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The depreciation puzzle solved; A VAR analysis on fiscal announcements

Fiscal policies are a government's strongest tool to influence the economy. Institutions agree that a government must implement expansionary fiscal policies during economic recessions to recover (Tcherneva, 2011). Traditional approaches to fiscal policies have shown that expansionary fiscal policies result in the appreciation of the real exchange rate causing the current account to increase, a process known as twin deficits (Kim & Roubini, 2008). Yet, the empirical data shows the while expansionary fiscal policies cause an appreciation, the appreciation causes the current account to fall (Forni & Gambetti, 2016). The process in which appreciation leads to a worsening of the current account is known as twin divergence. Strangely, in some instances, a fiscal expansion causes the real exchange rate to depreciate in a phenomenon called the exchange rate puzzle. There are several opposing results on the topic of what the effects of fiscal policies are on the current account, whether be through twin deficit, divergence, or the exchange rate puzzle. With theoretical approaches being revisited, this paper will solve the exchange rate puzzle and show how twin divergence is reflected through the empirical data, while twin deficits are not.

Through a Vector Autoregressive (VAR) model one can see the effects of several variables on each other over time and how past results influence future results. VAR models are crucial for analysing the impact of fiscal policies on the current account. Forni and Gambetti (2016) considered the econometric issues behind the exchange rate puzzle and their work will be expanded on in this paper. Twin deficits and twin divergences are differentiable in empirical data when one considers the nature of the expansionary fiscal shock. By implementing a variable for the announcements of fiscal policies, the two effects can be separated and thus, the exchange rate puzzle can be identified clearly. As will be

discussed in more detail, “the set of twins” occur under the same conditions of an open economy and persistent shocks, with the impact for policymakers being opposites.

Ultimately, this paper argues against the usage of fiscal policies to correct any current account deficits from negative long run effects on GDP and consumption.

Section 2 will cover the theory behind both the traditional approach and discuss a new approach to understanding the puzzles. Section 3 will go through the details behind the VAR analysis conducted in this paper. Then the econometric issues of the puzzles are brought forward. Section 4 will consider the empirical findings of the model and its importance to policymakers. Finally, section 5 will summarise the findings of this paper.

2. Theoretical approaches revisited

The traditional discussion of whether fiscal policies create a twin deficit or twin divergence or lead to the depreciation puzzle considers the Mundell-Fleming model and the intertemporal model. Twin deficits are argued for in both the traditional theoretical approaches. Expansionary fiscal policy is the action of increasing government spending, which raises demand, which will increase interest rates. Increased domestic interest rates make domestic bonds more attractive which increases its demand causing an appreciation of the real exchange rate. Under a flexible exchange rate regime, this causes exports to fall, creating a current account deficit. Thus, the Mundell-Fleming model argues for the existence of twin deficits (Fan & Fan, 2002).

The intertemporal approach argues that a transitory fiscal shock also creates a current account deficit. Basic accounting shows the current account (CA) as an expression of disposable income with government savings:

$$CA = (Y + rB - T) - C - I + (T - G)$$

Where $(Y + rB - T)$ is the GDP plus income on net foreign assets minus taxes net transfers. Subtracting consumption (C), investments (I), and adding government savings $(T - G)$ yields the current account. The model argues that the increase in consumption is less than the increase in government expenditure (G), which creates a positive impact on the current account. A net positive on the current account is thus a reflection of twin deficits.

Neither of these approaches fully considers the effect of real exchange rates on investment decisions and therefore the cost of production. With an appreciation of the real exchange rate, imports are relatively cheaper. Thus, the domestic production cost

decrease and the product of domestic investment increases. This in turn has a negative impact on the current account. While the intertemporal model understands the importance of decreased consumption, it wrongly predicts that government expenditure increase is enough to crowd out the fall in consumption (Kim & Roubini, 2008). The new approach argues the impact of appreciation on investment decisions confirms the presence of twin divergence from a decreased current account.

Ultimately, the new approach is reflected in the empirical data, whereas the traditional approach of twin deficits is only reflected in the presence of depreciation. The following section will detail the VAR analysis this paper conducts and how expectations on fiscal policy is crucial to solving the exchange rate puzzle, and how twin deficits exists through the presence of the exchange rate puzzle.

3. Econometric Issues Solved

Perfect foresight is a heavily contested assumption since it is unreasonable to assume economic agents can know all relevant information to accurately predict the future (Bray , 1990). To account for this, the econometric analysis will use a variable for the information on announcements of fiscal policies. The prevention of omitted variable bias has crucially been overlooked in previous work as confirmation bias where empirical results wrongfully overlapped with theory. Through a new variable, the Moving Average (MA) specifications can be considered invertible, preventing misleading VAR results.

The “news” variable as used in Forni and Gambetti (2016) takes from the Survey of Professional Forecasters (SPF) conducted by the Federal Reserve Bank of Philadelphia. The autoregressive analysis conducted on the variable showed that predictions were highly accurate up to four (4) quarters forward and accurate up to two (2) years ahead. An autoregressive model looks at how a variable’s previous values linearly impact its future values. The Moving Average looks at past white noise (error terms) to predict a time series. Through an improved MA model which reduces the error terms, the VAR analysis can be considered more reliable.

The tests conducted will be that of a Cholesky impulse response function of the impact of government expenditure and news on the following variables: government expenditure (GOV), Gross Domestic Product (GDP), Consumption (CON), Real Exchange Rate (RER), trade balances as a percentage of GDP (NEXP_GDP), and News (NEWS). All variables except “news” are converted to log-level and then multiplied by 100 to express as percentage changes. The Cholesky decomposition will order the surprise shock first, and then the announced shocks. The exchange rate puzzle and twin divergence is reported by the impulse response functions, while twin divergence is not.

The impulse-response functions are created with and without the Hamilton filter to control for the cyclical component of the variables. Vector autoregressive functions will also be conducted on the variables to consider the variables' stability.

It is worth noting that the survey is done by professional forecasters and so is not a perfectly accurate portrayal of the average consumer. However, the accuracy of forecasts, and the results being within statistical significance allows the values to be applicable to the entire economy.

4. The Data

The following section analyses the results of the vector autoregression on the variables and their stability. Then, the analysis of the impulse-response functions of news and government with and without the cyclical component (detrended using the Hamilton filter) will commence.

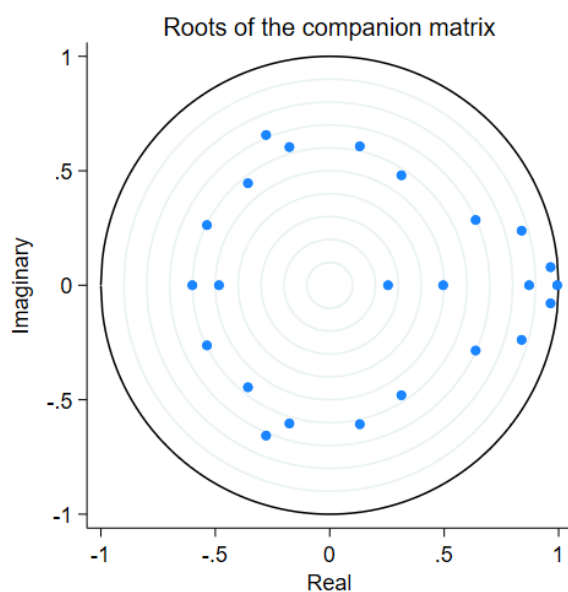
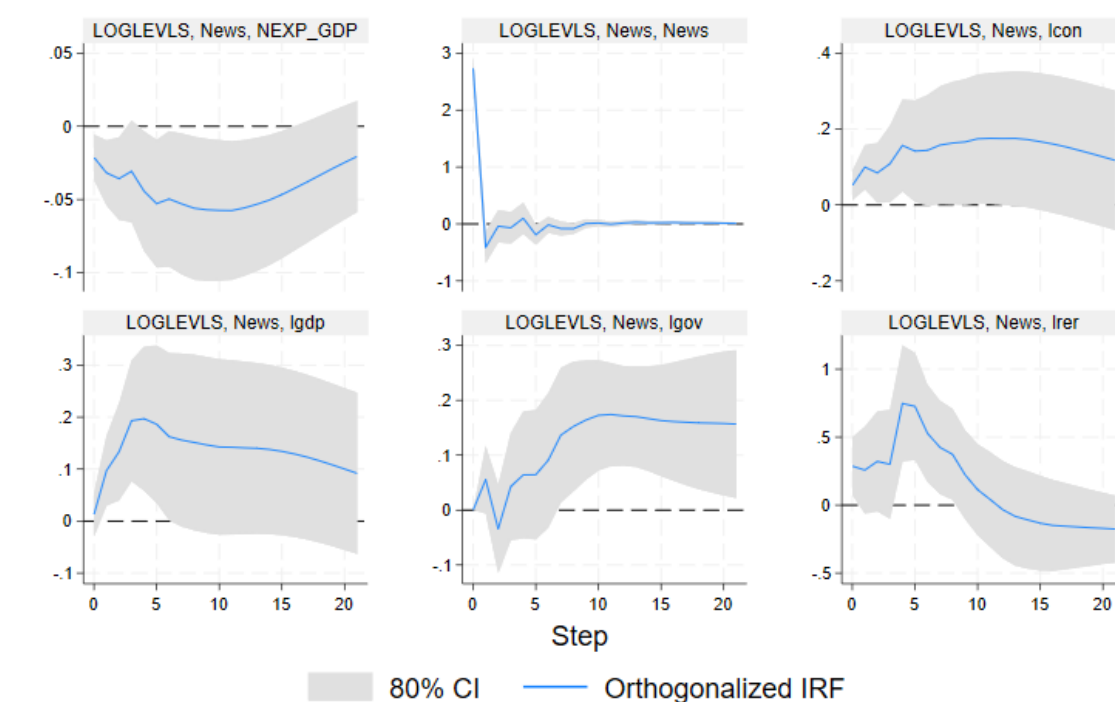


Figure 1 – Vector Autoregression of Log-Level stability

Figure 1 depicts the roots of the companion matrix of the log-level values and the news variable from the variables that are to be used for the VAR model with the cyclical component. The roots are computed from the Vector Autoregression. The model is stable since all roots are within the unit circle (diameter of 1)



Graphs by irfname, impulse variable, and response variable

Figure 2 - Cholesky Impulse-Response function to changes in News variable

Figure 2 shows the impact of a shock on news with an 80% confidence level. This figure will be used to explain the procedure of analysing the impulse response functions. The second graph on the top row (News, News) shows how there is an increase in News which then quickly falls to zero. A positive news shock is equivalent to policymakers announcing future expansionary fiscal policies. The confidence intervals that cover the value of $y = 0$ are not significant. Essentially, only the white sections of $y = 0$ can consider its blue response function for those quarters. Therefore, numerical analysis is pointless and only trends will be considered.

The positive news shock causes a positive change in the real exchange rate. The appreciation leads to increased return on domestic investments, which increases investments. This is showcased through GDP increasing in the bottom left graph (News – IGDP). The increase in GDP is significant for 6 quarters (1.5 years). While it is GDP clearly decreases after 5 quarters, the results are not significant after 6 quarters, meaning only a

short run shock can confidently be predicted. The increase in GDP is noticeable from the increase in consumption in the top right corner of Figure 2 (News-Icon). For simplicity, one can consider the difference in GDP and consumption to be investments. With the appreciation of currency, the net exports over GDP decreases and the effect lingers for 15 quarters (3.75 years). The net export over GDP is representative of the current account. The values are significant for 14 of the 15 quarters that the decrease is observed. The results are concerning for policymakers as they show that there is a long-term effect to the

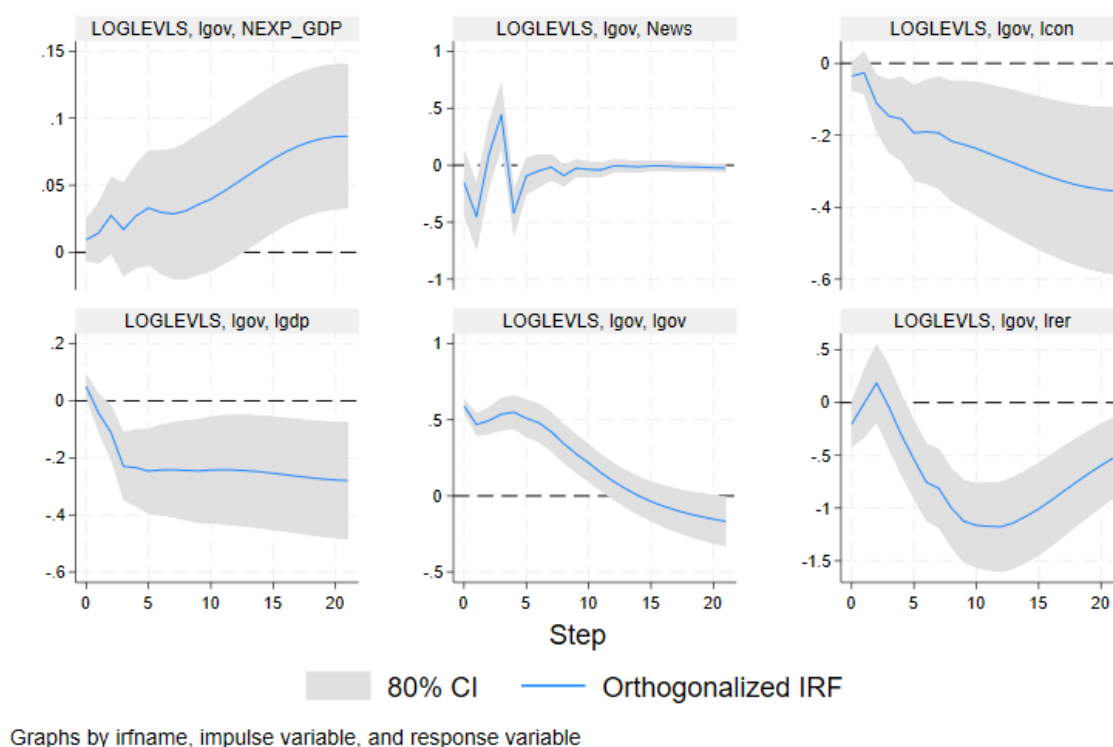


Figure 3 - Cholesky Impulse-Response Function to changes in government expenditure

fiscal policy announcement. However, the results will be discussed in more detail once the graphs controlling for the cyclical component has been introduced.

Figure 3 shows the impact of the implementation of expansionary fiscal policies. The increase in government expenditure is significant for 12 quarters (3 years) as shown in the bottom middle graph (lgov-lgov). There is a depreciation of the real exchange rate that becomes significant after 5 quarters as seen in the bottom right graph (lgov-lrer). This depreciation increases exports and reduce imports, which is shown from the increase in

net exports over GDP shown in the top left graph (lgov-NEXP_GDP). This is – in this paper, considered as an increase in the current account. The increase in net exports is significant after 12 quarters (3 years). Consumption decreases continuously for 20 quarters, being significant from the second quarter as seen in the top right graph (lgov-lcon). Thus, the decrease in consumption can be considered as manifesting itself after 2 quarters (6 months). This decrease comes from households expecting the increase in government expenditure to be financed through an increase in taxes in the future. Thus, households save for the future through a reduction in current consumption. The process of two period consumption-savings decision-making is called the Ricardian equivalence theorem and is heavily used in the intertemporal model. Return on investments fall due to the depreciation, which alongside a decrease in consumption decreases GDP as seen in the bottom left graph (lgov-lgdp). Again, these results are long run effects. An increase in government expenditure over 10 quarters causes a decrease in GDP over 20 quarters due to the depreciation of real exchange rate and the Ricardian equivalence theorem. The implication for policymakers will be discussed in more detail after the Hamilton filter model has been presented.

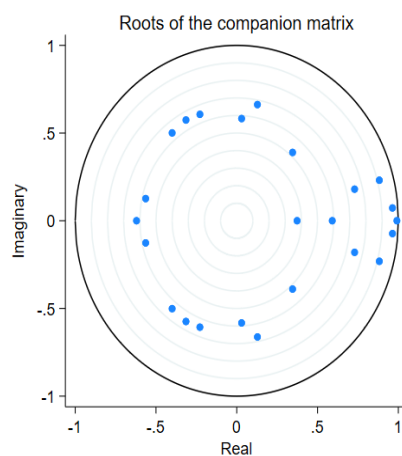
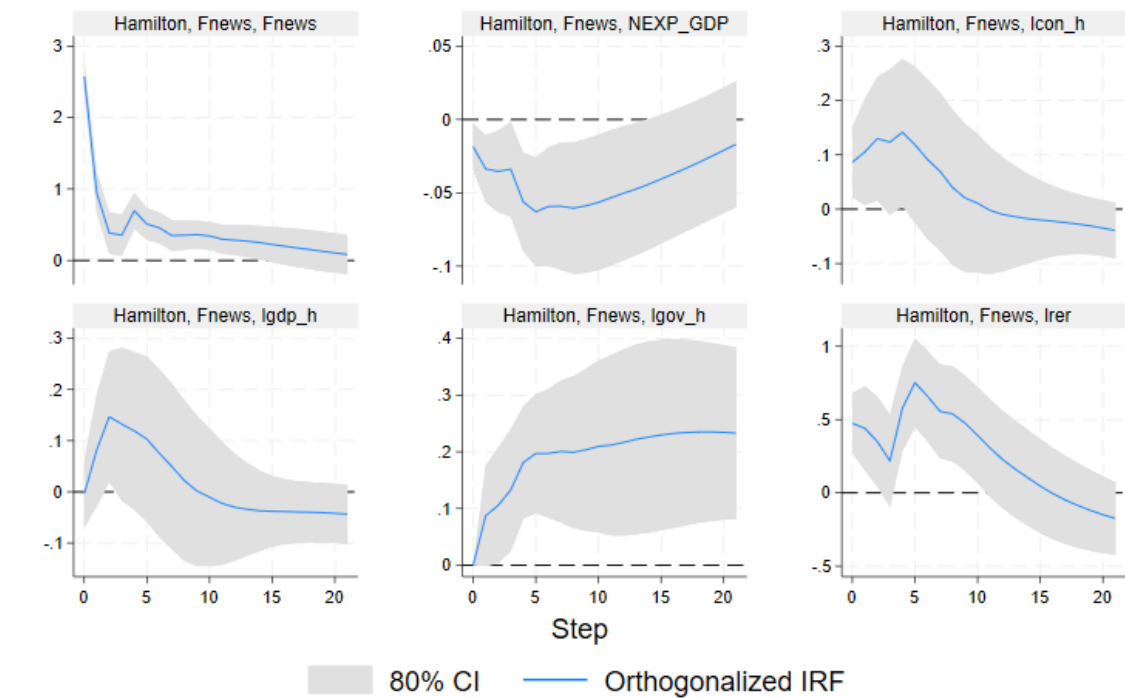


Figure 4 - Vector Autoregression of Log-Level stability with Hamilton Filter

Figure 4 depicts the roots of the companion matrix of the log-level values and the news variable with the Hamilton filter applied. The roots are computed from the Vector Autoregression with the Hamilton filter. Since all values are within the unit circle (diameter of 1) the model is stable.



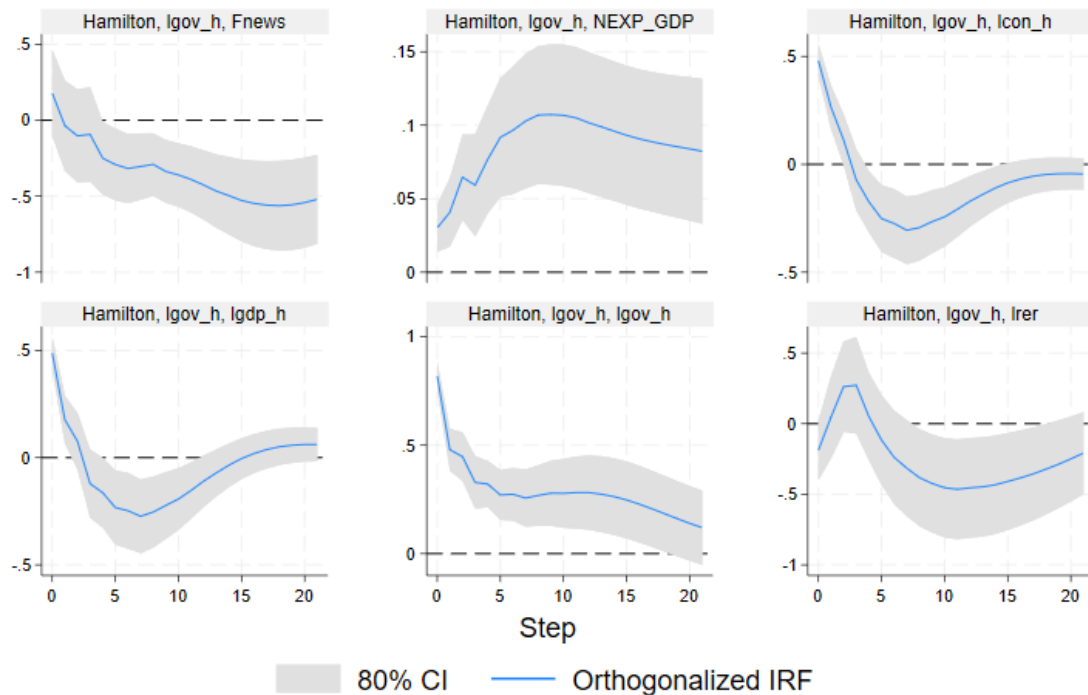
Graphs by irfname, impulse variable, and response variable

Figure 5 - Cholesky Impulse-Response function to changes in News variable with Hamilton filter applied

Figure 5 shows shock of news with the Hamilton filter applied. The trends are the exact same as its counterpart without the Hamilton filter, with more quarters being considered significant at the 80% confidence interval. The impact of news with the Hamilton filter is generally more persistent as more quarters are significant.

The news variable is persistently positive at the 80% confidence interval for 14 quarters as seen in the top left graph (Fnews-Fnews). It is evident that there is an appreciation, emerging from 1st quarter and lasting until 10th quarter, being significant for 9 quarters. The impact of the appreciation is noted in the top middle graph (Fnews-NEXP_GDP) where net exports have fallen from 1st quarter until the 12th, being significant throughout. The appreciation has a brief impact on consumption, only positively affecting it for two quarters at the 80% significance interval as seen in the top right graph. This is further showcased

through a 1 quarter increase in GDP emerging in the second quarter after the increase in News.



Graphs by irfname, impulse variable, and response variable

Figure 6 - Cholesky Impulse-Response Function to changes in government expenditure with Hamilton filter applied

Figure 6 shows the impact of a persistent positive shock on government expenditure with the Hamilton filter applied. Again, the trends are mostly the same, while having more statistical significance. The graph in the bottom right (lgov_h-lrer) shows an appreciation immediately following the shock, yet it is not significant. After two (2) years, there is a depreciation of the real exchange rate. At a lower confidence interval, or with a more accurate representative dataset, the data could be aligned with traditional theoretical approaches, yet that is hindered by insignificant values. The depreciation causes a long-lasting and significant positive impact on the net exports. The result on consumption is positive on the impact for a few quarters, then after a year becomes negative. The GDP follows the same pattern, which allows one to assume the investments follow the same pattern.

4.1 – Impact for Policymakers

There is twin divergence observed from the empirical data rather than a twin deficit with cyclical component controlled for. As the description for Figure 5 states, there is an announced increase in government spending which leads to appreciation. The appreciation leads to a decrease in the net exports, meaning there is a worsening of the current account. The findings that expansionary fiscal policies causing an appreciation that leads to a worsening of the current account is predicted by the new theoretical approach as discussed in Section 2. There is only a positive impact on GDP and consumption for one quarter when fiscal policies are announced. Thus, the idea that economic recessions can be corrected through expansionary fiscal policies only holds in the short run without announcements. The concern to recover from recessions should be carefully revised as the data shows long-lasting negative effects on consumption, GDP, and real exchange rates. The focus of other works on the topic of recession recoveries should be whether the monetary efforts can correct the predicted negative impacts caused by fiscal policies.

If the aim of the government is to strengthen its current account, the graphs above show that an unannounced fiscal shock is more suited than an announced fiscal shock. The persistent strengthening of the current account occurs simultaneously as consumption and GDP falls. Thus, this paper cannot recommend that policymakers focus their attention on improving the current account through fiscal policies as their consumers will decrease their consumption to combat expected increases in taxes.

The empirical findings are in line with the new theoretical approach that there is a twin divergence rather than a twin deficit when fiscal shocks are announced. However, twin

deficits can exist through a depreciation puzzle, if there is a fiscal surprise shock to the economy.

5. Conclusion

This paper has through the implementation of a news variable shown that an anticipated fiscal expansion does not reflect a twin deficit, while unannounced fiscal expansion does. Increasing government expenditure causes an appreciation of the real exchange rate. With a stronger currency, the relative price of production goes down which allows for increased exports and increased imports, resulting in a decrease in the current account.

Unannounced expansionary fiscal policies cause a depreciation of the real exchange rate which strengthens the current account. The exchange rate puzzle has short-lasting improvements on consumption and GDP with the lingering effects being negative. Thus, this paper cannot recommend stabilizing the current account through fiscal policies as the long run effects on consumption and GDP are too substantial. The data would recommend that policymakers be cautious when using fiscal shocks to stabilize the economy.

The depreciation puzzle is solved through the implementation of a variable for announcements of fiscal policies. Through the news variable, one can identify the anticipated shocks and the non-anticipated shocks. The new approach to the theory perfectly explains the anticipated shocks, whereas the traditional theoretical approach somewhat explains the surprise shocks. The assumption of perfect foresight has been corrected and introduced to the VAR analysis in a way that allows for higher accuracy in forecasts which overlap arguably well with the theory.

The traditional theoretical approach predicts that the appreciation leads to a strengthening of the current account, while the new theoretical approach argues the appreciation worsens the current account. The new approach is reflected in the empirical data. The traditional approach is reflected in that data only in the presence of the depreciation puzzle for unannounced shocks.

Future research should be focused on whether other (supply-side or monetary) policies are able to correct the expected decrease in consumption and GDP from the surprise shock. Yet, without proof of this, and as its nature falls outside the scope of this paper, blindly increasing the current account cannot be recommended.

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