"POLITICAL REGIMES AND ECONOMIC PERFORMANCE A TIME SERIES APPROACH"

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The Economic Consequences of the Chilean Democratic Transition

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Abstract

This article uses tools from the macroeconomic time series literature to study the economic effects of the post-dictatorship Chilean democratic transition. Using autoregressive vectors (VAR) the dynamic effects of the "democratic shock" that occurred in Chile during the years 1988-89 are estimated, providing relevant empirical evidence for the study of the historical relationships between economic growth, inequality and type of political regime. It is found that this democratic improvement resulted in a higher long-term growth rate of GDP per capita (3% above the baseline scenario) and a slight decrease in inequality of 0.3-0.4 Gini points. In line with the related literature, improvements were observed in the variables associated with human and physical capital. The effects were not immediate, which raises the dilemma of the political economy of transitions: in the Chilean case, the democratic shock of 1988-89 took 3 years to have a positive impact on the growth rate of GDP per capita and the total effect peaked after 7 years.

Key words: *Political Regimes, Democratic transitions, Chile*

JEL Classification: *C32, O11, O43, P16*

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1. *Introduction*

This article uses a time series approach to study the long-term economic effects triggered by changes in the type of political regime. The case studied corresponds to the post-dictatorship Chilean democratic transition, with an approach that combines elements of historical narrative with tools from the macroeconomic literature of Autoregressive Vectors (VAR).

When the differences between rich countries and poor and middle-income countries are observed, we see that the former exhibit higher levels of productivity and a workforce with better education and health, as well as more and better machines and equipment and innovation capacities. And it is often believed that in these variables lies the explanation for the determinants of growth. But the really interesting question, as raised by Acemoglu et al. (2014), is about the ultimate conditions that make possible the highest levels of innovation and Research and Development, as well as human, social and physical capital. The answer from the neo-institutionalist literature is that institutions, the rules of the game or restrictions that we design as a society, defines the incentives that shape decisions regarding innovation, the accumulation and better use of social knowledge, and the accumulation of human and physical capital. A part of this literature has studied how a specific institution - democracy - influences economic performance.

Here a first caveat. There are significant qualitative differences between democracies and the index that will be used throughout this work - The Polity Index - does not necessarily reflect the "orientations" of each type of democracy: there are democracies that can implement public policies that favor one social class or economic sectors in relative detriment of another with very different consequences for growth and inequality. But here is the point. Given that the effects are analyzed at the specific country level, to the extent that there is an adequate set of data (such as inequality or sectoral productive structure, for example), through the observed results it will be possible to infer the orientation of the policies adopted in the political regimes of each country.

This work is inserted precisely in that line of research. Exploiting the recent availability of long series for the variables of interest, the objective of this research is to test a set of the neo-institutionalist hypotheses, using well-known tools from the macroeconomic literature of Autoregressive Vectors (VAR) and provides estimates of the economic effects of the Chilean democratic transition after the Pinochet dictatorship.

Chile has interesting characteristics for a study of this kind. The first is the availability of data. The recent versions of Polity IV and the Maddison database (v.2018) allow us to have long series of variables associated with the level of democracy and the growth rate of GDP

per capita, respectively. Added to this work is the series constructed by Rodríguez-Weber (2017) who estimates, under different methods, a series for the long-term Gini coefficient for Chile. Finally, the existence of the project "La República en cifras"(Díaz et al. 2016) of the CliometricsLab of the Universidad Católica de Chile allows for making robustness analyzes of the estimated models, in addition to opening up new lines of research.

Second, the series associated with the democratic variable exhibits a level of variability that allows for such an investigation. In other words, the history of Chile post '73 has exhibited changes of relevant magnitude in the indicator that captures the type of political regime.

Third, but beyond the scope of this article, the characteristics of its democratic transition are interesting to address the problem of commitment and the behavior of the elites in the face of "revolutionary threats." For example, according to Acemoglu (2008), by making democracy less threatening to the interests of the elites, the democratization process is facilitated:

"If a nondemocratic regime or elite can design or manipulate the institutions of democracy so as to guarantee that radical majoritarian policies will not be adopted, then democracy becomes less threatening to the interests of the elites… For instance, when democracy is less threatening, it will be less attractive to use repression to avoid it. Thus, Pinochet's constitution, according to our framework, facilitated democratization in Chile."

In Chile, the so-called "*commitment problem*" was solved through a series of mechanisms and compromises: A first level corresponds to the rigid legal structure established in the 1980 Constitution. The same happened in various sectoral laws through the so-called "tie laws" (*"leyes de amarre"*) dictated during the last days of the regime. In practice, a situation of veto power was granted to a minority through gerrymandering, the over-representation of this minority due to the bi-nominal system and the high quorums required for key laws,and finally the threat of a military veto with respect to democratic decisions (see Acemoglu 2008, Londregan 2000 and Siavelis 2000).

Having long-term data allows us to use the time series approach, and to characterize the dynamic effects of "democratic shocks" on the economic system in line with, the research program that studies the effects of monetary policy on the economy. Thus, it is possible to explore the consequences of unexpected changes in a given "policy variable". From the econometric point of view, finally, this approach is justified, since focusing on a single economic system makes it possible a better control for the characteristics of unobservable variables that in general can produce biases in cross-section studies.

The main results of the estimated central scenario show that the democratic shock of '88-'89 resulted in a higher long-term growth rate of GDP per capita of a magnitude of 3 points above the baseline scenario, and a slight decrease in inequality of 0.3-0.4 points of the Gini.

The rest of the article is structured as follows. Section 2 presents the arguments for and against democracy, as well as recent empirical evidence. Section 3 gives a brief historical overview of the Chilean democratic transition, highlighting the uncertainty regarding the outcome of the plebiscite and the subsequent recognition of the results. Section 4 shows the main data used, as well as the definitions and their sources. Section 5 shows the econometric strategy used, the main results and the robustness analyzes carried out and investigates some of the possible channels through which democracy affects economic results. Section 6 presents the conclusions.

2. *The arguments and the evidence*

"*No famine has ever taken place in the history of the world in a functional democracy*", stated Amartya Sen in his 1999 book, "Development as Freedom". Two decades earlier, in "Poverty and Famines: An Essay on Rights and Deprivation", Sen had already identified inequitable distribution mechanisms rather than a lack of food as the main cause of famines. Famines are not the result of scarcity. They are the result of the effective priorities that a society expresses and there is when democracy plays a fundamental role.

The impact of a democratic improvement on economic growth is still disputed. A 2009 New York Times columnist argued that there were advantages of a one-party regime –which is by definition undemocratic–due to its ability to enforce decisions that can be politically costly but fundamental to the progress of a modern economy. Thus, a single party can make costly investments in the short term that would be difficult to implement in a democratic environment.

The defenders of this vision conclude that a dictatorship has a greater capacity to force savings - reducing current consumption - and thus promote growth. Or put in other words, democracy hinders growth since it is not able to contain the pressures to increase current consumption, thus reducing the capacity to save and invest. Rao (1984) cited in Przeworski and Limongi (1993) synthesizes it like this:

"*Economic development is a process for which huge investments in personnel and material are required. Such investment program simply cuts in current consumption that would be painful at the low levels of living that exist in almost all developing societies. Governments must resort to strong measures and they enforce them with an iron hand in order to marshal the surpluses needed for investment. If such measures were put to a popular vote, they would surely be defeated. No political party can hope to win a democratic election on a platform of current sacrifices for a bright future*."

On the opposite side, Persson and Tabellini (2009) coined the idea of "democratic capital" suggesting the existence of a virtuous circle where the accumulation of physical capital and democratic capital positively feed each other, facilitating the process of economic development along with a consolidation of democratic institutions. Along the same lines is the argument that democracy enhances the ability to minimize the veto power of a minority, which in its search for rents (Rajan, 2009) can ends up influencing the political system and shaping the economic environment in its favor. In this way, the elite prevent the entry of new economic actors, which slows down the growth of the economy and favors the concentration of income. Acemoglu (2008) shows the possible sources of inefficiency derived from excessive power on the part of what he calls the "oligarchic elite".

Democracy then operates as a mechanism that helps to solve the problems of political economy involved in the elaboration of public policies. In the game of political counterweights, the provision of evidence and the possibility of openly disagreeing with any public issue lies part of the power of democracy, which allows, on the one hand, for having a process of permanent improvement in public policies and, on the other, gives them legitimacy. Democracy institutionalizes negotiation procedures between parties with dissimilar views with the expectation that the result of these procedures will turn out to be more effective and efficient in resolving conflicts, with the ability to find better solutions than those that would be imposed from above, in a dictatorial or broadly speaking, autocratic regime.

2.1 The arguments in the Chilean case

A BBC report (2019) asked *"Is Chile's economic miracle really a Pinochet inheritance? Who is the author of the Chilean economic miracle?"*

Ffrench-Davis (2014) highlights that the economic results were meager compared to other periods in Chile:"*The Pinochet dictatorship was not successful economically, but rather mediocre and disastrous in terms of distribution*". He also lists the restrictions on labor rights and the accentuated precariousness of the labour market. The gap between rich and poor increased in the period, emphasizing the poor growth of the minimum wage. He also questions the benefits of the economic management of the dictatorship, recalling how "… in 1983, the free market champions allocated 35% of GDP to bail out private banks, for which they drastically reduce pensions, family allowances, and salaries of public employees. , contributions to the health ministry, teachers' salaries and cut investment in infrastructure ". He concludes that "the net balance of the neo-liberal reforms, in the end, is not pro-development but rather pro-speculation and pro-inequality."

There was then no "economic miracle" in the Pinochet era. What took place was a risky deregulation and hyperexpansion of the financial sector, which left Chile highly exposed to reversals of international flows.

In the same BBC report, regarding the policies put in place by the governments of the "Concertación", an academic and high level former official of the said coalition points out:

"*The democratic governments steadily increased the role of the state, particularly in the areas of infrastructure, social policies, consumer protection, health and education. At the end of the dictatorship in Chile there were no universal health insurance, unemployment insurance, free education superior, nor solidarity pillars in the pension system* ".

Noah Smith, a columnist for the international news agency Bloomberg, summed up the discussion in a tweet in November 2018: *"The annualized growth of real GDP per capita for Chile under Pinochet (1973-1990) was 1.6%. The annualized per capita real GDP growth for Chile in the 17 years after Pinochet (1990-2007) was 4.36%. Pinochet is way overrated".*

Beyond the averages and arguments, the difficulty lies in making an evaluation that controls for as many factors as possible, considering, for example, international crises, variations in the terms of trade and the interaction with other socio-economic variables. This work provides an empirically-based answer to explain the post-dictatorship economic growth. The results show that the notorious democratic improvement was the fundamental causal variable that explains the economic performance for that period.

2.2 A critical review of the empirical evidence

There are various approaches to studying the effects of institutions on economic performance. Most studies correspond to cross-sectional regressions at the level of countries or local areas and address the inherent endogeneity problems in different ways, devising and proposing various instruments to find plausibly exogenous variations in the institutional variable. Some of the most prominent studies using this strategy are those of Acemoglu et al. (2015) and Acemoglu et al. (2019), in which they explore the relationships between democracy, growth and inequality. The latter work, in addition to critically pointing out the shortcomings of previous studies, offers a set of evidence with various methodologies and identification strategies, concluding that "democracy does cause growth."

From the perspective of a time-series methodological approach, it is possible to raise some general criticisms of these studies. First, they do not allow us to study the possible bi-directional relationships between economic and political variables. (López, 2020). It is feasible to think that unexpected changes in the growth rate for a certain period - for example, a sharp drop - are transmitted through political pressure, even in a dictatorial regime. The same occurs with the relationship between inequality and the political regime.

Chang (2011) raises several criticisms of this type of literature. He also states that the bulk of this literature does not consider the possibility that causality goes from economic development to institutions. This also points to the risk of assuming linear functional forms, ruling out non-monotonic or time-varying effects. Finally, he is critical of the excessive weight that cross-sectional studies have, arguing in favor of the use of time series with a coherent historical perspective. This work is inserted precisely in this debate, taking into account the aforementioned criticisms and testing them in a novel way for the case of a specific economy.

2.3 The contribution of this work

This article is eminently empirical. It does not seek to give theoretical explanations of the results found. There is abundant theory about the effects and channels through which institutions - particularly democracy - affect different economic paths.

As mentioned, much of the evidence for the effects of institutions on economic performance has been provided by cross-sectional studies, with different degrees of refinement. Discontinuous regression and propensity score matching techniques have also been used to evaluate the effects of institutional and micro-institutional changes.

Each tool exhibits pros and cons and the choice will depend on the problem and the question to be answered. The strategy used in this work is novel in terms of the relationships it analyzes, but it is analogous to the study of the effects of monetary policy (or technological shocks) on economic activity or other variables. In this case, the object of study are the dynamic effects on the economic performance triggered by what is called a "democratic shock".

Using a time-series approach, a simple methodological proposal is used to test some of the predictions of the neo-institutionalist literature. This methodology proceeds as follows: First, the impulse-response functions are estimated using the Sims recursive method based on the Cholesky decomposition. Since this method can be sensitive to the order of the variables in the VAR, the consistency of the results with the different possible orders of the variables is checked. Also, the generalized IRFs proposed by Pesaran and Shin (1998) and

Pesaran and Smith (1998), whose appeal is that they do not depend on the ordering of the variables in the VAR, are also estimated. Finally, and with the aim of identifying long-term relationships between the variables, this methodology uses the "General to Specific" approach developed by Hendry and co-authors in several articles[2] . The latter is explained more extensively and reported for the case of several countries in Accorsi (2022) and here only the results are commented.

The time-series approach also makes it possible to link and reconcile the historical analysis with the economic one, since it provides empirical evidence that, if well interpreted, becomes valuable historical information.

Thanks to the information available for the Chilean case, it is possible to estimate more flexible specifications of the VAR, including variables associated with human capital, physical capital, inflation and fiscal policy. The results are robust to these specifications even when copper production is subtracted from GDP and when the terms of trade are included, a variable usually associated with the Chilean economic cycle.

3. The historical context of the 1988 Plebiscite: An uncertain result

The 1980 Constitution, approved through a questioned plebiscite during the dictatorship, contemplated the future holding of a consultation regarding the continuity of the government. The person proposed as a candidate by the government for the said continuity could be approved or rejected. The candidate was the commander-in-chief of the army and head of the governing board, Augusto Pinochet.

If the "Yes" option won, the president-elect would assume office for a period of eight years, from March 11, 1989, the same day that the previous term was to end, until March 11, 1997. It also contemplated the call to general elections of senators and deputies.

If the "No" option won, Augusto Pinochet's presidential term would be extended for one more year, until March 11, 1990, together with the functions of the Governing Board, and presidential and parliamentary elections would be called.

The outcome of the October 1988 election was extremely uncertain. Annex 1 shows the high variability in the predictions of the surveys[3]. One explanation for this is that fear and

[2] Among others, see Krolzig and Hendry, (2001), Campos et al., (2003), Hendry and Krolzig (2004, 2005), Campos, Ericsson and Hendry, (2005) and Hendry and Doornik (2014)

[3] According to a CEP survey carried out at that time, among the causes that motivated the majority to vote "NO" the bad economic situation prevailed (72%) —more than human rights (57%) due to the 20% unemployment that existed during the military dictatorship — as well as the poor distribution of income, which would explain why these arguments were made amid the apparent economic boom.

mistrust made these measurement tools less reliable. It stands out that the number who were undecided in these surveys fluctuated between 11% and 40%.

Added to this predictive uncertainty was the opaque handling of information on the same day as the historic consultation. At 7:30 p.m. on October 5, the first official report was delivered: the "Yes" obtained 57.36% compared to 40.54% for the "No".

At 10:00 pm, a new calculation was delivered: «Yes», 51.3% and «No», 46.5%. It was further announced that the next count would be delivered at 11:15 p.m. The television channels stopped covering the news and programmed cartoons. "Television broadcast cartoons on the tensest day in the country in decades," explained the head of the NO campaign years later.

There was no official recognition until the early hours of October 6. On his way to the Palacio de La Moneda, the Commander in Chief of the Air Force, Fernando Matthei, pointed out: "I am quite clear that No has won, but we are calm." According to Arancibia and de la Maza (2003), at the said meeting, Pinochet gave the members of the Military Government Junta a decree by which he would assume all power not to recognize the results of the plebiscite. This would have infuriated the members of the Board, especially Matthei, who claims that he tore the decree document into pieces with his bare hands.

Thus, the result of the election was closest to flipping a coin in terms of the political future. At 2:00 in the morning, the official counts were announced: "Yes" obtained 43% compared to 54.7% for "No".

4. *Data, definitions and sources*

The type of political regime, which can be understood as the degree of democracy that a country exhibits, is captured through the Polity2 variable, obtained from the Polity IV project database.

The Polity IV index consists of the measurement of a series of components that approximate or register the most important characteristics associated with 3 dimensions: an impersonal or non-discretionary executive power, the existence of (formal) restrictions on the executive power and the level of competitiveness that is observable in the political realm.

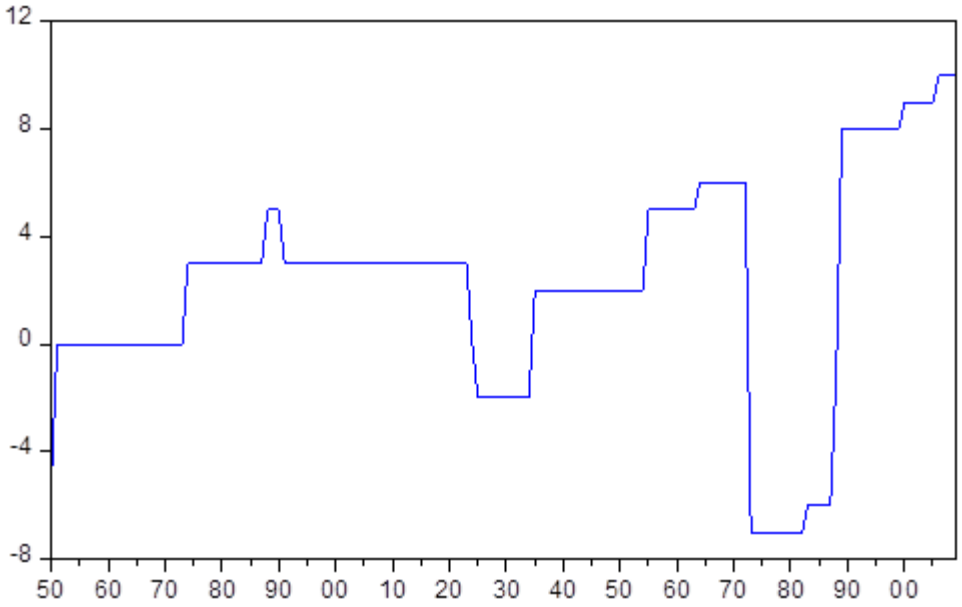
For each country and year, a “Polity Score” is determined with a range that goes from -10 to +10. The ranges and respective types of political institutionality are shown in table 1. The evolution over time of the Polity Score for the Chilean case (1850-2009) is shown in Figure 1.

TABLE 1

Polity score, definition and characterization

Range	Political regime	Characterization
[-10, -6]	Autocracies	An authoritarian regime, characterized by the concentration of all power in a dictator or despot. Its decisions are not subject to any type of legal restrictions or mechanisms of popular representation.
[-5, 5]	Annocracies	A set of government systems that can be defined as "part democracy" and "part dictatorship". It combines at different levels democratic aspects with autocratic aspects.
[6, 10]	Democracies	A Government system that allows citizens to express their political preferences. The main executive and legislative authorities are elected by individuals.

FIGURE 1. Polity Score – Chile (1850-2009)



The (log) of GDP per capita, its growth rate, as well as other statistics of interest for the said variable, are shown in Figures 2, 3 and 4 respectively.

The data for the GDP were obtained from 2018 version of the Maddison Project Database.

FIGURE2. (Log) of GDP per capita – Chile (1850 – 2009)

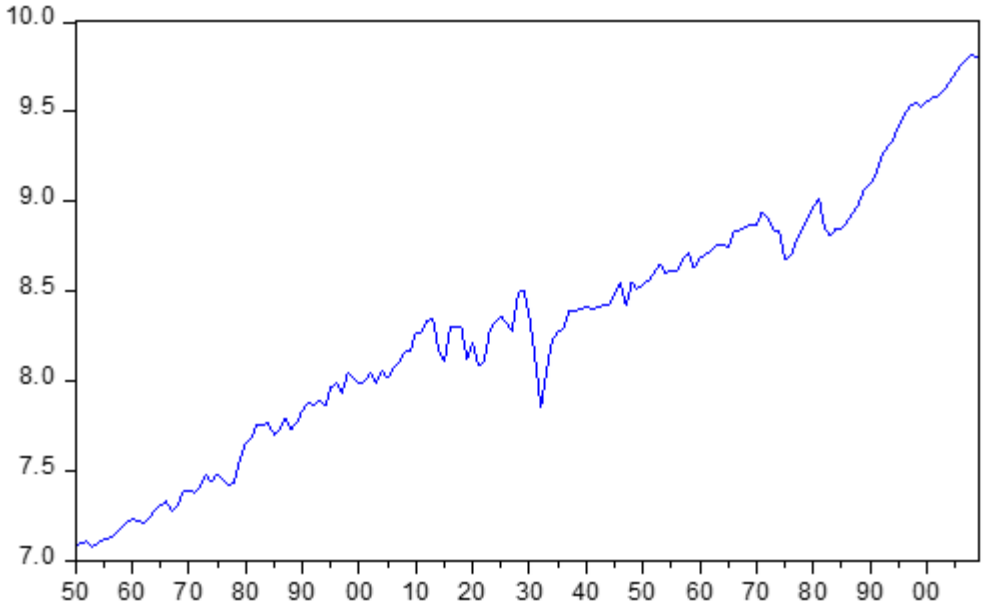


FIGURE3.GDP per capita growth rate, Chile (1850-2009)

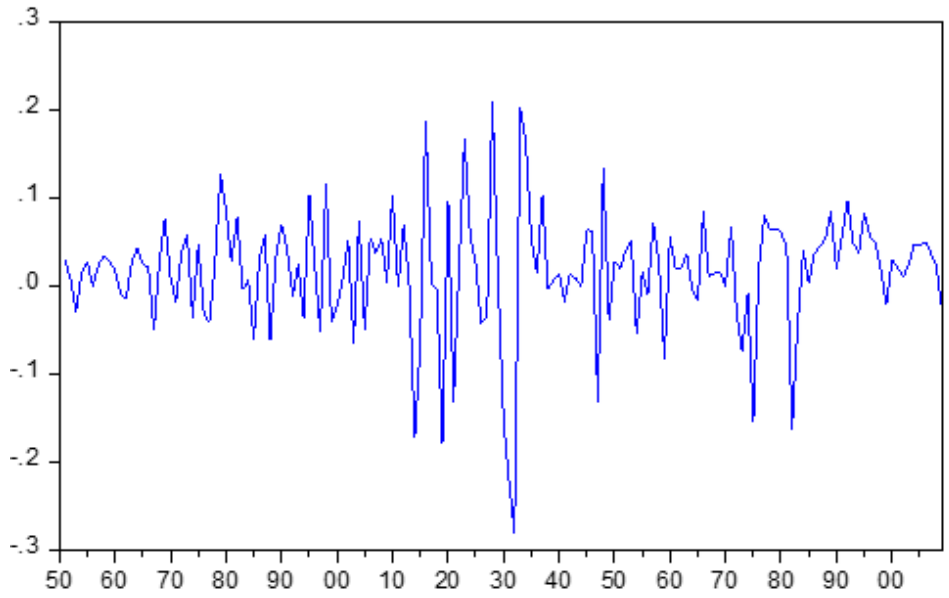
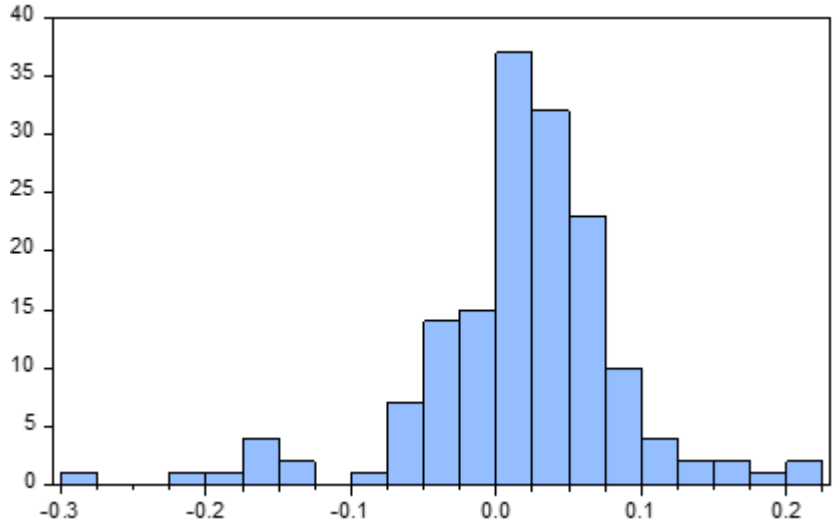
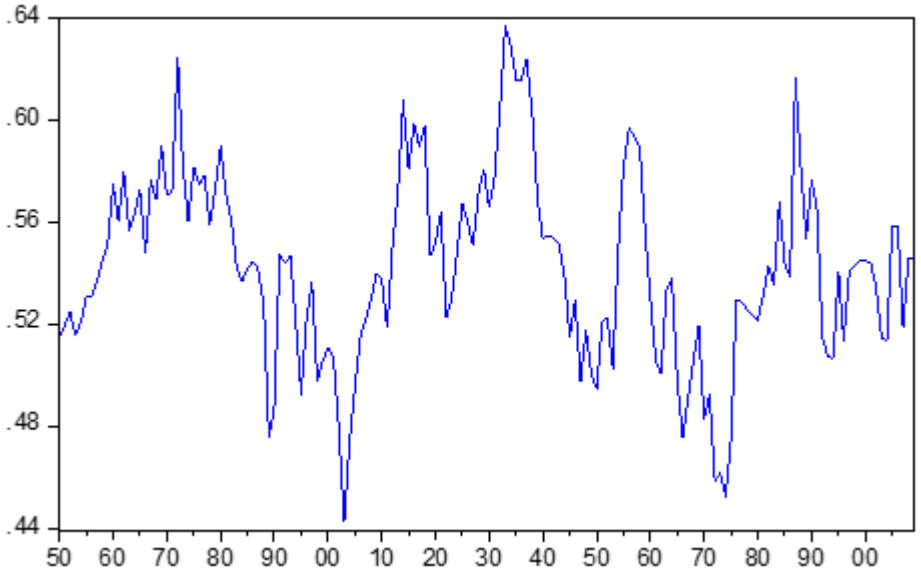


FIGURE4. Histogram of GDP per capita growth rate, Chile (1850-2009)



The Gini coefficient was obtained from Rodríguez Weber[4] (2017) and its variation are presented in Figures 5 and 6:

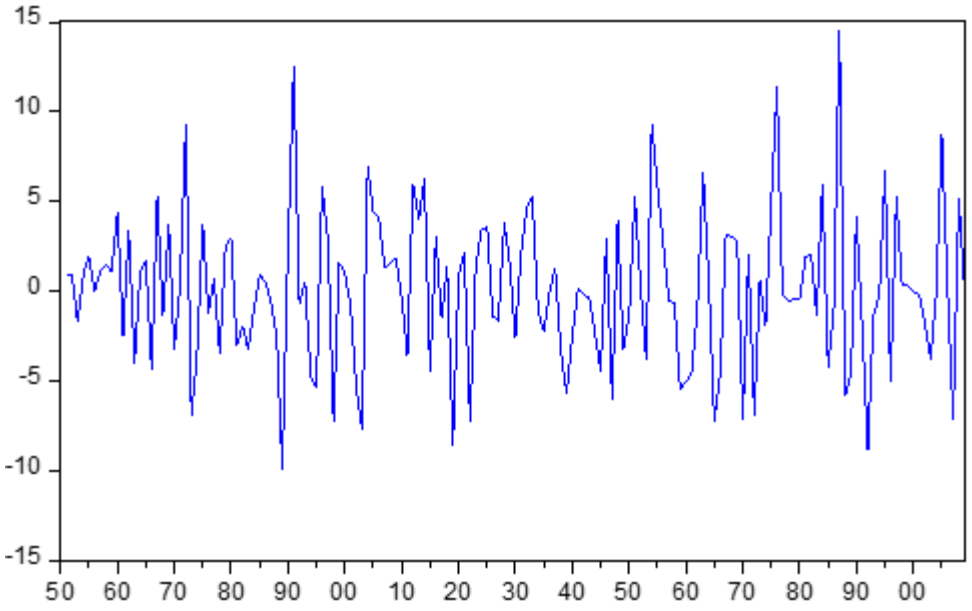
FIGURE5. Gini coefficient, Chile (1850 – 2009)



Source: Rodríguez Weber (2017)

FIGURE6.Change (%) of the Gini Coefficient, Chile (1850 – 2009)

[4] The methodology to calculate the Gini coefficient for the period 1860-1970 is based on the elaboration of "dynamic social tables". The social tables contain information on the number of people and income according to the different social or occupational categories. One of its obvious limitations is that it does not capture the inequality that exists within each category. The social tables capture only the inequality between categories and for this reason it is important to achieve a high degree of disaggregation. For the period 1860-1930, 49 categories of income recipients are obtained, while for the period 1929-1970 the breakdown reaches 116 categories. The main source of information are the population censuses that in Chile present the characteristic of having been carried out with remarkable regularity.
For the period 1970 onwards, the Gini coefficient is estimated from the Gran Santiago Occupation Survey.



4.1 A note regarding inequality in Chile

According to Rodríguez Weber (2017), in Chile there has always been an economic elite capable of concentrating a significant part of capital and income. This elite has been able to renew itself in its composition and sources of income, with periods of greater economic concentration than others, "but always a small number of families have owned or controlled the most profitable productive assets"

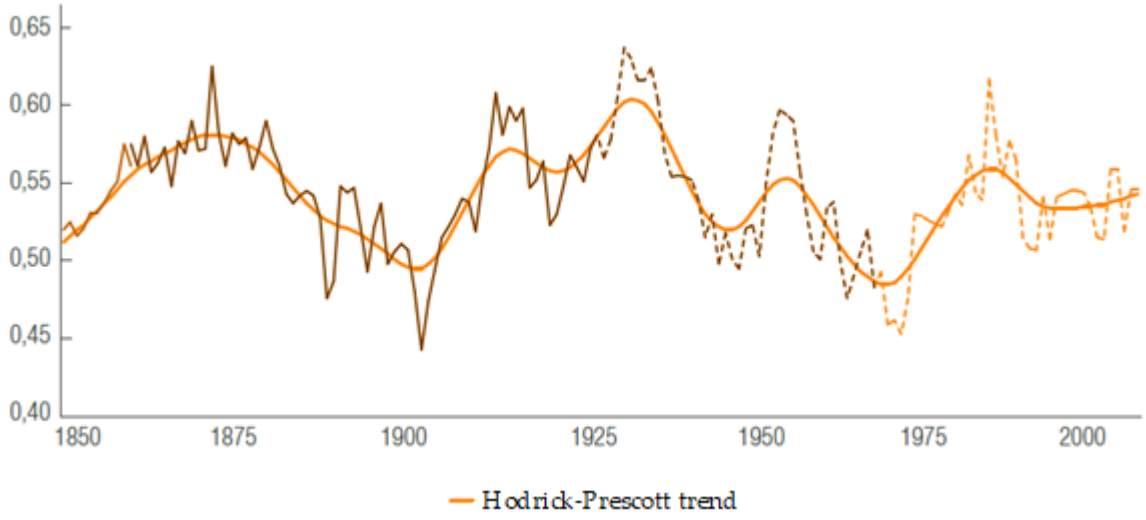
As can be seen in Figure 7, the average inequality in the country has remained relatively stable since the mid-nineteenth century. In the very long term, there is no appreciable upward or downward trend. Around the average, of approximately 0.53, there have been large oscillations in which inequality increases or decreases due to economic and international trade factors as well as political economy or geopolitical factors (Rodríguez Weber, 2017). Furthermore, comparing the Gini indices estimated for various countries in the period prior to the start of their respective industrialization processes, Chile appears to have been a country of great inequality from very early on in its development process (Milanovic, Lindert and Williamson, 2011).

This stationarity characteristic has empirical support: the long-term Gini coefficient series estimated by Rodríguez Weber and used in the present work is statistically stationary; that is to say, its mean and variance do not change as a function of time. This characteristic of the series in turn is confirmed by the historical narrative from the perspective of the "Political Economy of Inequality" and has historical support in the description of the behavior of the Chilean right in the political sphere described in the book "With the Reins of Power" (Correa Sutil, 2005)

This description is framed with an analysis of inequality along the lines of the Ricardian tradition. As Palma (2020) points out, inequality must be understood as "the result of the political articulation of the distributive conflict - in which history, politics and institutions are what really matter". Similarly, Rodríguez Weber (2017) reminds us that "the political side of the economy is always present, especially when we talk about inequality," emphasizing the importance of the institutional environment in which the market is framed and, more generally, the asymmetric power relations between those who exchange.

The degree of inequality (or inequalities) is then the emergent result of a series of underlying processes. "Inequality is a choice between perfectly feasible alternatives in a world of multiple equilibria", Palma (2020) reminds us. The conclusion, as the title of Palma (2016) indicates, is that each country deserves the inequality it has.

FIGURE7.The cyclical behavior of inequality, Chile (1850-2010)



Source: Rodríguez Weber (2017)

5. *Econometric strategy and results*

A VAR is a standard tool of macroeconomic research, which allows for estimating and tracking the short and long-term effects of different types of shocks: technological (Galí et al., (2003), monetary (Christiano et al. (2005, 2010)) or due to public expenditure (see Blanchard and Perotti (2002) Christiano et al. (2011) and Céspedes et al., (2013) specifically for the Chilean case).

The VAR approach has a number of advantages. Generally speaking, VARs represent a natural tool for economic practice. According to Christiano (2012) "*VARs are a fruitful way to organize data because they can be used as a sort of battle ground for testing alternative theories… Economists are accustomed to thinking about models in terms of impulses and propagation mechanisms, and VARs are a device for organizing the data precisely into these categories*".

Here the reduced form of a VAR (6) of three variables is estimated in order to obtain the statistics of interest:

$$(1) \qquad y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \ldots + \Phi_8 y_{t-6} + \varepsilon_t$$

Where $y_t = \left(\frac{p_t}{g_t\, i_t}\right)$, and p_t, g_t e i_t correspond respectively to the variables (change of) political regime, measured by the first difference in the Polity index, the growth rate of GDP per capita in period t and inequality, measured by the Gini.

But a VAR by itself only describes the history of the statistical relationships between the variables. It does not allow us to draw conclusions about causal relationships or make direct causal inference.

To obtain conclusions with economic sense, to evaluate the effects of some policy shock or to be able to test different hypotheses, it is necessary to add identification assumptions. These assumptions establish a priori a causal chain of relationships between the VAR variables and therefore predefine which is the exogenous variable.

Thus, the first identification strategy - based on the Cholesky decomposition - consists in assuming that there is a definite causal chain that begins with the unexpected movement of the political variable. With this, the simultaneity bias present in systems of equations of this

type is eliminated and orthogonal shocks are constructed that allow for isolating the effects of one variable on the others.

This procedure is usually called "Sims recursive method" and for the case of the system described in (1) it performs the following operation: in the first equation, p acts as the dependent variable and the regressors are the lagged values of the three variables of y. In the second equation, g is considered as the dependent variable and the regressors are the lags of the three variables, *plus* the contemporary value of p. In the third equation, i plays the role of dependent variable and in this case the regressors are the lags of the three variables, and the contemporary values of g and g and p.

The IRFs as well as the variance decomposition are relevant statistics in their own right. They are capable of providing us with the empirical-historical regularities that underlie theoretical modeling and therefore are an object of natural interest for empirical research. In trying to find some interesting empirical regularities that can provide an insight into the underlying structure of the phenomenon we want to model, IRFs seem to be a natural starting point.

5.1 *A democratic shock*

For the analysis sustained up to now to be valid, we have assumed that, in a certain period, an exogenous variation occurs, which we classify as our policy variable. In this case, the exogenous variation represents a value that is very far from the best prediction based on a linear projection that uses the information available up to $t - 1$.

What does this mean in terms of a historical narrative? It means that the change, or rather the magnitude of the change, in the political regime that occurred in 1973 and '88-'89,despite being partly explicable by the previous economic-political conditions, was very far from what was predictable based on that set of information.

Figures 8.a and 8.b show the residual series for the case of Chile and Argentina, which allows us to identify the shocks. The history of these residuals also allows for the construction of a political-institutional history based on the unexpected political changes identified as the innovations.

Furthermore, for the Chilean case, it is possible to know that the shock to which the effects are to be traced corresponds to the unexpected positive change from '88-'89'and not to the democratic worsening that occurred in '73. None of the IRFs studied were shown to be significantly different from zero for the model applied to the period prior to 1988; therefore,

the observed effects must be attributed to the positive democratic shock that occurred with the return to democracy.

This approach is different from the one typically used in the VAR macroeconomic literature that tracks the effects of shocks that are explicitly or implicitly assumed to be normally distributed. Here it is possible to isolate an unexpected movement of one of the variables to be modeled, through a combination of historical narrative and typical methods of time series in macroeconomics.

FIGURE 8a. Identifying a residual-based shock (Chile)

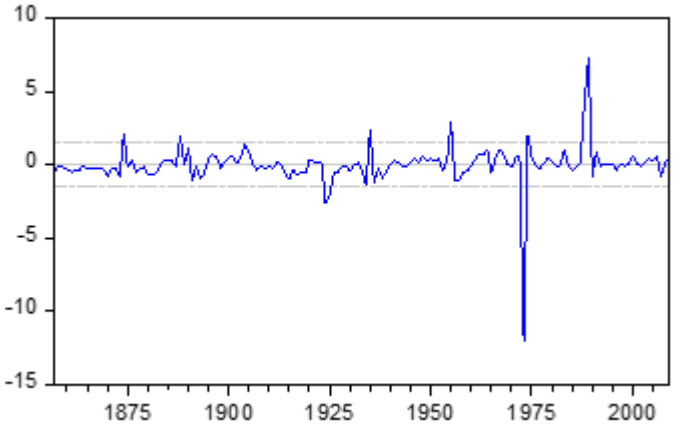
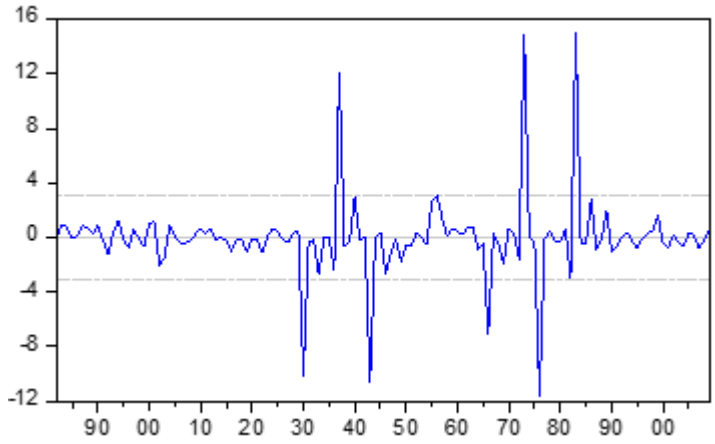


FIGURE 8b. Identifying a residual-based shock (Argentina)



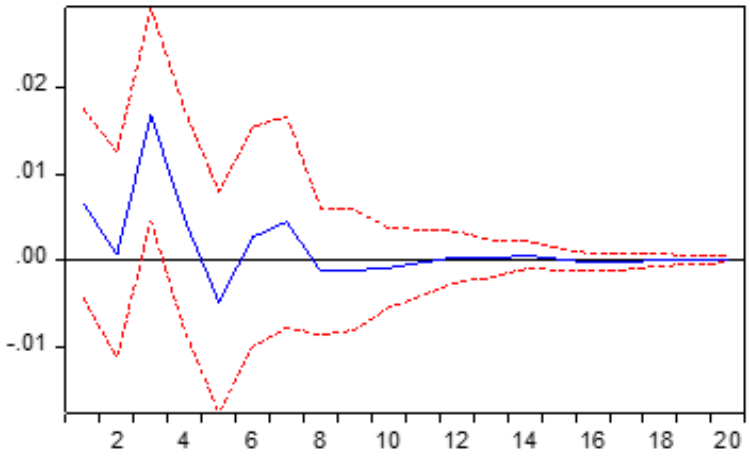
5.2 Effects on economic growth

The long-term effect of democracy on GDP growth is 3 percentage points, reaching a peak after 7 years. The exogeneity assumption of a democratic shock is reinforced by the results of the Granger causality tests. The evidence of causality goes from the political regime to the growth in GDP per capita. This coincides with the results obtained through the GETS algorithm, where a minimum model is obtained in which the democratic variable meets the criteria of exogeneity with respect to the parameters associated with growth.

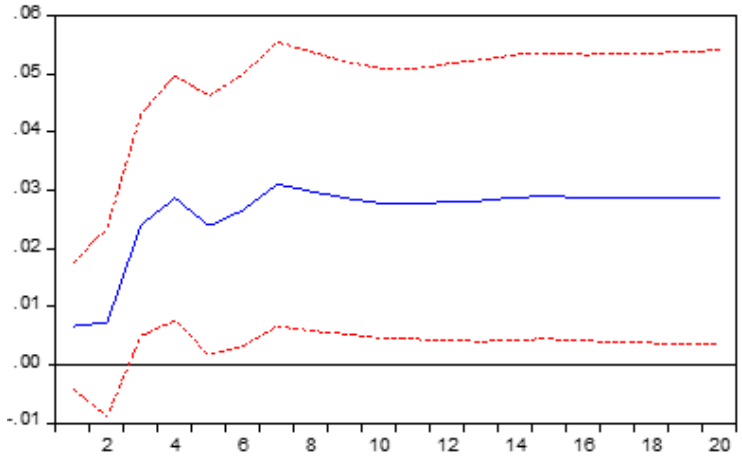
Figure 9. Short and long-term effects of a democratic shock on the GDP per capita growth rate

9.a. IRF of GDP per capita growth rate to first difference of polity variable

Response to Cholesky one S.D innovations



9.b. Accumulated response of GDP per capita growth rate to first difference of polity variable



Another interesting characteristic is that the effect of democracy on the growth rate of GDP per capita takes 3 years to become positive, so there may be short-term costs or uncertainties that increase the possibility of failure of the reform processes.

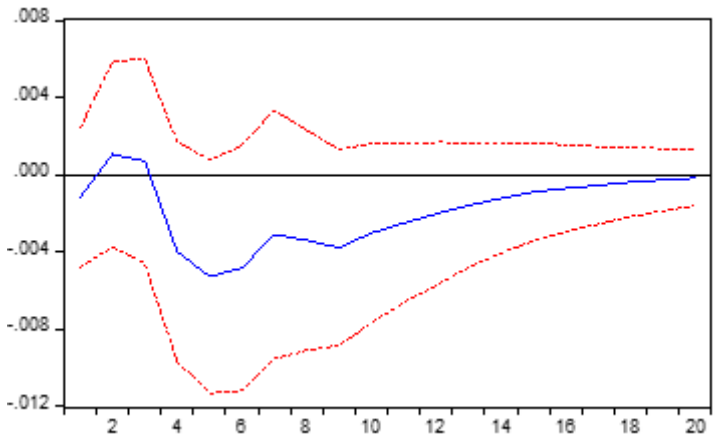
5.3 Effects on inequality

The effect on inequality is estimated to be a decrease of 0.037 Gini points. As mentioned in a previous section, a characteristic of the Gini series for the Chilean case is that it is stationary, which indicates that it does not exhibit any trend and oscillates around its mean value (0.53). It is not clear whether the impact of democracy should be interpreted as an

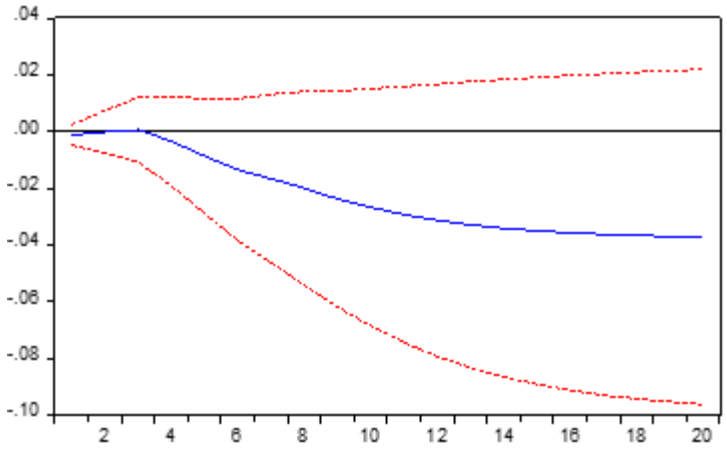
effective decrease with respect to the historical average or is, rather, a return to the said average after the sharp increases in inequality observed in the last years of the dictatorship.

FIGURE10. Short and long-term effects of a democratic shock on inequality

10.a. IRF of Gini to first difference of polity variable



10.b. Accumulated response of Gini to first difference of polity variable



5.3.1 The interdependence between democracy and inequality

Let us remember that we want to trace the economic consequences of the Chilean democratic shock of '88-'89. Despite this, the question arises as to the long-term relationship between democracy and inequality.

The Granger causality tests show that the relationship would go from inequality to democracy. If we specify a VAR and estimate the IRF assuming that inequality is exogenous with respect to democracy, we find a significant effect. This is confirmed by the GETS algorithm. The problem here is that it is not possible to identify which is the "inequality shock" that we want to analyze.

But it is interesting to verify this evidence for the Chilean case. Periods in which there are sudden or unexpected decreases in the levels of inequality somehow favor the appearance of a "conservative response" that is expressed in a less democratic political regime. This happened with the governments of Balmaceda (1886-1891) and Allende (1970-1973). And vice versa, when inequality (or the perception of it) reaches critical levels, the system's response materializes in a more democratic political system, as occurred in Chile just before the return into democracy and again in 2019. This evidence is consistent with the Political Economy approach and the arguments presented by Rodríguez Weber (2015, 2017) and Palma (2020) for the Chilean case and by López (2020) in terms of a theoretical model.

5.4 Robustness analysis of and possible channels[5]

[5] For another robustness check in the line of the "Narrative approach" of Ramey and Shapiro (1998) and Ramey (2011) see Annex 3.

Thanks to the information available for the Chilean case, it is possible to estimate more flexible specifications of the VAR, including variables associated with human capital, physical capital and inflation, as well as fiscal variables that have been shown to be irrelevant. The results are robust to these specifications even when including the terms of trade, a variable usually associated with the Chilean economic cycle, and subtracting copper production from GDP.

The robustness exercises provide relevant information about the channels through which democracy impacts economic growth. The evidence seems to be consistent with interpreting the democratic shock analogously of a technological shock that, at the same time, increases the productivity of human capital and physical capital. This is consistent with the findings of Persson and Tabellini (2009), Acemoglu et al (2015, 2019),and Glaeser et al (2004) among others.

The results in the previous section are robust to a number of alternative specifications. The growth rate of the human capital index, the growth rate of the gross formation of fixed capital per capita and the growth rate of the consumer price index (CPI) have been included, all of which were obtained from Díaz et al., (2016). Two additional robustness exercise is provided in the annex that uses an inequality series based on top income shares taken from the work of Flores et al., (2020) and the capital share series obtained from Díaz et al. (2016).

In this first alternative specification, the VAR considers the following variables:

$$y_t = (y_{1t}, y_{2t}, y_{3t}, y_{4t}, y_{5t}, y_{6t})$$

Where:

y_{1t} : GDP per capita growth (annual %)

y_{2t} : First difference of the variable "Polity2"

y_{3t} : Gini coefficient

y_{4t} : Human capital index growth rate

y_{5t} : Gross fixed capital formation (p/c) growth rate

y_{6t} : Consumer price index growth rate

This model incorporates variables that must be considered in the growth analysis and that respond to the neoclassical approach to economic growth accounting (growth rates of

physical capital and human capital) and the institutionalist and neo-institutionalist literature by incorporating the institutional variable that reflects the type of political regime and the Gini coefficient. This specification also allows for testing the effect of inflationary shocks on the long-term economic performance by incorporating the growth rate of the CPI. The specifications with fiscal variables (variation in per capita public spending, variation in the social spending / GDP ratio, and variation in taxes) do not alter the results obtained here and the AIRFs associated with the said variables turn out to be non-significant for our variables of interest.

When changing the human capital index for the average schooling growth rate, the results remain basically the same: The AIRFs continue to replicate the results obtained in the initial model.

The next strategy is to use a VAR-X, that is, a VAR with a variable predefined as exogenous by the researcher. For a country that is historically dependent on international trade, it seems plausible to use the variation in the terms of trade as an exogenous variable. By incorporating the variation in the terms of trade, it is intended to control for a variable that is traditionally associated with the economic cycle for a small country that is highly dependent on its exports of raw materials and that is not capable of affecting the price (and therefore the terms of trade) systematically. When incorporating this variable, the long-term effect hardly varies.

We investigated some of the channels through which democratic improvement can impact growth and distribution. In fact, it is possible to interpret the democratic shock as a technological shock that increases the productivity of both human and physical capital. This is observed in IRFs that are consistent with a higher growth rate of the accumulation of physical capital and the remuneration of workers, in an environment of diminishing inequality.

5.5 Solving the conceptual puzzle

The VAR results, under different specifications, show that in the Chilean case, the return to a democratic regime had significant implications for economic performance, with positive effects on GDP per capita and a decrease in inequality. There is abundant evidence that allows us to conclude the existence of a virtuous relationship between the reduction of inequality and higher economic growth. This would be one of the most important factors behind the rise in the growth rate of the period.

Indeed, inequality can negatively impact growth in several ways. In the short and medium term, high inequality implies weak growth in aggregate demand. This is because to the differences in the marginal propensities to consume between the low-income sectors and those of high income, in which the latter consume a smaller proportion of their income than

the former. A less unequal economy implies a more vigorous aggregate demand, since "transforms" the increases of income in higher effective levels of aggregate consumption. This is the "Kaleckian" viewpoint that links lower inequality with higher economic growth.

On the other hand, inequality can undermine progress in health and education, cause political and economic instability that may reduce investment and weaken the social consensus necessary to make adjustments during a crisis.

Inequality is a key determinant of the development path of an economy because it defines the access of economic agents to capacities and opportunities. Inequality also implies severe costs in terms of efficiency and its overcoming is considered a necessary condition for development (CEPAL, 2018). Policies in favor of equality not only produce positive effects in terms of social welfare, but rather they also establish a favorable economic system for learning, innovation, and increased productivity.

From an empirical perspective, Dabla-Norris et al (2015) found for a sample of 159 countries that increases in the income share of the poorest 20% are associated with a higher GDP growth rate. They also find that an increase in the income share of the richest 20% translates in the medium term into a lower GDP growth rate, suggesting that these benefits captured by the richest 20% do not "spill over" to the rest of the population. the economy. They conclude that the poorest sectors and the middle class are the most important to increase growth and that this occurs through a series of interrelated economic, social, and political channels.

In Berg et al., (2018) the problem of the empirical relationship between inequality and growth is addressed for a panel of 130 countries. They find that lower inequality is associated with a higher GDP growth rate, while high inequality shortens periods of GDP expansion. In this context, redistributive policies have a benign effect on growth18. They find that lower inequality promotes growth by facilitating a higher level of human capital accumulation. In related work, Ostry et al (2014) reach the same conclusions and emphasize that "inequality can undermine progress in health and education, cause political and economic instability that reduces investment, and weaken the social consensus necessary to make adjustments in case of large shocks. These empirical results have a solid theoretical basis in Galor (2005) and Galor and Moav (2004), which emphasizes the importance of accumulating human capital in the development process and how inequality – added to market failures – increases the probability of falling into a "growth trap" with a suboptimal level of human capital accumulation. This evidence serves as an adequate conceptual framework to evaluate the post-dictatorship Chilean experience.

From the point of view of post-Keynesian analysis that distinguishes between wage-led and profit-led regimes, the results also make sense. To a large extent, the policies implemented

upon the return of democracy were pro-labor, which allows us to understand the simultaneous movement of less inequality and greater growth.

For the Chilean case, Flores et al (2020) reports a decline in the concentration of income in the richest 1% during the post-dictatorship period, from 17.8 percent in 1990 to 16.2 percent in 2017. However, the largest decline occurs during the first half of the 1990s. In this period, the participation of this segment decreases two points, greater than the total fall that it had for the period. In fact, the decrease of 2 points in the participation of the richest 1% between 1990 and 1995 is greater than the total fall that took place during the period 1990 to 2017. Something similar occurs with the participation of the top 0.1 percent, whose greatest drop is also observed in the period 1990-1995. When considering the functional distribution of income, it is observed that labor share reached a minimum of 0.32 in 1988. From there, an upward trend is observed, reaching a peak of 0.43 in 1999 (Reinbold and Restrepo, 2018).

French-Davis (2018) points out that at the beginning of the return to democracy, there is an effort to have more public resources to increase social spending with a focused perspective. Thus, the tax reform negotiated at the beginning of President Aylwin government in 1990 partially reversed the regressive tax reductions carried out during the dictatorship in 1975, 1984 and 1988. In this way, it was possible to stop the decrease in tax collection that reached a minimum in 1990, representing 13.3% of GDP. Added to this is a labor reform is implemented, whose objective was to reduce the asymmetries of bargaining power between employers and employees, and an agreement was reached for a significant increase in the minimum wage.

Despite this, part of the "economic order" inherited from the dictatorship was maintained. Solimano (2012) emphasizes that the economic policies implemented in the return to democracy largely had a conceptual continuity with those of the dictatorship. This is observed in a fiscal design with targeted public spending, maintaining privatization and profit in education, and in the health and pension system. It also indicates that the labor reforms were not effective in balancing the relations between labor and capital.

However, both authors agree that one of the main deficits of the post-dictatorial governments was the absence of a productive transformation strategy. In general terms, during the 1990s no changes were detected that brought the Chilean economy closer to the structure of developed economies, although in the mid-1990s certain changes were detected that brought the Chilean economic structure closer to that of Portugal, the same it occurs in the mid-2000s. Soza-Amigo and Aroca (2018) identify these similarities through analysis of the input-output tables of various countries and also detect that from the second half of the 2000s this incipient structural convergence is reversed, which demonstrates that the Chilean economy is beginning to lose the structural characteristics of developed economies.

6. *Conclusions*

For any specific time period, there are multiple factors that determine the possible equilibrium outcomes for a given socioeconomic system. Interactions in the economic dimension do not occur in a vacuum, nor are they simply embedded in a larger political system. Strictly speaking, there is a dynamic interdependence between the institutional structure determined through the political system and certain socioeconomic outcomes such as the growth rate of GDP per capita, inequality, tax rates, public spending, innovation and schooling among others. The institutional environment shapes the evolution of economic results and vice versa, in a circular and self-generated relationship.

Chile exhibits outstanding characteristics for analyzing the relationship between democracy and economic performance. During the years 2019-2022, Chile again is on the verge of starting a new sociopolitical cycle, which has similarities and differences compared with another democratic milestone in Chile: the return in 1988-89 - through institutional means - to a democratic regime after the dictatorship of the period 1973-1988. One of the interesting aspects of the Chilean case is that both processes were channeled institutionally, using only a pencil and the ballot as the most revolutionary weapon.

In some way, the process associated with October 5, 1988, resonates in the shock of the social outbreak of 2019 that opened up the possibility for a new democratizing impulse. In both transitions, a high degree of uncertainty was observed regarding the evolution of the economic variables. This paper argues that there are good reasons for optimism regarding the results of the current process in terms of inequality and growth.

On the other hand, the findings of this work indicate that it is democracy, and not necessarily the (radical) pro-market policies, what is behind the remarkable economic performance in the Chilean case. The results indicate that the long-term consequences of the democratic shock of the '88-'90 period implied a higher growth rate of GDP per capita of the order of 3% compared to the hypothetical "counterfactual without democratic shock". Likewise, a quite moderate decrease in inequality is observed, which indicates the main debt of the democratic promise in Chile.

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8. Annex 1

1988 Plebiscite Polls (Sorted by date of completion)

Survey company	**Date**	**Sí**	**No**	**Undecided**	**Blank/invalid**
CED / FLACSO	June-1987	12,4 %	**47,3 %**	40,3 %	-
CERC	November-1987	31,1 %	**40,3 %**	18,2 %	-
Gallup	December-1987	**39,4 %**	26,6 %	34 %	-
Diagnos	March-1988	20 %	**38 %**	30 %	-
CEP / Adimark	June-1988	37 %	**41 %**	22 %	-
FLACSO	June-July-1988	17,3 %	**42,1 %**	33 %	7,7 %
CERC	August-1988	30,8 %	**40,6 %**	22 %	8,4 %
CIS	Ausgust-1988	20,1 %	**43,4 %**	33,6 %	3 %
Univisión	September-1988	26 %	**61 %**	-	-
CEP	September-1988	27 %	**45 %**	23 %	5 %
FACEA, U. Chile	September – 1988	**48,1%**	41%	11%	-
CEP / Adimark	October – 1988	32 %	**52 %**	16 %	-

Skopus	October – 1988	**53,9 %**	46,1 %	-	-
CERC	October – 1988	19,6 %	**47 %**	22 %	-
CIS	October – 1988	17,9 %	**46,8 %**	33,4 %	-
Gallup (forecast)	October – 1988	**47 %**	42 %	-	-
Gemines (forecast)	October – 1988	31 %	**58,6 %**	-	-
Policía de Investigaciones* (forecast)	October – 1988	**53,25 %**	46,75 %	-	-

Sources: Cañas (2012), Revista Cauce (1988), CEP (1988).

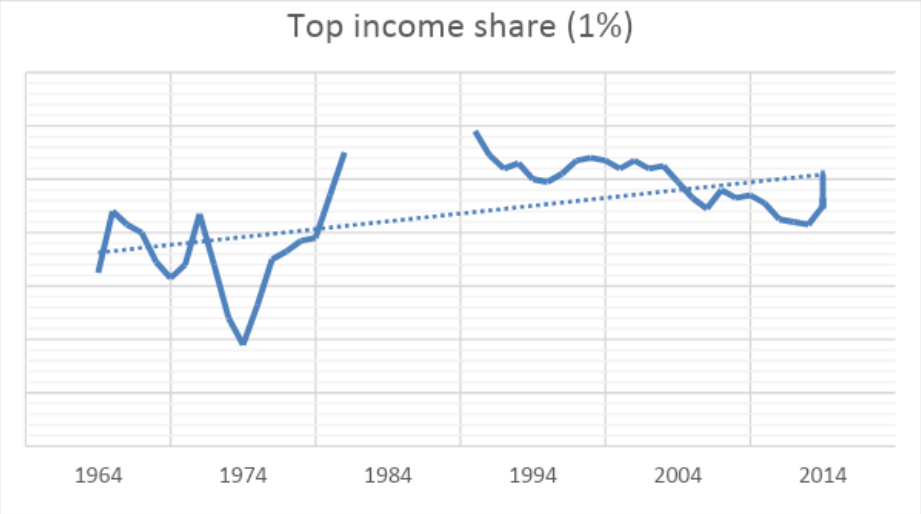
*Chilean Investigative Police

Annex 2

Robustness exercise with top income shares and capital share

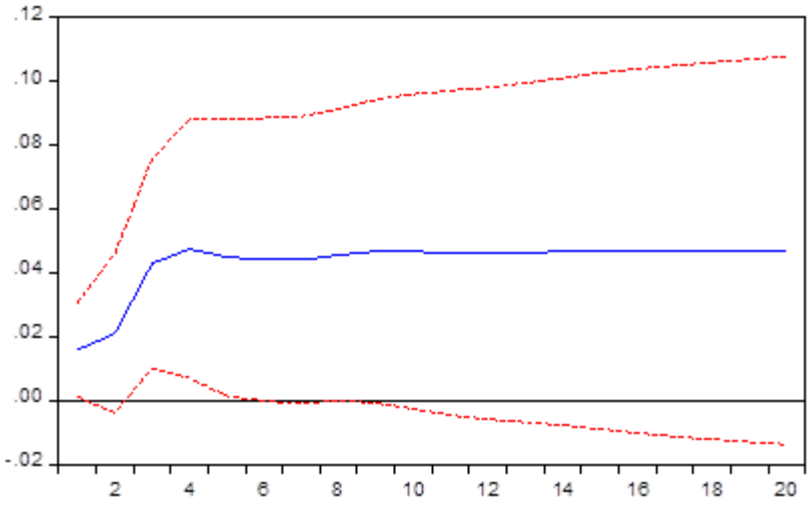
Flores et al., (2020) present series of Chilean top-income shares covering the period 1964-2017), mainly based on income-tax declarations and the National Accounts. One of the problem of this series is the lack of data for the period 1982-1989. In order to have an undisrupted series to run de VAR, a cubic spline was used (Fig. 11).

FIGURE 11. Chile top income shares (1%) – 1964-2017 (spline)



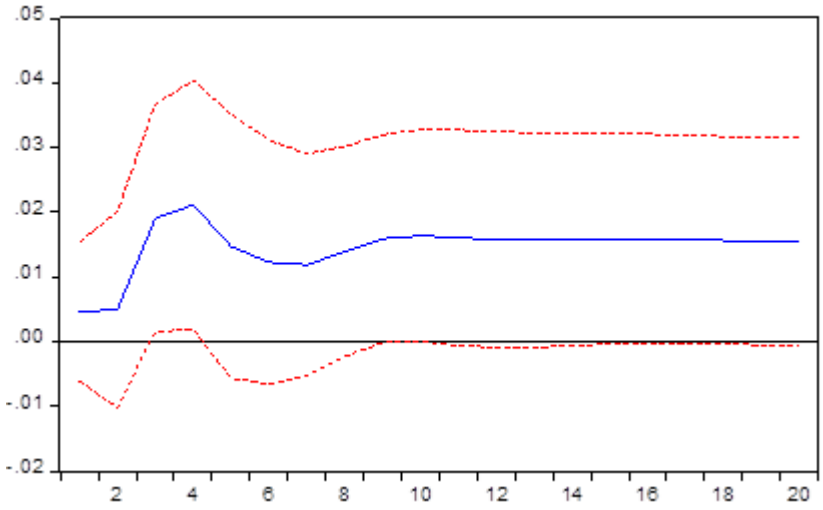
Due to having fewer degrees of freedom, VAR models were estimated with only 3 lags. The main result is robust to this new measure of inequality:

FIGURE 11. Accumulated response of GDP per capita growth rate to first difference of polity variable



Finally, the capital share obtained from Díaz et al. (2016) is also used for the same purposes with similar results trough the estimation of a VAR(4) for the period 1850-2009:

FIGURE 12. Accumulated response of GDP per capita growth rate to first difference of polity variable

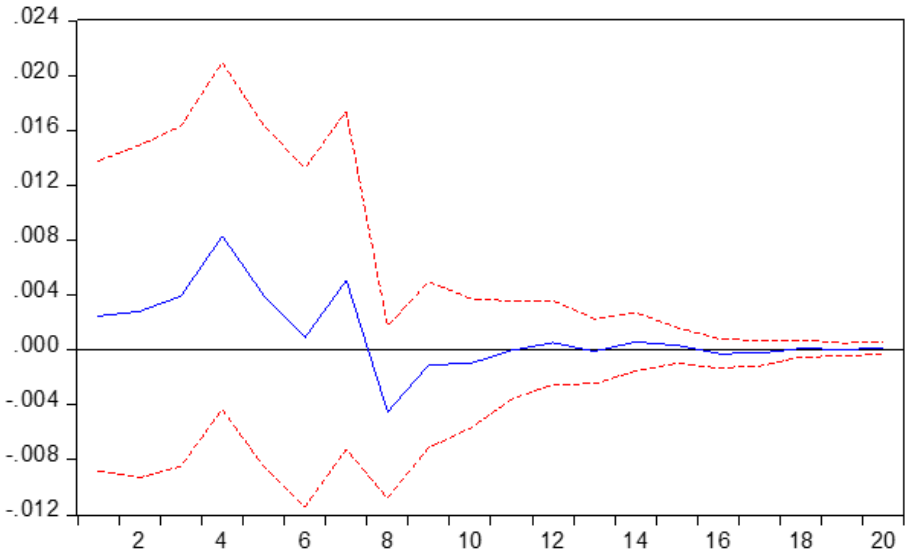


Annex 3

Using the "Narrative Approach"

Another robustness check of the results is in line with the "narrative approach" literature[6]. In this case, the VAR is estimated again but instead of using the polity index, a (dummy) variable is used that takes the value 1 in 1989 and zero for the rest of the periods. As can be seen in the respective figures, the results are consistent with those previously obtained.

Figure 1. IRF of GDP per capita growth rate to the "dummy" polity variable (Cholesky Factors)



[6] See Ramey and Shapiro (1998) and Ramey (2011)

Figure 2. IRF of GDP per capita growth rate to the "dummy" polity variable (Diagonal unit Factors)

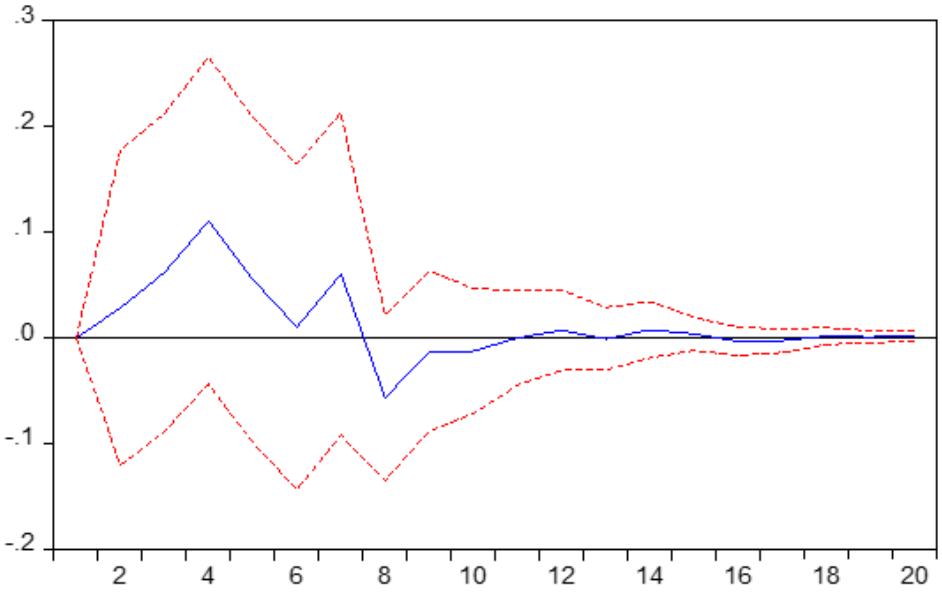


Figure 3. Accumulated response of GDP per capita growth rate to the "dummy" polity variable (Cholesky Factors)

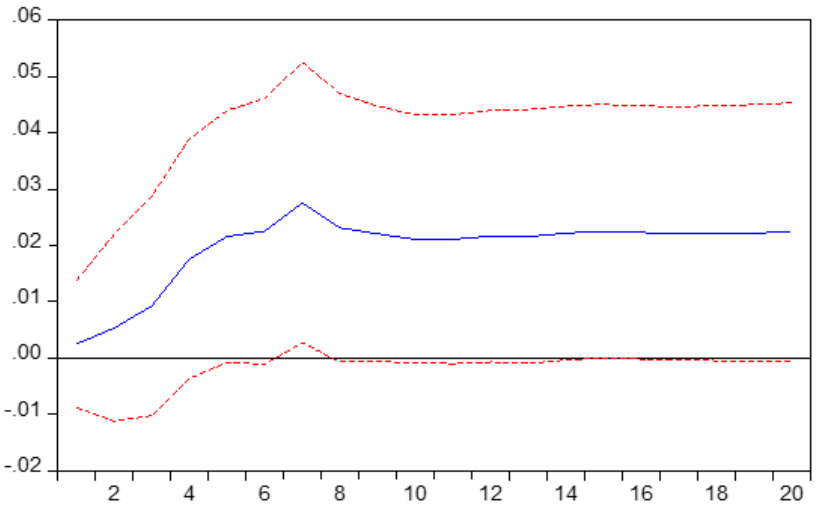


Figure 4. Accumulated response of GDP per capita growth rate to the "dummy" polity variable (Diagonal unit Factors)

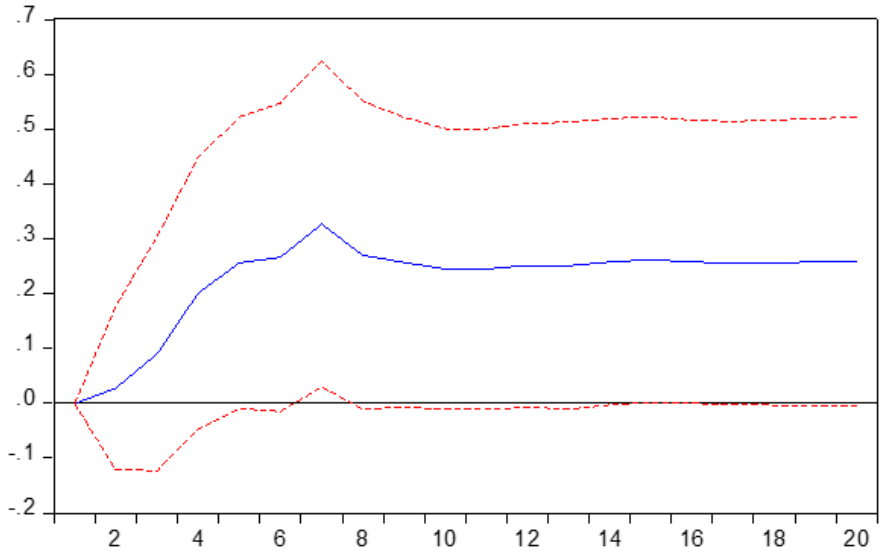


Figure 5. IRF of Gini to the "dummy" polity variable (Cholesky Factors)

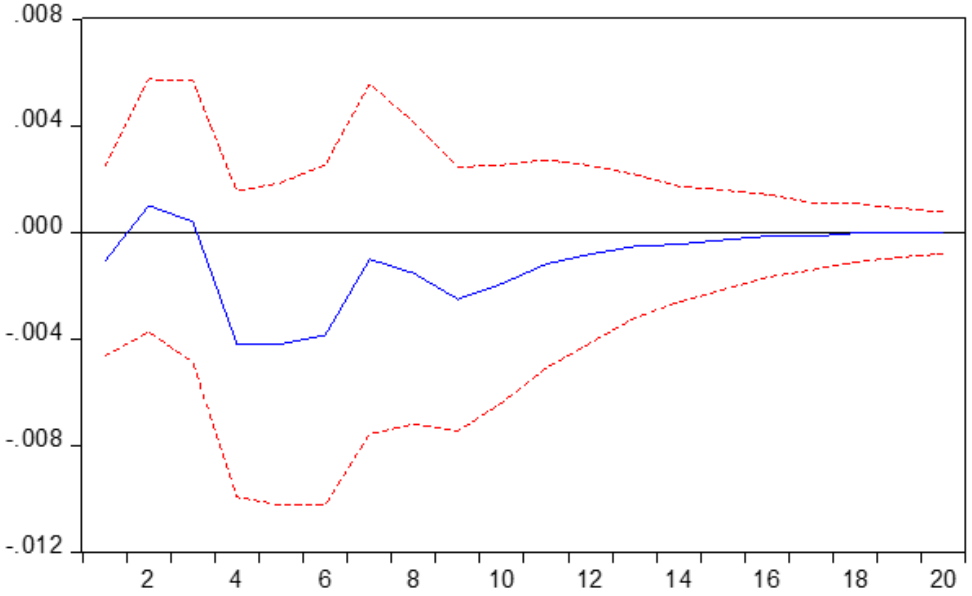
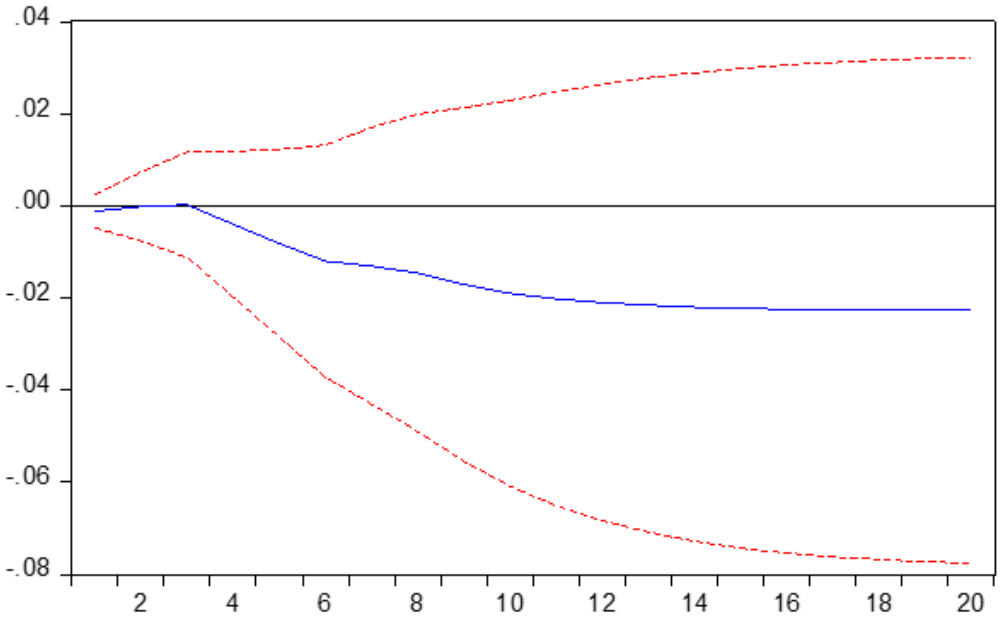


Figure 6. Accumulated response of Gini to the "dummy" polity variable (Cholesky Factors)



Democracy, Economic Growth and the Identification Problem in Macroeconomics

Simón Accorsi O.[7]

Abstract

This article analyzes and deals with the so-called "identification problem" in macroeconomics to study the causal relationships between the type of political regime and the path of medium and long-term economic growth with a time series approach. Taking as a starting point the estimation of

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an Autoregressive Vector (VAR), the identification problem is presented, and then the solution strategies used in the macroeconomic literature to trace and estimate the consequences of democratic shocks on per capita GDP growth are explained. The article presents novel empirical evidence for the neo-institutionalist literature, exploiting long-term series of the Polity index and GDP per capita. Thus, it is possible to estimate the effects of democratic improvements on economic growth. For the 13 countries analyzed, the results are diverse, so the statement that "*democracy does causes growth*" must be qualified and put into each country-specific historical context.

Key words: *Democracy, Economic Growth, Time-series*

JEL Classification: *C30, O11, O43, O47, P16*

1. Introduction

The objective of the empirical research program in macroeconomics is to identify historical regularities in the relationships between a set of variables and to understand how unanticipated changes in some of them impact on, and propagate in the economic structure. The efforts towards this objective are framed in the search for an adequate mixture between good economic theory, empirical evidence and a convincing historical narrative.

Macroeconomics has been guided by a series of key questions: What are the effects of an unanticipated change or monetary policy shock? What are the consequences for growth or consumption of an unprecedented fiscal boost? What effects does a "technological shock" or productivity have on product and leisure-work decisions? What are the long-term determinants of economic growth and the causes of its cycles?

To answer these questions, modern macroeconomic time series thinking and modelling is based on the idea that the economic system is driven, moment by moment, by structural shocks. Thus, the main challenge of empirical work in macroeconomics consists in trying to evaluate the impacts of the so-called "policy variables" on the economic system.

In this type of inference, the estimation of "identified moments", or in other words, the estimation of the responses to the identified structural shocks, plays a key role. The equivalent of this exercise in applied microeconomics is called the estimation of causal effects.

In an economic system, a shock spreads dynamically and its effects are captured through statistics, such as the analysis of variance decomposition and in particular through the estimation of the impulse-response functions (IRFs) and accumulated impulse-response functions(AIRFs).

In an ideal model, the estimated coefficients of the VAR would reflect agents' decisions at the macro-level. The economic system in this sense is the result of these exogenous shocks plus the responses of economic agents.

The problem is that the mere estimation of the VAR only illustrates the historical regularities of the statistical relationships between the variables, and does not allow us to draw any conclusions about the possible economic or structural relationships between them. A VAR by definition is a-theoretical and, in order to turn it into a tool that reflects some underlying economic theory and therefore allows for testing alternative hypotheses, it must deal with the identification problem by making certain *identification assumptions*.

In this article, two strategies are reviewed to address the identification problem. The first consists of assuming a temporal order of causality between the variables, obtaining a series of orthogonal shocks or, analogously, a system of linearly independent linear equations. These assumptions are usually justified based on the framework defined by the research question, the attempt to test the predictions of a theoretical model and the previous evidence. Making these assumptions is equivalent to imposing certain restrictions on the estimation of the VAR, assuming a priori that some coefficients are null, thus making it possible to isolate and trace the effects of a given innovation or disturbance. These restrictions can be short-term (Sims, 1980) or long-term, as introduced in the literature by Blanchard and Quah (1989). A refinement of this strategy is to obtain IRF and AIRF that do not depend on this pre-defined ordering. The latter are the so-called Generalized Impulse Response Functions (Pessaran and Shin, 1998) that are often used to confirm the robustness of the results obtained.

A second approach to solving the identification problem goes from the general to the specific and allows a choice between over-identified models. This approach was defended early by Sargan (1980) and later developed in Krolzig and Hendry, (2001) Campos et al., (2003), Hendry and Krolzig (2004, 2005). In Campos, Ericsson and Hendry, (2005) it is possible to find an adequate introduction, an overview and the main articles, while in Hendry and Doornik (2014), the background and methodological details of the approach are systematically developed.

This procedure identifies a minimal model based on the results of an automatic variable reduction algorithm. In this approach, the estimation process begins with an unrestricted general model and, according to a series of statistical tests, we proceed by discarding variables until a parsimonious model is reached. In this approach, from the English school of econometrics, exogeneity becomes an empirical problem whose answer is based on a series of criteria established by the researcher and is a priori agnostic about causal relationships. The type of exogeneity required depends on the problem to be solved, whether it is the estimation of consistent parameters (weak exogeneity), predicting a series (strong exogeneity) or evaluating the effect of a policy (super-exogeneity). Unlike the structural VAR approach, this approach provides us with information about the long-term relationships between the variables and bases its identification strategy on an empirical procedure that defines ex-post the minimum model that best represents the data generating process.

1.1 Economic Performance and Political Institutions

The neo-institutionalist literature establishes that "institutions matter" and that they are capable of influencing the long-term economic performance of societies. However, this literature has not incorporated the methodological tools of time series for the study of this hypothesis. In contrast, the standard macro-econometric research program has also not incorporated the analysis of political variables in its analysis of long-term real cycles.

One reason for this is the scarcity of long-term data for economies. In particular, Lloyd and Casey (2018) point out that the absence of long-term series for institutional variables makes it difficult to study the adaptive or evolutionary aspects of institutions and how they are related to economic processes and results. Chang (2011) argues in favor of the use of time series complemented by a congruent historical narrative and criticizes the excessive weight of cross-sectional studies.

Chang (2011) and López (2020) question why that the bulk of this literature does not consider the possibility that it is economic variables that cause movements in institutional variables, claim that there are more complex relationships, with self-generated cycles or bi-directional relationships. Added to these criticisms is the inability to capture non-monotonic effects with respect to time.

This work is inserted precisely in these debates. Taking advantage of the recent publication of long-term series for the Polity Index, and the data for the growth rate of GDP per capita obtained from the Maddison Project Database (2018), a reduced VAR is estimated and the dynamic effects of a low VAR are reported.

The identification problem has been addressed in various ways in the literature that explores the relationships between democracy and economic performance. On the one hand, there are the cross-sectional studies by Papaioannou and Siourounis (2008), Acemoglu et al. (2008), Acemoglu et al., (2015) and Acemoglu et al., (2019), which use dynamic panels with increasingly refined econometric specifications. For example, Acemoglu (2019), in addition to various robustness exercises and the use of instrumental variables, incorporates the dynamics of GDP per capita to better model the fall in GDP that precedes the moment of "democratization". This also makes it possible to obtain the long-term effect of democratization in a way that is similar to the AIRFs estimated in this work.

Persson and Tabellini (2009) coined the idea of "democratic capital", which interacts in a virtuous circle with physical capital, mutually reinforcing each other. In this way, as democracy consolidates and becomes more stable, the income of the population grows more rapidly. This validates and promotes more democratic stability and even more

economic growth. At the same time, the accumulation of democratic capital generates even greater stability and growth.

Meyersson (2015) studied the effects of coups on economic growth, comparing "successful" and "failed" coups. Coups d'etat in autocratic countries show imprecise and sometimes positive effects on economic growth. Meanwhile, when they occur in democratic societies there is clearly a negative effect on growth: *"When overthrowing democratic leaders, coups not only fail to promote economic reforms or stop the occurrence of economic crises, but they also have substantial negative effects across a number of standard growth-related outcomes including health, education, and investment."*

An important channel through which democracy translates into a higher level of income for a country is related to human capital.

For example, Fujiwara (2015) exploiting the sequential pattern of the introduction of electronic voting in Brazil, found that the reduction of barriers to voting translates into better indicators of human capital in the newborns of low-income women, with all of the future cognitive advantages that this implies. Naidu (2012) finds that the voting restriction that was imposed on African-Americans in the 19th century in the United States implied a reduction in the teacher / student ratio in black schools.

Miller (2008) studied how access to the right to vote for American women was able to influence child survival. Through political pressure, the dissemination of the health advances of the time accelerated, which is also consistent with the models of electoral competition. Along the same lines are the works of Duflo (2003), Chattopadhyay and Duflo 2004 and Duflo and Topalova 2004.

Franck and Michalopoulos (2017) studied the long-term economic consequences of the French Revolution and found that greater equality expressed in greater fragmentation in land ownership reduces labor productivity and income in the short term. However, in the long run, this facilitates the process of human capital accumulation, reversing the process. This work presents interesting empirical evidence in favour of theoretical models that study the link between inequality, human capital and long-term development process, such as those developed in the works of Galor (2000), and Galor and Moav (2004), among others.

Taken together, these studies indicate that the effects of improving democracy may be relevant for the accumulation of human capital and that the reduction of inequalities plays a key role in this process.

The time series approach, in an analogous effort to that of the study of the effects of monetary policy, seems ideal to explore the relationships between changes in political regime and economic performance and, to the extent of data availability, to study the possible channels through which the political variables interact with the economic variables. Additionally, the focus on a single economic system allows for better control of

the characteristics of unobservable variables that can produce biases in cross-sectional studies.

Through the separate estimation of a bivariate VAR for 13 countries and specifying the identification strategies used, the AIRFs are obtained that correspond to the measure of the long-term impact of democratic shocks on the economic growth rate. A positive effect of the growth rate of GDP per capita is observed in the cases of Chile (2.5%), Italy (3%) and France (4%). The effect is negative in the cases of Spain (-2.8%) and Bolivia (-3.8%). Finally, there are a number of countries (Botswana, Nigeria, Argentina, Colombia, Brazil, Portugal, Austria, and Sweden) for which the effect is not significant.

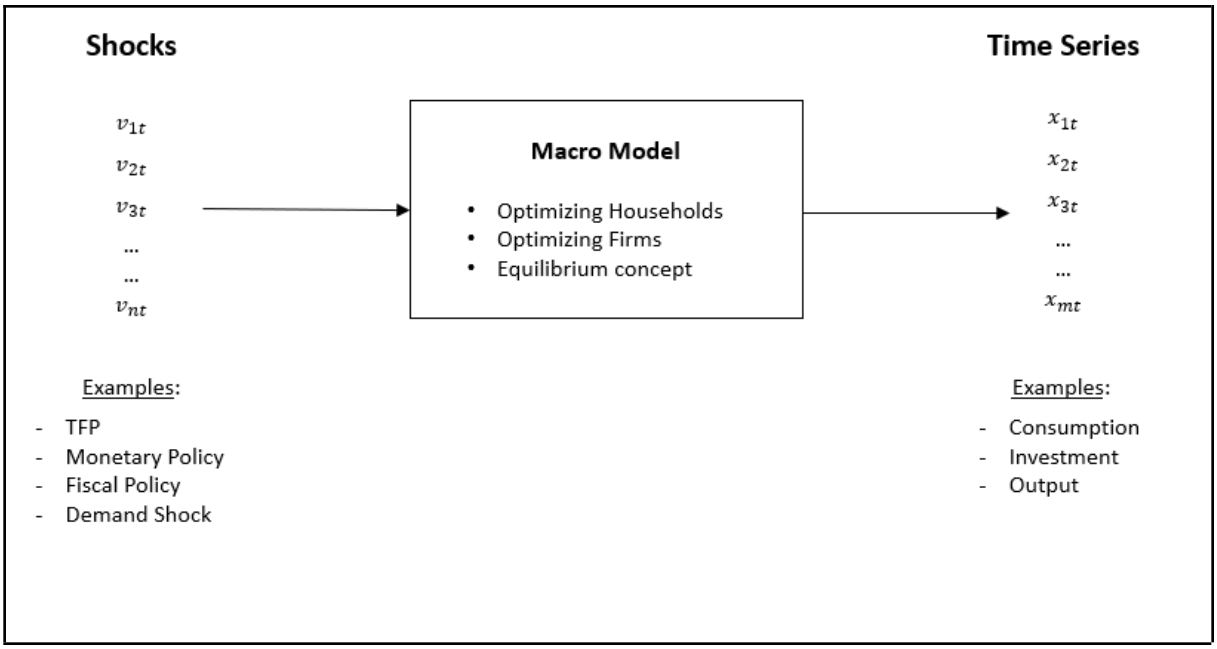
The rest of the article is structured as follows. In section 2 the identification problem in the context of time series is reviewed, with a conceptual framework that incorporates political variables in the context of the propagation mechanism proposed by Frisch and Slutzky, and identification strategies based on short and long-term a priori restrictions on the causal relationships between the variables are presented. Section 3 shows the data used, the definitions and their sources. In section 4 the time series tools are applied to the problem of plotting the consequences on the growth rate of GDP per capita triggered by an unexpected change in the type of political regime. The IRF and AIRF for each country and the results are estimated and reported. The general results of the automatic variable reduction algorithm are also reported in search of evidence of long-term relationships. Section 5 presents the conclusions.

2. *Time-series, political economy and the identification problem*

Figures 1 and 2 present in very simple terms the conceptual framework underlying the empirical research developed in this work. As mentioned, a key idea in modern macroeconomic thinking and modeling is that the economic system is driven by structural shocks. The main challenge for empirical work in macroeconomics is to identify plausibly exogenous changes in so-called "policy variables" and to use this variation to analyze and evaluate the effects of a given policy. This line of research has been called direct causal inference (Nakamura and Steinsson, 2018)

Figure 1

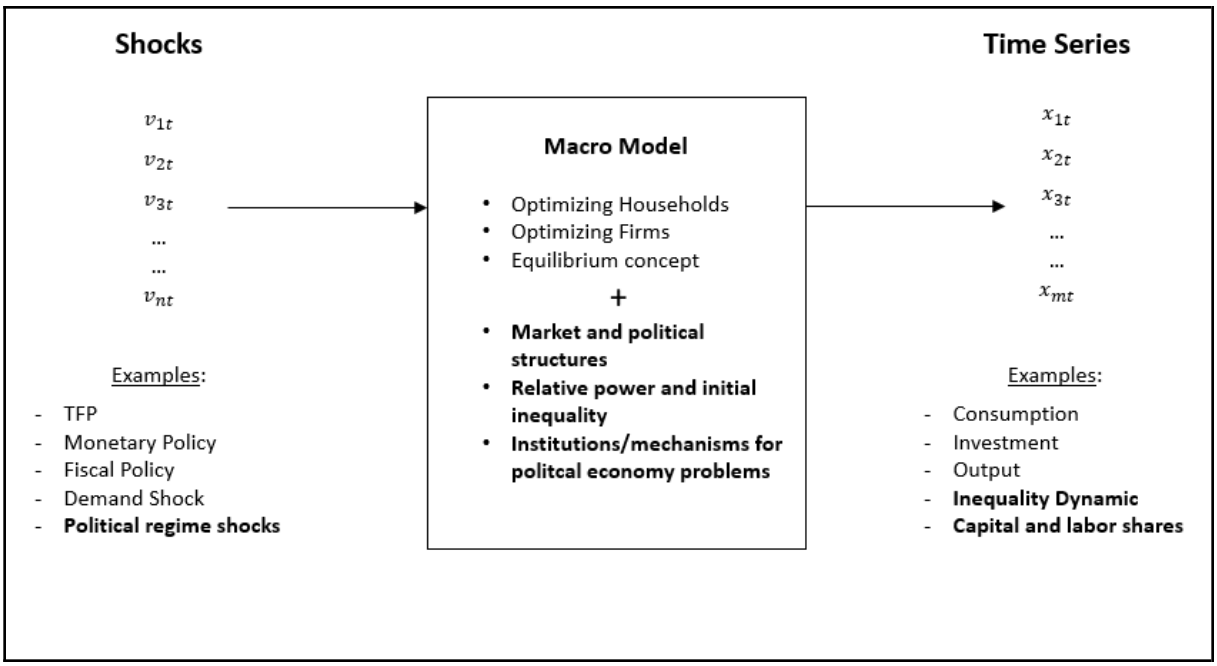
GE Macro Models in a Nutshell



Taken from Engel (2020)

Figure 2

Political Economy GE Macro Models in a Nutshell



Adapted from Engel (2020)

The standard approach outlined in figure 1 is expanded in figure 2 allowing for the introduction of "political" or institutional shocks. In this way, the "black box" of macro models, which assumes optimizing agents in an environment of competitive equilibrium, must be enriched by considering at least the institutions and mechanisms through which a society solves its political economy problems. In this way, the extended model allows for incorporating the study of inequality trends and the differences between the relative returns of the different types of capital.

In this work, the notion of exogenous impulses and propagation mechanisms of Frisch and Slutsky will be used, but now unexpected changes in the political regime will be incorporated as possible exogenous shocks. Thus, it will be possible to use traditional time series tools in this expanded context.

2.1 Structural VAR's, reduced VAR's, and the identification problem

A VAR with a highly flexible specification is a standard macroeconomic modelling tool, which permits to estimate and track the short and long-term effects of different types of shocks: technological (Galí et al., (2003), monetary (Christiano et al. (2010)) or fiscal (Blanchard and Perotti (2002) Christiano et al. (2011). This flexible, unrestricted estimate is intended to "let the data speak" by reporting the relevant statistical relationships that arise between the variables of interest. These stylized facts should serve as input for the elaboration of general equilibrium models that adequately incorporate the political/institutional aspects, in a way similar to what was done by Giacominni (2013) and Del Negro and Schorfheide (2006).

The estimation of VARs and their main statistics (IRF, AIRC and variance decomposition) is a widely used tool in empirical analysis that seeks to test the existence of causal links between variables, as well as in the analysis of the design and evaluation of the effectiveness of economic policies. Because of their very structure, VARs represent a natural tool for economic practice. According to Christiano (2012):

"VARs are a fruitful way to organize data because they can be used as a sort of battleground for testing alternative theories…Economists are accustomed to thinking about models in terms of impulses and propagation mechanisms, and VARs are a device for organizing the data precisely into these categories".

When estimating a VAR directly we obtain what is called the "reduced form", which is an a-theoretical representation of the data behaviour. The VAR in its reduced form only describes the history of the statistical relationships between the variables; it does not allow

for drawing conclusions about causal relationships or any kind of direct causal inference. In order to transform this reduced VAR into a tool that allows for studying the possible economic or structural relationships between the variables, certain identification assumptions must be made. Thus, from a reduced VAR we obtain a structural VAR.

The identification problem can be illustrated from the structural model described by (1), which is assumed to represent the true and underlying structure of the economy.

(1) $$\Gamma Y_t = BX_t + e_t$$

Y_t is a$(n \times 1)$vector of endogenous variables, $X_t$contains lags of the endogenous variables and may include variables considered a priori exogenous.$\Sigma_e = E(ee')$ is the variance-covariance matrix of the structural innovations. The coefficients in Γ and B are the parameters of interest.

The problem is that the sample information is not enough to directly estimate (1) and thus obtain the "true" values of the coefficients. Indeed, there is an infinite set of different values for Γ and Bthat imply exactly the same probability distribution for the observed data. This makes it impossible to infer and hence obtain the values for Γ and B from the data alone; therefore, these parameters are said to be unidentified.

By estimating a reduced form of (1) we will obtain:

(2) $Y_t = B_\Gamma X_t + u_t$ where $B_\Gamma = \Gamma^{-1}B;\ u_t = \Gamma^{-1}e_t$

This reduced form summarizes the (historical) sample information of the data set, expressing each endogenous variable only as a function of predetermined variables, unlike the structural VAR, which allows contemporary interactions between the variables. The variance-covariance matrix of the reduced form is given by $\Sigma_u = E(uu')$

Now, let's do the following exercise: pre-multiply (1) by a full-rank Q matrix. This means a different structural model from the first:

(3) $\Gamma_Q Y_t = B_Q X_t + e_{Qt}$ with $\Gamma_Q = Q\Gamma;\quad B_Q = QB;\quad e_{Qt} = Qe_t$

The reduced form of (3) is given by:

$$(4)\ Y_t = \Gamma_Q^{-1} B_Q X_t + \Gamma_Q^{-1} e_{Qt} = \Gamma^{-1} Q^{-1} QBX_t + \Gamma^{-1} Q^{-1} Qe_t = \Gamma^{-1} BX_t + \Gamma^{-1} e_t$$

This reduced form coincides with that obtained in (2), implying that both models are *observationally equivalent*. Here is the core of the identification problem. If no additional assumptions are made, ("identification assumptions"), it will not be possible to draw conclusions about the structural parameters of the "true" model. And this is because, given the data, different structural models originates the same reduced form model.

One way to solve this problem is to use the Cholesky decomposition to obtain "structural" errors, which means that these errors are not correlated with each other. Under this assumption it is possible to identify the effect of a policy shock or innovation. The Cholesky decomposition method, popularized by Sims (1980), imposes a set of "zero constraints" on contemporary coefficients. As an example of the strategy used by Sims, often referred to as "Sims Recursive Method" or "Recursive VAR's", lets suppose a system with three variables, y_1, y_2, y_3. In the first equation of the VAR, y_1 acts as the dependent variable and the regressors are the lagged values of the three variables. In the second equation, y_2 is considered as the dependent variable and the regressors are the lags of the three variables, *plus* the contemporary value ofy_1. In the third equation y_3 plays the role of dependent variable and in this case the regressors are the lags of the three variables, *plus* the contemporary values of y_1 andy_2.

In this work the first approach will be to suppose that the "policy variable" does not respond within the same period to the other endogenous variables. In Blanchard and Perotti (2002), this type of restriction is imposed to identify and trace the consequences of a fiscal expenditure shock on output. There, the assumption used is that government spending does not respond in the same period to output or tax changes.

The procedure is then based on obtaining results from a first identification strategy based on a Cholesky decomposition, assuming a priori the exogeneity of the democratic shock. This assumption answers the main research question: What is the effect of a democratic shock on economic growth?

Another approach consists of imposing a combination of identification assumptions in the form of restrictions on the short- and long-term effects of shocks on endogenous variables (Blanchard and Quah (1989), (Galí, 1992) assumes that demand shocks only have short and medium-term effects and that they do not modify the output level in the long term; therefore the restriction imposed is that the cumulative effect of output responses to the demand shock is zero. In turn, supply shocks are the only source of long-term variation in output. The main problem with this approach is that the identification assumption used leaves out precisely the phenomenon to be explored, since, for example, it is not ruled out a

priori that a demand shock has effects over an extended period of time, as poses the post-Keynesian line of thought.

The main criticism of the methodology based on recursive VAR focuses on the arbitrary decomposition that is carried out to identify shocks. A partial way of solving the problem is proposed by Pesaran and Shin (1998). The Generalized Impulses Functions construct an orthogonal set of innovations that does not depend on the VAR ordering. In this work the results of the first strategy are reported. The results are extensively reported in a companion article (Accorsi 2021)

A different identification strategy for estimating the dynamic effects of a change in certain policy variable is called *narrative approach*, which construct "narrative measures" that correlate with the policy shocks but are orthogonal to the other structural shocks. In the paper of Ramey and Shapiro (1998) they investigate how does the economy respond to a rise in government purchases. For that purpose, they constructed the "military date" variable, based on episodes where a specialized magazine suddenly began to forecast large rises in defense spending induced by geopolitical events that are claimed to be unrelated to the state of the U.S. economy. They identified three episodes: the Korean war, the Vietnam war, and the Carter-Reagan buildup. Ramey (2011) added the 9/11 episode. The military date variable entered in a standard VAR but ordered before the other variables and takes a value of one in 1950:3, 1965:1, 1980:1, and 2001:3, and zeroes elsewhere. It also has a reasonable predicting power for the growth of real defense spending. Romer and Romer (2009) try to capture exogenous changes in tax system based on several government reports by recording the (projected) impact on tax liabilities of legislated tax code changes.

Finally in the works of Mertens and Ravn (2013, 2014) they took an eclectic approach to estimate tax multipliers combining narrative with a traditional VAR framework. In this line of research, the key identifying assumptions are that the narrative measures correlate with tax shocks but are uncorrelated to other structural shocks. In sum, the narrative measure is treated as proxy "latent structural tax shocks".

2.2 A minimal Political Economy Macro model

In a research effort analogous to that devoted to exploring the effects of monetary, fiscal or technological shocks on output, the purpose here is to identify regularities in the relationship between the level of democracy or type of political regime and the growth rate of the economy.

For the purposes of fixing ideas, let us consider a stationary bivariate VAR (1), (y_t, x_t) in which y_t represents the indicator associated with the type of political regime (its first difference, strictly speaking), while x_t symbolizes the growth rate of GDP per capita.

Expressed in equations, the first order VAR for this bivariate system is:

$$y_t = \phi_{11} y_{t-1} + \phi_{12} x_{t-1} + u_t$$

$$x_t = \phi_{21} y_{t-1} + \phi_{22} x_{t-1} + v_t$$

Which can be written as follows:

$$(5)\ \begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{21} & \phi_{22} \end{pmatrix} \begin{pmatrix} y_{t-1} \\ x_{t-1} \end{pmatrix} + \begin{pmatrix} u_t \\ v_t \end{pmatrix}$$

Or:

$$(6)\ z_t = \phi z_{t-1} + w_t \quad ,$$

Where $z_t = \begin{pmatrix} y_t \\ x_t \end{pmatrix}$; $\phi = \begin{pmatrix} \phi_{11} & \phi_{12} & \phi_{21} & \phi_{22} \end{pmatrix}$; $w_t = \begin{pmatrix} u_t \\ v_t \end{pmatrix}$; $\Omega = E\left(w_t w_t'\right) = \begin{pmatrix} \sigma_u^2 & \sigma_{u,v} & \sigma_{u,v} & \sigma_v^2 \end{pmatrix}$

The model described by (5) and (6) is called a *reduced form* of a VAR. It is a purely a-theoretical econometric model. The problem is that it is not possible to assume that u_t and v_t are not contemporaneously correlated. In general, it is very likely that they are correlated, that is, they are non-orthogonal or in other words: $\sigma_{u,v} \neq 0$. If this is the case, it will not be possible to isolate the effects of a shock in one of the variables since it is not possible to keep v constant while only u varies.

However, taking as a starting point the estimation of the reduced form of the VAR, and using the Cholesky decomposition, it is possible to obtain a model in which the variance-covariance matrix of the errors is diagonal and therefore the errors are orthogonal.

The Cholesky decomposition method consists of finding a lower triangular matrix A such that:

$$\Omega = AA'$$

Let $A = (a\ 0\ b\ c)$. The Cholesky decomposition solves:

$$AA' = \Omega \leftrightarrow (a\ 0\ b\ c)(a\ b\ 0\ c) = \begin{pmatrix} \sigma_u^2 & \sigma_{u,v} \\ \sigma_{u,v} & \sigma_v^2 \end{pmatrix}$$

The solutions for a, b and c always exist and are given by:

(i) $a = \sqrt{\sigma_u^2}$

(ii) $b = \frac{\sigma_{u,v}}{\sqrt{\sigma_u^2}}$

(iii) $c = \sqrt{\sigma_v^2 - \frac{\sigma_{u,v}^2}{\sigma_u^2}}$

A new error vector $\tilde{w}_t$ is defined as a linear transformation of w_t.

(7) $\tilde{w}_t = A^{-1} w_t$

By construction, the variance-covariance matrix for this error is diagonal:

$$var(\tilde{w}_t) = A^{-1} var(w_t) A^{-1'} = A^{-1} \Omega A^{-1'} = A^{-1} A A' A^{-1'} = I$$

Using the Wold decomposition for covariance stationary time series, the system in (2) can be written in the form of an $MA(\infty)$ process:

(8) $z_t = w_t + \phi w_{t-1} + \ldots + \phi^j w_{t-j} + \ldots = AA^{-1} w_t + AA^{-1} \phi w_{t-1} + \ldots + AA^{-1} \phi^j w_{t-j} =$

(9) $z_t = A\tilde{w}_t + \phi A\tilde{w}_{t-1} + \ldots + \phi^j \tilde{w}_{t-j}$

Thus, the response to the impulse triggered by the orthogonal error, $\tilde{w}_t$, j periods ahead, is $\phi^j A$.

Recall that in (6) the error w_t is not orthogonal. On the other hand, in the structural form specified in (9) it is possible to isolate the effects of a shock, since the error $\tilde{w}_t$ is orthogonal.

(10) $z_t = \phi z_{t-1} + w_t$

(11) $$A^{-1}z_t = A^{-1}\phi z_{t-1} + A^{-1}w_t$$

(12) $$A^{-1}z_t = A^{-1}\phi z_{t-1} + \tilde{w}_t$$

When observing the structural form in (9), it is noted that $A^{-1}$is lower triangular, and therefore:

(13) $$A^{-1}z_t = (1/a\ 0\ -\ b/ac\ 1/c)\left(y_t\ x_t\right) = \left((1/a)y_t\ (-\ b/(ac))y_t + (1/c)x_t\right)$$

This implies that when the system is expressed in equations, x_t does not appear in the regression for y_t (the policy variable), while y_t does appear in the regression for x_t. Here is an *identification assumption*. It should be noted that, in a more general system, with a larger number of lags, the lags of the variable x, do appear in the equation for y_t.

In summary, (i) from the estimation of Ω and its elements, (ii) assumptions about short-term relationships or (iii) the imposition of long-term restrictions, it is possible to identify and estimate the model and characterize the dynamic response to a given shock. Thus, it is possible to overcome the "*curse of dimensionality*" and a meaningful economic system– a structural VAR - is obtained from its reduced form.

Despite being used extensively, this approach has its weaknesses. The first is that the Cholesky decomposition implies an arbitrary assumption about how the variables are contemporaneously related. In particular, it assumes that the variable associated with economic growth does not affect the first difference of the political variable in the same period. This is the only assumption about the short-run relationships between the variables of interest. This assumption seems plausible given the relative inertia of institutional structures and the sluggishness of their change. Although economic aspects can trigger or unleash a process that ends up altering the type of political regime, it is possible to assume that said change will probably not materialize within the same period. No assumptions are made about long-run relationships, so there are no restrictions on the values that the cumulative impulse response functions can take.

3. Data used, definitions and sources

The type of political regime is captured through the Polity index. For each country and year, it defines a value in a range that goes from -10 to +10 and a higher index reflects a better democratic institutionality. The ranges and the respective type of political institutionality are shown in table 1.

The Polity Index has been widely used in studies with similar purposes (Papaioannou and Siourounis, (2008), Acemoglu et al. (2008), Acemoglu et al., (2015) and Acemoglu et al., (2019)), although never in a specific time series frame. This indicator measures and weights

a series of components associated with three dimensions: (i) the existence of an impersonal or non-discretionary executive power, (ii) the (formal) restrictions to the executive power and (iii) the level of observable competitiveness in the political sphere, and classifies the type of political regime according to a defined range.

TABLE 1

Polity score, definition and characterization

Range	**Political regime**	**Characterization**
[-10, -6]	Autocracies	An authoritarian regime, characterized by the concentration of all power in a dictator or despot. Its decisions are not subject to any type of legal restrictions or mechanisms of popular representation.
[-5, 5]	Annocracies	A set of government systems that can be defined as "part democracy" and "part dictatorship". It combines at different levels democratic aspects with autocratic aspects.
[6, 10]	Democracies	A government system that allows citizens to express their political preferences. The main executive and legislative authorities are elected by individuals.

The data for the GDP per capita of the respective countries were obtained from the *Maddison Project Database*, version 2018.

4. An application: The relationship between democracy and economic growth

There are different approaches to the identification problem to establish links between what are very loosely called "institutions" and variables associated with economic performance. The most popular econometric strategy used in cross-sectional studies consists of finding a suitable instrumental variable and thereby obtaining an exogenous variation of the institutional variable. This approach is used in Acemoglu et al., (2001) and extended for the case of the relationship between democracy and GDP per capita in Acemoglu et al. (2019).

From a logical point of view, it is not correct to extrapolate the conclusions of these studies, and from the empirical side they exhibit serious econometric flaws, as Acemoglu et al. (2019) point out.

Unlike cross-sectional studies or studies based on discontinuous regression techniques or propensity score matching, the strategy based on time series provides evidence about the temporal causality between variables, with flexible models that allow for bi-causality or a certain degree of interdependence between them. This is generally not possible in cross-sectional studies or "experimental" type studies.

Thus, this approach provides a natural ground for testing some of the predictions of theoretical models, often conceived in terms of dynamic general equilibrium models for a single economy, as for example in the study of the economic performance of oligarchic versus democratic societies (Acemoglu, 2008).

Another attractive aspect is that it provides information about the causality between the variables of interest. The effect may well be from the economic variables to the institutional ones. This part of the puzzle, mentioned in the past but not seriously addressed by the neo-institutionalist literature, has been neglected both theoretically and empirically.

4.1 A VAR with economic and political variables

For each country a bivariate VAR (6) is estimated:

$$(1)\ z_t = \phi_1 z_{t-1} + \phi_2 z_{t-2} + \ldots + \phi_6 z_{t-6} + w_t \qquad \text{, with } z_t = \left(\frac{p_t}{g_t}\right) ; w_t = \left(\frac{u_t}{v_t}\right)$$

Where p_t corresponds to the variable of the type of political regime (its first difference), while g_t is the growth rate of GDP per capita.

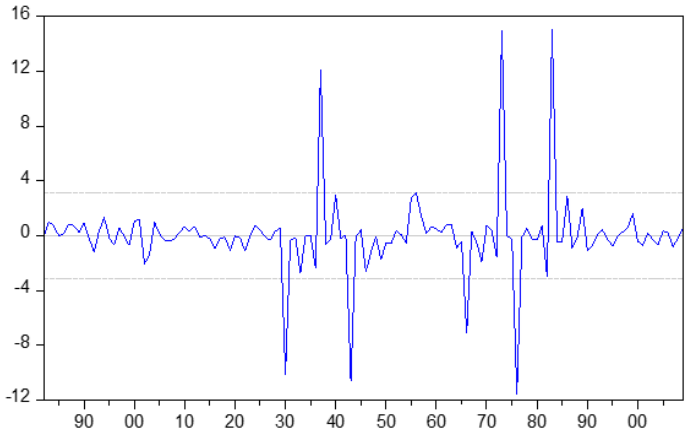
As indicated in the previous section, from this reduced form of the VAR it is possible to obtain a structural form through the identification assumption based on the Cholesky decomposition. This implies a model in which p_t appears in the regression for g_t while g_t does not appear in the regression for p_t.

The shocks in the type of political regime are obtained as the residuals of a regression that includes current and lagged values of both variables of the VAR. In this sense, a shock will be a realization of a variable that signifies a large deviation from its best linear projection or expectation for a given set of information. It is an unexpected value of one of the variables, typically the so-called "policy variable" and has a propagation mechanism that depends on the parameters of the model.

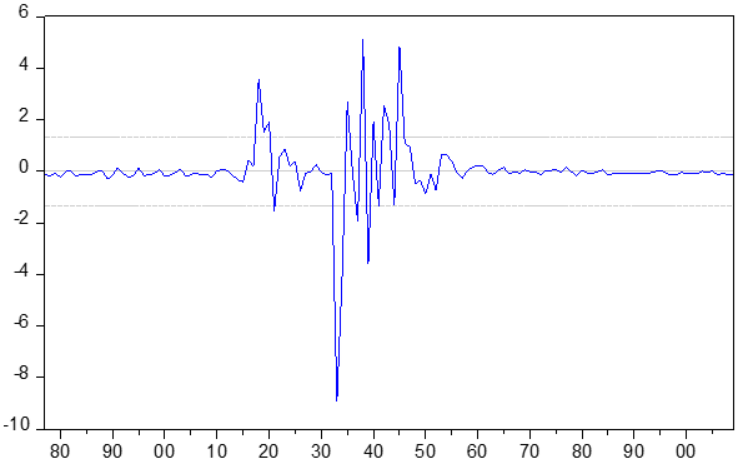
Next, the series of residuals for the countries analyzed are presented. In the Chilean case for instance, it is possible to identify two dates (1973 and 1988-'89) associated with "political shocks", that is, when the effective value of the policy variable was very far from the linear projection based on current and lagged values of both variables. The first was a drastic worsening of the democratic conditions, the magnitude of which was not predictable from the economic conditions, that is, what happened in the year '73 and later in '88 was of a greater magnitude than what could have been predicted under the best set of information and previous structure of the relationship between the variables. For Chile, thanks to data availability, the identification of these shocks is still valid, and a large number of additional variables are even incorporated into the VAR, among which are average schooling, growth of gross fixed capital formation per capita, and inflation (Figure 3.b).

Figure3 – Series of residuals

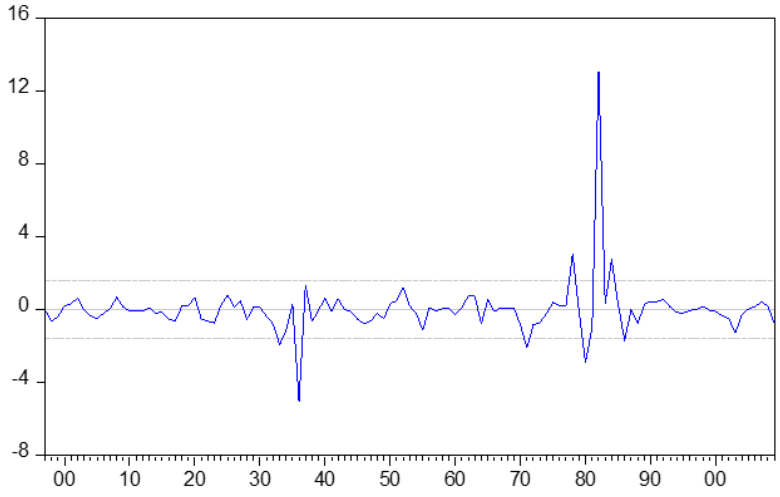
(a) Argentina



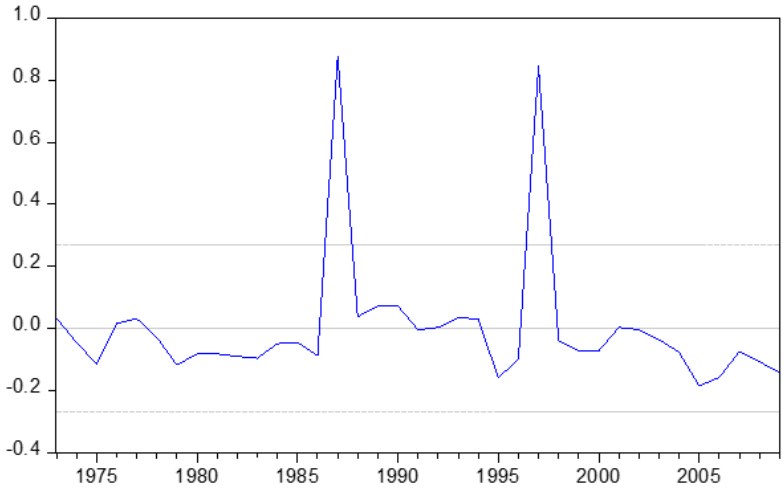
(b) Austria



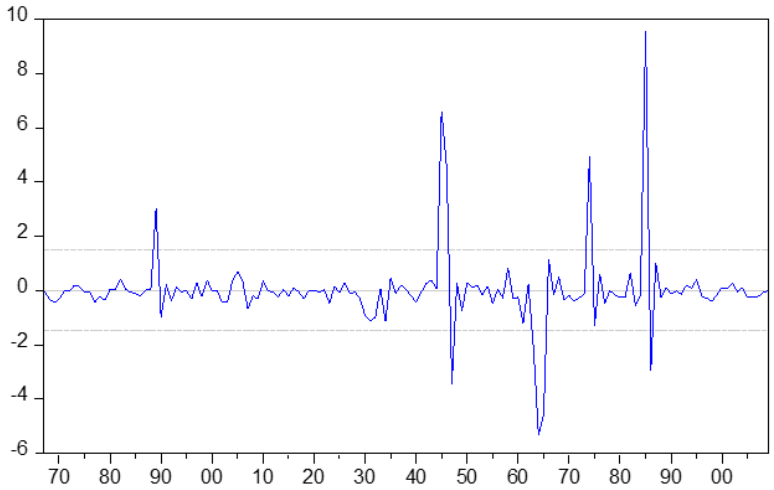
(c) Bolivia



(d) Botswana

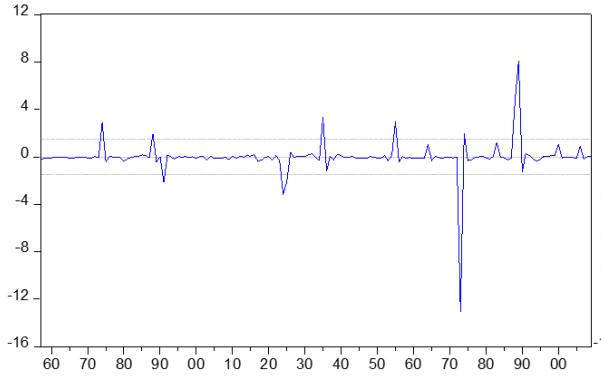


(e) Brazil

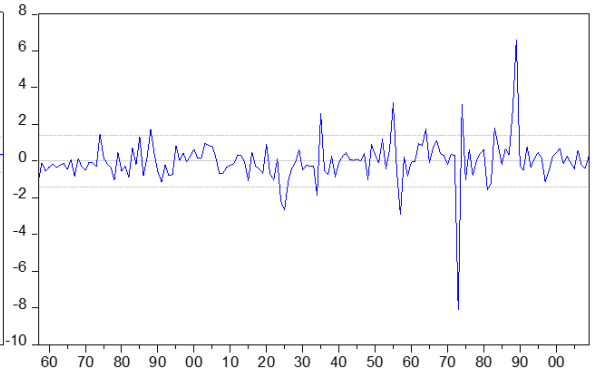


(f) Chile

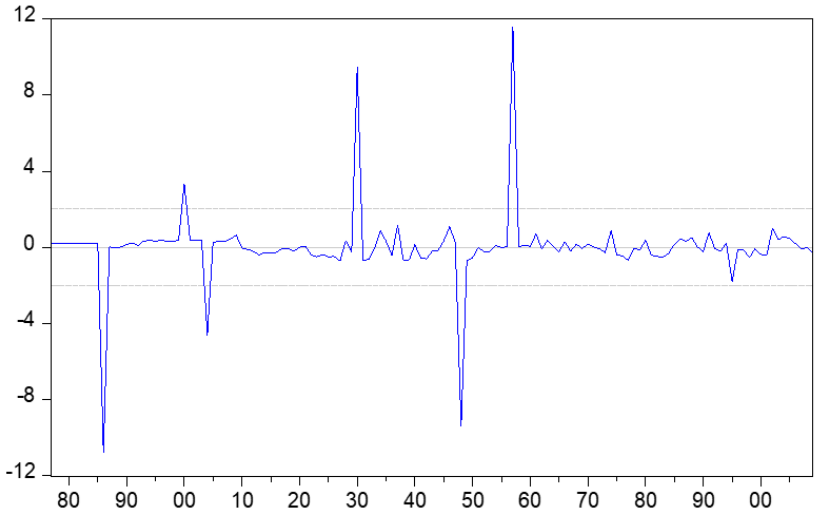
(i) Usual residuals



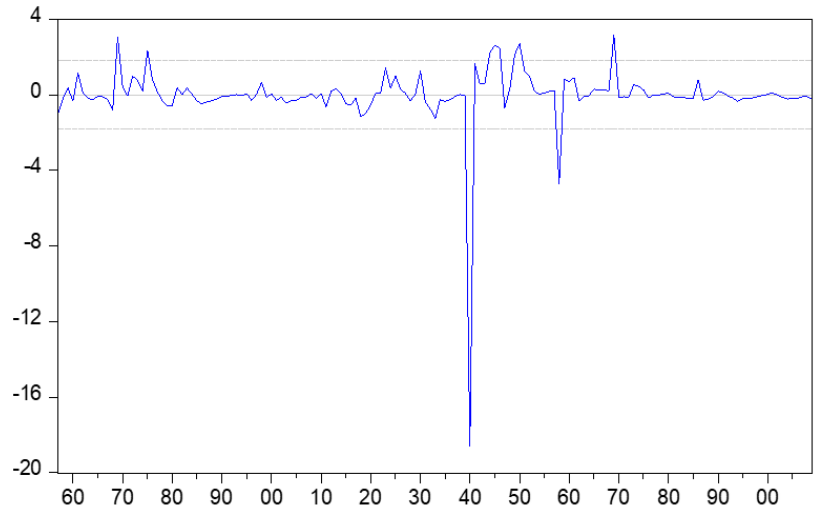
(ii) Including other control variables



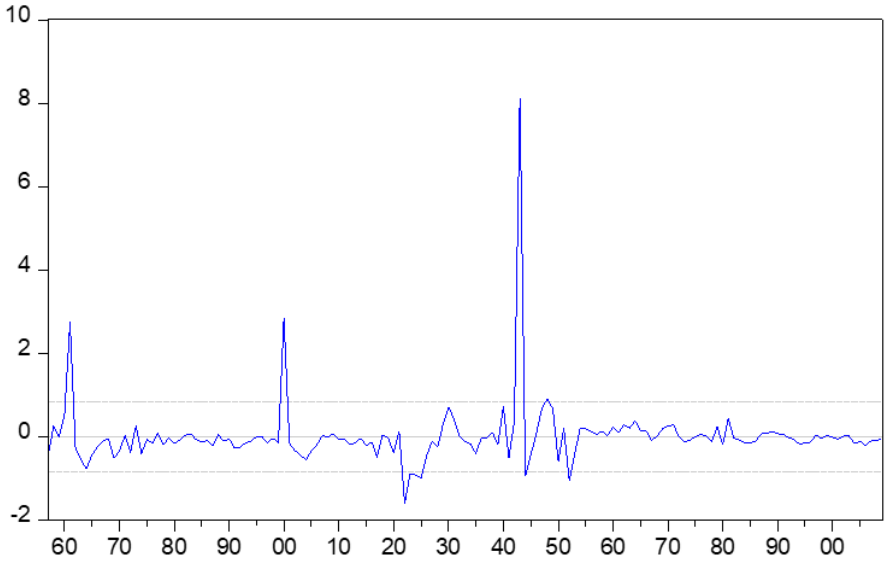
(g) Colombia



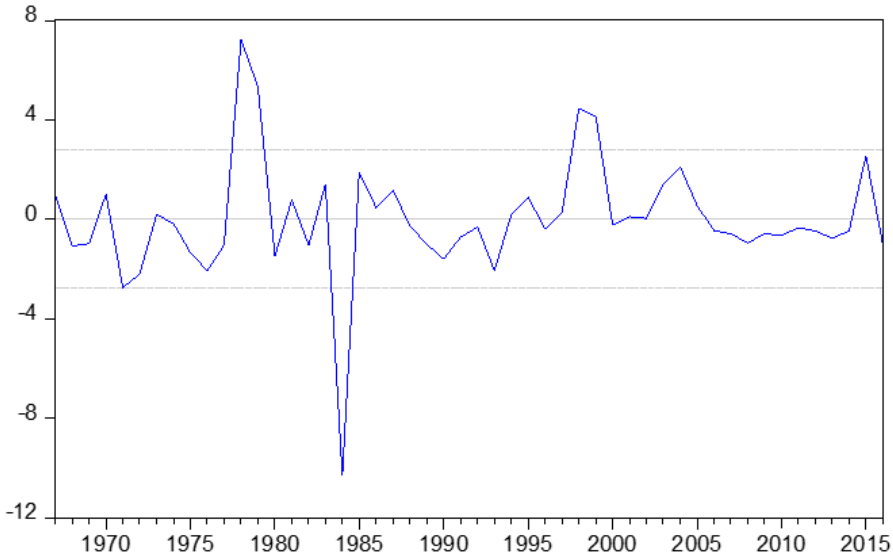
(h) France



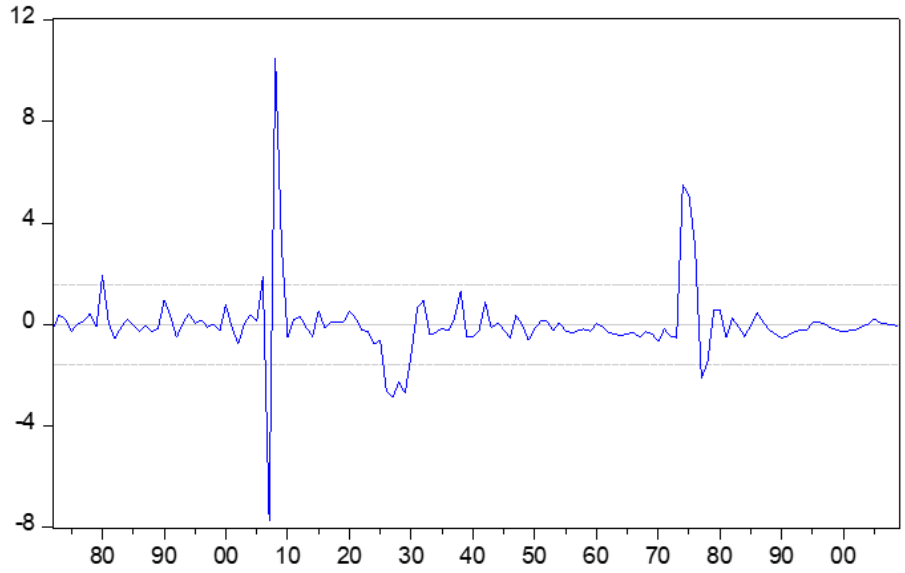
(i) Italy



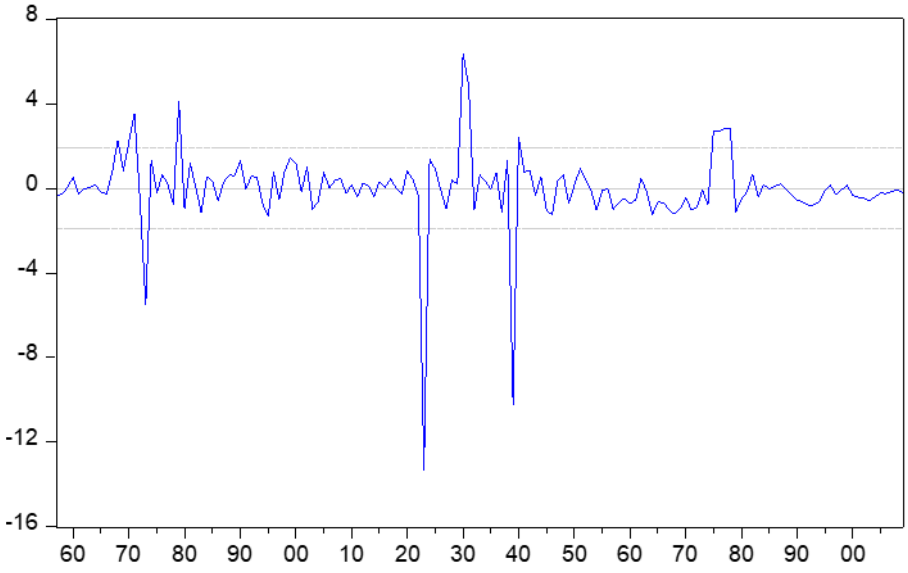
(j) Nigeria



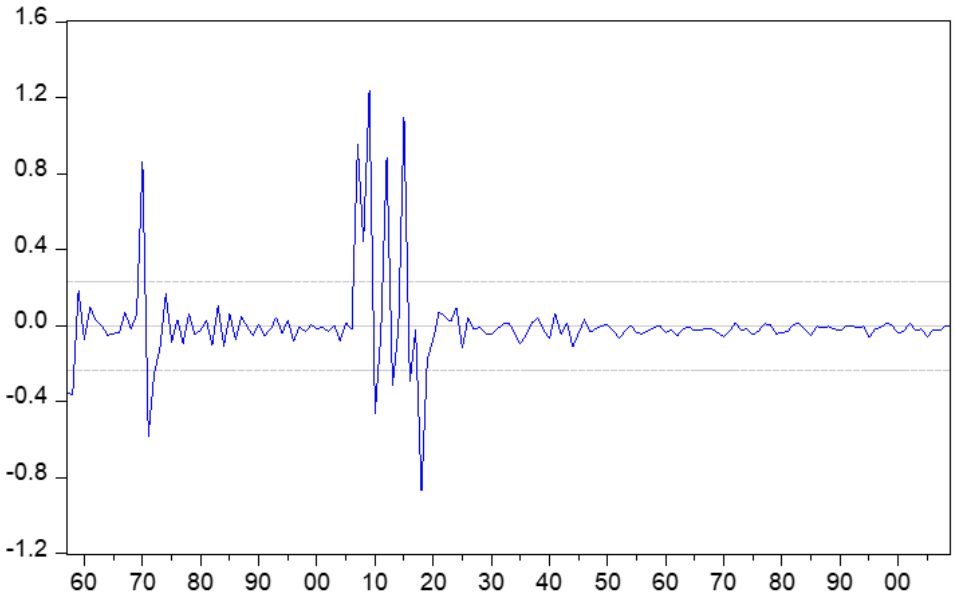
(k) Portugal



(l) Spain



(m) Sweden



4.2 The dynamic effects of a "democratic shock" on economic growth

This section shows the estimates of the short- and long-term responses to a "democratic shock", represented by the IRF and AIRF, respectively.

The results identify patterns that are specific to each of the selected countries. Through the estimation of the VAR and the corresponding IRFs and AIRFs, we can classify the countries according to the long-term effects that a democratic shock has on the growth rate of GDP per capita. Three of the countries studied show a positive and significant effect of democracy on growth (Chile, France and Italy), while for two of the countries (Bolivia and Spain) the long-term effect is negative. For the remaining seven cases studied (Argentina, Colombia, Brazil, Nigeria, Portugal, Austria and Sweden) the long-term effect is not different from zero.

Some interesting patterns are identified. While for some countries the effect is monotonic, for other countries the empirical relationship obtained is non-monotonic. In Italy, there is an effect on the growth rate of GDP per capita and only after a certain number of periods does the effect turn positive. This is consistent with recent evidence regarding the long-term

consequences of the French Revolution on growth, income, and inequality (Franck and Michalopoulos (2017)). The political economy dilemma of such a dynamic is obvious.

The Chilean case shows an oscillatory pattern of response, measured by the IRF, but with a positive cumulative effect. The Italian case shows a special pattern with a non-monotonic effect: a democratic shock initially has a marked negative effect on economic growth in the short term, but its long-term effect is positive. This is similar to what was found for the French case and is consistent with the evidence highlighted by Franck and Michalopoulos (2017).

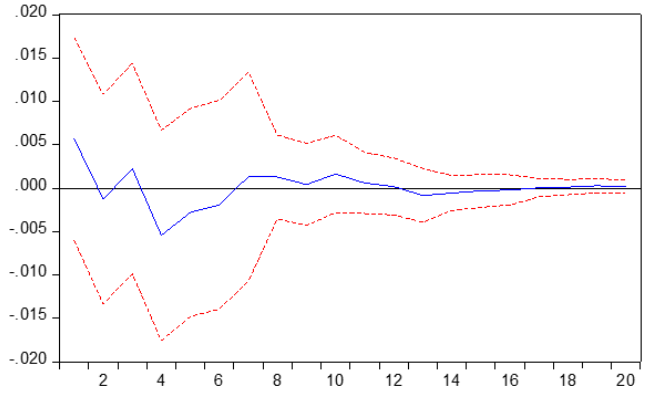
Meanwhile, the cases of Bolivia and Spain show how the democratic shock has a negative effect on the long-term economic performance. This is partly explained by the good economic performance of the Franco era and the specific forms of democratization in the 1980s for the Bolivian case. This illustrates that behind each statistic there must be a coherent historical context. Each country has its own idiosyncratic response to what we have called a democratic shock or disturbance. Authoritarian regimes may have promoted important advances in industrialization, as seems to be the case of the Franco regime in Spain.

The dynamics of evolution also raise interesting questions. Consider the case of Italy. The short-term effect associated with the democratic shock of the years 1946-48 is negative until the third year, which raises the question of the fragility of democratic consolidation if it involves costs in terms of the short-term economic performance. This is the challenge of the Political Economy and highlights the importance of having solid democratic institutions. Development is learning about how to move towards a legitimate social contract that is capable of putting the common good and a long-term perspective of public policy and economic policy decision-making.

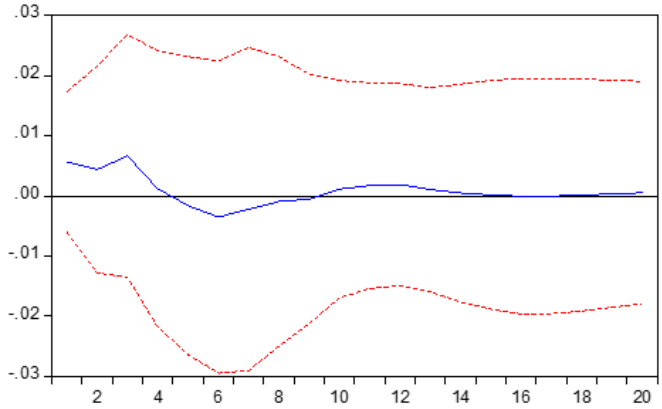
Figure 4

(a) Argentina

IRF of GDP per capita growth rate to first difference of polity variable

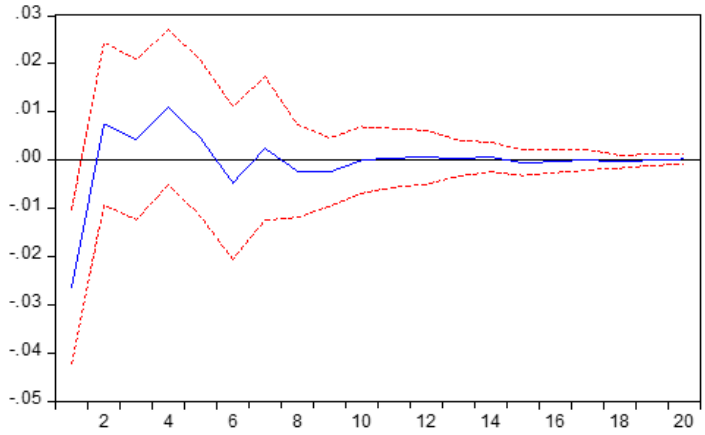


Accumulated response of GDP per capita growth rate to first difference of polity variable

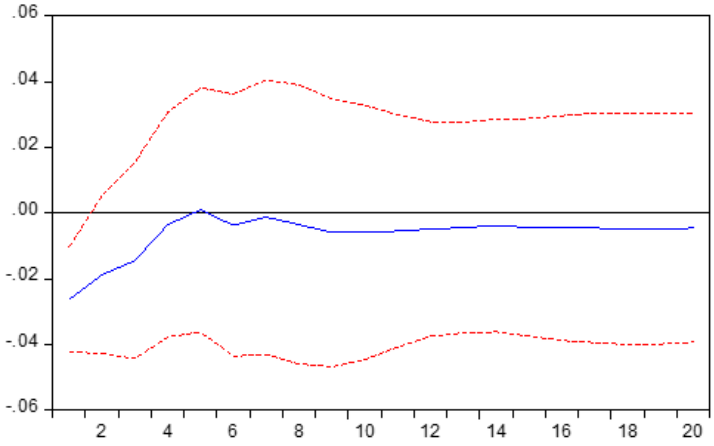


(b) Austria

IRF of GDP per capita growth rate to first difference of polity variable

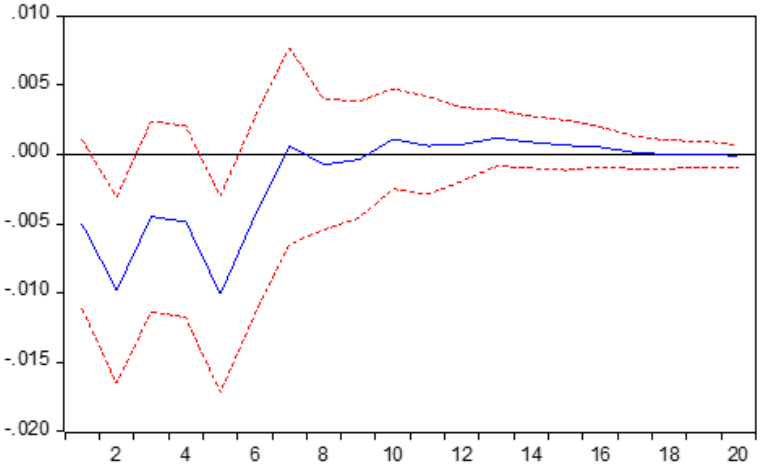


Accumulated response of GDP per capita growth rate to first difference of polity variable

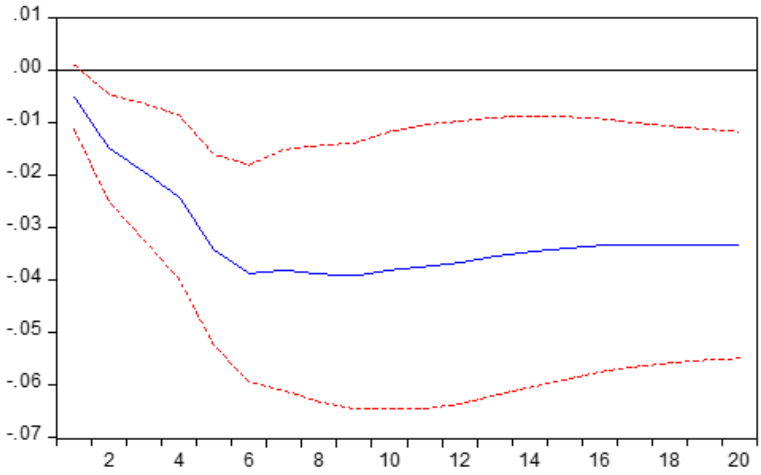


(c) Bolivia

IRF of GDP per capita growth rate to first difference of polity variable

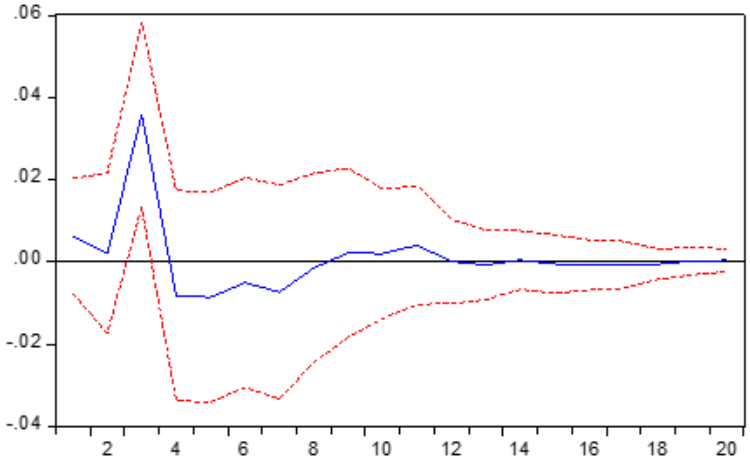


Accumulated response of GDP per capita growth rate to first difference of polity variable

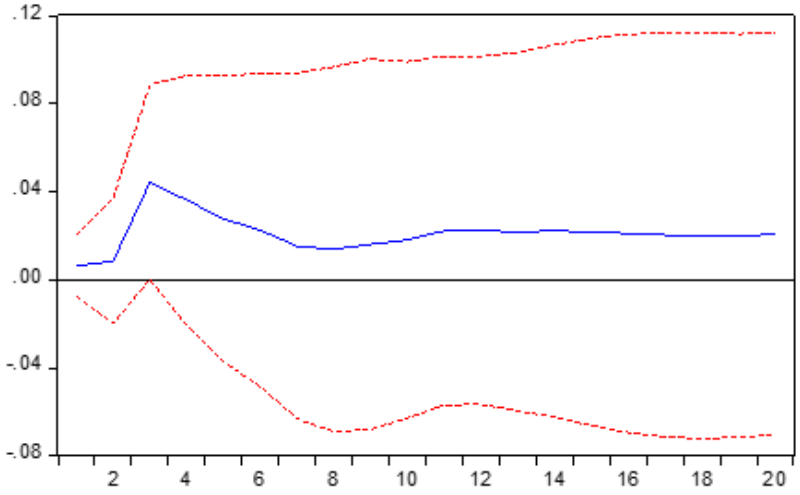


(d) Botswana

IRF of GDP per capita growth rate to first difference of polity variable

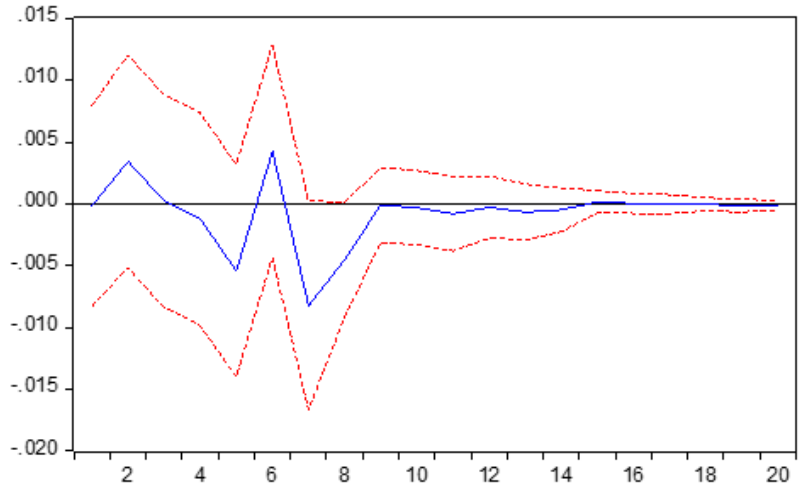


Accumulated response of GDP per capita growth rate to first difference of polity variable

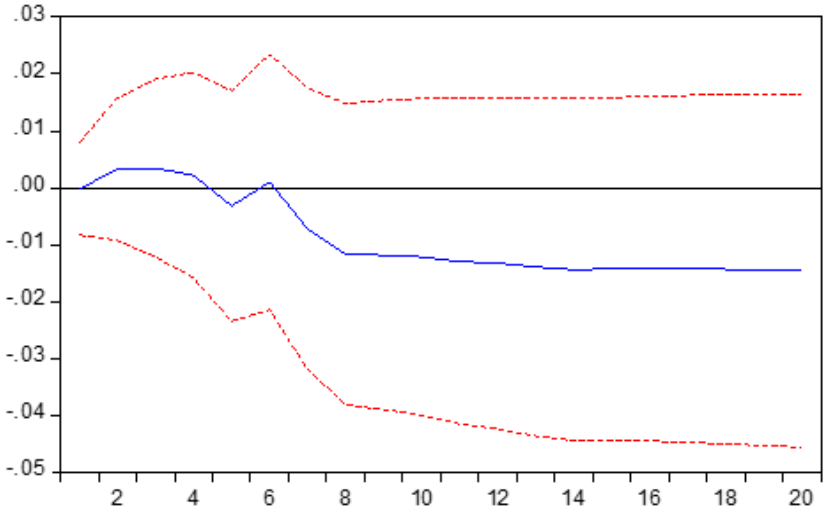


(e) Brazil

IRF of GDP per capita growth rate to first difference of polity variable

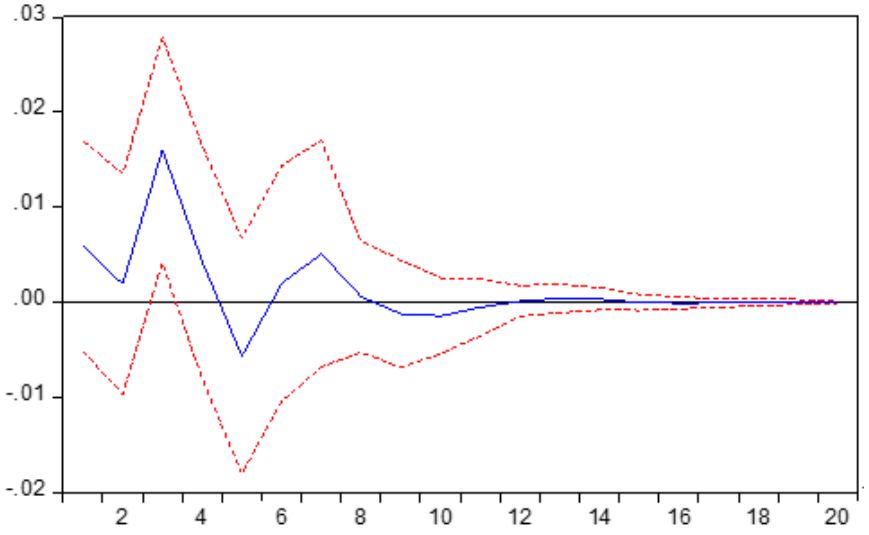


Accumulated response of GDP per capita growth rate to first difference of polity variable

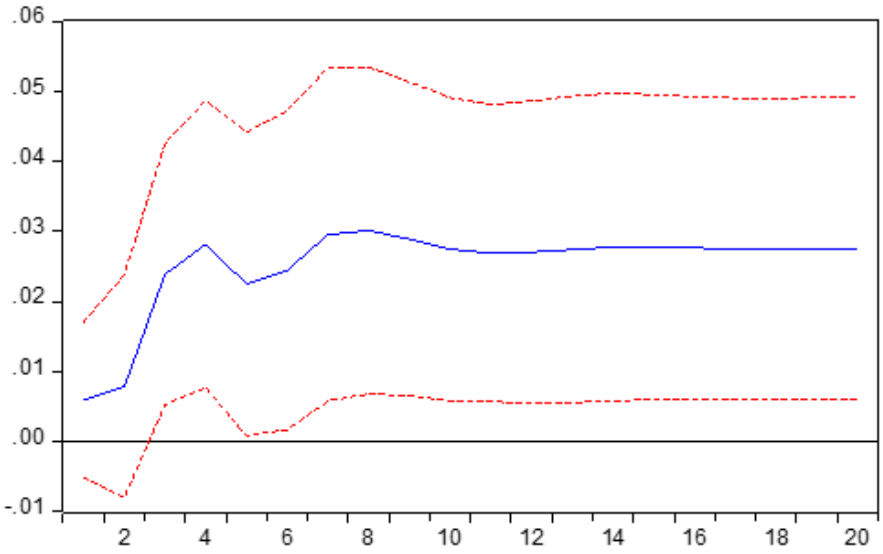


(f) Chile

IRF of GDP per capita growth rate to first difference of polity variable

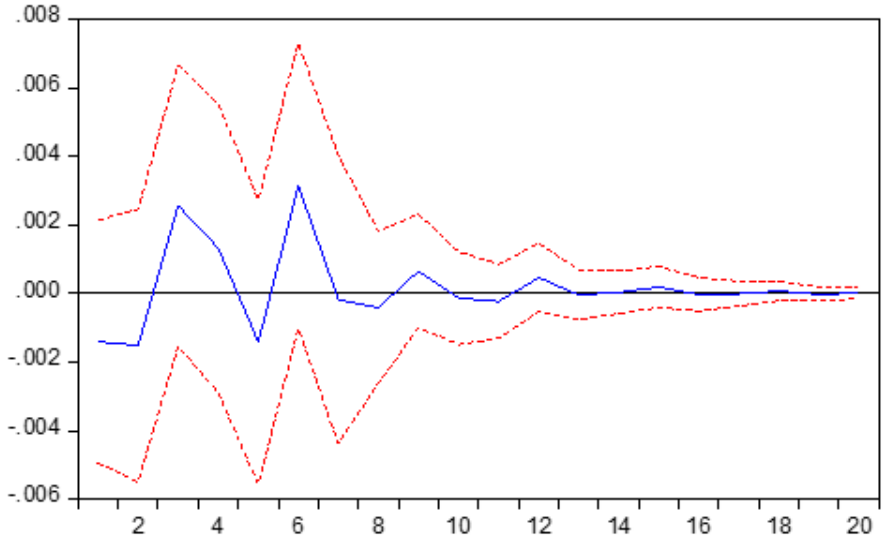


Accumulated response of GDP per capita growth rate to first difference of polity variable

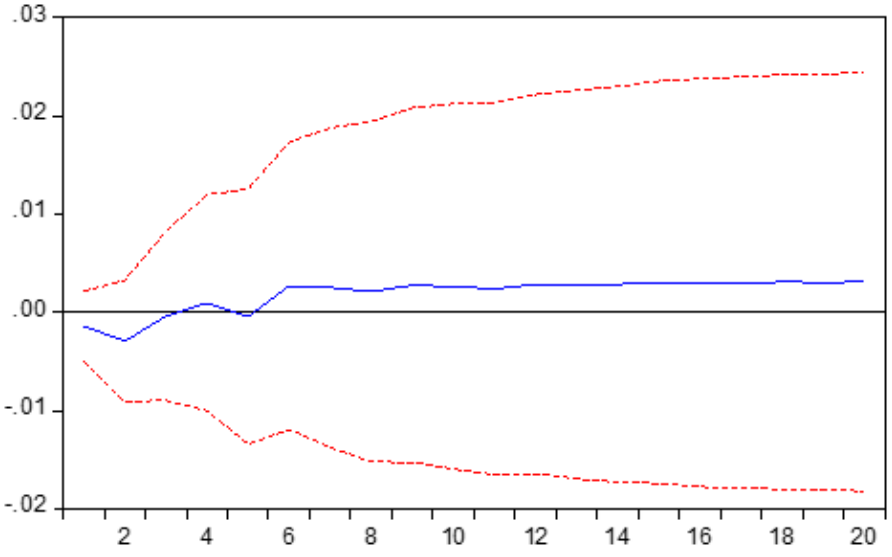


(g) Colombia

IRF of GDP per capita growth rate to first difference of polity variable

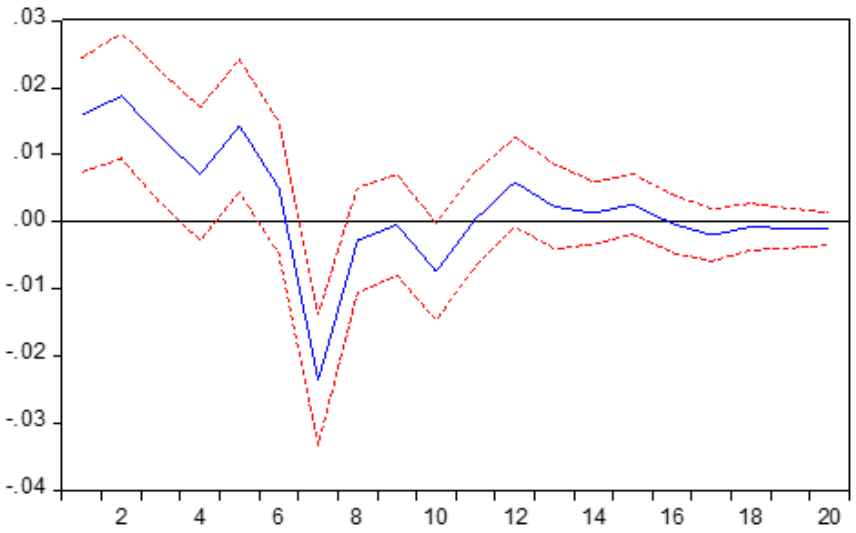


Accumulated response of GDP per capita growth rate to first difference of polity variable

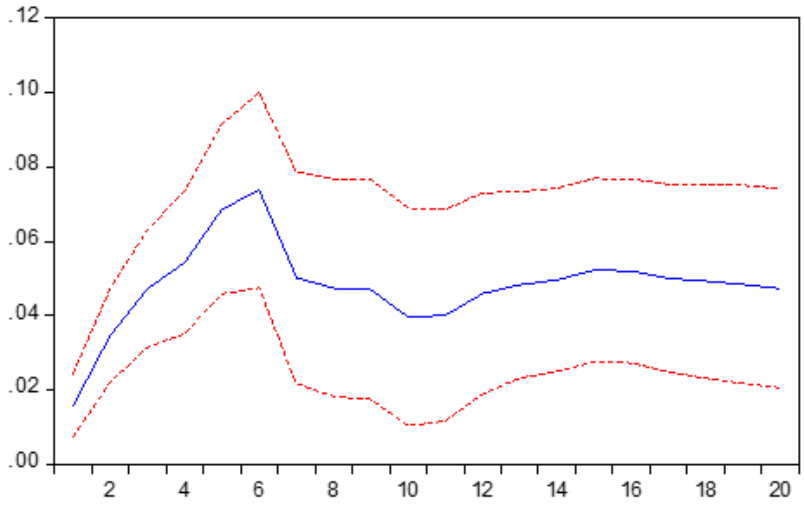


(h) France

IRF of GDP per capita growth rate to first difference of polity variable

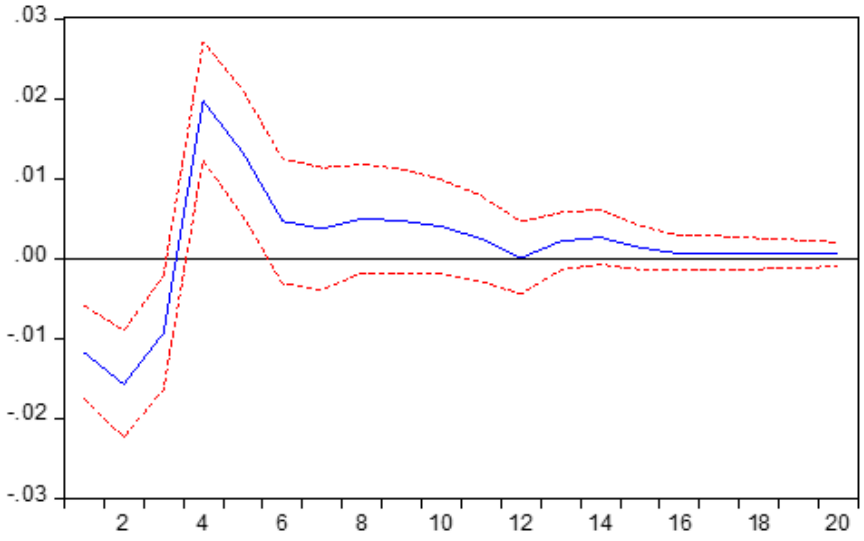


Accumulated response of GDP per capita growth rate to first difference of polity variable

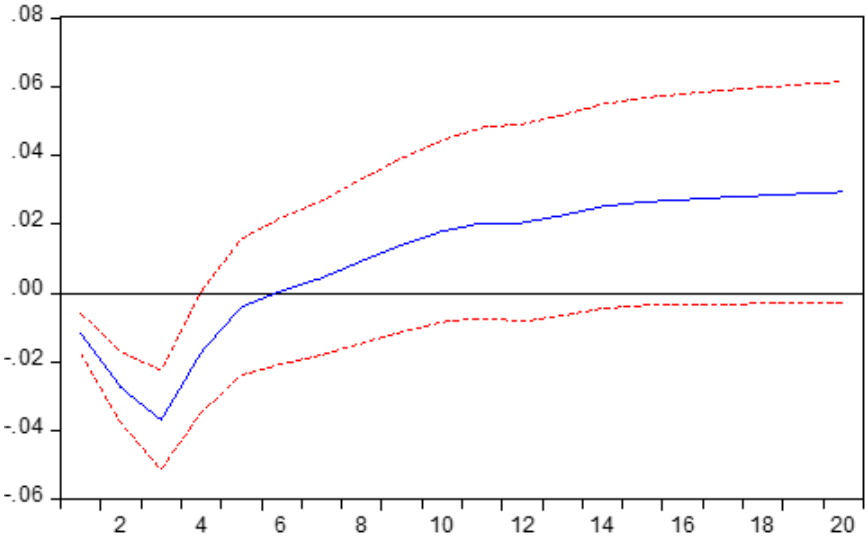


(i) Italy

IRF of GDP per capita growth rate to first difference of polity variable

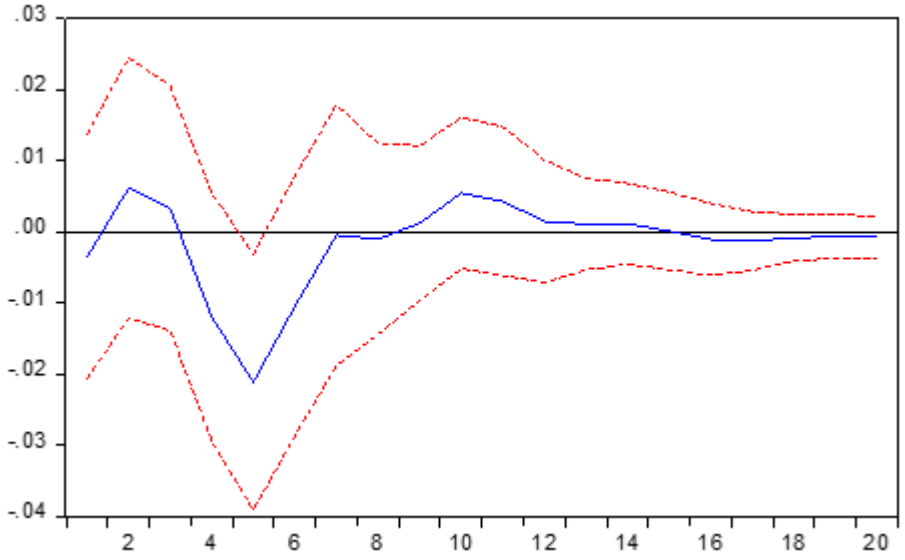


Accumulated response of GDP per capita growth rate to first difference of polity variable

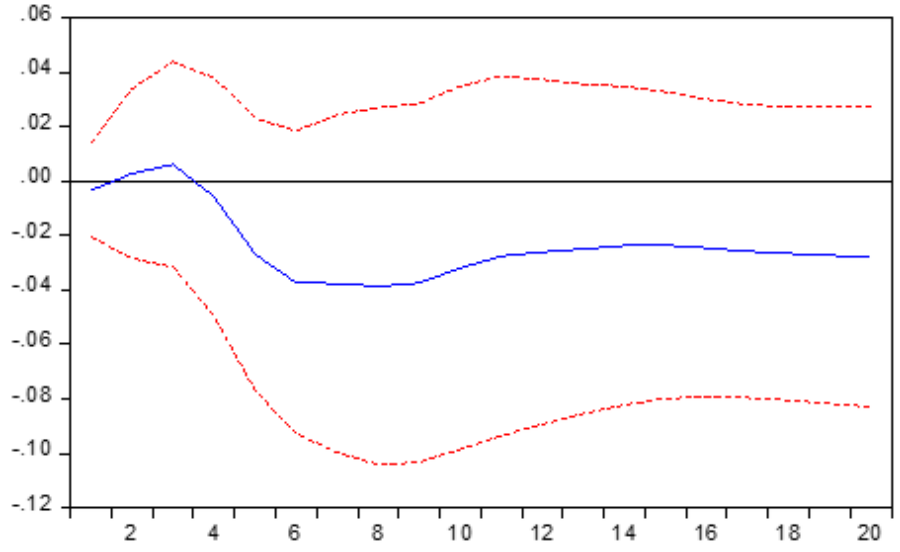


(j) Nigeria

IRF of GDP per capita growth rate to first difference of polity variable

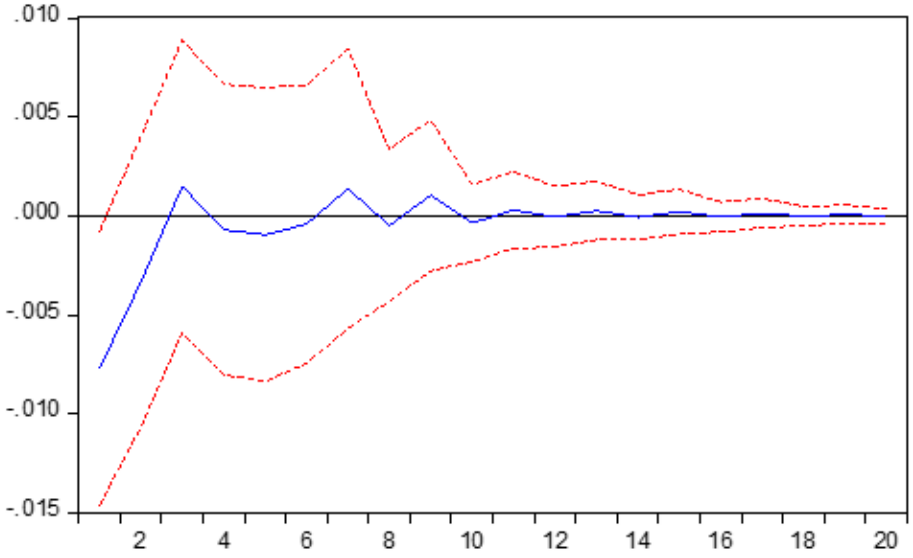


Accumulated response of GDP per capita growth rate to first difference of polity variable

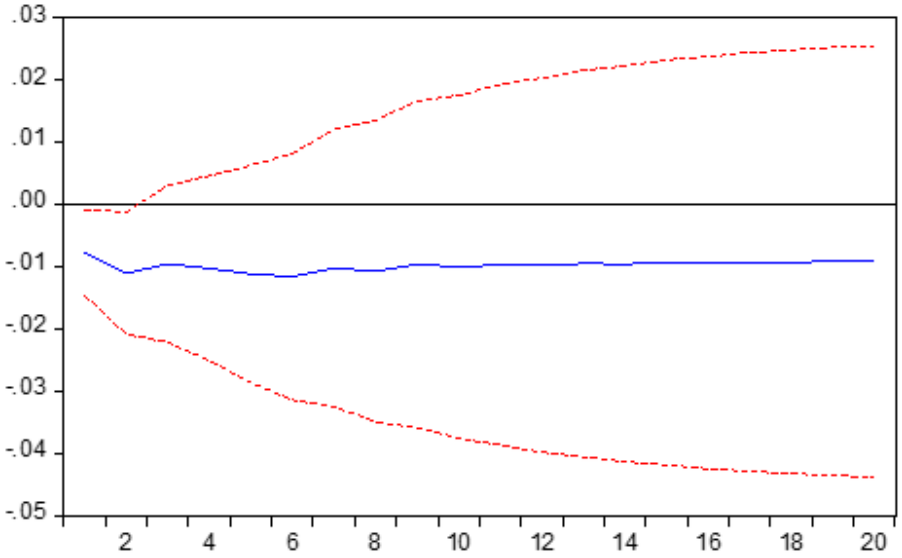


(k) Portugal

IRF of GDP per capita growth rate to first difference of polity variable

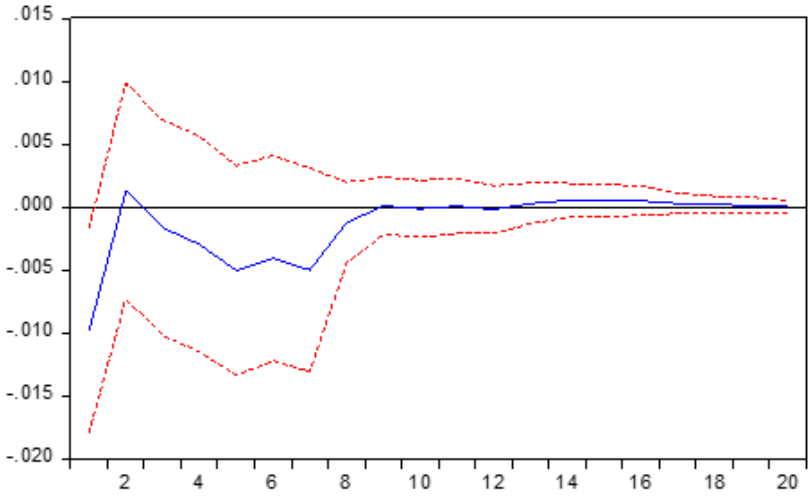


Accumulated response of GDP per capita growth rate to first difference of polity variable

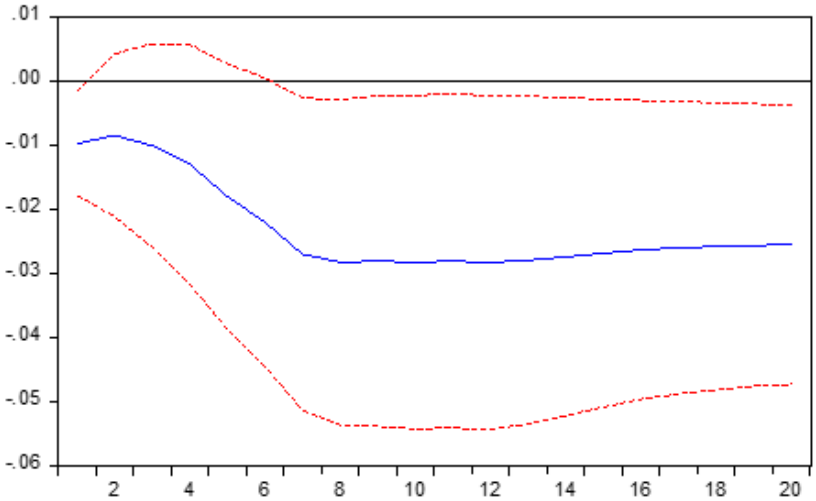


(l) Spain

IRF of GDP per capita growth rate to first difference of polity variable

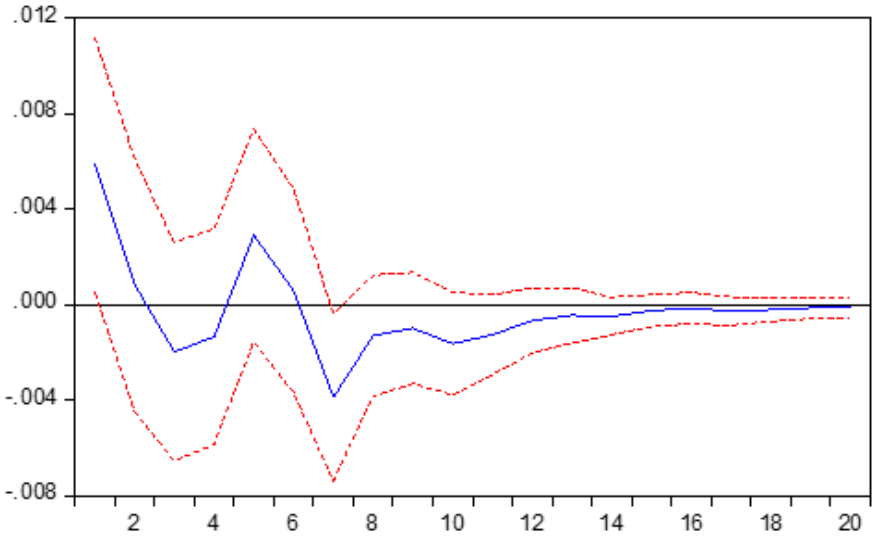


Accumulated response of GDP per capita growth rate to first difference of polity variable

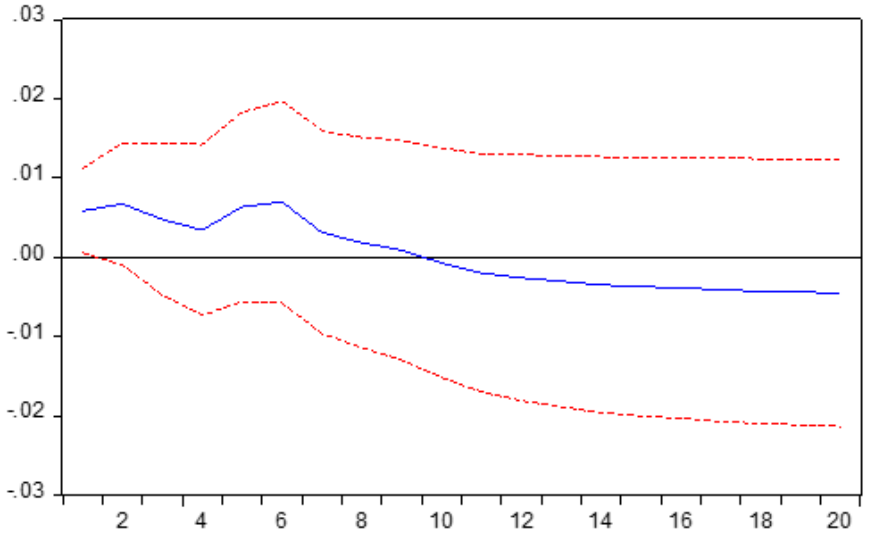


(m) Sweden

IRF of GDP per capita growth rate to first difference of polity variable



Accumulated response of GDP per capita growth rate to first difference of polity variable



4.3 From General to Specific: Looking for long-term relationships

The problem of model selection is central to empirical economic research. In general, there are only a priori theories that do not have to be applicable to new research and therefore are at least risky when used as a guide for econometric specification. In the same way, a problem arises when it is necessary to evaluate or contrast the existing theories about the same phenomenon.

There is a branch of the so-called "British econometrics" literature of a marked empirical nature that uses automatic model selection methods that proceed from the General to the Specific (GETS). This procedure was used to obtain parsimonious autoregressive vector models in Hendry and Krolzig (2005), while Heinlin and Krolzig (2012) applied this methodology to find a VAR with which they examined the consequences of exchange rate overreactions.

The objective of this approach is to identify or discover an empirical model that does not deviate substantively from the evidence and that in turn can account for alternative models that use the same data. The first idea refers to the notion of congruence of the model, that is, its ability to reproduce the data in a coherent way, and the second idea is summarized in the notion of matching.

In the previous sections, an unrestricted general model (GUM) has been estimated and the IRFs and AIRFs have been obtained. The objective in this subsection is to find patterns that are indicative of the long-term relationship between the (change in) political regime and economic growth, and thus complement the evidence found in the previous sections.

The "General to Specific" (GETS) procedure is a form of model reduction based on the specification of certain relevant criteria that "searches" in different ways until it reaches a minimum model. This methodology was proposed by Hendry in 1995 and is based on a series of reduction stages, which are described below.

Generally speaking, an automatic model selection process is based on a series of reduction stages and proceeds by initially estimating a General Unrestricted Model (GUM) from the available data. With this, a bound is obtained for the fit of the model based on the standard deviation of the estimated errors. The selection and elimination of variables then involves a trade-off between minimizing the presence of irrelevant variables and losing too many

relevant variables. The process leads to a terminal model, where all of the acceptable reductions by the algorithm have been made.

In this framework, the concepts of weak, strong and super-exogeneity correspond to the objectives of estimation, prediction and policy analysis, respectively (Ericsson, Hendry &Mizon, 1998). Weak exogeneity assures the consistency of the estimated parameters and magnitudes of interest. The GETS procedure allows us to select the minimum number of significant variables that meet this condition. By combining weak exogeneity with the results of the Granger non-causality tests, we arrive at the concept of strong exogeneity. Each of these notions of exogeneity is associated with some of the levels of knowledge expected in the research: consistent estimation of the magnitudes in the case of weak exogeneity and predictive capacity in the case of strong exogeneity. Another concept, that of "super-exogeneity" assures us that the conditioning variables are weakly exogenous for the parameters of interest and that, furthermore, the distributions of these variables can change without altering the estimated parameters.

With this process, it is possible to identify a reduced linear system that is considerably simpler and easier to interpret than the unrestricted VAR, with estimated parameters that are consistent and with a model that has predictive capacity and a certain level of stability in its parameters that allows it to be carried out.

4.3.1 Results

Two specifications or models are estimated for each country. Column M serves to distinguish them. Model 1 has incorporated the political regime variable as a contemporary variable, while in model 2 only lags have been incorporated. The results are reported for a significance level of 95%. The initial GUM considered between 6 and 8 lags and the results were practically coincident. For reasons of space, only the sign of the coefficients is shown.

TABLE 2

Aggregate results of the *General to Specific* Procedure

	M	Lags of GDP per capita growth						Political variable						
		1	2	3	4	5	6	0	1	2	3	4	5	6
Botswana	1	+								+				

	2	+								+				
Brazil	1													
	2													
Chile	1		-	-						+				
	2		-	-						+				
Colombia	1	+											+	
	2	+											+	
France	1			+				+	+			+		-
	2			+					+			+		-
Italy	1	-					+	-	-		+	+		
	2	-	-		+				-	-	+	+		-
Sweden	1													
	2													
Austria	1						-	-	+		+			
	2						-				+			
Bolivia	1	+										-		

	2	+										-		
Portugal	1		+		+									
	2				+									
Spain	1	+												
	2													
Argentina	1													
	2													

*Nigeria was not included

For the case of Chile, France and Italy, the results are confirmed, and even reflect the non-monotonic effect described above. In the case of Bolivia, a coefficient with a negative sign is associated with the policy variable, but this does not occur in the Spanish case, where no lag of the political variable is statistically significant. In line with what was previously found, no lag of the political variable is different from zero in the cases of Brazil, Sweden, Portugal, Spain and Argentina. Some discrepancies are observed in the cases of Botswana and Colombia (both with a positive lag of the political variable) and also in the case of Austria, which exhibits two positive lags.

5. Conclusions

The discussion about the relationship between economic performance and democratic institutions turns out to be an extremely relevant research topic today. On the one hand, democracy could represent an obstacle to economic growth (due to greater insecurity regarding property rights, redistributive measures that decrease the net profitability of

capital, etc.) or, on the other, democracy could represent a true "social technology " that allows information to be used in the best possible way, since it allows knowledge to flow and power to be dispersed, but also allows the socioeconomic system greater evolutionary flexibility around the application of best self-governance practices and accountability, regarding, for example, control over the political class, the possibility of carrying out citizen consultation processes for certain issues, the best management that could exist in a participatory local budget design, and addressing pressing issues such as climate change. This entails a recognition that the nature of problem has to do with the political institutionality that defines the incentives and shapes the material results in the economic sphere.

For 13 countries, an empirical study was carried out with the objective of identifying long-term regularities that could be identified through the specification of highly flexible time series models, complemented by the use of an automated model reduction algorithm.

It was found that a higher level of democracy does not necessarily cause a higher growth rate of GDP per capita. In three of the countries studied (Chile, France and Italy), democracy was shown to have a positive effect on the long-term growth path, while for two countries (Bolivia and Spain) the long-term effect was found to be negative. No significant effect was found for the remaining seven cases studied (Argentina, Colombia, Brazil, Nigeria, Portugal, Austria and Sweden).

This should lead to contextualizing the statement that "*democracy does generate growth*" and should also guide long-term economic development studies to incorporate the evidence of time series with a coherent narrative of the socio-economic processes and the specific historical context of each country.

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Annex 1

More about the Polity Index

The Polity Index is a data set widely used in economics and political science research. Together with the "Varieties of Democracy" and "Freedom House" projects, they are part of the indicators commonly used to identify the type of political regime at the country level.

The Polity Index captures the extent to which the executive branch is chosen through open, multi-party, and competitive elections, as well as the constraints and degree of competitiveness of the political environment. It goes from -10 (hereditary monarchy) to 10 (consolidated democracy). Covers all major independent states in the global system from 1800 onwards, having a population of 500,000 or more in the most recent year. Strictly speaking, the index is a measure of the different constraints faced by the governing elites and does not necessarily capture other relevant facts such as the enfranchisement or political expansion of suffrage.

Instead, the Polity Index focuses on the formal structure of the political regime and does not capture or differentiate the effective levels of democracy or autocracy existing in an economy, which could be determined by the capture of the media, lobbying or overrepresentation of a minority in electoral processes.

Nevertheless, this variable has been pointed out as the most popular measure of the political regime of a country. According to Coppedge et al. (2017)[8] the Polity Index, with nearly 5.000 citations, is by far the most used indicator of democracy based on a Google Scholar citation report. The second most used is Freedom House's Civil Liberties and Political Rights with nearly 1.500 citations. The bulk of the "political economy" core literature has used extensively the polity index, either directly or as a basis for the construction of an indicator of political regime[9].

Because democracy is a broad concept that includes the interaction of various institutions that are not easy to measure, there are strong limitations to quantify and measure econometrically the potential effects and their relationship with other phenomena, such as economic development, inequality, poverty and education. From a statistical and econometrical point of view, Boese (2019)[10] has criticized the Polity Index for the presence of discontinuities and missing observations, but also recognizes the high level of agreement for those observations included in all the three main datasets namely, "Polity Project", "Varieties of Democracy" and "Freedom House". These issues may limit the scope of application of these types of indexes, especially for cross-country analysis and comparisons. Some of this problem may be avoided using a time-series approach, like in this article.

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Annex2

A Panel VAR Exercise

Below is a panel VAR model of order p with fixed effects at the panel level, which can be expressed by the following system of linear equations:

$$Y_{i,t} = \sum_{l=1}^{p} Y_{i,t-i} A_l + \mu_i + \varepsilon_{i,t}$$

Where $i \in \{1, 2, \cdots, N\}$ denotes the panel units and $t \in \{1, 2, \cdots, T_i\}$ represents the periods. $Y_{i,t}$ is a $(1 \times k)$ vector of endogenous variables, μ_i $(1 \times k)$ vector of fixed effects dependent variables and $\varepsilon_{i,t}$ is a $(1 \times k)$ vector of idiosyncratic errors. The $(k \times k)$ matrices $A_1, A_2, \cdots, A_p$ contains parameters to be estimated. It is assumed that innovations satisfy $E(\varepsilon_{i,t}) = 0$; $E(\varepsilon'_{i,t} \varepsilon_{i,t}) = \Sigma$ and $E(\varepsilon'_{i,t} \varepsilon_{i,s}) = 0$ for all $t > s$.

The above model is estimated by GMM. To remove endogeneity, the model is transformed by applying "Forward Orthogonal Deviations" (FOD) to the variables under study. The selection of the model is carried out using the "model and moment selection criteria" (MMSC) method proposed by Andrews and Lu (2001).

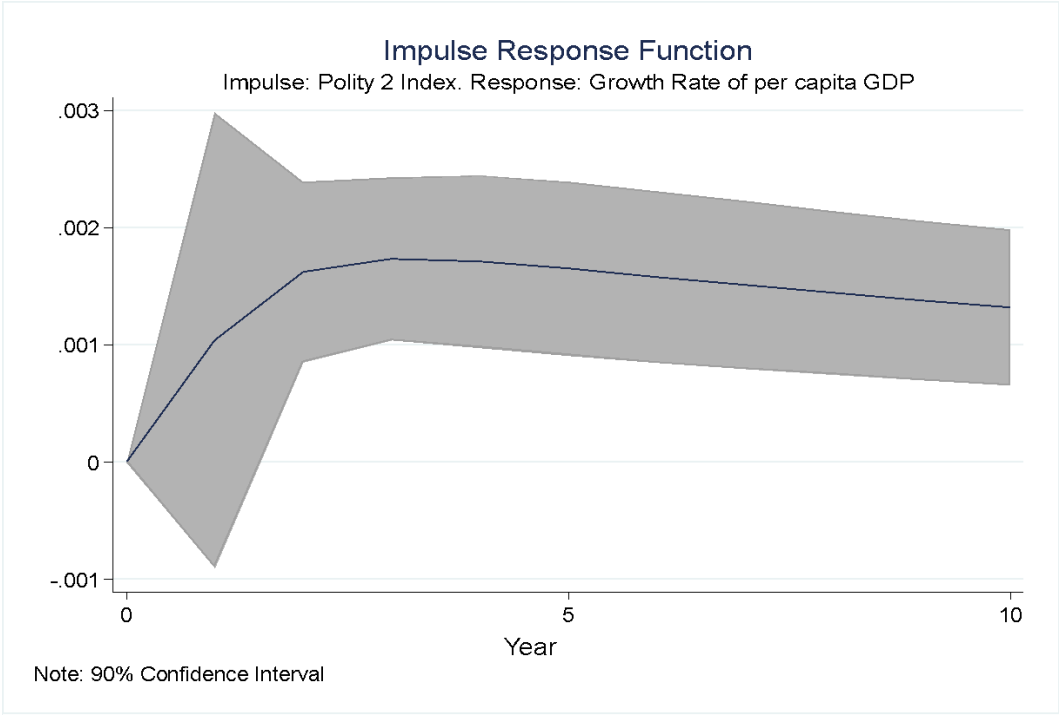
Results

To obtain valid results, it was verified that the series used were stationary. For this, the Im-Pesaran-Shin unit root test was used, concluding that the two series studied (the polity 2 democracy index and the per capita GDP growth rate) are stationary with 90% confidence. Likewise, all the eigenvalues are within the unit circle, therefore the stable system and the model allow us to draw statistically valid conclusions from the results obtained.

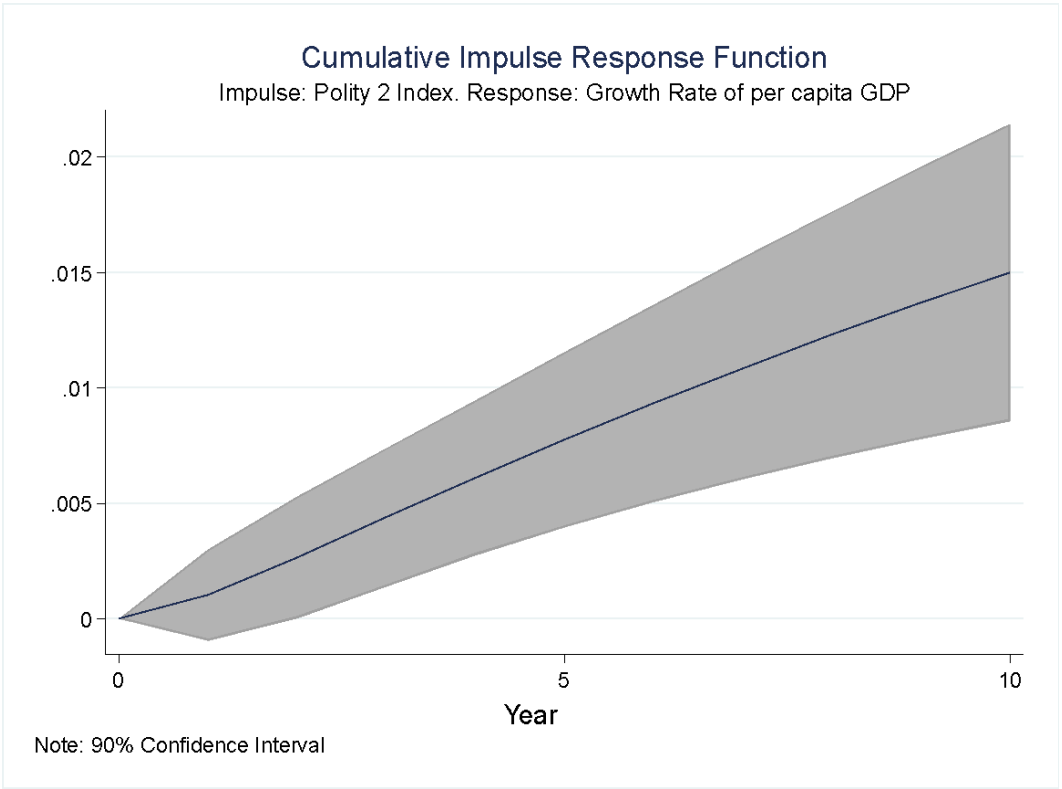
Once the model selection criterion has been applied, it is concluded that the model that best fits the data is a VAR panel with p=2 lags and the first 9 lags of the endogenous variables as instruments.

Below are the results of the impulse response functions (IRFs), cumulative IRFs, orthogonalized IRFs, and cumulative orthogonalized IRFs, as well as the Granger causality test.

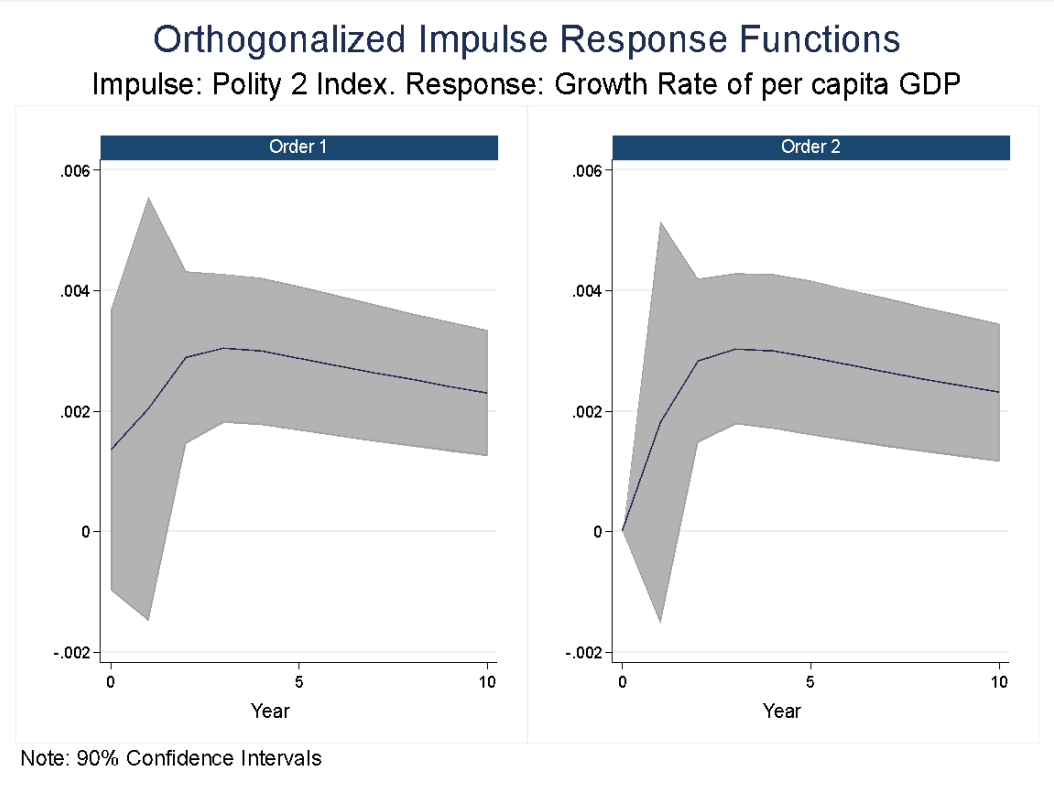
Graph 1: Impulse-response function for the effects on the per capita GDP growth rate in the face of a shock that increases the polity 2 variable by one unit.



Graph 2: Cumulative impulse-response function for the effects on the growth rate of GDP per capita in the face of a shock that increases the polity 2 variable by one unit.



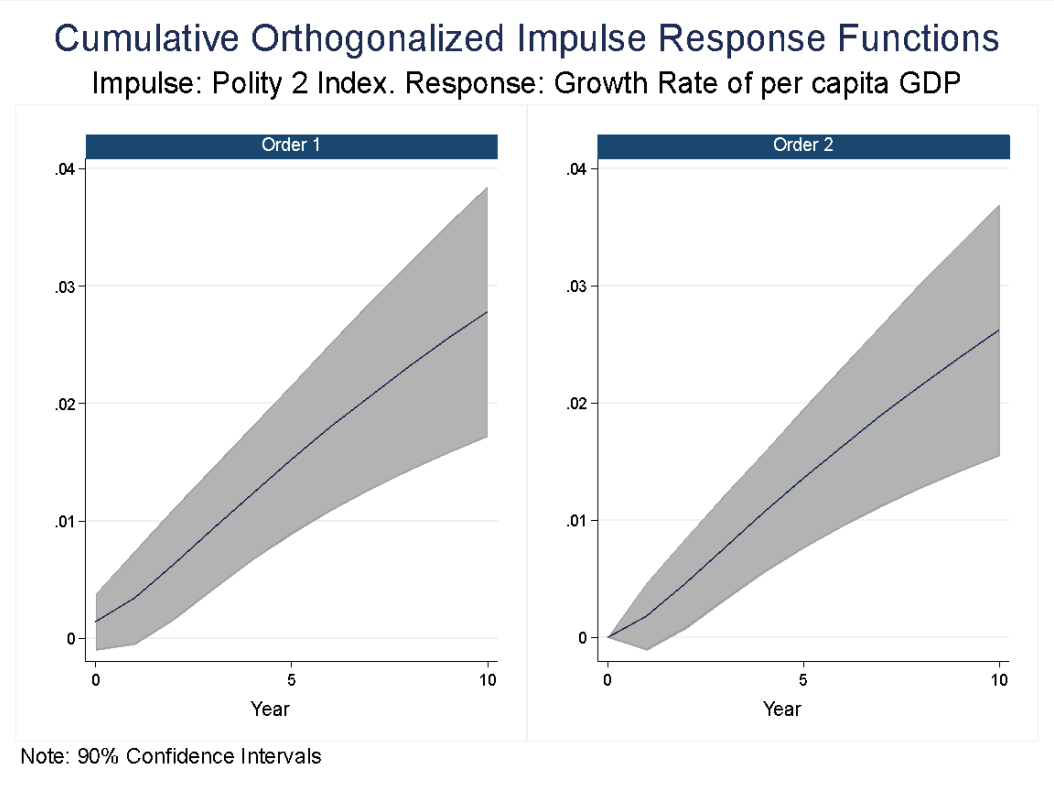
Graph 3: Orthogonalized impulse-response function of the effects on the growth rate of GDP per capita in the face of a shock that increases the polity 2 variable by one standard deviation.[11]



Graph 4: Cumulative orthogonalized impulse-response function (for the two orders of the Cholesky decomposition) of the effects on the growth rate of GDP per capita in the face of a shock that increases the polity 2 variable by one standard deviation.[12]

[11] For the two orders of the Cholesky decomposition

[12] For the two orders of the Cholesky decomposition



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Technical Note

Political Regimes and Economic Growth:

A Time Series Analysis

Simón Accorsi O.[13]

Abstract

This paper studies the relationship between democracy and economic growth with a time series approach. For a number of Latin America and European countries we estimate the long term effect of a "democratic shock" on the per capita GDP growth rate. The starting point is an Autoregressive Vector (VAR) acting as general unrestricted model (GUM). This general model is subjected through an automatic reduction process using a *General to Specific* (*GETS*) algorithm. This methodology ensures the weak exogeneity of the variables with respect of the parameters of interest and allows to investigate the strong exogeneity. Results show no clear patterns for the relation between political regime and economic performance, which is indicative of a country-specific relationship.

Key words: *Political Regimes, Democracy, Economic Growth*

JEL Classification: *C32, O11, O43, P16*

1. *Introduction*

Societies and their economic structures are highly complex, evolutionary, multidimensional systems whose changes or time-paths are exposed to different types of innovations or shocks. They are subject to endogenous or exogenously triggered structural changes. The development of a research program that identifies some of the properties of these systems - detecting patterns or regularities - is a primary objective of empirical modelling.

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In this paper, some of the aspects of the dynamic relationship between institutional structures - characterized by different types of political regimes - and economic development, measured through the growth rate of GDP per capita, are empirically characterized. The objective is to estimate the long-term effect of a democratic shock on the growth rate of GDP per capita. The main methodological novelty is that this problem is addresed with a time series approach and its respective tools, and hence, with a different approach to the usual identification problems in the related literature, which mostly uses cross-section panels, propensity score matching techniques and instrumental variables.

In plain terms, what is behind of this idea and the related literature, is to consider institutions – and in this case, democracy or the political regime - as a significant part or determinant of technological progress. As a brief theoretical motivation for the empirical excersice presented in this article, lets consider a simple dynamic programming growth problem:

The social planner goal is to solve:

$$Max \sum_{t=0}^{\infty} \beta^{t} u(c_t)$$

s.t.

$$k_{t+1} = f\left(k_t\right) - c_t$$

$$f\left(k_t\right) = y_t = A_t k_t^{\alpha}$$

Were $u(\cdot)$ is the utility function, and the production function $f(\cdot)$ it is assumed that satisfies the usual assumptions regarding concavity. A_t is the level of productivity of period t.

Whether the problem is approached via a Lagrangian or via Bellman's equation, we arrive at the same first-order necessary condition expressed in the following Euler equation:

$$u'\left(c_t\right) = \beta f'(k_{t+1}) u'\left(c_{t+1}\right) = \beta A_{t+1} \alpha k_{t+1}^{\alpha-1} u'\left(c_{t+1}\right)$$

For illustrative purposes, lets consider $u\left(c_t\right) = log(c_t)$. In this case is possible to arrive to:

$$(1 + g) = \frac{c_{t+1}}{c_t} = \beta A_{t+1} \alpha k_{t+1}^{\alpha-1}$$

Is possible to think in a general functional form to incorporate the relevance of the political regime. This implies that today`s productivity level depends on the lags of the institucional variable or political regime, p:

$$A_t = a(p_{t-1}, p_{t-2}, p_{t-3}...)$$

So, in this case the growth rate of this economy is determined by the variable associated with the level or type of political regime and their lags reflecting the persistence of institutions.

The purpose of this note is to carry out an empirical exercise in order to identify data regularities and thus provide evidence for the evaluation or contrast of alternative theories. Besides from this brief theoretical note, the main purpose here is not to discuss theories about the relationship between political regimes and economic development.

The strategy used here starts with the estimation of a general unrestricted model, in the form of an autoregressive vector foe each of the thriteen countries analized. From this, the cumulative impulse-response functions (AIRF) for all countries are obtained. For the Chilean case, the robustness of the relationship found is checked by incorporating a greater number of variables. The countries were chosen in order to achieve certain degree of representativity of the continents and alo with the condition of exhibiting a certain degree of variability in the variables of interest, in particular, the political variable.

The results identify patterns specific to each of the selected countries. Through the estimation of the VAR and the corresponding AIRF we can classify the countries according to the long-term effects that a democratic shock has on the growth rate of GDP per capita. For three countries in the sample the long-term effect of a democratic shock is positive (Chile, France and Italy), while for two of the countries (Bolivia and Spain) the long-term effect is negative. For the remaining cases studied (Argentina, Colombia, Brazil, Portugal, Austria, Sweden, Botswana and Nigeria) the effect is not significant.

Other patterns of interest are also identified: while for some countries the effect is monotonic, for other countries the empirical relationship obtained is non-monotonic: a democratic shock initially has a negative effect on the growth rate of GDP per capita and only after a certain number of periods does the effect become positive. This is consistent with recent evidence regarding the long-term consequences of the French Revolution on growth, income, and inequality (Franck and Michalopoulos (2017)). The political economy dilemma of such a dynamic is obvious.

In order to obtain a reduced model that allows these relationships to be expressed in terms of a simpler and more interpretable linear system of equations and thus avoid the "curse of dimensionality", an automatic reduction process of variables of the General to Specific type is applied. (GETS).

The approach adopted here is agnostic about exogeneity and causality between variables. It is only through the GETS procedure that we obtain variables that are weakly exogenous for the parameters of interest and using Granger non-causality tests we obtain evidence regarding strong exogeneity and the possible direction of causality. In this way we arrive at a set of stylized facts with which every theory should be consistent or capable of explaining.

This note is structured as follows: Section 2 presents the methodology used and the evidence obtained from the estimation of vector autoregressive (VAR) models for each of the countries considered. Section 3 describes the data and sources. In section 4, the empirical evidence is presented in the form of impulse-response functions and cumulative impulse-response functions. In section 5 we proceed to the reduction process using the GETS algorithm. Section 6 summarizes the main conclusions obtained.

2. *Econometric Specification*

In order to obtain the statistics of interest, for each country, the following bivariate VAR (6) is estimated

$$y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + ... + \Phi_8 y_{t-6} + \varepsilon_t \qquad (1)$$

Where $y_t = \left(\frac{p_t}{g_t}\right)$, and p_t y g_t correspond respectively to the variable "political regime", measured by the Polity index and to the growth rate of GDP per capita in period t.

A VAR with a highly flexible specification is a standard macroeconomic modeling tool that allows estimating and tracking the short- and long-term effects of different types of shocks: technological (Galí et al., (2003), monetary (Christiano et al. (2010)) or fiscal (Blanchard and Perotti (2002) Christiano et al. (2018). This flexible, unconstrained estimation is intended to "let the data speak" by reporting the relevant statistical relationships that arise between the variables of interest. Stylized facts should serve as input for the elaboration of general equilibrium models that adequately incorporate political/institutional aspects, in a similar way to what was done by Giacominni (2013) and Del Negro and Schorfheide (2006).

The time series approach has a number of advantages. Generally speaking, VARs represent a natural tool for economic practice. According to Christiano (2012) "VARs are a fruitful way to organize data because they can be used as a sort of battleground for testing alternative theories…Economists are accustomed to thinking about models in terms of

impulses and propagation mechanisms, and VARs are a device for organizing the data precisely into these categories".

The IRF's, the AIRF's and also the variance decomposition (not analyzed here) are relevant statistics in their own right. They are capable of providing us with the empirical-historical regularities that underlie theoretical modeling and are therefore a natural object of interest for empirical research. In the attempt to find some interesting empirical regularities that can shed light on the underlying structure of the phenomenon we want to model, IRFs seem to be a natural starting point.

2.1 Impulse-response functions

Usually, IRFs are estimated from the Wold decomposition of a linear, multivariate Markov process, such as a VAR.

Consider the following VAR(p):

$$y_t = \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + ... + \Phi_p y_{t-p} + \varepsilon_t \qquad (2)$$

Where Φ_j

corresponds to an $(n \times n)$ matrix of autoregressive coefficients $(j = 1, 2, ..., p)$. The term ε_t is a vector white noise in which:

$$E(\varepsilon_t) = 0$$

$$E(\varepsilon_t \varepsilon_\tau') = \{\Omega, \ t = \tau \, 0, \ t \neq \tau$$

Ω, is a positive definite symmetric $(n \times n)$ matrix. Using the lag operator it is possible to write:

$$\Phi(L) y_t = \varepsilon_t \qquad (3)$$

$$\Phi(L) = \left[I_n - \Phi_1 L - \Phi_2 L^2 - \ ... \ - \Phi_p L^p \right].$$

The VAR is covariance stationary if the values of z that satisfy:

$$\left| I_n - \Phi_1 z - \Phi_2 z^2 - \ ... \ - \Phi_p z^p \right| = 0$$

Are outside the unit circle.

If this is true, the process y_t can be expressed as a convergent sum of ε :

$$y_t = \Phi^{-1}(L)\varepsilon_t = \varepsilon_t + \Psi_1\varepsilon_{t-1} + \Psi_2\varepsilon_{t-2} + \Psi_3\varepsilon_{t-3} + ... = \Psi(L)\varepsilon_t = \sum_{i=1}^{\infty} \Psi_i\varepsilon_{t-i} \qquad (4)$$

In this $MA(\infty)$ representation, the fundamental innovation for y is ε_t. Ψ_i is a $(n \times n)$ coefficient matrix that is interpreted as:

$$\frac{\partial y_{t+s}}{\partial \varepsilon_t} = \Psi_s$$

The Ψ_s matrix then quantifies the consequences or marginal effects derived from shocks or innovations in the other variables in period t, keeping all innovations constant in the rest of the periods. In particular, the element of row i i, column j of Ψ_s traces the consequences of an increase in period t of one unit in the innovation associated with variable j for the value of variable i in period $t + s$ ($y_{i,t+s}$), keeping the rest of the innovations constant. The macroeconomic literature named this type of parameters "dynamic multipliers".

There is also an alternative $MA(\infty)$ representation based on a vector white noise $u_t \neq \varepsilon_t$ whose main characteristic is that $E\left(u_t u_t^{'}\right) = D$, where D is a diagonal matrix and where the elements of u_t are not correlated .

Let H be an $(n \times n)$ non-singular matrix. An let u_t be define as:

$$u_t \equiv H\varepsilon_t \qquad (5)$$

Is obvious that u_t is a white noise. It is possible to rewrite equation (4) as:

$$y_t = J_0 u_t + J_1 u_{t-1} + J_2 u_{t-2} + J_3 u_{t-3} + ... \qquad (6)$$

Where $J_s \equiv \Psi_s H^{-1}$.

H can be any matrix such that $H\Omega H^{'} = D$, where D is a diagonal matrix. With this choice of H, we have:

$$E\left(u_t u_t^{'}\right) = E\left(H\varepsilon_t \varepsilon_t' H'\right) = D \qquad (7)$$

That is, the elements of u_t are not correlated as stated above. This means that it will always be possible to write a stationary $VAR(p)$ process as a convergent $MA(\infty)$ process based on a vector white noise u_t. This representation, and its successive simplifications, represent approximations to a linear system of linearly independent equations.

2.2 Accumulated Impulse-Response Functions

The *Accumulated Impulse-Response Function* or *AIRF* is the cumulative response s periods ahead of a unitary shock in variable i over variable j. It is determined by adding the corresponding coefficients:

$$\psi_{ij}^{(s)} = \sum_{k=0}^{s} \psi_{ij,k}$$

The total cumulative effect is:

$$\psi_{ij}^{(\infty)} = \sum_{k=0}^{\infty} \psi_{ij,k}$$

Which is also called the total multiplier or long-term multiplier. Of particular interest in this work are the long-term effects of a (unitary) increase in p_t over g_t.

The existence of significant IRFs or AIRFs does not imply causality, but they provide evidence about aggregate correlations that must be taken into account by theoretical modeling. In other words, every theoretical model should be consistent with the empirical evidence obtained from these statistics.

3. Data used, definitions and sources

The type of political regime is captured through the Polity index. For each country and year, it defines a value in a range that goes from -10 to +10 and a higher index reflects a

better democratic institutionality. The ranges and the respective type of political institutionality are shown in table 1.

The Polity Index has been widely used in studies with similar purposes (Papaioannou and Siourounis, (2008), Acemoglu et al. (2008), Acemoglu et al., (2015) and Acemoglu et al., (2019)), although never in a specific time series frame. This indicator measures and weights a series of components associated with three dimensions: (i) the existence of an impersonal or non-discretionary executive power, (ii) the (formal) restrictions to the executive power and (iii) the level of observable competitiveness in the political sphere and classifies the type of political regime according to a defined range.

TABLE 1

Polity score, definition and characterization

Range	Political regime	Characterization
[-10, -6]	Autocracies	An authoritarian regime, characterized by the concentration of all power in a dictator or despot. Its decisions are not subject to any type of legal restrictions or mechanisms of popular representation.
[-5, 5]	Annocracies	Set of government systems that can be defined as "part democracy" and "part dictatorship". It combines at different levels democratic aspects with autocratic aspects.
[6, 10]	Democracies	Government system that allows citizens to express their political preferences. The main executive and legislative authorities are elected by individuals.

The data for the GDP per capita of the respective countries were obtained from the *Maddison Project Database*, version 2018.

FIGURE 1. Polity Score – Chile (1850-2009)

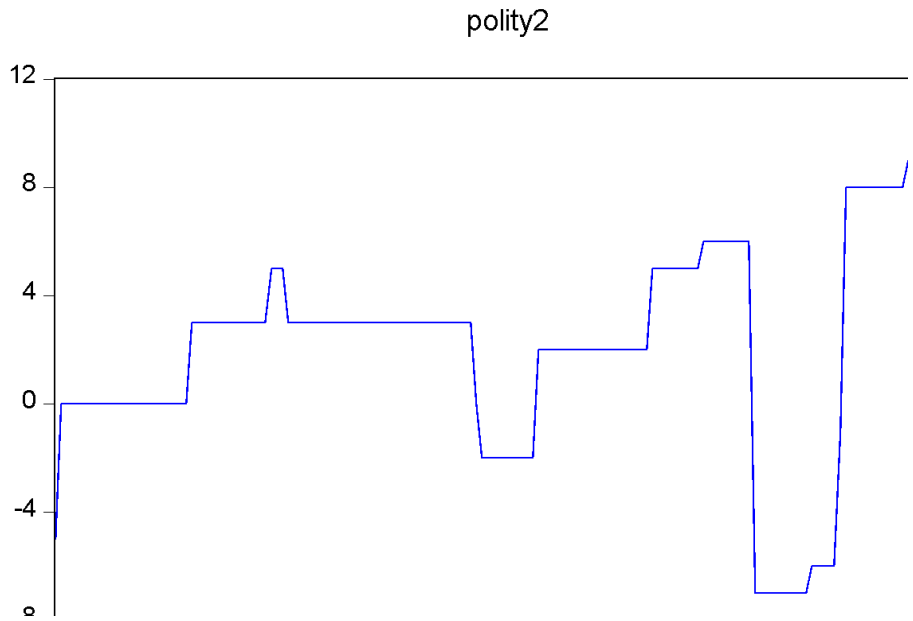


FIGURE 2. GDP per capita growth rate, Chile (1850-2009)

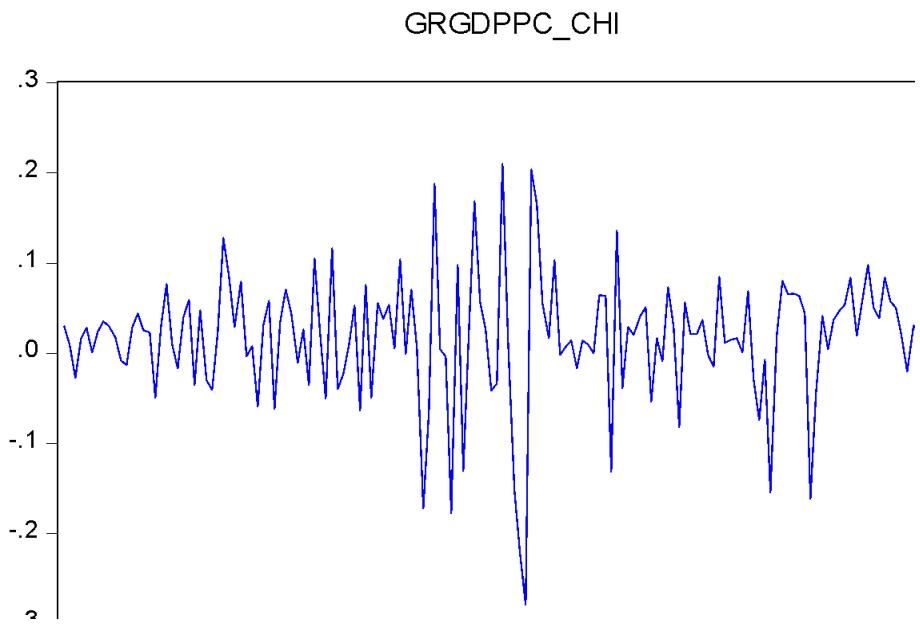
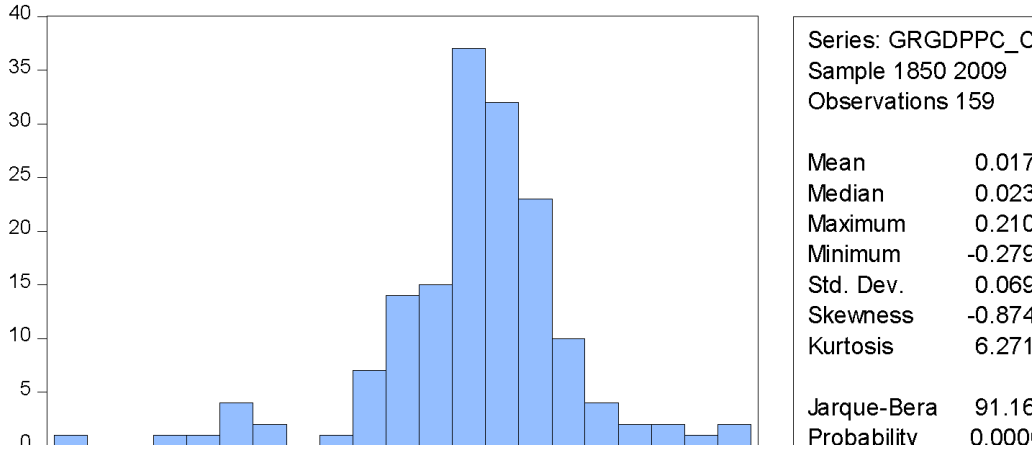


FIGURE 3. Growth of per capita GDP, Chile (1850-2009) – histogram and statistics of interest



4. *Results*

4.1 Effect of a democratic shock on the growth rate of GDP per capita

This section shows the estimates of the short- and long-term responses to a "democratic shock", represented by the IRF and AIRF, respectively.

The results identify patterns specific to each of the selected countries. Through the estimation of the VAR and the corresponding IRF's and AIRF's, we can classify the countries according to the long-term effects that a democratic shock has on the growth rate of GDP per capita. Three of the countries studied show a positive and significant effect of democracy on growth (Chile, France and Italy), while for two of the countries (Bolivia and Spain) the long-term effect is negative. For the remaining seven cases studied (Argentina, Colombia, Brazil, Nigeria, Portugal, Austria and Sweden) the long-term effect is not different from zero.

Some interesting patterns are identified: while for some countries the effect is monotonic, for other countries the empirical relationship obtained is non-monotonic: in Italy, a effect on the growth rate of GDP per capita and only after a certain number of periods does the effect turn positive. This is consistent with recent evidence regarding the long-term consequences of the French Revolution on growth, income, and inequality (Franck and Michalopoulos (2017)). The political economy dilemma of such a dynamic is obvious.

The Chilean case shows an oscillatory pattern as response, measured by the IRF, but with a positive cumulative effect. The Italian case shows a special pattern with a non-monotonic effect: a democratic shock initially has a marked negative effect on economic growth in the short term, but its long-term effects is positive. This is similar to what was found for the French case and is consistent with the evidence highlighted by Franck and Michalopoulos (2017).

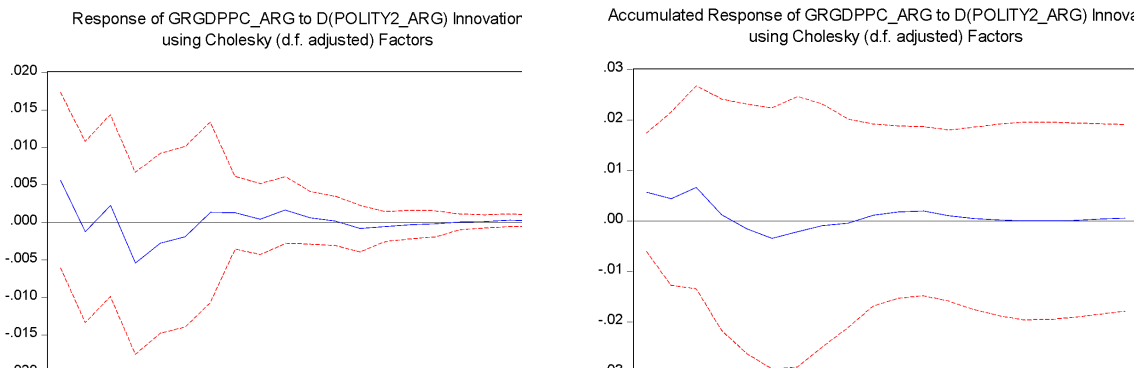
Meanwhile, the case of Bolivia and Spain shows how the democratic shock has a negative effect on long-term economic performance. This is partly explained by the good economic performance of the Franco era and the specific forms of democratization in the 1980s for the Bolivian case. This illustrates that behind each statistic there must be a coherent historical context.. Each country has its own idiosyncratic response to what we have called a democratic shock or disturbance. Authoritarian regimes may have promoted important advances in industrialization, as seems to be the case of the Franco regime in Spain.

The dynamics of evolution also raises interesting questions. Consider the case of Italy. The short-term effect associated with the democratic shock of the years 1946-48 is negative until

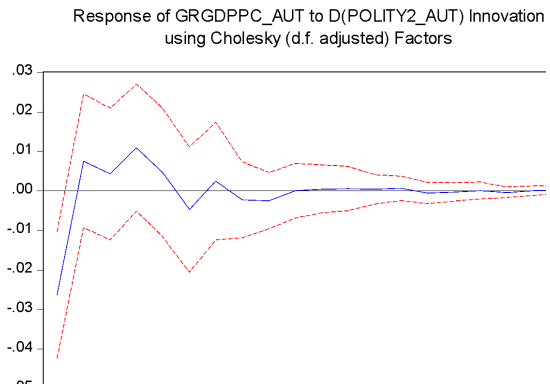
the third year, which raises the question about the fragility of democratic consolidation if it involves costs in short-term economic performance. This is the art of Political Economy and the importance of having solid democratic institutions. Development is learning about how to move towards a legitimate social contract that is capable of putting the common good and a long-term perspective in public policy and economic policy decision-making.

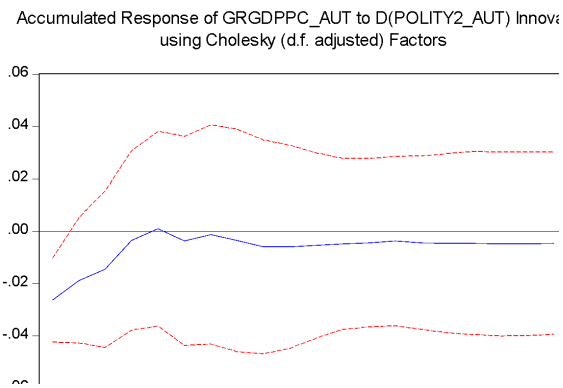
Figure 4

(n) Argentina

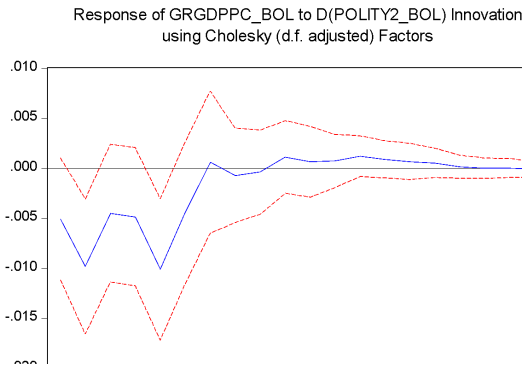


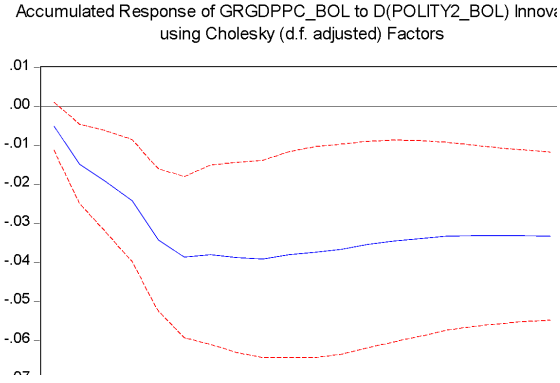
(o) Austria


Response of GRGDPPC_AUT to D(POLITY2_AUT) Innovation
using Cholesky (d.f. adjusted) Factors
.03
.02
.01
.00
-.01
-.02
-.03
-.04

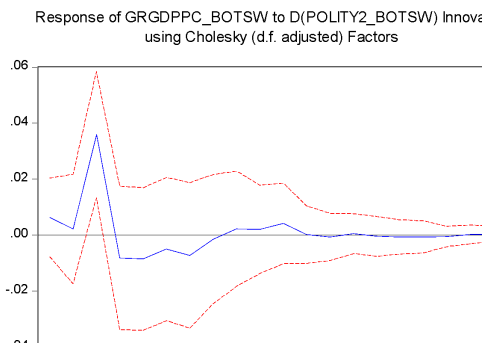

Accumulated Response of GRGDPPC_AUT to D(POLITY2_AUT) Innova
using Cholesky (d.f. adjusted) Factors
.06
.04
.02
.00
-.02
-.04

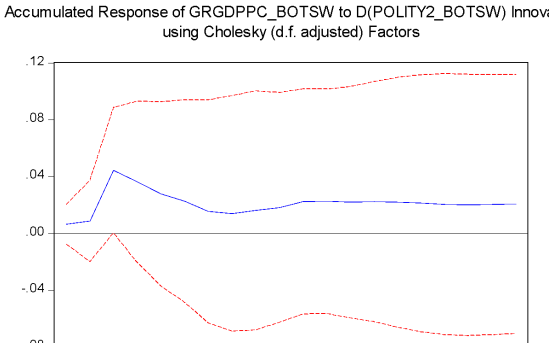
(p) Bolivia


Response of GRGDPPC_BOL to D(POLITY2_BOL) Innovation
using Cholesky (d.f. adjusted) Factors
.010
.005
.000
-.005
-.010
-.015

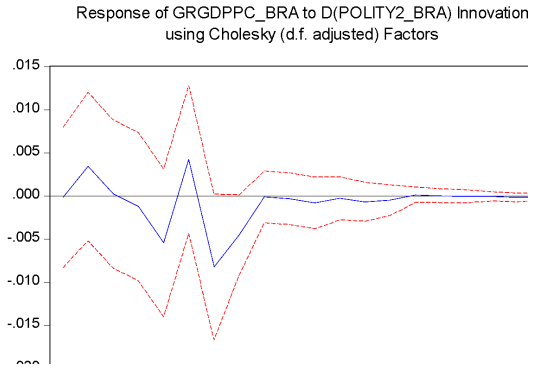

Accumulated Response of GRGDPPC_BOL to D(POLITY2_BOL) Innova
using Cholesky (d.f. adjusted) Factors
.01
.00
-.01
-.02
-.03
-.04
-.05
-.06

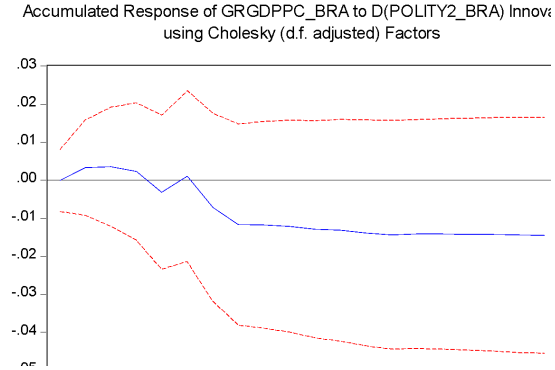
(q) Botswana



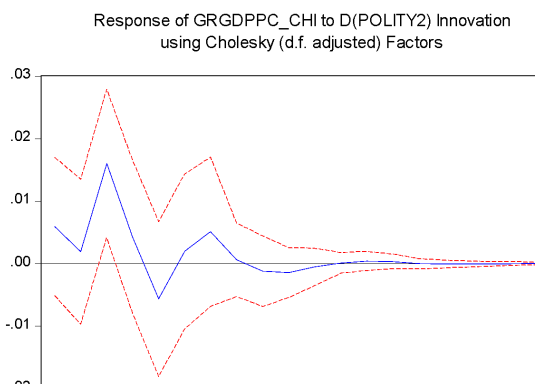


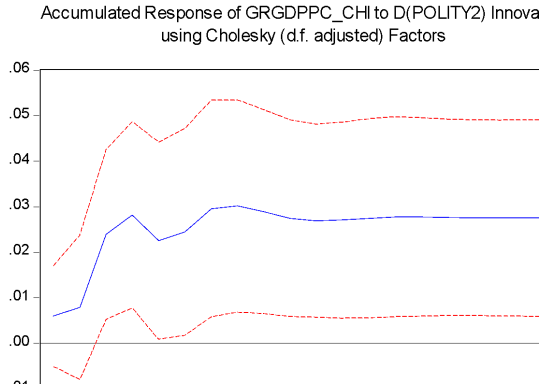
(r) Brazil



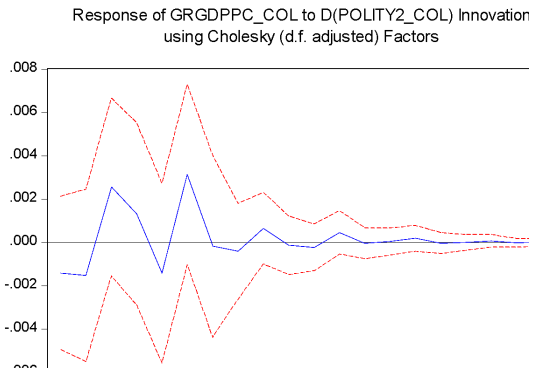


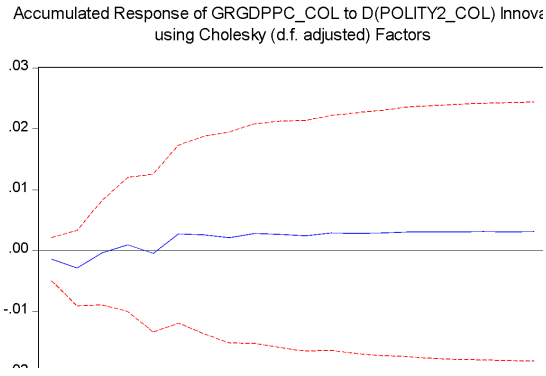
(s) Chile



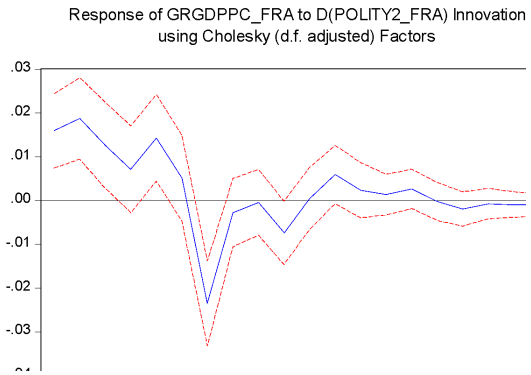


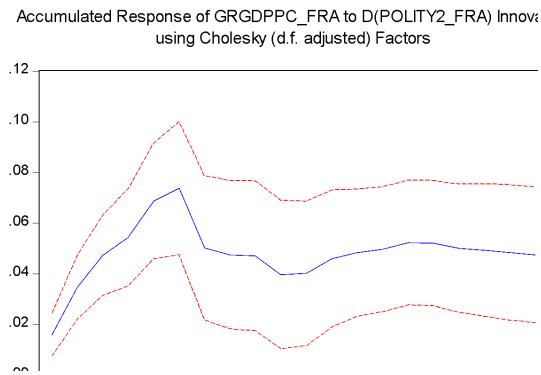
(t) Colombia



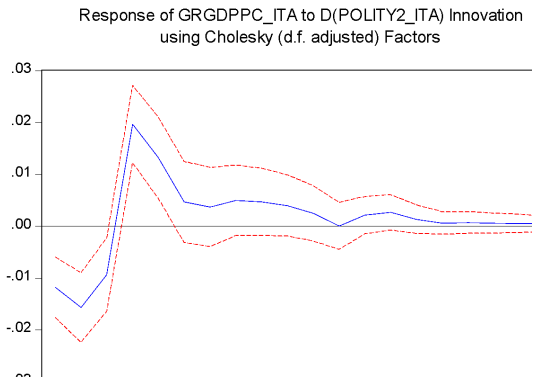


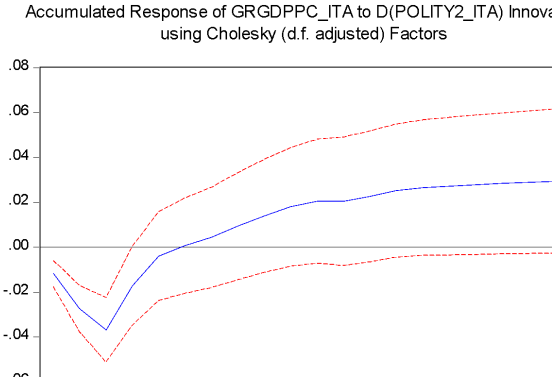
(u) France



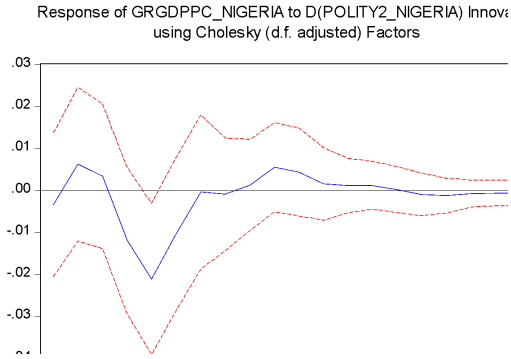


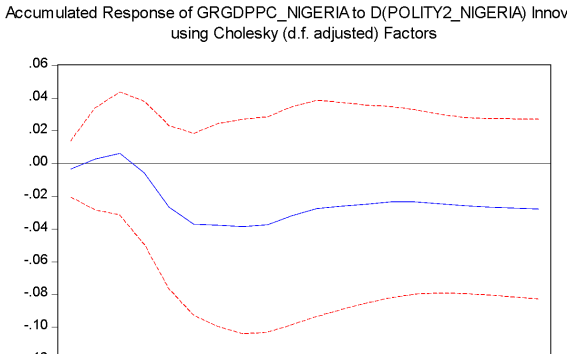
(v) Italy



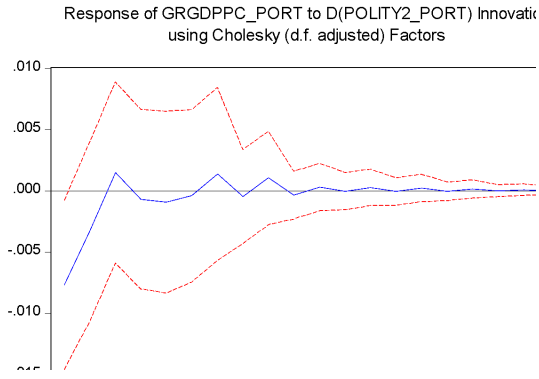


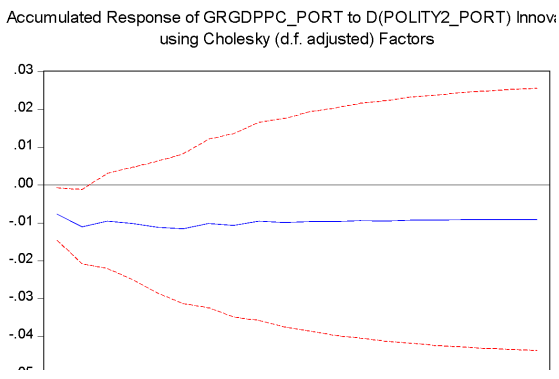
(w) Nigeria



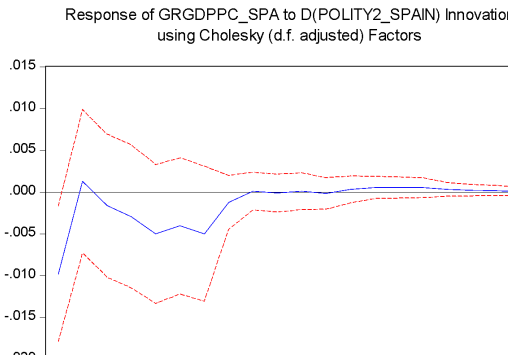


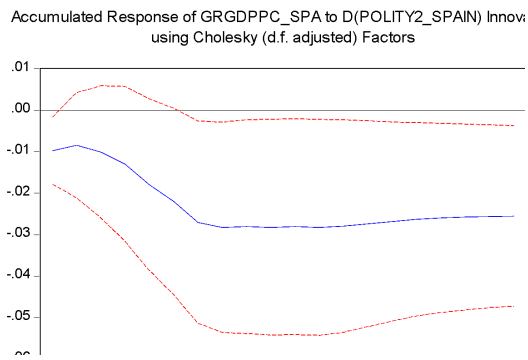
(x) Portugal



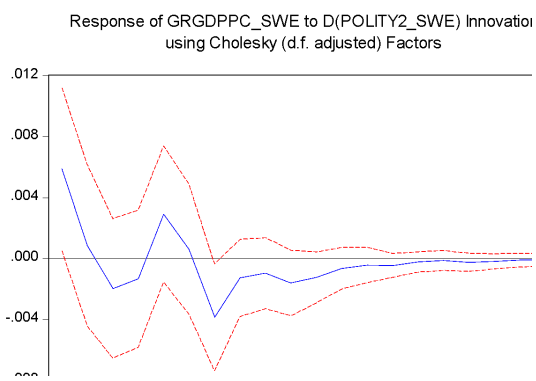


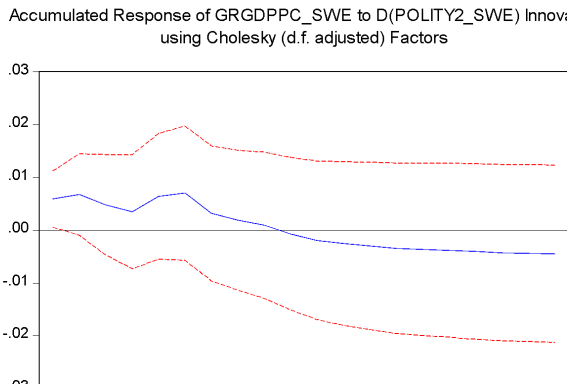
(y) Spain





(z) Sweden





4.2 Tests for Granger non Causality

The results of the Granger non-causality tests are reported below. These tests together with the results of section 5.2 (weak exogeneity) constitute de evidence to establish the existence of strong exogeneity (Hendry, 1995).

TABLE 2

GRANGER NON-CAUSALITY TESTS

País	Reporte Test	Comentario
Argentina	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_ARG) does not Granger Cause GRGDPPC_ARG 128 0.27619 0.9471 GRGDPPC_ARG does not Granger Cause D(POLITY2_ARG) 0.65230 0.6882	There is no evidence of causality in either direction
Austria	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_AUT) does not Granger Cause GRGDPPC_AUT 133 0.50424 0.8041 GRGDPPC_AUT does not Granger Cause D(POLITY2_AUT) 2.22587 0.0451	Evidence of causality goes from GDP per capita growth to political regime
Bolivia	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_BOL) does not Granger Cause GRGDPPC_BOL 113 2.56571 0.0236 GRGDPPC_BOL does not Granger Cause D(POLITY2_BOL) 1.78076 0.1106	Evidence of causality goes from political regime to GDP per capita growth
Brazil	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_BRA) does not Granger Cause GRGDPPC_BRA 143 1.48711 0.1875 GRGDPPC_BRA does not Granger Cause D(POLITY2_BRA) 0.49953 0.8078	There is no evidence of causality in either direction
Chile	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2) does not Granger Cause GRGDPPC_CHI 153 2.14541 0.0519 GRGDPPC_CHI does not Granger Cause D(POLITY2) 0.20459 0.9749	Evidence of causality goes from political regime to GDP per capita growth
Colombia	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2) does not Granger Cause GRGDPPC_COL 133 0.58706 0.7401 GRGDPPC_COL does not Granger Cause D(POLITY2) 1.20293 0.3095	There is no evidence of causality in either direction
España	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_SPAIN) does not Granger Cause GRGDPPC_SPA 153 0.77123 0.5938 GRGDPPC_SPA does not Granger Cause D(POLITY2_SPAIN) 3.35580 0.0040	Evidence of causality goes from political regime to GDP per capita growth

Francia	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_FRA) does not Granger Cause GRGDPPC_FRA 153 9.82987 5.E-09 GRGDPPC_FRA does not Granger Cause D(POLITY2_FRA) 1.36616 0.2324	Evidence of causality goes from political regime to GDP per capita growth
Italia	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_ITA) does not Granger Cause GRGDPPC_ITA 153 12.3227 4.E-11 GRGDPPC_ITA does not Granger Cause D(POLITY2_ITA) 3.09373 0.0071	There is evidence of bicausality
Portugal	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_PORT) does not Granger Cause GRGDPPC_PORT 138 0.31091 0.9303 GRGDPPC_PORT does not Granger Cause D(POLITY2_PORT) 0.94947 0.4624	There is no evidence of causality in either direction
Suecia	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_SWE) does not Granger Cause GRGDPPC_SWE 153 1.06113 0.3889 GRGDPPC_SWE does not Granger Cause D(POLITY2_SWE) 0.74996 0.6104	There is no evidence of causality in either direction
Botswana	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_BOTSW) does not Granger Cause GRGDPPC_BOTSW 37 4.15823 0.0053 GRGDPPC_BOTSW does not Granger Cause D(POLITY2_BOTSW) 0.27440 0.9435	Evidence of causality goes from political regime to GDP per capita growth
Nigeria	Null Hypothesis: Obs F-Statistic Prob. D(POLITY2_NIGERIA) does not Granger Cause GRGDPPC_NIGERIA 50 1.23033 0.3132 GRGDPPC_NIGERIA does not Granger Cause D(POLITY2_NIGERIA) 0.40191 0.8730	There is no evidence of causality in either direction

For only one of the countries (Austria) the evidence of causality goes from g_t to p_t, where g_t is the growth rate of GDP per capita and p_t corresponds to the political regime classification. For 4 countries (Bolivia, Chile, Spain, France) the evidence of causality goes from p_t to g_t. For Austria the evidence of causality goes from g_t to p_t. For Italy there is evidence of bi-causality. For the rest of the countries (Argentina, Brazil, Colombia, Portugal, Sweden) there is no evidence of causality in any sense.

4.3 Robustness analysis for the Chilean case

For the Chilean case, the significant relationship described through the AIRF is robust to a series of alternative specifications. Using the data of Díaz et al., (2016), the growth rate of the human capital index, the growth rate of gross fixed capital formation per capita and the growth rate of the consumer price index (CPI) have been included. Additionally, the long-term Gini coefficient used in the work of Rodríguez Weber (2014) has been incorporated.

Specificaction 1

In the first specification (Specification 1a), the VAR considers the following variables

$$y_t = (y_{1t}, y_{2t}, y_{3t}, y_{4t}, y_{5t}, y_{6t})$$

With:

y_{1t} :Per capita GDP growth rate

y_{2t} : First difference of the "*Polity2*" variable

y_{3t} : Gini coefficient

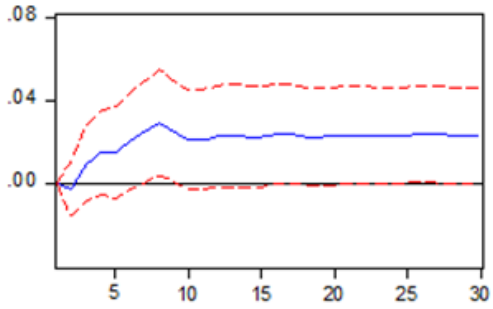
y_{4t} : Human capital index growth rate

y_{5t} : Growth rate of gross fixed capital formation per capita

y_{6t} : Growth rate of the consumer price index

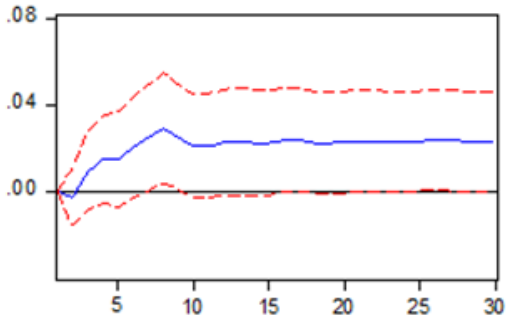
This model incorporates variables that are usually considered in empirical growth analyses, gathering aspects of the neoclassical approach to accounting for economic growth (by considering the growth rates of physical capital and human capital) and of the institutionalist and neo-institutionalist literature trough the incorporation of the institutional variable that reflects the type of political regime and a measure of inequality accounted by the Gini coefficient. This specification also allows testing the effect of inflationary shocks on long-term economic performance by incorporating the growth rate of the CPI. The specifications with fiscal variables (variation in public spending per capita, variation in the social spending/GDP ratio, and in taxes) do not alter the results obtained here and the AIRFs associated with these variables turn out to be insignificant for our variables of interest.

FIGURE 6. *AIRF – Specification 1*



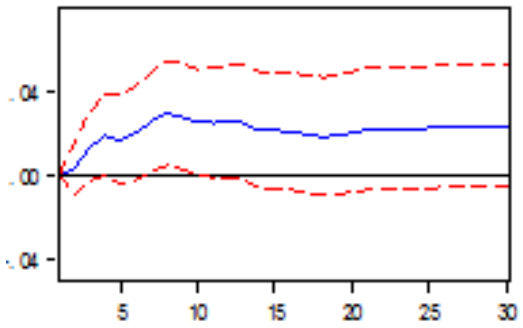
The results vary only slightly when changing the human capital index by the growth rate of average schooling (Specification 1a)

FIGURE 7. *AIRF – Specification 1a*



Incorporating the growth rate of salaries, and eliminating the growth rate of average schooling (Specification 1b), a similar result is obtained.

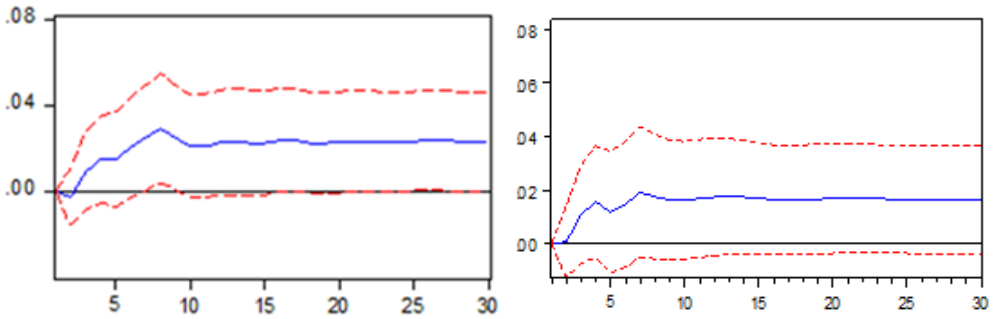
FIGURE 8. *AIRF – Specification 1b*



Specification 2: VAR-X

Now the VAR model incorporates the terms of trade variable that we will assume is exogenous for a small country open to international trade. Such a specification, with a plausibly exogenous variable, is called VAR-X. By incorporating the variation in the terms of trade, the aim is to control for a variable that is traditionally associated with the economic cycle for a small country that is highly dependent on its exports of raw materials and that is not capable of affecting the price (and therefore the terms). of exchange) in a systematic way.

FIGURE 9. Comparison: *Specification 1and Specification 2*



For the Chilean case, the results are robust to different VAR specifications that have incorporated a large number of potentially relevant variables. The results also hold when excluding copper production. Although it is not the objective of this technical note, it is worth noting that, at least for the Chilean case, the evidence seems to be consistent with interpreting the democratic shock as a simile of a technological shock that, at the same time, increases in productivity of human capital and physical capital. This is observed in IRFs consistent with a higher growth rate of the accumulation of physical capital and the remuneration of workers, in an environment of decreasing inequality.

5. *A reduced model: From General to Specific*

The problem of model selection is central to empirical economic research. In general, there are only a priori theories that do not have to be applicable to a new investigation and therefore are at least risky when used as a guide for the econometric specification. In the same way, the problem arises when it is necessary to evaluate or contrast existing theories about the same phenomenon.

Automatic model selection methods that proceed from the General to the Specific (*GETS*) are particularly suitable when the model has a dynamic structure since the variables are expected to act with different levels of lag. The objective of this approach is to identify or discover an empirical model that does not deviate substantially from the evidence and that, in turn, can account for alternative models that use the same data. The first idea refers to the notion of consistency of the model, that is, its ability to reproduce the data in a coherent way, and the second idea is summarized in the notion of *encompassing*.

In the previous sections (3 and 4) a general unrestricted model (*GUM*) has been estimated and three statistics of interest have been obtained: the *IRF's*, the *AIRF's* and the Granger non-causality tests. The objective in this section will be to find a reduced model, with weakly exogenous variables with respect to the parameters of interest and that is consistent with the evidence found through the *AIRF's*.

Weak exogeneity is needed for the consistent estimation of the parameters and others magnitudes of interest. The *GETS* procedure allows us to select the minimum number of significant variables that meet this condition. By combining the weak exogeneity with the results of the Granger non-causality tests, we arrive at the concept of strong exogeneity. Each of these notions of exogeneity is associated with one of the levels of knowledge expected in the research: consistent estimation of magnitudes in the case of weak exogeneity and predictive capacity in the case of strong exogeneity (since bias effects are ruled out). feedback between the variables, at least statistically. Another concept, that of "super-exogeneity", assures us that the conditioning variables are weakly exogenous for the parameters of interest and that, moreover, the distributions of said variables can change without altering the estimated parameters.

With this process it is possible to identify a reduced linear system that is considerably simpler and easier to interpret than the unrestricted VAR, with estimated parameters that are consistent and with a model that, at least, has predictive capacity.

a. Description of the algorithm and tests used

In general terms, an automatic model selection process is based on a series of reduction steps and proceeds by initially estimating a General Unrestricted Model (GUM) from the available data. This gives a bound for the goodness of fit of the model based on the standard deviation of the estimated errors. The selection/elimination of variables thus involves a trade-off between minimizing the presence of irrelevant variables and missing too many relevant variables. The process leads to a terminal model, where all reductions acceptable to the algorithm have been performed.

The "General to Specific" (GETS) procedure is a form of model reduction based on the specification of certain relevant criteria and that "searches" different paths until it finds a minimum model. This methodology was proposed by Hendry in 1995 and is based on a series of reduction stages described below.

The first step is to formulate a general unrestricted model (GUM) specific to the problem to be studied. It is important that this model is flexible enough in terms of dynamics and at the same time is chosen in such a way that theory and history are reflected in its formulation. The second step is to reduce this formulated model, verifying that in each reduction step, the model meets the minimum necessary characteristics of congruence. The algorithm therefore starts with a general model that characterizes the series to be studied and the reduction is based on the following criteria:

1. Relative Past: This criterion seeks to verify that model errors are not correlated with any variable outside the model and that they are not correlated with its past. An orthogonal parameterization of the regressor candidates is needed. In addition, in this step, homoscedasticity and normality are evaluated, although both criteria are not strictly necessary, nor are models that do not meet them excluded.

2. Relative Present: This criterion is required when there are contemporary variables as explanatory variables. The objective is to verify that these variables are free of variation to ensure a correct estimation of the model. That is, there is no simultaneity or that the regressors are correlating with something that is not found in the model.

3. Relative Future: This criterion is required if projections of the series are to be made or policy evaluations are to be made. For this, evaluations of strong exogeneity of the series are carried out and stability and reliability of their parameters are demonstrated.

4. Compatibility with theory: This criterion is used both in the estimation of the GUM and to verify the reduced models. It is based on the verification that the model makes sense with the theory, with the institutional knowledge, the history and the previous information that is known and what has been studied about the relationships between the variables of interest.

5. Data eligibility: Like criterion 4, this is also used to estimate the GUM. This criterion seeks to verify that the necessary amount of sample is available, the explanatory variables are accessible and in the event that any criteria mentioned in 1, 2, 3 are not met, there is the possibility of having variables that do the work of instrumentalizing.

6. Rival models: This criterion is used to evaluate final models that have been the result of different forms of reduction. If there were different terminal models, it would be necessary to evaluate whici one encompass the others.

Given these criteria, the algorithm starts with a chosen GUM fulfilling criteria 4 and 5. The hypotheses of criteria 1, 2 and 3 are tested and the least significant variable is removed from the model. The new model goes through the tests again. The algorithm stops when the desired level of significance is obtained or when any of the criteria is no longer met.

For the relative past criterion, the Ljung-Box test and the Breusch-Pagan test were used. Ljung-Box was used as a criterion to check that the series is white noise. That is, that his error terms are not correlated with his past. The Breusch-Pagan test was also used, which is an LM test used to verify that the series is not correlated with any variables outside the model, including variables that have been eliminated in previous steps of the algorithm.

For the second criterion, relative present (2), the weak exogeneity of the variables was evaluated through a Hausmann test. This test verifies that the contemporary variables are weakly exogenous to the variable of interest. For this, it was searched in each step if there were contemporary variables and an indirect test was carried out to verify that the errors of the model of the contemporary variable are not correlated with the errors of the original model.

5.2 Results of the GETS procedure

For each country, model 1 has incorporated the political regime variable as a contemporary variable, while in model 2 only lags have been incorporated. Results are reported for a 95% level of significance. In the assumption the results are shown for a 90% significance. Only the sign of the coefficients is shown.

	M	Lags of GDP per capita growth						Lags of Political variable						
		1	2	3	4	5	6	0	1	2	3	4	5	6
Botswana	1	+								+				
	2	+								+				
Brazil	1													
	2													
Chile	1		-	-						+				
	2		-	-						+				
Colombia	1	+											+	
	2	+											+	
France	1			+				+	+			+		-
	2			+					+			+		-
Italy	1	-					+	-	-		+	+		
	2	-	-		+				-	-	+	+		-
Sweden	1													
	2													
Venezuela	1													
	2													
Austria	1						-	-	+		+			
	2						-				+			
Bolivia	1	+										-		
	2	+										-		
Ecuador	1				+						-	-		
	2				+						-	-		
Peru	1	+												
	2	+												
Portugal	1		+		+									
	2				+									
Spain	1	+												
	2													
Uruguay	1													
	2													
Argentina	1													

	2													

6. Conclusions

The discussion about the relationship between economic performance and democratic institutions is an extremely relevant research topic today. On the one hand, democracy could represent an obstacle to economic growth (due to greater insecurity regarding property rights, redistributive measures that reduce the net profitability of capital, etc.) or on the other hand, democracy could represent a true "social technology". ” that allows information to be used in the best possible way, since it allows knowledge to flow and power to disperse on the one hand, and on the other, it allows the socioeconomic system greater evolutionary flexibility around the application of best self-governance practices , regarding, for example, the control over the political class, the possibility of carrying out citizen consultation processes regarding certain issues, the best management that could exist in a participatory local budget design, and addressing pressing issues such as climate change, recognizing that the problem has to do with the political institutionality that defines the incentives in the economic sphere.

For a series of countries, an empirical study is carried out with the aim of identifying long-term regularities that can be identified through the specification of highly flexible time series models, complemented by the use of an automated model reduction algorithm.

It is found that a higher level of democracy does not necessarily cause a higher growth rate of GDP per capita. In many of the countries considered, it is not even possible to establish a significant long-term correlation based on the AIRF. In another group of countries, a long-term effect is identified that turns out to be significant and in at least one case studied in detail (Chile), the relationship shows to be robust to different specifications. For other countries, a shock in the political regime variable towards a more democratic regime shows negative long-term effects on economic performance measured through the growth rate of GDP per capita.

The evidence from the Chilean case turns out to be interesting, since democracy (and not the pro-market policies) would be the explanation behind the high rates of economic growth in Chile during the post-dictatorship period.

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Annex

6 lags		Model	Lags of GDP per capita growth						Lags of Political variable						
			1	2	3	4	5	6	0	1	2	3	4	5	6

Botswana	0,1	0	+								+	-			
	0,05	1	+								+				
	0,1	2	+								+	-			
	0,05	3	+								+				
Brazil	0,1	0												-	
	0,05	1													
	0,1	2													
	0,05	3													
Chile	0,1	0		-	-	-					+			+	
	0,05	1		-	-						+				
	0,1	2		-	-	-					+				
	0,05	3		-	-						+				
Colombia	0,1	0	+		+			+			+			+	
	0,05	1	+											+	
	0,1	2	+		+			+			+			+	
	0,05	3	+											+	
France	0,1	0			+				+	+	+		+		-
	0,05	1			+				+	+			+		-
	0,1	2			+					+			+		-
	0,05	3			+					+			+		-
Italy	0,1	0	-					+	-	-		+	+		
	0,05	1	-					+	-	-		+	+		
	0,1	2	-	-		+				-	-	+	+		-
	0,05	3	-	-		+				-	-	+	+		-
Sweden	0,1	0		-											
	0,05	1													
	0,1	2		-											
	0,05	3													
Venezuela	0,1	0					+		+						
	0,05	1													
	0,1	2					+								
	0,05	3													
Austria	0,1	0	+					-	-	+		+			
	0,05	1						-	-	+		+			
	0,1	2	+					-				+			
	0,05	3						-				+			
Bolivia	0,1	0	+	-	+	-				-		-	-		
	0,05	1	+										-		
	0,1	2	+		+	-				-		-	-		
	0,05	3	+										-		

Ecuador	0,1	0				+						-	-		
	0,05	1				+						-	-		
	0,1	2				+						-	-		
	0,05	3				+						-	-		
Peru	0,1	0	+												
	0,05	1	+												
	0,1	2	+												
	0,05	3	+												
Portugal	0,1	0		+		+			+						
	0,05	1		+		+									
	0,1	2				+									
	0,05	3				+									
Spain	0,1	0	+						-				-		
	0,05	1	+												
	0,1	2	+												
	0,05	3													
Uruguay	0,1	0	-			-									
	0,05	1													
	0,1	2	-			-									
	0,05	3													
Argentina	0,1	0													
	0,05	1													
	0,1	2													
	0,05	3													