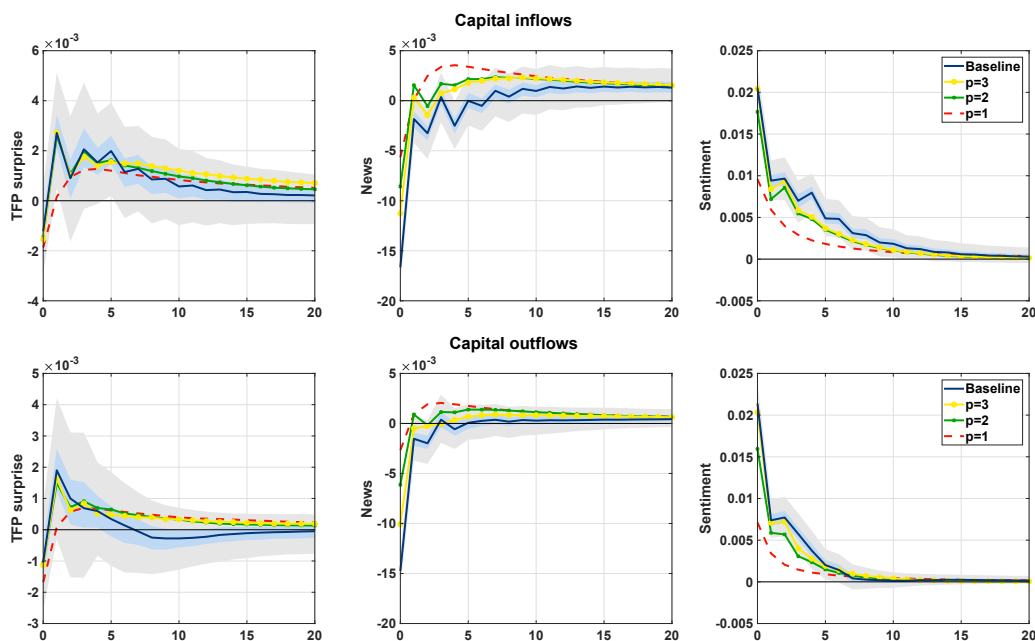
Figure A.2: U.S. IRFs of net capital inflows to TFP surprise, news and sentiment shocks
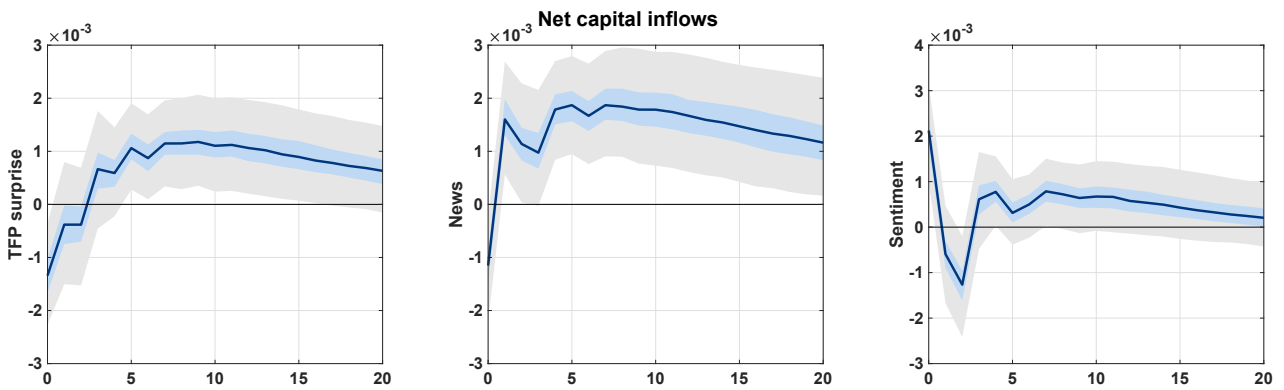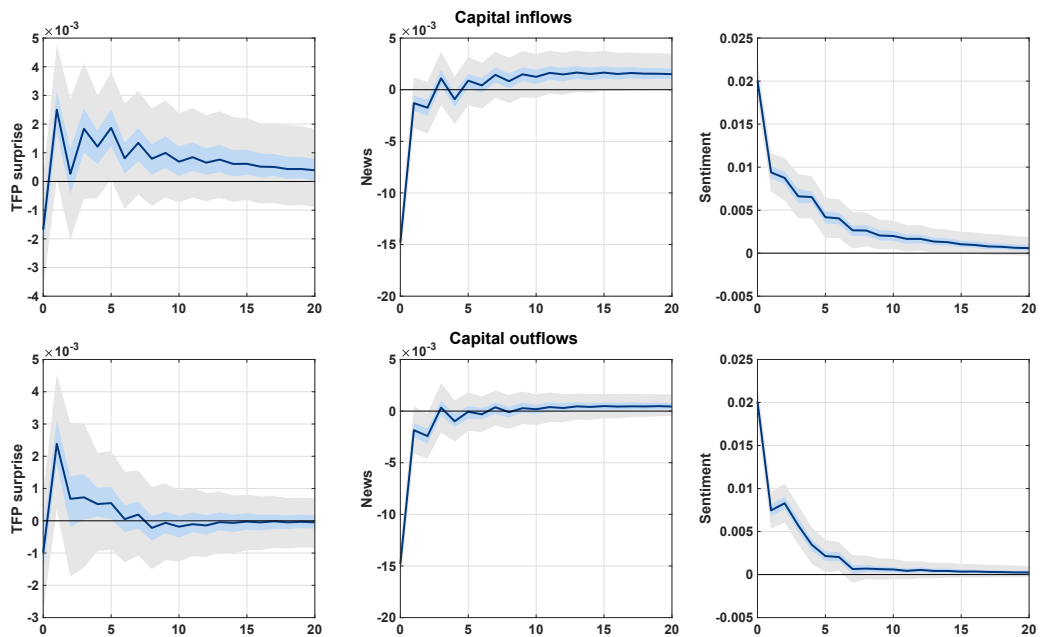

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.3: Forecast Error Variance Decomposition of gross capital flows
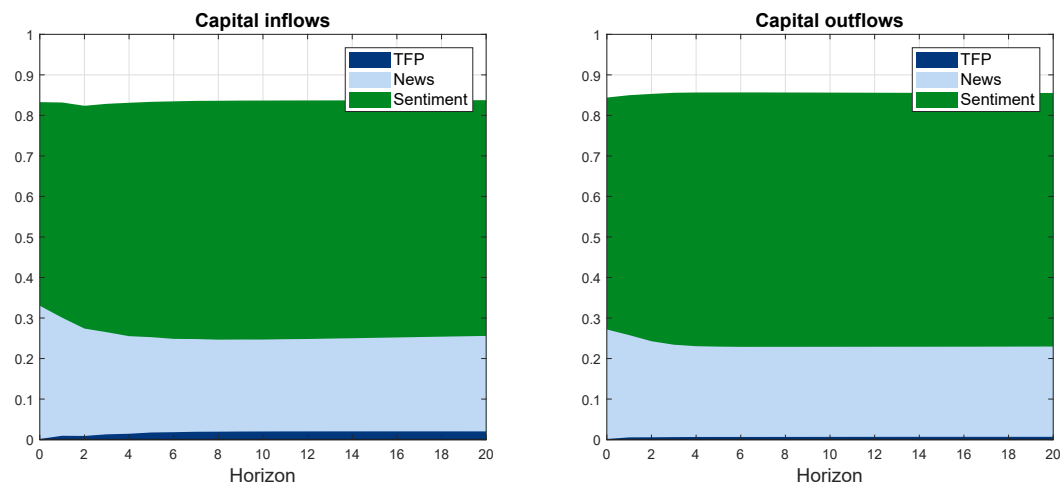
Figure A.4: U.S. IRFs of stock price to TFP surprise, news and sentiment shocks
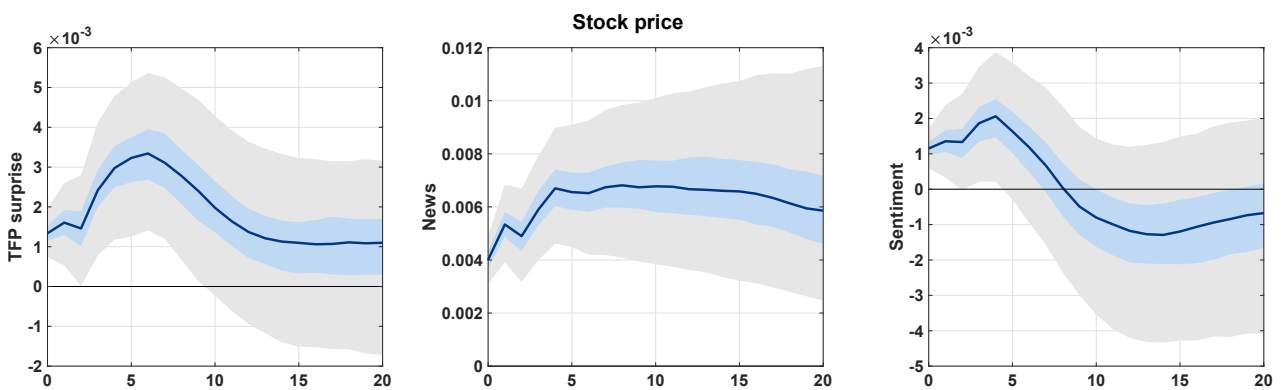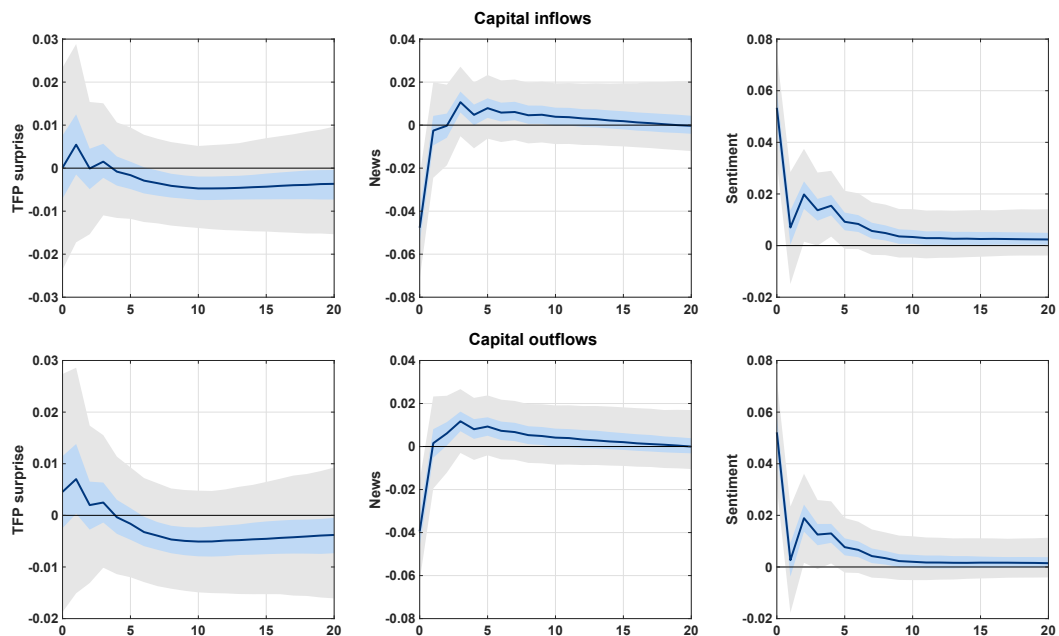

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.5: IRFs to TFP surprise, news and sentiment shocks - FDI flows
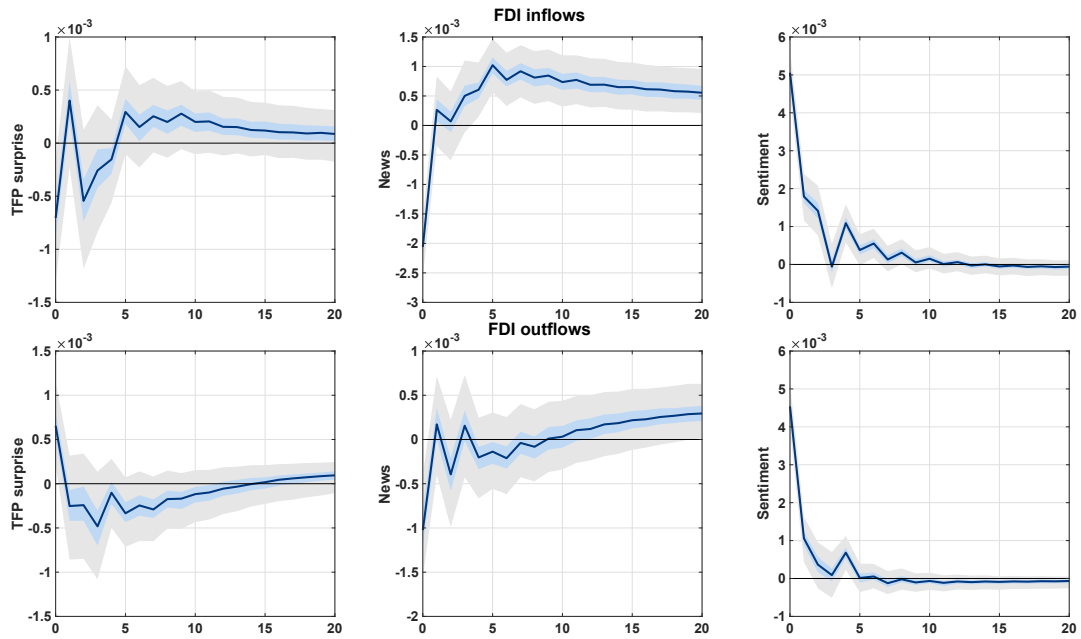
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

**Figure A.6:** IRFs to TFP surprise, news and sentiment shocks - Portfolio equity flows
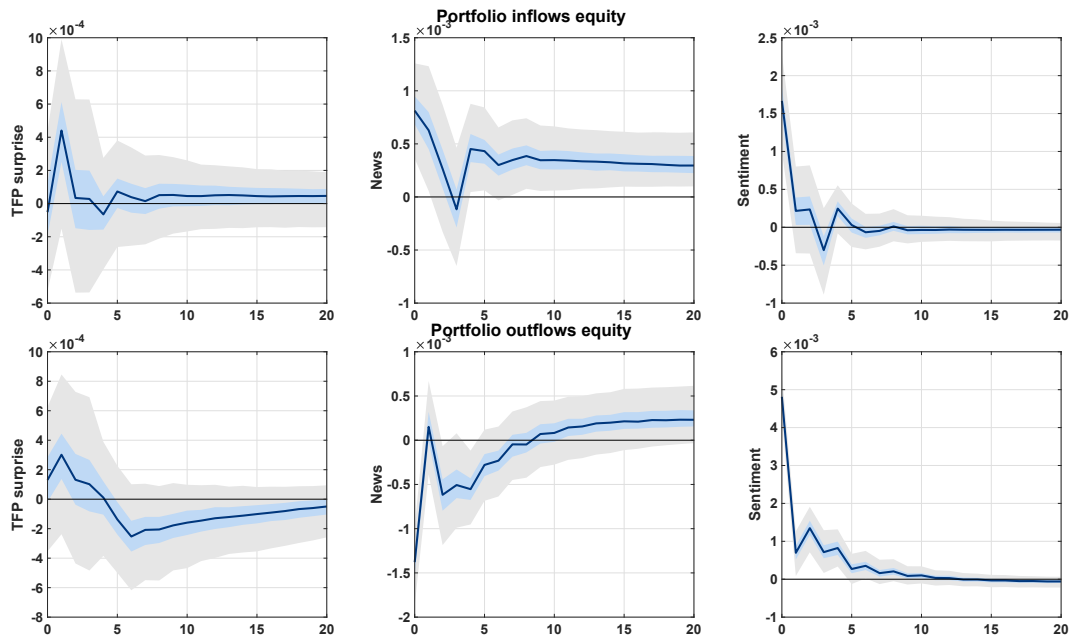
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.7: IRFs to TFP surprise, news and sentiment shocks - Portfolio bond flows
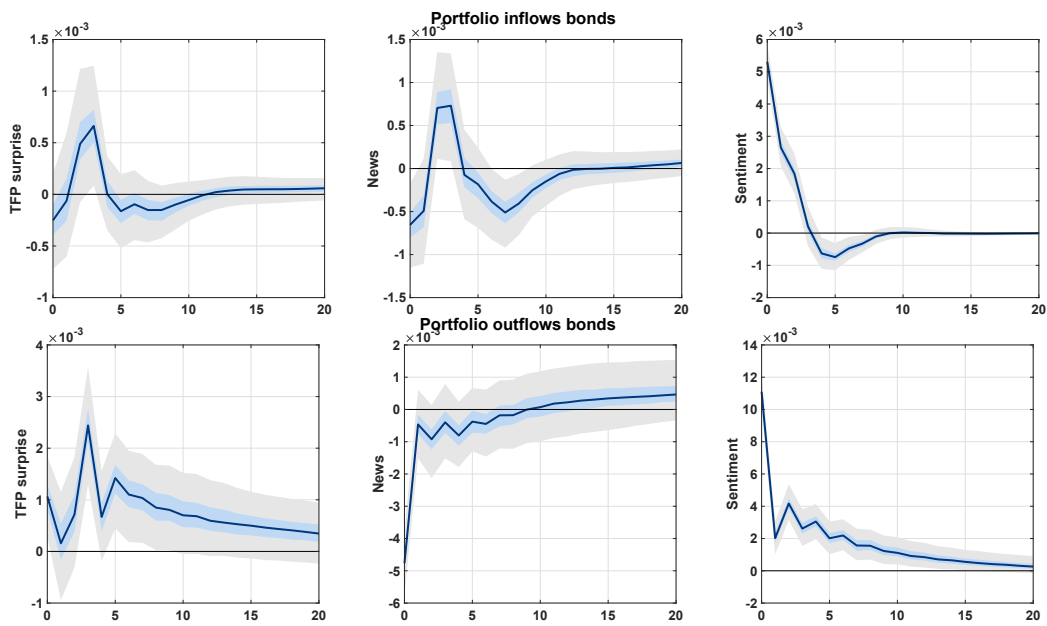
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.8: IRFs to TFP surprise, news and sentiment shocks - Other investment flows
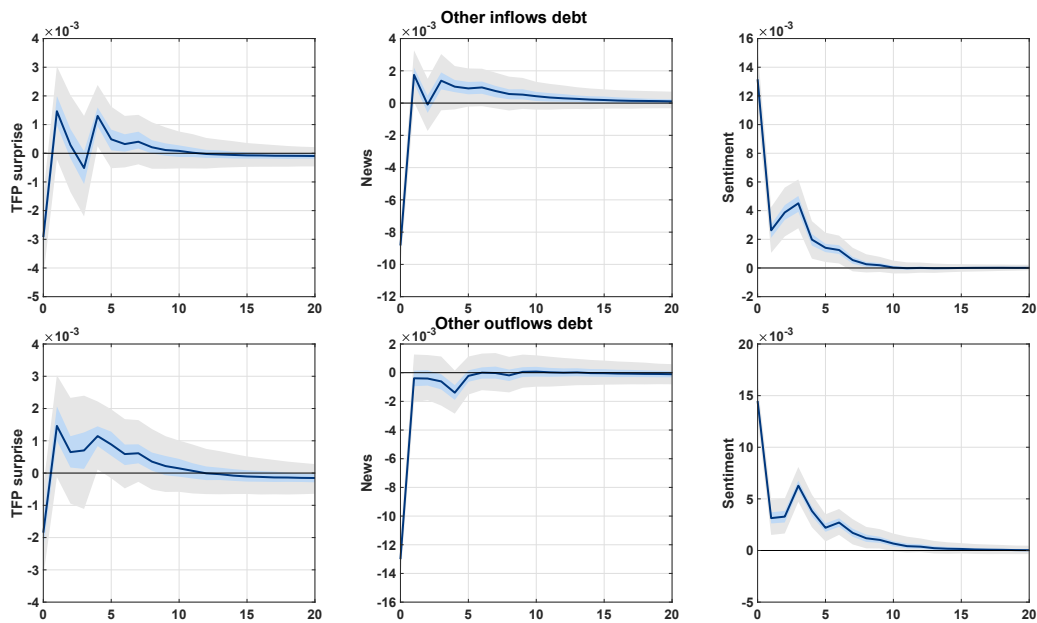
Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.9: Forecast Error Variance Decomposition of gross capital flows - VAR with 7 variables

Figure A.10: U.S. IRFs of NEER to TFP surprise, news and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.11: IRFs of log-change in US liabilities and assets to TFP surprise, news and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.12: Capital flows IRFs to TFP surprise, news and sentiment shocks – Various lag specifications

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors. Confidence intervals are built for the model with $p = 4$.

Figure A.13: Capital flows IRFs to TFP surprise, news and sentiment shocks – Including both inflows and outflows in estimation

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors.

Figure A.14: Panel mean IRFs to TFP surprise, news and sentiment shocks

Darker blue and lighter grey shaded areas represent the 67.5% and 90% confidence intervals from 2000 bias-corrected bootstrapped standard errors

Figure A.15: Forecast Error Variance Decomposition of gross capital flows for the panel
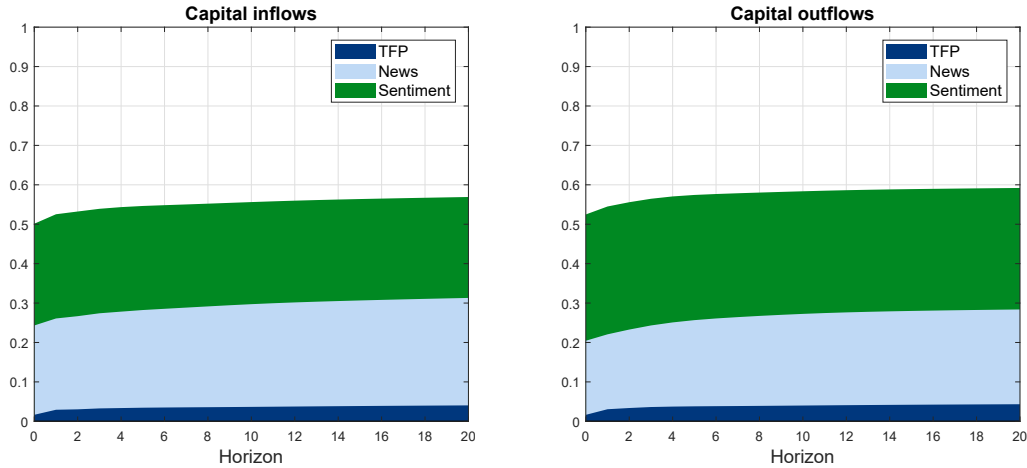
B Other countries

We also collect TFP, GDP and sentiment data for 17 OECD economies. Unfortunately, to our knowledge, no TFP measure similar to the U.S. series exists for any of the other countries considered in our analysis. We therefore build our own measure of TFP based on the methodology of Imbs (1999). This approach adjusts the Solow residuals for capital and labor utilization, using aggregated measures of investment, hours worked, wages and consumption. To assess the quality of our approach, we compute a TFP series for the United States and compare it with Fernald (2014)'s series. The methodology seems to do a fairly good job: a Kernel analysis of the differences between the two series does not show the presence of a systematic bias. These graphs and further details on the methodology can be found in Appendix D. Moreover, as argued by Sims (2016), the less precise the TFP measure, the smaller are the measured effects of news shocks. Therefore, if anything, bad measures of TFP imply less important effects of news shocks.

For output, we use the chain-weighted real GDP variable from the OECD database. Labor force - active population aged 15 or over, is obtained from the ILO. As expectations' variable, we use the forward-looking component of the consumer confidence index. The survey question considered is the following: "How do you expect the general economic situation in this country to develop over the next 12 months?".[20] There are six possibilities

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[20]The question described here is the one asked in most countries that are part of the joint harmonized EU program of business and consumer surveys, but other countries' survey questions are very close. Each

of answers: it will get a lot better (+2)/ a little better(+1)/ stay the same (0)/ a little worse (-1)/ a lot worse (-2)/ I do not know (0), from which the net balance is computed. The countries in our sample are selected based on data availability and are listed below with their respective timespans.

Table B.1: Time coverage including baseline data

Panel - OECD economies		
Australia	1995Q1	2018Q3
Austria	2005Q1	2018Q3
Belgium	2002Q1	2018Q3
Czech Republic	1995Q3	2018Q3
Denmark	1995Q3	2015Q4
Estonia	2000Q3	2017Q4
Finland	1990Q3	2017Q4
France	1985Q1	2018Q3
Germany	1992Q1	2018Q3
Ireland	2005Q1	2018Q3
Italy	1996Q3	2018Q3
Netherlands	1996Q3	2018Q3
Portugal	1995Q3	2017Q4
Spain	1995Q3	2018Q3
Sweden	1995Q4	2018Q3
Switzerland	1999Q1	2017Q4
United Kingdom	1995Q3	2018Q2
United States	1973Q1	2018Q3

C   Model appendix

C.1   Proof of equations (6.3)-(6.5)

Consider j investor's program in country H. Define as $s_j^H = S_j^H/\beta$ the share of savings in the total investor's endowment and $X_j^{H*} = Q^* K_j^{H*}/S_j^H$ the share of savings invested abroad. The household's program then consists in maximizing

$$U_j^H = (1 - \beta e^{-\gamma^H}) \log(1 - s_j^H) + \beta e^{-\gamma^H} E_j^H \left\{ \log(s_j^H) + \log\left(e^r(1 - X_j^{H*}) + e^{r^*} X_j^{H*}\right) \right\} - \log(\beta)$$

country's details are available on the OECD website (link).

where $r = \delta - q$ and $r^* = \delta^* - q^*$. This yields the following first-order conditions with respect to s_j^H and X_j^{H*}:

$$\frac{(1 - \beta e^{-\gamma^H})}{1 - s_j^H} = \frac{\beta e^{-\gamma^H}}{s_j^H} \tag{C.1}$$

$$E_j^H \left\{ e^{r - \tilde{r}_j} \right\} = E_j^H \left\{ e^{r - \tilde{r}_j} \right\} \tag{C.2}$$

with $\tilde{r}_j = \log \left(e^r (1 - X_j^{H*}) + e^{r^*} X_j^{H*} \right)$ is the average return on wealth.

After rearranging, (C.1) yields a constant saving rate across investors $s_j^H = s^H = \beta e^{-\gamma^H}$, and hence (6.3). Using the fact that $E(e^x) = e^{E(x) + \frac{1}{2} Var(x)}$ when x is normal, (C.2) yields:

$$e^{E_j^H(r - \tilde{r}_j) + \frac{1}{2} Var_j^H(r - \tilde{r}_j)} = e^{E_j^H(r^* - \tilde{r}_j) + \frac{1}{2} Var_j^H(r^* - \tilde{r}_j)}$$

$$\Rightarrow E_j^H(r - \tilde{r}_j) + \tfrac{1}{2} Var_j^H(r - \tilde{r}_j) = E_j^H(r^* - \tilde{r}_j) + \tfrac{1}{2} Var_j^H(r^* - \tilde{r}_j)$$

We approximate $\tilde{r}_j$ around $r = \bar{r}$ and $r^* = \bar{r}^*$, which are their steady-state values:

$$\tilde{r}_j = \bar{\bar{r}}(X_j^{H*}) + (1 - X_j^{H*})r + X_j^{H*} r^*$$

with $\bar{\bar{r}}(X_j^{H*}) = \log[(1 - X_j^{H*})e^{\bar{r}} + X_j^{H*} e^{\bar{r}^*}]$ a term that is known in period 1. Replacing in the first-order condition and rearranging, we obtain:

$$E_j^H(r^* - r) = \tfrac{1}{2}[Var_j^H(r) - Var_j^H(r^*)] + (1 - \bar{X}_j^{H*})Cov_j^H(r^* - r, r) + X_j^{H*} Cov_j^H(r^* - r, r^*)$$

$$\Rightarrow E_j^H(r^* - r) = -\frac{(1 - 2X_j^{H*})Var_j^H(r^* - r)}{2}$$

which yields (6.4).

Equations (6.5) are derived in a similar way by solving the foreign investors' program.

C.2 Proof of Equation 6.12

Asset prices are thus key to determine capital flows. Log-linearizing equations (6.6), we establish

$$q = \frac{x^F - x^{H*}}{2} + \frac{s^H + s^F}{2}$$
$$q^* = \frac{x^{H*} - x^F}{2} + \frac{s^F + s^H}{2}$$

Using the equilibrium equations (6.6), we can also show that $q + q^* = -\gamma^H - \gamma^F$: demand shocks decrease the global demand for assets, which decrease the global asset price. We can derive the equilibrium home asset price:

$$q = \frac{\phi}{1 + 4\phi} \left[E^H(\delta - \delta^*) + E^F(\delta - \delta^*) \right] - \frac{\gamma^H + \gamma^F}{2} \tag{C.3}$$

The home asset price increases if either home or foreign investors think that the domestic asset is relatively more productive than the foreign asset, or if there is a decrease in the world demand for goods, which increases the world demand for assets. The foreign asset price q^* is then obtain simply as $q^* = -q - \gamma^H - \gamma^F$.

Using Equations (6.10), (6.11), (C.3) and $q^* = -q - \gamma^H - \gamma^F$, we obtain (6.12).

C.3 Proof of proposition 1

Using the expression for cross-border holdings (6.12) and the expression for expectations (6.7), we can show that

$$k^F = -\phi(\alpha_1 - \alpha_0)\delta + \phi(\alpha_0 - \alpha_2)e + \dots$$
$$k^{H*} = -\phi(\alpha_1 - \alpha_0)\delta + \phi(\alpha_0 - \alpha_2)e + \dots$$

where we consider only terms that affect the expectations of δ.

Since $\kappa > 0$ in the presence of asymmetric information, we have $\alpha_1 = [\alpha_0 + \kappa(1 - \alpha_0)] > \alpha_0 > \alpha_2 = (1 - \kappa)\alpha_0$. Therefore, a noise shock e generates an increase in capital inflows and outflows and a news shock δ generates a reduction in capital inflows and outflows as long as there is asymmetric information.

In the absence of asymmetric information ($\kappa = 0$), δ and e generate no capital flows.

D TFP construction

Methodology

An ideal measure of utilisation-adjusted TFP would be similar to the US series by Fernald (2014). To our knowledge, such series cannot be constructed for the 17 countries considered in this paper. Therefore, we compute a measure of TFP using the methodology proposed by Imbs (1999) and close to the one used in Basu et al. (2006). The main idea is to adjust Solow residuals for capital and labour utilisation, using aggregated measures of investment, hours worked, wages and consumption. Hence, this approach does not use industry-level data nor control for sectors and non-constant returns to scale. The remaining of the Appendix aims at providing the equations of the iterative algorithm used to construct TFP series for each country. For more details on the derivations, the reader should refer to Imbs (1999).

Output

The output is assumed to be given by the following production function:

$$Y_t = X_t(K_t u_t)^{1-\alpha}(N_t e_t)^{\alpha}$$

where Y_t is aggregate output, K_t is the capital stock, N_t represents hours worked over the period, e_t is the labour effort and u_t the capital utilisation rate. Thus, $(K_t u_t)$ gives us the effective capital services and $(N_t e_t)$ the effective labour input.

Capital stock series

First, the capital stock series is constructed using the perpetual inventory method, with a time-varying depreciation rate:

$$K_{t+1} = (1 - \delta_t)K_t + I_t. \tag{C.1.}$$

The initial level of capital K_0 is constructed following Berlemann and Wesselhöft (2014):

$$K_0 \approx \frac{I_1}{g_I + \delta}$$

The initial investment value I_1 is obtained by regressing the logarithm of investment series on a constant and time t. The first observation of investment is excluded and the OLS regression therefore goes from $t = 2$ to T.

$$ln(I_t) = \alpha + \beta t + \epsilon_t$$

The initial investment value is then given by the fitted value for period $t = 1$:

$$\widehat{ln(I_t)} = \widehat{\alpha} + \widehat{\beta} t$$

After taking the exponential, this fitted value of investment is used to compute the initial stock of capital. The growth rate of investment g_I is obtained using the $\hat{\beta}$ estimated in the OLS regression.

We slightly depart from their methodology by taking a fixed rather than time-varying depreciation rate to estimate the initial stock of capital. In other words, we use $\delta = 2.5\%$ and do not re-estimate K_0 after having determined a vector of time-varying depreciation rates. Having estimated the initial stock of capital, K_0, the capital stock series can therefore be constructed using the perpetual inventory method as described in equation (C.1.).

Utilisation and depreciation rates

The second step is to determine the utilisation rate of capital, using the following equation:

$$u_t = \left(\frac{Y_t/K_t}{Y/K}\right)^{\delta/(r+\delta)} \tag{C.2.}$$

where Y/K is the average output-capital ratio. r is set to 4% and $\delta = I/K - g_I$, with I/K the average investment-capital ratio and g_I the growth rate of investments.

Then, the series for the depreciation rate is updated according to the following rule:

$$\delta_t = \delta u_t^\phi \tag{C.3.}$$

with $\phi = 1 + (r/\delta)$ and $\phi > 1$ such that depreciation is a convex function of utilisation.

This algorithm departs from Imbs (1999) paper regarding δ. In the original version, δ is defined as the average of the depreciation rate series. However, with this specification, the expectation of $\delta_t = \delta u_t^\phi$ would be equal to one.

Our definition of δ comes from the steady-state of the capital accumulation equation (C.1.);

$$K(1 + g_K) = (1 - \delta)K + I$$
$$\Leftrightarrow (1 + g_K) = (1 - \delta) + I/K$$
$$\Leftrightarrow \delta = I/K - g_K$$

As data on capital stock is constructed, the growth rate of capital g_K is approximated by the growth rate of investment, g_I.

Once the depreciation rate series is constructed, the process restarts at equation (C.1.), generating a new capital stock series, until (C.3.). As soon as the average depreciation rate δ converges - i.e. two consecutive identical δ, the iteration process stops and the final utilisation and capital stocks series are constructed. From these series for K_t and u_t, one can construct the series for the effective capital service, $K_t u_t$.

Labour effort series

The series for labour effort can then be constructed using the following equation:

$$e_t = \left(\alpha \frac{Y_t}{C_t} \right)^{1/(1+\psi)}$$

with C_t the data on consumption, α given by

$$\alpha = 1 - (K/Y)(r + \delta)$$

and ψ being such that

$$\psi = \frac{\alpha}{w(e_t)N_t/Y_t} - 1$$

with $w(e_t)$ the data on wages. These steps allow the computation of the effective labour input series, $N_t e_t$.

TFP series

Finally, using the utilisation adjusted series of capital and labour, the TFP series can be computed using the production function:

$$X_t = Y_t * ((u_t K_t)^\alpha (e_t N_t)^{(1-\alpha)})^{-1}$$

Data

The present section aims at describing the data series used in the TFP construction.

- Y_t: Real GDP - Gross domestic product using the expenditures approach, chained volume estimates at quarterly frequency, seasonally adjusted and in domestic currency. Source: OECD.

- I_t: Real investment - Gross fixed capital formation using the expenditures approach, chained volume estimates at quarterly frequency, seasonally adjusted and in domestic currency. Source: OECD.

- C_t: Real private consumption - Private final consumption expenditures (households and non-profit organisations), using expenditures approach, chained volume estimates at quarterly frequency, seasonally adjusted and in domestic currency. Source: OECD.

○ N_t: Total hours worked - Hours per worker times the total number of persons employed. Sources: OECD Economic Outlook/ILO.

○ w_t: Real wages - Total wages in value, denominated in domestic currency (earning per employee times number of persons employed for Portugal), deflated by private final consumption expenditures deflator. Sources: OECD/Oxford economics.

Comparing U.S. TFP series

The two graphs presented here assess differences between the U.S. TFP series from Fernald (2014) and the one obtained using the methodology described above. The first graph on the left compares the one-year average of the Fernald's series with the constructed one: except for few spikes in the 90s it seems to do a fairly good job. This impression is confirmed by the plot of the estimated Kernel density based on differences between the two.
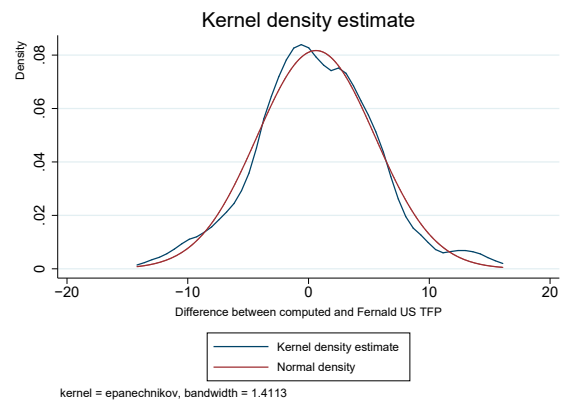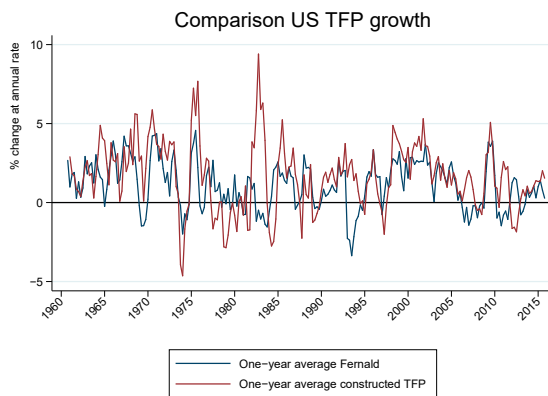
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