How Important Are Terms-Of-Trade Shocks in a Monetary Union? *

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November 2020

Abstract

[NO ABSTRACT YET]

Introduction

The analysis of business cycle fluctuations using calibrated business cycle models seems to attribute a major role to terms-of-trade shocks. For example Mendoza (1995) studies the relationship between terms of trade and business cycles using a three-sector intertemporal equilibrium model and finds that terms-of-trade shocks explain about 56% of aggregate output fluctuations. Kose (2002) extends Mendoza's work by enriching the production structure to account for certain features that are empirically inherent in developing countries. He finds that world price shocks (fluctuations in the prices of capital, intermediate, and primary goods, and in the world real interest rate) explain roughly 88% of aggregate fluctuations in output.

In a recent paper by Schmitt-Grohé and Uribe (2018) (Henceforth, SGU), the authors argue that when analyzed within the framework of an empirical structural VAR model

*This research project is still at an embryonic stage.

(SVAR), the contribution of terms-of-trade shocks to business cycle fluctuations is rather modest. They first estimate country-specific SVARs using data from 38 developing and emerging countries and find that terms-of-trade shocks explain less than 10% of fluctuations in aggregate activity. They then estimate key structural parameters of a three-sector business cycle model country by country, and find an important gap between the role attributed to terms-of-trade shocks by this model and the empirical SVAR.

The current research project aims to extend the work of Schmitt-Grohé and Uribe (2018) by focusing on developing countries that are part of a monetary union. The goal is to ascertain whether the "empirical" importance assigned to terms-of-trade shocks by Schmitt-Grohé and Uribe (2018) remains valid when the specificities of a monetary union are accounted for. Specifically, the approach is to first replicate the authors' key empirical results for countries included in their sample that are part of a monetary union. Then I will employ a panel SVAR identified with the restrictions necessary for the countries involved to be considered as part of a monetary union. The rest of this paper is organized as follows. Section I present the methodological approach, including SGU's empirical strategy. Section II discusses some preliminary replication results and Section III concludes (TENTATIVE...)

1 Methodology

1.1 SGU's Empirical Strategy

The first part of this research project consists in replicating the main empirical results in SGU for countries in their sample that are part of a monetary union, using more recent data. Those include the country-by-country estimation of the terms-of-trade process, the impulse responses to an innovation in the terms of trade, and the share of the variances explained by terms-of-trade shocks. This is for the purpose of comparing them with the

results from the approach being proposed in this project. To replicate those results, I use the same empirical strategy as the authors, which is as follows:

The model includes six quadratically detrended variables: the terms of trade (tot_t), the trade balance (tbt), output (y_t), consumption (c_t), investment (i_t), and the real exchange rate (RER_t), where:

$$tot_t \equiv \frac{P_t^x}{P_t^m}; \qquad\qquad RER_t = \frac{\mathcal{E}_t P_t^{US}}{P_t}$$

The trade balance is first divided by the trend component of output and then quadratically detrended. P_t^x and P_t^m denote, respectively, indices of world prices of exports and imports of a particular country. $\mathcal{E}_t$ denotes the dollar nominal exchange rate, given by the domestic-currency price of one U.S. dollar, P_t^{US} denotes the U.S. consumer price index, and P_t denotes the domestic consumer price index. The empirical model is of the form

$$\mathbf{A}_0 x_t = \mathbf{A}_1 x_{t-1} + \mu_t,$$

where the vector x_t is given by

$$x_t \equiv \begin{bmatrix} \widehat{tot_t} \\ \widehat{tb_t} \\ \widehat{y_t} \\ \widehat{c_t} \\ \widehat{i_t} \\ \widehat{RER_t} \end{bmatrix}$$

Hat variables denote log deviations of the variables from their time trends. $\mathbf{A}_0$ and $\mathbf{A}_1$ are 6 -by- 6 matrices of coefficients, and $\mathbf{A}_0$ is assumed to be lower triangular with 1 on the main diagonal. The variable μ_t is a 6 -by-1 random vector with mean 0 and

diagonal variance-covariance matrix Σ. Pre-multiplying the system by $\mathbf{A}_0^{-1}$, we can write

$$x_t = \mathbf{A}x_{t-1} + \Pi\epsilon_t$$

where

$$\mathbf{A} \equiv \mathbf{A}_0^{-1}\mathbf{A}_1, \quad \Pi \equiv \mathbf{A}_0^{-1}\Sigma^{1/2}, \quad \text{and} \quad \epsilon_t \equiv \Sigma^{-1/2}\mu_t$$

The vector ϵ_t is a random variable with mean 0 and identity variance-covariance matrix. All elements (except the first) of the first row of $\mathbf{A}_1$ are restricted to be 0, so that the first equation of the SVAR system represents the law of motion of the terms of trade given by:

$$\widehat{tot}_t = a_{11}\widehat{tot}_{t-1} + \pi_{11}\epsilon_t^1$$

where a_{11} and π_{11} denote the elements (1,1) of $\mathbf{A}$ and Π, respectively. The model is estimated country-by-country by OLS, using annual data on 38 emerging and poor countries covering the period 1980–2011 (Source: World Bank's World Development Indicators (WDI) database).

I use more recent and extended data (from 1980 to 2018) to replicate results for the relevant countries. The details on the data are provided in the Appendix.

1.2 The Panel SVAR Strategy

I propose a Panel SVAR approach to estimate the importance of terms-of-trade shocks in the three existing monetary unions monetary unions in Africa, namely the West African Economic and Monetary Union (UEMOA), the Economic and Monetary Community of Central Africa(CEMAC) and the The Common Monetary Area (CMA). This empirical strategy helps capture static and dynamic interdependencies between countries as well as allows for cross sectional heterogeneity (Canova et al., 2013). Broda (2004) used a panel SVAR approach to assess whether the responses of real GDP, real exchange rates,

and prices to terms-of-trade shocks differ systematically across exchange rate regimes in 75 developing countries. The difference with my approach is that I will estimate union-by-union panel SVARs instead of pooling all countries together. I argue that the latter approach used by Broda (2004) assumes that all 75 countries he considers share some strong links so that their macroeconomic variables all depend on one another. This is hardly defendable.

The model can be expressed as:

$$\boldsymbol{A}_0 \boldsymbol{Y}_{it} = \boldsymbol{A}(L)\boldsymbol{Y}_{it} + \boldsymbol{u}_{it}$$

where

$$\boldsymbol{Y}'_{it} = \left(\widehat{tot}_{it}, \widehat{tb}_{it}, \widehat{y}_{it}, \widehat{c}_{it}, \widehat{i}_{it}, \widehat{RER}_{it}\right)$$

and

$$\boldsymbol{u}'_{it} = \left(u^{tot}_{it}, u^{tb}_{it}, u^{y}_{it}, u^{c}_{it}, u^{i}_{it}, u^{rer}_{it}\right)$$

are the structural errors, $A(L)$ is a matrix polynomial in the lag operator of order to be determined and $\text{var}\left(u_{it}\right) = \Omega$. In general, the dynamic responses of $\boldsymbol{Y}_{it}$ to u^{tot}_{it} can be identified if A_0 and Ω can be recovered from the reduced form estimates. This is where the identification strategy is needed. By imposing the necessary restrictions on the responses of the relevant variables to a terms-of-trade shock for countries in a monetary union (in addition to the panel framework), the structural parameters can be estimated. This is still a pending exercise.

2 Preliminary Replication Results

The countries considered in the analysis are as follows: UEMOA: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau,Mali, Niger, Senegal, Togo; CEMAC: Cameroon, Central

African Republic, Chad, Republic of the Congo, Equatorial Guinea, Gabon; CMA: Lesotho, Namibia, South Africa, Eswatini. Five (5) of those are included included in SGU's sample, namely Côte d'Ivoire, Senegal, Cameroon, Central African Republic, and South Africa. The replication results will focus on those 5 countries

2.1 Estimates of the Terms-Of-Trade Process

Table 1 below compares the replication results to those in SGU (SM for replication results). I use more recent and extended data (1980-2018) while SGU uses older data covering the 1980-2011 period. N/A means I do not have results for the concerned country yet.

TABLE 1: The Terms-of-Trade Process: Country-by-Country Estimates

$$\widehat{tot}_t = a_{11}\widehat{tot}_{t-1} + \pi_{11}\epsilon_t^1; \quad \epsilon_t^1 \sim (0,1)$$

Country	a_{11}		π_{11}		R^2	
	SGU	SM	SGU	SM	SGU	SM
Côte d'Ivoire	0.46	**0.49**	0.16	**0.15**	0.22	**0.24**
Senegal	0.75	**0.81**	0.09	**0.08**	0.50	**0.67**
Cameroon	−0.05	**0.30**	0.13	**0.14**	0.00	**0.09**
Central African Republic	0.86	**N/A**	0.09	**N/A**	0.71	**N/A**
South Africa	0.74	**0.67**	0.04	**0.04**	0.53	**0.49**

2.2 Impulse Response Functions

[Insert graphs here]

2.3 Variance Decompositions

TABLE 2: Share of Variance Explained by Terms-of-Trade: Country-by-Country SVAR Evidence

Country	*tot*		*tb*		*y*		*c*		*i*		*RER*	
	SGU	SM	SGU	SM	SGU	SM	SGU	SM	SGU	SM	SGU	SM
Côte d'Ivoire	100	100	30	**28**	43	**42**	36	**19**	43	**42**	70	**71**
Senegal	100	100	4	**53**	8	**30**	3	**44**	19	**9**	57	**45**
Cameroon	100	100	9	**18**	14	**2**	13	**8**	13	**7**	16	**10**
CAR	100	–	37	–	6	–	14	–	13	–	53	–
South Africa	100	–	12	–	11	–	9	–	8	–	23	–

Conclusion

[NO CONCLUSION YET]

APPENDIX

A. Data Description

The data source is the World Bank's WDI database. The raw data from this source consists of the following annual time series.

(1) $\frac{P_t^x}{P_t^m}$, Net barter terms[] of trade index (2000 = 100),

(2) y_t^o, GDP per capita in constant local

(3) $\frac{P_t^i I_t}{P_t^y Y_t}$, Gross capital formation (% of GDP),

(4) $\frac{P_t^m M_t}{P_I^y Y_t}$, Imports of goods and services (% of GDP),

(5) $\frac{P_t^i X_t}{P_t^y Y_t}$, Exports of goods and services (% of GDP)

(6) $\frac{P_t^c C_t}{P_I^y Y_t}$, Households and NPISHs final consumption expenditure (% of GDP)

(7) GDP per capita, PPP (constant 2005 international $)

(8) Consumer price index (2010 = 100),

(9) Official exchange rate (LCU per US$, period average)

(10) Real effective exchange rate index (2005 = 100)