

# Economic Growth and Financial Development: Time Series Evidence from Regime-Switching Models (Brazil, 1890-2003)

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October 26, 2018

## Abstract

This study revisits the growth-finance nexus using a new econometric approach and unique data set. In particular by employing the smooth transition framework and annual time series data for Brazil from 1890 to 2003, we attempt to address on the one side, what is the relationship between financial development, trade openness, political instability and economic growth and, on the other, how it changes over time. The main finding is that financial development has a mixed positive and negative time-varying impact on economic growth, which significantly depends on jointly estimated trade openness thresholds. Moreover our estimates highlight a positive impact of trade openness on growth but with interesting variation regarding their size and power, whereas the effect of political instability (both formal and informal) on growth is mainly negative. We also find that changes between regimes tend not to be smooth. Finally, our estimates show that in 57% of the years in which financial development has a below the mean effect, we find that trade openness experiences a substantial above the mean change.

**JEL classification:** C14; O40; E23; D72

**Keywords:** Economic growth; financial development; political instability; smooth transition models; trade openness

# 1 Introduction

Already by the end of the 1990s, the gross domestic product of the four BRIC countries (Brazil, Russia, India and China) accounted for almost a quarter of the world's total *gdp* in purchasing power parity terms. According to Goldman Sachs (O'Neil 2001) in 40 years the *gdp* of the BRICs as a whole could be larger than that of the G6. In the same report, it is noted that Brazilian economy is expected to overtake the Italian by 2025, the French by 2031 and the German and British by 2036. Brazilian *gdp* was about US\$ 2.253 trillion in 2012 making it the seventh largest economy in the world and by far the largest one in Latin America. This constitutes a remarkable transition. In the last 130 years or so, Brazil (and a handful of other emerging markets) was transformed from a poor, rural, authoritarian, and over-specialized economy to a vibrant and democratic market economy. This transition has not received the attention it deserves and, consequently, a number of important questions remain inadequately addressed and under-researched.

This paper tries to start filling these lacunae by systematically investigating the time-varying links between finance, political instability, trade openness and economic growth in Brazil from the 1890s. It uses the smooth transition framework and annual time series data for Brazil covering a very long period of time (1890-2003). The study addresses the following specific questions: What is the precise relationship between economic growth, on the one hand, and financial development, trade openness, and political instability on the other? Does the intensity and the sign of these effects systematically vary over the time? Has the transition between such possible regimes been often smooth or has it generated substantial costs and negative externalities?

Our econometric result supports as main finding the notion that development of financial institutions should occupy center stage in understanding the process of economic growth. For the case of Brazil it is found to have more direct and robust impacts than, for instance, trade openness or political institutions. Hence the paper relates closely to the literature on the finance-growth nexus. Schumpeter (1934), Gurley and Shaw (1955) and Goldsmith (1969) argue that financial development is central to economic growth, while Hicks (1969) illustrates this case by documenting that financial development drove industrialization in England by encouraging flows of capital. More recent endogenous growth scholarship concludes that the financial sector has an extremely positive role in the economy (Bencivenga & Smith, 1991). Financial development leads to more efficient allocation of resources, reduces uncertainty and transaction costs, and promotes more rapid capital accumulation and technological advancement (Roubini & Sala-I-Martin, 1992; King & Levine, 1993; Greenwood & Smith, 1997; Levine, 1997; Levine, 2005). It should be noted, however, that authors such as Gavin and Hausmann (1996), and Loayza and Ranciere (2006) argued that

in the short-run financial liberalization and expansion without any constraints could cause banking crises and thus economic collapse. Kar et al. (2011) highlight the difficulty in establishing the exact relationship between economic growth and financial development and argue that there is no clear evidence on the direction of the causality between them.

Another contribution of the paper relates to the economics of an important emerging market, Brazil. One of the most influential studies of the long-run Brazilian economic growth is de Paiva Abreu and Verner (1997). Covering a period from 1930 to 1990 they analyze the effects of various factors such as financial development, trade openness and education policies on economic growth. Their results show little evidence supporting the notion that financial development boosted economic growth. In contrast Bittencourt (2011) argued that financial development played a significant role in promoting growth in Latin America. Moreover Pinheiro and Bonelli (2005), Vale (2005), Muichos and Nakane (2006) and Stefani (2007) examined the relationship between financial development and economic growth in Brazil and found that a strong positive relationship exists between financial development and output growth.

This paper uses a new econometric approach to these issues, namely the smooth transition framework, which allows us to examine positive and negative effects jointly. We find that financial development has a mixed positive and negative time-varying impact on economic growth, which significantly depends on jointly estimated trade openness thresholds. As far as trade openness is concerned there is a positive effect on growth throughout the period, albeit we identify periods where this impact is either high or relatively low. Finally, with respect to the impact of political instability, both informal and formal, on output growth, this is mainly negative, with the interesting exception of the revolutions where a mixed time-varying relation was detected.

This paper is organized as follows. Section 2 presents a brief early economic and political history, which explains the economic performance of Brazil from 1890 to 2003. Section 3 provides details and justification for our econometric methodology and Section 4 describes the data. Section 5 presents our results and finally Section 6 concludes and suggests directions for further research.

## **2 Background: History of Trade and Political Instability in Brazil**

In this Section, we will record briefly the early political and trade history of Brazil. The recorded history of Brazil (the name stands for brazilwood, source of red dye) began with the arrival of Portuguese sailors. Brazil was ‘discovered’ on April 21<sup>st</sup> 1500 by Portuguese commander Pedro Alvares Cabral, who was

appointed by Manuel I (King of Portugal and Algarves). The treaty of Tordesilhas of 1494 divided the discovered South American continent between Portugal and Spain and assigned to the first a considerable part of modern Brazil (which in 1494 was still undiscovered). Modern Brazil is the world's fifth largest country. However, during the first 200 years after its discovery, Brazil was not so crucial for the economic and strategic interests of the Portuguese empire and the crown. Nevertheless, Amazonian drugs, gold, diamonds, sugar and the slave trade were some of the most important commodities that the young colony offered to the Old World. The discovery of gold and diamonds in 1695 and 1729 accordingly in the area called Minas Gerais was a nodal point, since the Portuguese changed the capital from Salvador to Rio de Janeiro, which was closer to the gold and diamond mines and had a port and a bay, which were easier to defend. The transition from sugar to gold resulted in a smooth change in domestic elites (from sugar to gold based ones)<sup>1</sup>.

In the following paragraphs we will cover the period 1890 to 2003 from an economic and political point of view as well, stressing both financial development and political instability.

#### *Late 19<sup>th</sup> and Early 20<sup>th</sup> Century*

The military started to express its opinion publicly and to debate government policies in 1879. More specifically the latter supported education, industrialization, abolition of slavery, regeneration of the nation and guarding of the fatherland, the so-called *solider citizen*, by proclaiming them as agents of social change. Under Deodoro's orders, on November 15<sup>th</sup> 1889, the army captured the Royal Palace, the main government building and silenced Rio de Janeiro. Using a strict authoritarian tone the Marshal of the general order announced to the surprised nation that from then on the empire belonged to the past. The day after November 15<sup>th</sup>, Deodoro declared Brazil a federal republic. The period that followed, the First Republic (1889-1930), was characterized by political unrest as well as the politics of coffee with milk (known as *cafe com leite*), a combination of the São Paulo coffee and the Minas Gerais milk political elites. The main target of the First Republic was to balance the power between the two oligarchic elites (that of coffee and milk) and the army. However, the problems of the oligarchic system developed further. More specifically the 'Tenent Revolt' of 1922 and 1924 rocked the interior of Brazil.

#### *1930s and 1940s*

During the Great Depression of 1929, coffee exports were brought to a deadlock, while the Paulista regime hooked up to power, resulting in the end of the politics of coffee with milk agreement. In 1930, the situation got out of control, where gun assassinations and revolutions took place (for example the Revolta da Princesa outburst in the Northeastern state of Paraíba and the assassination of João Pessoa,

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<sup>1</sup>For more information for the early and mid-19<sup>th</sup> Century see Appendix C.

governor of Paraíba occurred. Shortly after Pessoa's death, more riots followed, including the Revolution of 1930, on October 24<sup>th</sup> 1930).

Getúlio Vargas, after failing to be elected as president in 1930, led a revolt that placed him in power. From 1930 until 1934 he ruled Brazil as a dictator, from 1934 to 1937 he was elected as president and then again as a dictator from 1937 to 1945. Under the Estado Novo (1937-1945), among others, state autonomy ended, all political parties were dissolved and governors were replaced until 1944 (see Hudson, 1998). After 1945, Vargas still served as a senator until 1951, when, after general elections, he was elected president, a position which was held by him until 1954. Hence Getúlio Vargas played a central political role in Brazil for nearly 24 years. According to Maddison (1995), during the Vargas era (and up to 1980) the economic growth of Brazil was among the highest in the world. The Vargas years had a significant impact on national politics and economics. Even in the 1990s, the local political leaders were still called *colonels*. During his era, reorganization of the armed forces, the economy, international trade and foreign relations took place. The average annual *gdp* growth rate during that period was 4%. Finally, the 1930-1945 period added a new term to the Brazilian political lexicon, that of corporatism<sup>2</sup>. Vargas committed suicide on August 24, 1954. However, his influence in Brazilian politics remained indelible for decades (Hudson, 1998). Thus during the 1930s and 1940s Brazil was characterized by significant political unrest.

#### *1950s and 1960s*

If corporatism was the benchmark of the 30s and 40s period, populism, nationalism and developmentalism dominated the two following decades (50s and 60s). Each of these terms contributed to the crisis that occurred in Brazil, which resulted in the authoritarian regime that occurred after 1964. By the early 1960s, Brazilian society was boiling. Labor classes became more and more active seeking a better future, and the population continued to grow beyond the state's capability to increase educational and social services. As a consequence, the conservative elites alongside the middle classes, which tended to follow the elites' vision considering the lower classes as a threat, feared that they were going to lose control of politics and of the state. It was the same elites that opposed Vargas due to his intention to use the state for a fairer distribution of resources. During the period 1956-1961 Juscelino Kubitschek (who was the only post Vargas elected president to serve a full term) promoted the establishment of an automotive industry, which could help Brazil to overcome the economic stagnation. The new factories produced 321,000 vehicles in 1960. Among his legacies are the world's eighth largest automobile production and a great highway network of the late twentieth century. Constant motorized advancement in farm equipment and changes in transportation transformed the vast countryside areas of Mato Grosso and Goiás, making

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<sup>2</sup>The term developed mostly in Italy under Benito Mussolini. Corporatism is a concept opposite to that of Marxism and Liberal Democratic political philosophies.

Brazil the world's number two food exporter. All these led the overall economy to grow by 8.3% a year. Hence there might be some truth in Kubitschek's motto *Fifty Years of Progress in Five* (Hudson, 1998).

Brazil of 1960 was completely different from that of 1930. The population reached 70 million from 34 million in 1930, with 44% residing in urban areas. Life expectancy increased as well. The number of workers increased from 1.6 million in 1940 to 2.9 million in 1960, an approximate 100% increase in 20 years. The share of industrial productivity as a percentage of *gdp* was higher (25.2%) than of agriculture (22.5%). From the other side the annual rate of inflation kept rising from 12% in 1949 to 26% in 1959 and to the shocking 39.5% in 1960. Savings depreciated, lenders' unwillingness to offer long-term loans that are essential for investments, high interest rates and the government's refusal to comply with the International Monetary Fund (IMF) conditions created a negative environment among the people. The high differences between poor and rich remained, with 40% of the national income to be enjoyed by 10% of the population, 36% going to the next 30% and the remaining 24% distributed to the remaining 60% of the population. Struggling to maintain control, the government of João Goulart<sup>3</sup> in a huge rally in Rio de Janeiro on March 13<sup>th</sup> 1964 attempted to promote reforms. An opposition rally held six days later in São Paulo put 500,000 people on the streets. Rio de Janeiro's *Correio da Manhã* (a daily newspaper of Rio de Janeiro) published an unusual front cover with the headline *Enough* whereas the next day's front cover had the title *Out*. In the next few days the military intervened to secure the country and Goulart fled to Uruguay. The period of the military republic (1964-1985) had begun. Summarizing, the 1950s and 1960s periods were marked by high political instability, which in turn affected the level of the trade openness of the Brazilian economy in different ways.

### *1970s and 1990s*

As with the previous regime changes of 1889, 1930 and 1945, the coup of 1964 divided the military into two groups. The first one included those who believed that they should focus on their professional duties and the second group, the hard-liners, who believed that politicians were betrayers that would deliver Brazil to communism. The dominance of the hard liners' opinion led Brazil into what a political scientist (named Juan J. Linz) defined as *an authoritarian situation*. In 1983 the economy was running with average *gdp* growth of 5.4%, but the importance of this was diminished by the rising inflation and the weak and disheartening political leadership. Millions of Brazilians went out to the streets in all major cities demanding a direct vote (*diretas ja*). In April 1984, Congress failed to achieve the necessary numbers in order to grant the people's wish and the choice was left to an electoral college. On January

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<sup>3</sup>Vice President, a populist and a minister of labor under Vargas, he won the presidency on the 7<sup>th</sup> of September 1961 until the 1<sup>st</sup> of April 1964 when he left power.

15<sup>th</sup> 1985, the electoral college elected Tancredo Neves of Minas Gerais. Similarly to the regime changes of the previous years (namely that of 1822, 1889, 1930, 1946 and 1964) the 1985 change would prove to be full of obstacles as well. Some years later it was Fernando Collor de Mello's turn to rule the country (in office from 1990 to 1992). Mello was the first Brazilian president elected directly by the people. During his term in office he attempted to control hyperinflation and started a massive program of privatization of state-owned firms. His tenure ended in 1992 with the presidency of Itamar Franco, who stayed in power until 1995. The last five years of the 20<sup>th</sup> century found Fernando Henrique Cardoso in office, whose administration was characterized by the promotion of human rights in Brazil.

To sum up, the period since 1890 is a significant era for Brazilian history since the country experienced significant economic and political expansion, being transformed to an emerging market and forming one of the BRIC countries. However, there is an ongoing debate which tries to identify the key factors that are responsible for this astonishing route. Financial development, trade openness and macroeconomic stability are the main factors that most of the previous literature pays attention to. This paper will attempt to shed light on the main causes of economic growth since there seems to be a dissatisfaction within the empirical growth literature. Using data that cover a period from 1890 to 2003 we will try to explain (under a smooth transition approach) the role that financial development, trade openness and political instability played in economic growth and the transformation of Brazil in general (for a brief review of the main political events\periods in the history of Brazil see Table B1 in the Appendix B).

### 3 Econometric Framework

Non-linear models have attracted the interest of more and more researchers in recent years. Chan and Tong (1986) introduced the threshold autoregressive (TAR) models. Then Teräsvirta (1994) suggested a specification technique of three stages, assuming that if the process is not linear, then the alternative might be a smooth transition autoregressive (STAR) model, which captures regime-switching behavior. The first stage of the estimation procedure is to identify a linear autoregressive model. The second focuses on testing linearity for different values of  $d$ , the delay parameter, and the third one on choosing between an exponential STAR (ESTAR) or a logistic STAR (LSTAR) by testing a sequence of three hypotheses (see Teräsvirta, 1994). Nevertheless, initial estimation of both models and the usage of post-estimation information criteria could provide us with the final choice between the models, Teräsvirta (1994). The STAR model for the economic growth series  $y_t$  is given by

$$y_t = \phi_1' \mathbf{x}_{t-l} + \phi_2' \mathbf{x}_{t-l} G(s_{t-d}) + \epsilon_t \quad (1)$$

where  $\mathbf{x}_{t-l} = (1, x_{2,t-l}, \dots, x_{4,t-l})'$  is the  $4 \times 1$  vector of the constant and the three explanatory variables,  $\phi_i = (\phi_1^{(i)}, \dots, \phi_4^{(i)})'$ ,  $i = 1, 2^4$ , are the  $4 \times 1$  vectors of coefficients, and  $G(s_{t-d})$  is the transition function (see eq. 2 below), which changes smoothly from 0 to 1 as the transition variable  $s_{t-d}$  increases; the term  $d$  determines the lag-length of the transition variable and  $\{\varepsilon_t\}$  are independently and identically distributed (*i.i.d.*) random variables. Here we use the first order logistic function, which is defined as:

$$G(s_{t-d}) = \frac{1}{1 + e^{-\gamma(s_{t-d}-c)}}, \quad (2)$$

where  $\gamma$  determines how smooth the change in the value of the logistic function is (and hence the transition from one regime to another) and the intercept  $c$  is the threshold between regimes. In eq. 2, when the smoothness parameter becomes very large ( $\gamma \rightarrow \infty$ ) then the transition is abrupt. When  $\gamma \rightarrow 0$  the logistic function approaches a constant. Thus when  $\gamma = 0$  the LST model reduces to a linear one. However, previous research shows that the transition parameters  $\gamma$  and  $c$  are quite difficult to estimate (see Teräsvirta, 1994). Following Teräsvirta (1994) we test whether the non-linear model is preferred and if the use of the logistic function is warranted.

## 4 Data

Our data set contains annual data of economic growth, financial development, trade openness and political instability for Brazil between 1890 and 2003, excluding the World War years. The main data source for the first three series is Mitchell (2003), (see Figures A.1 and C.1 in the Appendix A and C respectively). Economic growth is measured as annual growth rates of gross domestic product (*gdp*). Our three measures of financial development consist of commercial bank deposits (*cbd*), deposits at Banco do Brasil (*dbb*) and money supply (*m1*). *Cbd* is defined as the sum of time deposits in commercial banks and deposits at the end of the period in commercial banks over *gdp* and alongside *dbb* it tries to capture the efficiency of the financial sector and not its relative size. Data have been reported by Mitchell (2003) but due to missing values we follow the approach of Pelaez and Suzigan (1976) to reconstruct the series. The second financial development indicator is the ratio *m1* over *gdp* (retrieved from Mitchell, 2003). One potential drawback of this measure is that the ratio reflects the depth or the relative size of the financial system and not its efficiency. The third and final one, *dbb*, is measured by the added value of time deposits and deposits at the end of the period in the central bank over *gdp*. Given *m1*'s and *dbb*'s more restrictive nature we use both of them as a robustness check of our results and thereby we attach greater weight to commercial bank deposits.

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<sup>4</sup>where superscript  $i$  in parentheses denotes an index.

As far as trade openness is concerned we use the standard ratio of exports plus imports as a share of *gdp*. The idea that trade liberalization is the horsepower of growth has its roots back in Adam Smith. Among others Krueger (1978) and Wacziarg and Welch (2008) argued that trade openness does indeed lead to higher growth rates. The IMF (1997) has stated that policies favoring international trade are among the most significant elements in promoting economic expansion and convergence in developing countries. In addition, a report from the OECD (1998) concluded that more open and outward oriented economies tend to surpass countries with restrictive and more isolated trade policies. Finally, Fischer (2000) during a lecture (for further information see Rodriguez and Rodrik, 2001), argued that the optimal way for a nation to grow is to harmonise its policies with the global economy. However, these arguments were lacking general approval especially after the Great War in developing countries and in particular Latin America, which very often adopted the so-called Import Substitution Industrialization policies, which imposed barriers on international trade. The outbreak of World War II turned Latin America back to protectionism and to high tariff policies and it was not until the 1990s when liberal policies took effect (Edwards, 1994). This paper tries to capture these changes in trade policies by using trade openness as the transition variable in the case of Brazil for the following reasons. Brazil is the most advanced industrial economy in South America (Pereira et al., 1993). According to the United Nations' statistical agency<sup>5</sup> it is a major exporter of iron ore and concentrates, petroleum oil, soya beans, coffee and processed meat, and it is involved in the manufacture of small aircraft. Finally, the importance of trade policies for successive Brazilian governments is apparent from: the fact that its patent law dates back to 1809 (in contrast to Germany, where it only appeared 70 years later); their participation in every international conference associated with intellectual property rights since that time; and the signing of the founding declaration of GATT (General Agreement on Tariffs and Trade) in 1947 (Lattimore and Kowalski, 2009).

The data we use for political instability measures constitutes one of the main contributions of this paper. We use a taxonomy of political instability divided into two categories, informal and formal (Campos et al., 2012). Formal political instability originates from within the political system, informal from outside. Arthur Banks' Cross National Time Series Data Archive (CNTS) consists of our starting point as the source of historical annual data for the various types of political instability. The informal political instability measures consist of: the number of demonstrations (*dem*), defined as peaceful public gatherings of at least 100 people; revolutions (*rev*), representing illegal or forced change in the top governmental elite, attempts at, or successful or unsuccessful armed rebellion; the number of strikes (*str*) of 1000 or more workers involving multiple employers and aimed at government policies; and coups d'état

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<sup>5</sup>For further information regarding Brazil's profile please check the: <http://comtrade.un.org>

(*coup*) measuring the number of overthrows/sudden and forced seizure of the government (see Figures A.2 and C.2 in the Appendix A and C respectively).

Formal political instability is measured by: purges (*pur*) including any systematic elimination by jailing or execution of political opposition within the ranks of the regime or the opposition; the number of constitutional changes (*cc*) including governmental crises; legislative selections (*ls*) taking the value 0 when no legislature exists, the value 1 in the case of nonelective legislature<sup>6</sup> and 2 when legislators or members of the lower house in a bicameral system are selected by means of either direct or indirect popular election; and legislative elections (*le*) defined as the number of elections for the lower house each year (see Figures A.3 and C.3 in the Appendix A and C respectively).

For these formal and informal political instability variables, Banks data (2005) do not exist for the pre-1918 period. For the creation of this new data set of political instability measures, all suitable political events from years 1890 to 1939 were recorded and grouped into different forms of political instability (see Campos et al., 2014). We then took advantage of the intentional overlap between the series during the period 1919 to 1939 to assess whether or not the new dataset was reliable. We find that there are a few cases where there is little difference between the two series and hence argue that the new data set is as reliable as the CNTS data.

Results from the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests are presented in Table C1 in the Appendix C. Both suggest that either the level of the series or their first differences are stationary. In addition, unit root tests with breaks [provided by Zivot and Andrews (ZA), 1992 and Lumsdaine-Papell (LP), 1997] have been conducted (see Tables A.1 and A.2 in the Appendix A). For *gdp* and informal and formal political instability the unit root hypothesis is rejected at either the 1%, 5% or 10% level in all cases (with the exception of *le*, which fails to reject the unit root hypothesis when we allow for a break in the trend: see Table A.1 in the Appendix A). Regarding the two financial development measures *cbd* and *dbb*, the results fail to reject the unit root hypothesis in the case of the ADF tests, while they rejected the unit root in the case of the PP, the ZA as well as the LP tests (see Tables A.1 and A.2 as well as C1 in the Appendix A and C respectively). Due to the aforementioned incongruity we use the first difference of the series where the results from both the ADF and the PP tests reject the unit root hypothesis (see Table C1 in the Appendix C). As far as the *m1* and *to* are concerned the ADF and the PP tests do not reject the unit root hypothesis for the level while both tests rejected it when the first differences of the series were considered (see Table C1 in the Appendix C). Therefore for all the three measures of financial development (*cbd*, *dbb*, *m1*) and for *to* we employ first differences.

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<sup>6</sup>An example could be the selection of legislators by the effective executive, or by means of heredity or ascription.

## 5 Empirical Results

### *The Transition Model*

In this section we use the smooth transition approach to investigate the relationship between economic growth, financial development and political instability with the level of trade openness in the economy as the transition variable. The economic history of Brazil demonstrates the close relation between trade openness and economic growth (Baer, 2013), so this is clearly the most intuitive choice for our transition variable. The reasons for the choice of trade openness as our transition variable are not just easily found in economic history but this choice is also fully supported econometrically by standard linearity tests. In particular, when *cbd* and *dbb* are used as the transition variable the rejection of the linearity hypothesis fails (from now on LM<sub>2</sub>) to occur in the majority of the cases, 9 out of 12 (see Tables A.3a and A.3b in the Appendix). The reason why we do not test linearity using political instability as the transition variable is simply because our measures display (in most of the cases) the characteristics of a binary variable (taking either the value 0 or 1) and thus show very little time variation. Hence we could say that linearity rejection shows homogenous behavior only when we use trade openness as the transition variable (where linearity rejection occurs in all models).

### *Logarithmic versus Exponential*

A range of linearity tests suggest the use of logistic instead of the exponential function (see Tables A.4 and A.6 and C.2 in the Appendix A and C). The only case in which an ESTAR is the preferred choice is when legislative elections serve as the political instability measure (see Tables A.6 and C.2 in the Appendix A and C respectively). However, based on Teräsvirta (1994) the choice between the two functions could be postponed until after both types of models are estimated and evaluated using post-estimation criteria. In our case an LSTAR model seemed more appropriate<sup>7</sup>. We use the RATS software to estimate equations (1) and (2) above.

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<sup>7</sup>This choice was derived from postestimation Ljung and Box (LB) statistic for residual autocorrelation and on the basis of the minimum value of Akaike information criterion (AIC).

### *The Lag Order*

As noted in Section 3, Teräsvirta (1994) argued that specifying a linear autoregressive model constitutes the first stage of the estimation procedure. A common way would be the usage of the AIC or the Schwarz information criterion (SBIC) in order to select the appropriate lag structure of the model. However, a choice based on SBIC could lead to too parsimonious models since the estimated residuals derived from the selected model are not free from serial correlation. Hence, models suggested by any information criteria should be followed by a test of residual serial correlation, for instance the LB portmanteau test. In addition, Luukkonen and Teräsvirta (1990) stressed that (they examined the case of US unemployment) the linearity might be rejected when the lag length is increased, which indicates on one side the significance of longer lags in explaining nonlinearity and the weakness of shorter ones on the other side. We select the optimal lag length ( $l$ ) that rejects stronger linearity, that is, for financial development measures  $l = 3$ , while for demonstrations, strikes, coups, purges and legislative elections  $l = 4$ . For trade openness, revolutions, constitutional changes and legislative selections the selection of  $l = 4$  was made on the basis of the minimum value of LB and the General to Simple (GS) information criterion (see Table A.7 in the Appendix A). Finally, a portmanteau test, namely the LB was conducted to control for residual autocorrelation in our model and hence possible misspecification. The results indicated no residual serial correlation (results not reported but are available upon request).

### *The Delay Parameter*

The choice of the delay parameter is determined by the strongest linearity rejection relative to different values of  $d$ . Accordingly, we set  $d = 4$ . The vector of explanatory variables, for our models of Table 1 below (see also Tables C.3 and C.4 in the Appendix C), contains the drift, the third lag of the three financial development measures ( $fd$ ) and the fourth lags of the various measures of political instability ( $pi$ ), and trade openness ( $to$ ). That is,  $\mathbf{x}_{t-4} = (1, fd_{t-3}, pi_{t-4}, to_{t-4})$ . The preferred model was the one with  $\phi_4^{(2)} = 0$  and where the regime indicator variable  $s_{t-d}$  was chosen to be  $to_{t-4}$ .

Table 1, 2 and 3 report the baseline results. In order to calculate the time-varying effects of financial development trade openness and political instability on growth we use the three equations C.1, C.2 and C.3 provided in the Appendix C.

## 5.1 Commercial Bank Deposits

### 5.1.1 The Impact of Trade Openness

First notice that there is a positive and statistically significant (see the coefficient  $\phi_4^{(1)}$ ) time-varying relationship between trade openness and economic growth in all models of Table 1, except in the case when  $le$  is the political instability measure, where the link is positive but statistically insignificant. Notice from Figure C.4 (see also: equation C.1 in the Appendix on how we calculate this effect, the parameter estimates of Table 1, the summary Table 2 below and Figure C.4 in the Appendix C) that there are periods where the size of the positive effect of trade openness on growth is high and some periods where it is relatively low (though still positive). In the analysis below we will focus on the dates\periods where trade liberalization displayed low values, which in turn might explain the low size effect of trade openness on growth (see Figure C.4 in the Appendix C).

#### *First Period of Low Size Effects: 1893*

From our results it follows that the first period where the low size effects of trade openness on growth took place was during 1893. Political instability and violence during the first years of the First Brazilian Republic created a negative macroeconomic environment for the Brazilian economy, which might explain low levels of trade openness. The main source was the fight for power between different elite groups that had contrasting visions regarding the government model and the role of the military in society. After the adoption of the new constitution of 1891 (which established the Republic of the United States of Brazil and adopted the US system of governance) Deodoro da Fonseca and Floriano Peixoto were elected president and vice president respectively, with the former receiving 123 votes and the latter 153. However, after difficulties that the president (Deodoro da Fonseca) faced in sharing power with the Congress, he dissolved it in November 1891, simultaneously encouraging revolts in the navy and in the Rio Grande do Sul (a state in the southern part of Brazil, which is the ninth largest by area and the fifth most populous region). One of the most cruel revolts was the one that broke out in Rio de Janeiro in September 1893, the well known Revoltas da Armada (Brazilian Naval Revolts), which could constitute an extra cause of low trade liberalization levels (see Appendix C for more details).

#### *1908 to 1910*

The second period of reduced trade openness size effects on growth occurred from 1908 to 1910. Events that might explain low trade openness during that period are the following. In 1906, the Taubate Convention was signed, in which it was proposed that the government should buy the excess coffee production at a price which would be at a minimum pre established level, and that it should restrict the

production of low-quality coffee, stimulate internal consumption, and promote the product abroad. It was the first trade intervention policy following the coffee crisis of 1902 (Luna and Klein, 2014). The aim of this Treaty was to mitigate the problems caused by the excess stock of Brazilian coffee. By 1906 Brazil was producing alone all the quantity that the whole world was consuming in a year. The significance of the coffee economy can be seen by the fact that it represented more than half of Brazilian exports, defining it as the main economic activity of the country. Although the government politics until that time were in favor of free trade, they were forced to implement policies that had a negative impact on trade liberalization during the period 1908 to 1910.

#### *1929 to 1933*

The third period covered the years from 1929 to 1933, namely the Great Depression. The US stock market collapse of 1929 affected Latin America severely. Specifically in the case of Brazil the political repercussions of the revolution of 1930 (under Getulio Vargas) put an end to the Old Republic. In the field of the economy, the Depression had a severely negative impact on Brazil's exports, whose value fell from US\$ 444.9 million in 1929 to US\$ 180.6 million in 1932 (Baer, 2003). This fall in export earnings combined with the large amount of foreign exchange that the country needed in order to serve its external debt forced the government to take actions. Accordingly, after a devaluation of the currency, the cost of imports increased and hence the value fell from US\$ 416.6 million to US\$ 108.1 million (or by 75%). The combination of the aforementioned events (reduction in exports and imports) caused a drop in the level of trade openness that may explain the low levels of the size effect of trade liberalization on growth.

#### *1947 to 1954*

The fourth period where trade liberalization size effects on growth were low covers the period from 1947 to 1954 (with the exception of 1948 and 1950, see Figure C.4 in the Appendix C). The years after the second war and up to 1962 were marked by severe Import Substitution Policies (ISP). From 1947 exchange controls were introduced that lasted up to 1953. The overvalued cruzeiro<sup>8</sup> encouraged imports, which were boosted by the outbreak of the Korean war as well (Baer, 2003). Hence ISPs were considered to be an antidote to the aforementioned exchange controls by keeping the economy protected and relatively closed. Notably our results suggested a significant drop in the effect of trade openness on growth from 1951 to 1954 (when the ISP's launched). An additional occasion that might have kept trade liberalization at low levels might be when Getúlio Vargas, the Brazilian president as of 1951, tried to re-boost the weak economy<sup>9</sup>.

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<sup>8</sup>The currency of Brazil from 1942 to 1986 and from 1990 to 1993.

<sup>9</sup>It was 3<sup>rd</sup> of October of 1953 when Petrobras was established. Petrobras is a multinational energy company with headquarters in Rio de Janeiro of Brazil.

### *1969 to 1973*

An exception to the rule was the period from 1969 to 1973, where, despite the fact that we detect low size trade openness effects on growth, the history suggests that the aforementioned period was characterized by spectacular growth as well as by the increased levels of trade openness. In particular only in that period was the average annual growth of *gdp* around 11%, with that of industry reaching 13%. After years of ISPs, timid openings in trade policies occurred from 1967 to 1973 (Braga and Tyler, 1990). Policy makers realized that growth without opening in trade cannot be sustainable. Among these measures were included modifications in the exchange rates policies, the introduction of export incentives and the relaxation of the import obstacles. Following *gdp*'s upward trend, exports increased from US\$ 1.4 billion in 1963 to 6.2 US\$ billion in 1973 while imports in the same period rose from US\$ 1.3 billion to US\$ 4.4 billion (Hudson, 1998).

### *1974 to 1980 and 1982 to 1989*

The year 1974 and the period from 1978 to 1980 is the sixth period where low size trade openness effects (on growth) were observed. This might be attributed to events that reduced the level of the trade liberalization such as the oil shock of 1973 (for further information see also Appendix C), which might have resulted in reductions of terms of trade (this period covers from 1974 to 1980 and it is known as the period of growth with debt).

The penultimate period of low size trade liberalization effects was from 1982 to 1989 (with the exception of 1988, when the new constitution institutionalized the first presidential election directly from the people since 1960). While the economy tried to cope with the first oil shock in 1973 a second one in 1979 doubled the price of imported oil in Brazil and worsened the balance of terms of trade even more. The debt crisis and the Lost Decade (1979-1989) had just started. The reaction was the same as with the first oil shock of 1973. The policy makers increased borrowing from abroad and further import tariffs were imposed (which worsened the trade openness).

### *1993 to 1999*

Finally, the last period of constraint size effects of trade openness on output growth was during 1993 and from 1996 to 1999 (see Figure C.4 in the Appendix C). The series of events and policies listed below might be responsible for low trade liberalization levels and possibly, therefore, for the low size effects of trade openness on growth. In particular, after the constitution of 1988, the first presidential election since 1960 was held in 1989 appointing Fernando Collor de Mello<sup>10</sup> as the first president elected by

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<sup>10</sup>a former governor of Alagoas, located in the Northeast region and member of National Reconstruction Party (NRP) at that time.

the people after 30 years of military regimes. Collor de Mello was considered the solution to Brazil's economic difficulties. Despite the government's efforts to control hyperinflation and to heal the almost bankrupted public sector, inflation continued to run with rates higher than 30% a month, the levels of productivity gains were relatively low and real exchange rate appreciation, which lowered the degree of competitiveness, was observed in Latin America during 1993 (where our results indicate low trade openness size effects), Edwards (1994). In the following year the implementation of the Real Plan (Plano Real), despite its successful attempts to maintain inflation rates at lower levels, could not do much in terms of the real exchange rate appreciation that occurred. Hence the Brazilian products became more expensive and less competitive, which in turn contributed to higher current account deficits. The situation became worse when the policy of overvalued inflation rate as a stabilization tool between 1994 and 1998 was implemented by the government. The burden of these deficits became even heavier when the Asian financial crisis in 1997 and the default of Russian bonds in late summer of 1998 broke out. It was a blow to investors' confidence in emerging markets (where Brazil's exports to East Europe and Asia fell by 11.4% and 27.4% respectively, while globally they shrank by 3.5% between 1997 and 1998, see Averbug, 1999)<sup>11</sup>.

### 5.1.2 The Effect of Political Instability

Regarding the time-varying impact of political instability (either informal or formal) on economic growth the results show that it is mainly negative throughout (see additionally: the parameter estimates of Table 1, equation C.2 in the Appendix C on how we calculate this effect and the summary Table 2 below). The only exception are revolutions, where the impact on growth seems to be mixed (positive effect in 60 out of 104 cases\years) whereas that of *cc* is statistically insignificant. According to Stokes (1952) since 1900 and up to 1950 Latin American governments were overthrown by revolts seventy six times, and nobody knows how many unsuccessful attempts occurred during those years. In the analysis below we will focus on the most important periods when revolutions displayed a positive effect on economic growth.

#### *1899 to 1902 and 1920 to 1926*

The first period with a positive size effect of revolutions on economic growth was from 1899 to 1902. During that period events of great political and economic importance took place, which might explain this positive effect. More specifically, the last decade of the 19<sup>th</sup> century was marked by countless political rebellions (two naval revolts in 1891 and 1893-1894, the Federalist Riograndense Revolution of 1893-95 and the war of Canudos in 1896-97) and a major economic bubble called Encilhamento. The

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<sup>11</sup>For more details see Appendix C and in particular page 49.

devastated economy was in the hands of Manuel Ferraz de Campos Sales (the Old Republic's first civilian government), ex minister of Justice in Deodoro's provisional government, where he fulfilled his duties successfully (Bello, 1959). Campos Sales's non inflationary policies and drastic but harsh measures at the financial level allowed the Brazilian economy to recover and to avoid the danger of bankruptcy. Notably even the Rothschilds (a well known international banking family) were applauding Campos Sales's efforts in the field of the economy at the end of his term of office (Bello, 1959).

The second period covers the years from 1920 to 1926 (with the exception of 1923). After the end of the first War and the signing of the Treaty of Versailles in 1919, Brazil was faced with events of great importance (which might explain this positive link) such as the Bolshevik Revolution in Russia in 1917, which was welcomed very enthusiastically by the Brazilian elite of the labor movement (Alexander and Parker, 2003) and considered by many as the harbinger of subsequent changes. Furthermore, during 1922 and later from 1924 to 1927 the Revoltas Tenentistas (Tenente Revolt) outbreak took place. The revolt was orchestrated by low rank officers demanding, among others, significant reforms in the agricultural sector, nationalization of the mines and modernization of the society. Despite the fact that it was unsuccessful it opened the way for the Revolução de 1930 (Revolution of 1930), which ended the era of the Old Republic and paved the foundations of the reinvention of the Brazilian economy (with the Constitution of 1937, for more see Appendix C).

#### *1930 to 1938 and 1948 to 1958*

The next nine years (1930-1938) marked the end of the Old Republic and the beginning of the Vargas Era. During most of that period (excluding the years 1931, 1933 and 1935) our results indicate a positive link between revolutions and economic growth. This might be explained by the fact that the leader of the country (at that period) Getúlio Dornelles Vargas was to leave his footprint on Brazilian political and economic life for the next 15 consecutive years. More specifically he attempted (using his populist rhetoric) to stimulate the middle class by converging the interests between the Paulista coffee oligarchy and the bourgeoisie. With his policies, especially from 1930 to 1934, he favored Brazilian manufacturers, since the traditional elites had little interest in promoting the interests of the former (industrial/manufacturers interests) during the previous years. Influenced by the Revoltas Tenentistas mentioned before, he implemented a program of social welfare and reforms that were in parallel with the New Deal (a series of reforms over the period 1933-1938, which were focused on the 3 Rs, Relief, Recovery and Reform. These reforms were the response of the American government under Franklin D. Roosevelt to the Great Depression) in the United States of America, promoting a benign macroeconomic environment that boosted growth. Sharing the dream of the New Deal, Vargas attempted to mitigate

the differences between capital and labor (for more see Figure C.4 and Appendix C).

The fourth period when revolutions had a constructive effect on growth was during 1948-1958 (excluding 1951 and 1954). Following the resignation of Vargas in 1945 the second Brazilian Republic (1946-1964) began. History shows that during that period a series of constructive events took place (among others Dutra's and Kubitschek's presidency). In particular it all started when Eurico Gaspar Dutra (1946-1951) took control of the country. Dutra's period of administration was marked by a sequence of significant reforms and actions that favored economic growth, such as the establishment of the 5<sup>th</sup> Constitution<sup>12</sup>, the strengthening of the relations between US and Brazil, the breaking of diplomatic relations with the USSR and the implementation of the Salte Plan, which incorporated reforms in basic economic sectors such as transportation, energy, food and health. Among others more than 4,000 new schools in rural areas were founded, railways were expanded and improved as were roads connecting Rio de Janeiro with Salvador and Sao Paulo (Hudson, 1998). Finally, the average growth rate during his term was around 7.20% (according to ipeadata) and 8.06% from 1948 to 1950 (where our results report positive impact of revolutions on *gdp* growth). In the following years (1952-1953) Brazil continued to experience high growth rates as a consequence of the political reforms that Dutra established. The economic success of the country continued as well during the presidency of Juscelino Kubitschek de Oliveira (1956-1958), who was the only post-Vargas era president that managed to remain in office for a full term of five years. His term was characterized by political stability and respect for democratic principles. Kubitschek's political legacy was represented by the Plano de metas (*Goals' Plan*) comprising 31 goals.

#### *1975 to 1978 and 1994 to 1995*

The penultimate period where the revolutions seem to have had a positive influence on economic expansion was from 1975 to 1978, during the Brazilian (economic) Miracle<sup>13</sup>. In particular, at that time Ernesto Beckmann Geisel came to the presidency with Medici's approval. He was the second president appointed by the military junta of 1969. Despite the oil shock of 1973 he sought ways to sustain the high economic growth rates of the previous years. In particular during Emilio Garrastazu Medici's term the economy was growing at an average of 11%. This period is well known as The Brazilian Miracle, which might explain why revolutions had a positive link with output growth during that period (for more details see Appendix C).

Concluding with our analysis related to political instability, the final period when revolutions contributed towards growth was from 1994 to 1995 during Itamar Augusto Cautiero Franco's leadership

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<sup>12</sup>The first constitution that provided full political freedom, even for the banned Communist Party and the last one that officially used the name Estados Unidos do Brasil (United States of Brazil). One of the key points of the new constitution referred to postal privacy and the prohibition of entering houses by the police without permission.

<sup>13</sup>see Figure C.4.

(who was the last non-elected president of Brazil and the one that restored political stability). During his term a series of actions (for example, the free trade zone in South America could be credited to his administration) and policies led to the economic recovery of Brazil, hence possibly explaining why the revolutions displayed a positive link with economic growth during the aforementioned period.

### 5.1.3 The Impact of Commercial Bank Deposits

Our principal findings refer to the financial development, (Figure C.4 shows our estimates for this mixed time-varying relationship); notwithstanding the annual frequency, we estimate a negative effect in 56 cases (years) out of 104 (see: formula C.3 in the Appendix C on how we calculate this effect, the parameter estimates of Table 1, the summary Table 2 below as well as Figure C.4 in the Appendix C). While previous research argues in favor of a negative relationship between financial development and growth in the short-run and a positive one in the long-run, we argue that there is a mixed (negative and positive) time-varying impact of financial development on output growth, which captures the short-run. The aforementioned finding constitutes one of the contributions of this paper.

In particular in three periods financial development has a clearly positive effect on economic growth, namely 1968-1974, 1991-1993 and 1997-1999. Levine (1996) argued that Goldsmith's cross country work in 1969 provided evidence that rapid economic growth was accompanied by above the average financial development. Similarly Haber (1991, 1996) suggested that capital market development had a significant impact on economic growth. He justified this view by using the case of Brazil, Mexico and the United states. In Brazil the liberalization of the capital markets after the fall of the monarchy in 1889 provided the Brazilian firms with easier access to foreign capital. While Mexico followed the example of Brazil, the opening of the financial policies was much more subdued. Consequently economic growth in Mexico was weaker and slower than that of Brazil. Finally McKinnon (1973) studied the link between financial systems and economic expansion among others in Argentina and Brazil after the end of the 2<sup>nd</sup> War. His findings strongly indicated the beneficial nature of well functioning financial systems for economic growth.

The first of the three periods indicating positive financial development effects (1968-1974) is the one known as the Milagre economico (Brazilian Miracle), when average annual growth rates were extremely high following a number of important financial sector reforms that underpinned a massive increase in infrastructure investment, Goldsmith et al. (1986).

The second period of positive *cbd* impact on growth occurred during the period 1991-1993. Among the reasons that could explain the positive link between *cbd* and *gdp* growth during that period might be the fact that from the early 1990s there were various attempts to develop non-inflationary sources of finance

and to diminish Brazil's dependency on foreign savings. More specifically, despite the political turmoil that marked the early 1990s, 1991 saw law changes allowing foreign institutions to trade domestically issued bonds and securities, Studart (2000). From 1992 onwards capital flows rose rapidly due to the repatriation of the capital that fled in the 1980s after the interest rate shocks of 1979.

The third and final period of constructive impact of cbd on output growth covers the late 1990s (1997-1999, see again Figure C.4 in the Appendix C). This could be attributed to the successful implementation of the 1994 Real Plan and the expansion of the PROER programme from 1997 onwards, which supported a wave of mergers and acquisitions in the financial sector (see Folkerts-Landau et al., 1997). Moreover, the opening of the Brazilian market to new financial institutions contributed towards liberalization of the financial system, Bittencourt (2011). An interesting point in our results is the fact that when the financial development effect was positive (and at relatively high levels) trade openness levels were either stagnant (1969-1974) or on a downward slope (1993, 1995-1999). This could potentially show us the changes in the priorities of the Brazilian government after 1969.

#### 5.1.4 The Transition Parameters $\gamma$ and $c$

Finally, as far as the level of  $\gamma$  is concerned, the change between the two regimes is not so smooth, with the exception of legislative elections, where the transition is smoother (see the parameter estimates of Table 1 below and Figure C.5 in the Appendix C). The value of  $c$  represents the point when the transition between the two regimes happens (see the parameter estimates of Table 1 below).

Table 1. LSTAR Model (cbd as the Financial Development Measure)

	$\phi_1^{(1)}$	$\phi_2^{(1)}$	$\phi_3^{(1)}$	$\phi_4^{(1)}$	$\phi_1^{(2)}$	$\phi_2^{(2)}$	$\phi_3^{(2)}$	$\gamma$	$c$
dem	0.08*** (0.02)	-0.86*** (0.18)	-0.04*** (0.02)	0.58** (0.28)	-0.04 (0.02)	1.16*** (0.38)	0.04** (0.02)	5.54 (5.07)	-0.008 (0.00)
rev	0.07*** (0.02)	-0.80*** (0.20)	0.03*** (0.01)	0.88** (0.39)	-0.05 (0.04)	1.12*** (0.44)	-0.03* (0.02)	4.09 (3.26)	-0.005 (0.00)
str	0.09*** (0.03)	-0.86*** (0.25)	-0.03** (0.01)	0.76* (0.41)	-0.06 (0.05)	1.21*** (0.51)	0.03 (0.02)	3.52 (2.84)	-0.007 (0.00)
ls	0.14*** (0.03)	-0.78*** (0.21)	-0.04*** (0.01)	0.69** (0.34)	-0.12* (0.06)	1.18*** (0.46)	0.04* (0.02)	3.94 (3.11)	-0.005 (0.00)
cc	0.06*** (0.02)	-0.79*** (0.24)	0.03 (0.02)	0.52** (0.32)	-0.03 (0.03)	1.10** (0.49)	-0.04 (0.04)	4.33 (4.67)	-0.007 (0.00)
le	0.13** (0.06)	-1.02** (0.46)	-0.02** (0.01)	0.91 (0.60)	-0.14 (0.11)	1.62* (0.88)	0.03 (0.02)	2.02 (1.50)	-0.005 (0.00)

Notes: Table reports parameter estimates for the following model:

$$y_t = \phi_1^{(1)} + \phi_2^{(1)}cbd_{t-3} + \phi_3^{(1)}pi_{t-4} + \phi_4^{(1)}to_{t-4} + (\phi_1^{(2)} + \phi_2^{(2)}cbd_{t-3} + \phi_3^{(2)}pi_{t-4})(1 + \exp[-\gamma(to_{t-4} - c)])^{-1} + \epsilon_t.$$

The numbers in parentheses represent standard errors.

\*\*\*, \*\*, \* indicates significance at the 1%, 5% and 10% level respectively.

## 5.2 Other Financial Development Measures - Robustness Checks

To validate our results we additionally used money supply and deposits at Banco do Brasil as financial development measurements. As noted above, given  $m1$ 's and  $dbb$ 's more restrictive nature we use both of them as a robustness check of our results and thereby we attach greater weight to commercial bank deposits. The results in general are in full compliance with the ones reported for  $cbd$ . Accordingly, the parameter estimates of Tables C.3 and C.4 in the Appendix C report the estimation outputs when either  $m1$  or  $dbb$  is considered as the financial development measure. First notice that there is a positive (in all 104 cases\years) and statistically significant time-varying link between trade openness and economic growth in most of the models, 10 out of 12<sup>14</sup>. These findings confirm our primary results on the time-varying link between trade openness and economic growth when commercial bank deposits were considered as the measure of financial development.

Regarding the time-varying relation between political instability (either informal or formal) on growth the results are as follows. From the estimated parameters of Table C.3 we found a negative effect of  $dem$ ,  $str$  and  $ls$  throughout the years (see equation C.2 in the Appendix C on how we calculate this effect), a beneficial effect of purges (this effect is measurable during the same periods when revolutions<sup>15</sup>, had a positive impact on growth), but quite low in most of the cases (in 60 out of 104 cases\years), and a mixed impact of coups (positive effect in 69 cases\years out of 104) on economic growth. As far as the  $cc$  is concerned, its effect was statistically insignificant. Results from Table C.4, when  $dbb$  is the financial development measure, are in line with the ones reported above. Specifically we observe a statistically significant negative effect between political instability and growth [with the exception of  $cc$ , where there is a mixed effect, (negative effect in 48 out of 104 cases\years)].

Regarding our baseline findings for  $m1$ <sup>16</sup>, we find a mainly negative effect on growth, but significantly reduced in magnitude especially during 1968-74, 1991-93 and 1997-99 (periods where a positive association between  $cbd$  and economic growth was detected) whereas the results when  $dbb$  is considered as the financial development indicator show a mixed time-varying link between  $dbb$  and economic growth (negative in 55 out of 104 cases\years<sup>17</sup>). Notably, our parameter estimates show that the periods where  $dbb$  and  $cbd$  appeared to have a positive impact on growth were identical.

Finally, as far as the level of  $\gamma$  is concerned the change between the two regimes is not so smooth, with the exception of  $str$  and  $le$ , where the transition is smoother (see Figures A.9 and A.10 in the Appendix A respectively). The value of  $c$  represents the point when the transition between the two regimes occur.

<sup>14</sup>See equation C.1, the parameter estimates of Tables C.3 and C.4 in the Appendix C, the summary Table 2 below and Figures A.7 and A.8 in the Appendix A.

<sup>15</sup>See Figure C.4 in the Appendix C.

<sup>16</sup>See equation C.3 and the parameter estimates of Table C.3 in the Appendix C as well as Figure A.7 and Table 2.

<sup>17</sup>See equation C.3 and Table C.4, Figure A.8 in the Appendix A, as well as Table 2.

## 6 Concluding Remarks

Within a STAR framework utilizing data for Brazil from 1890 to 2003, we find that: (a) the level of openness of the economy displays a positive association with growth, however we detect low positive effects during the Great Depression (from 1929 to 1933); (b) informal (e.g., demonstrations and strikes) and formal (e.g., legislative selections and legislative elections) political instability have a negative impact on economic growth throughout our sample; (c) interestingly revolutions, coups and constitutional changes displayed a mixed (either positive or negative) effect on growth: one of these periods covers the years from 1975 to 1978, where despite the establishment of the military junta, the Brazilian economy was growing with an average 11%; (d) unlike the previous literature, which reports a negative short-run association between financial development and growth, we argue in favor of a mixed time-varying impact (in the short-run) when the financial development measures are the commercial bank deposits and deposits at Bank of Brazil, whereas that impact becomes mainly negative for money supply,  $m1$ . In particular, we find three periods where financial development impacted positively growth, namely 1968-1974, 1991-1993 and 1997-1999; (e) in 57% of the years, where financial development had a below the mean effect, we estimate that trade openness had a substantial above the mean change; (f) our parameter estimates confirm the fact that the change between the regimes was not smooth.

The aforementioned findings raise a number of new questions that we believe may be useful in motivating future research. In this paper we place emphasis to the following suggestions: on the role of finance and political instability and on methodology. As far as the role of finance in the process of economic development is concerned, our results corroborate and extend a large body of previous research by estimating a mixed either negative or positive impact of financial development on growth in the short-run. However, the positive effects of political instability on growth might outweigh the negative influence of financial development. In particular, we find that different types of political instability (either informal or formal ones), affect economic growth differently over various time windows.

Hence future studies should focus on the link between financial development, political instability and economic growth in a panel of developing countries. This task might prove challenging due to lack of historical data for most of developing countries. However, the latter fact does not diminish the significance of the task. The second suggestion refers to some further methodological considerations, that of panel STAR modeling. This will facilitate the estimation of the finance-political instability-growth system in a panel of countries, providing hence further progress to the field which is something we feel future research should try to address.

Table 2. Effects of Financial Development, Trade Openness and Political Instability on Economic Growth and Periods Where a Time-Varying Effect was Detected

Variables	Significant effect	Periods
<i>Trade Openness</i>		
Panel A		
trade openness	+	low size effects during the period: 1893, 1908 – 1910, 1929 – 1933, 1947 – 1954 (not 1948, 1950), 1969 – 1973, 1974, 1978 – 1980, 1982 – 1989(not 1988), 1993, 1996 – 1999
<i>Informal Political Instability</i>		
Panel B		
demonstrations	–	
revolutions	<i>mixed</i> →	positive effects during the period: 1899 – 1902, 1920 – 1926(not 1923), 1930 – 1938(not 1931, 1933, 1935), 1948 – 1958(not 1951, 1954), 1975 – 1978, 1994 – 1995
strikes	–	
coups	<i>mixed</i> →	positive during the same period as those of revolutions
<i>Formal Political Instability</i>		
Panel C		
purges	+	
legislative selections	–	
legislative elections	–	
constitutional changes	<i>mixed</i> →	positive during the same period as those of revolutions
<i>Financial Development measures</i>		
Panel D		
commercial bank deposits	<i>mixed</i> →	positive effects during the period: 1968 – 1974, 1991 – 1993 1997 – 1999
money supply	–	
deposits at Bank of Brazil	<i>mixed</i> →	positive effects during the period: 1968 – 1974, 1991 – 1993 1997 – 1999

Notes: Table reports a summary of the results obtained from the parameter estimates of Tables 1 above and C.3 and C.4 in the Appendix C.

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## APPENDIX A

Figure A.1. 3D Graphs for Financial Development (cbd, m1,dbb) vs gdp % and time

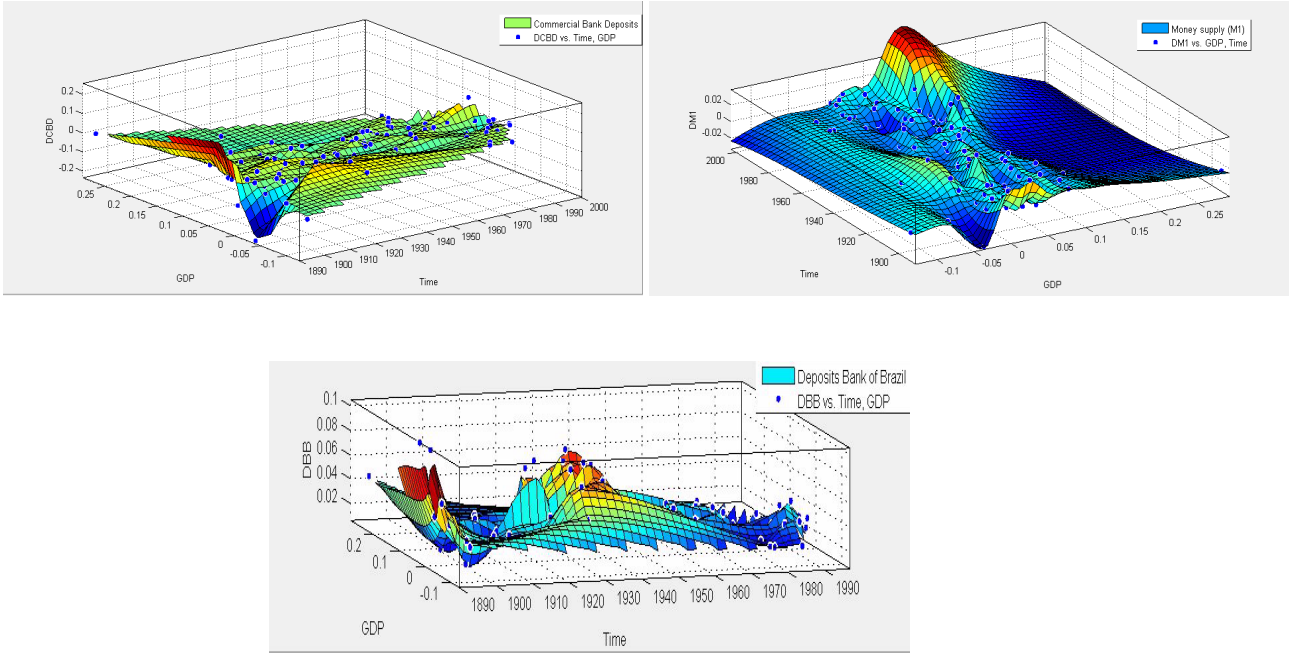


Figure A.2. 3D Graphs for Informal Political Instability vs gdp % and time

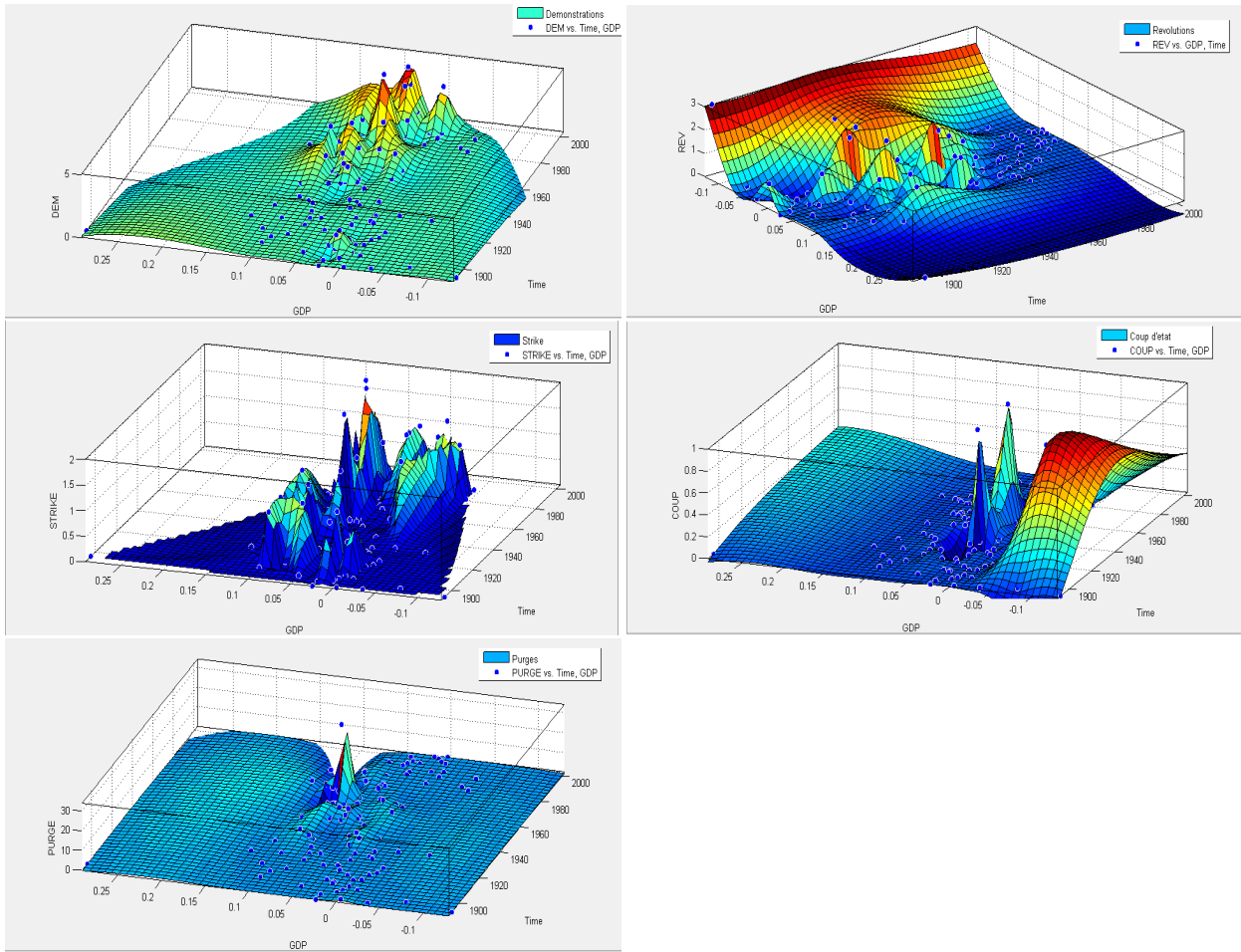


Figure A.3. 3D Graphs for Formal Political Instability vs gdp % and time

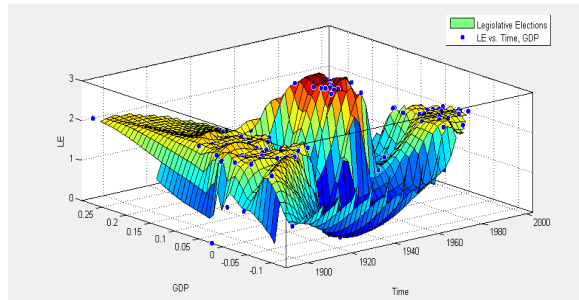
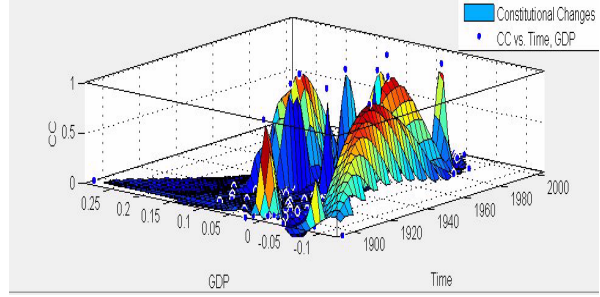
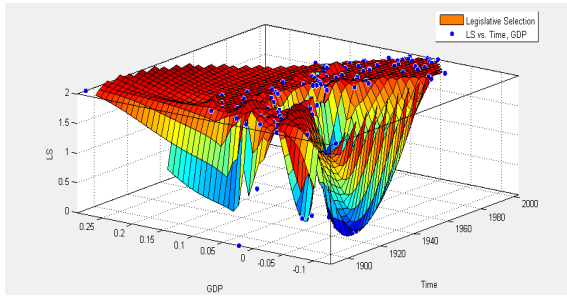


Table A.1. Zivot and Andrews (1992) Unit Root tests with Breaks

Variable	Type of Break		
	With Intercept	With trend	Both
gdp	-10.77*** (1981)	-10.37*** (1973)	-10.72*** (1981)
cbd	-12.94*** (1906)	-13.87*** (1906)	-14.34*** (1919)
m1	-7.79*** (1939)	-7.39*** (1908)	-7.79*** (1939)
dbb	-7.54*** (1935)	-7.28*** (1908)	-7.77*** (1935)
to	-13.85*** (1909)	-13.81*** (1916)	-14.09*** (1920)
dem	-9.76*** (1984)	-9.58*** (1981)	-9.66*** (1984)
rev	-5.52*** (1922)	-5.14*** (1932)	-5.48*** (1930)
str	-9.41*** (1978)	-9.15*** (1988)	-9.82*** (1978)
coup	-11.20*** (1930)	-10.89*** (1938)	-11.27*** (1930)
pur	-5.71*** (1967)	-5.49*** (1964)	-6.47*** (1963)
ls	-7.09*** (1930)	-6.75*** (1933)	-7.58*** (1946)
cc	-12.37*** (1930)	-11.58*** (1958)	-12.31*** (1930)
le	-4.78* (1940)	-3.72 (1971)	-4.80* (1940)

Notes: \*\*\*, \* indicate significance at 1% and 10% level respectively.

Columns 2, 3 and 4 report estimated t-statistics when we allow for breaks in the intercept, in the trend and in both respectively. Numbers in parentheses represent break points. Only the case of *le* is unit root when we allow for a break in the trend.

Table A.2. Lumsdaine Papell Unit Root Tests with two Breaks in the Intercept

Variable	Break	
	in intercept	Breakpoints
gdp	-10.88***	1929, 1974
cbd	-13.27***	1906, 1932
m1	-14.26***	1938, 1975
dbb	-10.47***	1934, 1975
to	-14.08***	1919, 1974
dem	-9.91***	1951, 1983
rev	-10.71***	1921, 1937
str	-9.61***	1933, 1977
coup	-11.32***	1929, 1950
pur	-6.43**	1954, 1972
ls	-9.38***	1929, 1950
cc	-12.78***	1929, 1960
le	-6.17**	1939, 1981

Notes: \*\*\*, \*\* indicate significance at 1% and 5% level respectively. Column 2 reports estimated t-statistics when we allow for two breaks in the intercept. Column 3 reports the estimated breakpoints. In all cases we reject the unit root hypothesis.

When *cbd* is used as the transition variable, linearity is not rejected in the case of demonstrations, constitutional changes and legislative elections while for revolutions, strikes and legislative selections the p-values of  $LM_2$  are weaker than those when trade openness is the transition variable (see Tables A.3a below and C.2 in the Appendix C). When *dbb* represents the transition variable linearity is rejected in all cases (see Tables A.3b and A.4 below). Only when *m1* is used as the transition variable does rejection of the linearity hypothesis take place in all cases (see Tables A.5 and A.6 below).

Table A.3a. Linearity testing, using commercial bank deposits (*cbd*) as the transition variable.

Variable	Linearity $LM_2$	<i>d</i> -delay parameter
dem	0.25	4
rev	0.03	4
str	0.03	4
ls	0.07	4
cc	0.39	4
le	0.20	4

Notes: Column 2 represents p-values of the linearity rejection. Based on Teräsvirta (1994) *dem*, *cc* and *le* fail to reject linearity while *rev*, *str* and *ls* reject it. However, this rejection is weaker compared to the case when trade openness is used as the transition variable (see Table 1 in Section 5).

Table A.3b. Linearity Testing, Using Deposits Bank do Brazil (*dbb*) as the Transition Variable.

Variable	Linearity $LM_2$	<i>d</i> -delay parameter
dem	0.71	4
rev	0.86	4
str	0.33	4
ls	0.17	4
cc	0.32	4
le	0.71	4

Notes: Column 2 represents p-values of the linearity rejection. Based on Teräsvirta (1994) all the cases fail to reject linearity.

Table A.4. Linearity Testing, Determining the Delay Parameter and Selection Between LSTAR and ESTAR. Results when *dbb* is the Financial Development Measure and Trade Openness is Used as a Threshold.

Variable	Linearity $LM_2$	<i>p</i> -value H01	<i>p</i> -value H02	<i>p</i> -value H03	<i>d</i> -delay parameter	TP choice
dem	0.01	0.05	0.18	0.03	4	LSTAR
rev	0.02	0.03	0.06	0.27	4	LSTAR
str	0.00	0.15	0.09	0.02	4	LSTAR
ls	0.02	0.05	0.28	0.05	4	LSTAR
cc	0.08	0.03	0.46	0.19	4	LSTAR
le	0.00	0.05	0.10	0.00	4	LSTAR

Notes: Column 2 represents the p-value (strength) of the linearity rejection. Based on Teräsvirta (1994) selection process, columns 3 to 5 suggest an LSTAR model. Column 6 represents the delay parameter, which in our case is 4, since the power of linearity rejection is stronger relatively to other values of *d*. The usage of  $LM_2$ , H01, H02 and H03 follows Teräsvirta (1994).

Table A.5. Linearity Testing, Using Money Supply ( $m1$ ) as the Transition Variable.

Variable	Linearity LM <sub>2</sub>	$d$ -delay parameter
dem	0.00	4
coup	0.03	4
pur	0.00	4
ls	0.00	4
cc	0.00	4
le	0.02	4

Notes: Column 2 represents p-values of the linearity rejection. Based on Teräsvirta (1994) all the cases reject linearity.

Table A.6. Linearity Testing, Determining the Delay Parameter and Selection Between LSTAR and ESTAR. Results when  $m1$  is the Financial Development Measure and Trade Openness is Used as a Threshold.

Variable	Linearity LM <sub>2</sub>	$p$ -value H01	$p$ -value H02	$p$ -value H03	$d$ -delay parameter	TP choice
dem	0.03	0.16	0.84	0.00	4	LSTAR
coup	0.01	0.07	0.23	0.04	4	LSTAR
pur	0.00	0.58	0.63	0.00	4	LSTAR
ls	0.10	0.26	0.69	0.03	4	LSTAR
cc	0.10	0.18	0.94	0.01	4	LSTAR
le	0.04	0.47	0.06	0.08	4	ESTAR*

Notes: Column 2 represents the  $p$ -value (strength) of the linearity rejection.

Based on Teräsvirta (1994) selection process, columns 3 to 5 suggest an LSTAR model except from  $le$ . However the use of the LSTAR model fits better in our data. Column 6 represents the delay parameter, which in our case is 4, since the power of linearity rejection is stronger relatively to other values of  $d$ . The usage of LM<sub>2</sub>, H01, H02 and H03 follows Teräsvirta (1994).

Table A.7. Lag Specification

Variables	Information Criteria				
	AIC	SBIC	LBQ	LM	GS
cbd	0	0	1	0	2
dbb	2	0	0	0	2
m1	2	2	2	0	2
to	5	1	1	1	<b>4</b>
dem	3	2	2	2	2
rev	<b>4</b>	2	2	1	4
str	0	0	0	0	0
coup	0	0	0	0	7
pur	2	0	0	0	2
ls	7	1	<b>4</b>	1	3
cc	<b>4</b>	0	0	0	4
le	8	1	1	1	8

Notes: The Table reports the maximum lag-length on the basis of minimum information criteria\*. For the cases of *to*, *rev*, *ls* and *cc* we choose four lags (numbers in bold). For *cbd*, *dbb*, *m1*, *dem* and *pur* the optimal lag-length is two, for *str* and *coup* zero while for *le* is eight. However for linearity rejection purposes we use three lags for *cbd*, *dbb* and *m1* and four for *dem*, *str*, *coup*, *pur* and *le* respectively.

\*AIC stands for Akaike information criterion.

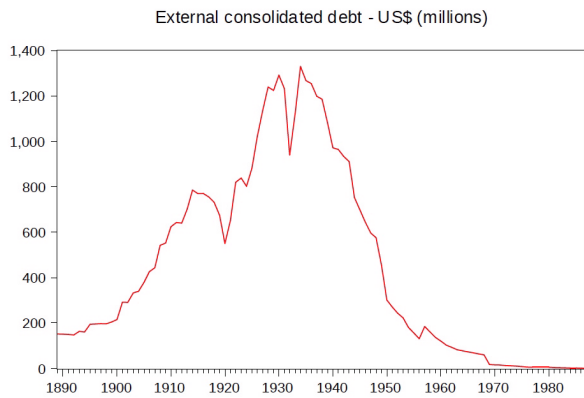
SBIC stands for Schwarz information criterion.

LBQ stands for Ljung-Box test for residual serial correlation.

LM stands for Lagrange multiplier test for residual serial correlation.

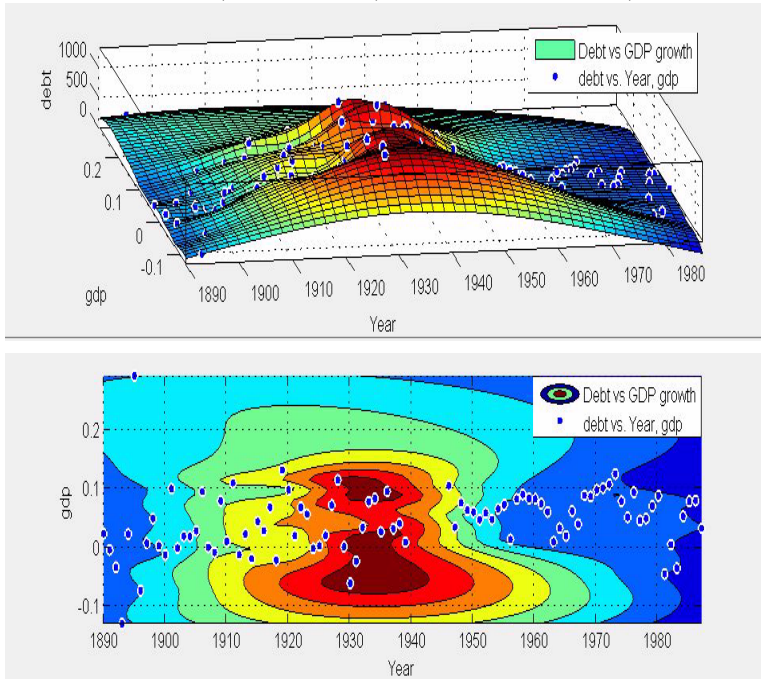
GS stands for General-to-Simple reduction test.

Figure A.4. Brazilian External Consolidated Debt in US\$ (Millions) from 1889 to 1987.



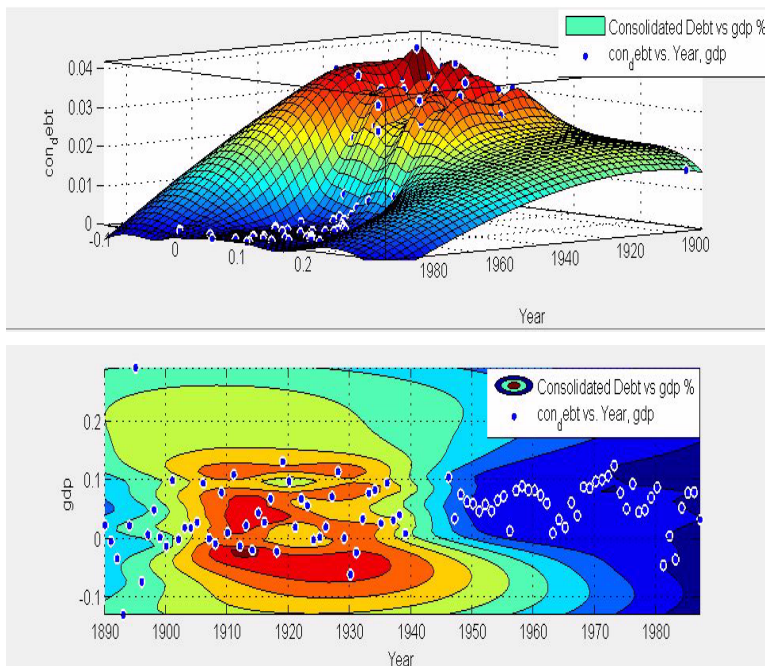
Source: Ipeadata-<http://www.ipeadata.gov.br>

Figure A.5. Debt (US\$ Millions) vs gdp % and time (3D and 2D graphs)



Notes: Both graphs plot consolidated debt (in US\$ millions) and gdp growth across the time. Brown colour represents high amounts of debt while deep blue low amounts of debt. In particular debt after 1905 started rising, in 1934 reached its highest value and from 1935 started displaying a downward trend. It was not before 1950 where Brazilian debt levels will begin to rationalize (blue).

Figure A.6. Consolidated Debt as a share of gdp (cd/gdp) vs gdp % and time (3D and 2D graphs)



Notes: Both graphs plot consolidated debt as a share of gdp and gdp growth across the time. Brown colour represents high levels of consolidated debt as a % of gdp while deep blue low level. In particular after 1904 debt started rising, in 1914 reached its highest value while from 1937 it showed a downward trend. It was not before 1946 where Brazilian debt levels will begin to rationalize (blue). For the construction of the Consolidated debt as a share of gdp we used data from the following links:

- 1) <http://www.ipeadata.gov.br/> (for consolidated debt)
- 2) <http://www.ggd.net/maddison/maddison-project/home.htm> (for gdp)

Figure A.7. Time-varying Effects of Financial Development (m1) and Trade Openness on Growth Using Various Political Instability Measures. Results Retrieved from the Parameter Estimates of Table C.3 in the Appendix C.

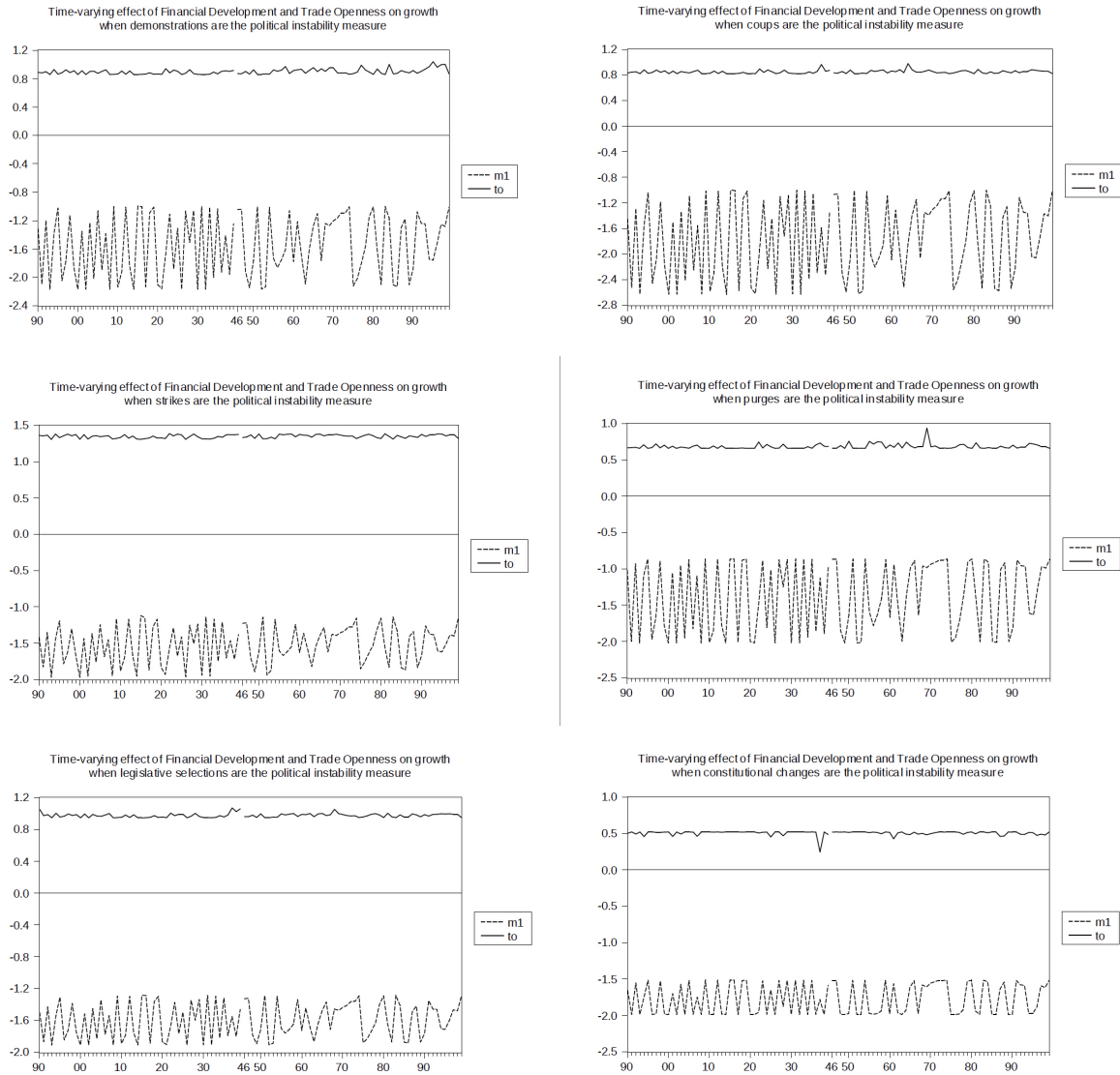


Figure A.8. Time-varying Effects of Financial Development (dbb) and Trade Openness on Growth Using Various Political Instability Measures. Results Retrieved from the Parameter Estimates of Table C.4 in the Appendix C.

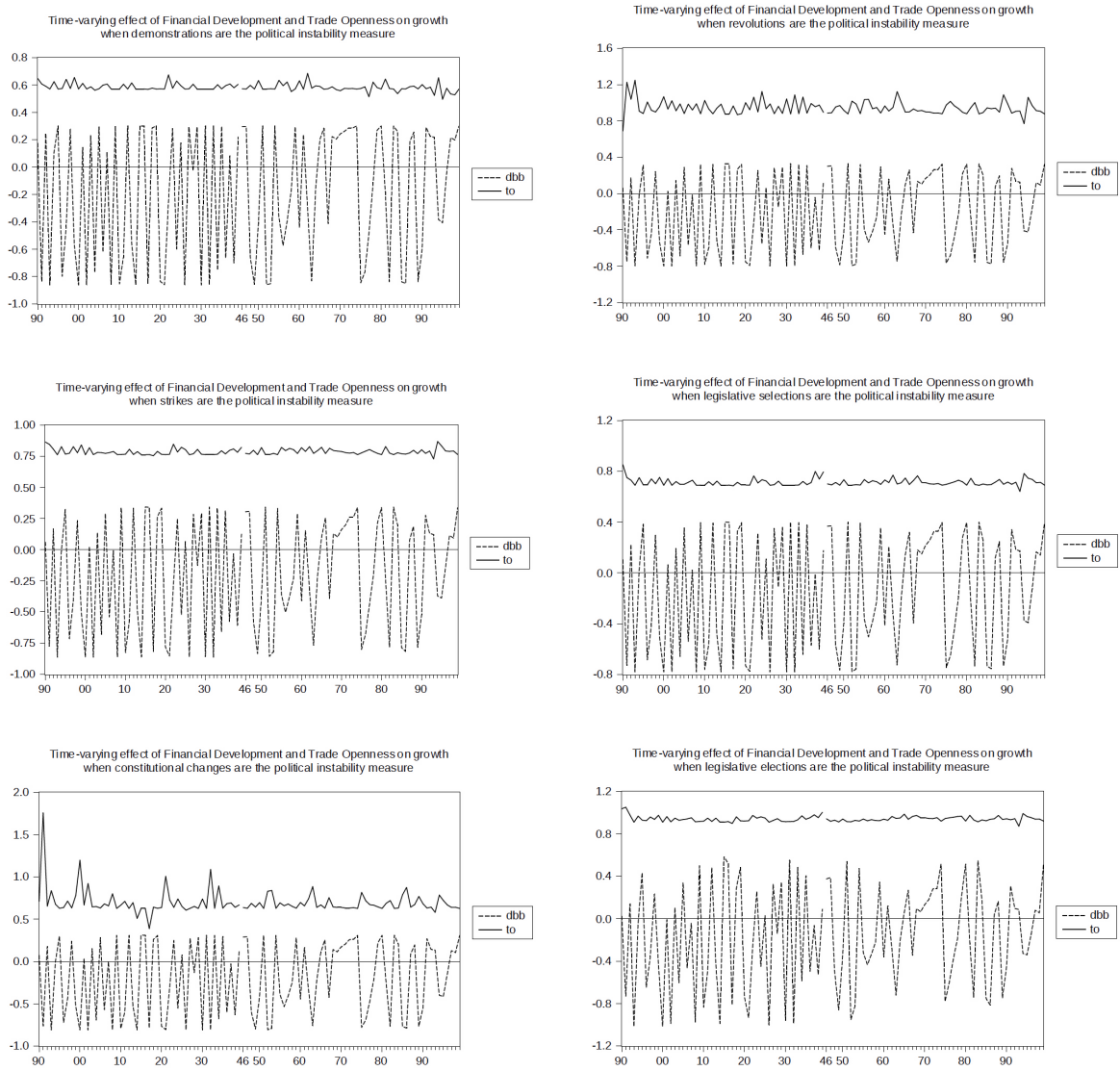
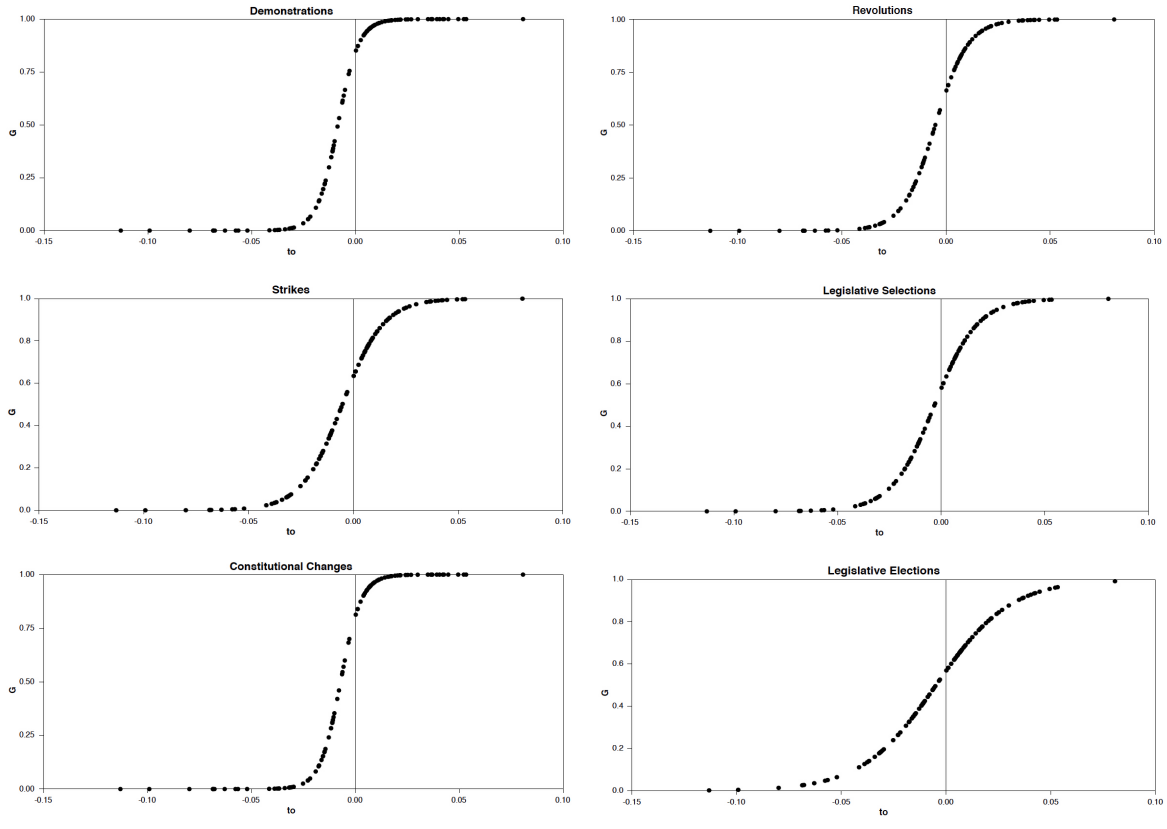


Figure A.9. Smooth Transition Function ( $G(s_{t-d})$ ) vs Transition Variable ( $to_{t-4}$ ). Results Retrieved from the Parameter Estimates of Table C.3 in the Appendix C.



Figure A.10. Smooth Transition Function ( $G(s_{t-d})$ ) vs Transition Variable ( $to_{t-4}$ ). Results Retrieved from the Parameter Estimates of Table C.4 in the Appendix C.



## APPENDIX B

Table B.1. Timeline of Brazilian History-main political events (1899-1929)

Year	Old Republic (1889-1930) events		
1889	Deodoro da Fonseca 1 <sup>st</sup> president of Brazil	1922	18 of the Copacabana Fort revolt
1891	Deodoro da Fonseca was ousted by a navy revolt	1922	Communist Party founded
1891	Florianio Peixoto 2 <sup>st</sup> president known as the Iron Marshal	1922 1924-27	Tenentes Revolts
1893	Naval Revolt	1922	Arthur da Silva Bernardes 12 <sup>th</sup> president
1893-5	Federalist Riograndense Revolution	1926	Washington Luis Pereira de Sousa 13 <sup>th</sup> president
1894	Prudente Jose de Morais Barros 3 <sup>rd</sup> civilian president	1929	Great Depression
1896-7	Canudos war		
1898	Dr. Manuel Ferraz de Campos Sales 4 <sup>th</sup> president		
1902	Coffee crisis		
1902	Francisco de Paula Rodrigues Alves 5 <sup>th</sup> president		
1904	Vaccine Revolt		
1906	Afonso Augusto Moreira Pena 6 <sup>th</sup> president		
1909	Nilo Procopio Pecanha 7 <sup>th</sup> president		
1910	Hermes Rodrigues da Fonseca 8 <sup>th</sup> president		
1914	World War I		
1914	Venceslau Bras Pereira Gomes 9 <sup>th</sup> president		
1917	Brazil declares war in Central Powers		
1918	Delfim Moreira da Costa Ribeiro 10 <sup>th</sup> president		
1919	Epitacio Lindolfo da Silva Pessoa 11 <sup>th</sup> president		
1921	Crisis of the False Letters		

Table B.1. Timeline of Brazilian History-main political events (1930-1964)

Year	Getulio Vargas era (1930-1954) events	Year	Post Vargas era (1954-1964) events
1930	Revolution of 1930	1954	João Fernandes Campos Cafe Filho 18 <sup>th</sup> president
1930	Getulio Dornelles Vargas 14 <sup>th</sup> president, Father of the Poor	1955	Carlos Coimbra da Luz 19 <sup>th</sup> president, shortest president of Brazil
1932	Constitutionalist Revolution or Paulista war	1956	Nereu de Oliveira Ramos 20 <sup>th</sup> president
1934	Constitution of 1934	1956	Juscelino Kubitschek de Oliveira 21 <sup>st</sup> president
1935	Intentona Comunista, Communist Attempt to take power failed	1960	Brasilia new capital
1937-45	Estado Novo, New State established Constitution of 1934 abolished	1961	Janio da Silva Quadros 22 <sup>nd</sup> president
1939	World War II outbreaks	1961	Relations with USSR and Cuba reestablished
1942	Brazil declares war on Axis powers	1961	Parliamentary system established
1944	Brazilian expeditionary forces sent to Italy	1961	Pascoal Ranieri Mazzilli 23 <sup>rd</sup> president
1945	Military coup disposes Vargas	1961	João Belchior Marques Goulart 24 <sup>th</sup> president
1945	Jose Linhares 15 <sup>th</sup> president	1963	Presidential system restored
1946	Eurico Gaspar Dutra 16 <sup>th</sup> president	1964	Brazilian coup d'etat
1946	5 <sup>th</sup> Constitution established	1964	Pascoal Ranieri Mazzilli 25 <sup>th</sup> president
1947	forfeiture of Communist Party Interruption of diplomatic tights with USSR		
1948	Salte Plan		
1951	Getulio Dornelles Vargas 17 <sup>th</sup> president		
1954	Vargas commits suicide		

Table B.1. Timeline of Brazilian History-main political events (1964-1995)

Year	Military Republic (1964-1985) events	Year	Redemocratization (1985-2003) events
1964	Humberto de Alencar Castelo Branco <b>26<sup>th</sup></b> president	1985	Military Republic era ends
1964	First Institutional Act legislated	1985	Jose Sarney de Araujo Costa <b>31<sup>st</sup></b> president
1965	Second Institutional Act All political parties are out of the law	1986	Cruzado Plan
1966	Third Institutional Act replaces direct election of governors with indirect ones	1987	Bresser Plan
1967	Artur da Costa e Silva <b>27<sup>th</sup></b> president	1988	Constitution institutionalized the <b>1<sup>st</sup></b> presidential election from the people since 1960
1967	Fourth Institutional Act gives to the army the total control over national security	1988	Presidential system restored
1968	Fifth Institutional Act gives to Silva absolute powers	1989	Summer Plan
1969	Military junta	1989	First Presidential Election since 1960
1969	Emilio Garrastazu Medici <b>28<sup>th</sup></b> president	1990	Fernando Affonso Collor de Mello <b>32<sup>nd</sup></b> president
1973	First oil Shock	1990	Collor Plan implemented
1974	Ernesto Beckmann Geisel <b>29<sup>th</sup></b> president	1992	Itamar Augusto Cautiero Franco <b>33<sup>rd</sup></b> president
1974	Relations with China officially established	1993	Referendum reconfirms presidential republic
1975	Diplomatic links with Angola	1994	Congress reduces presidential term of office to four years
1975	Signing of the nuclear energy accord with West Germany	1994	Real Plan, New currency the Real introduced
1977	Repudiation of alliance between Brazil-US	1995	Fernando Henrique Cardoso <b>34<sup>th</sup></b> president
1978	Second oil Shock		
1979	Decree ends Fifth Institutional Act providing political amnesty		
1979	João Baptista de Oliveira Figueiredo <b>30<sup>th</sup></b> president		
1979	IMF austerity plan		

## APPENDIX C

### Background: Economic and Political History of Brazil

#### *Early 19<sup>th</sup> Century*

Throughout the 19<sup>th</sup> century approximately 80% of the world's gold supply was provided by Brazil. The effects of the discovery of gold and diamonds were tremendous both for the colony and the metropolis (Portugal). The aforementioned discovery of precious stones came at the precise moment when Portugal's economy was in decline and appeared seemingly to revitalize the economy. However, despite these promising signs the gold and diamond mines never provided more than a facade of wealth. The reason why this happened was that all this wealthiness went to the hands of northern Europeans and especially the English, who sold manufactured commodities to the Portuguese. Hence the sector of agriculture did more to improve and to accelerate the Brazilian economy since at a corresponding stage the average per capita income from the sugar industry was significantly higher than that provided by gold and diamonds. The nineteenth-century economic decline of Portugal can be attributed among others to the negative effects of the Napoleonic Wars, which forced the royal family to move to Brazil and to transfer the crown from Lisbon to Rio de Janeiro. Thus, Brazil might be the only colonial place in the world that became the Imperial center. The events described above and the opening of all the Brazilian ports to other nations, such as England (with the royal decree of 1808), concluded with Brazilian independence in 1822. The following period (meaning the next couple of decades) is marked by high political, economic and social unrest. It is worth mentioning that the aforementioned period (1820-1840) in Brazil coincides with an event of great importance, The Industrial Revolution.

#### *Mid 19<sup>th</sup> Century*

There is little dispute in the literature that the years from 1830 to 1930 was a period during which the Brazilian economy flourished, despite the fact that its economy passed from difficulties and constraints during the World War I and the Great Depression of 1929. The age of sugar, which was the dominant export commodity of the colonial economy, faded rapidly in the nineteenth century. In around 1830 sugar fell to the second place behind coffee (see Burns, 1970) and never again recovered. The Coffee Economic Cycle would be the horsepower of the Brazilian economy for almost a century (1830-1930). In particular the importance of coffee (which was greater than that of gold, diamonds and sugar) for the Brazilian economy lies in the fact that coffee exports accounted for about a fifth of the total Brazilian exports by the period of independence, a figure which rose by two thirds until the collapse of the monarchy in 1889. Moreover the value of coffee sold during these years was equal to that of all exports during the entire colonial period. The decade of the 1860s gave the opportunity to Brazil to develop other factors

of prosperity than coffee. The Civil War in the United States of America reduced the world's cotton reserves, hence European textile manufacturers started to seek other sources to buy cotton. Brazil as a response to that increased the production of cotton to meet the high demand. More specifically during the 1860s cotton accounted 18.3% of the total exports, a threefold increase over the previous decade. However, coffee remained the main export product since apart from the boost that coffee offered to the Brazilian economy, it influenced Brazil's relations with the outside world and helped the country to transform internally. The abolition of slavery<sup>18</sup> in 1822, the introduction of the wage salary in 1888 and the end of the monarchy in 1889 marked the beginning of a new socioeconomic and political era in Brazil. During the late 1920s, Brazil was a major coffee exporter, covering 80% of the world's demand for coffee, while they (coffee exports) constituted 12.5% of the country's gross national product (*gnp*). Baer (2013) argued that coffee exports were the engine of growth during most of the 19<sup>th</sup> century. Nevertheless, an economic expansion of such an extent requires financial backing. One of the main objectives of this paper is to understand the interplay between trade openness and financial development and the resulting effect of this on economic growth.

In the period from 1864 to 1870 a war between Brazil (and its allies Argentina and Uruguay) and Paraguay took place culminating in victory for Brazil and its allies. The military of Brazil as an institution appeared to have a significant role from that period and onwards. Five years of conflicts increased both its significance and its size. The army from 17,000 soldiers in 1864 rose to 100,000 by the end of 1870. After finishing their military actions in 1870, officers focused their attention on politics. The Duque de Caxias held the military under constant audit. However, his death in 1880 gave the military a more significant political role. Hence, there were now two classes in parliament: on the one side, the landed aristocracy with their traditional way of thinking and political acting, and on the other military officers, who represented the middle classes of the society.

Up to this point we have described briefly the early and mid 19<sup>th</sup> century background of Brazil, which is mainly linked to trade openness. In the initial paragraphs of Section 2 (of the main text) we will cover the period 1890 to 2003 from an economic and political point of view as well, stressing both financial development and political instability.

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<sup>18</sup>In particular in 1822 the new nation counted approximately 4 million inhabitants (Burns, 1970) of whom probably half were slaves of African origin. When Princess Isabel signed the Golden Law in 1888 roughly 600,000 slaves gained their freedom.

Figure C.1. Growth rate, Financial Development and Trade Openness

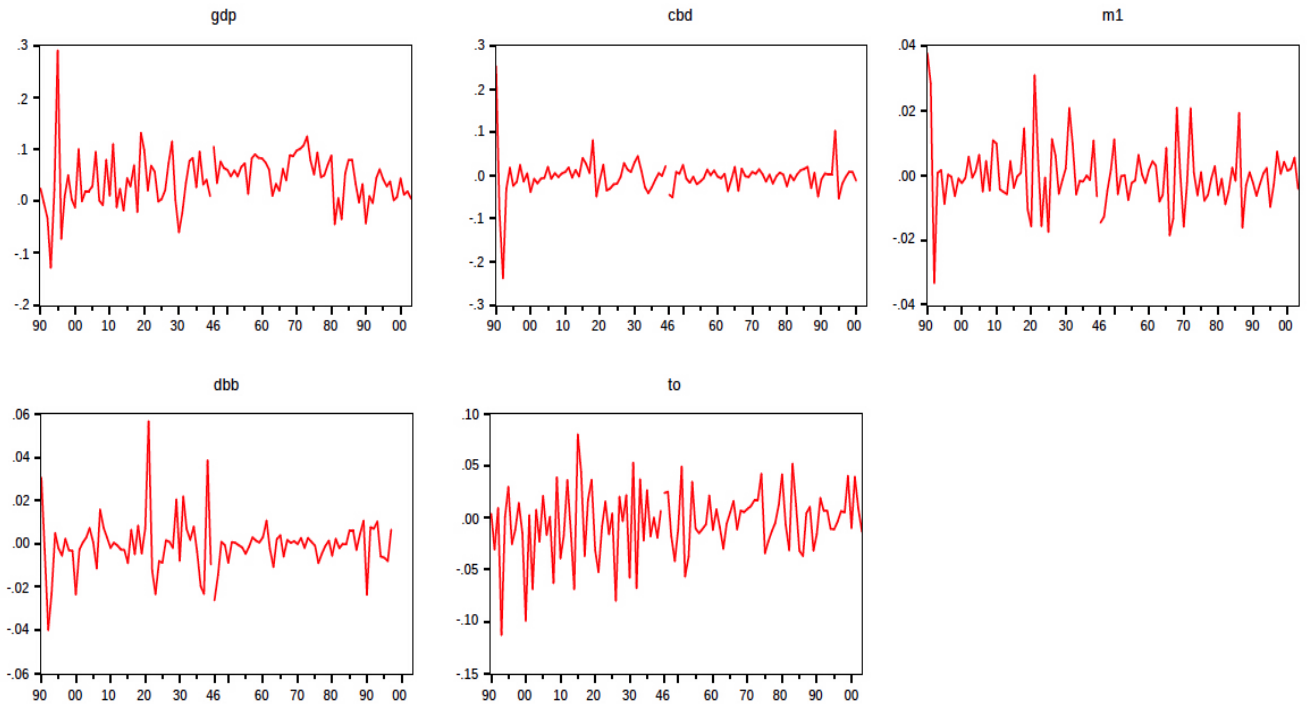


Figure C.2. Informal Political Instability Measures

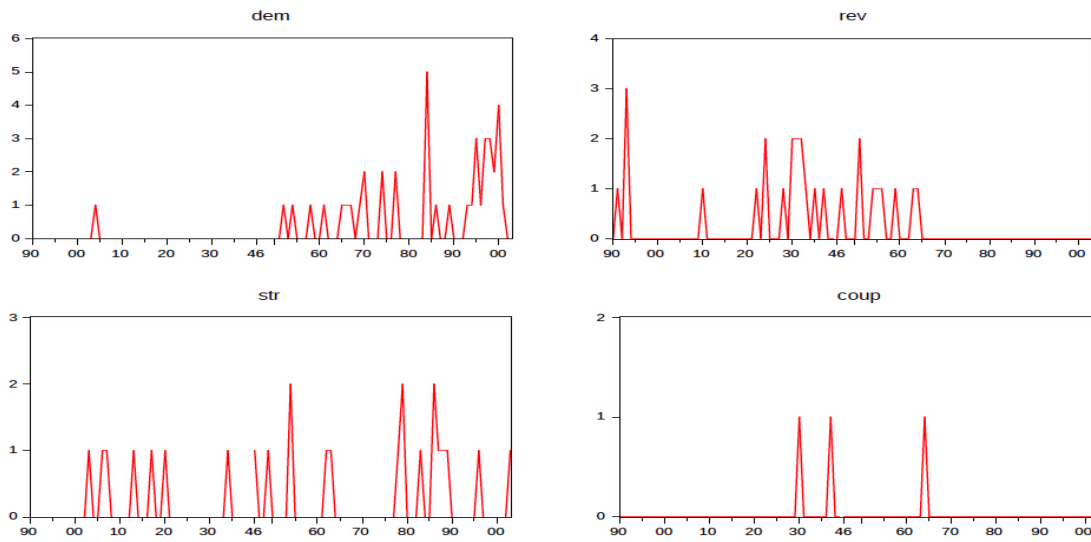


Figure C.3. Formal Political Instability Measures

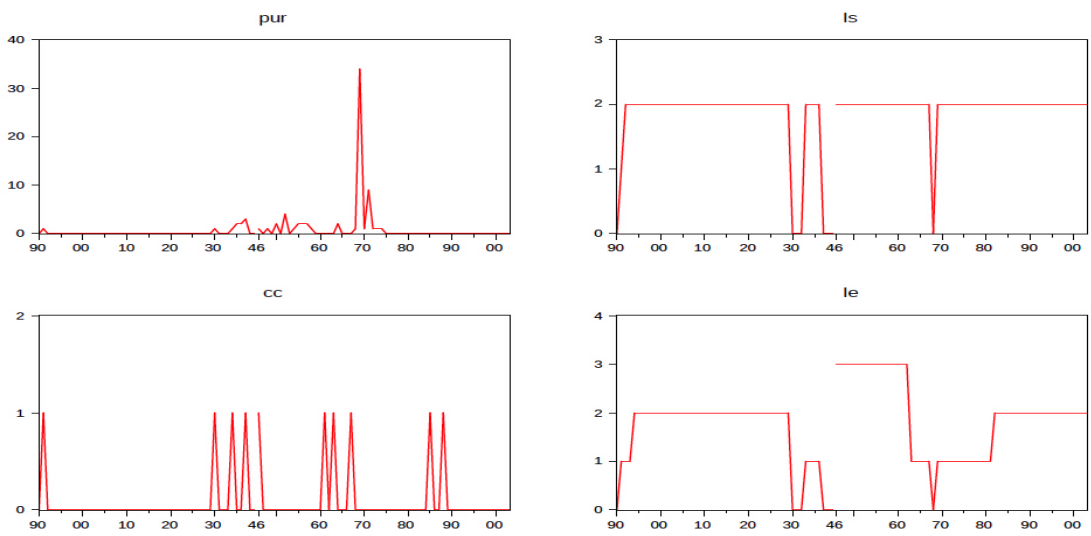


Table C1. Augmented Dickey Fuller (ADF) and Phillips Perron (PP) Unit Root Tests.

Variable	ADF at level	ADF at first difference	PP at level	PP at difference
gdp	-9.29***		-9.29***	
cbd	-1.09	-12.35***	-3.35***	-11.94***
m1	-0.95	-13.39***	-0.94	-14.79***
dbb	-1.35	-9.23***	-4.37**	-10.11***
to	-1.67	-13.00***	-1.31	-13.00***
dem	-4.54***		-7.37***	
rev	-3.98***		-9.09***	
str	-8.99***		-8.99***	
coup	-10.55***		-10.56***	
pur	-5.51***		-9.91***	
ls	-6.29***		-6.37***	
cc	-3.48***		-11.39***	
le	-3.63***		-3.69***	

Notes: \*\*\*, \*\* indicate significance at 1% and 5% level respectively.

Numbers represent the estimated ADF and PP t-statistics respectively.

ADF tests suggest that either the level of the series or their first difference are stationary at the 1% level. PP tests suggest that all the series are stationary either at level or their first difference at the 1% or 5% level, with one exception of cbd and dbb, which are stationary both at level and at first difference.

Table C.2. Linearity testing, determining the delay parameter and selection between LSTAR and ESTAR. Results when cbd is the financial development measure and trade openness is used as a threshold.

Variable	Linearity LM <sub>2</sub>	p-value H01	p-value H02	p-value H03	d-delay parameter	TP choice
dem	0.02	0.01	0.84	0.03	4	LSTAR
rev	0.02	0.02	0.80	0.02	4	LSTAR
str	0.01	0.02	0.16	0.13	4	LSTAR
ls	0.01	0.27	0.13	0.01	4	LSTAR
cc	0.06	0.01	0.34	0.43	4	LSTAR
le	0.01	0.25	0.02	0.03	4	ESTAR*

Notes: Column 2 represents the p-value (strength) of the linearity rejection.

Based on Teräsvirta (1994) selection process, columns 3 to 5 suggest an LSTAR model except from *le*. However the use of the LSTAR model fits better in our data. Column 6 represents the delay parameter, which in our case is 4, since the power of linearity rejection is stronger relative to other values of *d*. The usage of LM<sub>2</sub>, H01, H02 and H03 follows Teräsvirta (1994).

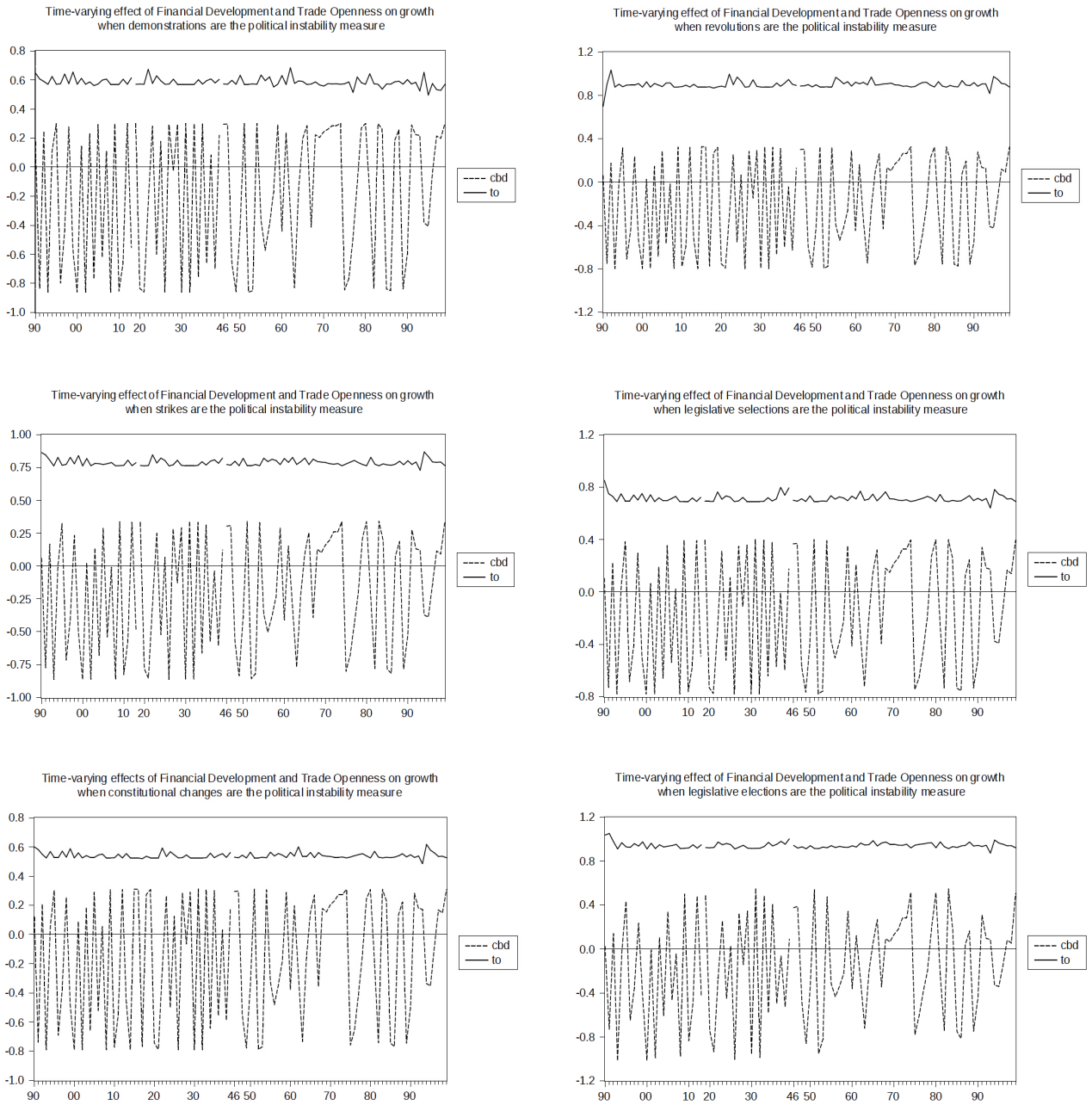
In order to calculate the time-varying effects of trade openness, political instability and financial development on growth we use the following three equations:

$$\frac{\vartheta(y_t)}{\vartheta(to_{t-4})} = \phi_4^{(1)} + \gamma(\phi_1^{(2)} + \phi_2^{(2)}fd_{t-3} + \phi_3^{(2)}pi_{t-4}) \exp[-\gamma(to_{t-4} - c)](1 + \exp[-\gamma(to_{t-4} - c)])^{-2}, \quad (\text{Equation C.1})$$

$$\frac{\vartheta(y_t)}{\vartheta(pi_{t-4})} = \phi_3^{(1)} + \phi_3^{(2)}(1 + \exp[-\gamma(to_{t-4} - c)])^{-1}, \quad \text{and} \quad (\text{Equation C.2})$$

$$\frac{\vartheta(y_t)}{\vartheta(fd_{t-3})} = \phi_2^{(1)} + \phi_2^{(2)}(1 + \exp[-\gamma(to_{t-4} - c)])^{-1}. \quad (\text{Equation C.3})$$

Figure C.4. Time-varying Effects of Financial Development (cbd) and Trade Openness on Growth Using Various Political Instability Measures. Results Obtained From the Parameter Estimates of Table 1 in Section 5.



# Empirical Results

## Commercial Bank Deposits

### The Impact of Trade Openness

*First period of low size effect of trade openness on growth (1893):*

One point worth mentioning is that during this specific rebellion we have the first documented intervention in Brazil's internal affairs by the United States of America. The Brazilian-US relationships have gone through various stages during the last 200 years: from indifference to close alignment (see Hirst, 2005). In particular during the last decade of the 19<sup>th</sup> century from the one side Brazilian diplomacy tried to borrow features of the US political behavior while from the other the US opened its market to coffee, Brazil's main export. Proof of that was the signing of the Treaty of Commercial Reciprocity of 1891 between the two countries. However, the panic of 1893 in the United States created a significant economic depression in that country, which was the worst at that time. It was not until 1897 that the US economy recovered and began steadily to expand. Hence the aforementioned economic crisis might be an additional reason for reduced trade openness and hence low size effects of the latter on growth during 1893.

*Third period of low size effect of trade openness on growth (1929-1933):*

Moreover, in August of 1931, Brazil temporarily stopped partial repayments of foreign debt and started negotiations towards a new agreement related to debt. In addition the crisis harmed the backbone of the Brazilian economy, which was the coffee industry. The low levels of demand due to the shock of 1929 (resulting in low market prices) and the overproduction of coffee because of the planting in the 1920s led to protectionist policies in the following years, which decreased the openness of the economy. In particular, the coffee support program was centralized and transferred from the states to the federal government. The Conselho Nacional do Café (National Coffee Council) was established in May 1931. It was assigned to buy all the quantities of coffee and to destroy whatever could not be sold or stored.

*Fourth period of low size effect of trade openness on growth (1947-1954):*

In particular during the early 1950s the government introduced a multi-level exchange rate system (the tariff law designed in 1957 with some minor changes was in force up to 1990) whose main purpose was not only to rationalize the scarcities in foreign exchange but also to offer insurance for a range of import-competing business activities (see Braga and Tyler, 1990). The main effect of these inward-looking trade policies (alternatively less extrovert trade policies) was to allocate capital to import-substitution activities and to provide protection for the domestic industry.

*Sixth period of low size effect of trade openness on growth (1974, 1978-1980):*

In addition, during the early 1970s Brazil's exports were limited by an overvalued currency. Furthermore, the fall of inflation during 1968 to 1974 was reversed by a remarkable increase during 1973 to 1980. It is notable that the growth rate of the general price index from 16.2% a year in 1973 increased to 110.2% a year by 1980 (Hudson, 1998). However, instead of undertaking measures of devaluation of the domestic currency and growth reducing policies the government chose the opposite way, that of high growth and import protectionism (which imposed constraints\tariffs on imports). This strategy from one side reduced the trade openness of the Brazilian economy while from the other maintained its growth.

*Seventh period of low size effect of trade openness on growth (1982-1989):*

For instance trade barriers related to extensive import restrictions and import financing requirements were introduced, foreign exchange controls were established by the Central Bank<sup>19</sup> and finally negotiations between individual importing companies and the CACEX<sup>20</sup> were conducted every year in order to determine the annual import levels. However, borrowing from outside increased the debt and trade surpluses policies employed in order to deal with that problem. The arrival of IMF in the economic life of Brazil and the austerity program imposed as a result in late 1979 lasted until 1984. During that period the Mexican debt crisis (of 1982) limited Brazil's access to international financial markets. In addition, the program of IMF, while it facilitated the interest payments on the debt, also worsened the economy and increased the inflation rates. All these events, namely the general economic crisis, the import tariffs that were imposed, hyperinflation, low net capital inflows as a share of *gdp* (Edwards, 1994), the Cruzado Plan in 1986, the Bresser Plan in 1987, and the Summer Plan in 1989 (for more information regarding the Cruzado, Bresser and Summer Plan see Hudson, 1998) lessened trade liberalization levels, which in turn might explain the low size trade openness effects (on growth) that were indicated by our results during 1982-1989.

*Eighth period of low size effect of trade openness on growth (1993, 1996-1999):*

As an answer to the financial crisis in Asia, in 1997 all the members of MERCOSUR<sup>21</sup> agreed to increase the Common External Tariff (CET) by 3% points. In addition, tariffs were imposed on imported

<sup>19</sup> following the foreign exchange deficit in 1982 and 1983 (see Braga and Tyler, 1990).

<sup>20</sup>CACEX stands for Carteira de Comércio Exterior do Banco do Brasil S.A. or Portfolio Foreign Trade Bank of Brazil S.A.. It was an agency established by the government of Getulio Vargas in 1953. Some of the main roles of this agency included exports and imports licensing, funding of foreign trade as well as keeping records of statistical data on exports and imports. The agency paused its activities in 1990 under the government of Collor.

<sup>21</sup>MERCOSUR stands for Mercado Comum do Sul (Southern Common Market) comprising Argentina, Brazil, Paraguay, Uruguay and Venezuela. Its associate countries are Chile, Bolivia, Colombia, Ecuador and Peru. Observer countries are New Zealand and Mexico. Its main purpose is to promote free trade and the fluid movement of goods, people, and currency. The Treaty of Asuncion was signed by the member states in March of 1991. It could be said that MERCOSUR was Latin America's attempt to form its own Union like the one that Europeans established initially in 1951. For more information about MERCOSUR follow the link: <http://www.mercosur.int/msweb/porta%20intermediario/>.

consumer goods (from 0% to 5%). Therefore, the reduction of the average import tariffs (which constitutes the main trade instrument of Brazil according to the World Trade Organization) of the previous years (namely 1990-1995), was replaced by a slight rise in import tariffs in 1996 and in 1997 and a bigger one in 1998 (see Averbug report) lowering the openness of the Brazilian economy.

## The Effect of Political Instability

### *Second period with positive size effects of revolutions on growth (1920-1926):*

At the economic level the Brazilian economy during the 1920s performed well, with an average growth rate of 4.8%<sup>22</sup>. The expansion in the economy was driven more by the flourishing coffee economy and less by the growth in the industrial sector (Baer, 2003). However, there were some industrial sub-sectors such as chemicals, metallurgy and tobacco, which achieved significant growth rates that were above the average, showing the trend and the diversification that the Brazilian economy started to exhibit.

### *Third period with positive size effects of revolutions on growth (1930-1938):*

Nevertheless, the rise of Nationalism and Fascism in Europe led him to adopt a hybrid system of political thought between Mussolini's in Italy and Salazar's Estado Novo in Portugal. The inevitable consequence was the abolition of the policies that the provisional government (1930-1934) had carved out. However, the Constitution of 1934 and the unsuccessful revolt of the Communists to gain control of the government left Vargas the only considerable force in the country. The importance and the effects of the new constitution (from 1934 to 1937) and the Estado Novo (New State 1937-1945) were reflected by transferring the institutional powers of coffee elites to the central government and by creating a more centralized authority in Rio de Janeiro. Moreover, the federal government activities were meant to become more rational and fixed, freed from the tactics of the Old Republic and especially the Coronelismo (Rule of Coronels), promoting the expansion of the economy. Hence after the Constitution of 1934 there was a more direct mechanism of exercising the power of the federal government in the economy. Public and mixed companies dominated the important heavy and infrastructure industries, while the private sector established its rule in the manufacturing activities. In addition, positive effects of the 1930 revolution on the Brazilian economy include among others the increase in foreign direct investments (FDI)<sup>23</sup> and the more than double rise of industrial production (Baer, 2003). Furthermore, 1934 was the turning point for the external consolidated debt, which started to de-escalate after almost 40 years of upward trend (see Figures A.4, A.5 and A.6 in the Appendix A) while the average growth rate only for the period from

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<sup>22</sup>Source <http://www.ipeadata.gov.br/>.

<sup>23</sup>Ipea-data show a boom in the investment rate especially after 1933. In particular during the period 1936 to 1938 investments ran at an average rate of 12.85%.

1936 to 1938 (which are the main years that when results indicated a positive effect of revolutions on economic growth) was around 7.06% (source, ipeadata).

*Fourth period with positive size effects of revolutions on growth (1948-1958):*

The further opening of the economy to foreign capital, the exemption of the taxes of all machinery and industrial equipment imports (under the condition that the foreign capital was linked with national income) boosted the economy. In addition the promotion of the automotive industry, which was able to transform the economy and Brazilian life within 30 years (a generation), the construction of a remarkable highway network and the transfer of the capital from Rio de Janeiro to Brasilia were some of his achievements as president. Because of the transportation system and the accessibility of agricultural machinery, Brazil was transformed into the second largest food exporter in the world during the next decades (Hudson, 1998). Hence, (as mentioned before) from one point of view Kubitschek's government motto *Fifty years of progress in five* could sound reasonable.

*Fifth period with positive size effects of revolutions on growth (1975-1978):*

His actions consisted of three axes. The first one under the name *distensao* allowed the consolidation of the democratic norms. The second axis included investments in infrastructure such as, highways, telecommunications, hydroelectric dams, mineral extraction, factories, and atomic energy (Hudson, 1998). Furthermore, he allowed foreign firms to search for oil in Brazilian soil for the first time after almost 25 years. Finally the third axis introduced a new more realistic foreign policy, so-called Responsible Pragmatism. Despite his anti-communist feelings his government recognized Angola, China and Mozambique and started building closer bonds with Europe, Japan and Hispanic America. The final report of his tenure (1974-1979) was an economy with growth rates around 6%.

*Sixth period with positive size effects of revolutions on growth (1994-1995):*

More specifically after the exhausting economic crisis of the previous years (1981-93) with inflation rates of 1,100% in 1992 and 2,400% in 1993 the implementation of the *Plano Real* (Real Plan) in 1994 started stabilizing the crumbling economy and deflating the prices. The new currency introduced (Real) gained value over the US dollar, keeping inflation under control while the economic recession of the previous 3 years was now replaced by growth of almost 5%.

Figure C.5 Smooth Transition Function ( $G(s_{t-d})$ ) vs Transition Variable ( $to_{t-4}$ ). Results Obtained from the Parameter Estimates of Table 1 in Section 5.

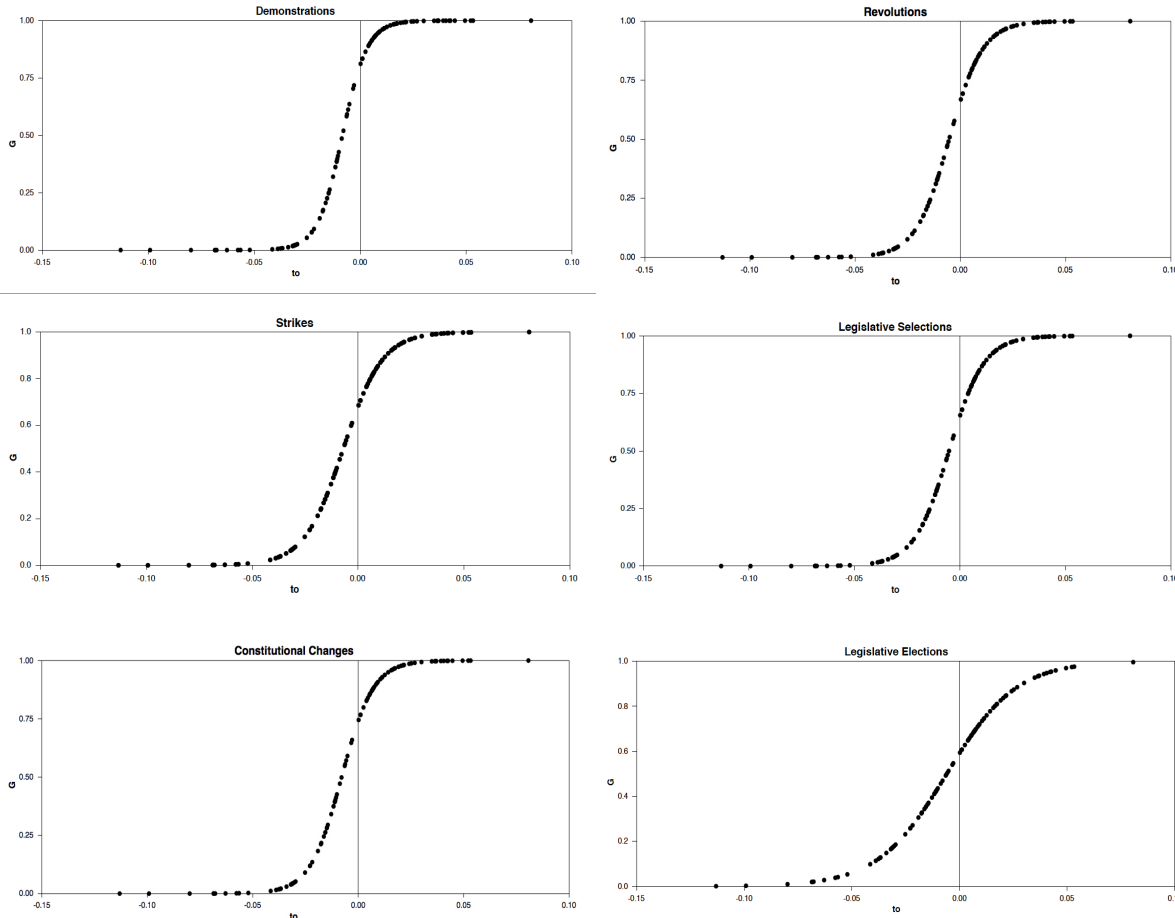


Table C.3. LSTAR Model (m1) as the Financial Development Measure)

	$\phi_1^{(1)}$	$\phi_2^{(1)}$	$\phi_3^{(1)}$	$\phi_4^{(1)}$	$\phi_1^{(2)}$	$\phi_2^{(2)}$	$\phi_3^{(2)}$	$\gamma$	$c$
dem	0.09*** (0.03)	-2.18*** (0.75)	-0.04** (0.02)	0.86* (0.45)	-0.07 (0.05)	1.17 (1.35)	0.05* (0.03)	3.52 (3.02)	-0.005 (0.00)
coup	0.08*** (0.03)	-2.63*** (0.82)	0.11** (0.05)	0.82* (0.48)	-0.06 (0.05)	1.63 (1.49)	-0.13 (0.12)	3.45 (3.42)	-0.005 (0.00)
str	0.13* (0.08)	-1.97** (0.91)	-0.04** (0.02)	1.31 (0.91)	-0.14 (0.14)	0.85 (1.75)	0.04 (0.03)	2.11 (1.73)	-0.006 (0.00)
pur	0.07*** (0.02)	-2.02*** (0.68)	0.02* (0.01)	0.66** (0.34)	-0.04 (0.03)	1.16 (1.15)	-0.01 (0.01)	5.57 (5.74)	-0.007 (0.00)
ls	0.17*** (0.05)	-1.91*** (0.72)	-0.05*** (0.01)	0.95** (0.48)	-0.17** (0.08)	0.63 (1.45)	0.05** (0.03)	3.10 (2.44)	-0.003 (0.00)
cc	0.05*** (0.01)	-1.99*** (0.60)	0.06*** (0.02)	0.52** (0.25)	-0.03 (0.02)	0.47 (1.13)	-0.09** (0.04)	9.78 (14.99)	0.001 (0.00)

Notes: Table reports parameter estimates for the following model:

$$y_t = \phi_1^{(1)} + \phi_2^{(1)} m1_{t-3} + \phi_3^{(1)} pi_{t-4} + \phi_4^{(1)} to_{t-4} + (\phi_1^{(2)} + \phi_2^{(2)} m1_{t-3} + \phi_3^{(2)} pi_{t-4})(1 + \exp[-\gamma(to_{t-4} - c)])^{-1} + \epsilon_t$$

The numbers in parentheses represent standard errors.

\*\*\*, \*\*, \* indicates significance at the 1%, 5% and 10% level respectively.

Table C.4. LSTAR Model (dbb) as the Financial Development Measure)

	$\phi_1^{(1)}$	$\phi_2^{(1)}$	$\phi_3^{(1)}$	$\phi_4^{(1)}$	$\phi_1^{(2)}$	$\phi_2^{(2)}$	$\phi_3^{(2)}$	$\gamma$	$c$
dem	0.08*** (0.02)	-1.78*** (0.58)	-0.05*** (0.02)	0.69** (0.31)	-0.05* (0.03)	2.32** (1.01)	0.05** (0.02)	6.49 (7.15)	-0.008* (0.00)
rev	0.08*** (0.02)	-1.68*** (0.63)	0.04*** (0.01)	1.09*** (0.46)	-0.06 (0.05)	2.44** (1.23)	-0.05*** (0.02)	4.15 (3.69)	-0.005 (0.00)
str	0.09*** (0.04)	-1.44** (0.71)	-0.03* (0.02)	0.91* (0.53)	-0.07 (0.06)	2.16 (1.44)	0.03 (0.03)	3.32 (3.08)	-0.005 (0.00)
ls	0.18*** (0.04)	-1.69** (0.73)	-0.05*** (0.01)	0.90** (0.44)	-0.18** (0.08)	2.56* (1.52)	0.06** (0.03)	3.14 (2.32)	-0.003 (0.00)
cc	0.06*** (0.02)	-1.53*** (0.57)	0.06*** (0.02)	0.52* (0.30)	-0.02 (0.02)	2.14** (1.04)	-0.08** (0.04)	6.55 (10.93)	-0.007 (0.00)
le	0.17* (0.10)	-2.06 (1.33)	-0.03** (0.02)	1.22 (0.92)	-0.20 (0.19)	3.25 (2.67)	0.05 (0.03)	1.84 (1.61)	-0.005 (0.00)

Notes: Table reports parameter estimates for the following model:

$$y_t = \phi_1^{(1)} + \phi_2^{(1)} dbb_{t-3} + \phi_3^{(1)} pi_{t-4} + \phi_4^{(1)} to_{t-4} + (\phi_1^{(2)} + \phi_2^{(2)} dbb_{t-3} + \phi_3^{(2)} pi_{t-4})(1 + \exp[-\gamma(to_{t-4} - c)])^{-1} + \epsilon_t$$

The numbers in parentheses represent standard errors.

\*\*\*, \*\*, \* indicates significance at the 1%, 5% and 10% level respectively.

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