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The Brazilian Economy in the Recent Decades: an Analysis Using Synthetic Control

Luciano Ferreira Gabriel[1]

[1] Department of Economics, Federal University of Juiz de Fora, Juiz de Fora, Brazil

Correspondence: Luciano Ferreira Gabriel, Department of Economics, Federal University of Juiz de Fora, Juiz de Fora, Brazil. E-mail: luciano.gabriel@ufjf.br

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Abstract

Applying the synthetic control method, this article analyzes the cyclical reversal of the Brazilian economy after 2010 and the 2015-2016 recession considering thirty-five macroeconomic, institutional, and sectoral variables. In general terms, it was observed that the inconsistency of fiscal and monetary policies, the low level of productivity (sectorial and aggregate), the internal rate of return on capital, investment rate, the declining economic complexity (which also affect technical progress and the productive specialization), as well as the low quality of institutions, explain, to a large extent, the lower economic growth performance in the period when compared to other emerging economies.

Keywords: Brazilian Economy, economic growth; synthetic control

JEL: E3, E6, O11

1. Introduction

At the beginning of the 21st century, the economy of both Brazil and developing countries grew steadily. The projected terms of trade and the less rigid monetary policy in the USA meant that from 2002 onwards, the growth in such countries was stimulated. In the case of Brazil specifically, it was even more intensely favorable after 2003, with the increase in international commodity prices.

With the economic slowdown from 2011 onwards, the end of the commodities super cycle (Reinhart, Reinhart and Trebesch, 2016) and the beginning of Dilma ś government, the implementation of the so-called "New Economic Matrix" (NEM) began, with greater flexibility of the "macroeconomic tripod". In this context, fiscal and monetary policies gained new dimensios with a large set of stimuli and (dis)coordination.

The main objective of this article is to analyze the cyclical reversal of the Brazilian economy after 2010 and the 2015-2016 recession, considering thirty-five macroeconomic, sectoral, and institutional variables applying the synthetic control method. The intervention period for the application of this method is 2011, considered, as will be discussed, an important turning point regarding fiscal and monetary policies.

The empirical exercises using synthetic control emphasized the variables that directly or indirectly affected economic growth, according to data availability. It is a very efficient method for non-experimental data as it identifies the best possible groups of countries (and weights) for comparison in each dimension evaluated. Thus, the comparability problem is reduced by choosing a weighting of countries that are most similar to Brazil before 2011 in a statistical sense.

To fulfill the objective of this research, the article is divided into 5 sections in addition to this introduction. Section 2 analyzes Brazil from a global perspective. In section 3, an analysis of the main elements (and stimuli) of fiscal policy on the economy and the aggregate results is carried out. Section 4 presents an analysis of monetary policy and its aggregate results, mainly in terms of inflation. In both sections 3 and 4 the main goal is to present the type of lack of alignment of both policies. In section 5, empirical exercises using synthetic control, the main contribution of the article, are presented. In section 6, final considerations are made.

2. Comparative Analysis among Countries: A Brief Global Perspective

The fundamental issue concerning the period between 2003-2016 is that when broken down according to the Brazilian political cycle, Brazil's growth has almost systematically been below the world in general, and Latin America (LA) in

particular. According to the data in Table 1, in the 2003-2010 sub-period Brazil had a growth phase with relative macroeconomic stability, reaching 4.08% p.a. of GDP growth and 2.99% p.a. growth in *per capita* income, on average (see Table 2). A major reversal occurred in the 2011-2016 sub-period, when the average GDP growth rate was 0.43% p.a., with a negative growth rate of 0.44% p.a. of *per capita* income.

For the years 2011-2020, Brazil's average growth was worse than that seen in the so-called "lost decade" (1981-1990). While in the first period the average GDP growth was 0.30% p.a., with (de)growth in *per capita* income at -0.52% p.a., in the second, the averages were 1.67% p.a. and -0.43% p.a., respectively.[1]

Table 1. Average GDP growth rates in real terms between 1995-2020

Region	95-98	99-02	03-06	07-10	03-10	11-14	15-16	17-18	01-10	11-16	11-20
World	3.35	3.10	4.00	2.41	3.21	2.98	2.94	3.34	3.00	2.97	2.39
Latin America and the Caribbean (LA)	3.81	2.09	4.46	2.23	3.34	2.60	2.13	1.87	2.94	2.44	1.09
Latin America and the Caribbean (ex. Brazil)	3.85	2.09	4.49	2.16	3.33	2.60	2.27	1.88	2.92	2.49	1.11
Brazil	2.54	2.32	3.52	4.64	4.08	2.35	-3.41	1.55	3.71	0.43	0.30
Difference between Brazil and Latin America (ex. Brazil)	-1.31	0.24	-0.97	2.48	0.75	-0.25	-5.68	-0.33	0.79	-2.06	-0.81
Difference between Brazil and World	-0.80	-0.77	-0.49	2.23	0.87	-0.63	-6.35	-1.78	0.71	-2.54	-2.09
Argentina	3.66	-4.87	8.69	4.32	6.50	1.22	0.33	0.10	3.67	0.92	-0.62
Bolivia	4.76	1.78	4.03	4.55	4.29	5.65	4.56	4.21	3.85	5.28	3.36
Chile	6.83	2.76	5.82	3.42	4.62	4.37	1.95	2.67	4.33	3.56	2.15
Colombia	2.81	0.73	5.20	3.91	4.56	5.12	2.52	1.96	4.06	4.26	2.56
Ecuador	2.89	1.12	5.16	3.16	4.16	5.56	-0.56	1.83	4.14	3.52	1.70
Mexico	3.12	1.81	3.04	0.82	1.93	2.88	2.96	2.15	1.50	2.91	1.36
Peru	4.07	2.57	5.73	6.77	6.25	5.18	3.60	3.24	5.61	4.65	2.57
Uruguay	4.30	-3.86	4.34	6.44	5.39	4.14	1.03	1.05	3.16	3.11	1.50

Source: Author ś own from World Bank Data.

Note: Data at constant prices (in 2015 US$). For Latin America and the Caribbean, 42 countries were considered in the sample, whose data were available for each subperiod analyzed.

Table 2. Per capita income average growth rates in real terms between 1995-2020

Region	95-98	99-02	03-06	07-10	03-10	11-14	15-16	17-18	01-10	11-16	11-20
Mundo	1.85	1.73	2.70	1.16	1.93	1.73	1.74	2.18	1.71	1.73	1.22
Latin America and the Caribbean (LA)	2.30	0.86	3.38	1.23	2.30	1.56	1.11	0.93	1.89	1.41	0.12
Latin America and the Caribbean (ex. Brazil)	2.34	0.86	3.43	1.20	2.32	1.80	1.26	0.94	1.90	1.62	0.21
Brazil	1.00	0.96	2.35	3.62	2.99	1.45	-4.21	0.75	2.57	-0.44	-0.52
Difference between Brazil and Latin America (ex. Brazil)	-1.34	0.10	-1.08	2.42	0.67	-0.36	-5.47	-0.19	0.68	-2.06	-0.73
Difference between Brazil and World	-0.86	-0.77	-0.34	2.46	1.06	-0.29	-5.94	-1.43	0.87	-2.17	-1.74
Argentina	2.39	-5.92	7.58	3.48	5.53	0.08	-0.74	-0.92	2.69	-0.19	-1.68
Bolivia	2.83	-0.03	2.23	2.76	2.50	3.93	2.94	2.65	2.06	3.60	1.77
Chile	5.40	1.60	4.77	2.39	3.58	3.35	0.83	0.96	3.27	2.51	0.87
Colombia	0.97	-0.87	3.74	2.71	3.23	4.06	1.50	0.24	2.68	3.20	1.26
Ecuador	1.05	-0.61	3.35	1.43	2.39	3.92	-2.03	0.09	2.37	1.94	0.09
Mexico	1.32	0.22	1.57	-0.47	0.55	1.50	1.78	1.12	0.09	1.60	0.21
Peru	2.17	1.11	4.75	5.98	5.37	4.19	2.30	1.51	4.64	3.56	1.24
Uruguay	3.71	-4.18	4.22	6.20	5.21	3.84	0.70	0.86	2.97	2.80	1.27

Source: Author ś own from World Bank Data.

Note: Data at constant prices (in 2015 US$). For Latin America and the Caribbean, 42 countries were considered in the sample, whose data were available for each subperiod analyzed.

Table 3 presents data for the level of *per capita* income in real terms from 1995 to 2020 (in average terms *per* sub-period). Between 1995 and 2020, the world's income level increased by 32.79%, in Latin America and the Caribbean (excluding Brazil), 40.54%, in Brazil, 20.47%, in Chile, 42,99%, in Uruguay, 40.40%, in Peru, 45.28%, in Colombia, 28.90%, in Argentina, 12.10%, in Bolivia, 36.08%, in Ecuador, 17.96%, and in Mexico, 17.68%. Between 1990 and 2020 (expanding the horizon of analysis), the world's income level increased by 35.25%, in Latin America

[1] Data for the 1980s are from the World Bank and were not included in Tables 1 and 2. However, they are considered at constant prices (in 2015 US$).

and the Caribbean (excluding Brazil) by 44.65%, in Brazil, 25.82%, in Chile, 57.85%, in Uruguay, 49.43%, in Peru, 53.12%, in Colombia, 36.99%, in Argentina, 28.18%, in Bolivia, 42.21%, in Ecuador, 21.60% , and in Mexico, 16.2%. Therefore, in a more general perspective, Chile was the country that achieved the greatest growth rate in *per capita* income, while Brazil increased its *per capita* income by a little more than half that seen elsewhere in Latin America.

Table 3. Average level of per capita income in real terms – 1995 - 2020

	95-98	99-02	03-06	07-10	03-10	11-14	15-16	17-18	01-10	11-16	11-20
World	7271	7855	8516	9184	8850	9723	10235	10659	8672	9894	10211
Latin America and the Caribbean (LA)	7787	8929	11049	13599	12324	13873	14123	14261	11730	13956	13894
Latin America and the Caribbean (ex. Brazil)	7823	8994	11157	13746	12452	13999	14268	14412	11846	14089	14031
Brazil	6599	6729	7226	8239	7733	9090	8605	8512	7548	8928	8739
Difference between Brazil and Latin America (ex. Brazil)	-1224	-2265	-3931	-5507	-4719	-4909	-5663	-5899	-4298	-5160	-5291
Difference between Bazil and World	-673	-1126	-1290	-944	-1117	-633	-1630	-2147	-1124	-966	-1472
Income gap: Brasil - USA - %	85	86	86	85	85	83	85	86	85	84	85
Argentina	10712	10135	10745	12998	11871	13934	13575	13350	11396	13814	13364
Bolivia	1945	2017	2129	2385	2257	2715	3015	3177	2210	2815	2941
Chile	7859	8604	9979	11415	10697	13035	13607	13761	10320	13226	13341
Income gap: Chile - USA - %	82	82	81	79	80	76	76	77	80	76	77
Colombia	4198	4002	4394	5058	4726	5796	6260	6301	4586	5951	6057
Ecuador	4441	4306	4791	5232	5011	5958	6048	5995	4883	5988	5911
Mexico	8075	8763	8904	9061	8983	9390	9825	10059	8929	9535	9649
Peru	3222	3293	3761	4771	4266	5789	6259	6465	4078	5946	6090
Uruguay	9874	9828	9824	12317	11071	14887	15763	16115	10730	15179	15469
United States	43675	48482	52012	53278	52645	54529	57028	58907	51898	55362	56914
Upper middle income	3237	3716	4607	5998	5303	7386	8273	8977	5012	7682	8291
Lower middle income	1132	1218	1415	1667	1541	1912	2132	2293	1483	1985	2116

Source: Author's own based on World Bank data.

Note: Data at constant prices (in 2015 US$). For Latin America and the Caribbean, 42 countries were considered in the sample, whose data were available for each subperiod analyzed.

3. The Fiscal Policy

To understand the role of fiscal policy over the period and its influence on economic growth, we will analyze the (de)composition of the government's primary result as well as the public sector investment rate by subcomponents.

In Figure 1 the (de)composition of the central government's primary result as a percentage of GDP can be seen. The primary structural result can be used as an indicator to evaluate the role played by fiscal policy. The cyclically adjusted primary result is calculated based on series of revenues and expenses isolated from effects arising from the cyclical position of the economy. The purpose of the cyclically adjusted primary result is to evaluate fiscal policy, considering fluctuations in economic cycles, to smooth out the effects of economic fluctuations (Pinto and Andrade, 2021).

According to the Secretaria de Política Econômica (SPE, 2021), the structural primary result should be understood as the (conventional) primary result – the circles in Figure 1 – without the influence of transitory events. In this way, the structural primary result will provide a more accurate analysis regarding the degree of expansionism of fiscal policy over time.

If the structural primary result increases (increase in surplus or reduction in deficit) from one period to another, the fiscal impulse will be contractionary. If the structural primary result decreases (reduction in surplus or increase in deficit) between two moments in time, the fiscal impulse will be expansionary, such as in 2012, 2013 and 2014 (Figure 2). Finally, if the structural primary result does not vary, fiscal policy will be neutral (Pinto and Andrade, 2021).

According to Figure 1 (below), successive generations of primary surplus occurred between 1998 and 2013 but became negative from 2014 onwards. Brazil's fiscal policy sought to achieve significant annual primary surplus targets defined by the IMF, after a sequence of primary deficits before 1998. According to Borges and Pessoa (2022), much of this fiscal consolidation came from increases in the tax burden through indirect taxation, accounting for around 6 p.p. of GDP between 1997 and 2005[2].

[2] In 2020, the Covid-19 pandemic period led the primary deficit to 10% of GDP. However, this is a period that goes beyond the analysis goals of this article.

From 2011 onwards, a series of fiscal stimuli took place in the form of fiscal immunity, exemptions, subsidies, and various tax incentives designed in a less than judicious manner, without more comprehensive planning regarding their efficiency, coverage, and effectiveness, in terms of their impacts of sectoral multipliers, losses of tax revenues and economic growth itself. Therefore, in Figure 1 we can see in aggregate terms the picture of fiscal deterioration (mainly after 2011). While public investment decreased, private investment grew, discreetly, until 2013 (Figure 3 and 4, discussed below).

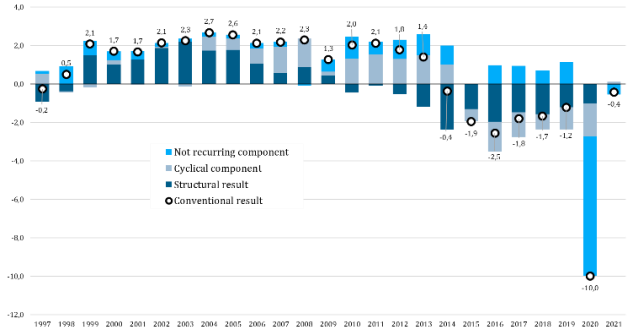


Figure 1. Decomposition of the central government's primary result - % GDP – 97-21

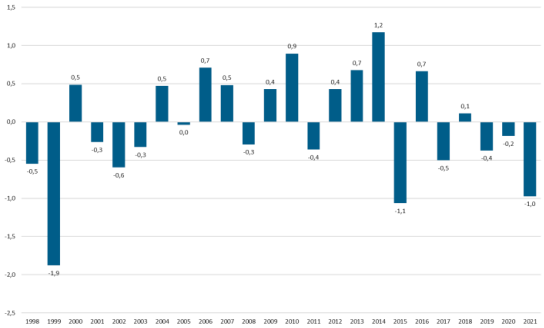


Figure 2. Fiscal Impulse

Source: IFI (2021).

The worsening of the primary result occurs mainly after 2011, with the New Economic Matrix (NEM). From Schymura (2017) the expression NEM was coined and used by members of the government at the time (in interviews and internal documents), and widely used by Guido Mantega as a kind of "victorious innovation" of the government. The government members themselves reported that in the first year of the NEM, there would be a "structural change" in the economy (Mantega, 2012).

Within this "structural" change, there was a reduction in the tax burden of around 1% of GDP in 2012. According to an announcement by the Minister himself, in the context of the NEM, there was also a reduction in the price of electricity, the beginning of the Investment Support Program (ISP) with resources subsidized by BNDES, new forms of public concessions (airports, highways and railways), payroll relief for certain sectors, which exempted some economic activities from taxes. Furthermore, there was the use of public banks to reduce banking spread, among other measures that negatively impacted Brazil's fiscal framework.

Some key facts can be seen from Figure 1 for the NEM period. There is a clear lack of coordination in fiscal policy as there was a reduction in revenues, harming the fiscal consolidation achieved from 1997 to 2005, simultaneously with a reduction in primary surpluses with great dependence on the non-recurring component. This greater importance of the non-recurring result for the primary result has occurred since 2009, that is, before the NEM (and policies that, despite not being linked to it, received this "seal"). Therefore, the worsening of the fiscal situation came before the fall in public investment as a proportion of GDP (in aggregate terms, Figure 3 and 4), which amplified the economic slowdown after 2010. More importantly, the rate of change in government consolidated investment was in decline after 2008 and federal public companies after 2009. Furthermore, there was a turning point in general government investment after 2010 (Figure 4)[3].

It must be noted that although there were primary surpluses from 2010 to 2013, there was also a worsening of their "quality", since the non-recurring component grew (Figure 1), with a worsening of the structural result. In a slowing economy, the "quality" of spending matters even more, given its impacts in multiplier terms (tax, income, production, jobs, among others). In a broader perspective, from 1998 to 2021 the cyclical component of the primary result exerted influence in the same direction as the conventional primary result. Therefore, the activity cycle explained the dynamics of the conventional primary result, according to IFI (2021) calculations so the economic slowdown harmed the conventional result itself.

[3] The General Government (GG) is made up of the Central Government plus State and Municipal governments.

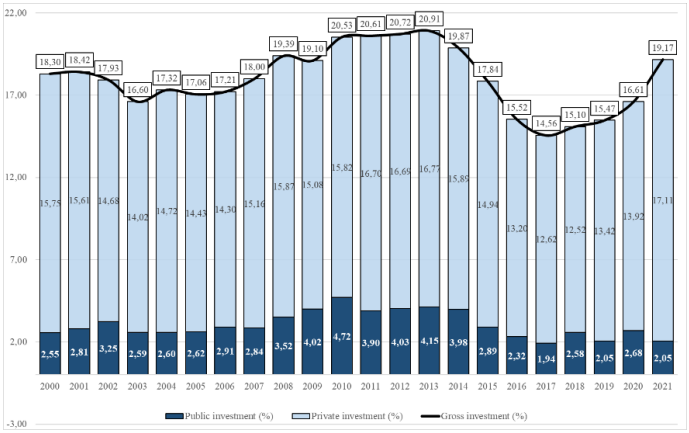


Figure 3. Investment rate-%-GDP -2000 – 2021

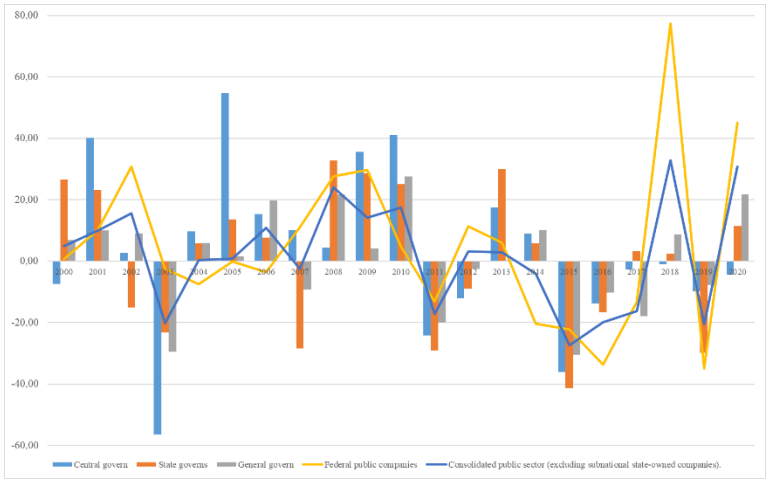


Figure 4. Public investment annual variation rate

Source: Author's own based on data from IBGE and IBRE (FGV).

In Figure 1, the structural primary result was a surplus from 1999 to 2009, which was consistently negative from 2010 to 2020. This worsening of the structural fiscal result began in 2006, the year the agreement with the IMF ended and was associated with an acceleration in public investments (Figure 3 and 4). According to Borges and Pessoa (2021), on average 1999-2005, General Government (GG) investments were equivalent to 1.7% of GDP p.a., reaching more than 2% of GDP p.a., from 2006 onwards. According to them the Growth Acceleration Program (PAC) was launched in 2007. However, when taking into account the public sector investment rate in aggregate terms - in which General Government (GG) is one of the subcomponents[4] - one can observe a drop after 2010, when the average was 4.03% in the period between 2011 and 2013 and it fell sharply from 2014 to 2017.

The worsening of the government's fiscal conditions led public debt (gross and net) as a proportion of GDP on an upward trajectory, increasing, *pari passu*, the perception of country risk, captured by EMBI+, which fluctuated at almost 500 (average) basis points in December 2015. In mid-2015, a fiscal adjustment was adopted by Finance Minister Joaquim Levy, resulting in a further reduction in federal government investment spending (see Figure 3 and Figure 4, in particular) with a negative fiscal impulse (Figure 2). Therefore, there was a combination of negative factors, such as economic slowdown, which contributed to a reduction in budget revenues (in aggregate terms), worsening of the structural fiscal framework, which deteriorates the government's solvency and debt sustainability indicators.

As can be seen in Figure 3,4 and 5, private and public investment did not react to the incentive policies (exemptions, subsidies, and fiscal immunity) mentioned in this section. In a context of falling aggregate demand and a reduction in the economic return of non-financial companies (Figure 6), the rate of change in aggregate investment in the economy was negative for 14 consecutive quarters (from 2014 Q2 to 2017 Q3) and that of GDP in 11 consecutive quarters (from

[4] This subcomponent reached (as a % of GDP) 2.85% in 2010, 2.28% in 2011, 2.22% in 2012, 2.23% in 2013 and 2.45% in 2014, with a major inflection from 2015, when it reached 1.70%, falling sharply until 2017, when it reached 1.26%.

2014 Q2 to 2016 Q4), as shown in Figure 5. However, it had already been falling since 2010 Q2, after reaching the highest rate of change in 2010 Q1 (Figure 5)[5].

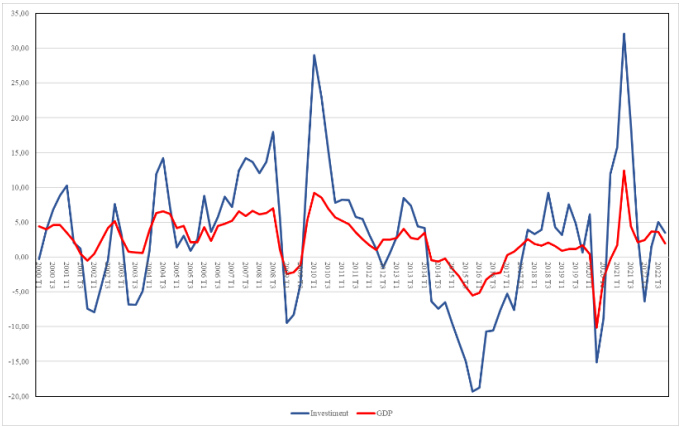


Figure 5. Quarterly change rate (over the same quarter of the previous year) of the investment rate and the GDP (both in real terms) - 2000 (Q1) to 2022 (Q3).

Source: Author ś own based on (IBGE/SCN Quartely).

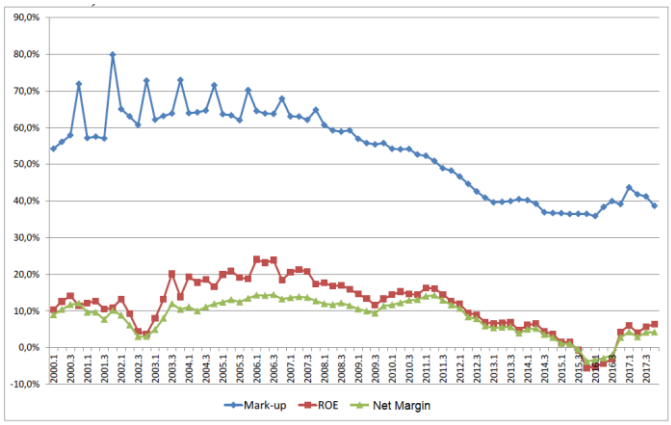


Figure 6. Evolution of average ROE, average Net Margin and Mark-up of non-financial companies (2001 – 2017)

Source: Meyer (2021) based on Economática Data.

4. Monetary Policy

Muinhos and Carvalho (2022) show that between 2011 and 2015 the Central Bank (CB) practiced an inconsistent monetary policy by setting short-term nominal interest rates at values below those that would be necessary for inflation to converge to the target set by the National Monetary Council (NMC). During this period, according to the authors, there was a strong deviation in the BCB ś interest rate policy in relation to what would be expected by applying the Taylor rule (Taylor, 1993). Only from 2016 onwards did the Central Bank once again define the interest rate in a manner more consistent with the aforementioned rule, targeting the inflation target set by the NMC.

In an expanded version of the Taylor Rule, Clarida, Gal í and Gertler (1997) proposed that the Central Bank (CB) defines its interest policy considering the future expected value of inflation, compared to the target, and the gap between the effective GDP and potential GDP. A Central Bank that is overly concerned about keeping inflation close to the target will react quicker when the economy presents any deviation in inflation from the target. On the other hand, a CB that is much more concerned with maintaining the level of activity close to potential will exhibit a greater speed of reaction based on product deviations in relation to potential GDP. The adjustment speeds in relation to inflation deviations from the target are given by the Beta parameter (β), while the adjustment speeds in relation to activity deviations in relation to potential output are given by the Gamma parameter (γ).

Figure 7 presents the β term estimated by Carvalho (2021). It can be observed that the parameter was above 1 for most of the sample period, demonstrating that the Central Bank of Brazil (BCB) was following the Taylor rule, with an emphasis on the convergence of inflation to the target. However, the value of β fell significantly from the second quarter of 2011, becoming negative between 2012 and 2015. This parameter recovered from 2016 onwards at a level lower than that seen in the period prior to 2011.

[5] The “Lava Jato” operation contributed to the decrease in the investment rate in the oil and civil construction sector after 2014. However, it does not explain in isolation the reduction in the rate of investment in the economy as we can see in this section. To focus only on the first sector mentioned, by 2013 Petrobr ás greatly increased its level of debt, subsequently readjusting its investment strategies and liabilities. Furthermore, in 2014 and 2015 there were sharp drops in the price of oil on the international market, affecting the company's cash flow. It is worth mentioning that in the same period, projects such as the Abreu e Lima refinery (PE) and the Petrochemical Complex (COMPERJ) were already costing many times more than the initial project and with a low economic return.

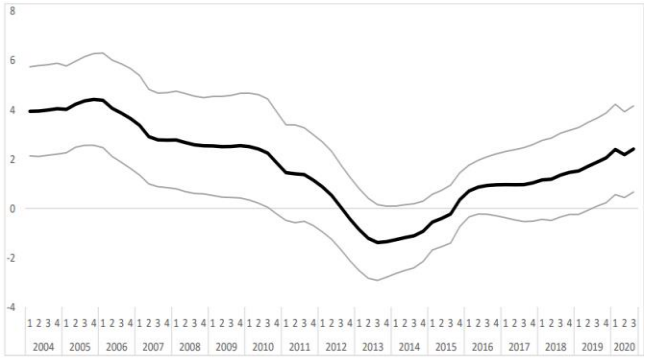


Figure 7. Estimate of β as the only time-varying parameter (plus/minus two SD).
Source: Carvalho (2021).

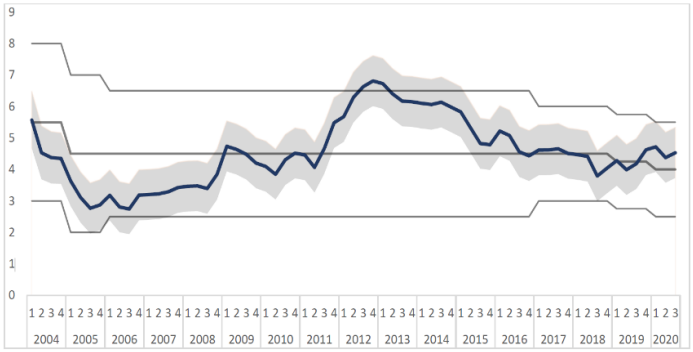


Figure 8. Implicit inflation target (plus/minus two SD) and official inflation target (with upper and lower limit).

The same empirical analysis is presented by Muinhos and Carvalho (2022) and Carvalho (2021) considering the Central Bank's implicit inflation target, which may differ from the target defined by the National Monetary Committee (NMC). In Figure 8 two large "detachments" from the implicit inflation target and the center of the CMN target can be seen. The first "decoupling" occurred from 2004 to 2008, in which the BCB's implicit target was below the center of the NMC's target. The second "decoupling" is between the third quarter of 2011 and the first quarter of 2015, when the estimated implicit inflation target for the CB was significantly above the center of the NMC inflation target.

The periods of greatest alignment between the implicit inflation target and the center of the inflation target are in the periods of the first quarter of 2009 and the second quarter of 2011, as well as the period between the second quarter of 2015 and the third quarter of 2019. More importantly according to Carvalho (2021, p. 37), deviations from the implicit target from the official target suggest a certain temporal precedence in the change in inflation expectations of economic agents consulted by the Central Bank and present in the Focus report.[6]

Therefore, we can observe that before the country entered recession, there was also a lack of coordination of monetary policy, since there was an expansionary fiscal policy (e.g., see Figure 2, fiscal impulse as a % of GDP, in 2011, 2012 and 2013), with an acceleration in the inflation rate measured by the IPCA[7], simultaneously with a dovish monetary policy.

5. Synthetic Control Analysis: A Counterfactual Analysis

5.1 Method

By implementing the synthetic control method for causal inference in comparative case studies, it is possible to estimate the effect of an intervention of interest (e.g., some exogenous shock) and compare it with the evolution of the same aggregate result (e.g., economic growth) to a synthetic control group. This control group is a weighted combination of units (in this case, a panel of countries) chosen to approximate the unit affected by the intervention in terms of outcome predictors. The outcome variable for each estimated synthetic control group is the counterfactual of what would have been seen for the affected unit in the absence of the intervention of interest.[8]

To construct the control group, the following variables (predictors) were considered: investment rate as % of GDP; degree of openness of the economy as a % of GDP; government consumption in terms of goods and services in relation to GDP; total and *per capita* capital stock; net capital stock; level of economic complexity; the inflation rate; the level of human capital, the level of labor market regulation (degree of flexibility of labor regulations, particularly with regard

[6] If the implicit target is above the official inflation target, monetary policy is "looser" than it should be (dovish) and otherwise "tighter" (hawkish). Furthermore, in general terms, the results of Carvalho (2021) and Muinhos and Carvalho (2022) do not change substantially with the inclusion of the output gap (associated with the Gamma adjustment coefficient (γ).

[7] It must be noted that the IPCA did not increase with greater intensity only because there were a certain number of *ad hoc* price restrictions on public tariffs, such as energy, after 2011.

[8] See Abadie e Gardeazabal (2003) and Abadie, Diamond e Hainmueller (2010, 2014) for more details.

to hiring, working hours and dismissal) and the economic freedom index (taking into account its subcomponents). All variables of interest and predictors are briefly described in Table 4 (below).

The most comprehensive sample of countries involved all those considered developing by the World Bank between 2000 and 2020. The control group is made up of the following emerging countries: Argentina, Bolivia, Chile, China, Colombia, Ecuador, India, Indonesia, Malaysia, Mexico, Paraguay, Peru, Russia, Türkiye, and Uruguay. The application of the method requires a balanced panel, which for the period from 2000 to 2020 the best possible matching occurred for these fifteen countries, considering the variables in Table 4. The treatment year is 2011, according to the discussions in sections 3 and 4. In this way, we can have the counterfactual of Brazil in the post-intervention period.

In general, it appears that in the pre-intervention period, the sample of countries used managed to capture the trajectory in terms of level and/or rate well for most of the period under consideration, based on the weights used (*unit weights*) for the group of control. Naturally, for some variables, there is no good comparison group for Brazil in the sample, given the particularities of the economy and the sample itself. In all figures, Brazil (*treated unit*) and synthetic Brazil (*synthetic control unit*) are shown. Appendix A presents all the control groups and weights for each estimation (*unit weights*).

Table 4. List of (annual) variables of interest and predictors

Abbreviation	Brief description of the variables	Source
pcGDP	*Per capita* income at constant prices (2015 US$).	World Bank
pcgGDP	*Per capita* income growth rate at constant prices (2015 US$).	Author´s own based on the World Bank
GDPgrowth	Growth rate (real), at constant prices (2015 US$).	World Bank
fbkf	Gross fixed capital formation as GDP share (%)	World Bank
misxrate2	Real exchange rate adjusted for the Balassa-Samuelson effect according to Rodrik (2008) and Purchasing Power Parity – measure of exchange rate devaluation/appreciation.	Author´s own based on Penn World Tables 10.0
openness	Degree of openness of the economy as a % of GDP.	World Bank
tfp	Total factor productivity.	Penn World Tables 10.0
unemployment	Unemployment, total (% of total labor force).	International Labour Organization (ILO)
govexp	Government consumption in terms of goods and services in relation to GDP (%).	World Bank
kstockr	Total capital stock (gross, at constant prices) - 2015 US$.	Penn World Tables 10.0
pckstockrl	Capital stock *per capita* (gross, at constant 2015 prices, US$).	Penn World Tables 10.0
kstockrl	Net capital stock (taking into account the average depreciation rate) at constant prices (in 2015 US$).	Author´s own based on Penn World Tables 10.0
iir	The real internal rate of return on capital (IRR), which provides a measure of the required rate of return on capital (%).	Penn World Tables 10.0
eci2	Economic Complexity Index (eci2 or ECI) is a measure of the amount of capabilities and know-how of a country determined by the diversity, ubiquity, and degree of sophistication of its exports.	The Observatory of Economic Complexity (OEC)
eciplus	It represents the ECI of an economy (calculated based on exports) corrected for the difficulty of exporting each product and the size of that country's export economy.	OEC
hcpwt	Human capital index, based on years of schooling and returns to education.	Penn World Tables 10.0
inflagdp	Implicit GDP deflator (%).	World Bank
Infla	Consumer inflation (%).	World Bank
efindex	Index of economic freedom, which considers in its indicator: i) size of the government; ii) quality of the legal system and property rights; iii) monetary stability; iv) freedom of international trade; v) regulatory quality.	Fraser Institute
lreg	Index - degree of flexibility in labor regulations, particularly with regard to the areas of hiring, working hours and dismissal.	World Bank - Doing Business
agedependr01	Dependency ratio of people under 15 years old or over 64 years old in relation to the working-age population.	World Bank
agriculture01	Agriculture, forestry, and fishing, added value (% of GDP).	World Bank
agriculture02	Agriculture, forestry, and fishing, added value (annual growth rate).	World Bank
agriculture06	Productivity (average) of agriculture, forestry and fishing, value added *per* worker, at 2015 prices (US$).	Penn World Tables 10.0 e World Bank
domesticcredit03	Domestic credit to the private sector by banks (% of GDP).	World Bank
emplagr01	Employment in agriculture (% of total employment).	ILO
emplind01	Employment in industry (% of total employment).	ILO
emploser01	Employment in services (% of total employment).	ILO
manu01	Manufacturing industry (% of GDP).	United Nations Industrial Development Organization (UNIDO)
manu02	Manufacturing industry (annual growth rate).	UNIDO
ttrade	Terms of trade (2000 = 100).	World Bank

services01	Services, value added (% of GDP).	World Bank
services02	Services, added value (annual growth rate).	World Bank
industry06	Productivity (average) of the industry (including civil construction), at 2015 prices (US$).	Penn World Tables 10.0 e World Bank
services06	Productivity (average) of services, at 2015 prices (US$).	Penn World Tables 10.0 e World Bank

Source: Author ́s own.

5.2 Results and Discussion

In Figure 9 (below), GDPgrowth presents an almost completely coincident trajectory for Brazil, as for synthetic Brazil, with a good part of it being just a parallel trajectory. However, the trajectories are different from 2010 onwards and more so after 2011. These trajectories only become similar again after 2019.

In Figure 10 we have the same exercise for pcgGDP. It can be observed that there is a good degree of adjustment in the pre-intervention trajectory (2011), with only one difference in level between 2002 and 2007. The different trajectories from 2010 onwards and, with more intensity, after 2011 are quite evident. This mismatch in trajectory corroborates the hypothesis that a set of economic policy mistakes, starting from the intervention period, had consequences on the per capita income growth rate from Brazil, i.e., something not seen in other economies, according to data in section 2 and the discussions in sections 3 and 4.

Figure 11 shows Brazil's incomegap[9] in relation to the USA and the best adjustment of the synthetic control group. From 2006 to 2011, Brazil managed to perform better than the best weighting of countries in the synthetic control group. After this period, a trajectory of stagnation and decline (i.e., worsening) of the income gap until 2020 begins to appear. It is important to note that incomegap in 2016 is remarkably close to that seen in 2007.

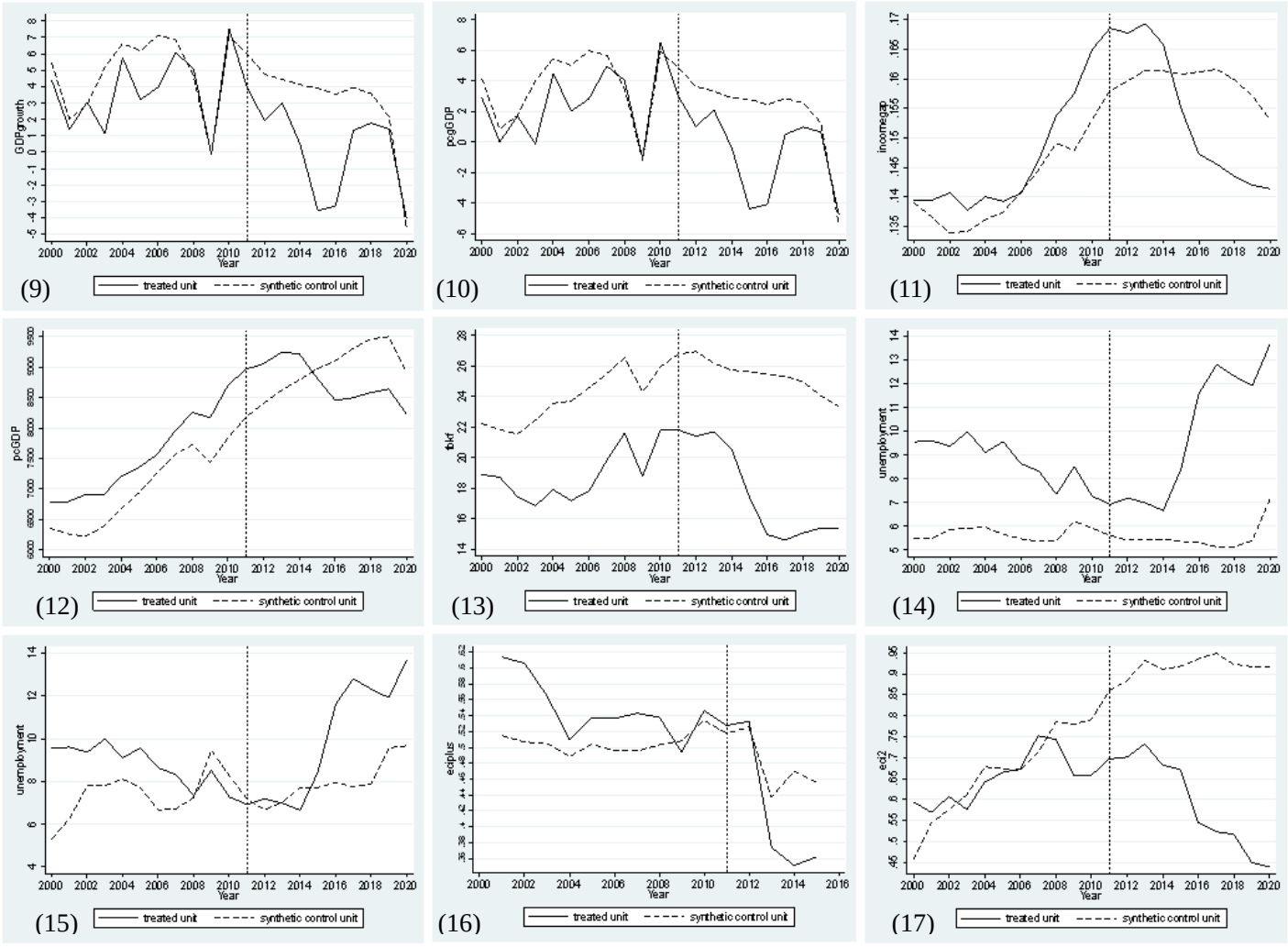
Figure 12 presents the *pcGDP* between Brazil and the best adjustment of the comparison group for synthetic Brazil. There is a long trajectory of increase in the level of *per capita* income for almost all years. This trajectory has two interruptions, after leaving a declining performance (in level) in 2000-2002: i) the first in 2008, with recovery from 2009 and ii) in 2019, with a downward trend maintained in 2020, the final year of the series. Furthermore, noteworthy is the good adjustment between the trajectories before the 2011 intervention.

Figure 13 presents the *fbkf* for Brazil and synthetic Brazil. It can be observed that for the best control group the percentage of investment is quite different, despite the good adjustment in terms of the "parallel" trajectories before the intervention period. It should be noted that since 2010 this variable has stagnated for Brazil with a decline until 2017.

There is a strong correlation between the investment growth rate and the product growth rate. For Brazil it is 0.8775, with 1% significance[10] (from 2000 to 2020). For the same period, this correlation is lower for China (0.6338, with 1% significance), Chile (0.8196, with 1% significance), but higher for Mexico (0.9255, with 1% significance), for example. For the sample (without Brazil) it is 0.3065, with 1% significance, that is, this linear association between the two variables is only moderate. Therefore, the fall in the investment rate in Brazil had stronger effects on GDP behavior see section 3 for a further discussion regarding this variable, in particular, Figure 5).

[9] For this exercise, the income gap is the ratio between the *per capita* income of each country (or weighted sample of countries in synthetic Brazil) in relation to the *per capita* income level of the USA.

[10] Considering the *t* statistics.



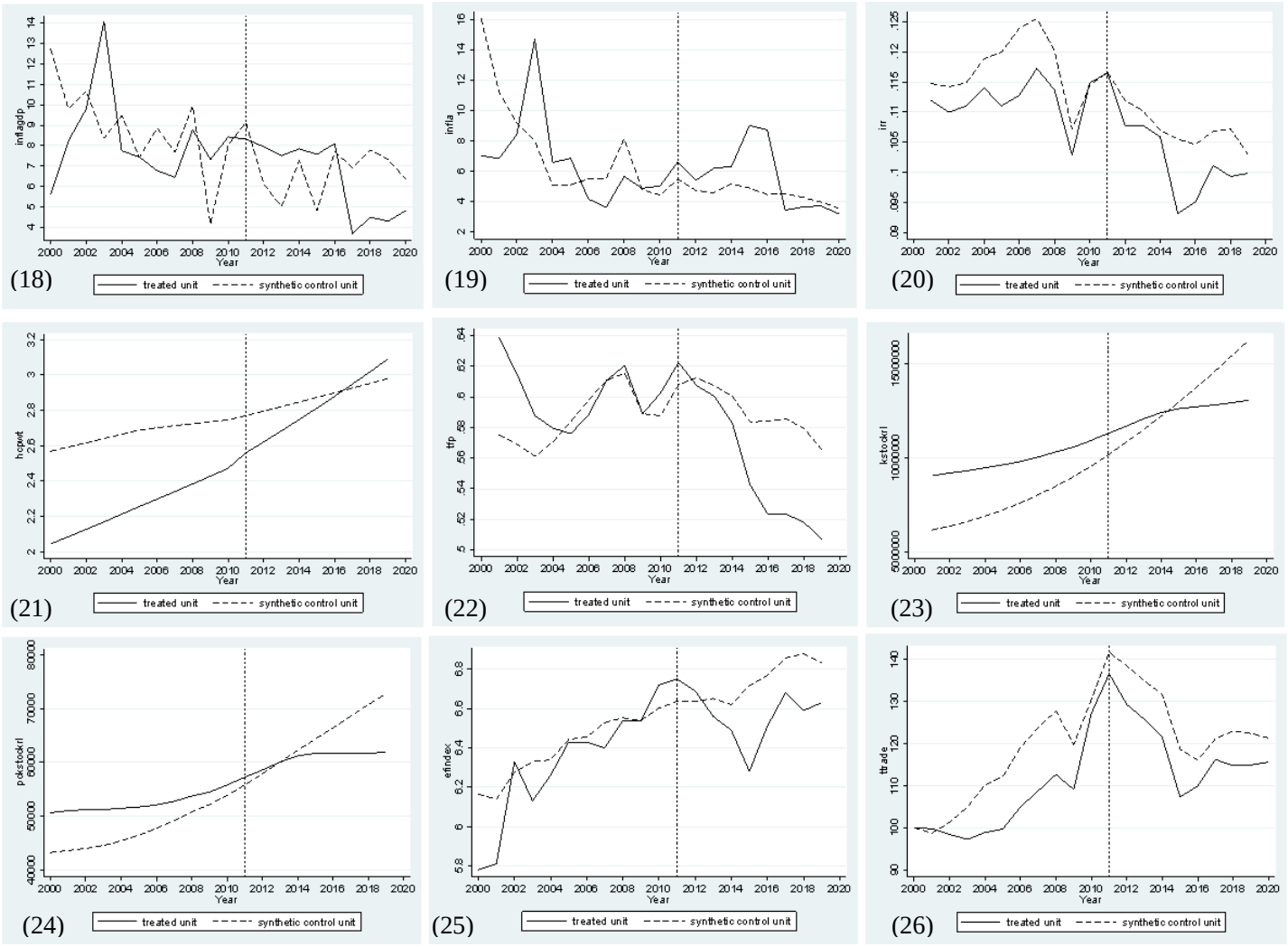
Figures 9 – 17. Application of the synthetic control method 2000 - 2020

Source: Author ś own.

A lower level of aggregate investment has consequences on the real net capital stock (*kstockrg*) and *per capita* capital stock (*pckstock*) to the extent that a decrease in the working capital stock ratio influences its average (and marginal) productivity; a relationship that is particularly important in the industrial sector (analyzed below).

Figures 14 and 15 show the application of the synthetic control method for the unemployment variable. The best adjustment occurred when the variable that measures the degree of flexibility in labor regulations was placed as a predictor (Figure 13). In fact, after 2014 the unemployment rate grows rapidly when analyzed in relation to the best comparison group. This demonstrates that after the intervention period, "real" Brazil presented an unemployment rate that was much higher than that of "synthetic" Brazil, which is due to the lack of coordination of economic policy and the drop in the investment rate.

Figures 16 and 17 show the application of the synthetic control method for Brazil, considering economic complexity indicators (*eciplus* and *eci2*, respectively). Roughly speaking, the more complex a product (or service) is, the greater the level of knowledge and skills necessary for an economy to produce it. The greater the diversity of products that require know-how, technologies, and knowledge and the lower the ubiquity of these products (services), the greater the level of economic complexity tends to be (Hausmann *et alii*., 2011). It is evident, mainly from Figure 15, that the Brazilian economy shows a sharp drop in its level of complexity after 2010.



Figures 18 – 26. Application of the synthetic control method 2000 - 2020

Source: Author ś own.

In Figure 18 (above) the application of the synthetic control method for the implicit deflator of Brazil's GDP (*infla gdp*) is presented and the best comparison group. It can be observed that, before the intervention period, the trajectories are reversed in the period preceding 2003, but similar (with differences in magnitude) from 2004 to 2011. However, after 2011, the inflation rate is persistently higher than the best group comparison, only falling after 2016.

In Figure 19 we redo the exercise for the consumer price index. We can observe that for the best comparison group the analysis of the trajectories is similar to that verified for the implicit GDP deflator. The difference resides, to a considerable extent, only in the magnitudes. When we restricted the number of countries by weighting only the best units (*unit weights*) that best responded to the optimization of the synthetic control, only Paraguay and Uruguay managed to more adequately reproduce the behavior of inflation in Brazil before the pre-intervention period.

These results suggest that, even considering different inflation indicators, or even restricting the number of countries in the synthetic control group, there are very particular characteristics of inflation in Brazil, which, at least, in the sample used, make the trajectories differ in terms of some subperiods. Most importantly, from 2004 to 2008 there was lower inflation (Figure 18), but also lower growth, both aggregate and *per capita* (Figure 9 and Figure 10, respectively) when compared to the control group. In the period from 2011 to 2016 there was less growth and higher inflation (Figure 18 and 19), when compared to the best control group.

According to Inklaar and Woltjer (2019), the *irr* (Figure 20) allows you to monitor the return on capital over time and compare levels between countries. In PWT 10.0, the Jorgenson and Nishimizu (1978) method is applied, which is a more accurate measure of the return on capital than the frequently used Marginal Product of Capital (MPK), as it

considers differences in the composition of the stock of capital. According to Inklaar and Woltjer (2019) the required rate of return on capital is chosen to exhaust the remaining income after subtracting labor income from GDP.

Figure 20 shows a parallel trajectory adjustment in the pre-intervention period from 2001 to 2011, with an improvement in the adjustment over the period. After the intervention period there is a larger gap between this variable between real Brazil and synthetic Brazil. This result suggests that after the intervention period (2011), the real rate of return on capital (*irr*) suffered the effects of economic policies of such magnitude that the *irr* of the best comparison group was higher than the *irr* of Brazil.

The stock of human capital involves education, training, and health. When analyzing Brazil with the best comparison group (Figure 21), we see a positive reaction after the intervention (2011). In comparison to the other countries in the sample, Brazil made efforts that in the pre-intervention period reduced the distance between the human capital measure and the comparison group. In this way, "real" Brazil surpassed "synthetic" Brazil after 2017.

Figure 22 shows the evolution of *tfp* for Brazil and for the best comparison group. TFP is an important explanatory part for product growth. The latter is equal to a weighted average of capital and labor growth plus the TFP growth rate, that is, total factor productivity or multifactor productivity growth.

It can be noted that from 2005 to 2011 Brazil's *tfp* was in line with the best comparison group. After this period, *tfp* decreased more intensely when compared to the comparison group. The drop after 2011 was sharp. The intensity of this decrease over the period was not the same in relation to the best comparison group.

The capital stock at time *t* for each country is based on all previous investments up to that year, according to PWT 10.0. As Brazil's investment rate was systematically lower (in % of GDP) than the best comparison group, the net aggregate real capital stock (*kstockrl*) and the real *per capita* capital stock (*pckstockrl*) present different trajectories, even before the pre-intervention period (2011). As of 2014, these two variables are practically horizontal for Brazil (Figure 23 and 24, respectively). From 2001 to 2013 the growth rate of *kstockrl* is lower (given its slope), so that the weighting of the best comparison group presents a higher growth rate. The *pckstockrl* from 2000 to 2006 is almost constant, increasing only from 2007 to 2014. In both the first and second cases, the biggest change in trajectory occurs from 2014 onwards.

According to Marquetti and Miebach (2022), between 1947 and 1980, average labor productivity grew 4.3% p.a., while from 1980 to 2021 it grew only 0.28% p.a. In this first period, labor productivity grew *pari passu* with the increase in physical capital *per* worker. The stagnation of labor productivity in the second period coincides with the low growth of physical capital *per* worker, which expanded at a rate of just 0.47% p.a. This also partially explains Brazil's falling behind in terms of growth and *per capita* income (in level and rate) in relation to other Latin American countries.

In Figure 25, a proxy variable for the quality of institutions is presented. From 2002 to 2010, the trajectory of the comparison group followed the same trajectory as Brazil. However, there was a turning point inflection point in 2011 until its lowest rate in 2015, with subsequent recovery. For the comparison group this turning point does not occur. Furthermore, throughout the entire period there is a certain constancy in the trajectory of institutional quality.

Figure 26 presents the terms of trade (*ttrade*) for Brazil and the best comparison group of countries. We can observe that after 2002, even considering the period of intervention, there is almost synchronism between the real Brazil and the "synthetic Brazil". Therefore, before the intervention period, both Brazil and the best comparison group reaped the positive effects of the improvement in terms of trade, while for both there was a clear worsening after 2011.

The fundamental point to be highlighted here is that from the 2000s onwards Brazil grew more than LA (Table 1) only between 2007 and 2010 (but not in the 2003-2006), however, there was a worsening of Brazil's trajectory in relation to LA (from 2011 to 2020), even in a scenario in which the terms of trade worsened for everyone (as in the case of the control group). The lack of coordination of fiscal and monetary policy, the drop in economic complexity, the low level of productivity, the drop in investment rates, the worsening of the institutional environment, the low growth (and stagnation) of the capital stock and the acceleration of inflation therefore suggest a preponderance of endogenous factors on the economic performance of the Brazilian economy in the period.[11]

In Figure 27 (below) we can observe domestic credit to the private sector from the banking sector as a proportion of GDP (*domesticcredit03*). From 2003 to 2015 there was a credit boom in the economy, unparalleled in the best comparison group of countries.[12] A dramatic drop was noted after 2015. This was not shared by the best comparison group in the construction of "synthetic Brazil" after 2011. For this period of credit expansion, economic growth was strongly related to a higher level of domestic consumption without much expansion of the economy's investment rate.

[11] Later on, sectoral productivity and other variables related to the quality of institutions will be analyzed.

[12] For this variable, credit contraction in Brazil began in 2016.

In Figure 28 we can see the application of the synthetic control method for manufacturing industry's share in the GDP (*manu01*) of Brazil and the best comparison group of countries. The first key point to consider is that even considering the best comparison group for the construction of "synthetic Brazil" in the optimization process, "real Brazil" presents a lower share of this sector in GDP. More importantly, even before the intervention in 2011, the "real Brazil" is losing a greater share of GDP at a faster rate, i.e., the country is deindustrializing faster, without the expansion of the modern services sector (or sophisticated, like the one linked to software development, telecommunications, engineering, etc.). This is linked both to ineffective industrial policies and to the high degree of exchange rate misalignment in the Brazilian economy in the period[13].

In Figure 28 the growth rate of added value (real) of the manufacturing industry for Brazil (*manu02*) and the best comparison group of countries (Figure 29) is considered. Now, we can see a better adjustment of the "real Brazil" and the "synthetic Brazil" before the intervention. From 2011 to 2017, the sector suffered more intensely from negative rates of variation in its added value than when compared to the best control group making up "synthetic Brazil". This suggests that the sector suffered more intense effects in the economic slowdown that the country underwent.

Figures 30 and 31 present the case for the services sector (*services01* and *services02*, respectively). The first key point is that even considering the best comparison group of countries, this sector is more hypertrophied in Brazil. The best pre-intervention adjustment occurred after 2004. After the 2011 intervention, the sector grew much more quickly in terms of its relative share when compared to "synthetic Brazil". This is related to the drastic drop in the country's economic complexity over the period, particularly after 2010 (Oreiro *et alii*, 2023).

Figures 32 and 33 apply the synthetic control method for the agriculture, forestry, and fishing sector, in terms of GDP share and growth rate, respectively, *agriculture01* and *agriculture02*. In both figures there is a good adjustment in the pre-intervention period. There is a certain proximity in terms of relative participation between Brazil and the countries in the best comparison group. We can observe that it was the most resilient sector after the 2011 intervention, despite the strong volatility in value added in 2016 and 2017.

[13] Industrial policies, as a rule, without export targets, use of resources for Research and Development (R&D), analysis of insertion in global value chains (GVC), for example. About the degree of exchange rate misalignment in Brazil, Figure 40 ś analysis addresses this issue more directly.

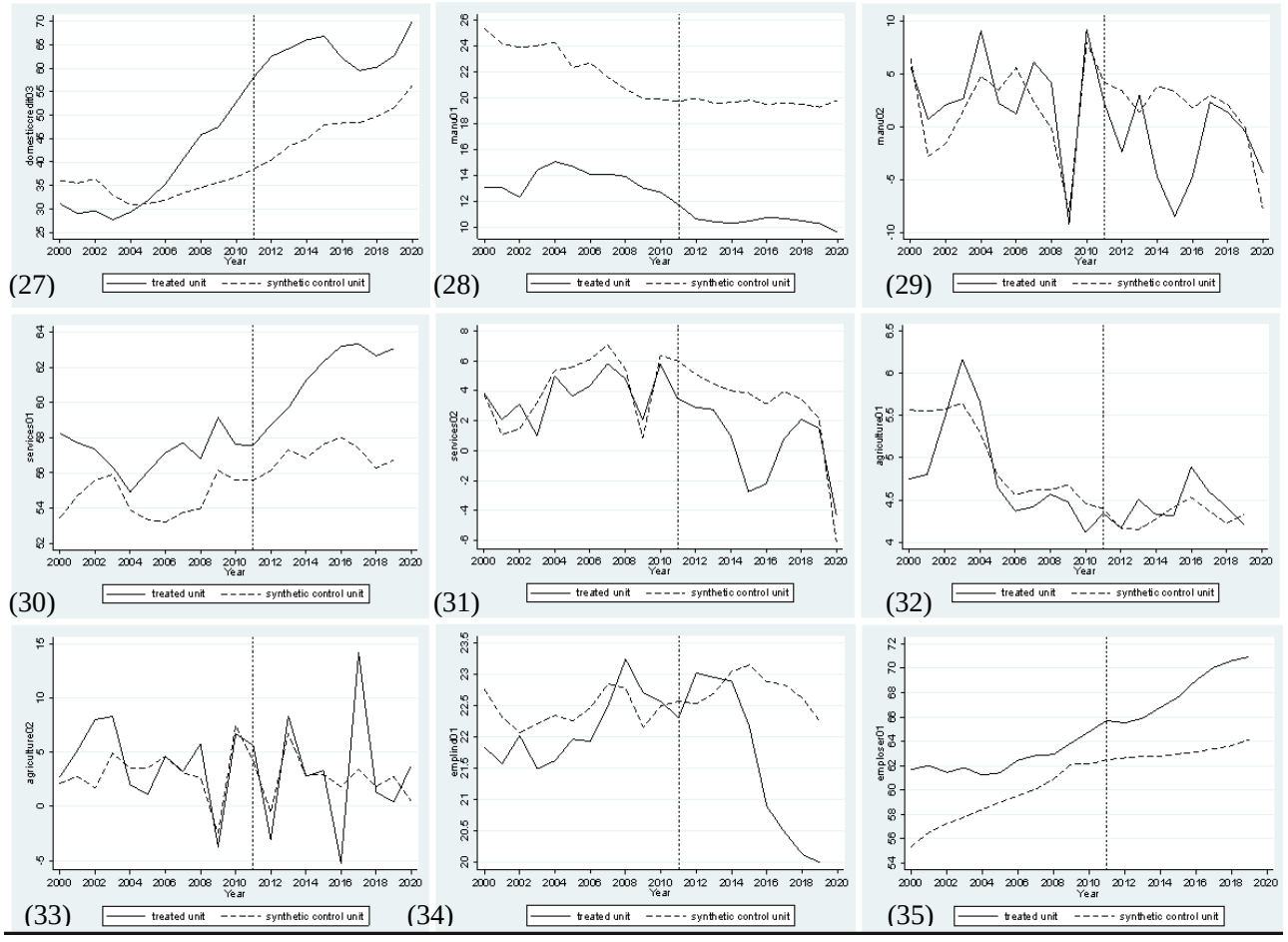


Figure 27 – 35. Application of the synthetic control method 2000 - 2020

Source: Author ś own.

Figure 34 and 35 (above) and 36 (below) consider the share of employment in different sectors of the economy (*emplind01*, *emploser01*, *emplagr01*, respectively). After the intervention period, we have evidence that reinforces the issues discussed above, that is, the sector most affected after 2011 was the industrial sector (Figure 34). Here we see that the relative loss in relation to total employment is accentuated from 2013 onwards. The services sector (Figure 35) increases its share in relation to total employment in a greater proportion than the best comparison group for "synthetic Brazil". Employment in the agriculture, forestry, and fishing sector (Figure 36) is affected less intensely in relation to total employment in the economy after the intervention.

In addition to the TFP, discussed above, we present the application of the synthetic control method for the average productivity of the three sectors of analysis, considering 2011 as the year of intervention (Figures 37, 38 and 39). In general terms, Brazil presented the worst average productivity, in relation to the best comparison group, in the industrial sector (Figure 38). It should be noted that after the year of intervention this worsened until 2017, something that did not occur with "counterfactual Brazil".

The sector whose productivity improved for competitiveness and economic growth is that related to the agricultural, forestry and fishing sectors (Figure 37). Throughout the entire period it showed higher growth rates than the best comparison group. Furthermore, only in 2012 and 2016 did it show a small reversal in its trajectory, recovering quickly afterwards.

The services sector (Figure 39) presented higher average productivity in relation to the best control group, with behavior quite in line with that presented by the best comparison group of countries. The productivity of this sector fell singularly after 2013, not observed in "synthetic Brazil". As this sector is the one that is responsible for the largest share in the national product, this drop in average productivity indicates lower growth potential in the long term, considering that it has a lower share of modern (or sophisticated) services, to the detriment of traditional services in the country.

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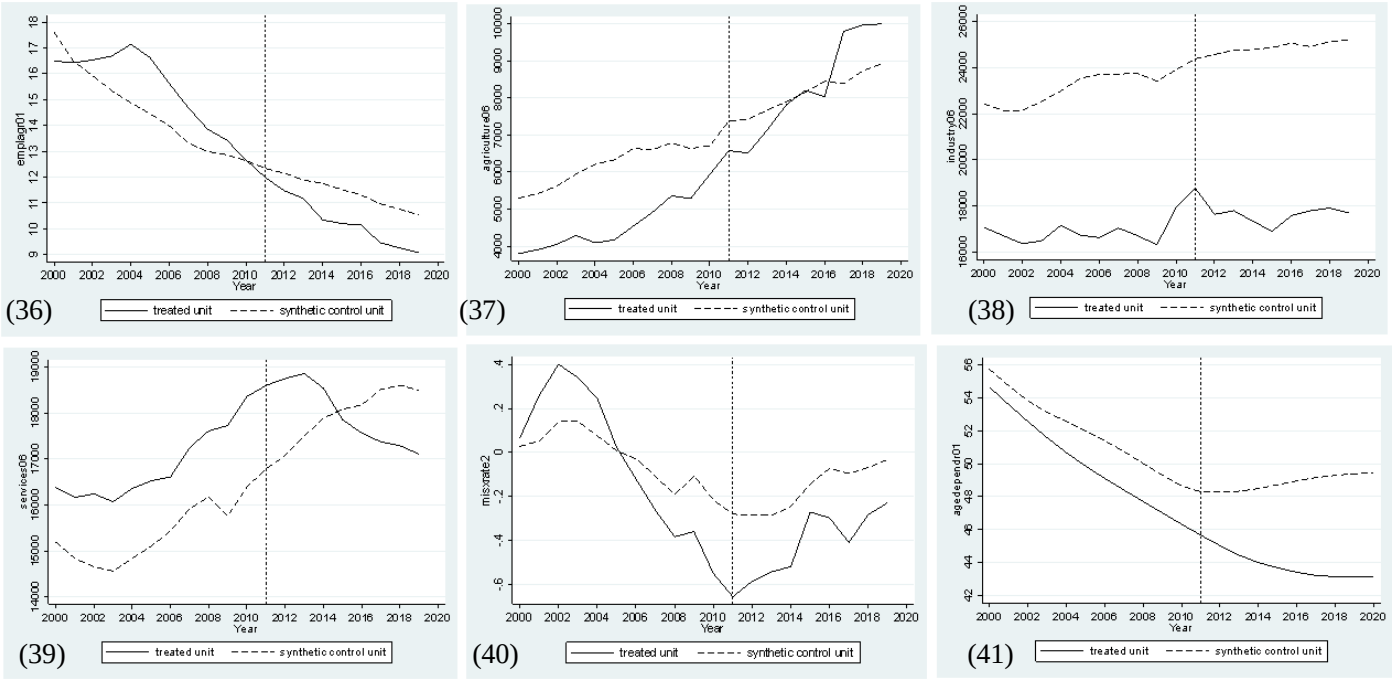

Figure 36 to 41. Application of the synthetic control method 2000 - 2020

Source: Author ś own.

The services sector (Figure 39) presented higher average productivity in relation to the best control group, with behavior quite in line with that presented by the best comparison group of countries. The productivity of this sector fell after 2013, not observed in "synthetic Brazil". As this sector is the one that holds the largest share in the national product, this drop in average productivity indicates lower growth potential in the long term, considering that it has a lower share of modern (or sophisticated) services, to the detriment of traditional services in Brazil (Oreiro *et alii*, 2023).

Figure 40 highlights the fact that the Brazilian real exchange rate has been chronically overvalued since 2005 (in this case taking into account the Balassa-Samuelson effect and Purchasing Power Parity, PPP). From 2000 to 2002 the RER (real exchange rate) reflected the effects of the Argentine crisis (contagion effect and uncertainty on other emerging economies) and the presidential elections. After this period, there is a tendency for greater overvaluation than the best comparison group. After 2011, for the best comparison group in the construction of "counterfactual Brazil" there is a smaller misalignment of the real exchange rate (*misxrate2*).

RER impacts the economy mainly due to the key role it plays in modern *tradable* activities and its negative effect on the competitiveness of the manufacturing industry and modern services (when is overvalued).

Figure 41 presents Brazil ś dependence ratio and contrasts it with the best comparison group of countries. This measure refers to the percentage of the population of working age in relation to the population under 15 years old or over 64 years old. We observe a parallel trajectory, but one that increases the gap between the curves until the pre-intervention period. After 2011 this gap between Brazil and the best comparison group increases. There are two main reasons for this: i) the decrease in the impact of the demographic dividend on Brazil and ii) the effect of the pandemic in the period after 2019. Naturally, the latter occurs more sharply after the arrival of the virus in the country.

The beginning of the demographic dividend in Brazil began around 1970. However, the low growth rate of the economy, the prominent level of unemployment in the last decade, as well as the allocation of workers in precarious jobs (even those with diplomas) renders the impact of the bonus low (although important). The pandemic removed numerous people from the job market and very unfortunately, from the general population seven hundred thousand lives were lost. This calculation includes people of working age.

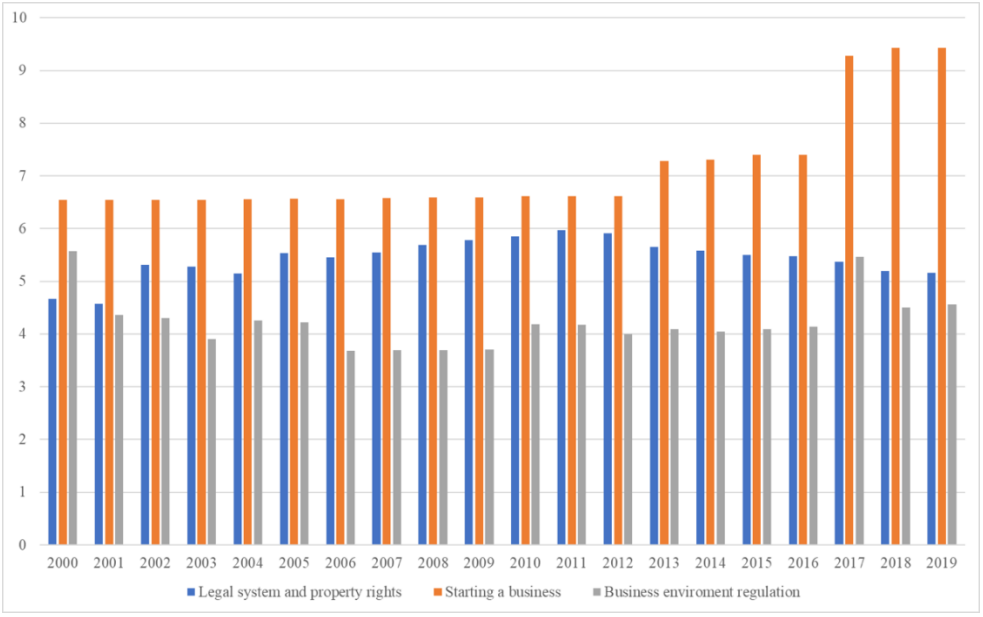

Figure 42. Score of institutional variables for Brazil 2000 - 2019

Source: Author ś own based on data from the Fraser Institute and the World Bank.

We have observed (Figure 25) that, in relative terms, the quality of institutions in Brazil worsened when analyzed in relation to the best comparison group. Abobe, in Figure 42, we observe some subcomponents of the more aggregated indicator. The variable "starting a business" measures the amount of time and cost of opening a new business. We can see a certain rigidity and it worsens over time, making it difficult for economic agents to legally start an economic activity. In relation to the variable that measures the quality of laws and institutions that protect and guarantee property rights, we experienced a significant worsening throughout the series. The variable related to the quality of the business environment shows some stability, with two years of worsening, in 2000 and 2017, to the detriment of a stable average score.

Finally, it is important to mention that synthetic control does not allow statistical inference to be made through traditional hypothesis tests and confidence intervals. This is a topic on which the literature is evolving at this point. However, as an alternative to these traditional confidence tests, Abadie, Diamond and Hainmueller (2010) and Abadie and Gardeazabal (2003) suggest a placebo test technique to increase the reliability of the results, which consists of applying the same method to a country in which there were no similar economic policies (generally the country with the highest weight in the control group[14]), comparing it with the results of the synthetic country. By comparing the difference between the treated country (Brazil) and its synthetic control (from the donor countries) with the differences between the placebo countries and their controls, it is possible to assess whether the treatment effect observed in the treated country is due to chance (i.e., randomness).

The placebo tests applied to the other countries in the sample that had greatest weight in the control group for Brazil did not show greater differences in variation between them and the new synthetic groups when compared to what was observed for "real Brazil" (and its controls), considering the intervention from 2011 onwards. This suggests that several (non-random) factors in the intervention period considered were important for the low performance of the Brazilian economy in the period in comparison to other economies in the control group.

6. Final Remarks

The Brazilian economy went through a cyclical reversal after 2010 and a recession in 2015-2016 due to uncoordinated monetary and fiscal economic policies, with no verifiable parallel in the control group of countries, used in the construction of the "synthetic Brazil", which was based on a series of macroeconomic, institutional, and sectoral variables. For empirical tests, the year of intervention was 2011 due to the deepening lack of coordination of monetary and fiscal policies.

In this context, the economy's performance was negatively influenced by the fall in the investment rate, the capital stock (aggregate and *per capita*) and the increase in the inflation rate, which in an inflation targeting regime, causes the Central Bank to increase the interest rate with unfavorable impacts on the credit market and aggregate demand. This

[14] In Appendix A is presented the weight of each country in the application of the synthetic control method.

ended up influencing the increase in the unemployment rate, the mediocre performance in *per capita* income growth and the worsening of the income gap in relation to the USA, with no similar occurrence in the sample of countries used in the counterfactual.

It was found that, after the intervention period, there was a drop in the internal rate of return on capital, in the aggregate and sectoral productivity of industry and services, with greater resilience only in the productivity of the sector related to agriculture, forestry and fishing. The hypertrophy of the services sector and the drop in employment and productivity in industry are linked to the decrease in economic complexity observed in the period.

Finally, the low dynamism of variables related to capital stock, investment rate, institutions and productivity has greatly conditioned the performance of the Brazilian economy in the recent past. A combination of these factors produced on average a low-growth economy in the period after 2010. Naturally, further research is needed concerning the determinants of productivity growth and technological gap in Brazil.

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Authors' contributions

There is just an author for this manuscript.

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Competing interests

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Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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Data availability statement

The data that support the findings of this study are available along the article, described in table 4.

Data sharing statement

No additional data are available.

References

Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *American Statistical Association, 105*(490), 493-505. https://doi.org/10.1198/jasa.2009.ap08746

Abadie, A., & Gardeazabal, J. (2003). The Economic Costs of Conflict: A Case Study of the Basque Country. *The American Economic Review, 93*(1), 113-132. https://doi.org/10.1257/000282803321455188

Clarida, R., Gal ί J., & Gertler, M. (1997). *Monetary policy rules in practice: some international evidence*. NBER Working Paper Series 6254. https://doi.org/10.1016/S0014-2921(98)00016-6

Feenstra, R. C., Robert, I., & Marcel, P. T. (2015). The Next Generation of the Penn World Table. *American Economic Review, 105*(10), 3150-3182. https://doi.org/10.1257/aer.20130954

IMF. (2023). *World Economic Outlook: A Rocky Recovery*. Abril, 2023. Philip Barrett, Christoffer Koch, Jean-Marc

Natal, Diaa Noureldin, and Josef Platzer, with support from Yaniv Cohen and Cynthia Nyakeri, Chapter 2.

IBGE. *Estatísticas do Século XX – IBGE*. Disponível em: https://seculoxx.ibge.gov.br/

Instituto Fiscal Independente (IFI). *Séries Especiais.* 2021. Disponível em: https://www12.senado.leg.br/ifi

Inklaar, R., & Woltjer, P. (2019). *What is new in PWT 9.1?* Retrieved from https://www.rug.nl/ggdc/productivity/pwt/?lang=en

Jorgenson, D. W., & Nishimizu, M. (1978). U.S. and Japanese Economic Growth, 1952-1974: An International Comparison. *Economic Journal, 88*(352), 707-726. https://doi.org/10.2307/2231974

Mantega, G. (2012). *O primeiro ano da nova matriz econômica*. Valor Econômico, 19 de dezembro.

Marquetti, A., & Miebach. (2022). *Quatro décadas de "quase estagnação"*. Valor Econômico, 17 de agosto.

Marquetti, A., Madonado Filho, E., Miebach, A. & Morrone, H. (2023). Uma interpretação da economia brasileira a partir da taxa de lucro: 1950-2020. *Brazilian Journal of Political Economy.* https://doi.org/10.1590/0101-31572023-3432

Meyer, T. R. (2019). *Determinantes do investimento privado no Brasil no período recente: uma abordagem pós-keynesiana*. Tese (Doutorado em ciências econômicas) – Programa de Pós-Graduação em Ciências Econômicas, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2019.

Nóbrega, M. (2016). Construção e desmonte das instituições fiscais. In Salto, F. e Almeida, M. (2016). *Finanças Públicas: da contabilidade criativa ao resgate da credibilidade.* 1ªed. Editora Record. Capítulo 1.

Oreiro, J. L., Gabriel, L. F., Damato, S., & Silva, K. M. (2023). Labour Market Reforms in Brazil (2017-2021): An Analysis of the Effects of Recent Flexibilization on Labor Marlet Legislation. *Panoeconomicus, 4,* 601-625. https://doi.org/10.2298/PAN2304601O

Reinhart, C., Reinhart, V., & Trebesch, C. (2016). Global Cycles: Capital Flows, Commodities, and Sovereign Defaults, 1815-2015. *American Economic Review, 106*(5), 574-80. https://doi.org/10.1257/aer.p20161014Pinto, V., & Andrade, A. (2021). *Simulações para o resultado primário estrutural do governo central*. Instituto Fiscal Independente (IFI), Estudo Especial no. 17.

Rodrik, D. (2008). *Real Exchange Rate and Economic Growth*, Brookings Papers on Economic Activity, Fall.

Salto, F., & Almeida, M. (2016). *Finanças Públicas: da contabilidade criativa ao resgate da credibilidade*. 1ªed. Editora Record.

Schymura, L. G. (2017). O rico debate sobre a nova matriz econômica no Blog do Ibre. *Conjuntura Econômica, Novembro, 71*(11).

SPE – SECRETARIA DE POLÍTICA ECONÔMICA (2021). *Resultado Fiscal Estrutural 2020*. Brasília, Secretaria de Política Econômica do Ministério da Fazenda (MF/SPE), Nota Metodológica, Maio de 2021. Disponível em: https://bit.ly/3sjp6yK

Taylor, J. B. (1993). *Discretion versus policy rules in practice*. In Carnegie-Rochester Conference Series on Public Policy, 39.

World Bank Database - *World Development Indicators.* Disponível em: *http://data.worldbank.org/indicator*

Appendix A – Unit weights of the control group for each estimation carried out**.**

Figure 9 – GDPGrowth - Argentina (0.039), Bolivia (0.019), 40(0.032), China (0.182), Colombia (0.04), Ecuador (0.02), 89(0.059), 90(0.043), Malaysia (0.066), Mexico (.279), Paraguay (0.023), Peru (0.024), Russia (0.09), Türkiye (0.049), Uruguay (0.037).

Figure 10 – pcgGDPGrowth - Argentina (0.038), Bolivia (0.02), Chile (0.032), China (0.18), Colombia (0.039), Ecuador (0.02), India (0.059), Indonesia (0.043), Malaysia (0.062), Mexico (0.285), Paraguay (0.023), Peru (0.024), Russia (0.09), 197 (0.048), Uruguay (0.036).

Figure 11 – incomegap - Argentina (0.054), Bolivia (0.023), Chile (0.04), China (0.039), Colombia (0.052), Ecuador (0.023), India (0.042), Indonesia (0.039), 120 (0.083), Mexico (0.37), 153(0.035), Peru (0.024), 161(0.06), 197(0.058), Uruguay (0.057).

Figure 12 – pcGDP - Argentina (0.049), Bolivia (0.016), Chile (0.04), China (0.079), Colombia (0.054), Ecuador (0.017), India (0.056), Indonesia (0.044), Malaysia (0.093), Mexico (0.315), Paraguay (0.024), Peru (0.025), Russia (0.074), Turkey (0.061), Uruguay (0.051).

Figure 13 – fbkf - Argentina (0.039), Bolivia (0.015), Chile (0.038), China (0.08), Colombia (0.053), Ecuador (0.024), India (0.055), Indonesia (0.039), Malaysia (0.064), Mexico (0.302), Paraguay (0.025), Peru (0.02), 161 (0.163), Turkey (0.04), Uruguay (0.044).

Figure 14 – unemployment (without the lreg predictor) - Argentina (0.017), Bolivia (0.008), Chile (0.012), China (0.047), Colombia (0.036), Ecuador (0.008), India (0.364), Indonesia (0.028) , Malaysia (0.031), Mexico (0.322), Paraguay (0.018), Peru (0.009), 161(0.014), Turkey (0.062), Uruguay (0.023).

Figure 15 – unemployment (lreg predictor included) - Mexico (0.336), Paraguay (0.095), Türkiye (0.569).

Figure 16 – eciplus - Argentina (0.049), Bolivia (0.043), Chile (0.045), China (0.211), Colombia (0.046), Ecuador (0.044), India (0.088), Indonesia (0.066), Malaysia (0.048), Mexico (0.066), Paraguay (0.043), Peru (0.044), Russia (0.109), Turkey (0.055), Uruguay (0.043).

Figure 17 – eci2 - 6-digit series HS96 (1998-2021) - Argentina (0.03), Bolivia (0.007), Chile (0.016), China (0.027), Colombia (0.019), Ecuador (0.004), India (0.024) , Indonesia (0.012), Malaysia (0.041), Mexico (0.706), Paraguay (0.008), Peru (0.006), Russia (0.05), Turkey (0.023), Uruguay (0.026).

Figure 18 – inflation dp - Argentina (0.075), Bolivia (0.064), Chile (0.06), China (0.016), Colombia (0.061), Ecuador (0.06), India (0.032), Indonesia (0.046), Malaysia (0.054), Mexico (0.247), Paraguay (0.045), Peru (0.043), Russia (0.052), Turkey (0.063), Uruguay (0.079).

Figure 19 – inflation - Bolivia (0.069), Chile (0.062), China (0.016), Colombia (0.066), Ecuador (0.067), India (0.041), Indonesia (0.053), Malaysia (0.054), Mexico (0.245), Paraguay (0.077), Peru (0.051), Russia (0.051), Türkiye (0.061), Uruguay (0.086)

Figure 20 – irr - Argentina (0.049), Bolivia (0.043), Chile (0.045), 41 (0.212), Colombia (0.046), Ecuador (0.044), India (0.088), Indonesia (0.066), Malaysia (0.048), Mexico (0.066), Paraguay (0.043), Peru (0.044), Russia (0.107), Turkey (0.055), Uruguay (0.043).

Figure 21 – hcpwt - Argentina (0.636), Mexico (0.364).

Figure 22 – tfp - Argentina (0.039), Bolivia (0.026), Chile (0.034), China (0.149), Colombia (0.051), Ecuador (0.024), India (0.059), Indonesia (0.042), Malaysia (0.057), Mexico (0.352), Paraguay (0.03), Peru (0.031), Russia (0.023), Turkey (0.045), Uruguay (0.039).

Figure 23 – kstockrl - Argentina (0.049), Bolivia (0.016), Chile (0.04), China (0.079), Colombia (0.054), Ecuador (0.017), India (0.056), Indonesia (0.044), Malaysia (0.093), Mexico (0.315), Paraguay (0.024), Peru (0.025), Russia (0.074), Turkey (0.061), Uruguay (0.051).

Figure 24 – pckstockrl - Argentina (0.049), Bolivia (0.043), Chile (0.045), China (0.211), Colombia (0.046), Ecuador (0.044), India (0.088), Indonesia (0.066), Malaysia (0.048), Mexico (0.066), Paraguay (0.043), Peru (0.044), Russia (0.109), Turkey (0.055), Uruguay (0.043).Argentina (0.636), Mexico (0.364).

Figure 25 – efindex - Argentina (0.049), Bolivia (0.043), Chile (0.045), China (0.212), Colombia (0.046), Ecuador (0.044), India (0.088), Indonesia (0.066), Malaysia (0.048), Mexico (0.066), Paraguay (0.043), Peru (0.044), Russia (0.107), Turkey (0.055), Uruguay (0.043).

Figure 26 – ttrade - Argentina (0.07), Bolivia (0.064), Chile (0.058), China (0.017), Colombia (0.062), Ecuador (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), Turkey (0.057), Uruguay (0.08).

Figure 27 – domesticcredit03 - Bolivia (0.075), Chile (0.067), China (0.02), Colombia (0.072), Ecuador (0.073), India (0.046), Indonesia (0.058), Malaysia (0.06), Mexico (0.231), Paraguay (0.083), Peru (0.056), Türkiye (0.066), Uruguay (0.093).

Figure 28 – manu01 - Argentina (0.011), Bolivia (0.003), Chile (0.006), Colombia (0.007), Ecuador (0.002), India (0.012), Indonesia (0.005), Malaysia (0.555), Mexico (0.376), Paraguay (0.003), Peru (0.002), Türkiye (0.009), Uruguay (0.008).

Figure 29 – manu02 - Argentina (0.038), Bolivia (0.007), Chile (0.02), Colombia (0.024), Ecuador (0.005), India (0.031), Indonesia (0.015), Malaysia (0.056), Mexico (0.728), Paraguay (0.008), Peru (0.007), Türkiye (0.029), Uruguay (0.032).

Figure 30 – services01 - Argentina (0.023), Bolivia (0.007), Chile (0.013), China (0.004), Colombia (0.015), Ecuador (0.005), India (0.017), Indonesia (0.009), Malaysia (0.039), Mexico (0.407), Paraguay (0.008), Peru (0.005), Russia (0.412), Turkey (0.018), Uruguay (0.019).

Figure 31 – services02 - Argentina (0.07), Bolivia (0.064), Chile (0.058), 41 (0.017), Colombia (0.062), Ecuador (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), Turkey (0.057), Uruguay (0.08).

Figure 32 – agriculture01 - Argentina (0.025), Bolivia (0.006), Chile (0.013), 41 (0.006), Colombia (0.016), Ecuador (0.004), India (0.019), Indonesia (0.009), Malaysia (0.043), Mexico (0.408), Paraguay (0.007), Peru (0.004), Russia (0.402), Turkey (0.019), 206 (0.02).

Figure 33 – agriculture02 - Argentina (.049), Bolivia (0.016), Chile (0.04), China (0.079), Colombia (0.054), Ecuador (0.017), India (0.056), Indonesia (0.044), Malaysia (0.093) , Mexico (0.315), Paraguay (0.024), Peru (0.025), Russia (0.074), Turkey (0.061), Uruguay (0.051).

Figure 34 – emplind01 - Argentina (0.07), Bolivia (0.064), Chile (0.058), China (0.017), Colombia (0.062), 57 (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), Turkey (0.057), Uruguay (0.08).

Figure 35 – emploser01 - Argentina (0.02), Bolivia (0.008), Chile (0.012), China (0.001), Colombia (0.014), Ecuador (0.007), India (0.013), Indonesia (0.01), Malaysia (0.03), Mexico (0.406), Paraguay (0.008), Peru (0.007), Russia (0.432), Turkey (0.016), Uruguay (0.016).

Figure 36 – emplagr01 - Argentina (0.024), Bolivia (0.006), Chile (0.013), China (0.006), Colombia (0.016), Ecuador (0.005), India (0.018), Indonesia (0.009), Malaysia (0.041), Mexico (0.409), Paraguay (0.007), Peru (0.005), Russia (0.404), Turkey (0.019), Uruguay (0.019).

Figure 37 - agriculture06 - Chile (0.067), China (0.017), Colombia (0.072), Ecuador (0.073), India (0.044), Indonesia (0.057), Malaysia (0.059), Mexico (0.26), Paraguay (0.084), Peru (0.055), Russia (0.055), Türkiye (0.066), Uruguay (0.094).

Figure 38 – industry06 - Argentina (0.07), Bolivia (0.064), Chile (0.058), China (0.017), Colombia (0.062), Ecuador (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), Turkey (0.057), Uruguay (0.08).

Figure 39 – services06 - Argentina (0.07), Bolivia (0.064), 40 (0.058), China (0.017), Colombia (0.062), Ecuador (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), Turkey (0.057), Uruguay (0.08).

Figure 40 – misxrate2 - Argentina (0.07), Bolivia (0.064), Chile (0.058), China (0.017), Colombia (0.062), Ecuador (0.063), India (0.04), Indonesia (0.05), Malaysia (0.051), Mexico (0.22), Paraguay (0.071), Peru (0.049), Russia (0.048), 197 (0.057), Uruguay (0.08).

Figure 41 – agedependr - Argentina (0.025), Bolivia (0.006), Chile (0.013), China (0.006), Colombia (0.016), Ecuador (0.004), India (0.019), Indonesia (0.009), Malaysia (0.043), Mexico (0.408), Paraguay (0.007), 154 (0.004), Russia (0.402), Turkey (0.019), Uruguay (0.02).