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The effects of surprise and anticipated technology changes on international relative prices and trade[☆]

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ABSTRACT

This paper argues that it is important to distinguish surprise and anticipated components of total factor productivity (TFP) when we study the international transmission of TFP shocks. We document that surprise and anticipated shocks to US TFP induce distinct dynamics for international relative prices (the real exchange rate and the terms of trade) and international trade (real exports, real imports, and the trade balance). Our empirical findings can reconcile some conflicting empirical results in the literature and hence lead to a better understanding of the international transmission of TFP shocks. In addition, we evaluate a standard international macroeconomic model and discuss the mechanisms that may help to replicate our empirical findings.

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1. Introduction

This paper studies the international transmission of surprise and anticipated shocks to US total factor productivity (TFP) in structural vector autoregressions (SVARs). Surprise shocks, hereafter called contemporaneous TFP shocks, affect TFP immediately. Anticipated shocks have no immediate impact on TFP but portend its future movements. Following the literature, we refer to them as news TFP shocks. We empirically show that the international transmission of these two types of TFP shocks is strikingly different. Therefore, empirical studies that do not carefully distinguish these two shocks can reach incomplete and even misleading

results on the international transmission of country-specific technology changes. We also examine the mechanisms that may help theoretical models to replicate our empirical findings, shedding light on future theoretical studies on this issue.

Recently, there has been a revived and growing interest in the role of news shocks in explaining business cycles. In the empirical studies, news TFP shocks are found to account for a large fraction of US business cycles.¹ Therefore, it is of interest to study the international transmission of US news TFP shocks by distinguishing them from US contemporaneous TFP shocks. There are several recent empirical studies on the international transmission of US-specific productivity shocks, for instance, Corsetti et al. (2006, 2014), Enders and Muller (2009), Enders et al. (2011), and Juvenal (2011). However, none of these studies make a distinction between news and contemporaneous components of productivity shocks. The findings in our paper complement theirs and shed light on some puzzling results in these previous studies, highlighting the importance of distinguishing these two shocks in empirical studies.

In our empirical exercises, we focus on the effects of US news and contemporaneous TFP shocks on international relative prices (the real

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¹ For instance, see Beaudry and Portier (2006), Barsky and Sims (2011), and Schmitt-Grohé and Uribe (2012).

exchange rate and the terms of trade) and international trade (real exports, real imports, and the trade balance). This focus is motivated by the fact that both trade volume and international relative prices play important roles in the international transmission of country-specific productivity shocks. In particular, relative price movements are a major channel for trade adjustment and induce important cross-country wealth effects.² Furthermore, we examine the roles of these two TFP shocks in accounting for real exchange rate movements. This is motivated by previous studies suggesting that exchange rates behave like asset prices and exchange rate movements are more linked to expected changes in future fundamentals rather than current fundamental changes, for instance, Engel and West (2005) and Chen et al. (2010), among others. Although some empirical studies examine the link between future productivity and asset prices (e.g., stock prices and interest rates), no study has been done to examine whether, and to what extent, exchange rates are influenced by news about future productivity.³ Our work also fills this gap in the literature.

We first identify news and contemporaneous shocks to US TFP in the SVAR framework by employing the identification strategy in Barsky and Sims (2011), and then study the international transmissions of these two TFP shocks.⁴ We also investigate the relative importance of these two shocks in explaining US real exchange rate movements. Then we estimate and evaluate a standard international macroeconomic model, using our estimated VAR impulse response functions (IRFs).

Quarterly data for the US and an aggregate of the rest of G7, which is referred to as the rest of the world (ROW), are used in this paper. Our VAR models include US TFP, US trade variables, and the US–ROW differences of the other aggregate variables including the real exchange rate and the terms of trade. One of our main findings is that the US real exchange rate exhibits substantially different dynamics in response to the identified news and contemporaneous shocks to US TFP. Following a favorable news TFP shock, the real exchange rate appreciates strongly on impact and continues to appreciate for a few quarters before starting to converge back to its initial level. That real appreciation is very persistent, lasting for more than 16 quarters. We define the exchange rate such that a decrease indicates an appreciation. Under this definition, the IRF of the real exchange rate to a favorable news TFP shock resembles a horizontal J-curve. In contrast, the real exchange rate exhibits a hump-shaped impulse response to a favorable contemporaneous TFP shock: it slightly drops below zero (appreciates) or barely moves on impact of the shock, but quickly increases above zero (depreciates) and remains significantly depreciated for more than 12 quarters before converging back to its initial level.

We also find that both news and contemporaneous TFP shocks generate co-movement among US–ROW relative macroeconomic aggregates although the dynamics of the aggregates are different under these two shocks. Following a positive news TFP shock, US TFP only increases gradually with a delay of more than one year. In contrast, US–ROW relative consumption, investment, GDP, and hours all rise substantially and peak before US TFP starts to increase significantly, with a sharp increase in relative consumption leading the increases in relative investment, GDP, and hours. This pattern is consistent with the narrative of expectations-driven business cycles as documented in Beaudry and Portier (2006) and Beaudry et al. (2011). On the other hand, following a positive contemporaneous TFP shock, US TFP jumps immediately and then declines gradually over time. US–ROW relative consumption,

investment, and GDP all increase immediately with TFP and these increases are persistent, which is consistent with productivity-driven business cycles as predicted by standard international macroeconomic models.

We highlight three findings for the effects of news and contemporaneous TFP shocks on US trade variables. First, the terms of trade has similar dynamics to the real exchange rate. Second, the dynamics of real exports and real imports are distinct for news and contemporaneous TFP shocks, reflecting different dynamics of domestic absorption and the terms of trade following these two shocks. Third, the trade balance (measured by the ratio of nominal net exports to nominal GDP) exhibits a well-known J-curve following both news and contemporaneous TFP shocks. However, the dynamics of the J-curve are also quite distinct for these two TFP shocks. The different dynamics of international relative prices and trade variables following news and contemporaneous TFP shocks demonstrate the importance of separating these two shocks when studying the international transmission of TFP changes.

We also find that news TFP shocks are more important than contemporaneous TFP shocks in explaining the volatility of the US real exchange rate. The identified news TFP shocks explain about 30% of the forecast error variance of the US real exchange rate at most horizons up to 40 quarters. In contrast, the identified contemporaneous TFP shocks only account for less than 10%. This finding suggests that anticipated future changes in TFP, rather than unanticipated current changes, drive the US real exchange rate, lending support to the studies of exchange rates as asset prices.

In the last part of the paper, we evaluate a group of standard international business cycle models (e.g., Chari et al., 2002). We find that the standard international business cycle models have difficulties in replicating, both qualitatively and quantitatively, the documented real exchange rate dynamics following a news/contemporaneous TFP shock, although the models can match the dynamics of other variables (e.g., relative consumption, investment, GDP) in the data relatively well. We briefly discuss the mechanisms that may help to replicate our empirical findings.

The remainder of the paper is organized in three sections. Section 2 describes our identification strategy, data set, and benchmark VAR system. The empirical results are also reported in this section. Section 3 evaluates standard international business cycle models and Section 4 concludes.

2. International transmission of TFP shocks

2.1. Identification strategy, data, and benchmark VAR model

We identify news and contemporaneous shocks to US TFP in our VAR models, following Barsky and Sims (2011). The identification scheme of Barsky and Sims imposes a minimum of identifying restrictions only on a measure of TFP and allows the data to speak for itself. It can also be easily applied to large VAR systems.⁵ Specifically, their identification scheme assumes that news and contemporaneous shocks to TFP fully explain variation in observed TFP as a measure of true technology. Under this assumption, contemporaneous TFP shocks are identified as reduced-form innovations in TFP. News TFP shocks are restricted to have no immediate impact on TFP and also to be orthogonal to the contemporaneous shocks. Given these restrictions and the contribution of the contemporaneous shocks to variation in TFP, news TFP shocks are identified as a structural shock that can account for TFP variation as much as possible over all forecast horizons up to a truncation

² For instance, see Cole and Obstfeld (1991) and Corsetti et al. (2008).

³ Fama (1990) and Schwert (1990) find that stock returns are highly correlated with future production growth rates. More recently, Beaudry and Portier (2006) find that stock price movements capture news about future productivity. Kurmann and Otrok (2013) document that movements in the slope of the term structure of interest rates mainly reflect the asset market's response to news about future productivity.

⁴ As Lorenzoni (2011) points out, our SVAR approach to studying the effects of news shocks implies that we restrict our attention to perfectly anticipated shocks and do not consider other types of news about future TFP, such as noise shocks in Lorenzoni (2009) and Blanchard et al. (2013).

⁵ In Monte Carlo exercises that are not reported in this paper, we find that their identification approach can correctly uncover the theoretical IRFs to news TFP shocks in standard international business cycle models with news and contemporaneous TFP shocks and several other shocks. Nevertheless, we admit that every identification scheme has its own shortcomings, and thus we take sign restrictions as an alternative identification approach in our robustness check. The results from our sign restrictions approach are available in an online appendix on the authors' websites.

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