BUSINESS CYCLE CAUSATION RELATIONS FOR MERCOSUR COUNTRIES

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1. Introduction

The aim of the research is to evaluate the causation relationships among the Mercosur countries business cycles and the impact of two main world economic actors, European Union (EU) and United States (US), on them.

Vector Auto Regression (VAR) model suits my purpose. I developed a VAR system among five economies: the above mentioned three Mercosur member countries, EU and US. The VAR estimation, a dynamic analysis and a causation one allow me to point out that some causation relations are present among the South-American countries, and that conversely, both the EU and the US do not play a relevant role in determining the fluctuations of their cycles.

The paper proceeds as follows. Section 2 goes through the not really wide literature review for Mercosur countries. Section 3 discusses in detail the empirical methodology and the data collection and elaboration process. I next show the obtained results on the business cycle causation relations and on the impact of EU and US in section 4. In the same section a comment of the reliability of the results is provided. Section 5 ends the paper reporting the conclusions.

2. Literature review

Nowadays there is a growing interest in the interdependencies and business cycle transmissions among economies[2]. At the beginning the tools used for the analysis were correlations, graphic techniques and ordinary regressions. Later, larger and more complicated macroeconometric models came to dominate the scene, up to the moment in which time series techniques, such as principal component analysis, spectral analysis, VAR, Structural VAR, Impulse Response functions (IRFs), variance decompositions, Gibbs samplers and cointegration analysis began to be applied.

The shift in focus from closed economy to open economy modelling was evident in the Brookings Institute project of the mid 80s by Bryant et al. (1988). That project included a number of structural equation models and the Minneapolis World VAR model developed by Litterman and Sims. The Minneapolis World VAR was based on three regional blocks of the US, Japan and Europe, and was a first attempt to use VAR methods to link more than two regions. Subsequent VAR research has concentrated on closed economy and two countries open economy models. Multi country models usually involve amalgamating countries into two blocks or regions, for example Monticelli and Tristani (1999).

A particular branch of international business cycle literature has concentrated on one open economy and attempted to show the sources and extents of foreign influences on this economy. For example, Burbidge and Harrison (1985), Burdekin and Burkett (1992), and Schmitt-Grohe (1998) investigate the effects of US economic variables on the Canadian economy. Lee and Lee (1995) assess the relative impact of US and Japanese economic variables on the Korean economy. Genberg et al. (1987) show that the economic disturbances in the US and other foreign countries have an impact on the Swiss economy. For Australia, the US and Japan have been the two largest countries in terms of trade and capital flow, and hence have been the focus of the studies of the foreign business cycle transmission in Australia. For example, Gruen and Shutrim (1994) show that the US business cycle has greater impact on the Australian business cycle than the business cycles of other trading partners. Similarly, Dungey and Pagan (2000), using a structural VAR, find that in the long run the influence of US variables (US GDP, US real interest rates and real share prices) is critically important in determining domestic activity of Australia. Selover and Round (1996) focused on measuring the magnitude and timing of business cycle transmissions between Japan and Australia, and attempt to find any differences between the transmission under the fixed and flexible exchange rate regimes. Not much empirical work is provided for Mercosur countries.

3. Empirical methodology

This section presents the empirical methodology by which the paper aims at answering the following questions: what are the causation relationships among the business cycles of the Mercosur countries from 1991 to 2006? What impact do EU and US have on these economies?

3.1. The model

In order to deal with the research question I proceed analysing the causation relationships among the Mercosur countries’ business cycles. Moreover it is interesting to understand the influence of a EU and US shock over the Mercosur members business cycles.

Vector autoregression (VAR) model could suit my purpose. This econometric model allows me to capture the evolution and the interdependencies between multiple time series generalising the univariate autoregression models. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model.

$$\begin{bmatrix} Y_{1,t} \\ Y_{2,t} \\ \vdots \\ Y_{n,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_n \end{bmatrix} + \begin{bmatrix} A_{1,1} & A_{1,1} & \cdots & A_{1,n} \\ A_{2,1} & A_{1,1} & \cdots & A_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ A_{n,1} & A_{n,2} & \cdots & A_{n,n} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} & Y_{1,t-2} & \cdots & Y_{1,t-l} \\ Y_{2,t-1} & Y_{2,t-2} & \cdots & Y_{2,t-l} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{n,t-1} & Y_{n,t-2} & \cdots & Y_{n,t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \vdots \\ \varepsilon_{n,t} \end{bmatrix} \quad (1)$$

where the GDP variables are collected in a $nx1$ vector Y_t, which has as the n^{th} element $Y_{n,t}$ the time t observation of variable Y_n.

I estimate the following VAR model:

$$\begin{bmatrix} Y_{ar,t} \\ Y_{br,t} \\ Y_{ur,t} \\ Y_{us,t} \\ Y_{eu,t} \end{bmatrix} = \begin{bmatrix} \alpha_{ar} \\ \alpha_{br} \\ \alpha_{ur} \\ \alpha_{us} \\ \alpha_{eu} \end{bmatrix} + \begin{bmatrix} A_{ar,1} & A_{ar,2} & \cdots & A_{ar,5} \\ A_{br,1} & A_{br,2} & \cdots & A_{br,5} \\ A_{ur,1} & A_{ur,2} & \cdots & A_{ur,5} \\ A_{us,1} & A_{us,2} & \cdots & A_{us,5} \\ A_{eu,1} & A_{eu,2} & \cdots & A_{eu,5} \end{bmatrix} \begin{bmatrix} Y_{ar,t-1} & Y_{ar,t-2} & \cdots & Y_{ar,t-4} \\ Y_{br,t-1} & Y_{br,t-2} & \cdots & Y_{br,t-4} \\ Y_{ur,t-1} & Y_{ur,t-2} & \cdots & Y_{ur,t-4} \\ Y_{us,t-1} & Y_{us,t-2} & \cdots & Y_{us,t-4} \\ Y_{eu,t-1} & Y_{eu,t-2} & \cdots & Y_{eu,t-4} \end{bmatrix} + \begin{bmatrix} \varepsilon_{ar,t} \\ \varepsilon_{br,t} \\ \varepsilon_{ur,t} \\ \varepsilon_{us,t} \\ \varepsilon_{eu,t} \end{bmatrix} \quad (2)$$

using quarterly time series of real output for Argentina, Brazil, Uruguay, US and EU.

In the literature (Wooldridge 2006) it is typically recommended to use four or eight lags for quarterly data. Given the small amount of observations I am going to use four lags.

After performing a set of classic tests for the significance of the VAR model, I carry out a causality and dynamic analysis based respectively on the Granger causality and on the IRFs.

3.2. Data

The chosen period goes from the first quarter of 1991 to the last quarter of 2006. The starting year is corresponding to the sign of the Asuncion Treaty, the official date in which Mercosur was formed.

The analysis focuses on the following Mercosur members: Argentina, Brazil, and Uruguay. Given the poor availability of data for Paraguay and its modest impact in percentage terms of GDP on the Mercosur aggregate, it has been neglected. Furthermore, GDP data for EU and US have been downloaded in order to evaluate their impact on Mercosur economies.

I have decided to use the natural logarithm of quarterly GDP in US Dollars at 2000 constant prices to run the VAR model. Therefore, the current and constant 2000 prices yearly data in US Dollars have been downloaded from World Bank (WB) - World Development Indicators (WDI). I got quarterly current GDP data in Pesos and quarterly real exchange rate from International Monetary Fund (IMF) – International Finance Statistics (IFS). Thus, I firstly calculated the quarterly current GDP data in US Dollars. Then, I calculated the yearly GDP deflator for Pesos and US Dollars as follows:

$$yearly\ GDP\ deflator_{2000}^{i,j} = \frac{yearly\ current\ GDP^{i,j}}{yearly\ constant\ GDP_{2000}^{i,j}} \qquad (3)$$

where i is the country and j is the currency. Finally, I computed both constant 2000 prices GDP quarterly data in US Dollars using the yearly GDP deflator.

$$quarterly\ constant\ GDP_{2000}^{i,j} = \frac{quarterly\ current\ GDP^{i}}{yearly\ GDP\ deflator_{2000}^{i,j}} \qquad (4)$$

I followed the same procedure for Brazilian data.

Uruguayan current and constant 2000 prices GDP yearly data in US Dollars are coming from WDI. As previously, I calculated the yearly GDP deflator by (3). I got quarterly constant 1983 prices GDP data in Pesos from Economic Commission for Latin America and the Caribbean (ECLAC) website. In order to compute quarterly current GDP data in US Dollars I downloaded quarterly real exchange rate from IFS. Finally, I calculated quarterly constant 2000 prices GDP data in US Dollars by (4).

Quarterly current GDP data as well as current and constant 2000 prices yearly GDP data for the US have been downloaded from IFS. I calculated the yearly GDP deflator by (3) in order to compute the constant 2000 prices quarterly GDP data by (4).

Since there were no available quarterly GDP data for some European countries, I built an aggregate Euro Area GDP time series for the following ones: Belgium, Germany, Spain, France, Italy, Netherlands, Austria and Finland. Since these eight countries cover the main contribution, the data obtained can be considered reliable. Quarterly current prices GDP data in Euros have been downloaded from Eurostat. Current and constant 2000 prices yearly data in US Dollars are coming from WDI, while quarterly real exchange rate data are from IFS. Constant 2000 prices GDP quarterly data in US Dollars have been calculated using the yearly GDP deflator through (4).

Once I got all the real GDP data, I calculated the natural logarithm.

3.3. Seasonality adjustment and de-trending

The plots of the real GDP seasonally adjusted time series against time are shown in Figure A1[3]. In each single graph the natural logarithm of the analysed variable is represented on the Y axis, while the time is set on the X axis. The graphs confirm the presence of a trend component for the majority of the variables.

First differencing at fourth lag has been applied to de-trend US Dollars real GDP time series for the VAR application. This methodology implies the loss of the first five observations. Although the Brazilian and the EU constant 2000 prices GDP time series in US Dollars result to be stationary without differencing, I used its first differencing for the VAR model in order to interpret the results as GDP growth rates.

With respect to the differencing methodology, I perform an Augmented Dickey-Fuller (ADF) test in order to test for stationarity of the seasonally adjusted time series. I set the test with an augmentation equal to five, as the literature suggests for quarterly data. Then I evaluated the augmentation order choice looking at the significance of the highest lag coefficient. If the fifth lag corresponds a t-Student (not standard) lower that 1.645, then I redo the test choosing the number of lags for which the highest is significant. Thus, I did the same for the first difference of the non stationary time series).

The plots of the first difference for the seasonally adjusted time series are presented in Figure A2. Table 3.1 is resuming the ADF test results.

Table 3.1 ADF results

Variable	ADF with augmentation 5	ADF with evaluated augmentation	ADF for the first difference with augmentation 5	ADF for the first difference with evaluated augmentation
Argentine constant 2000 prices GDP in US Dollars	*Non stationary*	*Non stationary*	*Stationary*	*Stationary*
Brazilian constant 2000 prices GDP in US Dollars	*Non stationary*	*Stationary*	-	-
Uruguayan constant 2000 prices GDP in US Dollars	*Non stationary*	*Non stationary*	*Stationary*	*Stationary*
US constant 2000 prices GDP in US Dollars	*Non stationary*	*Non stationary*	*Non stationary*	*Stationary*
European constant 2000 prices GDP in US Dollars	*Non stationary*	*Stationary*	-	-

4. Empirical findings

This section shows the results of the causation relations for Mercosur countries, the EU, and the US. These are generated by the VAR model with four lags, as suggested by the theory given the restricted number of observations.

Finally, the results are compared with other exercises, and a personal comment on their plausibility is provided.

4.1. Causation relations for Mercosur countries, EU, and US

Firstly this subsection presents the results of statistical tests, then it offers a graphic analysis based on the IRFs, and finally it proposes an interpretation of some elasticity figures.

The VAR output shows a R^2 measure considerably high for the Argentine, Brazilian and Uruguayan equations, in which I am interested. It turns out to be 85.7%, 70.11%, and 83.35% respectively. The F tests show joint significance for the lags of all countries for each equation at 5% significance level. Singularly, the majority of lags are significant for the considered equations at the same significance level.

I perform the Block-F tests to check the joint significance for all lags of every single country in the Argentine, Brazilian and Uruguayan equation. All the lags of each variable turn out to be significant at 5% significance level. Just the US lags on Brazilian equation turn out to be not significant at the mentioned level. Table 4.1 resumes the mentioned results.

Table 4.1 Block-F test for joint significance

Equation	Lags	Block-F test results
Argentina	Argentina	Prob > F = 0.0000
	Brazil	Prob > F = 0.0000
	Uruguay	Prob > F = 0.0000
	EU	Prob > F = 0.0465
	US	Prob > F = 0.0072
Brazil	Argentina	Prob > F = 0.0187
	Brazil	Prob > F = 0.0000
	Uruguay	Prob > F = 0.0834
	EU	Prob > F = 0.0020
	US	Prob > F = 0.1298
Uruguay	Argentina	Prob > F = 0.0000
	Brazil	Prob > F = 0.0022
	Uruguay	Prob > F = 0.0017
	EU	Prob > F = 0.0578
	US	Prob > F = 0.0151

The Lagrange Multiplier (LM) test for autocorrelation generally rejects the null hypothesis of autocorrelation absence at each specified lag order, with the exception of the fourth lag, as shown in Table 4.2. However it is quite common in VAR model to experience a certain degree of autocorrelation and it should not affect the estimates obtained too much.

Table 4.2 LM test for autocorrelation

```
. varlmar, mlag(4)

   Lagrange-multiplier test
  +--------------------------------------+
  | lag  |      chi2    df   Prob > chi2 |
  |------+-------------------------------|
  |   1  |   25.4533    25     0.43721   |
  |   2  |   20.5309    25     0.71845   |
  |   3  |   28.3554    25     0.29175   |
  |   4  |   46.4422    25     0.00570   |
  +--------------------------------------+
   H0: no autocorrelation at lag order
```

In order to perform a causality analysis I carry out a Granger causality test for every country pair, where the null hypothesis is the non Granger causality between the countries output in the specified direction. So, looking at the test results and considering a 5% significance level, the Argentine output is Granger caused by the Brazilian and Uruguayan one, but not by the EU and the US one. The Brazilian output seems to be independent, because it is not Granger caused by anyone of the considered countries. Finally, the Uruguayan output is Granger caused just by the Argentine, but not by the Brazilian, US and EU one. Results are resumed in Table 4.3.

Table 4.3 Granger causality test

Affected country	Causing country	Granger causality test results
Argentina	Brazil	Prob > F = 0.0308
	Uruguay	Prob > F = 0.0000
	EU	Prob > F = 0.1898
	US	Prob > F = 0.1560
Brazil	Argentina	Prob > F = 0.3649
	Uruguay	Prob > F = 0.7969
	EU	Prob > F = 0.1368
	US	Prob > F = 0.5285
Uruguay	Argentina	Prob > F = 0.0000
	Brazil	Prob > F = 0.2457
	EU	Prob > F = 0.5600
	US	Prob > F = 0.4918

The dynamic analysis is mainly based on the IRFs. I firstly perform a test to check for the VAR model stability, and results state that all the eigenvalues lie inside the unit circle, so the VAR model satisfies the stability condition.

Then I calculate and plot the IRFs as in Figures 4.1, 4.2 and 4.3. The impulse is set to one standard deviation of the residuals.

Figure 4.1: Countries impulse over the Argentine response, for 4 and 20 periods

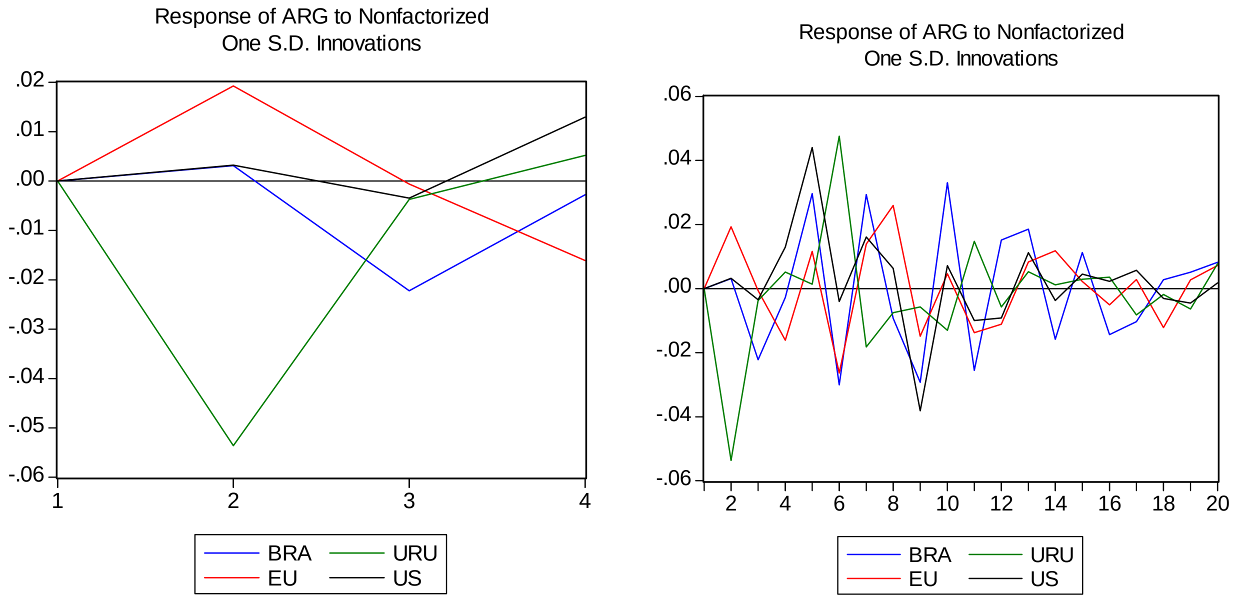


Figure 4.2: Countries impulse over the Brazilian response, for 4 and 20 periods

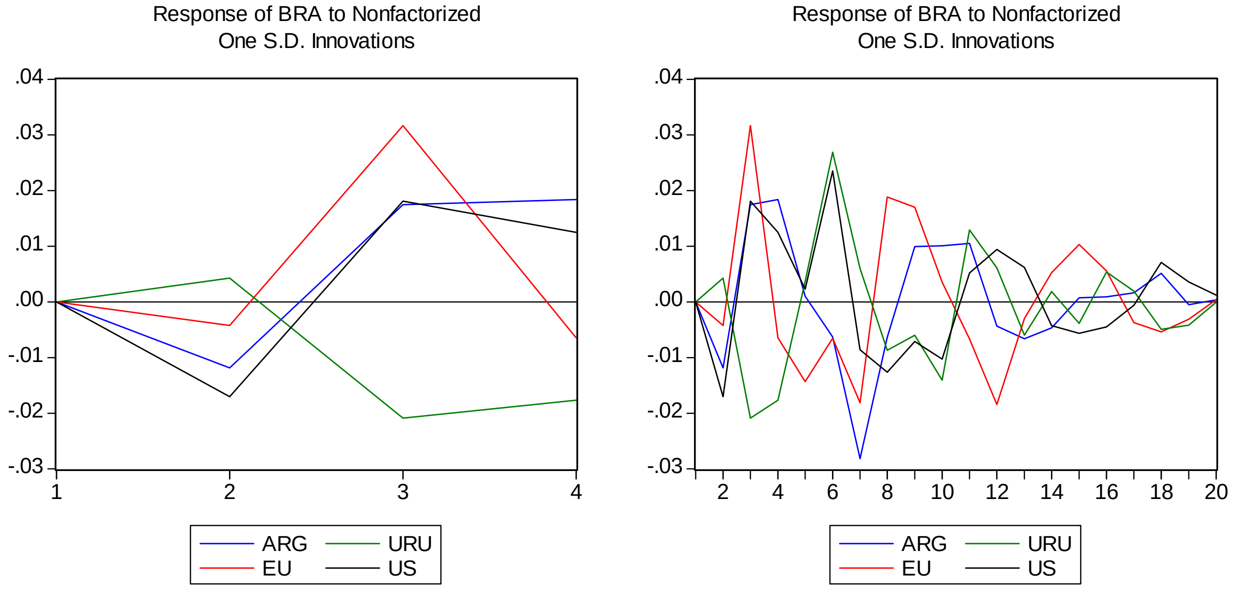
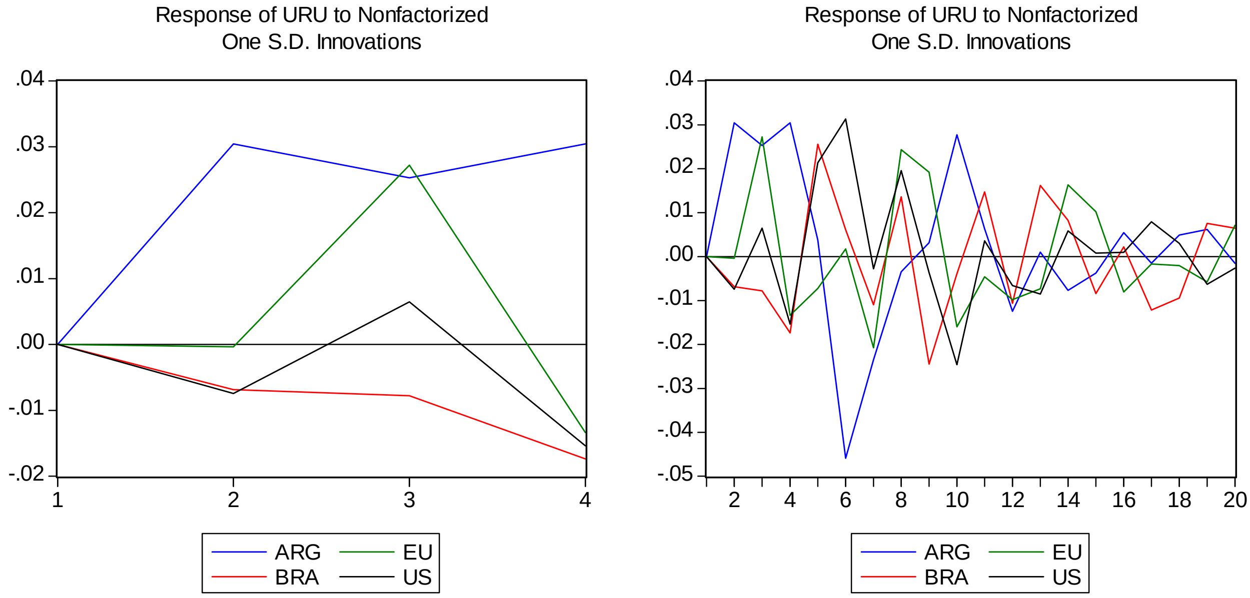


Figure 4.3: Countries impulse over the Uruguayan response, for 4 and 20 periods



In the short term, that is considering the first four periods equivalent to one year, it is quite evident that the Argentine output is reacting strongly to the Brazilian and Uruguayan impulses. The response to a EU impulse is not as large as the one to the US impulse (Figure 4.1).

The Brazilian output is not Granger caused by anyone of the countries considered, but in the short term the EU impulse is the one that is generating the largest Brazilian response. Notably, the Granger causality test result for the EU output over the Brazilian one is the only one that gets closer to the considered significance level (Figure 4.2).

Looking at the graph, it seems that Uruguayan output is reacting in a strong way to every country innovation. Let me recall that the Uruguayan output is Granger caused by the Argentine output, and it is clear that Argentine impulse is making the Uruguayan output fluctuate widely in the short term. Although the Brazilian output is not Granger causing the Uruguayan one, it is evident that it is heavily shocking the economy (Figure 4.3).

Taking into account the long term dynamic, that are the first 20 periods equivalent to five years, it seems that the Argentine, Brazilian and Uruguayan responses are dying off with time to each country impulse. The IRFs graphs show that the series converge across time. This suggests that after five years the countries conserve memory of the shocks, but given the decreasing width of the fluctuations over time, the economies are reaching a new equilibrium.

IRFs of the VAR model reflect elasticity values at every time period. The latter, as well as the Cumulated Impulse Response functions (CIRFs) figures, are shown in Table 4.4, 4.5 and 4.6. The later present the elasticity values on the first rows, and its standard errors on the second ones.

Table 4.4 Argentine IRFs and CIRFs to different countries impulse

	IRFs				CIRFs			
Period	***BRA***	***EU***	***URU***	***US***	***BRA***	***EU***	***URU***	***US***
1	0	0	0	0	0	0	0	0
	0	0	0	0				
2	0.003103	0.019262	-0.053588	0.00322	0.003103	0.019262	-0.053588	0.00322
	-0.00845	-0.00864	-0.01135	-0.00971				
3	-0.022222	-0.000596	-0.003701	-0.003468	-0.01912	0.018666	-0.057289	-0.00025
	-0.01131	-0.01114	-0.01315	-0.01302				
4	-0.002781	-0.016081	0.005192	0.012946	-0.0219	0.002585	-0.052097	0.012698
	-0.0119	-0.01148	-0.01458	-0.01413				
5	0.029628	0.011623	0.001362	0.044013	0.007728	0.014208	-0.050735	0.056711
	-0.01236	-0.01177	-0.01392	-0.01481				
6	-0.030044	-0.02632	0.047609	-0.004049	-0.02232	-0.01211	-0.003126	0.052662
	-0.01587	-0.01548	-0.01736	-0.0178				
7	0.029341	0.013932	-0.018188	0.016099	0.007025	0.00182	-0.021314	0.068761
	-0.01659	-0.01636	-0.01744	-0.01929				
8	-0.009284	0.025942	-0.007468	0.00629	-0.00226	0.027762	-0.028782	0.075051
	-0.01723	-0.01593	-0.01849	-0.01824				
9	-0.029261	-0.014858	-0.005707	-0.038093	-0.03152	0.012904	-0.034489	0.036958
	-0.0176	-0.01536	-0.01761	-0.0178				
10	0.033009	0.00463	-0.012994	0.007193	0.001489	0.017534	-0.047483	0.044151
	-0.01971	-0.01777	-0.01764	-0.01975				
11	-0.025533	-0.013743	0.014768	-0.009999	-0.02404	0.003791	-0.032715	0.034152
	-0.01935	-0.01814	-0.01793	-0.02024				
12	0.015173	-0.011142	-0.005698	-0.009153	-0.00887	-0.00735	-0.038413	0.024999
	-0.01917	-0.01662	-0.01803	-0.0189				
13	0.018515	0.008315	0.005298	0.011235	0.009644	0.000964	-0.033115	0.036234
	-0.0188	-0.01567	-0.01715	-0.01742				
14	-0.015819	0.011828	0.00116	-0.003679	-0.00617	0.012792	-0.031955	0.032555
	-0.01872	-0.01615	-0.01526	-0.01746				
15	0.011288	0.002268	0.002975	0.004506	0.005113	0.01506	-0.02898	0.037061
	-0.01877	-0.01583	-0.01498	-0.0174				
16	-0.014374	-0.005083	0.003587	0.002311	-0.00926	0.009977	-0.025393	0.039372
	-0.01806	-0.01486	-0.01432	-0.01642				
17	-0.010295	0.002839	-0.00819	0.005729	-0.01956	0.012816	-0.033583	0.045101
	-0.01744	-0.01349	-0.01405	-0.01486				
18	0.002809	-0.012133	-0.001814	-0.003076	-0.01675	0.000683	-0.035397	0.042025
	-0.01674	-0.01311	-0.01298	-0.01436				
19	0.005132	0.002733	-0.006372	-0.004534	-0.01162	0.003416	-0.041769	0.037491
	-0.01657	-0.01252	-0.01213	-0.01387				
20	0.008217	0.007231	0.00775	0.001774	-0.0034	0.010647	-0.034019	0.039265
	-0.01539	-0.01176	-0.01106	-0.01286				

Table 4.5 Brazilian IRFs and CIRFs to different countries impulse

	IRFs				CIRFs			
Period	**ARG**	**EU**	**URU**	**US**	**ARG**	**EU**	**URU**	**US**
1	0	0	0	0	0	0	0	0
	0	0	0	0				
2	-0.01183	-0.00422	0.004287	-0.017	-0.01183	-0.00422	0.004287	-0.017
	-0.01071	-0.01042	-0.0125	-0.01208				
3	0.01748	0.03164	-0.02085	0.018099	0.005648	0.027421	-0.01656	0.001099
	-0.0088	-0.01097	-0.01248	-0.01258				
4	0.018392	-0.00644	-0.01765	0.012495	0.02404	0.020982	-0.03421	0.013594
	-0.01009	-0.01238	-0.01445	-0.01383				
5	0.00105	-0.0143	0.003684	0.002317	0.02509	0.006686	-0.03052	0.015911
	-0.01094	-0.0125	-0.01492	-0.01406				
6	-0.00628	-0.00652	0.026896	0.023549	0.018814	0.000167	-0.00363	0.03946
	-0.01131	-0.01392	-0.01528	-0.01352				
7	-0.02812	-0.01813	0.005989	-0.00858	-0.00931	-0.01796	0.002362	0.030876
	-0.01324	-0.01447	-0.01687	-0.0145				
8	-0.00636	0.018854	-0.00868	-0.01263	-0.01566	0.000891	-0.00632	0.018242
	-0.01304	-0.01484	-0.01621	-0.01463				
9	0.009945	0.017011	-0.00597	-0.00709	-0.00572	0.017902	-0.01229	0.011153
	-0.01344	-0.01517	-0.01644	-0.01466				
10	0.010108	0.003561	-0.01404	-0.01027	0.004391	0.021463	-0.02634	0.00088
	-0.0133	-0.01429	-0.01668	-0.01423				
11	0.010492	-0.00665	0.012932	0.005207	0.014883	0.014818	-0.0134	0.006087
	-0.01289	-0.01358	-0.0162	-0.0135				
12	-0.00433	-0.01843	0.006107	0.009439	0.01055	-0.00361	-0.0073	0.015526
	-0.01311	-0.01361	-0.01512	-0.01294				
13	-0.00659	-0.003	-0.00594	0.0062	0.003964	-0.00661	-0.01324	0.021726
	-0.01298	-0.01301	-0.01469	-0.01267				
14	-0.00464	0.005272	0.001875	-0.00425	-0.00068	-0.00134	-0.01136	0.017478
	-0.01253	-0.01224	-0.01425	-0.01235				
15	0.000741	0.010313	-0.00384	-0.00563	6.4E-05	0.008978	-0.01521	0.011849
	-0.01161	-0.01145	-0.01331	-0.01168				
16	0.000919	0.005576	0.005362	-0.0045	0.000983	0.014554	-0.00985	0.00735
	-0.01179	-0.01093	-0.0128	-0.01137				
17	0.001627	-0.0037	0.001945	-0.00062	0.00261	0.010855	-0.0079	0.006735
	-0.01132	-0.01029	-0.01202	-0.01028				
18	0.005129	-0.00536	-0.00492	0.007097	0.007739	0.005492	-0.01283	0.013832
	-0.01053	-0.00954	-0.01115	-0.01002				
19	-0.00047	-0.00308	-0.00418	0.003583	0.007266	0.002412	-0.01701	0.017415
	-0.00996	-0.00926	-0.01019	-0.0096				
20	3.62E-04	3.95E-04	-7.31E-05	0.001224	0.007628	0.002807	-0.01708	0.018639
	-0.00976	-0.00917	-0.00977	-0.009				

Table 4.6 Uruguayan IRFs and CIRFs to different countries impulse

	IRFs				CIRFs			
Period	***ARG***	***BRA***	***EU***	***US***	***ARG***	***BRA***	***EU***	***US***
1	0	0	0	0	0	0	0	0
	0	0	0	0				
2	0.030444	-0.00686	-0.00036	-0.00742	0.030444	-0.00686	-0.00036	-0.00742
	-0.00908	-0.00843	-0.00841	-0.00969				
3	0.02531	-0.00779	0.027231	0.006477	0.055754	-0.01465	0.026873	-0.00095
	-0.0089	-0.01004	-0.01022	-0.01162				
4	0.030447	-0.01735	-0.01337	-0.01535	0.086201	-0.032	0.013508	-0.0163
	-0.01122	-0.0122	-0.01335	-0.0146				
5	0.003784	0.025567	-0.00726	0.021344	0.089985	-0.00644	0.006253	0.005044
	-0.01149	-0.01285	-0.01338	-0.01627				
6	-0.04587	0.006115	0.001761	0.031324	0.044111	-0.00032	0.008014	0.036368
	-0.01204	-0.01169	-0.01375	-0.01449				
7	-0.02347	-0.01095	-0.02078	-0.00277	0.020637	-0.01127	-0.01276	0.033598
	-0.01393	-0.01464	-0.01595	-0.01624				
8	-0.00346	0.013593	0.02437	0.019567	0.017176	0.00232	0.011606	0.053165
	-0.01313	-0.01436	-0.01604	-0.01613				
9	0.003183	-0.02445	0.019216	-0.00362	0.020359	-0.02213	0.030822	0.049541
	-0.01374	-0.01537	-0.01578	-0.0161				
10	0.027708	-0.00388	-0.01597	-0.02461	0.048067	-0.02601	0.014855	0.024933
	-0.0145	-0.01558	-0.01572	-0.01598				
11	0.006329	0.014726	-0.00456	0.003591	0.054396	-0.01128	0.010299	0.028524
	-0.01463	-0.01655	-0.01708	-0.01664				
12	-0.01246	-0.01062	-0.0098	-0.0066	0.041935	-0.02191	0.000498	0.021921
	-0.01411	-0.01589	-0.01624	-0.01682				
13	0.001024	0.016218	-0.00732	-0.00851	0.042959	-0.00569	-0.00682	0.013407
	-0.01308	-0.01518	-0.01532	-0.01584				
14	-0.00769	0.008263	0.016317	0.005857	0.035269	0.002575	0.0095	0.019264
	-0.01302	-0.01472	-0.01481	-0.01446				
15	-0.00375	-0.00845	0.010245	0.000771	0.031515	-0.00587	0.019745	0.020035
	-0.01283	-0.01447	-0.01426	-0.01414				
16	0.005462	0.002186	-0.00807	0.001005	0.036977	-0.00369	0.011675	0.02104
	-0.01221	-0.01427	-0.01344	-0.01345				
17	-0.00147	-0.01216	-0.00171	0.007926	0.035507	-0.01584	0.00997	0.028966
	-0.01142	-0.01352	-0.01283	-0.01292				
18	0.00493	-0.00946	-0.00207	0.003009	0.040437	-0.0253	0.007901	0.031975
	-0.01098	-0.01315	-0.01184	-0.01211				
19	0.00617	0.00757	-0.00574	-0.00631	0.046607	-0.01773	0.002159	0.02567
	-0.0108	-0.01249	-0.01134	-0.01167				
20	-0.00154	0.006459	0.007122	-0.00263	0.045072	-0.01127	0.009281	0.023039
	-0.01019	-0.01241	-0.01083	-0.01094				

Coming back to the short term dynamic, we can interpret the significant Granger responses in the following way: a shock of one standard deviation on Brazilian GDP growth generates a response in Argentine GDP growth equivalent to a variation of 0.31% in the following second quarter. If the shock is on the Uruguayan GDP growth, the Argentine GDP growth response equals to a fluctuation of 5.35% in the second quarter. As mentioned, Brazil seems to be Granger independent, while a shock of one standard deviation on Argentine GDP growth generates a response in Uruguayan GDP growth equivalent to a variation of 3.04% in the following second quarter.

It is interesting to note that the largest positive and negative elasticity fluctuations in the IRFs belong to the short or in some cases medium/short (seven lags) term period for all three economies under analysis (-0.053 and 0.047 for the Argentine response, -0.028 and 0.031 for the Brazilian response, -0.045 and 0.030 for the Uruguayan response).

Concerning the long term horizon, it is evident from the table how the cumulated elasticity figures converge toward zero, as suggested by the IRFs graphs. Taking into account twenty lags, on average the Uruguayan output and the Argentine one are the ones that suffer more from an external perturbation, whilst the Brazilian one is reacting in a slighter way (the average response values across all country impulses are 0.010 for Uruguay, 0.011 for Argentina and 0.008 for Brazil[4]).

4.2. Reliability of the results

The causation patterns are difficult to predict for the EU and US but quite credible for what concerns Mercosur countries. Uruguayan small size economy and its intense trade flows with Argentina explain the influence of the latter on the former, although the revealed inverse causation direction is striking and hard to explain. Moreover, the elasticity size casts some doubts on its reliability. The missing Granger causality from Argentina to Brazil calls for attention, but this is probably attributable to the Brazilian recovery during the Argentine recession following the 2001 crisis. More interestingly, the complete absence of influences from the EU and US was not expected. It is worthwhile noting that the results have been obtained through a simplified model and using a small number of time observations. The model, most likely, ignores some economic mechanisms of relevance. However, the reliability of the technique, widely tested in the literature, allowed me to use these results as an acceptable approximation of real phenomena and economic impacts in qualitative terms as well as quantitative ones.

5. Conclusions

In this paper an empirical analysis was conducted on the causation relations among business cycle activities of the cited countries. This should be considered an attempt to understand which cycles are dependent on others, considering the influences of the EU and US as well.

Thus, it seems that some links among the considered economies are present and result to be strong, while the EU and US do not play a relevant role in determining the fluctuations of their economies. Through a VAR model, in which I added the EU and US cycles, I found that the Argentine output is caused by the Brazilian and Uruguayan one, but not by the EU and the US one. The Brazilian output seems to be independent, because it is not Granger caused by anyone of the considered countries. In the end the Uruguayan output is just caused by the Argentine, but not by the Brazilian, US and EU one. A dynamic analysis confirmed this result. The IRFs study revealed that in the short term the Argentine output is reacting strongly to the Brazilian and Uruguayan impulses. The response to a EU impulse is not as large as the one to the US impulse. Even if a sort of independency can be inferred by the Granger test on the Brazilian output, in the short term the EU impulse is the one that is generating the largest Brazilian response. Lastly, Uruguayan output is reacting in a strong way to every country innovation, but particularly to the Argentine impulse. Taking into account the long term dynamic, that is the first 20 periods equivalent to five years, it seems that Argentine, Brazilian and Uruguayan responses are dying off with time to each country impulse.

Appendix

Figure A1 Seasonally adjusted real GDP time series

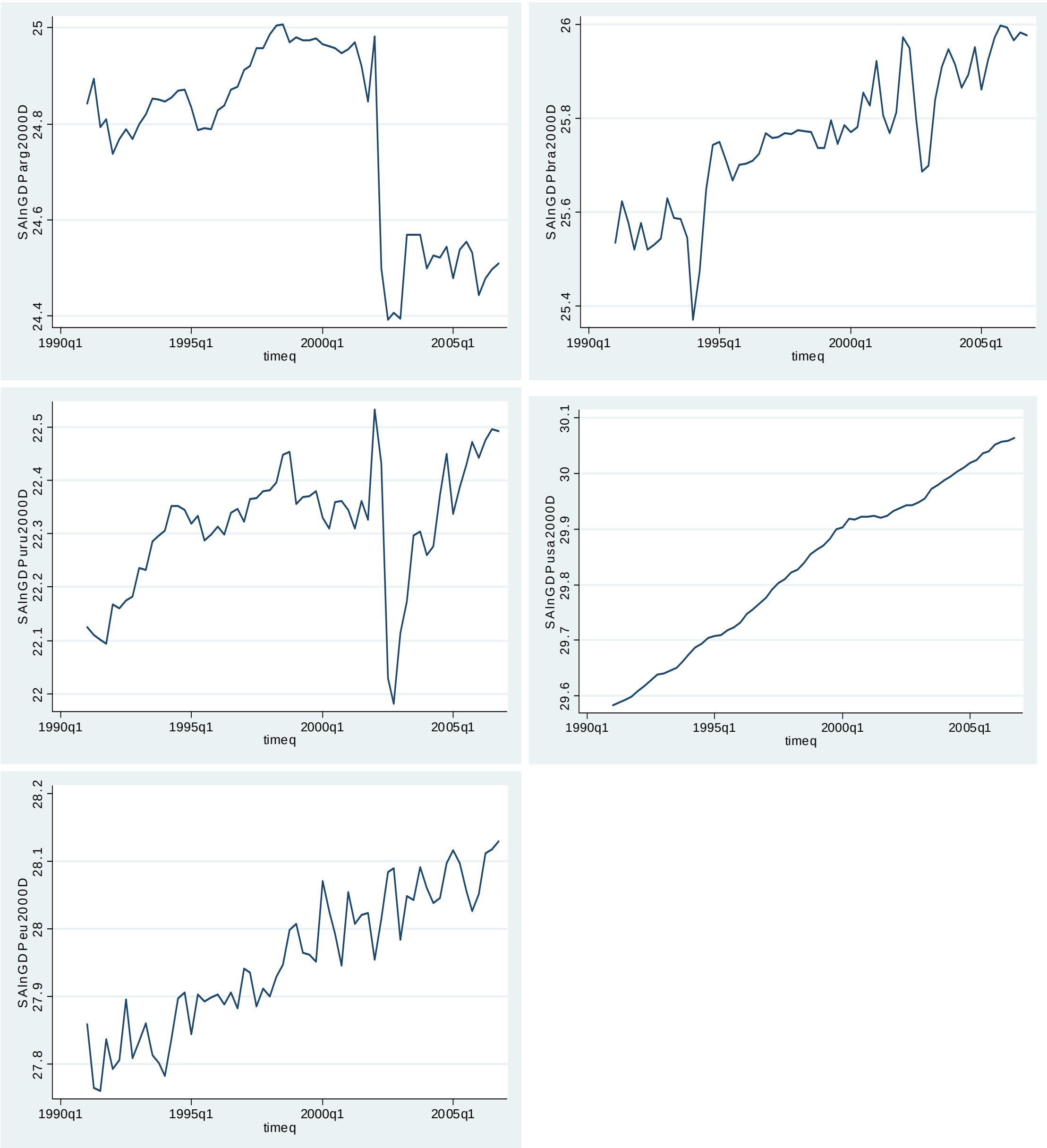
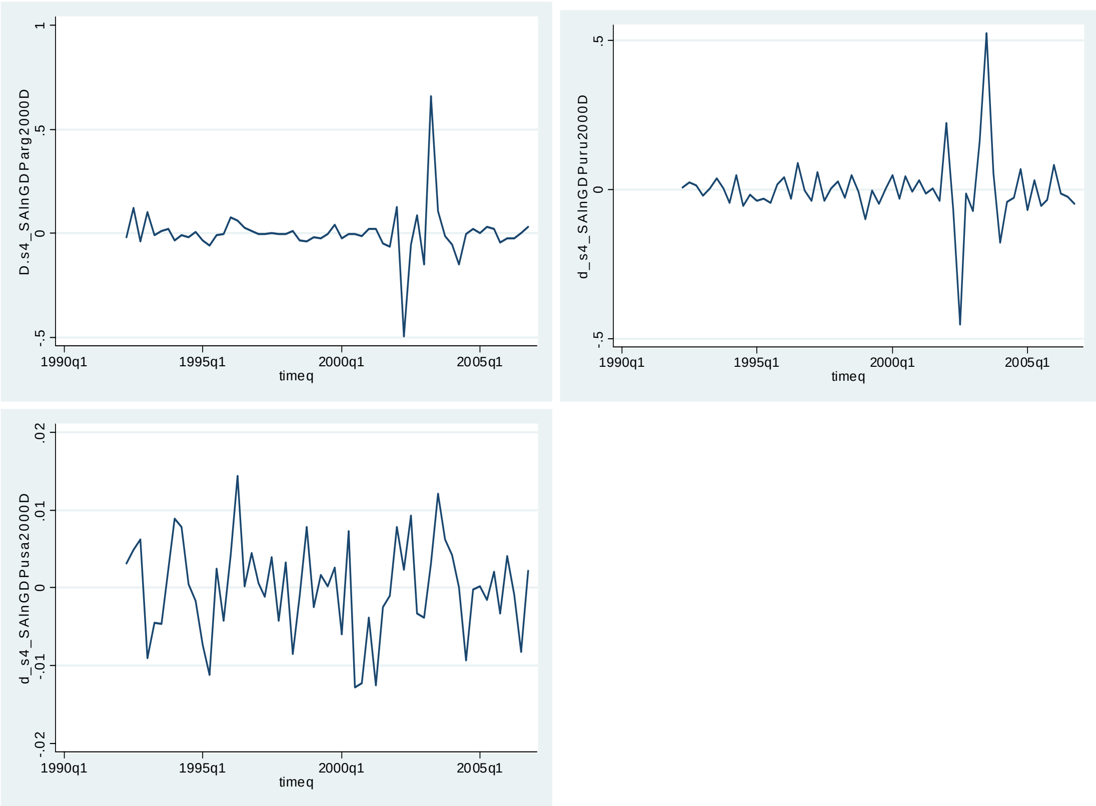


Figure A2 First difference of the seasonally adjusted real GDP time series



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Notes

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[2] For the economic theory about business cycle transmissions see Dornbusch (1980), Svensson (1988), Svensson and Wijnbergen (1989), Fukuda (1993), and Stockman and Tesar (1990).

[3] I removed the seasonality from the GDP and trade ratios time series using TSW (TRAMO/SEATS). It estimates the unobserved components in time series following the Autoregressive Integrated Moving Average (ARIMA) model-based method. The trend, seasonal, irregular and transitory components are estimated and forecasted with signal extraction techniques applied to ARIMA models.

[4] These figures are computed as average response of the averages of twenty lags elasticity values for each country impulse