Will it SURvive?

Analysis of a Common Currency between Argentina and Brazil[1]

Master Thesis in Policy Economics

Erasmus School of Economics

Student: Amanda Rocha Moreno[2]

Supervisor: Dr. Agnieszka Markiewicz[3]

Second assessor: Prof. dr. Ivo Arnold[4]

Final version: 30th October 2023

Abstract:

This study examines the potential for a common currency between Argentina and Brazil within the Optimal Currency Area framework. Using SVAR analysis and the Blanchard-Quah long-run restriction, we assess shocks symmetry and identify their sources. Our findings suggest significant convergence in long-term GDP trends, indicative of economic integration, though Argentina's higher volatility raises concerns. Supply shocks correlate strongly, possibly due to similar production structures, while demand shocks diverge, especially post-2014, reflecting differing domestic policies. The study underscores the need to address economic disparities before pursuing a common currency.

Keywords: Argentina; Brazil; Business Cycles; Comovement; HP Filter; Structural Vector Autoregression; Optimum Currency

---

[1] The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.
[2] Erasmus School of Economics; student number: 637230; amanda.lopes.175@gmail.com.
[3] Erasmus School of Economics.
[4] Erasmus School of Economics.

Content

List of Figures

List of Tables

1 Introduction

The announcement that Argentina and Brazil are in early talks to create a common currency has dominated headlines. The aim of the plan is to establish a new currency unit that streamlines trade between the two major economies in the region and decreases reliance on the US dollar. If the plan materializes, the new currency – the SUR – would be the world's second-largest currency union after the euro. While it has faced criticism, with economists like Olivier Blanchard and Paul Krugman expressing scepticism (Harris et al., 2023), the actual proposal is less stringent than it appears. In a first moment, the idea is the “creation of a synthetic currency for denominating bilateral trade and financial flows as an alternative to the U.S. dollar” (Steinberg and Otero-Iglesias, 2023). Therefore, the Brazilian real and Argentine peso would continue to exist with the new tender targeted narrowly at trade (Ayres, 2023).

This concept of a common currency in South America is not entirely new, as some regional leaders have long advocated for greater unity to enhance economic stability and sustainable growth. As a matter of fact, the idea of forming a monetary union in South America is not new. During the late 1980s, Brazil and Argentina considered the possibility of creating a common currency named the “gaucho” to facilitate trade between the two countries. However, this proposal was ultimately abandoned due to difficulties in its implementation. More recently, in 2019, former Brazilian President Jair Bolsonaro promoted the idea of a currency union, but this plan also failed to materialize. However, the path to achieving this goal is complex.

According to the Optimal Currency Area (OCA) framework proposed by Mundell (1961) and subsequent literature, effective currency unions require high levels of economic integration, synchronized and symmetric business cycles, and substantial labour and capital mobility among participating countries. Without meeting these criteria, adopting a common currency could induce severe economic challenges rather than benefits. Therefore, the possible impacts should be deeply taken into account and reasons for reasons leading to a high level of integration put into perspective.

Following a more practical fashion, Giambiagi (1998) argues that a South American currency union should be the final step of an integration process that includes: i) the elimination of the edges that still mark the formation of the free trade area; ii) the end of exception lists to the Common External Tariff (CET); iii) harmonization of legislation in the labour, tax, and capital markets; iv) and the integration of financial systems. Moreover, Eichengreen (1998) raises questions about the necessity of a common currency in the Mercosur region, emphasizing that its success depends on the depth of integration that countries aim to achieve. If the goal is to establish a genuinely unified regional market, beyond just a free trade area or customs union, a monetary union might be essential to mitigate the adverse effects of exchange-rate fluctuations. However, if the objective is to maintain a free trade zone similar to NAFTA (North American Free Trade Agreement), Brazil and Argentina could retain their individual national currencies while pursuing deeper economic integration.

In line with Mundell's framework, this study examines whether Brazil and Argentina constitute an optimum currency area in terms of the business cycle comovement criteria. The structure of the study is as follows: Section 2 defines common currency areas and business cycles theoretically, reviewing existing literature related to the Mercosur region. Section 3 assesses the current degree of economic integration between Argentina and Brazil. Sections 4 and 5 present a description of methodology and data, respectively. In Section 6, we provide some stylized facts on the comovement of business cycles, using the Hodrick and Prescott filter to estimate correlations. Section 7 employs a Structural Vector Autoregression model with long-run restrictions to identify the factors influencing comovement. Finally, Section 8 offers concluding remarks.

2 Literature Review

2.1 Optimum Currency Area

The concept of OCA is a fundamental framework in the study of the formation of currency unions and the transition from individual national currencies to a common one. Developed by seminal work by economists Mundell (1961), McKinnon (1963), and Kenen (1969), OCA theory identifies the conditions under a group of countries would find it beneficial to abandon their individual monetary policies and adopt a common currency. The theory is embedded in the analysis of costs and benefits of renouncing sovereignty over the monetary policy and the identification of prerequisites that can smooth these costs.

Some of the benefits associated with a common currency area might be an increase in intra-regional trade due to the elimination of exchange rate risk, a reduction in transaction costs, and the standardization of prices (Rose, 1999). Furthermore, greater financial integration can lead to improved conditions for investment, production, and consumption, while the adoption of an international currency could enhance credibility and price stability. Among the costs, the literature identifies the loss of autonomy in monetary policy, the inability to finance fiscal deficits through seigniorage, the risk of financial contagion during crises (Forbes, 2012), and the challenges of promoting fiscal integration, including government spending and taxation, across participating countries (Goodhart, 1998). Additionally, a union limit the ability of setting significantly different tax rates, limiting the ability of running budget deficits (Bayoumi and Eichengreen, 1992).

According to the theory, a region may benefit from a common currency if the economic costs associated with stabilization policies within the union are lower than those typically incurred by countries with sovereign monetary authority (e.g., adjusting the exchange rate and interest rate). To determine whether countries should pursue monetary integration, economists can identify the incidence of shock affecting the economies, determine the underlying mechanism and analyse the responses generated in the economy. If shocks affect economies symmetrically and at the same time, a common monetary and fiscal policy is enough to adjust economies participating in the union.

Besides monetary and fiscal adjustment, there are other mechanisms through which a common currency area can adapt to economic shocks. Frankel (1999) argues that highly integrated economies can cope with adverse shocks through their level of openness. Openness refers to the degree to which an economy is connected to the global economy, typically measured by the ratio of imports and exports to GDP. When the marginal propensity to import is high the variability in output under a fixed exchange rate is relatively low. This is because changes in external demand can help offset the effects of shocks on the domestic economy. In other words, openness could act as an automatic stabilizer. Additionally, as proposed by Mundell (1961), if labour can move freely between countries, then workers may be able to respond to a local recession by moving across borders in search of work. This can act as another automatic stabilizer for the economy. Frankel (1999) describes an additional stabilizer that can be established: a fiscal union. When a federal fiscal system exists, it allows for the redistribution of funds between regions to address regional disparities. Furthermore, stabilization could occur through capital mobility and adjustments in wages and price levels.

Despite the different mechanisms, business cycles similarity is still a relevant criterion to define if a monetary union is optimal. If the economies experience shocks of similar patterns and roots at the same time, coordinated macro policies can become desirable and it will not impose additional costs. Consequently, if countries experience idiosyncratic shocks or if shocks are asymmetric or asynchronous, the cost of monetary integration might be too high Frankel (1999).

Despite the relevance of the comovement criteria for OCA theory, Frankel and Rose (1998) presents some conflicting arguments. He finds that as trade intensity between countries increases, their business cycles become more correlated. This endogeneity challenges the criteria imposed by the theory, suggesting that a country is more likely to meet the entry criteria ex-post rather than ex-ante.

Before turning to the literature on optimum currency areas on the Mercosur region, it is important to define the concept of business cycles and characterize their behaviour first properly.

2.2 Business Cycles

Business cycles are typically characterized as systematic and recurring fluctuations in a nation's aggregate economic activity. These fluctuations occur simultaneously across various sectors of the economy and follow a specific periodic pattern. A cycle consists of an aggregate economic expansion, followed by a corresponding contraction, thus forming a complete cycle. This concept was put forward by Mitchell and Burns (1935) and later coined the classical approach by Zarnowitz and Ozyildirim (2006). According to the classical approach, the identification of business cycles revolves around recognizing specific turning points, namely peaks and troughs. The duration of a business cycle is measured from one trough to the next. Consequently, during an expansion phase of the business cycle, there is a noticeable increase in the absolute level of the aggregate economic activity index until it reaches a peak, whereas recessions correspond to a decline in this index to the trough.

An alternative approach, later referred to as the growth cycle approach, was first introduced by Mintz (1974). As highlighted by Perrotti (2021), this approach is closely related to the literature on Real Business Cycle (RBC) theory, pioneered by Lucas (1972) and Kydland and Prescott (1982). RBC theory primarily explains economic fluctuations as a result of exogeneous shocks affecting technology and productivity. In line with this class of models, the growth cycle approach offers a definition of business cycles based on deviations from the long-term output trend. When an economy's actual output grows at a rate higher than its potential output (the long-term trend), it enters a speedup phase characterized by a positive output gap. Conversely, when the actual output growth falls below potential output growth, resulting in a negative output gap, the economy experiences a slowdown phase.

The analysis of output deviations from its trend is a common focus in the literature, especially because such episodes occur more frequently in developed countries like the OECD (Organization for Economic Co-operation and Development) economies (Cotis and Coppel, 2005). Additionally, the growth approach serves as the foundation for the International Economic Indicators (IEI) project initiated at the National Bureau of Economic Research (NBER) in the early 1970s, as outlined by Klein and Moore (1985).

Whilst the classical approach is primarily descriptive, the growth cycle approach goes a step further and allows to output series to be decomposed into components. An output series (y_t) can be seen as follows:

$$y_t = g_t + c_t + s_t + \varepsilon_t$$

where g_t represents the long-run trend, c_t is the cycles, s_t the seasonal component and ε_t the disturbances. Therefore, the growth approach allows for a more in-depth understanding of the underlying dynamics of economic fluctuations. To decompose a macroeconomic series into these components, the application of statistical tools is essential. In Section 4, we will delve into the methodology behind one detrending technique proposed by Hodrick and Prescott (1997).

Another important characterization regarding our study is to define the concepts regarding the similarity of business cycles. In the literature, the concepts of symmetry and synchronicity are many times used interchangeably, or the term co-movement is also brought to light[5]. This study defines cycles symmetry as the similarity in the amplitude of business cycles between countries, while synchronization specifically refers to the timing of business cycles phases. Synchronous cycles means that countries go through cycles simultaneously. On the other hand, cycle comovement is a broader term that encompasses both symmetry and synchrony. It refers to the degree to which business cycles in different countries are correlated with each other.

2.3 Previous Research on Business Cycle in South America

Despite the importance and the relevance of business cycle analysis, studies for the South American countries have been notably limited, primarily due to data constraints stemming from the region's economic volatility and frequent adjustments in time series data due to hyperinflation episodes (Aiolfi et al., 2011). This research gap is striking considering the region's unique context, such as trade agreements, a shared historical past, considerable stability, and some well-developed nations.

Existing studies have often focused on shorter time periods or in general analysis, leaving a significant lack of comprehensive empirical research on business cycles in South America. This study provides a chronological overview of the most recent studies on business cycle comovement in the region and on evidence regarding the optimality of a common currency area.

Jacobo and Marengo (2002) conducted a study examining the behaviour of GDP fluctuations from 1970 to 1997 among Mercosur countries. The aim was to explore the degree of economic homogeneity and investigate the mechanisms driving business fluctuations, particularly the size and correlation of shocks, using VAR analysis. Brazil displayed a positive correlation with Argentina and Paraguay. Analysing supply shocks, the study found similarities in size among the shocks for Argentina, Brazil, and Uruguay, though they were not correlated. Regarding demand shocks, those in Argentina, Brazil, and Uruguay exhibited correlation, but their sizes were not uniform.

Gonzalez-Rozada and Fanelli (2004) used SVAR and BQ methodology following Eichengreen and Bayoumi (1992) to analyse Argentina, Brazil, and Uruguay from 1980 to 2002. They found strong correlations between supply shocks in Argentina and Brazil (0,13) but lack of comovement between demand shocks

[5] For a discussion see Belke et al. (2017).

(-0,06). Country-specific cycles explained over 84% of output variance. Gonzalez-Rozada and Fanelli suggested that countries should consider diversifying idiosyncratic risks associated with country-specific cycles through mechanisms such as reserve funds or fiscal instruments.

Hallwood et al. (2006) implemented a SVAR analysis, following the BQ decomposition, for all Mercosur countries during the period from 1990 to 2002. They used GDP and CPI as variables. Their findings indicated no common pattern of shocks emerging from any of the countries under analysis. Brazil and Argentina exhibited vaguely correlated permanent shocks (supply shocks) with a correlation of 0.22, and s temporary shocks (demand shocks) with a correlation of -0.14. As a result, the authors rejected the proposition of creating a monetary union in the region.

Neves et al. (2007) utilized data from 1973 to 2006 from Mercosur countries to conduct a cointegration analysis. Their initial findings suggested that the null hypothesis of non-cointegration could not be rejected for Mercosur. However, they cautioned against jumping to the conclusion that it constitutes an optimum currency area, as most cointegration parameters were non-significant.

Carrasco-Gutierrez and Reis Gomes (2007) conducted an analysis of business cycles in countries belonging to Mercosur and Chile. They aimed to identify evidence of a common economic cycle among these nations and studied the cyclical behaviour of real GDP per capita from 1951 to 2000. Their findings showed synchronization between Brazil and Uruguay, as well as between Chile and Argentina. In contrast, relationships among other countries appeared to be asymmetric, possibly due to differences in their economic and political structures.

In the case of Jacobo and Marengo (2020), the paper explores the macroeconomic behaviour of Argentina and Brazil during the period 1995-2018. It investigates whether their economic fluctuations exhibited similar patterns in terms of duration, intensity, and timing. While some features align, the findings indicate that Argentina's business fluctuations are more pronounced and longer lasting than those of Brazil. When analysed together, the highest degree of coincidence is observed in GDP fluctuations, with 72% of the observations lying on the same side of the zero line.

Moreover, Basnet and Padhan (2017) uncovered that between 2001 and 2012 Mercosur countries exhibit common trends in various macroeconomic variables, including real output through a VAR analysis. The authors underscore that the strong interdependence among Mercosur economies prevents their trends from drifting away from long-run equilibrium for extended periods. The correlation between Brazil and Argentina trend is 0,99. In addition to common trends, they discovered compelling evidence of macroeconomic variables in Mercosur countries sharing common short-term cycles as well – correlation of 0,93 between Brazil and Argentina.

More recently, Padilla and García-Brazales (2021) employed a SVAR model to determine the prevailing type of shock – whether global, regional, or country-specific – in South American economies. Their variance decomposition results demonstrated that the output trajectory of countries was primarily explained by country-specific shocks, suggesting that South America as a whole may not be considered an optimal monetary area. However, they identified a group of countries, Chile, Peru, Ecuador, Brazil, and Argentina, for which the costs of a hypothetical monetary union would be relatively lower.

3 Economic Integration and Composition

Brazil and Argentina, as two major South American economies, have been at the forefront of regional economic integration efforts within Mercosur. This regional trade bloc, formed in 1991, includes Argentina, Brazil, Paraguay, Uruguay, and Venezuela (currently suspended) as its full members. Over the years, Mercosur has played a pivotal role in fostering economic cooperation and reducing trade barriers between these countries. Economic integration between Brazil and Argentina has been critical for the overall success of the trade bloc, given that 95% of the bloc's GDP come from these countries (CFR, 2023).

The bilateral trade relationship between Argentina and Brazil is robust, with Argentina ranking as Brazil's third-largest trading partner (MDIC, 2023). Conversely, Brazil holds the position of Argentina's top trading partner (INDEC, 2023).Despite the substantial significance of this bilateral trade, Table 3.1 reveals a declining trend in trade intensity statistics. Table 3.1 provides data on imports and exports between countries as a percentage of total imports and exports with the world, respectively. This downward trend has become increasingly prominent since 2010, with the level of exports between the two countries dropping to its lowest point in 2020 and few variations in the two years following.

Table 3.1. Bilateral Trade between Argentina and Brazil

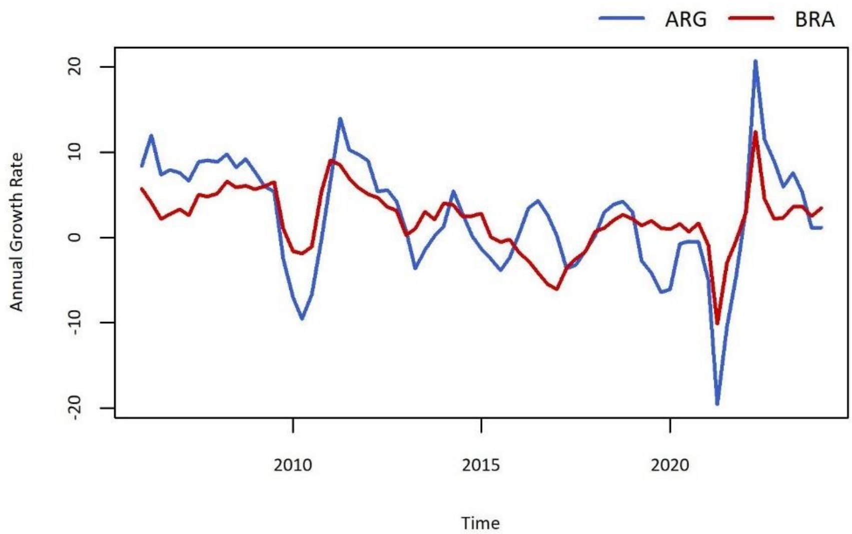
	Exports		**Imports**	
Year	**Argentina to Brazil** (in terms of total ARG exports)	**Brazil to Argentina** (in terms of total BRA exports)	**Argentina from Brazil** (in terms of total ARG imports)	**Brazil from Argentina** (in terms of total BRA imports)
2005	16%	8%	37%	8%
2010	21%	9%	32%	8%
2015	18%	7%	22%	6%
2020	14%	4%	21%	5%
2022	14%	5%	20%	5%

Source: International Trade Centre - Trade Map.

The core of the trade transactions lies on the automobile sector between both countries. According to 2022 institutional data, 35% of Brazil's imports from Argentina consisted of vehicles, parts, and accessories, followed by cereals, primarily wheat, which accounted for another 15% of the trade. Vehicles, parts, and accessories represented 26% of Argentina's imports from Brazil, followed by machinery and mechanical appliances (11%), and iron/steel (6%). Regarding exports to the world, Argentina's main products were cereals, which accounted for 16,4% of the country's total exports in 2022, followed by general commodities (14,8%) and animal food (11%). In Brazil's case, the most exported product in 2022 was mineral fuels and oils, representing 17% of the total export value to the world, followed by oilseeds and oleaginous fruits (14%), primarily dominated by soybeans. In third place were mineral commodities (9,7%).

In terms of GDP, Argentina and Brazil share a similar annual growth pattern, both averaging around 2,5% and 2,1% annual growth, respectively. Figure 3.1 displays the series. While their economic growth trajectories align closely, there is a substantial disparity in the size of their GDP. In 2022, Brazil's GDP reached approximately 1,92 trillion US dollars, representing 72% of Mercosur's GDP, whereas Argentina's GDP stood at 632,77 billion US dollars in the same year (World Bank, 2022).

Figure 3.1. Real GDP Annual Growth Rate (%)



To enhance our understanding of GDP, Table 3.2 provides a breakdown of the domestic product into three economic categories: agriculture, industry, and services. An examination of the table reveals striking similarities in the composition of GDP between the two countries. The services sector holds the most prominent position, followed by industry, which is more significant in Argentina than in Brazil. The agriculture sector ranks third in both countries. These similarities in domestic production structures suggest potential advantages in terms of establishing an optimal currency area. As pointed out by

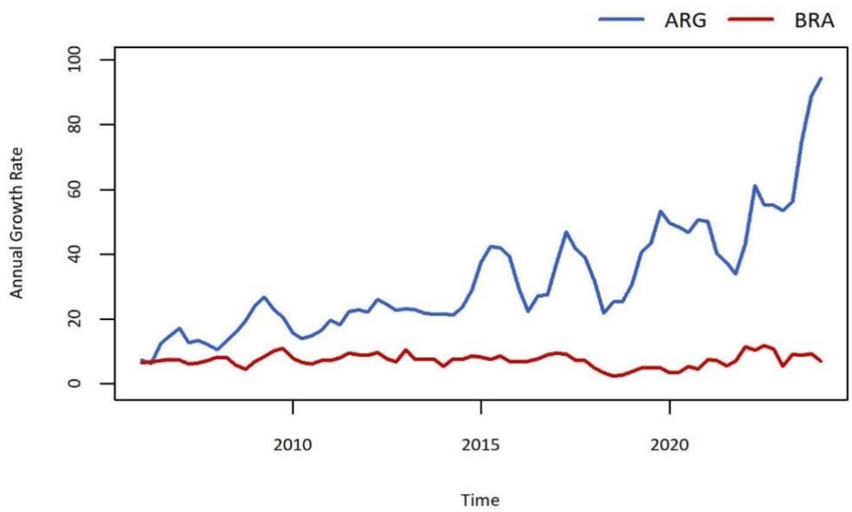
Mongelli (2022), the homogeneity in the production structure reduces the likelihood of countries to be subject to asymmetric disturbances.

Table 3.2. GDP Composition

	Agriculture		Industry		Services	
Year	**Argentina**	**Brazil**	**Argentina**	**Brazil**	**Argentina**	**Brazil**
2004	10%	6,7%	34%	28,6%	56%	64,7%
2014	7%	5,1%	29%	23,8%	64%	71,2%
2022	8%	7,9%	29%	23,9%	63%	68,2%

Source: National Institute of Statistics and Censuses (INDEC) and Brazilian Institute of Geography and Statistics (IBGE).

Figure 3.2. GDP Deflator Annual Growth Rate (%)



While, from a trade and GDP perspective, the initial signs of monetary integration may not seem unfavourable, another critical indicator warrants closer examination: inflation. The South American region has a history characterized by prolonged episodes of hyperinflation. Brazil, in particular, has effectively stabilized its inflation rates following the implementation of the Plano Real in 1994 and introduction of inflation targeting in 1999 (Barbosa-Filho, 2008). Conversely, Argentina implemented several approaches, including pegged currencies, dollarization, and currency board arrangements, all aimed at taming inflation.

Figure 3.**2** clearly illustrates a profound absence of similarity in the annual GDP deflator growth rates between these two nations. Consequently, the prospect of a monetary union with Argentina raises concerns about the potential contamination of inflation expectations to Brazil.

However, it is worth noting that the endogenous optimal currency area hypothesis, as proposed by Frankel and Rose (1998), suggests that deeper integration could yield benefits for these countries, particularly through fiscal policy convergence. With this perspective in mind, the following sections of this study present the methodology and data that will be employed to assess whether a new project for a common currency is desirable, considering the criteria of business cycle comovement.

4 Methodology

4.1 Stylized Facts Methodology

This study applies the Hodrick-Prescott Filter (HP Filter) to decompose the GDP in natural log of Argentina and Brazil into two components: cyclical (c_t) and trend (g_t). The HP Filter decomposition works by minimizing the sum of squared deviations of the original time series from its growth rate (trend) and the changes in estimated growth rate from one period to the next. A smoothing parameter, often denoted as λ, balances the trade-off between preserving the original data's fluctuations (the cyclical component) and smoothing the estimated trend component (Hodrick and Prescott, 1997).

Next, we use the decomposed GDP cycles to characterization of the business cycles is presented along three dimensions: synchronicity, persistence, and volatility.

To explore the comovement dimension a few procedures involving correlations are computed. Firstly, we proceeded to calculate contemporaneous correlations between the domestic cycles. The key understanding, we aim to derive here is the degree of business cycle synchronization between Argentina and Brazil. This approach was implemented following the methodology proposed by Frankel and Rose (1998). The rationale behind this analysis is that a high correlation indicates a high degree of business cycle synchronization, suggesting the presence of common sources of shocks and/or similar responses to these shocks. Conversely, a low correlation may result from different perturbations and distinct responses to shocks, indicating low synchronization.

Building upon the insights of Gonzalez-Rozada and Fanelli (2004), this study delves deeper to explore another critical dimension of business cycle co-movement: the timing of the relation between two cycles. To assess this aspect, we employ cross-correlations as a means of quantifying the degree to which the timing of fluctuations aligns between two countries over the course of their respective business cycles. A cross-correlation function (CCF) measures how two variables, x (Brazil output cycle) and y (Argentina output cycle), relate over time t and $t + k$, where k is a positive integer. It considers lags and leads: if k

is negative, it assesses x current value against y future value, and if k is positive, it compares x current value with y past value.

Furthermore, we analyse rolling correlations between the cyclical components. This approach captures time-varying relationships between countries' business cycles due to factors like economic policies, global shocks, and trade dynamics. According to Zivot and Wang (2003), the assumption that parameters of a time series remain constant over time, which is a critical assumption for statistical models, can be tested using rolling correlations. If the parameters remain constant throughout the entire sample, the estimates over the rolling windows should demonstrate stability. Conversely, any changes in the parameters at some point during the sample will be detected by the rolling estimates, revealing temporal variability. We have selected two window sizes, four and eight quarters, to analyse the evolution of business cycles.

Another dimension of cycles covered in this study is the persistence of the cyclical component, represented by the autocorrelation between the cyclical component at time t and $t+1$. High autocorrelation indicates high cyclical persistence, and vice versa. Finally, we also assess cycle volatility, measured by the standard deviation.

4.2 Empirical Methodology

4.2.1 Theory

To formally explore the relationship between business cycles in Argentina and Brazil, we adopt a Structural Vector Autoregression (SVAR) framework, as initially proposed by Blanchard and Quah (1988) and extended by subsequent researchers (Bayoumi and Eichengreen, 1992). This empirical approach allows us to evaluate the impact of transitory and permanent shocks on the economies through the imposition of restrictions on the cumulative effects of shock on the model. Whilst the HP Filter enabled us to decompose the data into the systematic components c_t and g_t, the SVAR allow us to retrieve residuals (ε_t) as well. We analyse how the endogenous variables, output and price, respond to the unexpected and non-systemic impulses these shocks create over the system.

Following the notation in Bjørnland (2006), we begin by defining the bivariate SVAR model we wish to estimate for each country:

$$\begin{bmatrix} GDP_t \\ DEF_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} - \begin{bmatrix} \psi_{12} \\ \psi_{21} \end{bmatrix} \begin{bmatrix} \Delta DEF_t \\ \Delta GDP_t \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix} \begin{bmatrix} \Delta GDP_{t-i} \\ \Delta DEF_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \qquad (1)$$

where we assume that both GDP_t and DEF_t are stationary series; $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are the structural innovations, which can be characterized as white noise with constant variance and orthogonal (zero covariance), leading to the following variance-covariance matrix of the residuals, $\sum \epsilon \sim \begin{vmatrix} \sigma_1 & 0 \\ 0 & \sigma_2 \end{vmatrix}$; the intercept for each equation is α_1 and α_2; $\sum \phi$ is the matrix of autoregressive coefficients for $i = 1, \ldots, p$; and the contemporaneous effects are described by ψ_{12} and ψ_{21}.

It is important to note that in this model, changes in GDP_t have contemporaneous effect on DEF_t, therefore, we also allow for an indirect effect of $\varepsilon_{1,t}$ on DEF_t, if $\psi_{21} \neq 0$. The same holds true for changes in DEF_t affecting GDP_t if $\psi_{12} \neq 0$. This feature distinguishes the SVAR model from the VAR model, where shocks to one variable can only impact another variable through lags. The advantage is that there is no specific shock that only affects one variable at time. Shocks are intertwined, since that they are ultimately described by economic forces that affect the whole economy – structural shocks.

While the feedback effects from contemporaneous variables are an advantage of the SVAR model, they make it impossible to estimate the model through Ordinary Least Squares (OLS) due to endogeneity. Consequently, we resort to estimating a reduced-form VAR and impose specific identification restrictions to recover the structural shocks.

To derive the reduced form, we can simply rewrite Equation (1) in a simplified matrix notation, shifting the contemporaneous coefficients to the right-hand side as shown in Equation (2). Subsequently, we can multiply all terms by Ψ^{-1} and rename parameters for clarity, as in Equation (4).

$$\Psi y_t = \alpha + \Theta y_{t-i} + \varepsilon_t \quad (2)$$

$$y_t = \Psi^{-1}\alpha + \Psi^{-1}\Theta y_{t-i} + \Psi^{-1}\varepsilon_t \quad (3)$$

$$y_t = \mu + A_i y_{t-i} + e_t \quad (4)$$

Thus, the relationship between the reduced-form and structural shocks can be defined as: $e_t = \Psi^{-1}\varepsilon_t$. Expanding this relationship to both variables, we find that:

$$\begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix} = \begin{bmatrix} 1 & \psi_{12} \\ \psi_{21} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \quad (5)$$

Which can be rewritten to:

$$e_{1,t} = (\varepsilon_{1,t} - \psi_{12}\varepsilon_{2,t})/(1 - \psi_{12}\psi_{21})$$
$$e_{2,t} = (\varepsilon_{2,t} - \psi_{21}\varepsilon_{1,t})/(1 - \psi_{12}\psi_{21})$$

Given that the structural errors are white noise processes, the reduce-form residuals shown in Equation 5 must have constant mean and variance. However, these residuals are not orthogonal as the structural shocks, meaning that the covariance between $e_{1,t}$ and $e_{1,t}$ is not zero. Thus, we find that the variance-covariance matrix of the reduced-form residuals is: $\sum e \sim \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}$. However, the VAR is still under-identified, making it impossible to retrieve the structural shocks. The reason for this under-identification is due to the covariance between residuals: $cov\left[e_{1,t}, e_{2,t}\right] = \sigma_{12} = \sigma_{21}$.

Without imposing some restrictions, it's impossible to retrieve the SVAR parameters. When considering a bivariate SVAR(1) and VAR(1), there would be ten structural parameters to estimate (eight coefficients and two variance elements), but only nine reduced-form parameters (six coefficients and three variance-covariance elements). Following the approach proposed by Blanchard and Quah (1988), we employ long-run restrictions, known as the BQ decomposition, to properly identify the structural parameters.

To understand how a long-run restriction works, we first need to describe how shocks accumulate over time in a structural model. Based on Equation (4), it follows that in the reduced form, the value of variable y_t is the accumulation of effects from all past shocks:

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + e_t \quad (6)$$

Applying a lag polynomial operator $A(L) = (1 - A_1 - A_2 L^2 - \cdots - A_3 L^3)$ to Equation (6), we find that:

$$A(L) y_t = \mu + e_t \qquad (7)$$

Equation (7) represents the system as a moving average. To isolate y_t, we can multiply all terms by $A(L)^{-1} = B(L)$. Moreover, considering that $e_t = \Psi^{-1} \varepsilon_t$, we derive an equation that describes the variables in terms of past structural shocks:

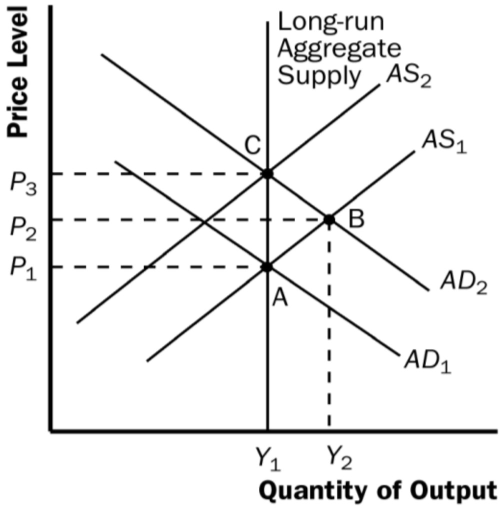
$$y_t = \nu + B(L)\Psi^{-1}\varepsilon_t = \nu + \Theta(L)\varepsilon_t \quad (8)$$

Now that we have the parameters ready for estimation, we discuss the method used to identify the orthogonal shocks (ε_t).

4.2.2 Long Run Identification

The identification restriction in this context is that demand shocks should not have long-term effects on GDP. Bayoumi and Eichengreen (1992) explain this restriction using a conventional aggregate demand (AD) and aggregate supply (AS) diagram in the price-output plane (Figure 4.1). In the diagram we have that AD is a downward curve, which means that as prices rise, the total quantity demanded by consumers, businesses, and the government decreases. The AS curve, on the other hand, can have two slopes: an upward slope representing the short-run (SRAS) and vertical slope for the long-run (LRAS). The upward slope reflects the fact that in the short run firms can adjust their production levels in response to changes in demand, because prices and wages are sticky. In contrast, the long run AS curve is vertical, which represents the economy's potential output when all resources are fully utilized. In the long run, changes in the price level do not affect the overall level of output.

Figure 4.1. Supply and Demand Diagram



Source: Minnesota State University, n.d.

In this diagram the curves intersect each other in the optimum (point A) and shocks, to both sides, lead to changes in the equilibrium. For instance, a technological shock, which increases the output potential is a supply shock that moves both SRAS and LRAS to the right (point C to B) by the same amount. A new technology decreases the production costs and increases efficiency. Therefore, supply shocks increase output and decreases prices in the short run, and this effect becomes even stronger as the aggregate supply curve becomes vertical (LRAS).

In the case of a positive permanent demand shock, the AD curve would move outwards (point A to B), leading to both higher output and higher prices in the short run. This is because, in response to increased demand, firms increase production and raise prices. However, in the long run, the vertical LRAS curve implies that the economy will return to its potential output, but changes in the price level will be permanent.

To summarize, the idea behind the long-run neutrality of demand shocks on output restriction is that nominal variables, such as inflation, cannot have a long-term effect on real variables, as GDP. The effect must converge to zero in the long run.

In terms of Equation (8), we can now expand the matrix notation to the GDP_t and DEF_t scenario and impose the restriction:

$$\begin{bmatrix} GDP_t \\ DEF_t \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} \theta_{11}(0) & \theta_{12}(0) \\ \theta_{21}(0) & \theta_{22}(0) \end{bmatrix} \begin{bmatrix} \varepsilon_{S,t} \\ \varepsilon_{D,t} \end{bmatrix} + \begin{bmatrix} \theta_{11}(1) & \theta_{12}(1) \\ \theta_{21}(1) & \theta_{22}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_{S,t} \\ \varepsilon_{D,t} \end{bmatrix} + \cdots \quad (9)$$

Given that there are only two variables under analysis, the SVAR requires the imposition of a single restriction to identify the orthogonal structural shocks. The BQ identification restriction will be expressed as a lower triangle on the coefficient matrix: $\sum_{i=0}^{\infty} \theta_{12}(i) = 0$. Each coefficient θ present in this matrix represent the time path of the effects of the demand and supply shocks on output and prices.

Besides the identifying restriction, the model has built-in over-identifying assumptions that will be proven important to analyse whether our results are in line with the model predictions. Namely, we must have that a positive demand shock should be associated with increase in prices while supply shocks should be associated with falling prices. In the next section, the data necessary to the implement the stylized facts and empirical methodology is described.

5 Data Description

The choice of variables is rooted in the methodology formulated by Bayoumi and Eichengreen (1992) to analyse comovement within European countries. This approach entails the identification of aggregate shocks within a bivariate SVAR, established across two key indicators: output and price level. Specifically, the study employs real GDP as a proxy for output and the GDP deflator as a representative of the price level. While some researchers opt for Consumer Price Index (CPI) data in cases where GDP deflator is unavailable, we fortunately possess GDP deflator series for both countries, leading us to prioritize this variable, since it reflects price variation driven by both demand and supply factors.

Our analysis spans from the first quarter of 2004 to the first quarter of 2023. The data timeframe is confined by Argentina's available series, which only starts in 2004. Prior to this year, Argentina's economy was significantly impacted by successive financial and debt crises. Moreover, from 1991 to 2002, the Argentinian Currency Board executed a Convertibility Plan, pegging the Argentinian peso to the U.S. dollar, with the aim of reducing hyperinflation and stimulating economic growth. The year 2002 marked the restoration of the peso's status as a floating exchange.

The series for GDP and the GDP deflator were sourced from the International Monetary Fund's International Financial Statistics (IFS) and are presented at quarterly frequency. The data available was already seasonally adjusted, therefore it was not necessary to pursue any additional methodology to clean the series from the seasonal component s_t. Detailed information on the selected time series can be found in Table 5.1.

Table 5.1. Data

Panel A

	Real GDP			
Country	**Period**	**Base Year**	**Currency**	**Seasonally Adjusted**
Argentina	2004Q1 – 2023Q1	2004	Peso	Yes
Brazil	1996Q1 – 2023Q1	1995	Real	Yes

Panel B

	GDP Deflator		
Country	**Period**	**Base Year**	**Seasonally Adjusted**
Argentina	2004Q1 – 2023Q1	2010	Yes
Brazil	1996Q1 – 2023Q1	2010	Yes

5.1 Data Preparation

Before we turn our attention to the analysis, it is essential to begin with a discussion of the data. This is a crucial step to guarantee the reliability and robustness of the subsequent model. Given the intricate nature of macroeconomic time series data, certain data manipulations are required to maintain the accuracy of our analysis. Among the primary concerns when dealing with time series is the critical condition of stationarity. Consequently, we will direct our attention toward specific techniques and methods that are in order in this context.

5.1.1 Base Year Adjustment

Firstly, to estimate an accurate model, we need to set the base year of all the time series to the same period. In the dataset provided by the IMF, the GDP deflator series is established at a base year of 2010. However, the base years for Argentina's real GDP and Brazil's real GDP differ: 2004 and 1995, respectively. This discrepancy requires attention.

Aside from the real GDP series, the IMF also supplies the nominal GDP series. By utilizing the nominal GDP and the GDP deflator, it becomes possible to derive the real GDP series with a common base year of 2010 for both countries.

5.1.2 Stationarity

Since the influential research by Nelson and Plosser in 1982, a significant shift has occurred in the way economists perceive most macroeconomic time series when observed in their original levels. They became commonly regarded as unit root processes, frequently falling into the I(1) category. This recognition of non-stationarity presents a substantial challenge for researchers because unit root series can lead to spurious regression results. In fact, an important requirement to apply the BQ decomposition, is to ensure stationarity. A time series is considered stationary when its key statistical properties—such as mean, variance, and autocorrelation—remain constant over time. This implies that the series follows a deterministic path towards a stable long-term equilibrium.

However, unit root processes differ in a crucial way. They exhibit a level of persistence, where current shocks have enduring impacts on the series, shaping its trajectory over an extended period, and imposing structural breaks on the trend. This means that these time series lack the tendency to revert to a fixed equilibrium and can exhibit more prolonged and complex dynamics.

To test whether the variables included in the model are stationary, we will conduct an Augmented Dickey-Fuller (ADF) test. In the ADF, the null hypothesis assumes the presence of a unit root, implying non-stationarity. If we can reject the null, then the test suggests that the series is stationary.

Firstly, we will conduct ADF tests for the variables in log. Tests are estimated with different specifications, including with drift, drift, and trend, and without either. The lag length selection is based on the Akaike Information Criterion (AIC). The ADF statistic obtained in these tests is then compared with critical values (see Appendix). If the ADF statistic is lower than the critical value at a 5% significance level, we reject the null hypothesis, indicating that there is no unit root, and the series is stationary. However, if we do not reject the null hypothesis, we proceed to take the first differences of the series and repeat the ADF test to ascertain the order of integration.

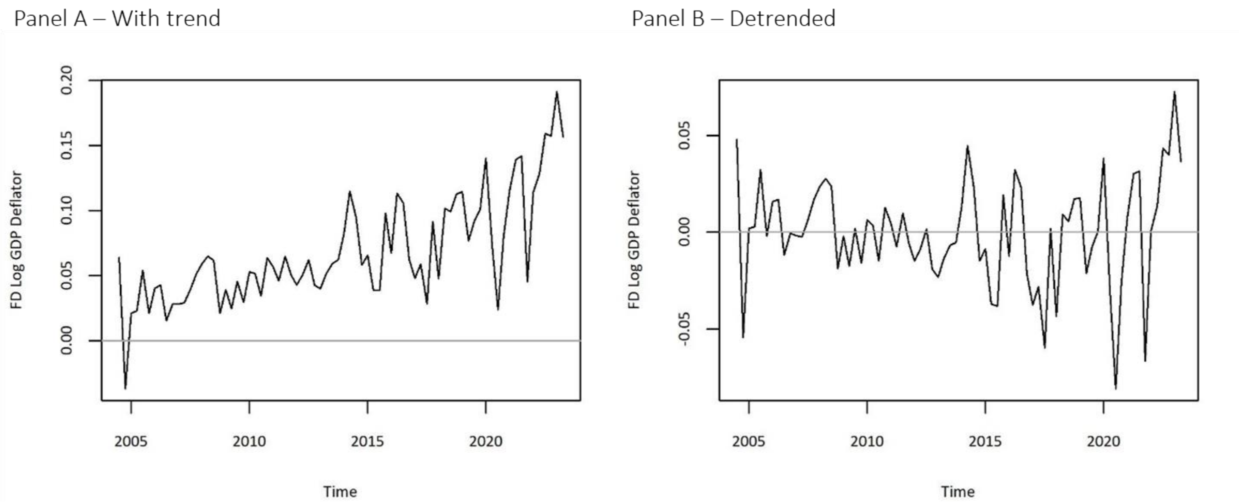
The results (see Appendix) indicate that all variables are non-stationary when considered in levels, with one exception: Argentinian GDP exhibits stationarity when a drift is included in the specification. Given the non-stationary of the other series as I(0), it becomes necessary to difference the variables and conduct new ADF tests on the transformed data.

In the ADF test conducted on the first differences of the log series, the null hypothesis of a unit root was rejected for all the variables examined (see Appendix). We can reject the null hypothesis at a 1% significance level when considering a specification with both a trend and drift. This rejection was supported by their ADF statistics, which were lower than -4,04 (the critical value). Furthermore, apart from the Argentinian GDP deflator, the other three series exhibited stationarity at 1% significance threshold in alternative model specifications, namely those with a drift component or neither a trend nor drift.

5.1.3 Detrending

The fact that the Argentinian GDP deflator exhibits stationarity only when both a drift and a trend are considered is expected. The Argentinian economy has been dealing with recurrent inflationary crisis in the past decade. Figure 5.1 plots the first differenced log GDP deflator for Argentina. Clearly, we can see in Panel A that the variable presents an upward trend.

Figure 5.1. Argentina First Differenced Log GDP Deflator



To simplify our future analyses and avoid adding an extra parameter for this trend, we detrend the GDP deflator. Detrending involves a straightforward process: a regression using a simple time trend variable as the independent variable, effectively purging the deterministic trend component (Panel B).

6 Stylized Fact of Business Cycles

In Section 3, we initiated an analysis of the behaviour of GDP and GDP deflator in two Mercosur countries spanning from 2004 to 2023. Figure 3.1 illustrates a notable observation: while there is a general similarity between the quarterly growth rates of Brazil and Argentina, the latter exhibits a higher degree of volatility in the rate of change. This heightened volatility in Argentina's GDP persists, even when we exclude the exceptional year 2020, a period marked by a significant economic downturn. These findings suggest an enduring economic instability in Argentina, a topic explored further in Section 7 through empirical evidence. While this preliminary analysis provides initial insights into the co-movements of output series between these nations, further investigation is necessary to ascertain whether the observed similar behaviour is correlated, potentially indicating symmetry and synchronicity between the time series, and if they are, whether it stems primarily from co-movements in cycles or trends.

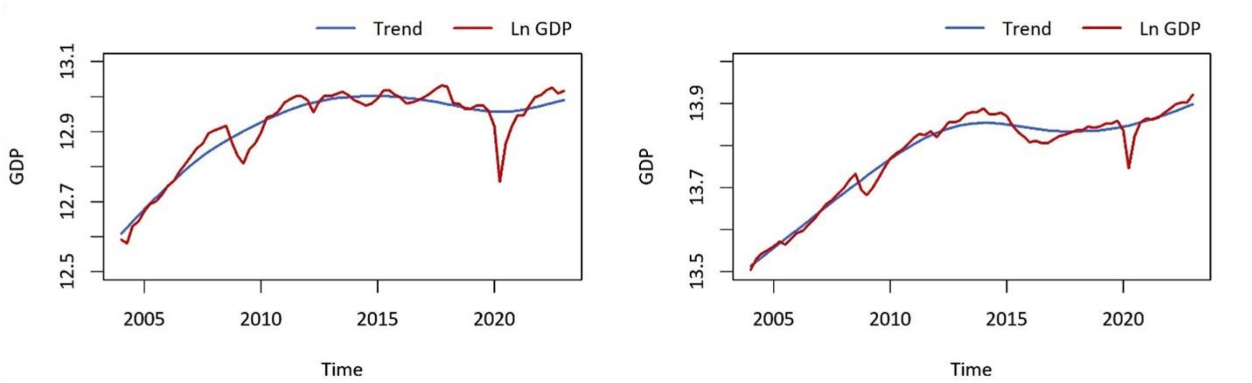
Additionally, it is also imperative to understand if business cycles in the Mercosur region are persistent and ascertain their degree of volatility.

To delve deeper into the business cycles analysis, we first need to isolate the trend component from the cyclical component of output. To achieve this, we apply the HP Filter to the GDP quarterly time series in log. Figure 6.1 highlights the extracted trend for both countries alongside the original time series. In Panel A, we present the trend and log real GDP for Argentina, while Panel B displays the same data for Brazil.

Figure 6.1. Real GDP (in log) and Trend

Panel A – Argentina

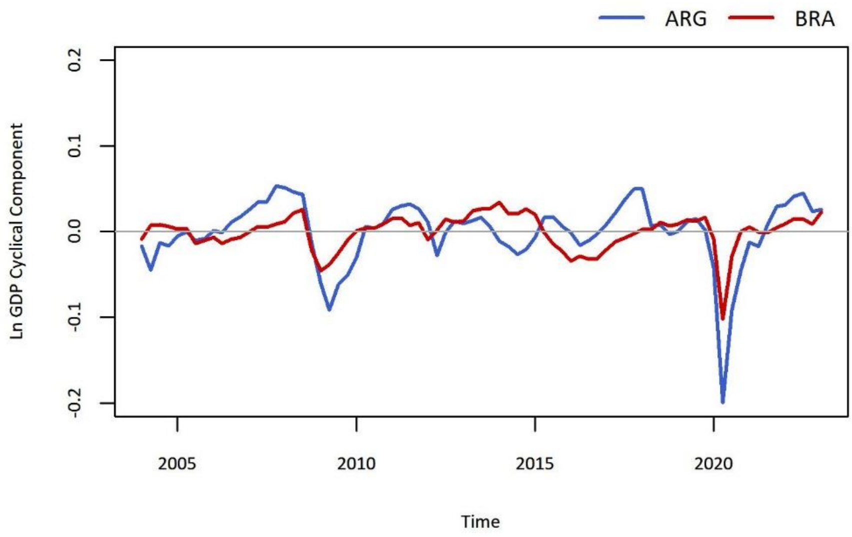
Panel B – Brazil



The Figure indicates that, despite clear disparities in the log GDP of the two countries, Argentina and Brazil share an exceptionally similar trend. This visual similarity is further corroborated by a substantial correlation coefficient of 0,98 between their respective long-run trends. Consequently, we can posit that the GDP series are expected to move together in the long run. This long-run convergence finding is also supported by empirical evidence concerning economic integration within Mercosur, as noted by Engle and Issler (1993), Camarero et al. (2006), and Basnet and Padhan (2017).

To assess the degree of comovement between the cyclical components of Argentina's and Brazil's output, this study relies on the correlation between their domestic business cycles. Figure 6.2 visually presents the cyclical components of GDP, represented as residuals from the HP Filter after removing the trend, for both Argentina and Brazil.

Figure 6.2. GDP Cyclical Component from the Hodrick Prescott Filter



Argentina's economic cycles appear to have higher volatility compared to those of Brazil. Furthermore, from 2012 to 2016, the cycles exhibit clear asymmetry: the Argentinian economy experienced a downturn and eventual recovery in 2014, while the Brazilian economy remained expansionary until 2014, when it began to slow down. Despite these points of asymmetry, it is also apparent that the past two international crises, the 2007-2008 financial crisis and the Covid-19 crisis, had a relatively synchronous initial impact on both economies. These ever-changing periods of higher similarity followed by asynchronous period may explain why previous literature is not so clear on the cycles comovement. Basnet and Padhan (2017) found a correlation coefficient of 0,93 while studying the 2001 to 2012 period, while correlation coefficients from Carrasco-Gutierrez and Reis Gomes (2007), analysing the period from 1950 to 2003, to range from 0,64 to 0,26 depending on the decomposition specification.

Our computation of contemporaneous correlation coefficient between the cyclical components of GDP across countries stands at approximately 0,65. This finding suggests that there is a degree of symmetry and synchronicity in business cycles between the two Mercosur countries. To put this level of correlation into perspective, we compare it to the correlation coefficients between regions in the United States, a well-established currency union. According to evidence presented in Kouparitsas (2002), the minimum value of the interregional correlation coefficient among U.S. states is 0,51, while the median is 0,77, and the mean is 0,75. Therefore, in light of the U.S. benchmark, it is reasonable to argue that the degree of co-movement between Argentina and Brazil is relevant, and further integration could be beneficial. Additionally, a high correlation between these countries indicates that they might share common sources of shocks and/or respond similarly to these shocks. To gain a better understanding of whether business cycles are symmetric, we take a step further and measure the synchronicity and stability of the cyclical component.

Building upon the insights of Gonzalez-Rozada and Fanelli (2004), this study delves deeper to explore another critical dimension of business cycles: synchronization. This aspect is assessed by analysing the leads or lags between domestic business cycles. To perform this analysis, we utilize a cross-correlation function (CCF) as a means of quantifying the extent to which the timing of fluctuations aligns between two countries throughout their respective business cycles. The CCF is a statistical tool that measures the relationship between two time series by calculating their correlation at various time lags. In the context of our study, it helps us understand whether economic expansions, contractions, or turning points in one country coincide with or lead/lag those in another country. A positive CCF value at a specific lag suggests that one country's economic cycle tends to lead or lag the others by that amount of time. Conversely, a negative CCF value at a lag indicates an opposite phase relationship.

Figure 6.3. Cross-Correlation Brazil and Argentina GDP Cyclical Components for k = 4.

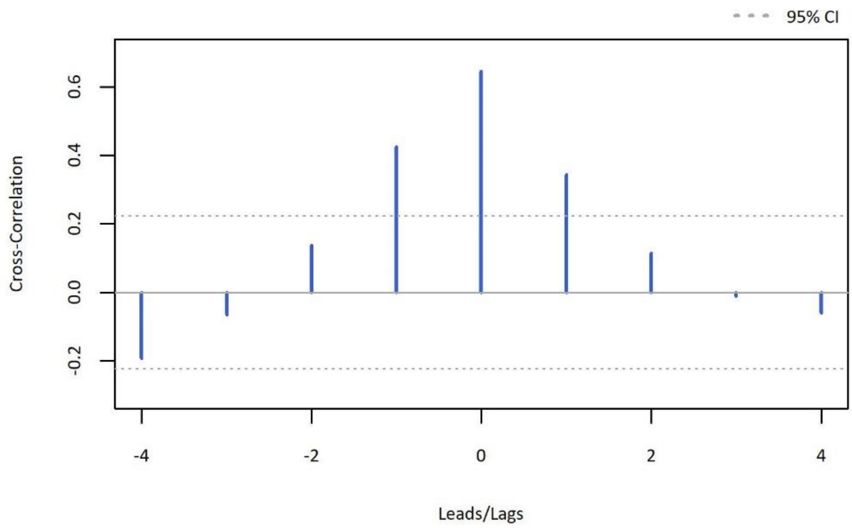


Figure 6.3 illustrates the cross-correlation between the quarterly GDP cycles of Brazil and Argentina, considering up to four lags[6]. To assess the statistical significance of the cross-correlation for a specific lag, we examine whether the CCF falls outside the range of 2 standard deviations from the mean. A commonly used rule of thumb for this purpose is to check if the CCF exceeds $\frac{2}{\sqrt{n-|k|}}$, where n represents the number of observations ($n = 77$), and k is the lag (Minitab 20. Support, n.d.). Based on this rule, a confidence interval is constructed, and when the CCF falls within this interval, there is no significant evidence to

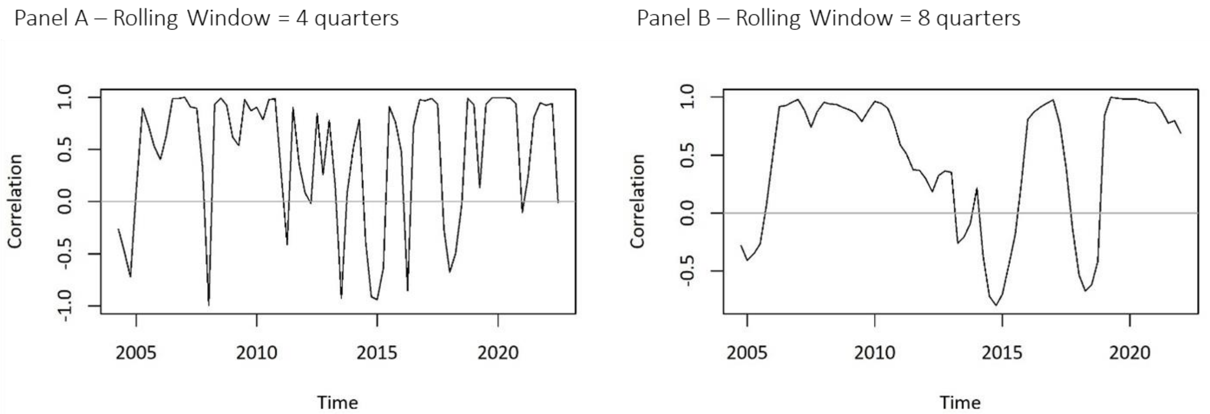
[6] To test the sensitivity to the choice of lags, the CCF was also calculated for k = 3, 5, and 6, but no different results were found.

reject the null hypothesis of zero cross-correlation. In the region where k is negative, it indicates that the Brazilian cycle leads the Argentinean cycle, while in the positive k region, it signifies the opposite, with the Brazilian cycle lagging behind the Argentinean cycle.

The CCF plot shows that $k = 0$ is the most likely scenario, suggesting that the Brazilian (Argentinian) cycles do not significantly lead the Argentinian (Brazilian) cycles during the years 2004-2023. Consequently, we can conclude that the variables display the highest degree of synchronization in with no country leading nor lagging the other.

Another logical step in understanding the behaviour of domestic business cycles in terms of co-movement is to analyse the timely relationship between variables. As suggested by Zivot and Wang (2003), rolling correlations serve as a tool to assess model stability over time by detecting changes in model parameters, meaning the dynamic economic environment. This approach offers insights into how the relationship between cycles evolves by calculating correlation coefficients over rolling windows of data. In this paper, we employ two rolling window sizes: four and eight quarters, with the results presented in Figure 6.4.

Figure 6.4. Rolling Correlation Brazil and Argentina GDP Cyclical Components



The decision to apply two rolling windows is rooted in Zivot's observation (2021) that correlation coefficients are highly sensitive to the chosen window width. Smaller windows yield volatile estimates due to their limited data points, making the coefficients prone to short-term fluctuations and thereby resulting in increased estimation errors. This characteristic becomes evident when we examine Panel A, which calculates rolling correlations using a four-quarter rolling window. In this case, we observe frequent shifts in the relationship between the countries' economic cycles. Conversely, employing a larger window width yields smoother estimates with reduced estimation errors, as it effectively filters out short-term fluctuations and emphasizes longer-term data trends. Panel B presents rolling correlations computed with an eight-quarter rolling window, revealing a more intriguing pattern for discussion.

At the beginning of the sample period, the correlation between the cyclical components of both nations was notably low and asynchronous at -0,28. During this phase, Argentina was in the midst of an economic recovery following the 2002-2003 Argentinian financial crisis, characterized by a partial deposit freeze, a partial default on public debt, and the abandonment of the hard peg exchange rate, all of which contributed to a significant economic downturn (IMF, 2003). In contrast, the Brazilian economy was undergoing a period of relative stability. As we observe the rolling window progressing, the correlation coefficient steadily increased from late 2005, reaching a local maximum of 0,98 in early 2007. This increase was a consequence of expansionary processes in both countries, and the correlation fluctuated between this level and 0,73 until 2010. This extended period of stable correlation occurred during the global financial crisis, when both countries experienced a substantial economic downturn at the same time. Following the aftermath of the 2008 financial crisis, correlation coefficients between the cycles gradually decreased again as the Brazilian economy enjoyed a prolonged period of growth until 2015, until an internal crisis, caused by political turmoil and declining commodity prices, lead the Brazilian economy into a recession. In contrast, the Argentinian economy faced various economic imbalances between 2010 and 2015, driven by soaring inflation and internal fiscal crises. From 2015 to 2017, the correlation between the cycles rebounded, reaching a local maximum of 0,97 in early 2017 before declining to fairly low coefficients when the Argentinian economy underwent a severe crisis that persisted until 2019. This crisis included a new debt default and currency devaluation. The correlation coefficients only returned to exhibit a synchronous and symmetric pattern in late 2019 and early 2020, coinciding with the negative impact of the Covid-19 pandemic on the global economy. During this period, both countries experienced a sharp decrease in GDP that initially had an effect of similar magnitude on the cyclical component of both countries. However, after this last crisis, the synchronicity of the business cycles between countries has been on a downward trend, as the Argentinian economy makes its way into a new default crisis accompanied by hyperinflation. In summary, we can state the correlation of domestic business cycles experienced a particular pattern between 2007 and 2010 but in general prevails compelling evidence that the correlation is not constant over time.

In the stylized facts final step, we examine another two dimensions of business cycles: persistence and volatility. After decomposing GDP into its components, we noted that Argentinian cycles appeared to be more volatile, an observation consistent with findings in prior literature (Jacobo and Marengo, 2020). The statistics presented in Table 6.1 confirm this perception. The volatility of cycles in Argentina, computed as the standard deviation of the time series, is indeed higher than that in Brazil. This indicates that the cycles in Argentina exhibit more significant deviations from the mean and reach more extreme values, encompassing both expansions and recessions. This heightened variability in Argentinean cycles further underscores the lack of symmetry between the two countries.

Table 6.1. Characteristics of GDP Cyclical Component

	Country	
Statistic	**Argentina**	**Brazil**
Persistence[a]		
t-1	0,71	0,64
t-2	0,39	0,31
t-3	0,11	0,15
t-4	-0,07	0,03
Volatility[b]	0,038	0,021

Note: (a) Autocorrelation, (b) Standard deviations.

To calculate persistence, we computed the autocorrelation between the cyclical time series of each country and itself at various time lags (up to four lags). According to Table 6.1, the autocorrelation is positive and follows a similar pattern in both countries. A positive autocorrelation signifies that past values are positively correlated with future values, and this enduring relationship gradually diminishes over four lags. The highest level of persistence is observed at lag 1, indicating a robust positive connection between consecutive quarters. As we delve further into the past (lags 2 and 3), the autocorrelation declines, suggesting a diminishing impact of preceding quarters on the current one. By lag 4, the relationship becomes frail for both countries.

While correlations provide an initial understanding of the relationship between economic cycles, they operate within a limited framework. As highlighted by Kouparitsas (2002) and Gonzalez-Rozada and Fanelli (2004), these procedures offer only a simplified overview of the nature of the cycle's relationship and do not allow for a thorough comprehension of the sources of disturbances or responses across regions. Blonigen et al. (2014) emphasize that business cycles aren't the sole drivers of output growth fluctuations; shocks to the trend component, which have permanent effects on output levels, are also crucial. In fact, the authors find that shocks to the trend account for over half of the variance in quarterly real GDP growth for the majority of the twenty-one developed countries under review.

To overcome these limitations and achieve a more profound insight into the sources of shocks and their impact on output, researchers frequently turn to advanced techniques, such as structural econometric models. In this study, we aim to address this gap by empirically identifying shocks to output and prices using the SVAR framework, specifically applying the BQ decomposition.

7 Supply and Demands Shocks

In our approach to identify the types of disturbances (transitory and permanent shocks), we follow a standard methodology, which involves estimating a SVAR model and then applying the Blanchard-Quah (BQ) decomposition technique. As mentioned by Cerro and Pineda (2002), the methodology holds two advantages when identifying the causes of comovement: first, it avoids imposing restrictions on short-run dynamics, and second, it mitigates the "endpoint" problem[7] often encountered in techniques like the HP Filter. However, as pointed out by Padilla and García-Brazales (2021), one limitation of this analysis is that it does not permit the differentiation of country-specific, regional, and global shocks.

This study focuses on Argentina and Brazil, examining the relationships between GDP and the GDP deflator. As discussed in Section 4.1.2, a crucial requirement for implementing econometric analysis on time series is ensuring that they are stochastic processes, meaning that the unconditional joint probability distribution of the data does not change when shifted in time. A property which guarantees that variance and mean are constant. Since the time series under analysis are not stationary in levels, we resort to working with first difference log data.

We begin our study by selecting the appropriate lag length for the reduced-form VAR. Various tests were considered for this purpose, including the Akaike Information Criterion (AIC), the Final Prediction Error (FPE), Schwartz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ) tests. These tests help us determine the optimal number of lags to include in the VAR model. For example, the AIC assesses the model's goodness of fit while penalizing for complexity, whereas the HQ test does the same but with a different penalty factor. The FPE measures the prediction error of the model, and the SC criterion balances goodness of fit and model complexity. For Argentina, all four tests indicate that a model with one lag is the optimal choice. However, for Brazil, the AIC and FPE suggest three lags, while the SC and HQ point to one lag (see Appendix).

Bayoumi and Eichengreen (1992) discuss the importance of selecting a uniform lag length to preserve the comparability of the models across countries. Given the divergence between tests for Brazil and the divergence between countries, we opted to select the number of lags in a way that would achieve a consistent specification—specifically, a reduced-form VAR with no autocorrelation of residuals. Autocorrelated residuals means that there is a pattern in the errors left unexplained by the model, which can undermine the reliability of the results. Simultaneously, we aimed for this VAR model to be stable,

[7] Given the smoothing technique employed by the HP Filter, which considers a window of data points around the point to be estimated, its accuracy might be sub-optimal at the endpoints (Baxter and King, 1999).

with characteristic polynomial roots (eigenvalues) inside the unit circle. This stability allows us to express the VAR as a VMA.

Following this approach, we begin by testing autocorrelation and stability for VAR models ranging from VAR(3) to VAR(1). In the case of autocorrelation, we employ a Portmanteau test and find that the errors from our model do not exhibit any systematic patterns over time (see Appendix). Thus, it confirms that the residuals from our VAR model behave like white noise, further supporting the validity of our modelling approach. To assess the stability in the residuals, we calculated eigenvalues of each model. For both countries, the eigenvalues of the VAR(3) model indicate the stability of the systems (see Appendix), indicating converge of the system to an equilibrium. After analysing the statistics for different orders, we eventually settled on a VAR(3) model. This choice was driven by the specification proving to be both stable and consistent. Additionally, a lag length of three is also more in line with previous literature (Gonzalez-Rozada and Fanelli, 2004; Hallwood et al., 2006).

Having specified the model, we proceed by estimating the reduced-form VAR. The results are displayed in the Appendix. The subsequent step involves deriving structural shocks from the VMA applying the long-term constraints outlined previously. It is important to note that four observations were lost in this process – three during VAR estimation, due to the lags, and an additional one during the transformation of the series into first difference.

The matrix of structural coefficients for the moving average representation of each country is presented in Table 7.1. Parameters θ_{11} and θ_{21} capture the cumulative long-run effects of supply shocks on GDP and GDP deflator, respectively, while parameter θ_{22} represents the cumulative long-run effects of demand shocks on GDP deflator. As indicated in Panel A, all shocks exhibit statistically significant cumulative long-run effects in Argentina. In Brazil, all cumulative shocks are significant, apart from the cumulative long-run supply shock on the GDP deflator. Moreover, the over-identifying assumption that demand shocks lead to higher prices is supported by positive θ_{22}; however, the assumption that supply shocks lead to lower prices, is not reflected in Argentina ($\theta_{21} > 0$) and is not statistically significant in Brazil.

Table 7.1. Structural Vector Autoregression Estimates

$$\Theta(L) = \begin{bmatrix} \sum_{i=0}^{3} \theta_{11}(i) & 0 \\ \sum_{i=0}^{3} \theta_{21}(i) & \sum_{i=0}^{3} \theta_{22}(i) \end{bmatrix}$$

Panel A – Argentina

$\Theta(L)$ Parameter	Coefficient
[1,1]	0,0298***
	(0,00246)
[2,1]	0,00577*
	(0,00342)
[1,2]	0
	(0)
[2,2]	0,0289***
	(0,00239)
Observations	73

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B – Brazil

$\Theta(L)$ Parameter	Coefficient
[1,1]	0,0175***
	(0,00145)
[2,1]	-0,000934
	(0,000994)
[1,2]	0
	(0)
[2,2]	0,00846***
	(0,000701)
Observations	73

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 7.1 shows the Impulse Response Functions (IRF) to a one standard deviation shock in Argentina and Brazil. The impulses into consideration are supply shock, driven by change in GDP, and demand, driven by a change in GDP deflator. The responses are the dynamics caused by these shocks on each variable under analysis (GDP and GDP deflator). The graphs below show how a one standard deviation change affects output and prices in twelve quarters ahead with a 95% confidence interval[8].

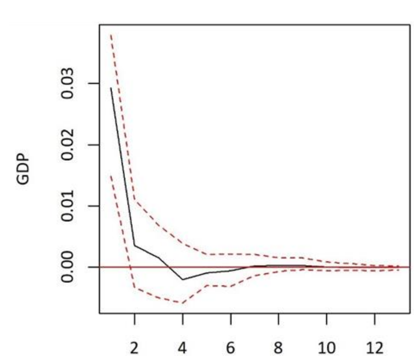
From Figure 7.1 Panel A, we can see that response of the Argentinian GDP to a one standard deviation supply shock is positive, but this effect dies out after only two quarters. The GDP deflator response to a one standard deviation supply shock, on the other hand, is not statistically significant at any point in time (Panel C). In terms of responses to a one standard deviation demand shock, GDP is not statistically significant affected by the impulse (Panel E). Finally, GDP deflator has a significant response to a one standard deviation demand shock in the first two quarters, rising on impact and slowly returning to zero (Panel G).

The results are quite similar for the Brazilian economy. Figure 7.1 Panel B shows that the response of the Brazilian GDP to a one standard deviation supply shock is positive on impact. GDP rises and progressively returns to the steady state in the following two quarters after the shock. The positive response is statistically significant. Once again, one standard deviation supply shock does not generate a statistically significant response on GDP deflator (Panel D), neither does a one standard deviation demand shock on GDP (Panel F). In Panel H, we see that GDP deflator is positively affected on impact and the impacts of the shock die out after two quarters.

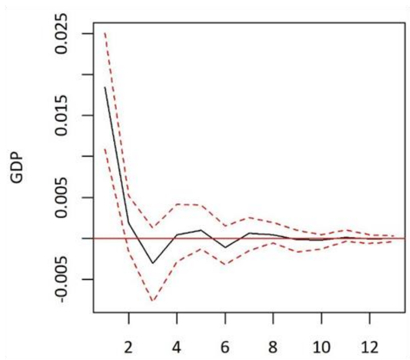
[8] The 95% confidence intervals of the IRFs were computed through a bootstrapping technique performed with 100 runs.

Figure 7.1. Impulse Response Functions

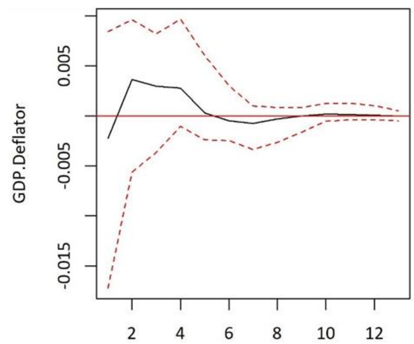
Panel A – Argentina One S.D. Supply Shock to GDP



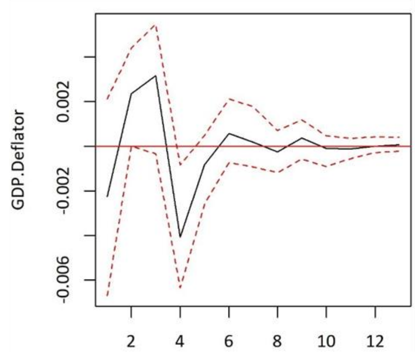
Panel B – Brazil One S.D. Supply Shock to GDP



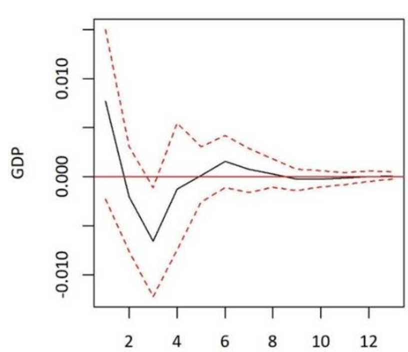
Panel C – Argentina One S.D. Supply Shock to GDP Deflator



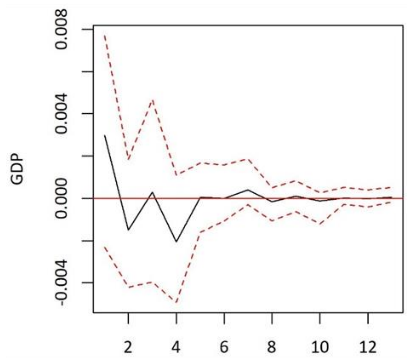
Panel D – Brazil One S.D. Supply Shock to GDP Deflator



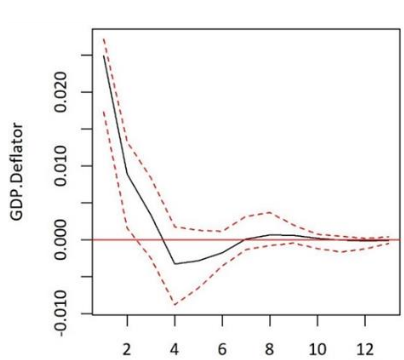
Panel E – Argentina One S.D. Demand Shock to GDP



Panel F – Brazil One S.D. Demand Shock to GDP



Panel G – Argentina One S.D. Demand Shock to GDP Deflator



Panel H – Brazil One S.D. Demand Shock to GDP Deflator

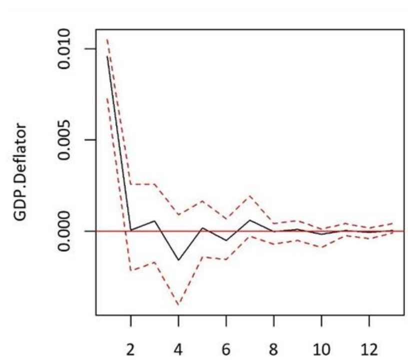
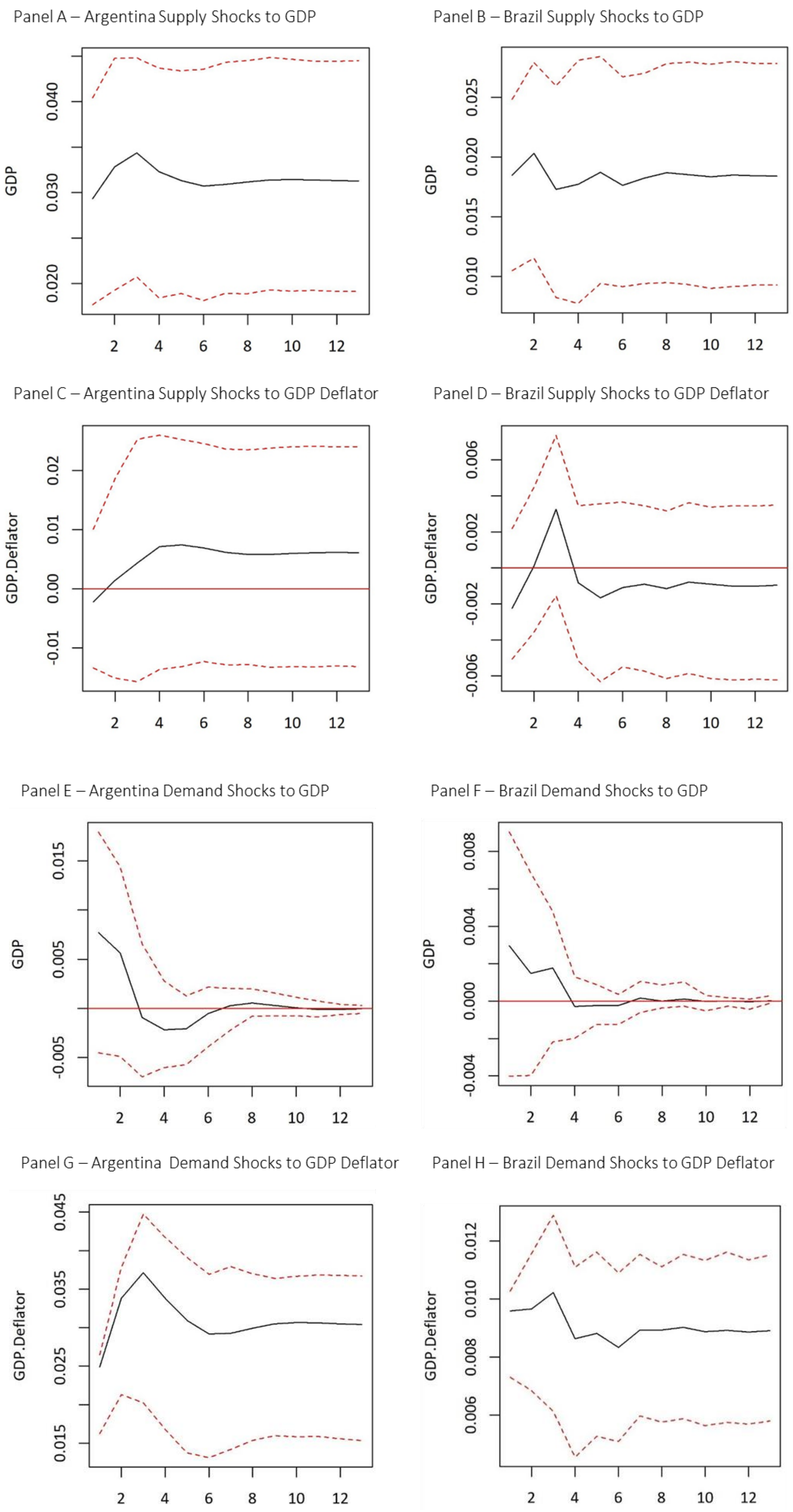


Figure 7.2. Cumulative Structural Impulse Response Functions



Apart from classical IRF, another important result from the SVAR is the Cumulative Structural Impulse Response Function (CSIRF). As described by the name, the CSIRFs reveal the cumulative impact of a shock over time, rather than showing the isolated impact of a one SD over time. This provides insight into the long-run consequences of the shock on the variables. Figure 7.2 presents the CSIRF for Brazil and Argentina.

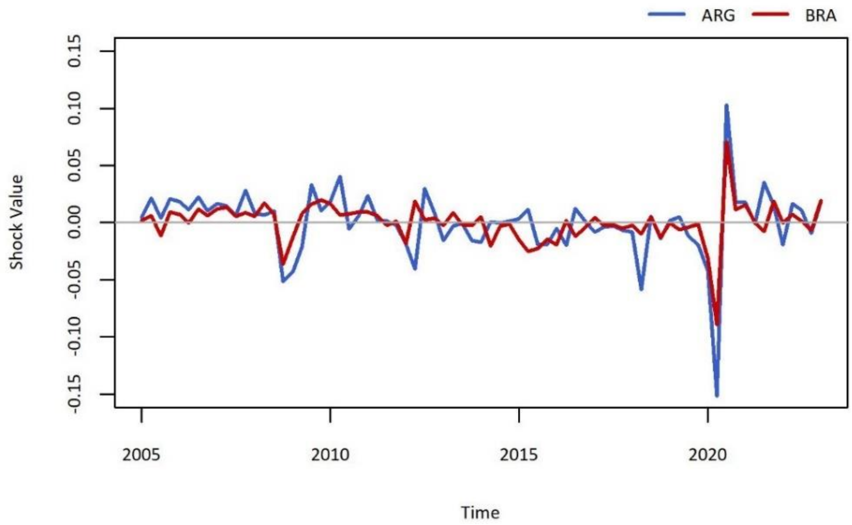
Once again, the only Cumulative Structural Impulse-Response Functions statistically significant are those of supply shocks on GDP and of demand shocks on GDP deflator. The pattern created by the accumulated shocks over the variables are in accordance with the AS-AD diagram detailed in Section 4.2.2. According to the theory, supply shocks have a permanent effect on GDP while a positive demand shock should drive prices up permanently. In Argentina, supply shocks are associated with positive change in GDP on impact. The GDP peaks after three quarters and after that the variable progressively levels off though remaining above zero (Panel A). The GDP Deflator response to a demand shock follows the same hump shape observed for supply shocks on GDP, it peaks after three quarters and the remains positive through the next twelve quarters (Panel G).

The CSIRFs for the Brazilian economy presents the same patterns as the Argentinian economy, although the magnitude of the effects is even smaller here. Shocks under analysis have a very conservative effect long-run effect on the variables and only GDP responses to supply shocks (Panel B) and GDP deflator responses to demand shocks have statistically significant results (Panel H). Those are also in line with the AS-AD diagram. In a study applying the same workhorse, Gonzalez-Rozada and Fanelli (2004) found that the BQ decomposition was not capable of meeting the over-identifying assumptions for the Mercosur countries. According to the authors, there might be some “unobserved” factors in more volatile economies that weaken the ability of the BQ decomposition to properly identify shocks.

The empirical methodology employed in this study allows for the recovery of demand and supply shocks from the residuals of the estimated VAR model. Demand shocks are represented by the residuals from the GDP deflator estimation, while supply shocks are captured by the residuals from the VAR estimation of GDP coefficients. Figure 7.3 visually presents these disturbances categorized by type for both Argentina and Brazil. Furthermore Table 7.2 provides insight into the correlation between pairs of shocks and their respective magnitudes.

Figure 7.3. VAR Residuals –Supply and Demand Shocks

Panel A – Supply Shocks



Panel B – Demand Shocks

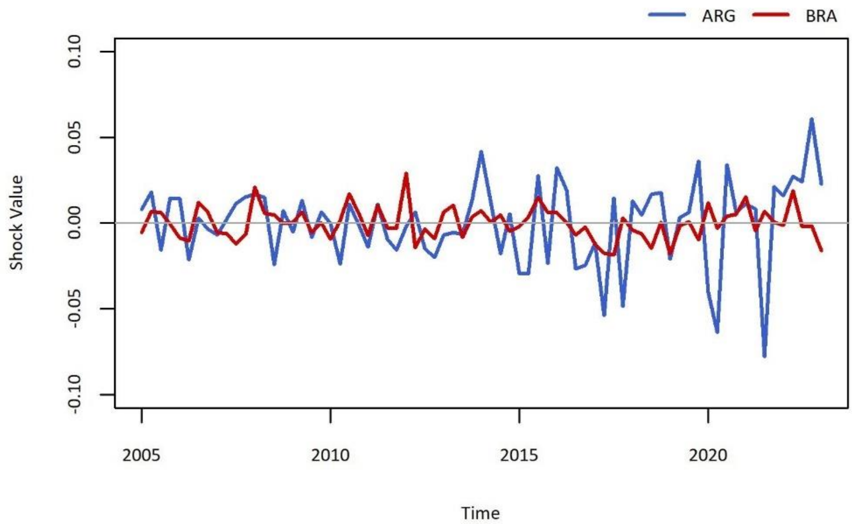


Figure 7.3 effectively portrays the impact of disturbances in the South American countries under analysis over the past two decades. Supply shocks have consistently followed a remarkably similar pattern throughout this period. This observation is supported by the statistics in Table 7.2, which indicate a strong correlation of 0,79 between supply shocks. To put into perspective, Fidrmuc and Korhonen (2003) did not find this level of correlation between any single EU country and the Euro area. In terms of size of shocks, Argentina's tend to be more pronounced than Brazilian, which indicates that countries might find it costly to maintain a fixed exchange rate. While this study does not distinguish between idiosyncratic, regional, and international shocks, it is possible to offer explanations for the occurrences of supply shocks and

identify factors contributing to specific periods of asymmetry. Panel A shows that one prominent supply shock is the 2008 global financial crisis, which had a discernibly negative impact on both economies. The magnitude of this shock was slightly higher in Argentina, and its effects persisted for a more extended period. In the subsequent years, Argentina experienced some sporadic positive supply shocks, potentially linked to an upsurge in Foreign Direct Investment (CEPAL, 2011) and the discovery of a significant natural gas deposit. Moreover, the post-global financial crisis period saw a weather-related supply disruption caused by drought and wildfires in Russia, Ukraine, and Kazakhstan, followed by floods in Asia (IMF, 2012). These events led to a surge in commodity prices, especially for grains, fostering momentary economic growth due to both countries' heavy reliance on agriculture-based exports.

Table 7.2. Statistics of Demand and Supply Shocks

Statistic	**Supply Shock**	**Demand Shock**
Std. Deviation		
Argentina	0,029	0,024
Brazil	0,018	0,01
Correlation	0,79	0,10

Note: all variables are measured in first difference log, so 0,029 indicates a SD of approximately 2,9%.

Continuing the analysis of asymmetries in supply shocks, the events experienced by the countries between 2009 and the Covid-19 pandemic, appear to be primarily driven by institutional and expectation breaks. In Argentina, from 2009 to 2012, the economy was marked by expansionary fiscal and monetary policy regime, which ended with rising inflation and the adoption of severe fiscal austerity policies in 2012, including currency controls and the nationalization of the leading oil company YPF, which prompted a deep negative shock in 2011-2012 (CEPAL, 2014). Moreover, the negative supply shock impacting Argentina in 2014 is another point of asymmetry. This shock can be explained by the default on its international debt originated in a battle against holdout creditors (Thomas and Cachanosky, 2016). In contrast, Brazil grappled with a negative supply disturbance between 2015 and 2016. This period was marked by the impeachment of the Brazilian president due to fiscal instability, political turmoil, and social unrest. Additionally, in 2018, Argentina faced another crisis due to a historical drought that led to reduced exports earnings and tax collection (Castillo-Ponce and Lai, 2020). Furthermore, the country's heavy reliance on short-term foreign borrowing, coupled with shifts in global financial markets, including U.S. interest rate hikes in 2018, further exacerbated Argentina's vulnerabilities, leading to a new debt default in 2020. Besides the specific critical scenario in Argentina, the supply shocks posed by the Covid-19 crisis was synchronized and symmetric, although the impacts in Argentina had a higher amplitude.

Analysing demand shocks, Panel B reveals a distinct pattern of demand shocks across countries, marked by clear asymmetries that persists to the present day and have grown more pronounced over the years. Notably, disturbances in Argentina have become more volatile, especially after 2014, whilst the Brazilian economy has experienced comparably mild demand disturbances, apart from the 2015 recession that had long-lasting effects on the economy.

Between 2011 and 2012, the Brazilian government implemented an interventionist program known as the "New Economic Matrix." This program included a series of measures aimed at expanding state intervention in the economy, increasing government spending, devaluing the currency, and lowering interest rates. As pointed by Barbosa Filho (2017), these policies encompassed the expansion of the BNDES (Brazilian Development Bank) balance sheet to promote "national champions" and strategic sectors, including automotive and naval industries, along with heightened protectionism and subsidies. Furthermore, government investments in the national oil company reached 10% of the total country's investments with a focus on pre-salt exploration and price controls in the oil and energy sector were introduced. The intention of these policies was to enhance the country's productivity and, consequently, its potential output. However, the sequence of fiscal and monetary policies, combined with failed “national champions” and external factors such as falling commodity prices, resulted in mounting fiscal deficit and creeping inflation, ultimately resulting in the 2015-2016 recession (Vartanian and Garbe, 2019). Panel B illustrates a prolonged demand disturbance during this period, characterized by significant declines in consumption and investment, with investment decreasing by 13,9% in 2015 and 10,6% in 2016, and consumption dropping by 3,9% and 4,5%, respectively (Barbosa Filho, 2017).

In contrast to the Brazilian economy, which has largely succeeded in controlling inflation since the introduction of the Plano Real in 1995, Argentina's persistent volatility, as illustrated in Panel B, has historical roots, making it challenging to identify specific reasons for demand disturbances, as they seem to be rooted in structural and ongoing mechanisms. Nevertheless, this study provides a broad overview of the drivers of volatility in the country.

The once rich and flourishing Argentina economy has been dealing with skyrocketing deficit and inflation for decades. The country has long been ruled by political forces that goes back to President Perón, a populist figure who has implemented an extensive welfare system in the country combined if intensive economic protectionism and strong state intervention. Despite some policy changes over the years, Argentina’s economy is still heavily influenced by the state (CFR, 2023). One of the country’s policy to improve welfare is the system of federal subsidies to public services, including electricity, gas, water and transport. The energy and gas subsidies, for example, accounted for 1,4% of GDP in 2019, having reached as high as 3,5% in 2014 (Giuliano et al., 2020). These subsidies have led to economic distortions, causing imbalances between supply and demand, as evidenced by a study indicating that electricity bills in Argentina reflected less than 10% of production costs in 2015 (Bidegaray, 2015).

The government's revenues have not been sufficient to fund the extensive spending, driving the country into a deficit spiral, with the government budget deficit reaching 6% of the country's GDP by 2017 (INDEC, 2023). To sustain expenditure, the government has heavily relied on both monetary and external financing. These instruments, however, have imposed significant costs: seigniorage has contributed to heightened inflation, whereas financing the budget through borrowing has left the country susceptible to changes in the cost and availability of financing. Argentina currently holds the title of the IMF's largest debtor (IMF, 2023), with a substantial portion of its international sovereign debt denominated in dollars, linking the debt's sustainability directly to the value of the Argentine peso. Nevertheless, the prevailing uncertainty and negative economic expectations have prompted investment flight and further devaluation of the peso, rendering inflation harder to control and increasing the real value of the debt.

In the current inflationary environment, with real wages continuously decreasing, individuals have implemented strategies to cope with rising living costs. One such strategy is to hoard reserves in dollars outside the local financial system, which undermines the economy and constrains the effectiveness of monetary policy. Moreover, as a means to protect financial assets from inflation, many individuals purchase goods and services instead of saving, a practice that can further contribute to the inflationary trend. Therefore, the Argentine economy has long been susceptible to vulnerabilities, where various internal or external events can trigger significant disturbances.

In summary, this study reveals that whereas supply shocks exhibit higher correlation and similarity between Argentina and Brazil, demand shocks display greater dissimilarity. Consequently, the cost of stabilization required to adjust the economy in response to demand shocks would likely be higher within a common currency framework, especially for Brazil. The increased volatility and frequency of disturbances in Argentina in recent years further accentuates the challenge. The establishment of a monetary union would necessitate Brazil to adopt a more hawkish monetary policy, including higher interest rates, to induce a contraction in Argentina and curb their rising inflation.

While our study points that the large dissimilarity between temporary shocks is the nail on the coffin of any possibility of common currency between the countries, it's worth noting that within established currency areas, asymmetries between supply shocks tend to more problematic, often necessitating more painful adjustments (Bayoumi and Eichengreen, 1992). The reason is that if demand shocks primarily originate domestically, a monetary union should lead to some extent to more convergent shocks as monetary policy becomes one (Fidrmuc and Korhonen, 2003). Brazil and Argentina, sharing similarities in economic structure and experiencing a high correlation of supply shocks, could potentially consider relinquishing monetary sovereignty without incurring substantial welfare losses. However, it's essential to acknowledge the persistence of temporary shocks at the present and the restriction it imposes in talking about unifying the currencies.

8 Conclusion

In conclusion, this study has analysed the scenario of a potential monetary integration between Argentina and Brazil in terms of the Optimum Currency Area. More specially, we analysed if business cycles and shocks presents a similar pattern between countries. For this end we have decomposed GDP series using HP Filter to study cycles and implemented a Structural Vector Autoregressive Model to identify the supply and demand shocks permeating the economies.

The results on business cycles analysis show a striking convergence in the long-term trends of GDP between these two nations, implying a degree of economic integration. This convergence is supported by a substantial correlation coefficient, indicative of their propensity to move together in the long run. These findings are in line with empirical evidence and historical data that suggest a common economic trajectory within Mercosur. Moreover, a closer examination of business cycles underscores both similarities and differences between Argentina and Brazil. While the quarterly growth rates exhibit general similarity, Argentina displays a higher degree of volatility in its GDP, raising concerns about its persistent economic instability, although a notable degree of synchronization in business cycles is observed, indicating a potential for closer economic cooperation.

On the other hand, the analysis of supply and demand shocks reveals distinct patterns. Supply shocks are remarkably correlated between the two countries, potentially due to internal factors, as the similar domestic production structures. In contrast, demand shocks have become less correlated over, especially after 2014, reflecting differences in domestic economic policies and challenges.

The study suggests that while there might have been potential for a common currency in the past, the window of opportunity for deeper integration seems be closed for now. The persistent differences in temporary shocks pose significant obstacles and costly adjustment policies. As monetary policy is useful for facilitating adjustment to disturbances, the notably different size and asymmetry between demand shocks would result in Brazil facing stricter monetary adjustment, given the inflationary scenario in Argentina. Despite countries not satisfying the shock symmetry for forming an union currency, the OCA theory suggests that countries can compensate for dissimilar shocks through mechanisms like factor mobility. Future research could explore the capacity of Argentina and Brazil to offset divergent demand disturbances through these mechanisms.

In essence, while the concept of a common currency within Mercosur holds promise for regional economic integration, this study highlights the necessity of addressing fundamental economic differences between Argentina and Brazil first. These include the restructuring of the Argentinian economy, particularly addressing its international debt, hyperinflation and fiscal imbalance, and the maintenance of stability in Brazil.

9 References

Aiolfi, M., Catão, L., & Timmermann, A. (2011). Common Factors in Latin America's Business Cycles. *Journal of Development Economics, 95*(2), 212-228. doi:10.1016/j.jdeveco.2010.04.003

Ayres, M. (2023, 1 23). Explainer: What Brazil and Argentina's 'currency union' really means. (Reuters, Ed.) Retrieved from https://www.reuters.com/world/americas/what-brazil-argentinas-currency-union-really-means-2023-01-23/

Barbosa Filho, F. (2017). A Crise Econômica de 2014/2017. *31*, 51-60. doi:10.1590/s0103-40142017.31890006

Barbosa-Filho, N. (2008). Inflation targeting in Brazil: 1999-2006. *International Review of Applied Economics, 22*(2), pp. 187-200. doi:10.1080/02692170701880684

Basnet, H., & Pradhan, G. (2017). Regional Economic Integration in Mercosur: The Role of Real and Financial Sectors. *Review of Development Finance, 7*(2), 107-119. doi:10.1016/j.rdf.2017.05.001

Bayoumi, T., & Eichengreen, B. (1992). Shocking Aspects of European Monetary Unification. *NBER Working Papers, 3949*. doi:10.3386/w3949

Belke, A., Domnick, C., & Gros, D. (2017). Business Cycle Desynchronisation: Amplitude and Beta vs. Co-movement. *Intereconomics, 52*(4), pp. 238-241.

Bidegaray, M. (2015). Subsidios eléctricos: habrá dos tipos de tarifas sociales. *Clarín*. Retrieved from https://www.clarin.com/economia/Subsidios-electricos-tipos-tarifas-sociales_0_ry_2qA_wmg.html

Bjørnland, H. (2006). PhD Course, Topics in Advanced Macroeconometrics I, Structural VAR Models. Retrieved from http://home.bi.no/a0310125/teaching/PhD_SVAR_Details.html

Blanchard, O., & Quah, D. (1988). The Dynamic Effects of Aggregate Demand and Supply Disturbances. *NBER Working Papers, 2737*. doi:10.3386/w2737

Blonigen, B., Piger, J., & Sly, N. (2014). Comovement in GDP Trends and Cycles Among Trading Partners. *Journal of International Economics, 94*(2), 239-247. doi:10.1016/j.jinteco.2014.06.008

Camarero, M., Flôres, R., & Tamarit, C. (2006). Monetary Union and Productivity Differences in Mercosur Countries. *Journal of Policy Modeling, 28*(1), 53-66. doi:10.1016/j.jpolmod.2005.07.005

Carrasco-Gutierrez, C. E., & Reis Gomes, F. (2007). Evidence on Common Feature and Business Cycle Synchronization in Mercosur. *MPRA Paper, 66064*.

CEPAL. (2011). *Argetina Report.* Economic Survey of Latin America and the Caribbean. Retrieved from https://repositorio.cepal.org/server/api/core/bitstreams/08f3003b-7dd2-4381-baba-0741635eb4a0/content

CEPAL. (2014). *Argetina Report.* Economic Survey of Latin America and the Caribbean. Retrieved from https://repositorio.cepal.org/server/api/core/bitstreams/1a909f46-4bc4-4e31-9e33-1a9249c5452a/content

Cerro, A. M., & Pineda, J. (2002). Latin American Growth Cycles. Empirical Evidence: 1960 - 2000. *Estudios de Economia, 29*(1), pp. 89-108.

CFR. (2022, 2 7). Argentina: A South American Power Struggles for Stability. Retrieved from https://www.cfr.org/backgrounder/argentina-south-american-power-struggles-stability

CFR. (2023, 5 9). Mercosur: South America’s Fractious Trade Bloc. Retrieved from https://www.cfr.org/backgrounder/mercosur-south-americas-fractious-trade-bloc

Cotis, J.-P., & Coppel, J. (2005). Business Cycle Dynamics in OECD Countries: Evidence, Causes and Policy Implications. *The Changing Nature of Business Cycles Reserves Bank of Australia Economic Conference.* Sydney, Australia.

Eichengreen, B. (1998). Does MERCOSUR need a single currency? *NBER Working Papers, 6821*.

Engle, R., & Issler, J. (1993). Common Trends and Common Cycles in Latin America. *Revista Brasileira de Economia, 47*(2).

Fidrmuc, J., & Korhonen, I. (2003). Similarity of Supply and Demand Shocks Between the Euro Area and the CEECs. *Economic Systems, 27*(3), 313-334. doi:10.1016/j.ecosys.2003.05.002

Forbes, K. (2012). The "BIG C": Identifying Contagion. *NBER Working Papers, 18465*.

Frankel, J. A. (1999). No Single Currency Regime is Right for All Countries or At All Times. *NBER Working Papers, 7338*. doi:10.3386/w7338

Frankel, J. A., & Rose, A. K. (1998). The Endogeneity of the Optimum Currency Area Criteria. *The Economic Journal, 108*(449), pp. 1009-1025. doi:10.3386/w5700

Giambiagi, F. (1998). Moeda Única do Mercosul: Notas para o Debate. *Revista Brasileira de Política Internacional, 1*. doi:https://doi.org/10.1590/S0034-73291998000100002

Giuliano, F., Lugo, M., Masut, A., & Puig, J. (2020). Distributional effects of reducing energy subsidies: Evidence from recent policy reform in Argentina. *Energy Economics, 92*. doi:10.1016/j.eneco.2020.104980

Gonzalez-Rozada, M., & Fanelli, J. (2004). Business Cycles and Macroeconomic Policy Coordination in Mercosur. *Econometric Society 2004 Latin American Meetings.*

Goodhart, C. A. (1998). The Two Concepts of Money: Implications for the Analysis of Optimal Currency Areas. *European Journal of Political Economy, 14*(3), pp. 407-432. doi:https://doi.org/10.1016/S0176-2680(98)00015-9

Hallwood, P., Scheibe, J., & Marsh, I. (2006). An Assessment of the Case for Monetary Union or Official Dollarization in Five Latin American Countries. *Emerging Markets Review, 7*(1), 52-66. doi:10.1016/j.ememar.2005.12.001

Harris, B., Elliott, L., & Stott, M. (2023, 1 27). Brazil and Argentina's joint currency plan raises economic concerns. Retrieved from https://www.ft.com/content/59cc26b3-d9fa-48f1-bdd5-fd4c83bc13ee

Helbling, T. (2012). Commodities in Boom: The global economic crisis hurt commodity prices far less than in earlier recessions. The long-run outlook is murkier. *49*(2). doi:10.5089/9781451922202.022

Hodrick, R., & Prescott, E. (1997). Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking, 29*(1), 1-16.

IMF. (2003). *The Role of the IMF in Argetina, 1991-2002.* Issues Paper/Terms of Reference for an Evaluation by the IEO. doi:10.5089/9781451922202.022

IMF. (2023, 10). *Total IMF Credit Outstanding.* Retrieved from https://www.imf.org/external/np/fin/tad/balmov2.aspx?type=TOTAL

INDEC. (2023). *Consultas del Comercio Exterior de Bienes.* Retrieved from https://comex.indec.gov.ar/#/

Jacobo, A., & Marengo, A. (2020). New Evidence of Common Features and Business Cycles Synchronization Between Argentina and Brazil. *Documentos De Trabajo De Investigación De La Facultad De Ciencias Económicas (DTI-FCE)*, pp. 1-32.

Kenen, P. B. (1969). The Theory of Optimum Currency Areas: An Eclectic View. (R. A. Mundell, & A. Swoboda, Eds.) *Monetary Problems of the International Economy*, pp. 41-60.

Klein, P., & Moore, G. (1985). Monitoring International Trade Flows with Leading Indicators. In NBER, *Monitoring Growth Cycles in Market-Oriented Countries: Developing and Using International Economic Indicators* (pp. 305-331).

Kouparitsas, M. (2002). Understanding U.S. Regional Cyclical Comovement : How Important Are Spillovers and Common Shocks? *Economic Perspectives (Federal Reserve Bank of Chicago), 26*(4).

Kydland, F., & Prescott, E. (1982). Time to Build and Aggregate Fluctuations. *Econometrica, 50*(6), 1345-1370. doi:10.2307/1913386

Lucas, R. J. (1972). Expectations and the Neutrality of Money. *Journal of Economic Theory, 4*(2), pp. 103-124. doi:10.1016/0022-0531(72)90142-1

McKinnon, R. I. (1963). Optimum Currency Areas. *The American Economic Review, 53*(4), pp. 717-725.

MDIC. (2023). *Balança Comercial e Estatísticas de Comércio Exterior.* Retrieved from https://www.gov.br/mdic/pt-br/assuntos/comercio-exterior/estatisticas

Mintz, I. (1974). Dating United States Growth Cycles. In NBER, *Exploration in Economic Research* (1 ed., Vol. 1).

Mitchell, W., & Burns, A. (1935). The National Bureau's Measures of Cyclical Behavior. In NBER.

Mongelli, F. (2022). New Views on the Optimum Currency Area : What is the EMU Telling Us? *ECB Working Paper, 138*. doi:10.2139/ssrn.357400

Mundell, R. A. (1961). A Theory of Optimum Currency Areas. *The American Economic Review, 51*(4), pp. 657-665.

Nelson, C., & Plosser, C. (1982). Trends and Random Walks in Macroeconmic Time eries: Some Evidence and Implications. *Journal of Monetary Economics, 10*(2), 139-162. doi:10.1016/0304-3932(82)90012-5

Neves, J. A., Stocco, L., & Sergio, D. (2007). Is Mercosur an Optimum Currency Area? *MPRA Paper*(2758).

Padilla, L., & García-Brazales, Á. (2021). Can South America form an optimal monetary area? A structural vector autoregression analysis. *International Economics and Economic Policy, 18*(2), 309-329. doi:10.1007/s10368-020-00490-2

Perrotti, D. E. (2021). Growth Cycles in Argentina: The Recent Behavior. *Revista Económica La Plata, 67*, pp. 107-143.

Rose, A. K. (1999). One Money, One Market: Estimating the Effect of Common Currency on Trade. *NBER Working Papers, 7432*.

Steinberg, F., & Otero-Iglesias, M. (2023, 2 14). South America’s ‘Common Currency’ Is Actually about De-dollarization. (CSIS, Ed.) Retrieved from https://www.csis.org/analysis/south-americas-common-currency-actually-about-de-dollarization

Thomas, C., & Cachanosky, N. (2016). Argentina's Post-2001 Economy and the 2014 Default. *The Quarterly Review of Economics and Finance, 60*, 70-80. doi:10.1016/j.qref.2015.08.002

Vartanian, P., & Garbe, H. (2019). The Brazilian Economic Crisis during the Period 2014-2016: Is There Precedence of Internal or External Factors? *Journal of International and Global Economic Studies, 12*, pp. 66-86.

World Bank. (2022). *World Development Indicators.* Retrieved from https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.MKTP.CD&country

Zarnowitz, V., & Ozyildirim, A. (2006). Time Series Decomposition and Measurement of Business Cycles, Trends and Growth Cycles. *Journal of Monetary Economics, 53*(7), pp. 1717-1739. doi:10.1016/j.jmoneco.2005.03.015

Zivot, E. (2021). Introduction to Computational Finance and Financial Econometrics with R. Chapman and Hall/CRC.

Zivot, E., & Wang , J. (2003). Rolling Analysis of Time Series. In *Modeling Financial Time Series with S-Plus®* (pp. 299–346).

Appendix

Appendix Table 1 – Augmented Dickey-Fuller Unit Root Tests for I(0) Series

Country	Variable	Series with	ADF (tau)	Sig. Level	Indication
ARG	GDP	Trend and Drift	-2,91	-	NS
		Drift	-3,20	**	S w/ D
		None	1,44	-	NS
BRA		Trend and Drift	-1,93	-	NS
		Drift	-2,06	-	NS
		None	2,20	-	NS
ARG	GDP Deflator	Trend and Drift	1,35	-	NS
		Drift	5,46	-	NS
		None	5,28	-	NS
BRA		Trend and Drift	-1,74	-	NS
		Drift	-0,69	-	NS
		None	7,18	-	NS

Note: ***, **, * indicates 1%, 5% and 10% statistically significance levels.

Appendix Table 2 – Augmented Dickey-Fuller Unit Root Tests for I(1) Series

Country	Variable	Series with	ADF (tau)	Sig. Level	Indication
ARG	GDP	Trend and Drift	-5,93	***	S*
		Drift	-5,77	***	S w/ D
		None	-5,60	***	S
BRA		Trend and Drift	-6,90	***	S*
		Drift	-6,73	***	S w/ D
		None	-6,07	***	S
ARG	GDP Deflator	Trend and Drift	-4,68	***	S*
		Drift	-2,35	-	NS
		None	-0,22	-	NS
BRA		Trend and Drift	-6,90	***	S*
		Drift	-6,73	***	S w/ D
		None	-6,07	***	S

Note: ***, **, * indicates 1%, 5% and 10% statistically significance levels.

Appendix Table 3 – Critical Values for ADF Unit Root Tests at Significance Level

	Critical Values		
Level	1%	5%	10%
Trend and Drift	-4,04	-3,45	-3,15
Drift	-3,51	-2,89	-2,58
None	-2,6	-1,95	-1,61

Appendix Table 4 – Lag Length Selection Criteria

	Argentina			
Lag	AIC	HQ	SC	FPE
1	-1,415e+01*	-1,407e+01*	-1,395e+01*	7,090e-07*
2	-1,407 e+01	-1,394e+01	-1,374e+01	7,689e-07
3	-1,398 e+01	-1,379e+01	-1,351e+01	8,469e-07
4	-1,387 e+01	-1,363e+01	-1,326e+01	9,452e-07

	Brazil			
Lag	AIC	HQ	SC	FPE
1	-1,677e+01	-1,669e+01*	-1,657e+01*	5,195e-08
2	-1,674 e+01	-1,661e+01	-1,641e+01	5,322e-08
3	-1,682 e+01*	-1,664e+01	-1,635e+01	4,933e-08*
4	-1,672 e+01	-1,648e+01	-1,611e+01	5,465e-08

Note: * Indicates lag order selected by the criterion.

AIC: Akaike information criterion

HQ: Hannan–Quinn information criterion

SC: Schwarz information criterion

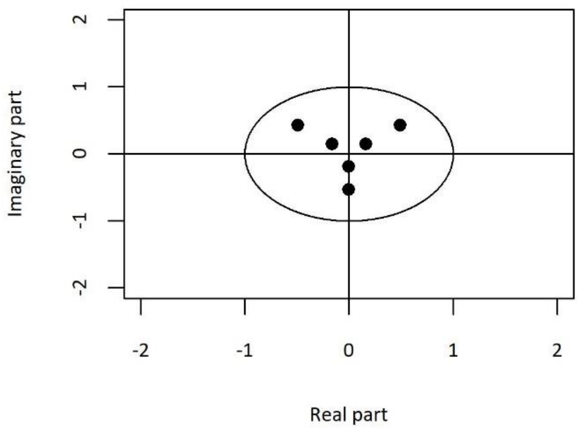
FPE: Final Prediction Error criterion

Appendix Table 5 – Portmanteau Test for Serially Correlated Errors in a VAR(3)

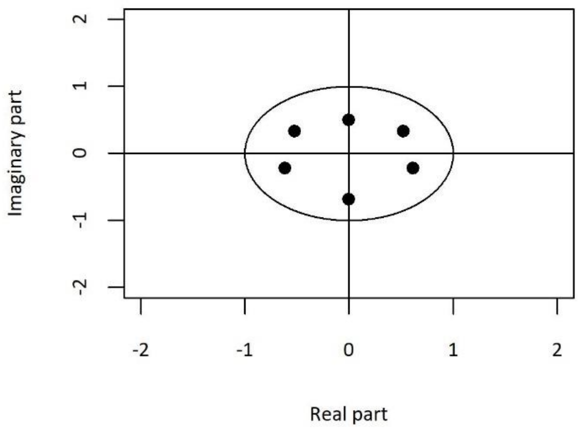
	Portmanteau Test (Asymptotic)		
Country	Chi-squared	df	p-value
Argentina	-1,415e+01*	-1,407e+01*	-1,395e+01*
Brazil	-1,387 e+01	-1,363e+01	-1,326e+01

Appendix Figure 1 – Unit Circles for a VAR(3)

Panel A – Argentina



Panel B – Brazil



Appendix Table 6 – Vector Autoregression Estimates

Endogenous variables: GDP, GDP Deflator

Deterministic variables: Constant

Sample size: 73

Log Likelihood: 325,715

	Argentina	
Variable	GDP	GDP Deflator
GDP(-1)	0,11 (0,125) (0,889)	0,147 (0,103) (1,437)
GDP(-2)	0,036 (0,123) (0,294)	0,046 (0,101) (0,456)
GDP(-3)	-0,03 (0,123) (-0,278)	0,036 (0,101) (0,358)
Deflator(-1)	-0,12 (0,149) (-0,782)	0,311 (0,123) (2,525)*
Deflator(-2)	-0,22 (0,156) (-1,437)	0,020 (0,129) (0,158)
Deflator(-3)	0,09 (0,145) (0,601)	-0,15 (0,120) (-1,255)
Constant	0,004 (0,004) (1,108)	-0,001 (0,003) (-0,432)
Multiple R^2	0,074	0,185
Adjusted R^2	-0,01	0,11
F-statistic	0,874	2,495

Note: Standard errors and t-test in parentheses.

Signif. codes: 0 ‘***’ 0,001 ‘**’ 0,01 ‘*’ 0,05 ‘.’

Endogenous variables: GDP, GDP Deflator

Deterministic variables: Constant

Sample size: 73

Log Likelihood: 428,143

	Brazil	
Variable	GDP	GDP Deflator
GDP(-1)	0,079 (0,122) (0,644)	0,124 (0,064) (0,06).
GDP(-2)	-0,139 (0,125) (-1,108)	0,166 (0,066) (0,015)*
GDP(-3)	0,041 (0,129) (0,319)	-0,224 (0,068) (0,358)
Deflator(-1)	-0,180 (0,220) (-0,817)	-0,031 (0,116) (-0,268)
Deflator(-2)	0,087 (0,214) (0,408)	0,027 (0,113) (0,236)
Deflator(-3)	-0,241 (0,207) (-1,167)	-0,07 (0,109) (-3,294)**
Constant	0,011 (0,007) (1,506)	-0,018 (0,003) (4,77)***
Multiple R^2	0,074	0,275
Adjusted R^2	-0,01	0,209
F-statistic	0,874	4,161

Note: Standard errors and t-test in parentheses.

Signif. codes: 0 ‘***’ 0,001 ‘**’ 0,01 ‘*’ 0,05