Institutional Change and Economic Growth in Brazil since 1870: Evidence from a New Dataset

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Abstract

Are institutions (and changes in institutions) a deep cause of economic growth? This paper tries to answer this question in a new way by focusing on within-country variation over long periods of time. It uses a new and unique hand-collected data set of political institutions and the power-ARCH econometric framework. The focus is on the link between institutional change and economic growth in Brazil from 1870 to 2003. The results suggest that both informal and formal political instability affect economic growth negatively, with important differences in terms of their short- versus long-run behavior, in that not all but just a few selected institutions affect economic growth in the long-run.

Keywords: economic growth, political instability, power-ARCH, volatility
JEL classification: C14, O40, E23, D72.

1 Introduction

It is difficult to identify the causal effect of institutions on economic growth. In developed countries, institutions do change but they do so extremely slowly and the relevant starting point to evaluate their effect is arguably well beyond most available data (e.g., early 1800s may be ideal). On the other hand, institutions do change much more quickly in developing countries but the quality of the few existing data sets tends to be often unsatisfactory. This paper explores a new dataset and within country variation over extremely long time horizons in order to assess the causal effects of various types of institutions in terms of the growth rate of GDP.

Institutional change can occur through changes in formal or through changes in informal political institutions. The latter includes for example events of political unrest like assassinations, revolutions and riots, and the former includes events such as government terminations and electoral surprises (Campos and Karanasos, 2008). In other words, formal political instability indicators are the result of the competition between different political institutions or factions while the informal political instability measures have no appropriate representation within such channels.

An important issue regards the channels through which political instability (that is, changes in formal and informal institutions) is expected to influence growth. It might be expected that instability will make property rights less secure and transaction costs too high, the rule of law weak and state capacity too thin to support sustained growth episodes. For example, Torstensson (1994) argues that many developing countries lack secure private property rights and that arbitrary seizures of property slow down economic growth. Kovac and Spruk (2016) quantified the impact of transaction costs on cross-country economic growth and find a significant negative effect of increasing transaction costs on growth. Weingast (1997) puts forward a game-theoretic framework to study the issue of political officials' respect for the political and economic rights of citizens in which democratic stability and the rule of law entails that political officials have motives to honor a range of self-enforcing limits on their behavior. Concluding, Acemoglu et al. (2015) study the direct and spillover effects of local state capacity in Colombia and find that the existence of central and local states with the ability to impose law and order is vital for economic development. They also note that the efficiency of state capacity is affected by various factors such as geographic, historical, political and social ones.

Recently there has been a lot of interest in the relationship between political instability and economic growth. In a seminal paper, using a cross section framework, Barro (1991) finds that assassinations, number of coups and revolutions have negative effects on economic growth. Campos and Nugent (2002) confirm this result by using panel data analysis but find that this negative impact (on growth) is mostly driven by sub-Saharan African countries. Yet, other researchers claim that there is no significant relationship between political instability and output growth. Easterly and Rebelo (1993) suggest that assassinations and war casualties have no significant effect on growth, while Benhabib-Spiegel (1997) and Sala-i-Martin (1997) support this argument using different data and methodologies. Knack and Keefer (1995) compared more direct measures of institutional environment (such as the security of property rights and the Gastil indicators of political freedoms and civil liberties) with instability proxies utilized by Barro (1991). They argue that institutions that protect property rights are important for economic growth. Roland (2008) proposes a classification of "slow-moving" and "fast-moving" institutions and explains the potential implications of their interaction. This interaction reveals the problem of transplanting institutions into distinct cultural environments and the advantages of very different institutional systems for efficient growth and development. Finally, Spruk (2016a) examined the impact of de jure and de facto political institutions on the long-run economic growth for a large panel of countries. The empirical evidence suggested among others that societies with more extractive political institutions in Latin America experienced slower long-run economic growth and failed to converge with the West.

Within a power-ARCH (PARCH) framework and using annual time series data for Brazil covering the period from 1870 to 2003, the aim of this paper is to put forward answers to the following questions. What is the relationship between the instability of a country's key political institutions, economic growth and volatility? Are the effects of these changes in institutions direct (on economic growth) or indirect (via the conditional volatility of growth)? Does the intensity and sign of these impacts vary over time? Does the intensity of these effects vary with respect to short- versus long-run considerations? Is the intensity

of these effects constant across the different eras or phases of Brazilian economic history (in other words, are they independent from the main structural breaks we estimate)?

This paper tries to contribute to the existing literature by examining whether the instability of a country's key political institutions affects output growth. This approach is original and valuable because: (a) we study only one individual country over a very long period of time with annual frequency data. Most of the researchers assess political instability from a cross-country perspective (Barro, 1991; Levine and Renelt,1992; Fosu, 1992 etc.) while others focused on much shorter periods (Campante, 2009), (b) we extensively use the economic history literature to guide our choice of potential reasons behind the performance of the Brazilian economy over a very large time window, (c) we use new, unique, hand-collected data on political institutions in Brazil going back as far as 1870 (the existing data starts in 1919 so we independently constructed whole new series from 1870 to 1939 and used the last overlapping 20 years to assess the reliability of these new data) , and (d) we choose an econometric methodology that has been seldom used in the empirical growth literature despite the fact that it easily allows us to contrast the direct to the indirect (i.e., via the volatility channel) effects of each of our candidate reasons, sort out the short- from the long-run impacts, and distill the consequences of accounting for important structural breaks on the robustness of our key results. Another important, albeit more technical, benefit of our choice of econometric framework is that it helps to shed light on an important and resilient puzzle on the relationship between output growth and its volatility. For example, while Ramey and Ramey (1995) show that growth rates are adversely affected by volatility, Grier and Tullock (1989) argue that larger standard deviations of growth rates are associated with larger mean rates. The majority of ARCH papers examining the growth-volatility link are restricted to these two key variables. That is, they seldom assess whether the effects of the presence of other variables affect the relation and, on the rare occasions that happens, it is usually inflation and its volatility that comes into play. For reviews of this literature see Fountas and Karanasos (2007) and Gillman and Kejak (2005).

The Brazilian case is particularly interesting to study the relationship between the instability of political institutions and economic performance. Brazil is a relevant case to study because of its size (both in terms of populations and output), its hegemonic role in South American and its relatively important role globally (as one of the original BRIC countries) This exercise also provides a deeper understanding of the specific case of Brazil. The Brazilian case is important because despite the reputation of having a relatively peaceful history, this is a country that exhibits a huge variety of types of instability of political institutions (indeed of all the formal and informal types one can find in large cross-sections of countries) under considerable variation of contexts (empire and republic as well as over varying degrees of democracy and autocracy), over the very long time window we consider.

Our results focusing on specific types of effects. That is, we discuss direct (on mean economic growth), indirect (via volatility), dynamic (short and long-run) and structural break effects. As for the direct effects of institutional change on economic growth, we find evidence for negative direct influences on real GDP growth from both the informal political instabilities (i.e., assassinations, coups and revolutions) and formal political instabilities (i.e., legislative effectiveness and number of cabinet changes). Equally importantly, we find that almost all of our political instability indicators have strong negative impacts on the output growth in the short-run. As for indirect (via volatility) effects, we find strong volatility-decreasing effects from both formal and informal political instability indicators. Our investigation of the dynamic effects shows important differences in terms of the short and long-run behavior of our key variables: almost all political factors affect growth negatively in the short-run but the evidence for the long-run is much weaker. Importantly, however, the negative impact of assassinations, coups, revolutions together with legislative effectiveness and cabinet changes remains strong in the long-run. Finally, we tried to adjust all the above results to the possibility of the presence of structural breaks. This is an important exercise given the long-term nature of our data. We find that our basic results are confirmed once we take structural breaks into account. It is also noteworthy that the contemporaneous direct effects on growth of our main explanatory variables (i.e., anti-government demonstrations and assassinations) are stronger before the structural breaks, whereas the indirect effects are weaker after accounting for these the breaks. Hence and in summary, over the whole range of results (negative direct/indirect, short and long-run impact on economic growth) the most robust we find are those obtained for assassinations, number of coups, legislative effectiveness and cabinet changes.

The paper is organized as follows. Section 2 sets the historical context for the paper by documenting Brazilian political history from 1870 to 1945. Section 3 describes the data. Section 4 provides details and justification for our econometric methodology. Section 5 presents our econometric results. Section 6 concludes and suggests directions for future research.

2 Economic and Political Background of Brazil

The objective of this section is to provide general background information about the main developments in Brazilian economic history. The reason for this is to help judge the range of variables we choose to focus on in the econometric analysis as well as to better evaluate our main estimation results. Our data cover the following main political periods in Brazil: the Brazilian Empire until 1889, the First Republic from 1889 to 1930, the Vargas Era from 1930 to 1945, the Second Republic from 1945 to 1964, the Military Dictatorship from 1964 to 1985, and the new democratic period since 1985.

The period after 1822, when Brazil declared independence from Portugal, is one of chaos, consolidation and civil war, which culminates with a major international conflict against Paraguay. From 1864 to 1870 Brazil and its allies, Argentina and Uruguay, fought a massive war against Paraguay which remains to this day the largest inter-country conflict in the history of South America. It involved all the rising and the declining powers at the time and as such is widely accepted and treated as a watershed moment. The war ended with victory for Brazil and its allies, but at a high price (Skidmore 2009). Although the decline of the Brazilian Empire can be attributed to various reasons, it can be roughly divided into three factors: economic, political factors and the army. First, the nascent bourgeoisie of Sao Paulo pushed for the end of the Empire in an attempt to keep benefitting more fully from the coffee economy. Second, the Empire had moved towards more political and administrative centralization. Regional oligarchies wanted to push for decentralization under a federal system to consolidate their power. As a result, the Empire was marked by considerable political instability in the 1880s. Finally, the army came under the influence of "positivism". They supported education, industrialization, the abolition of slavery, regeneration of the nation, and guarding the fatherland: the "solider citizen" as agent of social change. All these reasons led to the end of the Empire in 1889 (Skidmore 2009).

After the emperor was overthrown on November 15, 1889, Brazil passed from a centralized empire to a federal republic. It was basically a bloodless coup led by the army. The period from 1889 to 1930 is known as the Old Republic or the First Republic, and economically the period is marked by the politics of coffee-with-milk ("cafe com leite"), an alternation of governments led by the political elites from Sao Paulo (coffee) and Minas Gerais (milk). From a political point of view, Brazil was rarely stable during this period. The most sensitive feature of the oligarchic system of the First Republic was to adjust the political power between two groups – these two different regional oligarchies and the armed forces. During the 1920s, the problems of the oligarchy system developed. Politically, the "tenent revolt" of 1922 and then again in 1924, shook the interior of Brazil without ever being fully defeated by the armed forces. In October 1929, with the Great Depression coffee exports stalled, and the Sao Paulo oligarchy tried to stay in power ignoring the agreed alternation with the Minas Gerais elites. In the year 1930, the situation reached a breaking point. First, vice president Mello Vianna was shot three times at Monte Claros (in the state of Minas Gerais). Later, the Revolta da Princesa occurred in the Northeastern state of Paraiba. Soon after this event, Joao Pessoa, who was the governor of Paraiba, was murdered. After his death, more riots followed and on October 24th 1930, the "revolution of 1930" broke out. All those political crises together with the economic crisis led to the end of the Old Republic.

The Revolution of 1930 in Brazil not only marked the end of the Old Republic but also the beginning of the Vargas Era. By leading the revolution, Provisional President Getulio Dornelles Vargas ruled as dictator from 1930 to 1934, was elected as president from 1934 – 1937, and again governed as dictator from 1937 to 1945. Further, after 1945, Vargas still served as a senator until 1951 when after the general elections of 1950 once more Vargas returned to power as president (1951 - 1954). In other words, Getulio Vargas retained central political power in Brazil for nearly 24 years. Economic historians argue that Brazil during the Vargas Era and up until the late 1970s was as one of the fastest growing economies in the world (Maddison, 1995). As such, this era is also a turning point in the political history of Brazil. Under the Estado Novo (1937 - 1945), state autonomy ended, governors were replaced and all political parties were dissolved until 1944 (Hudson, 1998).

The following two decades (the 1950s and 1960s) were dominated by high levels of populism and nationalism that threw Brazil into crisis and led to the coup of 1964. It was a period when the conservative elites felt threatened by the labour classes that were seeking a better future. The Brazilian military government ruled for almost 20 years from 1964 to 1985. During that era Brazil experienced times of significant political oppression as well as periods of high economic growth. After the collapse of the military junta, the year 1990, Brazil elected its first president directly chosen by the people and a new journey towards democracy and promotion of the human rights had just started.

Against this eventful background this paper will try to address the association (if any) between changes in institutions and economic growth by using a new and unique dataset that covers the period from 1870 to 2003 under the power-ARCH econometric framework.

3 Construction of our New Data Set

This section presents the data we employed, constructed and subsequently utilized in our analysis. More specifically, we employ the growth rate of GDP at level[1] (see Figure 1) obtained from Mitchell (2003), as well as various political instability indicators covering a period between 1870 and 2003 for Brazil (for the descriptive statistics as well as the correlation matrix see the discussion and Tables A1 and A2 in the Online Appendix). With respect to political instability, following Campos and Karanasos (2008) and Campos et al. (2012) we use a taxonomy of political instability variables that can be divided into two categories, informal political instabilities and formal ones (that is, whether or not instability originates from within the political system). Our political instability variables enter our econometric framework one by one and thus the results are not affected by the taxonomy itself.

Both formal and informal political indicators are recorded yearly for Brazil from 1919 to 2003 with the exclusion of the World War II period (1940-1945). However, in order to track our political instability variables back to the year of 1870, we constructed our own informal and formal political instability series from 1870 to 1919 (see Figures A1 and A2 in the Online Appendix).

In the spirit of Acemoglu et al. (2019) and according to the definitions of the political instability variables (see below), we collect the related political events from 1870 to 1930. Then, by comparing the data we constructed to the existing data from 1919 to 1930, we can evaluate the accuracy of the series we generated. Therefore, in the following subsections, we describe in detail the construction of the political instability indicators from 1870 to 1930. We will also discuss how those political events we generated match our existing data set.

However, the substantial number of informal and formal indicators (analysed below) may introduce strong biases and inflate the measurement error by increasing the noise-to-signal ratio. To circumvent these concerns we conduct principal component (PCA) as well factor (FA) analysis in order to classify variables into components/factors and hence check whether this kind of latent analysis confirms the dominant blocks of informal and formal political instability[2]. From the PCA and FA two main components/factors were extracted (with a zero correlation coefficient). The first component has an eigenvalue of 2.53 and it consists of formal political instability indicators whereas the second component has an eigenvalue of 2.26 consisting of the informal political instability measurements. Moreover, based on the explained and unexplained variation of each of the two components the formal instability is more powerful than the informal one. Furthermore, among all informal indicators, guerrilla warfare and coups d'etat display the lowest unexplained variation, whereas among the formal ones it is legislation selection and purges (figures not tabulated).

Informal Political Instabilities

Our informal political instability variables include seven indicators. First of all, we identify the events that related to the anti-government demonstrations. As anti-government demonstrations are defined as peaceful government gatherings of at least 100 people, we find only one related political event which occurred in the year of 1904. With the approval of the law of Mandatory Vaccine, an uprising against the

[1] Furthermore we downloaded the Maddison growth rate of per capita GDP introduced by Bolt and Van Zanden (2014) and plotted it against our growth rate of GDP. The two lines were significantly intertwined (graph available upon request).

[2] To ensure the usage of principal component analysis the Kaiser-Meyer-Olkin measure of sampling adequacy was conducted. Results are not reported, but are available upon request.

government's decisions broke out. The event began on the 10th of November, with a group of student demonstrations (Fausto, 1986). Although the movement quickly turned into a riot in the end, it was a peaceful demonstration in the first few days. In the following 26 years, until the year 1930, we cannot observe any other information about anti-government demonstrations either from the political history resources or our existing data set.

Our second informal political instability measure, namely assassinations, is defined as any politically motivated murder or attempted murder of a high government official or politician. The only related event we found during the period of 1870 – 1919 is that Jose Gomes Pinheiro Machado, who was a Brazilian republican politician, was murdered in the year 1915 (Fausto, 1986). Further, we also find two other assassinations in the year 1930. Earlier in February, Vice president Mello Vianna was shot three times in the neck and in the hand at Monte Claros in the state of Minas Geraes[3] . After a few months, Joao Pessoa Cavalcanti de Albuquerqu, who was the governor of Paraiba, was murdered in July (Fausto, 1986).

In the case of general strikes, the identification is clear before the year 1889 since Brazil was still under slavery. According to the definition of general strikes, a general strike involved at least 1000 workers and aimed at government policies, we found that the first major strike in Brazil occurred in Rio de Janeiro in 1903 when workers at the Aliaca Textile Mill walked off the job. This strike paralyzed Rio de Janeiro for twenty days when over 40,000 workers from all the city's textile mills went on strike demanding better conditions and pay (Hall and Spalding, 1986). The next short and unsuccessful strike to shake Brazil was a general strike in the textile industry of Sao Paulo in 1907. Six years later, the strike led by city's Federacao Operaria Syndical occurred in Rio Grande do Sal. In the year 1917, one of the most violent general strikes broke out in Sao Paulo in July. According to Hall and Spalding (1986), records show that about 50,000 people joined the movement. From the year 1919 to 1930, our existing data set shows that one strike happened in the year 1920 which is recorded by Steven (2011). However, this general strike was called in 1920 for factory workers in Rio de Janeiro.

It is, sometimes, hard to distinguish guerrilla warfare from revolutions. In this paper, we defined our guerrilla warfare as armed activity, sabotage, or bombings carried on by independent bands of citizens or irregular forces and aimed at the overthrow of the present regime. According to this definition we found the Contestado War (Guerra do Contestado) is a typical guerrilla war that occurred in 1912 (Vinhas de Queiroz, 1966). Clashes between settlers and landowners lasted for four years. During that time, with the support by the Brazilian states' police and military forces, around 9,000 houses were burned and 20,000 people were killed. In the end, the guerrilla war was finally ended with the capture of Adeodato – the last leader of the Contestado, in August of 1916. Further, by comparing the series we quoted from 1919 – 1930, we found two more guerrilla wars. The first one is the revolution of 1923 while the second one is the movements led by Luis Carlos Prestes in the year 1924 (Fausto, 1986).

The fifth measure of our informal political instability variable is the number of the coups, which is defined as the number of extra constitutional or forced changes in the top government elites. It is very clear that in our examined period of 1870 – 1930, only two bloodless coups occurred, in the year 1889 and 1930 respectively. As Roett (1999) stated, the traditional resources of support for the monarchy were seriously weakened at the end of the Second Empire. Firstly, on November 15, 1899 the Emperor was dethroned and Brazil passed from a centralized Empire to a federal republic by a bloodless coup (Fausto, 1986). Secondly, in the year 1930, after Vargas took power, he issued a decree law which granted virtually dictatorial power to the government and dissolved the congress. The latter action has been characterised as a coup by Bethell (2008).

Our sixth informal political indicator is the revolutions, namely an illegal or forced change in the top governmental elite (any attempt). During the six years from 1864 to 1870, Brazil, Argentina and Uruguay fought a bloody war with Paraguay. The war ended with the victory of Brazil and its allies but at a terrible price. Nevertheless, in Brazil, the war contributed to the growth of manufacturing and to increased power of the central government. Thus, there was almost no revolutionary revolt against the government during the last two decades of the Second Empire. However, due to the competition between the President Deodora da Fonseca and vice President, Floriano Peixoto, soon after the formation of the First Republic, the first revolt of the Naval (Revolta da Armada) broke out in 1891. The President dissolved the congress, provoking rebellions in the navy and in Rio Grande do Sul (Hahner, 1969). One year later, a document sent by 13 generals to the president of the Republic called for new elections.

[3]Found the event in newspaper. Available at: http://trove.nla.gov.au/ndp/del/article/83815336.

President Floriano, who took office after the first revolt of the navy, suppressed the movement, and ordered the arrest of its leaders. Therefore, in the September of 1893, the second Revolta da Armada broke out at Rio de Janeiro (Hahner, 1969). While the naval insurgents still threatened the capital, the Federalists rapidly approached the southern borders of Sao Paulo. The Federalist Revolution, which lasted two years from 1893 to 1895, was defeated in the Battle of the Pulador. Moreover, in the same year of 1893, a more bloody conflict between the state of Brazil and a group of settlers who founded their own community, named Canudos, began. The Canudos war had a brutal end in October 1897, almost all the inhabitants were killed by a large Brazilian army force (MacLachlan, 2003). A few years later, The Revolt of the Lash (Revolta da Chibata), occurred in November 1910. There were about 2400 sailors involved in this so called sailors' revolt. The rebellion had been planned for about two years and was triggered by severe punishment applied to the sailor Marcelino Rodriguez Menezes. The movements lasted from 22^{nd} to 27^{th}, the crews, most of whom were black, deposed their white officers and threatened to bomb the city. However the mutiny was resolved within a week, see Schneider (2009) and page 1 in the Online Appendix for more details.

The last measure of our informal political instability variable is riots, which are defined as the violent demonstration or clash of more than 100 citizens. The riots before the First Republic have been documented in several books (Bethell, 1989, Macedo, 1998 and Carneiro, 1960). From 1873 to 1874 in southern Brazil, a clash which is called Revolt of the Muckers (Revolta dos Muckers) between two groups in one German community arose. From the end of 1874 to the middle of 1875, in the northeast of Brazil, a revolt called Quebra – Quilos revolt (Revolta do Quebra-Quilos) against a new system of weights and measures broke out. In the year 1875, about 300 women went through the streets (armed with stones and sticks) in order to protest against the compulsory military draft on August 30th (Guerra das Mulheres). During the last decade of the Empire, Revolt of the penny (Revolta do Vintem) took place from December 28, 1879 to January 4, 1880 on the street of Rio de Janeiro Carneiro, 1960). And once again, a revolt occurred between March 27 and March 30 in the city of Curitiba in 1883. Although the statistics of injuries and deaths are inaccurate, it is a fact that shots was fired from both sides, several were injured on both sides, and numerous arrests were made. Ten years after the first civilian president of the republic assumed power, in 1904, an uprising against a government decision broke out. On the 13^{th} of November, the centre of Rio de Janeiro became a battlefield (Fausto, 1986); it is recorded as a demonstration, however, the movement turned into a riot in the end. In the year 1914, with the policy of bailouts, the president's attempt to intervene in the northeast region neutralized the political power of the oligarchy in the state of Ceara. However, the attempt to replace the state governor quickly triggered the clash called the Sedicao de Juazeiro. From the year 1919 till the year 1930, our existing data set shows three riots. The first one occurred in the year 1920 (Fausto, 1986 recorded a revolt without many details) whereas another two riots took place in the year 1930 (namely Revolta de Princesa – Paraiba, see Fausto 1986). Soon after this event, Joao Pessoa, who was the governor of Paraiba, was murdered in July. After his death, there were more riots.

Formal Political Instabilities

Our formal political instability variables include eight measures: Changes in effective executive (the number of times in a year that effective control of the executive power changes hands. Such a change requires that the new executive be independent of his predecessor), government crises (any rapidly developing situation that threatens to bring about the downfall of the present regime - excluding situations of revolt aimed at such an overthrow), legislative effectiveness[4] and legislative selections[5], major constitutional changes (the number of basic alterations in a state's constitutional structure; there were no

[4] (0) None. No legislature exists.

(1) Ineffective. There are three possible bases for this coding: first, legislative activity may be essentially of a "rubber stamp" character; second, domestic turmoil may make the implementation of legislation impossible; third, the effective executive may prevent the legislature from meeting, or otherwise substantially impede the exercise of its functions.

(2) Partially Effective. A situation in which the effective executives' power substantially outweighs, but does not completely dominate, that of the legislature.

(3) Effective. The possession of significant governmental autonomy by the legislature, including, typically, substantial authority in regard to taxation and disbursement, and the power to override executive vetoes of legislation.

[5] (0) None. No legislature exists.

(1) Nonelective. Examples would be the selection of legislators by the effective executive, or by means of heredity or ascription.

(2) Elective. Legislators (or members of the lower house in a bicameral system) are selected by means of either direct or

major constitutional changes between the year 1891 and the Vargas Era), number of cabinet changes (the number of times in a year that a new premier is named and/or 50% of the cabinet posts are occupied by new ministers), purges, and size of cabinet (graphs available upon request).

With the exception of the government crisis and the purges, all other formal political events are recorded since the year 1870. There were no major changes for legislative effectiveness, legislative selections and number of cabinet changes during the First World War Period. According to the definition, the changes in effective executive are equal to the changes of the presidents. Therefore, we will discuss in detail the construction of the purges and government crisis respectively.

Given the definition of the purges - any systematic elimination by jailing or execution of political opposition within the ranks of the regime or the opposition- we find that during the last decade of the Second Empire, the empire was marked by considerable political instability in the 1880s. In the year 1884, records show that, out of a peacetime army of 13,500 men, more than 7,526 had been jailed for insubordination (Lima, 1986). Based on Woodard (2009) and Love (1980), from the year 1891 to the year 1892, along with the rebellions and the change of the president, purges and counter purges took place (there is no description of the event but a list of people who were involved in it). As our existing data recorded another purge activity in the year 1930, we found the corresponding political history event in Bethell (2008). In particular, soon after the 1930 revolution, a quick change among the armed forces had been adopted. The senior ranks were eliminated by a massive purge. By the end of 1930, nine of eleven major generals and eleven of twenty – four brigadier generals retired.

Although there is a clear definition of the government crisis, it is still hard to define which events or situations are rapidly developing states that threaten to bring about the downfall of the present regime. For instance, consider the Paraguay War (1864 – 1870). While the bloody war lasted for six years, produced nearly 50,000 deaths and caused a ruinous increase of the public debt, the Paraguay war, somehow, still has some positive effects on Brazil. The war centralized the government power, thus, there was almost no revolutionary revolt against the government during the 1860s. Taking all those factors into account, we believe that in the year 1870, Brazil was not in a situation for a government crisis. However, as Colson (1981) stated, the crisis of 1889 has long been seen as a turning point in Brazilian history. First of all, the Paraguay War raised massive public debts that seriously reduced the growth of the country. Then, the abolition of slavery without compensation gradually weakened the firm foundation of the monarchy – it had lost the support of vital groups like the landowners (Hahner, 1969)[6]. More importantly, the war with Paraguay greatly increased the political power of the Brazilian army. Eventually, with the allowance of a discontented republican minority to grow more audacious (Republicanism), a group of army officers led by Manoel Deodoro da Fonseca launched a coup to proclaim the Republic on November 15, 1889. All in all, we believe the first government crisis in Brazil, during the time period between 1870 and 1930, occurred in the year 1889. Another government crisis which is recorded in our existing data set can be observed in the year 1930. Similar to the crisis in 1889, the government crisis in 1930 resulted from a joint effect of multiple factors. Politically, the tenente revolt occurred in 1922 and then in 1924 had shaken the interior of Brazil without ever being defeated by the army. Then, the old republic suffered a big hit with the economic crisis. It was in October 1929 that the Great Depression began. Although there was little immediate outcome at the beginning, the problem of overproduction became serious within 4 to 5 years. Brazilian Exports fell about two thirds within 7 years' time – from 1929 to 1935. Losing profit on the coffee exports, the Paulista oligarchy tried to stay in power in the republic without respecting the alternation with Minas Gerais. This led to the end of the "politics of coffee with milk". Those political crises together with the economic crisis led to the end of the Old Republic on October 24, 1930.

To sum up, in order to generate our own political instability series, we track all the political events yearly from 1870 to 1930. Next, we classified each event to its own category according to the definition which has been mentioned above. Finally, by comparing the data we generate to the existing ones from 1919 to 1930, we found that the series we generated from these events are basically correct.

Comparison With Other Measures of Democracy and Institutional Development

How are our measures of informal and formal political instability related to the existing measures of Brazil's institutional development? In this part we will focus on comparisons with other common

indirect popular election.

[6]Hahner, J.E., 1969. Civilian – Military Relations in Brazil 1889-1898. University of South Carolina Press, pp 2-4.

measures of democracy and institutional development. Although our definitions and coding do not strictly match the concepts and measurements of democracy and institutional development introduced in past literature, we can still find some substantial correlations between our political instability indicators and those measures introduced by Acemoglu et al. (2002), Boix et al. (2013), Lindberg et al. (2014) and Spruk (2016a, 2016b). More specifically, Acemoglu et al. (2002) argue in favor of a reversal in relative incomes among the former European colonies due to European intervention, which in turn created an "institutional reversal". To quantify institutions they employed among others the constraints on the executive (a variable described in Gurr, 1996, and later updated in Marshall et al., 2015) from Polity III data set, which serves as a proxy for the level of concentration of political power in the hands of ruling groups. We then explore how our coding matches with that of Marshall et al. (2015). Despite the different scaling between our measures and that of Marshal et al. (2015) we notice from Figures A2.c, A2.d and A3.a (in the Online Appendix) that legislative effectiveness, legislative selection and executive constraints are highly correlated.

Boix et al. (2013) update and describe an extensively used dataset on democracy covering a very long period of time, from 1800 to 2007 and 219 countries and representing the most comprehensive dichotomous measure of democracy (see Figure A3.b). Figures A1.a, A2.h and A3.b entail that there is a significant correlation between the dichotomous measure of democracy (Boix et al., 2013) and our political instability indicator of demonstrations and size of the cabinet (informal and formal indicator respectively). Looking at those three graphs we notice that up to almost 1950, when the country was democratically repressed, the number of demonstrations were almost zero and the size of the cabinet was really small. This trend started reversing from 1950 and especially from 1980 onward when democratic values began to emerge.

Furthermore, Lindberg et al. (2014) generated a new dataset that measures democracy, the so-called Varieties of Democracy Project (V-Dem). Due to the lack of consensus on how to measure democracy they emphasize its multidimensionality. Out of the five principles that the authors follow in order to conceptualize democracy, we estimate high correlation coefficients between various electoral factors [such as election vote buy, elections free and fair, head of state legislation in practice and party ban (see Figure A3.c)] and liberal [such as executive respects constitution and freedom from political killings (see Figure A3.d)] components and some of our informal (namely demonstrations, assassinations, riots and guerrilla) and formal (namely legislative selection and size of cabinet) political instability indicators (due to space limitations, we project only a sample of the electoral and liberal components).

Concluding, Spruk (2016a, 2016b) measured institutional changes and investigated the impact of "de jure" and "de facto" political institutions on the long-run economic growth for a large panel of countries in the period 1810-2000 (due to space limitations see Figure A3.e for a sample of those components). Compared with their data set we estimate high correlation between their de jure (and in particular competitiveness and openness of executive recruitment) and de facto components (civil liberties and political rights) and our informal (namely assassinations, demonstrations and guerrilla warfare) and formal (such as legislative effectiveness and legislative selection) political instability indicators. The data for the de facto components, namely civil and political rights, were available from 1972 onward for Brazil.

4 Econometric Framework

The PARCH model was introduced by Ding et al. (1993)[7] and quickly gained currency in the economics and finance literature.[8] Let growth (y_t) follow a white noise process augmented by the lagged value of the political instability variable and the in-mean effect of output volatility (h_t) on output:

$$y_t = c + k \log(h_t) + \lambda x_{i,t-l} + \epsilon_t, \tag{1}$$

with

$$\epsilon_t = e_t h_t^{\frac{1}{2}},$$

[7] Following the seminal work of Higgins and Bera (1992).

[8] See, for example, Karanasos and Kim (2006). Karanasos and Schurer (2005, 2008) use this process to model output growth and inflation respectively.

where x_{it} is either the informal or formal political instabilities .

In addition, $\{e_t\}$ are independently and identically distributed (i.i.d) random variables with $E(e_t) = E(e_t^2 - 1) = 0$, while h_t is the conditional variance of output growth, which is positive with probability one and is a measurable function of the sigma-algebra $\sum_{t-1}$, which is generated by $\{y_{t-1}, y_{t-2}, \ldots\}$..

In other words, h_t denotes the conditional variance of growth. In particular, h_t is specified as an asymmetric PARCH(1,1) process with lagged growth included in the variance equation:

$$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} f\left(e_{t-1}\right) + \beta h_{t-1}^{\frac{\delta}{2}} + \phi x_{i,t-l} + \gamma y_{t-n}, \tag{2}$$

with

$$f\left(e_{t-1}\right) = \left(|e_{t-1}| - \varsigma e_{t-1}^{\delta}\right), \tag{3}$$

where δ (with $\delta \in (0, \infty)$) is the heteroscedasticity parameter, α and β are the ARCH and GARCH coefficients respectively, ς with $|\varsigma| < 1$ is the leverage term and γ is the level term for the nth lag of growth. The model imposes a Box-Cox power transformation of the conditional standard deviation process and the asymmetric absolute residuals, see equation (3) [following Ding et al. (1993) asymmetric effects were initially considered in our model, though they are insignificant and have hence been omitted]. In order to distinguish the general PARCH model from a version in which δ is fixed (but not necessarily equal to two) we refer to the latter as (P)ARCH.

The PARCH model increases the flexibility of the conditional variance specification by allowing the data to determine the power of growth for which the predictable structure in the volatility pattern is the strongest. This feature in the volatility process has important implications for the relationship between political instability, growth and its volatility. There is no strong reason for assuming that the conditional variance is a linear function of lagged squared errors. The common use of a squared term in this role is most likely to be a reflection of the normality assumption traditionally invoked. However, if we accept that growth data are very likely to have a non-normal error distribution, then the superiority of a squared term is unwarranted and other power transformations may be more appropriate.

The PARCH model could be considered as a standard GARCH model for observations that have been altered by a sign-preserving power transformation implied by a modified PARCH parameterization. He and Teräsvirta (1999) argue that if the standard Bollerslev type of model is augmented by the heteroscedasticity parameter, the estimates of the ARCH and GARCH coefficients are almost certainly different. Furthermore, by squaring the growth rates one essentially imposes a structure on the data that might lead to sub-optimal modeling and forecasting performance relative to other power terms. To assess the severity of this assumption we investigate the sample autocorrelations of the power transformed absolute growth $\mid y_t \mid^d$ for various positive values of d. Figure A4.a in the Online Appendix shows the autocorrelogram of $\mid y_t \mid^d$ from lag 1 to lag 20 for $d = 0.8, 1.0, 1.5, 2.0$ and 2.5. The horizontal lines show the $\pm 1.96/\sqrt{T}$ confidence interval (CI) for the estimated sample autocorrelation if the process y_t is *i.i.d.*. In our case $T = 128$, so $CI = \pm 1.96/\sqrt{T} = \pm 0.173$. The sample autocorrelations for $\mid y_t \mid^{0.8}$ are greater than the sample autocorrelations of $\mid y_t \mid^d$ for $d = 1.0, 1.5, 2.0$ and 2.5 at every lag up to at least 11 lags. Alternatively, this means that $\mid y_t \mid^d$ has the strongest and slowest decaying autocorrelation when $d = 0.8$. In addition, note that at the vast majority of the lags $\mid y_t \mid^d$ has the lowest autocorrelation when d is 2 and 2.5. To explore the choice of the PARCH process further, we calculate the sample autocorrelations of the absolute value of growth $\rho_\tau(\delta)$ as a function of δ for lags $\tau = 1, 5, ..., 30$ and taking $\delta = 0.125, 0.25, ..., 4.0$. Figure A4.b below provides the plot of the calculated $\rho_\tau(\delta)$. For example, for lag 1, there is a unique point δ^* equal to 0.8 for the absolute growth, such that $\rho_1(\delta)$ reaches its maximum at this point: $\rho_1(\delta^*) > \rho_1(\delta)$ for $\delta \neq \delta^*$. We also test whether the estimated power term is significantly different from two using Wald tests. The estimated power coefficient is significantly different from two (see Table A3, Panel A). In addition, the best fitting specification is chosen according to the Likelihood Ratio (LR) results and the minimum value of the Akaike Information Criterion (AIC), see Panel B of Table A3 for a sample of those results. Due to space limitations the remaining results are available upon request.. These findings provide evidence against Bollerslev's specification and empirical justification of the PARCH process. Concluding, the statistical significance of the in-mean effect greatly depends on the choice of the size of the heteroscedasticity parameter. If the power term surpasses a specific threshold then the aforementioned effect might become insignificant. The latter suggests that if one assumes a

linear link between a variable and its uncertainty a priori, then a significant association between the two might not be observed.

We present our main reasons in three interdependent blocs: the direct, indirect and dynamic (short and long-run) effects. We proceed with the estimation of the PARCH(1,1) model in equations (1) and (2) in order to take into account the serial correlation observed in the levels and power transformations of our time series data. The Tables in Appendix report the estimated parameters of interest for the period 1870-2003. These were obtained by the Quasi-Maximum likelihood (QML) estimation, which is robust to the presence of normality as implemented in EVIEWS and described by Bollerslev and Wooldridge (1992)[9]. Once heteroscedasticity has been accounted for, our specifications appear to capture the serial correlation in the power transformed growth series. Moreover, the tests for remaining serial correlation suggest that all the models for each individual political instability indicator seem to be well-specified since there is no remaining autocorrelation in either the standardized or squared standardized residuals at 5% statistical significance level (due to space limitations results are not tabulated but are available upon request).

Our set of variables tries to reflect the different explanations for the Brazilian puzzle previously put forward by economic historians. This set comprises seven measures of informal political instabilities and eight forms of formal political factors. In order to study the direct effects of our set of explanatory variables, we specify model 1 with $\phi = 0$ in equation (2), while model 2 with $\lambda = 0$ in equation (1) allows us to investigate their indirect impacts on growth.

5 Empirical Results

In this section, our results are presented following the specific types of effects. We start with the estimation of the (P)ARCH (1,1) model in eqs. (1) and (2) in order to obtain our baseline results on direct (on mean economic growth) and indirect (via volatility) effects of political instability on growth (Tables 1.a to 2.b). Then we refine our main findings by estimating the dynamic (short and long-run) as well as structural break impacts respectively.

5.1 Direct Impact on Growth

Tables 1.a and 1.b (see the Appendix) report the results from our estimation of the PARCH$(1,1)$ model for each one of the elements in our set of explanatory variables. In this paper, we estimate models with lagged values of our explanatory variables as regressors. As we will see below the lagged direct effect on growth is equivalent to the short-run impact.

The parameter we are most interested in is λ (in the third column of the Tables). The results reveal that the direct effects of informal political instabilities on economic growth rate are mostly negative and statistically significant (five out of seven), while the effects of formal political instability variables are negative and significant as well (six out of eight). As for the in mean parameter (k), notice that in all cases the estimates are highly significant and positive, which is in line with the theoretical argument of Black (1987). Also the power term coefficients δ are rather stable, with the Akaike IC (AIC) criteria choosing a PARCH specification with power terms in most of the cases equal to 1.00 (e.g., anti-government demonstrations, general strikes, changes in effective executive and the size of cabinet).

In summary, we find that our two main explanatory factors, formal and informal political instabilities, affect Brazil's economic growth negatively. Interestingly, four measures of informal political instability (anti-government demonstrations, assassinations, general strikes and number of coups d'etat) and three measures of formal political factors (changes in effective executive, legislative effectiveness and number of cabinet changes) seem to play important roles in determining growth. Next we will investigate whether or not such powerful effects remain in the presence of indirect (via volatility) effects.

Ommitted Variable Bias

[9]If the political events are clustered around a single year, the underlying effects may be contaminated by unreliable standard errors that over-reject the null. One recommendation for future research in a panel of countries would be to compute the priming values on the basis of the estimated variance of residuals from OLS, report the robust standard errors and then compare them with the ones produced under the Driscoll-Kraay (1998) approach that addressed the issue of spatial dependence.

One possible drawback of the identification strategy is to neglect the omitted variable bias. Even though we know from the work of Knack and Keefer (1995) and Rodrik et al. (2004) onwards that the institutions trump the contribution of geography and trade in explaining cross-country income differences over time, it is impossible to isolate the confounding effects of human capital as a competing channel that feeds directly into growth rates. Glaeser et al. (2004) show that poor countries tend to escape the poverty trap through human capital investment often pursued by benevolent dictators while Jeffery Sachs, Jared Diamond and his followers believe that geography makes all the difference. Relatedly, could it be that the informal instability variables partially capture the role of culture which many, starting with Max Weber and David Landes, believe makes all the difference by acting as a brake or filter on economic development?

To address this issue we control for the effect of human capital formation using the average years of education (data obtained from Spruk, 2016b) and see whether controlling for human capital renders the effects of informal and formal instability weak, stronger or intact. Furthermore, to eliminate any direct confluence of political instability induced by adverse physical geography (for more details see Miguel et al., 2004) we consider the variation in rainfall (rain) as well as the annual temperature (temp), which serve as observable measures of climatic shock (data obtained from the World Bank). Our findings show a positive (negative) impact of the average year of education (variation in temperature) on economic growth whereas the effect of both informal and formal political instability (on output) remains negative with either the same or slightly weaker magnitude (see parameter estimates ξ and ζ in Tables A4.a and A4.b in the Online Appendix).

In addition, we detect a negative link between the variation of rain and growth, though statistically insignificant (see parameter estimates θ in Tables A4.a and A4.b). Relatedly, a measure of culture would be beneficial to rule out the direct effects of culture on long-run growth. Although we are aware of the difficulty of such an easily tractable measure, we exploited the approach of McCleary and Barro (2006) and we searched for the fraction of the population that is Catholic as well as the immigration rate as rough proxies for the effects of culture, which have been one of the defining characteristics of Brazil's economic and institutional history. However, the data available from the Brazilian Institute of Geography and Statistics (IBGE) were discontinued for both variables (for example the immigration rate is available from 1870 to 1975). To address this lack of data and thus avoiding further decrease of observations in our sample, we include the immigration rate in our models separately and we find that there is a negative impact on output growth, though statistically insignificant (due to space limitations results are not tabulated).

Finally, to further assess the robustness of our baseline results we test whether or not the inclusion of financial development (measured by money supply 1, commercial bank deposits and deposits at bank of Brazil), trade openness and public deficit renders the impact of political instability on growth. Preliminary results show that both formal and informal political instability affects growth negatively (results are not reported due to space limitations).

5.2 Indirect Effects (Via Growth Volatility)

One of the main advantages of the (P)ARCH framework is that it allows us to study not only the direct growth effects from the full set of explanatory variables described above, but also their indirect effects on economic growth through the predicted component of growth volatility (conditional on its past values).

As we can see from Tables 1.a and 1.b, the effect of conditional or predicted volatility on growth is positive ($k > 0$) and statistically significant in all cases at conventional levels. Tables 2.a and 2.b report the estimation results for each one of the elements in our data set for what we call the indirect impact, which is the effect on growth via the volatility channel. The parameter we are most interested in is ϕ (in the fifth column of the aforementioned Tables). Our results show that the effects of both formal and informal political instabilities are mostly negative and significant (with the exceptions of revolutions and major constitutional changes).

We find that exogenous increases in political instability have a negative and significant indirect impact on growth. That is, less political instability is associated with a larger fraction of growth volatility, which is anticipated by the relevant economic agents. And the larger the share of the growth volatility that is anticipated, the higher growth rates we observe. Therefore, political instability registers a negative

lagged direct effect on growth but also a substantial impact on the expected or conditional share of growth volatility and thus a negative indirect effect as well.

To sum up, we find strong evidence that both formal and informal political instabilities have a negative indirect (via volatility) impact on growth.

5.3 Joint Estimation of Direct and Indirect Effects

How robust are these baseline results? It seems that both formal and informal political instability variables are dominant influences. Specifically, we ask how the results for the political instability indicators change if we examine the indirect and direct effects jointly.

Tables 3.a and 3.b present the results when we include our political instability indicators in both the mean and variance equations. In particular, our parameter estimates show that informal political variables have the expected negative and statistically significant lagged direct impacts (see the λ column in Table 3.a) except the guerilla warfare and riots. As far as the negative direct effect of formal political instability on growth is concerned it is significant in only four out of the eight cases. In other words, when we consider both direct and indirect effects, the negative direct impact of formal political instability on growth falls slightly since it becomes insignificant for legislative selection and size of the cabinet.

5.4 Dynamic Aspects

In this section we investigate how short and long-run considerations help us refine our baseline results. Another potential benefit from this exercise is that the required use of lags may help ameliorate any lingering concerns about endogeneity. In order to estimate short and long-run relationships we employ the following error correction (P)ARCH form

$$\Delta y_t = \mu + \theta \Delta x_{i,t-l} + \varphi(y_{t-1} - c - \zeta x_{i,t-1}) + \varepsilon_t, \tag{4}$$

where θ and ζ capture the short and long-run effects respectively, and φ is the speed of adjustment to the long-run relationship. This is accomplished by embedding a long-run growth regression into an autoregressive distributed lag (ARDL) model. In other words, the term in parenthesis contains the long-run growth regression, which acts as a forcing equilibrium condition

$$y_t = c + \zeta x_{it} + u_t, \tag{5}$$

where u_t is $I(0)$. The lag of the first difference of either the informal or formal political instability variable ($\Delta x_{i,t-l}$) characterizes the short-run effect. The condition for the existence of a long-run relationship (dynamic stability) requires that the coefficient on the error-correction term be negative and not lower than -2 (that is, $-2 < \varphi < 0$). We also take into account the PARCH effects by specifying the error term ε_t as follows

$$\varepsilon_t = e_t h_t^{\frac{1}{2}}, \tag{6}$$

where

$$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} |e_{t-1}|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \gamma y_{t-n}. \tag{7}$$

Tables 4.a and 4.b report the results on estimations of short and long-run parameters linking the explanatory variables with growth. In all cases, the estimated coefficients of the error correction term (φ) lie within the dynamically stable range $(-2, 0)$. Generally speaking, from investigating whether dynamic considerations affect our conclusions, we find major differences in terms of short and long-run effects. To be more specific, we find that, in total, fourteen out of the fifteen political instabilities have strong short-run effects while only five out of the fifteen explanatory variables have long-run effects.

Next we discuss the results regarding the informal political factors and formal ones separately. We first focus our analysis on those obtained from the informal political instabilities. Table 4.a presents the results. The estimated φ lies within the range -0.55 to -0.32, while θ and ζ capture the short and long-run effects respectively. With the exception of the guerrilla warfare, all other estimates of the short-run

coefficients (see the θ column) are significant and negative. However, the corresponding values for the long-run coefficients tell a very different story, that is the negative short-run effects of anti-government demonstrations, general strikes and riots disappear in the long-run (see the ζ column in the Table).

Similarly, we find strong evidence that formal political factors affect economic growth negatively (estimates of the short-run coefficients are significant and negative), while we observe long-run effects in only two out of the eight formal political indicators, namely: legislative effectiveness and number of the cabinet changes (see Table 4.b).

In summary, in the short-run, fourteen political instabilities have a negative effect on Brazil's growth whereas in the long-run, only five political instabilities (three informal and two formal ones) seem to affect growth negatively.

5.5 External Validity

In this subsection we will cross-validate our results with a country that has experienced similar magnitudes of political and institutional instability, such as Argentina. Campos and Karanasos (2008) investigated the growth volatility-political instability relationship using an econometric technique similar to us for Argentina from 1896 to 2000. Their findings on various dimensions of political instability (namely number of assassinations, general strikes, constitutional changes and legislative elections) show that while informal political instability has a direct negative effect on growth, formal instability has an indirect impact, via the growth volatility. Our parameter estimates for Brazil indicate a strong direct and indirect effect of both informal and formal political instability indicators on growth.

Campos et al. (2012) extend the work of Campos and Karanasos (2008) by examining the impact of informal political instability on growth in the short/long-run for Argentina from 1896 to 2000. Campos et al. (2012) argue that the informal instability effects are substantially larger in the short- than in the long-run. Similarly we report that: (a) political instability has a negative effect on Brazil's growth in the short-run (whereas in the long-run only a few of the instability indicators affect growth negatively); (b) both informal and formal political instability effects are larger in the short- than in the long-run. The latter provides evidence, in line with Campos and Nugent (2002) and Murdoch and Sandler (2004), for the notion that the duration of the political instability effect does indeed matter.

To facilitate our analysis further we plot the level of Brazilian per capita gdp against the one of Latin American (namely Argentina, Chile, Colombia, Uruguay and Venezuela) and Western European Countries (i.e. France, Germany, Portugal, Spain and United Kingdom) for the period 1870 to 2003 (obtained from Bolt et al., 2018). More specifically, Figures A5.a and A5.b in the Online Appendix report the level of Brazilian per capita gdp relative to Latin American and Western European countries respectively. The graphs show that Brazil has the lowest gdp per capita compared to both groups of countries by a considerable amount for most of the sample period. The Brazilian economic welfare was only comparable to that of Colombia, Venezuela and Portugal till around the 1940s and 1950s, although well behind after that period.

5.6 Structural Breaks

Considering the role of structural breaks, we adopt our final important robustness test. We use the methodologies developed by Bai and Perron (2003) and Wald-Chow to observe whether or not there are any structural breaks in growth, informal as well as formal political instability indicators (see Table A5 in Online Appendix for a list of all the identified breaks). Under very general conditions on the data and the errors, Bai and Perron (2003) address the problem of testing for multiple structural changes. In addition to testing for the existence of breaks, these statistics identify the number and location of multiple breaks. In the case of the economic growth series the Bai-Perron methodology supports three structural break points, which occur for the years 1893 (though statistically insignificant and hence omitted from the subsequent analysis), 1938 and 1979 respectively, whereas the Wald-Chow technique reports one break in 1893.

Based on the Bai-Perron test, for three measures of informal political instability (guerrilla warfare, number of coups d'etat and revolutions) and six measures of formal political measures (namely changes in effective executive, government crises, legislative effectiveness, major constitutional changes, purges and size of the cabinet), we find no structural breaks. However, our Bai-Perron results support one structural

break in anti-government demonstrations (it is dated 1964), assassinations (in 1978), and general strikes (in 1902). Additionally, we also find two structural breaks in riots during 1929 and 1964 respectively. Further, we observe one structural break for either legislative selections or number of cabinet changes, which occur in 1939 and in 1889, correspondingly. As far as the Wald-Chow results are concerned the breakpoints are substantially close to the ones provided by the Bai-Perron in half of the cases (see Online Appendix for structural breaks modeling).

We find our results to be quite robust to the inclusion of the structural break dummies. That is, both informal and formal political instabilities have strong negative effects on the growth and its volatility (see Tables A6 and A7 in the Online Appendix). As to the dynamic aspects, for three measures of informal political instability (namely assassinations, coups d'etat and revolutions) we find strong evidence of a negative impact in both short and long-run, whereas three out of the four other measures (namely anti-gevernment demonstrations, general strikes and riots) affect growth only in the short-run, see Table A8.a. Similarly, with the exception of legislative effectiveness and number of cabinet changes, all other formal political instabilities have only a short-run negative effect on growth, see Table A8.b.

Interestingly, the causal direct, indirect and the short-run impacts from anti-government demonstrations and assassinations become weaker after we account for structural breaks in 1964 and 1978, respectively (see the λ_d columns in Tables A6.a and A7.a, and the θ_d column in Table A8.a). Similarly, i) the direct effect of legislative selection is stronger before 1939 (see the λ_d column in Table A6.b) and ii) the indirect and short-run impacts of cabinet changes are stronger before 1889 (see the λ_d column in Table A7.b and the θ_d column in Table A8.b).

To further corroborate our structural break analysis we consider whether the break dates of major political events, which were tracked via the Bai-Perron test, are associated with the structural breaks in Brazil's long-run growth path. By utilizing the Wald-Chow test (with known breakpoints, since the break dates are postulated by the political events we used to construct our measures of political instability) we find that in all cases but one (the break for demonstrations in 1964) the political events triggered highly significant structural breaks on growth as well. For instance, for assassinations we detect a structural break in 1978, which in turn triggered a statistically significant structural break in the Brazilian gdp as well (see Panel B of Table A9 in the Online Appendix). In addition, we notice that the estimated breakpoints of political events are very close to the structural breakpoints of growth provided in Panel A. The aforementioned analysis indicates that our parametric estimates (from eq. A.1 to A.4) pick up the effect of instability on growth and not some other unelaborated channels of influence.

Finally, our structural break analysis indicates that the landmark dates of institutional change in Brazil's economic and institutional history (namely the end of the Second Empire in 1889, the economic collapse of 1929 and the subsequent revolution of 1930 as well as the enforcement of a military junta for almost 20 years till 1985) are highly associated with the structural breaks of growth as well as our political instability indicators.

5.7 Discussion

In this section we summarize our results. More specifically our parameter estimates show that informal and formal political instability indicators affect Brazil's economic growth negatively, both directly and indirectly (via the volatility channel). To investigate the robustness of our baseline results we consider whether or not these results change if we consider the indirect and direct effects jointly. With respect to our informal indicators, direct and indirect effects remain negatively strong, whereas for our formal measurements the negative direct impact on growth falls slightly. Finally, we report the short and long-run effect of political instability on growth. In summary, the results suggest a strong negative link between instability and growth in the short-run and a weak one in the long-run.

To further strengthen our results we consider the issue of omitted variable bias. To address this drawback of our identification strategy we control for the effect of human capital formation as well as the immigration rate. Moreover, to rule out any direct confluence of political instability induced by adverse physical geography we utilize the variation in rainfall and annual temperature. After controlling for the aforementioned factors our estimations concerning the impact of formal and informal political instability on growth remain unchanged.

Our results are consistent with those of other countries that experienced similar magnitudes of political and institutional arrest, such as Argentina (see for more details Campos and Nugent, 2002; Campos and Karanasos, 2008 and Campos et al., 2012).

Considering the role of structural breaks we find that our findings are robust to the inclusion of structural break dummies. In particular by employing the Bai-Perron and Wald-Chow statistics we find among others: (a) three breaks in the economic growth series for the years 1893, 1938 and 1979, (b) the landmark dates of institutional change in Brazil's economic and institutional history are closely associated with the structural breaks of growth as well as our political instability indicators, (c) informal and formal instability has strong negative effects on growth and its volatility, (d) there is a strong impact of instability on growth in the short-run, (e) under the Wald-Chow technique our parametric estimates pick up the effect of instability on growth and not some other unelaborated channels of influence.

There are not, after extensive search and to the best of our knowledge, theoretical models that differentiate growth effects by type of political instability. What there is instead is the recognition that political instability can escalate and with it, the relative magnitude of its growth effects can increase. For instance, general strikes can escalate into mass demonstrations, which can escalate into riots, which by their turn can escalate into guerrilla conflicts. The growth effects differ along the characteristics of each of these modalities. For example, a guerrilla conflict can have larger negative effects on growth if more widespread and long lasting than, say, mass demonstrations. Yet, if guerrillas are constrained to smaller and less populated areas, their effects should be relatively smaller.

6 Conclusions and Future Research

Using a PARCH framework as well as new and unique data for Brazil from 1870 to 2003 we attempted to provide answers to the following questions: What is the relationship between political instability, economic growth and (predicted) growth volatility? Are these effects fundamentally and systematically different? Does the intensity and the direction of these effects vary over time, in general and in particular, do they vary with respect to short- versus long-run considerations? Our empirical results show that the majority of the formal and informal political instability indicators have strong negative direct and indirect effects on economic growth in Brazil.

From investigating whether dynamic considerations affect our conclusions, we find important differences in terms of the short and long-run behavior of our key variables, more specifically, while strong negative impacts can be observed in the short-run (fourteen out of fifteen), the corresponding effects for the long-run are weaker (five out of fifteen).

In sum, for two informal political instabilities (assassinations and number of coups) and two formal ones (legislative effectiveness and number of cabinet changes) all four influences (direct/indirect, short and long-run) are highly significant.

The main goal of this study was to assess the role of the institutions on Brazilian economic growth by specifically disentangling formal and informal political instability components. Although the study conducted a thorough survey, there were certain limitations worth mentioning. One such limitation is that the empirical evidence does not provide a definite account of the causal link between institutions and growth since we do not exploit plausibly exogenous sources of variation in Brazil's long-run growth and do not report a research design that would allow us to exploit such channels. However, we have addressed the omitted variable bias issue in greater detail (see the analysis in Section 5). In addition, due to the historical scope of this paper, certain factors, such as culture, which potentially directly affect economic growth could not be considered due to the unavailability of data.

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APPENDIX

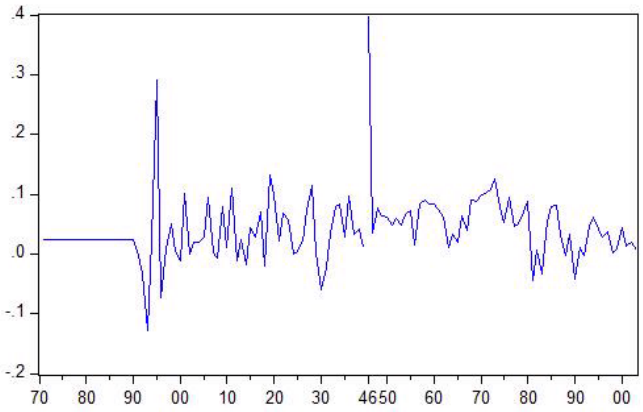

Fig. 1: GDP Growth

Table 1.a Direct Effect of Informal Political Instability on GDP growth

Informal Political Instability $x_{it} \downarrow$	k	λ	α	β	γ	δ
Anti-government Demonstrations	0.008	−0.038	0.69	0.46	0.287	1.00
	(4.10)	(−2.65)	(3.02)	(3.55)	(1.65)	−
		l=3			n=4	
Assassinations	0.011	−0.120	0.78	0.31	0.281	0.80
	(6.19)	(−5.29)	(5.83)	(4.31)	(2.05)	−
		l=8			n=3	
General Strikes	0.013	−0.209	0.70	0.42	0.198	1.00
	(5.29)	(−3.14)	(3.64)	(4.27)	(1.96)	−
		l=2			n=4	
Guerrilla Warfare	0.017	−0.011	0.57	0.48	0.236	1.00
	(4.81)	(−0.67)	(3.07)	(3.80)	(1.38)	−
		l=8			n=3	
Number of Coups d'etat	0.009	−0.089	0.71	0.19	0.173	0.80
	(4.12)	(−2.04)	(3.53)	(2.72)	(4.28)	−
		l=2			n=6	
Revolutions	0.007	−0.416	0.62	0.52	0.105	0.80
	(11.68)	(−1.83)	(3.72)	(4.25)	(1.68)	−
		l=7			n=8	
Riots	0.009	0.052	0.61	0.47	0.150	1.00
	(21.32)	(0.93)	(2.40)	(3.05)	(0.63)	−
		l=5			n=4	

Table 1.a reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \lambda x_{i,t-l} + \varepsilon_t$, $h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \gamma y_{t-n}$.

$x_{i,t-l}$ is an informal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 1.b Direct Effect of Formal Political Instability on GDP growth

Formal Political Instability						
$x_{it} \downarrow$	k	λ	α	β	γ	δ
Changes in Effective Executive	0.015	−0.209	0.77	0.36	0.099	1.00
	(13.84)	(−3.75)	(3.54)	(3.22)	(0.71)	−
		l=6			n=3	
Government Crises	0.008	0.074	0.65	0.47	0.338	0.90
	(3.65)	(1.10)	(3.19)	(3.82)	(1.66)	−
		l=2			n=4	
Legislative Effectiveness	0.007	−1.476	0.84	0.33	0.206	0.90
	(78.26)	(−2.12)	(4.91)	(3.46)	(2.28)	−
		l=6			n=4	
Legislative Selection	0.016	−1.547	0.51	0.58	0.111	0.80
	(5.42)	(−2.80)	(3.41)	(6.86)	(1.49)	−
		l=1			n=5	
Major Constitutional Changes	0.007	−0.090	0.55	0.56	0.036	0.80
	(1.90)	(−4.14)	(4.77)	(6.42)	(0.39)	−
		l=2			n=8	
Number of Cabinet Changes	0.012	−0.159	0.76	0.31	0.231	0.90
	(5.32)	(−3.03)	(4.29)	(3.36)	(1.46)	−
		l=3			n=3	
Purges	0.012	−0.002	0.55	0.42	0.385	0.90
	(3.60)	(−0.19)	(3.42)	(3.41)	(1.82)	−
		l=6			n=4	
Size of the Cabinet	0.013	−0.028	0.59	0.27	0.217	1.00
	(4.48)	(−2.99)	(4.50)	(3.00)	(2.59)	−
		l=4			n=6	

Table 1.b reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \lambda x_{i,t-l} + \varepsilon_t$, $h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \gamma y_{t-n}$.

$x_{i,t-l}$ is a formal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 2.a Indirect Effect of Informal Political Instability on GDP Growth

Informal Political Instability						
$x_{it} \downarrow$	k	α	β	ϕ	γ	δ
Anti-government Demonstrations	0.0088	0.59	0.52	−0.028	0.177	1.00
	(3.33)	(3.19)	(4.49)	(−3.51)	(0.92)	−
				l=1	n=4	
Assassinations	0.0101	0.63	0.47	−0.056	0.307	1.00
	(4.08)	(2.95)	(3.61)	(−2.88)	(1.77)	−
				l=8	n=4	
General Strikes	0.0205	0.45	0.23	−0.127	0.295	0.80
	(3.05)	(4.80)	(2.51)	(−3.34)	(2.47)	−
				l=2	n=7	
Guerrilla Warfare	0.0136	0.47	0.37	−0.043	0.259	0.90
	(5.06)	(3.67)	(3.36)	(−2.73)	(2.06)	−
				l=8	n=6	
Number of Coups d'etat	0.0002	0.23	0.79	−0.162	0.006	1.00
	(2.11)	(2.80)	(14.21)	(−2.00)	(0.133)	−
				l=1	n=5	
Revolutions	0.0081	0.73	0.34	0.268	0.088	1.00
	(4.64)	(4.15)	(3.62)	(1.16)	(1.50)	−
				l=5	n=4	
Riots	0.0050	0.72	0.51	−0.063	0.300	1.00
	(3.44)	(5.17)	(8.14)	(−3.37)	(1.56)	−
				l=1	n=4	

Table 2.a reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \varepsilon_t$, $h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \phi x_{i,t-l} + \gamma y_{t-n}$.

$x_{i,t-l}$ is an informal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 2.b Indirect Effect of Formal Political Instability on GDP Growth

Formal Political Instability						
$x_{it} \downarrow$	k	α	β	ϕ	γ	δ
Changes in Effective Executive	0.0045	0.57	0.36	−0.164	0.090	1.00
	(5.80)	(3.25)	(3.01)	(−5.07)	(2.37)	−
				l=1	n=7	
Government Crises	0.0147	0.57	0.39	−0.082	0.347	0.90
	(18.35)	(3.79)	(3.13)	(−1.94)	(1.35)	−
				l=8	n=4	
Legislative Effectiveness	0.0003	0.33	0.75	−0.894	0.069	1.00
	(3.81)	(2.71)	(9.47)	(−2.20)	(1.67)	−
				l=1	n=7	
Legislative Selection	0.0105	0.46	0.67	−0.755	0.083	1.00
	(6.83)	(3.75)	(10.36)	(−2.03)	(1.81)	−
				l=1	n=4	
Major Constitutional Changes	0.0070	0.69	0.37	0.098	−0.010	1.00
	(3.60)	(5.24)	(4.83)	(1.50)	(−0.16)	−
				l=5	n=3	
Number of Cabinet Changes	0.0065	0.64	0.36	−0.254	0.133	1.00
	(5.49)	(4.54)	(0.36)	(−5.83)	(1.46)	−
				l=1	n=2	
Purges	0.0122	0.71	0.43	−0.034	0.269	1.00
	(3.15)	(3.43)	(3.44)	(−2.17)	(1.13)	−
				l=7	n=3	
Size of the Cabinet	0.0106	0.72	0.36	−0.033	0.127	1.00
	(3.02)	(5.28)	(4.16)	(−4.38)	(0.61)	−
				l=2	n=3	

Table 2.b reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \varepsilon_t,\ h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \phi x_{i,t-l} + \gamma y_{t-n}.$

$x_{i,t-l}$ is a formal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 3.a Direct and Indirect Effects of Informal Political Instability on GDP Growth

Informal Political Instability							
$x_{it} \downarrow$	k	λ	α	β	ϕ	γ	δ
Anti-government Demonstrations	0.004	−0.0883	0.56	0.28	−0.087	0.134	0.90
	(2.38)	(−3.69)	(4.31)	(1.61)	(−2.55)	(1.20)	−
		l=3			l=2	n=6	
Assassinations	0.008	−0.1858	0.83	0.44	−0.158	0.126	1.00
	(8.52)	(−2.33)	(3.63)	(6.02)	(−3.69)	(1.43)	−
		l=8			l=3	n=2	
General Strikes	0.012	−0.1711	0.88	0.38	−0.086	0.182	1.00
	(7.40)	(−2.69)	(6.79)	(4.90)	(−2.16)	(2.46)	−
		l=2			l=2	n=4	
Guerrilla Warfare	0.009	−0.0004	0.64	0.47	−0.008	0.227	1.00
	(3.71)	(−0.12)	(3.12)	(3.94)	(−2.40)	(1.34)	−
		l=8			l=1	n=6	
Number of Coups d'etat	0.015	−0.0744	0.86	0.10	−0.094	0.057	1.00
	(15.64)	(−8.26)	(7.89)	(1.74)	(−7.89)	(2.75)	−
		l=2			l=7	n=6	
Revolutions	0.017	−0.1853	0.68	0.24	−0.002	0.207	1.00
	(3.32)	(−4.93)	(4.93)	(2.27)	(−0.03)	(2.15)	−
		l=5			l=1	n=3	
Riots	0.012	0.0436	0.77	0.36	−0.048	0.139	1.00
	(3.17)	(1.16)	(4.30)	(2.77)	(−2.32)	(3.98)	−
		l=1			l=1	n=5	

Table 3.a reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \lambda x_{i,t-l} + \varepsilon_t,\ h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \phi x_{i,t-l} + \gamma y_{t-n}.$

$x_{i,t-l}$ is an informal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 3.b Direct and Indirect Effects of Formal Political Instability on GDP Growth

Formal Political Instability $x_{it}\downarrow$	k	λ	α	β	ϕ	γ	δ
Changes in Effective Executive	0.017 (2.65)	−0.138 (−2.00) $l=6$	0.32 (4.73)	0.73 (14.44)	−0.091 (−1.86) $l=6$	0.071 (0.65) $n=6$	0.80 −
Government Crises	0.010 (4.66)	−0.002 (−0.05) $l=2$	0.89 (6.30)	0.41 (5.63)	−0.072 (−1.63) $l=1$	0.290 (4.26) $n=2$	0.90 −
Legislative Effectiveness	0.004 (4.13)	−1.100 (−1.97) $l=6$	0.65 (6.22)	0.52 (8.56)	−0.897 (−1.72) $l=2$	0.072 (1.83) $n=6$	1.00 −
Legislative Selection	0.013 (5.98)	−1.048 (−1.09) $l=1$	0.33 (3.77)	0.64 (8.41)	−1.368 (−1.99) $l=7$	0.071 (1.49) $n=8$	0.80 −
Major Constitutional Changes	0.011 (2.48)	−0.791 (−11.27) $l=2$	0.52 (3.75)	0.57 (4.57)	0.084 (0.54) $l=8$	−0.072 (−0.91) $n=5$	0.90 −
Number of Cabinet Changes	0.003 (4.67)	−0.120 (−3.61) $l=4$	0.53 (3.99)	0.37 (6.09)	−0.271 (−5.67) $l=1$	−0.010 (−0.32) $n=8$	1.00 −
Purges	0.011 (8.40)	0.007 (1.57) $l=4$	1.08 (2.90)	0.15 (2.00)	−0.002 (−3.09) $l=6$	−0.007 (−0.12) $n=8$	1.00 −
Size of the Cabinet	0.011 (3.94)	−0.013 (−0.94) $l=5$	0.69 (5.34)	0.45 (5.09)	−0.048 (−3.51) $l=3$	0.223 (4.32) $n=3$	1.00 −

Table 3.b reports parameter estimates for the following model:

$y_t = c + k\log(h_t) + \lambda x_{i,t-l} + \varepsilon_t$, $h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \phi x_{i,t-l} + \gamma y_{t-n}$.

$x_{i,t-l}$ is a formal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 4.a The Short- and Long-run Effects of Informal Political Instability on GDP Growth

Informal Political Instability $x_{it}\downarrow$	θ	ζ	φ	α	β	γ	δ
Anti-government Demonstrations	−0.040 (−1.90) $l=1$	−0.009 (−0.27)	−0.36 (−1.73)	0.52 (3.13)	0.64 (6.51)	0.036 (0.32) $n=3$	1.00 −
Assassinations	−0.144 (−2.48) $l=6$	−0.147 (−2.21)	−0.32 (−3.26)	0.62 (4.37)	0.62 (4.83)	−0.027 (−0.58) $n=5$	1.00 −
General Strikes	−0.201 (−5.18) $l=2$	−0.073 (−0.26)	−0.32 (−4.24)	0.62 (4.40)	0.59 (5.70)	0.037 (0.79) $n=3$	1.00 −
Guerrilla Warfare	−0.005 (−0.08) $l=5$	0.064 (0.36)	−0.40 (−3.47)	0.69 (6.91)	0.46 (7.16)	0.271 (4.83) $n=4$	1.00 −
Number of Coups d'etat	−0.061 (−1.86) $l=2$	−0.031 (−2.62)	−0.44 (−3.61)	0.69 (2.73)	0.47 (2.95)	0.186 (1.53) $n=4$	1.00 −
Revolutions	−0.214 (−1.63) $l=3$	−0.109 (−2.14)	−0.55 (−6.50)	0.61 (2.79)	0.61 (6.14)	−0.053 (−0.73) $n=2$	1.00 −
Riots	−0.022 (−2.06) $l=4$	−0.006 (−0.23)	−0.34 (−3.48)	0.60 (4.47)	0.63 (6.00)	0.002 (0.05) $n=5$	1.00 −

Table 4.a reports parameter estimates for the following model:

$\Delta y_t = \mu + \theta \Delta x_{i,t-l} + \varphi(y_{t-1} - c - \zeta x_{i,t-1}) + \varepsilon_t$,

$h_t^{\frac{\delta}{2}} = \omega + \alpha \left|u_{t-1}\right|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \gamma y_{t-n}$.

θ and ζ capture the short- and long-run effects respectively. φ indicates the speed of adjustment to the long-run relationship. $x_{i,t-l}$ is an informal political instability variable.

l and n are the order of the lags.

The numbers in parentheses are t statistics.

Table 4.b The Short- and Long-run Effects of Formal Political Instability on GDP Growth

Formal Political Instability $x_{it} \downarrow$	θ	ζ	φ	α	β	γ	δ
Changes in Effective Executive	−0.117 (−1.77) $l=3$	0.023 (0.53)	−0.42 (−5.76)	0.92 (4.63)	0.38 (5.85)	0.242 (1.62) $n=6$	1.00 −
Government Crises	−0.140 (−1.86) $l=3$	0.120 (1.29)	−0.50 (−4.15)	0.94 (2.58)	0.45 (2.28)	0.081 (0.58) $n=6$	1.00 −
Legislative Effectiveness	−3.669 (−2.36) $l=5$	−1.866 (−1.68)	−0.54 (−3.51)	0.65 (3.58)	0.57 (5.24)	0.003 (0.04) $n=4$	1.00 −
Legislative Selection	−0.883 (−1.60) $l=8$	−3.441 (−1.43)	−0.53 (−5.93)	0.73 (3.62)	0.17 (2.13)	0.057 (1.51) $n=5$	1.00 −
Major Constitutional Changes	−0.049 (−3.12) $l=2$	0.018 (1.26)	−0.30 (−2.06)	1.02 (3.15)	0.45 (3.28)	0.083 (1.15) $n=4$	1.00 −
Number of Cabinet Changes	−0.067 (−1.82) $l=5$	−0.145 (−2.27)	−0.65 (−6.82)	0.24 (1.80)	0.62 (3.66)	−0.120 (−1.02) $n=8$	0.80 −
Purges	−0.013 (−1.66) $l=6$	−0.003 (−0.11)	−0.34 (−2.57)	0.57 (3.08)	0.53 (4.45)	0.121 (0.80) $n=6$	1.00 −
Size of the Cabinet	−0.035 (−3.01) $l=2$	0.005 (0.98)	−0.28 (−3.05)	1.14 (3.09)	0.41 (5.55)	−0.087 (−0.59) $n=1$	1.00 −

Table 4.b reports parameter estimates for the following model:

$\Delta y_t = \mu + \theta \Delta x_{i,t-l} + \varphi(y_{t-l} - c - \zeta x_{i,t-l}) + \varepsilon_t,$

$h_t^{\frac{\delta}{2}} = \omega + \alpha \left|u_{t-1}\right|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \gamma y_{t-n}.$

θ and ζ capture the short- and long-run effects respectively. φ indicates the speed of adjustment to the long-run relationship. $x_{i,t-l}$ is a formal political instability variable. l and n are the order of the lags.

The numbers in parentheses are t statistics.