

# **SPACE AND TIME IN THE RELATIONSHIP BETWEEN INCOME INEQUALITY AND LEGISLATIVE POLARIZATION: EVIDENCE FROM BRAZIL**

Danilo Buscatto Medeiros

Univeristy of Virginia

XI Encontro da ABCP

Curitiba-PR, 31 de julho a 3 de agosto de 2018

AT Instituições Políticas

*Work in progress – Please do not cite nor circulate.*

### **Abstract**

Recent rising economic inequality in advanced industrial states attracted scholars to study whether and how political actors respond to socioeconomic changes. The evidence gathered suggested that income inequality is strongly and positively correlated with political polarization. Preliminary data from Brazil, however, challenge the generalization of these findings. This paper assesses the reasons why this is the case. I argue that, if the president is endowed with considerable agenda-setting powers, the priority given to redistribution by the executive should determine the level of division within Congress. To appraise my argument, I explore the aforementioned relationship in democratic Brazil using state-level Gini coefficients and ideal points of the representatives from each state to the federal legislature. Given that in Brazil the states are the electoral districts, going local allows me to analyze how legislators react to changes in their constituencies. I hypothesize that (1) as income inequality decreases in a state over time, legislative polarization rises when redistribution is a priority in the presidential policy agenda, and (2) relative to other states, a state with higher levels of income inequality is more polarized, but this relationship is more pronounced when the president has a redistributive agenda. The paper contributes to the extant scholarship by bringing a developing country to the analysis and focusing on a crucial institutional feature.

**Keywords:** Income Inequality, Legislative Polarization, Ideal Points, Agenda-setting, Brazilian Politics.

# 1 Introduction

How does variation in the level of income inequality affect legislative polarization? This paper provides a novel approach to address this question. New evidence from Brazil is introduced in order to advance our understanding of the relationship between inequality and polarization beyond the advanced industrial democracies. The starting point of my analysis is the notion that legislative powers invested in the executive change incentives and constraints to legislators when the President and its coalition show strong support to a policy agenda of redistribution.

Although income inequality is not a new variable in political science, it became critical to study whether and how political actors respond to changes in the socioeconomic landscape. As stated by Beramendi and Anderson (2008a, p. 4-5),

levels of equality or inequality feed back into the processes of democratic representation. Insofar as politics is about *who gets what*, the distribution of income becomes an important factor shaping the preferences of voters, parties, and politicians as well as their dispositions toward the political process and their actions in it.

Based on data from the United States (Garand, 2010; McCarty, Poole and Rosenthal, 2006) and a dozen advanced industrial nations (Pontusson and Rueda, 2008, 2010), the extant scholarship claims that these phenomena are strongly correlated. Although causality (and its direction) is still debated (Kwon, 2015; Voorheis, McCarty and Shor, 2015), the aforementioned relationship tends to be described as follows: the rise of income inequality is associated with the increase in distance between left- and right-wing parties in the legislature, which is followed by gridlock; the outcome is the lack of ability to reduce the former. If we were to accept that voters preferences have become more connected to their incomes, then, low- and high-income voters have more competitive interests during rising income inequality periods, which reinforce their ties with, respectively, left- and right-wing parties. In other words, mass polarization increases as a result from rising economic disputes and partisan differentiation between groups that are now more clearly divided according to their income. At the same time, McCarty, Poole and Rosenthal (2006) show that, in the U.S., congressional ideology had become more associated with constituency characteristics in recent (more unequal) decades.

The extant scholarship, however, provides little leverage on the generalization of its findings and conclusions. The relationship hypothesized and assessed by the literature does not necessarily and automatically translates to other democracies. The global south and other developing nations were not analyzed by the literature, which left unexplored very different trajectories in the evolution of income inequality. It is not evident that decreasing inequality should have the same impact on political polarization as rising inequality.

Another crucial limitation is the lack of attention to the characteristics of the party system. Despite the inclusion of multi-party settings, even the comparative work of Pontusson and Rueda (2008) has a *two-party bias*, i.e., their discussion, conceptualization and measurement of political polarization actually considers only the largest parties in each side of ideological continuum.

My research aims to tackle these shortcomings, assessing the relationship between income inequality and political polarization in Brazil for two main reasons: first, the country is a multi-party presidential democracy; second, there is increasing polarization with decreasing income inequality. Brazil's case, therefore, questions the extant scholarship. To address the broad question on how representation and citizens' wellbeing are connected I explore whether and how political elites react to socioeconomic changes in Brazil.

I further argue that the policy agenda of the government coalition or the President - i.e. the salience given to redistribution by the agenda-setter - conditions the responses offered by legislators and parties to income inequality. If legislative polarization is associated with disputes over redistribution, then governments that set this type of policies as a priority would activate or extrapolate social contradictions. Given the capacity that the executive (or, the legislative majority) has to introduce legislation, governments aiming to alleviate inequality could stress the legislative polarization because they are pursuing redistribution policies which are intimately related to social stratification and mass polarization.

When inequality is decreasing low-income voters get closer to the center of political gravity, reducing their appetite for redistributive policies. In multi-party systems, centrist parties, thus, should be able to capture many of these voters who are now close to the mean income. The old middle class will have incentives to ally with high-income voters so they can keep some privileges over low-income voters. This behavior would be exacerbated if the government coalition keeps signaling that redistribution policies are a priority. Legislators would have to respond to this situation by deciding whether they will support the redistribution agenda introduced by the government coalition and in face of the new distribution of voters preferences.

This paper explores whether members of Congress from electoral districts in which the level of inequality is higher are more radicalized and how this evolves over time. If we were to accept the idea that legislators respond to their constituencies, then, polarization should reflect local dynamics. These questions entail both longitudinal and cross-sectional comparisons. The evidence suggests that, in a comparison of states, income inequality and legislative polarization are positively associated and the relationship is more severe during Worker's Party (PT) presidencies.

Besides this introduction, the current paper is organized as follows. The second section discusses the extant scholarship on polarization and inequality and unpacks my argument and hypotheses. Data and methods are introduced on the third section. Results are shown on the fourth section and a discussion of the findings follow. Finally, in the last section I conclude offering contributions and future research.

## **2 From income inequality to political polarization**

As briefly stated in the previous section, the theory connecting income inequality and redistribution suggests the following sequence: changes in inequality redefine the distribution of voters' preferences; the political elite notices this alteration and pursue a new political platform trying to adjust to the new reality; these changes, thus, reflect on the level of polarization. This section introduces the debate on the literature focusing on each of these links. Before tackling these links, it is important to highlight that the literature is anchored in canonical models that aim to explain redistribution and inequality. After briefly presenting these ideas I evaluate how the scholarship moved towards analyzing inequality as an independent variable rather than only an outcome.

The classical model proposed by Meltzer and Richard (1981) suggests that the median voter will support and demand redistribution policies when inequality is higher and/or increasing. They argue that this is the result of enfranchisement: the entrance of new voters (typically poorer on average than the traditional electorate) dislocates the median in the direction of those who suffers more with income inequality, enhancing the likelihood of redistribution. Their canonical model proposes that voters – given the assumption that they prefer policies that maximize their material interests – will demand policies in favor or against redistribution according to the distance of their average wage from the mean voter income. Meltzer and Richard also assume that political parties will automatically follow the preferences of the median voter in order to increase their vote share. However, as Beramendi and Anderson (2008a, p. 6) point out,

If the median voter in fact rules the democratic game, there is no good reason why policies should exhibit partisan traits. Yet if there is one robust empirical finding in the comparative welfare state and political economy literatures, it is that government partisanship (ideology) has persistently shaped both how much of societal income is redistributed and, perhaps more important, how this share of income is redistributed.

As argued by Iversen and Soskice (2006), if the Meltzer-Richard model holds, one should expect no variation in welfare spending across democracies that have similar levels of inequal-

ity. However, that is not the case. As parties represent classes, the electoral system will impact on the governing coalitions, which will ultimately define redistribution. They argue that in majoritarian or plurality electoral systems with two parties, the middle class has an incentive to coalesce with the rich (to exploit the poor) because the poor, given the competition and the perfect correspondence of parties and constituencies, cannot credibly commit to not set redistribution policies in the center-left. In single-member districts, parties represent more than one income group and they need broad electoral coalitions to win pluralities; the middle class is the kingmaker. Parties under proportional representation formulas, in the authors' model, form coalitions to be able to govern. That commitment is credible under PR system with three parties because those who coalesce need each other's support to rule. Thus, the middle class has incentives to coalesce with the poor to tax the rich and improve redistribution.

The comparative statics derived from Iversen and Soskice's formal model predict that center-left governments tend to rule under PR and, in contrast, center-right coalitions dominate under majoritarian formulas; moreover, redistribution will be higher under PR systems.

Despite their divergences, both models share the lack of consideration for the effect that redistribution may have on the association between group of voters defined by their income and policy preferences. Shifts in voters' preferences - and also in parties positions - over time are left unexplored by the authors aforementioned. Indeed, as emphasized by Beramendi and Anderson (2008*b*, p. 392), "the effect of inequality on the democratic process [...] shapes how political parties define their positions on distributive issues. In particular, inequality can lead to political polarization".

The opportunity to take inequality as an independent variable comes from the absence of a detailed evaluation of those questions by the above discussed literature. Indeed, recent scholarship has been exploring this opportunity. Although the correlation between inequality and polarization in the U.S. and other advanced industrial democracies has been addressed by this recent literature, there is still a division opposing those who believe that the former affects the latter (Bonica et al., 2013; Duca and Saving, 2016; Garand, 2010; McCarty, Poole and Rosenthal, 2006; Pontusson and Rueda, 2008, 2010; Voorheis, McCarty and Shor, 2015) from those who do not share this view (Barth, Finseraas and Moene, 2015; Dettrey and Campbell, 2013; Gelman, Kenworthy and Su, 2010)<sup>1</sup>. Part of this disagreement is related to divergent interpretations on the linkage between the effect of rising inequality on the electorate and the politicians' strategies to respond to changing constituencies.

---

<sup>1</sup>Kwon (2015) discuss "the temporal causal ordering of" inequality and polarization in the United States. He argues that the evidence suggests that the latter is a better prediction of the former than vice-versa. The literature, in Kwon's view, basically assumes that income inequality affects congressional polarization. Voorheis, McCarty and Shor (2015) proposes an instrumental variable approach to show that this assumption is backed up by the data.

Analyzing advanced industrial democracies, Pontusson and Rueda (Pontusson and Rueda, 2008, 2010) tackle this question mobilizing the relationship between the core constituencies of left and right parties and the income segments they represent in advanced industrial democracies. The predictions of their model indicate that rising inequality encourage the left voters to demand more redistribution and the right less – meaning that income inequality affects voters' policy preferences and should generate more polarization at least at the mass level.

Barth and colleagues (2015) would not agree to Pontusson and Rueda. Voters below the mean income suffer more from rising inequality. Thus, the demand for redistribution tends to decrease even within the low-income group when inequality is rising, once they cannot afford welfare expenditures. Only the poorest segment of the electorate would react to these changes, moving towards the center of the ideological continuum.

In fact, McCarty, Poole and Rosenthal (2006) revealed that in the United States rising inequality gives an advantage to the right. Rising inequality should increase the divergence in the policy preferences of the rich and the poor (especially in what concerns redistribution and economic interests), and each segment will intensify their attachments to the Republican or the Democratic parties. Conservative economic policies tend to gauge more support when inequality is rising, which, in turn, increases the support for the right .

It is important to state that McCarty and colleagues are focusing their argument on partisanship. As Gelman, Kenworthy and Su (2010, p. 1213) assert, income inequality is not correlated with class-based voting although “rich and poor are more separated economically than they used to be, the two parties are more separated on economic policy than ever before, and economics remains voters' # 1 issue”. Moreover, Dettrey and Campbell (2013, p. 1063) argues that “despite the increases in both income inequality and polarization in recent years, income inequality does not appear to have been a significant cause of growing [...] ideological polarization among the mass electorate [in the United States]”.

Pointing out the necessity to look for this relationship at the state level in the U.S., Garand (2010, p. 1109) finds out that “Democratic and Republican identifiers stake out divergent ideological positions as a function of state income inequality”. He also shows that in states in which inequality is higher, voters' preferences are skewed towards the extremes of the ideological spectrum and, as consequence, U.S. Senators from these states are also more distant from the median voter. Garand (2010) and also McCarty, Poole and Rosenthal (2006) gather evidence suggesting that income inequality magnifies policy divisions and partisan attachments within the American electorate, which reflects in congressional behavior (as revealed preferences).

Adams (2012) goes beyond the American case and presents solid evidence in support of

the idea advanced by spatial voting theory that parties are willing to (and they do) shift their policy positions in response to the reconfiguration of voters' preferences. Barth, Finseraas and Moene (2015), again, only find support to this behavior in the left parties. They will move towards the right in their policy preferences (regarding welfare agenda) to adapt to the new position of their constituencies. Right parties do not pursue the same because their constituencies are less affected by socioeconomic changes. However, even in Barth, Finseraas and Moene (2015), it is implicit that the right may react to changes in voters' preferences if these changes considerable affect their electorate.

Political elites might respond to voters' policy positions (and changes in this scenario) using different strategies. Adapting their revealed preferences is one way to clearly send a signal to the electorate. Elected officials might express this compromise with their electorate in roll calls. According to Garand (2010), this is exactly what happens with U.S. Senators. Those from states where the electorate is more polarized tend to have more extremists positions as revealed by their votes. As the level of polarization changes, legislators will try to adapt.

The literature influenced by McCarty, Poole and Rosenthal (2006) tends to assert that parties will respond to their constituencies' demands and will radicalize or moderate accordingly. Voorheis, McCarty and Shor (2015, p. 1), for instance, show that

income inequality has a large, positive and statistically significant effect on political polarization [of state legislatures in the United States]. Economic inequality appears to cause state Democratic parties to become more liberal. Inequality, however, moves state legislatures to the right overall. Such findings suggest that the effect of income inequality impacts polarization by replacing moderate Democratic legislators with Republicans.<sup>2</sup>

In my view, the extant scholarship on the linkage between inequality and political polarization has five important shortcomings. First, elites' political polarization conceptualized as the distance among parties' policy preferences was only operationalized and measured in bipartisan systems or by comparing the positions of the most relevant/largest parties in the left and in the right. This *two-party bias* in the conceptualization and measurement of polarization leaves unaccounted crucial characteristics of multi-party settings, namely the level of fragmentation, the disputes within fields of the left-right scale, the importance of centrist parties, and the higher probability of multi-dimensionality (when compared to often unidimensional two-party systems). An adequate assessment of the phenomenon in multi-party settings must account for these fea-

---

<sup>2</sup>From this statement one could expect that the level of political polarization may be altered by the replacement of politicians, which may be associated with changes in the preferences of the electorate. Deeper investigation of this phenomenon is still needed.



tures, otherwise polarization will merely offer a partial view of what is happening with parties' policy preferences.

Second, there is no clear reference to the process in which legislators respond to their constituencies if the districts in which they are elected differ substantially in their characteristics and demands. Based on features often observed in proportional representation systems (e.g., variation in districts' magnitude) one could expect that the rise or the decrease of income inequality will create uneven incentives to legislators from different districts. The adoption of proportional representation makes variation across districts more likely. Moreover, each party's median voter in congress results from an aggregation of preferences of legislators who are elected in districts from very different backgrounds and characteristics.

Third, as recognized by Beramendi and Anderson (2008b), the extant scholarship explored the relationship between income inequality and political polarization only in industrialized and rich democracies, excluding the global south and other developing states, many of which have been consistently alleviating poverty and inequality. Therefore, our capacity to generalize those studies to other cases and compare the results is extremely limited.

Fourth, the policy agenda of the executive, as supported by a legislative coalition, is not carefully accounted for. This is not trivial. If taxation and redistribution are set as a priority by the government coalition, this issue will become more salient in the political arenas, which, in turn, can interfere in the levels of polarization. Moreover, introducing, supporting and/or implementing these type of policies can be used as a strategy to mobilize voters, which can also interfere in mass and elite polarization.

Finally, and in connection with the last shortcoming, the literature needs to focus on the relationship between the executive and the legislature, i.e., whether the regime is parliamentary or presidential and whether the executive holds control over the agenda. By excluding Latin American and Eastern European cases the extant scholarship does not disentangle the system of government (presidential vs. parliamentary) from the executive's control of the legislative agenda and from the party system (the number of parties) - one could also say that the idea of a presidential two-party system in which the president has relatively weak legislative agenda control is not challenged by the literature due to the strong influence and dominance of the study of American politics.

## **2.1 Argument and Hypotheses**

The literature suggests that inequality affects polarization by radicalizing parties' agenda regarding redistribution so they can respond to their constituencies. However, parties are not

only represented in the legislature. Parties also run candidates for president (in presidential systems), dispute to have the prime-minister (in parliamentary systems), and form coalitions (in multi-party systems, in both parliamentary and presidential regimes). Once holding agenda-setting powers, parties have more chances to implement their policies, including those related to taxation and redistribution. Voters react to signals sent by political actors in key positions to affect their lives.

If the constitution guarantees strong legislative powers to the executive (as Brazil), the policy agenda of the president matters to political polarization. I argue, then, that the policy agenda of the president needs to be incorporated to the analysis. This will show us how in different scenarios political actors responds differently to the socio-economic transformations. The scholarship seems to assume that the response is almost automatic, but, especially if analyzing the response in the legislature, one should consider that legislative behavior is constrained by the institutional arrangement.

Considerable powers over the legislative agenda give the executive the ability to have its top priorities voted on the Congress floor. As pointed out by Barber and McCarty (2013, p. 33), control over the agenda is theorized by part of the American politics scholarship (e.g., Aldrich, 1995; Cox and McCubbins, 2005) as generating “more party-line votes and a larger level of observed polarization”.

Nevertheless, the policy agenda of the president should determine how legislators express their preferences. Once endowed with strong agenda-setting powers the president can introduce a more radical agenda or one closer to the *status quo* and this decision has the capacity to influence the level of polarization in Congress. A more radical agenda (in terms of redistribution) tends to increase the division among legislators. Therefore, one would expect more legislative polarization in those years in which the president pursues major changes in taxation and redistributive policies. If these policy issues are determinants of the level of legislative polarization, the distance between political actors should increase when those issues end up in the Congress agenda.

Here I assume that (a) the executive, endowed with the power to set the legislative agenda, can decide whether to pursue redistributive policies, defining the degree of salience of this policy issue for legislators and voters; and (b) the policy space is unidimensional.

At higher levels of pro-redistributive agenda supported by the president, the association between income inequality and legislative polarization becomes stronger and negative. The logic behind this argument is that a pro-redistributive agenda of a powerful political actor as the president tends to force legislators and party leaders to move to the extremes of the left-

right continuum. Suppose that inequality is decreasing and the president is pushing hard to implement taxation and redistribution policies. Right-wing political actors - especially legislators willing to keep their seats and parties aiming to keep and, if possible, increase their share of seats - are more likely to work fiercely to maintain the status quo. In a highly fragmented party-system in which voters have many options (due to an open-list proportional representation electoral system) the uncertainty about who will capture the voters that now have new preferences should create incentives to those political to keep the distribution of preferences at the mass level as it is.

This idea can be expanded into two hypotheses to assess the linkages between income inequality and polarization at the state level. Going local would allow me to check how these two phenomena interact in face of institutional and demographic variation. The logic for also having a comparison across cases resides in the expectation that legislators from states with higher levels of inequality should be more likely to polarize (following the connection between income groups and electoral preferences), but during presidencies working to increase redistribution the relationship should be stronger because legislators will be compelled to express their positions regarding a divisive issue as polarization more directly and frequently.

Therefore, I test both an *over-time effects that vary over time* and a *cross-section effects that vary over time* hypotheses:

$H_1$ : as income inequality decreases in a state over time, legislative polarization rises when the president has a pro-redistributive agenda.

$H_2$ : relative to other states, a state with higher levels of income inequality is more polarized, but this relationship is more pronounced when the president has a pro-redistributive agenda.

In the next section I present the strategies, data and methods that I explore in order to answer the research questions here discussed and test the hypotheses.

### **3 Research Design**

The analysis of the Brazilian case should equip me to overcome the limitations imposed by the dominance of studies on inequality and political polarization that focus on advanced industrial states or even only on the United States. As largely discussed here Brazil is a multi-party system. Hence, the Brazilian case helps me to tackle the *two-party bias* that is recurrent in the literature. Analyzing a multi-party setting does not automatically translate into adequately account for the characteristics of the competition between more than two parties. Pontusson and

Rueda (2008), for instance, forced a two-party logic into their measure of political polarization - the number of parties was included only as control variable in their models. My goal is to pursue a measurement strategy that takes the number of parties (and its byproducts) seriously. Brazil, moreover, has not been facing a fixed number of parties competing for votes. Over the years the party system fragmentation and the number of parties with at least one deputy has been increasing. This scenario offers a challenge and an opportunity to include this variation in my measure. Given that the number of effective parties and also the most important and largest parties vary across Brazilian states, I can explore different types of competition by going local.

Therefore, I have the opportunity to investigate the importance of district characteristics to the strategic behavior of legislators and parties - and, then, I confront the second shortcoming. To understand how political actors react to changes in voters social experiences and preferences, we need to focus on the characteristics of the electoral districts, the jurisdiction where they compete for votes. Members of congress are elected having the states as their electoral district. Besides the variation in magnitude (from 8 to 70 seats, currently), they also have their own political traditions, and considerable socioeconomic and demographic differences. Brazil constitutes a great case to investigate whether and how this variation plays a role in the relationship between inequality and political polarization.

The exclusion of the global south and, specifically Latin American countries, from the usual analysis is another shortcoming that I aim to surpass with this research. Brazil is an important country in the continent, and heavily studied by scholars from the comparative politics field due to its unusual institutional architecture and regime history (e.g., Ames, 2001; Mainwaring, 1993; Mainwaring and Pérez-Liñán, 1997; Samuels, 2003). Bringing Brazil to the study of inequality and polarization adds a case that combines a presidential regime in which the president has strong legislative powers with a multi-party system and an open list proportional representation electoral system. This addition, I believe, might challenge the findings of the literature or improve its external validity, helping us to define whether institutional and socioeconomic characteristics that are not seen on advanced industrial democracies are crucial to this research agenda.

Focusing on the Brazilian case, then, my research would target the final two shortcomings of the extant scholarship, namely the urge to consider the policy agenda of the executive and the relationship between the president and the legislature. Legislative polarization can be highly influenced by those setting the agenda, i.e. legislators will have the opportunity to express their preferences regarding items that are under discussion in Congress<sup>3</sup>. Studying Brazil would

---

<sup>3</sup>Legislators and party leaders can make statements about any issue at anytime, but if we want to measure the legislative behavior we will need systematic information about their preferences over policies.

allow me to explore how legislators and parties respond to different levels of income inequality in a institutional environment in which the executive can set the agenda but at the same time it needs to strategically bargain with the legislature to form majorities in order to pass its policy agenda (Figueiredo and Limongi, 2009).

### **3.1 Data**

In order to assess the relationship between income inequality and legislative polarization in Brazil, I change the focus of the analysis from the country to the states (which are the electoral districts in Brazil). In other words, I work with a time series cross-sectional data in which the units are states-years: every variable is observed/measured for each Brazilian state yearly. The dataset I created puts together information for all 26 states and the federal district (which elects representatives who have the right to vote) between 1989 - the first year after the enactment of the new democratic constitution - and 2014.

To answer the research questions here proposed I rely on data from different sources. To measure legislative polarization I follow McCarty, Poole and Rosenthal (2006) and depart from roll calls taken on the floor of the Chamber of Deputies (“Camara dos Deputados”), the Brazilian Congress lower house. *CEBRAP’s Brazilian Legislative Database* gathers and organizes the roll calls and make them available to researchers under request. The long transition to democracy in Brazil was concluded with the enactment of the Federal Constitution in October 5, 1988. Roll calls taken on the floor of both houses started in 1989. The referred dataset contains all roll calls votes taken since then until the end of 2015. CEBRAP’s dataset is also the source to other variables on political institutions in Brazil.

The Brazilian Institute for Applied Economic Research (IPEA), a governmental agency, provides socioeconomic and demographic data at the national and the state level. The Gini index and some of the control variables were obtained via IPEA’s online dataverse (IPEA, 2016).

### **Dependent variable**

Political polarization, in general, is conceptualized as the level in which political actors are positioned in the extremes of the ideological continuum. Following Levendusky and Pope (2011, p. 229), this definition implies distance and overlapping: how far are each one from each other and how are they dispersed? Critical to this interpretation of the phenomenon is the definition of who are the political actors.

To measure how far elites spread out in policy preferences, I work with the polarization of parties. As I discuss in the sequence, parties’ policy positions are estimated based on their

members revealed preferences in the Chamber of Deputies' roll calls. Polarization at the elite level, thus, is understood here as the ideological distance between parties in the same state.

Studies of political polarization at the elite level tend to focus on bipartisan settings, where polarization is often measured as the difference between the positions (i.e. ideal points estimated based on roll calls, co-sponsorships, party manifestos or surveys with legislators and party leaders) of the median voters of both parties. The challenges on how to measure it in multiparty systems are rarely addressed. Pontusson and Rueda (2008, 2010), for instance, approach political polarization by analyzing the position of the most important/biggest parties on the left and on the right, leaving behind other parties even in fragmented systems. Dalton (2008) and Stanig (2011) are the exceptions. They propose simple formulas to calculate political polarization based on voter perceptions, expert surveys or manifestos. Stanig (2011, p. 4) argues that one should take the size of each party in account when measuring political polarization in multiparty systems because it is a phenomenon characterized by both “the positions of parties relative to the center of the policy space, and their relative strength”. Stanig’s measure is appealing due to its simplicity and its capacity to account for the size of each party and the distribution of policy preferences. Moreover, it can be easily applied in systems with different number of parties.

Therefore, I adopt Stanig’s measurement with few adaptations - interpreting parties’ relative strength as the share of seats in the Chamber of Deputies. In a system with  $J$  parties, each one with a share of seats  $p_j$  and a policy position  $x_j$ , the index of polarization, given a median voter  $\hat{x}$ , is calculated as follows:

$$\text{Legislative Polarization} = \frac{\sum_{j=1}^J p_j |x_j - \hat{x}|}{J \sum_{j=1}^J p_j^2}$$

In this paper the policy position of each party should be understood as the median voter of the party at the state level based on the ideal points estimated for the federal deputies. The first step is to estimate yearly ideal points based on roll calls that took place in the floor of the Chamber of Deputies (the lower house of the National Congress). A dynamic item response theory (IRT) model, implemented via Expectation-Maximization (EM) algorithms (Imai, Lo and Olmsted, 2016), is the methodology used to recover the ideal points<sup>4</sup>. The method here implemented is appropriate to estimate the legislators’ ideal points because it allows “assessment of uncertainty and hypothesis testing in the presence of large numbers of parameters” (Clinton, Jackman and Rivers, 2004, p. 355). The IRT model is largely known for its use in educational testing, in which the difficulty and the discrimination parameters of the items (i.e., the questions

---

<sup>4</sup>The methodological appendix presents this technique to estimate dynamic ideal points.

in a standardized exam) are estimated alongside the latent variable (i.e., “students ability”). Roll calls can be used instead of exam questions in order to estimate the ideal points.

After estimating individuals’ ideal points, I separate them according to their party affiliation and their home state. Finally, based on ideal points from individuals from the same party and state a median voter is estimated to serve as the policy positions of each party in each state. For instance, we may have the median voter of the Social Democrats (PSDB) in the state of Sao Paulo in 2003 scoring .6 in the ideal point scale and the median voter of the same party in the same year but in the state of Rio de Janeiro scoring .3.

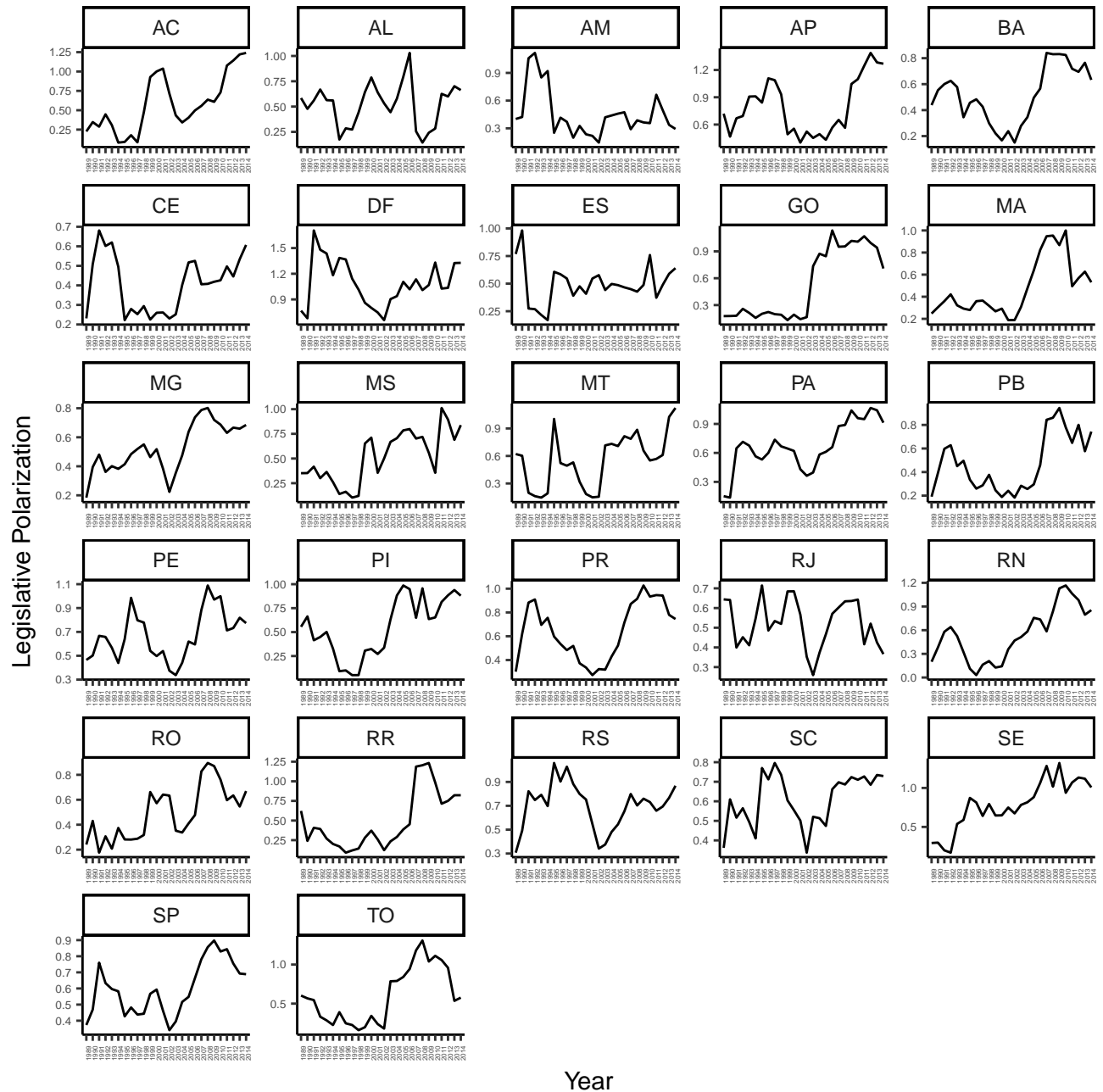
After estimating the dynamic ideal points and calculating the median voters for each party and each state (given the representatives elected on each state to serve at the national legislature) I can measure legislative polarization over time based on the aforementioned formula. The time series line graphs for legislative polarization are displayed for each state on the Figure 1. It is hard to find a clear pattern in the distribution of this variable over time. For some states one can identify shocks that are never forgotten and/or situations in which legislative polarization takes higher values before and after a period of lower mean, indicating non-stationarity, whereas for other states the time series tend to follow a long-term mean. Maybe the length of the time-series (26 years) is not enough to identify a clear pattern.

### **Independent variable**

The main independent variable of this study is state income inequality, which is measured as the income Gini coefficient (based on census data for households). The idea is to access the income distribution in the Brazilian society and, at the same time, the size of the gap between the poor and the rich in each state. The Gini coefficient ranges from 0 (perfect equality) to 1 (perfect inequality). Figure 2 depicts the income inequality time series for each state. As one can see, in the long-run the Gini coefficients tend to decrease in all states. It is important to highlight that the scales of these graphs are set free and, then, in some cases what seems a lot of variation is just small changes over a long-term mean. It seems hard to establish if the time series has unit root process.

In one of the models - testing for over-time effect that varies over time - an interaction is introduced with a dvariable indicating the presence of a president or a governing coalition that sets policies of income redistribution as a top priority. In order to have a simple measure for that, I created a straightforward dummy variable indicating those years in which the Worker’s Party was in the presidency - in my data all years after 2003 are coded as 1 because the Worker’s Party left the presidency (through an impeachment process) only in 2016. I don’t mean to

Figure 1: Legislative Polarization over time by state



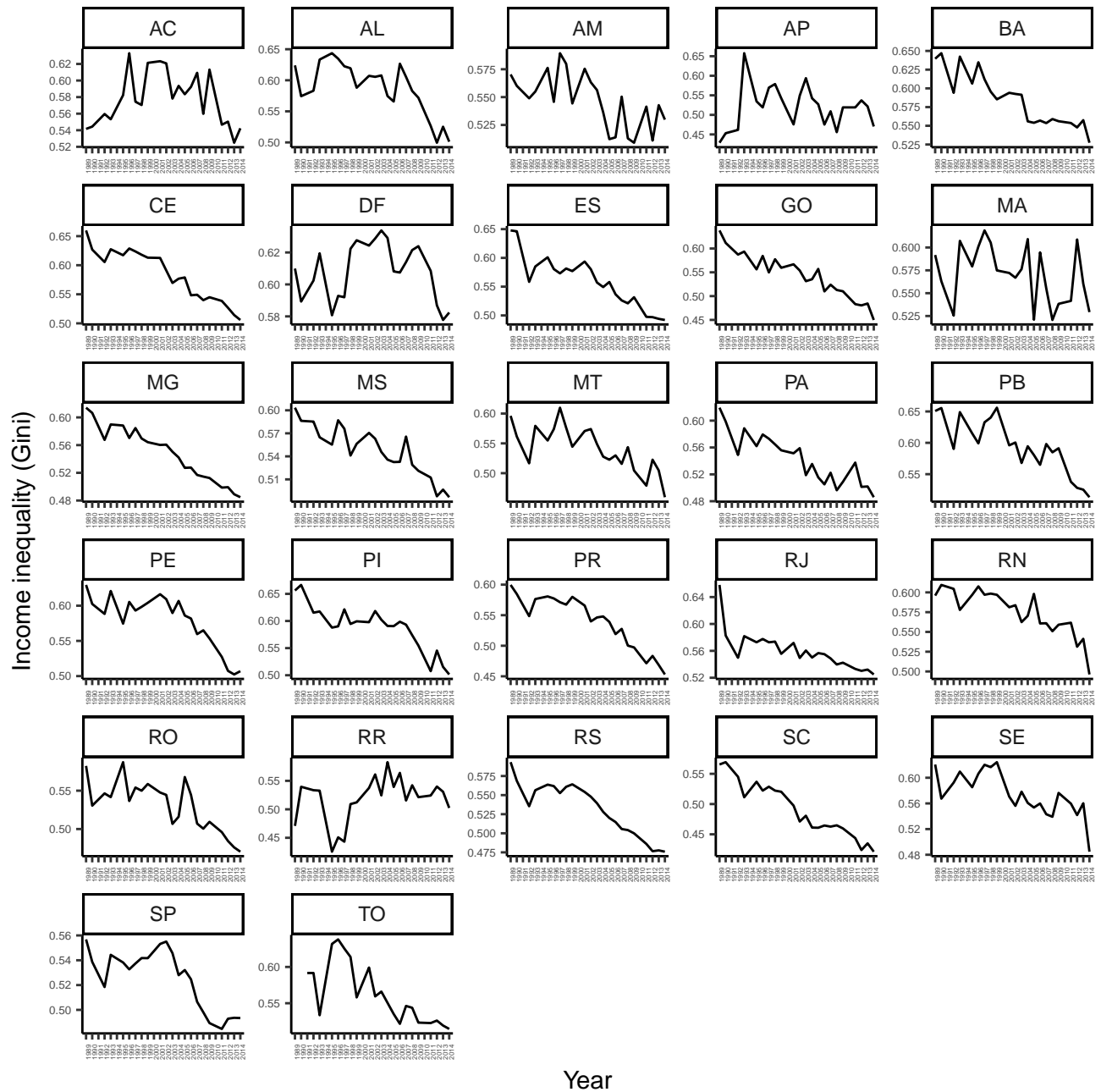
say that only presidents Lula and Rousseff sought to alleviate poverty and redistribute income. However, they clearly made those issues to their agendas whereas Cardoso, for instance, sought to reduce inequality mainly by achieving economic stability.<sup>5</sup>

The relationship between legislative polarization and income inequality is illustrated by Figures 3 and 4. The former displays the relationship by states and the shape of the points indicates which units are from the Worker's Party period (triangles) and which units are from

<sup>5</sup>Future versions of this paper will consider alternative measures for the presidential agenda.



Figure 2: Income inequality (Gini coefficient) over time by state



other administration (circles). From Figure 3 the relationship is clearly negative in many cases whereas in some states both variables do not seem to be associated. In only a few states one can detect a positive association. During the Worker's Party presidency inequality tends to take lower values and polarization higher values - there are many exception, including states that fits curves with opposite signs when comparing one period to the other.

Figure 4 depicts the relationship under investigation by year - each unit is a state in a given year. There is no clear association between income inequality and legislative polarization when

we focus in specific time points, although there is a tendency for small positive correlation after 2003 (the year the Worker's Party took the presidency).

Overall this descriptive evidence indicates that the linkage is not really strong, but the Worker's Party presidency appears to alter the relationship between income inequality and legislative polarization.

Figure 3: Legislative polarization and income inequality by state and presidency

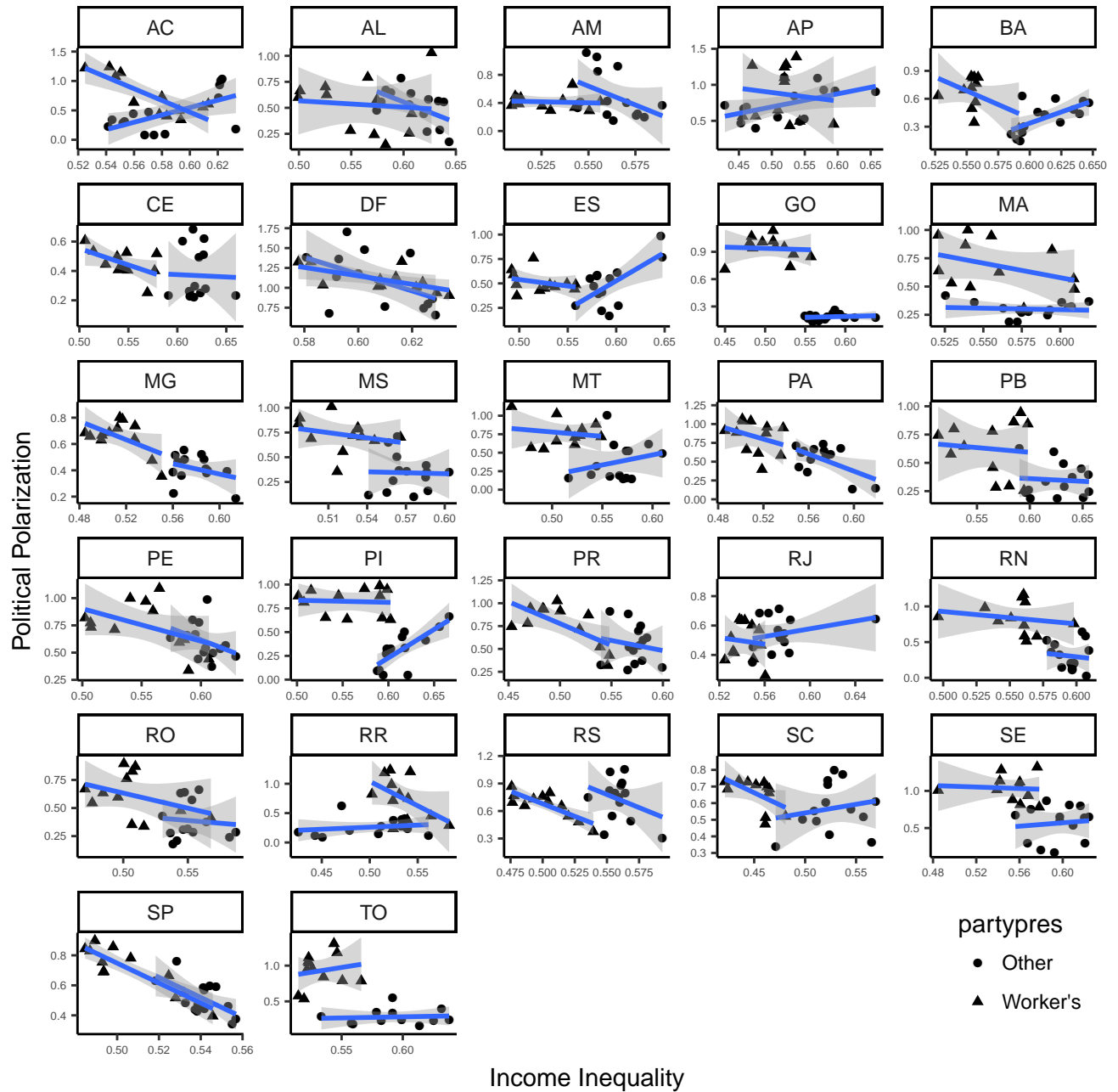
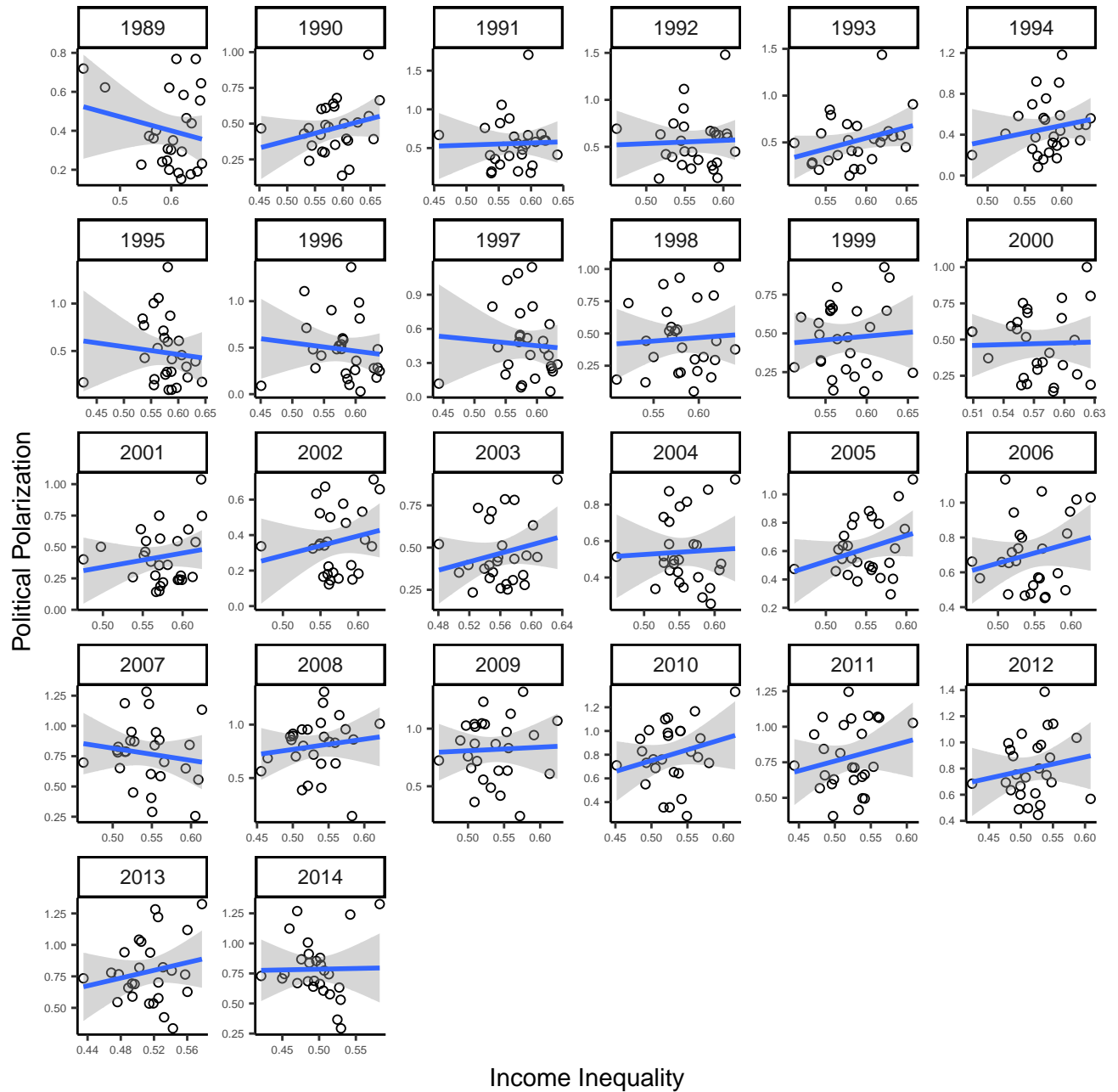


Figure 4: Legislative polarization and income inequality by year



### Control variables

The model specification also accounts for some socioeconomic and political variables. I am working with a limited number of controls due to the lack of yearly data at the state level. At the next stages of the research, my goal is to expand the list. The control variables vary over time and cases.

First, multiparty competition drives parties on the left and the right to move towards the

extremes of the ideological continuum (Cox, 1990). To account for these party system dynamics that can influence the level of political polarization I included a variable indicating the effective number of parties based on the share of seats (Laakso and Taagepera, 1979) for each state in each year. When the effective number of parties is higher the incentives for some of them to appeal to voters on the extremes increase, thus, polarization follows as some legislators radicalize in Congress. Also, if the party competition is not enough to offer an option to the poor - which tends to happen when the effective number of parties is close to two (Iversen and Soskice, 2006) - the likelihood of less policies of redistribution decreases, influencing income inequality.

Second, the proportion of rural population tends to be related to the average level of ideological conservatism in a district. Moreover, societies that are predominantly rural, although poor, are often more equal in terms of income. Hence, I included a variable measuring that proportion.

Third, access to formal education is associated, on average, with less conservatism. Less educated areas would have more legislators responding to this ideological conservatism at the mass level, tilting legislative polarization. Reduced access to formal income creates barriers for those trying to socially ascend, which, in turn, affects the chances of changing income inequality. A variable indicating the mean of the number of years people from that state spent on school was added.

Fourth, if income is associated with policy preferences as theorized by Meltzer and Richard (1981) and Iversen and Soskice (2006) the size of each social class matters to the type of coalitions will be formed, which should influence legislators behavior and the policy agenda they will try to implement - thus, affecting both polarization and inequality. In order to deal with that, I included a variable indicating the yearly proportion of poor in each state.

## **Descriptive statistics**

Before discussing model specifications let me introduce descriptive statistics of the dependent, independent and control variables for 27 states over 26 years<sup>6</sup>. One will notice that there is a considerable variation in all socioeconomic variables, indicating very different social situations within Brazil since the democratization. The Effective Number of Parties has a high mean (more than 5), but the variation is big.

---

<sup>6</sup>The panel is unbalanced only because the state of Tocantins was created in 1988 and no demographic data, including the Gini coefficient, is available for the first two years of the series.

Table 1: Descriptive statistics

Statistic	Mean	St. Dev.	Min	Max
Legislative Polarization	0.587	0.290	0.030	1.706
Income Inequality	0.558	0.045	0.421	0.666
Effective Number of Parties	5.443	1.880	1.600	10.965
Proportion of Rural Pop.	0.231	0.107	0.022	0.591
Education (mean of years in school)	5.882	1.417	2.424	10.082
Poverty Rate	29.749	16.381	2.861	76.636

### 3.2 Methods

To assess the effect of state income inequality on legislative polarization in Brazil dependent on the party of the president I formulated two hypotheses, once referring to over-time effects that vary over time and once referring to cross-section effects that vary over time. In order to adequately examine these hypotheses I use, respectively, a change point model with case fixed effects and a time fixed effects with a linear time interaction.

To assess the hypothesis regarding over-time effects that vary over time I'll interact the independent variable income inequality with a dummy for the Worker's Party presidency (which varies over time as a step), and keep the cases fixed. Hence, I'm interacting the main independent variable with a dummy that takes the value of 1 after a particular time point (in my case the year of 2003, or the year that the Worker's Party took the Brazilian presidency).

For the hypothesis regarding the cross-section effects that vary over time I'll use a one-way time fixed effects and interact income inequality with  $\tau$ , a variable that basically counts the time points (assuming the value of 1 in the first year of the series). The time fixed effects model with a linear time interaction has the advantage of maximizing the amount of power used. However, I am relying on an assumption that it varies linearly - I am using a linear time interaction because I do not have any obvious reasons to believe that it varies in a different way.

The interactions are specially important to my analysis because my hypotheses are not only about how income inequality and legislative polarization, but about how this relationship is stronger when the executive or governing coalition is led by a party that elects alleviating poverty and inequality as its top priority. Therefore, the interactions in both models allow me to identify whether the effects of income inequality on legislative polarization are different when comparing the Worker's Party period (started in 2003) with the previous administrations (from 1989 to 2002).

Fitting fixed effects models will suffice for this exercise specially because I am not working with variables that are time invariant. Also, my goal is not to average cross-sectional and over-time effects. Unit effects do not seem to independent from the independent variable. Hence,

random effects models are not necessary for the purposes of this paper.

It is important to highlight that case fixed effects supposedly eliminate time-fixed omitted variables, while time fixed effects supposedly eliminate case-fixed omitted variables. I do not use two-fixed effects model here because “the coefficients combine cross-sectional and temporal variance in a way that does not clearly describe how cases differ from one another or how these cases change over time” (Hox, p. 29), so instead of having the best of two worlds one cannot explore variation over time and over cases.

That being said, the equations to fit both regression models are as follows:

- Change point model (Case Fixed Effects):

$$y_{it} = \alpha + \beta_1 \text{Gini}_{it} + \beta_2 \text{WorkersP}_t + \beta_3 \text{Gini}_{it} * \text{WorkersP}_t \\ + \beta_4 \text{ENP}_{it} + \beta_5 \text{ruralpop}_{it} + \beta_6 \text{education}_{it} + \beta_7 \text{poverty}_{it} \\ + v_i + \varepsilon_{it}$$

- Time fixed effects with linear time interaction:

$$y_{it} = \alpha + \beta_1 \text{Gini}_{it} + \beta_2 \text{Gini}_{it} * \tau + \\ + \beta_3 \text{ENP}_{it} + \beta_4 \text{ruralpop}_{it} + \beta_5 \text{education}_{it} + \beta_6 \text{poverty}_{it} \\ + w_t + \varepsilon_{it}$$

where  $v_i$ , the unit effects or the unobserved heterogeneity in the model, and  $w_t$ , the time fixed effect, are part of the observed dataset and not treated as part of the residual.

The change point model with case fixed effects includes a constituent term for the interacting dummy variable. It is different than a random slope model in which the interacting independent variable drops out, leaving the model without a  $\beta$  for this variable. The time fixed effects with a linear interaction with time model, as the random slope model, does not contain the constituent term for the interacting  $\tau$  variable because it does not vary over cases in the same given year.

There are two main concerns that arise from the literature on the linkage between income inequality and political polarization. The first is reverse causality. As diagnosed by Kwon (2015) the extant scholarship tends to assume that the former affects the latter. Kwon argues that, at least for the United States, the causality runs in the opposite direction. (McCarty, Poole and Rosenthal, 2006) also called attention to a reinforcing effect between those two variables, which in the American case created a spiral of rising inequality and congressional polarization. (Voorheis, McCarty and Shor, 2015) seem to follow this idea, but they implement an instrumental variable approach to demonstrate that income inequality is in fact causing polarization. Although research on this topic for multiparty systems are rare, there is no evidence or theoretical

reason to believe that reverse causality would be a problem for the Brazilian case. Polarization can cause inequality if it enhances the likelihood of gridlock, preventing the legislature to pass legislation promoting redistribution. However, contrary to the expectations that the Brazilian institutions would create legislative paralysis (Ames, 2001), systematic evidence showed that when a government coalition has a majority in the legislature, as it had for almost all the democratic period, gridlock has not been a problem in Brazil (Figueiredo and Limongi, 1999, 2000; Freitas, 2013). Moreover, congressional polarization *per se* does not seem enough to cause income inequality. In a multiparty system, specially a fragmented one (as Brazil), the coalitions formed are decisive to reduce or increase redistribution and higher levels of polarization only make it harder to form coalitions, not to moderate their agenda (Figueiredo, 2007).

The second concern is lagging the variables. There is no clear discussion on the literature on why one should lag polarization and/or inequality. Can legislators respond to changes in the socioeconomic landscape immediately? It is hard to state that, for instance, changes in income inequality are only perceived by legislators after one year and then they will react altering the level of polarization. How one can say that is only one year? I argue that voters (and citizens, in general) can feel very quickly the effects of important economic trends on their lives (e.g., unemployment, changes in income, demographic changes in their communities) and their agreement or disagreement with that situation can be perceived by legislators, who, seeking reelection, are always paying attention to their constituencies. Hence, I don't have a clear theoretical reason to lag any variables in my models. My goal, moreover, is not to explore marginal effects at different points in time, which can be achieved by the introduction of lagged variables.

Before displaying and discussing the results draw from my models one can notice from the figures presented in the last section that the series appear to be non-stationary for many states. To the best of my knowledge there is still a debate on the literature about how to test for unit root process in panel data (Maddala and Wu, 1999). I conducted an augmented Dickey-Fuller for unit root process in panel data, computing the Maddala and Wu (1999) test, with drift and trend terms and no lags<sup>7</sup>. For both income inequality and political polarization the p-values of these tests approaches zero, indicating that we can reject the null hypothesis of unit root process and state that the series for both variables are stationary.

---

<sup>7</sup>I also conducted the same test but using the AIC metric to select the number of lags till a maximum of 5 lags and the results are the same

## 4 Results and Discussion

In this section, I present the results of my investigation on the relationship between state income inequality and legislative polarization in Brazil. Evidence from the models described in the last section are shown. The coefficients from the regression are not reported here because one cannot assess the effect of the independent variables on the dependent once an interaction is added to regression model. In this section the focus will be on the marginal effects.

Figure 5 depicts the marginal effects of income inequality on legislative polarization for the change point model. One will notice that the marginal effect of income inequality after the Worker's Party first inauguration in 2003 and the marginal effect of income inequality before that (i.e., under presidencies from other parties) have opposite signs: the latter is positive and the former is negative. However, the upper bound of the confidence interval of the marginal effect of income inequality during the Worker's Party presidency touches the zero, making it impossible to distinguish at the 5% level if the effect is really negative and even different than zero (no effect).

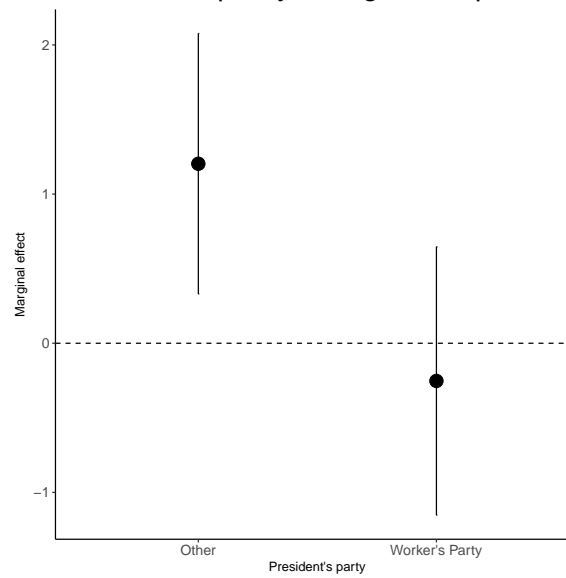
Reading only the marginal effect we can say that after the beginning of the Worker's Party presidency in 2003, a one-unit increase in income inequality is associated with .25 units decrease on legislative polarization for the same state over time, on average, after accounting for the effective number of parties, proportion of rural population, years of education, and proportion of people in poverty. For those years before 2003 (all other administrations), a one-unit increase in the Gini coefficient is associated with 1.20 units increase on legislative polarization for the same state over time, on average, after accounting for those aforementioned control variables - quite a large effect, given that the highest value for polarization is around 1.7.

Figure 6 depicts the marginal effects of income inequality on legislative polarization for the time fixed effects with linear time interaction. On the x-axis we have  $\tau$ , a variable that assumes the value of 1 in the first year of the series and grows linearly. Here the marginal effect is always positive and increases over time. In a comparison of states at the same time point, high levels of income inequality have a more benign effect on political polarization in the most recent years. Indeed, after 2003 ( $\tau = 15$ ) the average marginal effect of the Gini coefficient on legislative polarization is more pronounced than before the Worker's Party presidency. One can notice that the confidence intervals of the marginal effects only touch the zero at the beginning of the series, suggesting that across cases income inequality matters to legislative polarization over most of the years in the series.

We can say that for the last year of the Social Democrats' presidency (2002, or  $\tau = 14$ ), a one-unit increase in income inequality is associated with 1.05 unit increase on legislative

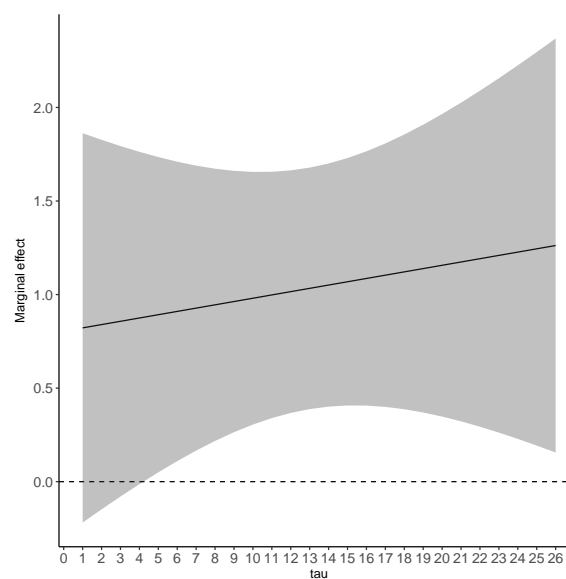


Figure 5: Marginal effects of income inequality on legislative polarization - change point model



polarization across states, on average, after accounting for the effective number of parties, proportion of rural population, years of education, and proportion of people in poverty. For the last year of Lula's administration (2010, or  $\tau = 22$ )<sup>8</sup>, a one-unit increase in income inequality is associated with 1.19 unit increase on legislative polarization across states, on average, after accounting for the effective number of parties, proportion of rural population, years of education, and proportion of people in poverty.

Figure 6: Marginal effects of income inequality on legislative polarization - time FE with linear time interaction



<sup>8</sup>Lula was the first president from the Worker's Party. He was followed by President Dilma Rousseff, who was elected and reelected representing the same party.

These findings offer partial support to my hypotheses. For the over-time effects that varies over time hypothesis the expectation was a negative effect on legislative polarization - meaning that rising inequality decreases polarization and vice-versa - for both the marginal effects of inequality after and before the first year of the Worker's Party presidency. Not even for the period initiated in 2003, which I hypothesize as being more pronounced, the marginal effect is negative (if we consider the 95% confidence intervals). This piece of evidence suggests that, in general, the relationship between income inequality and legislative polarization in developing countries might have some correspondence to what others found in advanced industrial democracies (McCarty, Poole and Rosenthal, 2006; Pontusson and Rueda, 2008, 2010; Voorheis, McCarty and Shor, 2015). It is important to highlight that although not statistically significant, income inequality affects legislative polarization in a different way during the Worker's Party presidency compared to other administrations. This evidence offers partial and weak support to the hypothesis that the effect should be negative and more severe during Lula's and Rousseff's administrations (the presidents from the Worker's Party). It is at least an indicative that income inequality could have different impacts on legislative polarization over time according to the party of the president and its agenda. One possible explanation is that no matter if overall income inequality is decreasing or increasing, in the same unit high levels of inequality will be associated with high levels of polarization if no important political force weighs in with an agenda to change the *status quo* regarding redistribution. The activation of such agenda may break that relationship by changing the way voters and other political actors mobilize.

Deeper investigation of this issue is necessary. The descriptive analysis had already indicated that the relationship we are analyzing varies considerably from state to state over time. Future research will keep exploring local differences in order to offer a better assessment of the phenomenon.

For the over-time effects that varies over time hypothesis the expectation was a positive effect on legislative polarization and a more severe effect of income inequality after 2003, when the first Worker's Party president was inaugurated. The outcome of the analysis here employed supports this hypothesis. States that have higher levels of income inequality, indeed, experience higher levels of legislative polarization and during the Worker's Party presidency these states will experience even higher political polarization. In other words, the policy agenda of a political actor with agenda-setting powers matters for the relationship between income inequality and political polarization.

Legislators seem to respond to their constituencies if we assume - based on theoretical models as Meltzer and Richard (1981) and Iversen and Soskice (2006), and empirical research

as Garand (2010) - that income inequality is associated with mass political polarization. A better assessment of this would implicate exploring also the impact of income inequality on voters' polarization and of the latter on congressional polarization. Due to the scarcity of public opinion surveys that have adequate samples for a considerable number of states and that are repeated over time, this is still a challenge.

Finally, the importance of testing for both over-time effect that varies over time and cross-section effect that varies over time deserves attention. Altogether they reveal that after 2003 the over time effect of income inequality on legislative polarization is negative (although not statistically significant at the 5% level) while the cross-sectional effect is positive (and statistically significant). This can be a paradox, but it seems plausible that different stories can be told by looking to the data with different views. For instance, the case A can have a decreasing inequality over time associated with rising legislative polarization, and the case B can face the same trajectory but always at lower levels than A.

## 5 Conclusion

My research aims to contribute to our understanding on how politicians respond to voters given changes in the socioeconomic landscape. This paper explores one of multiple options legislators have in order to advance their careers. Elite preferences is not a static phenomenon, meaning that changes in society (as those motivated by rising/decreasing inequality) might alter the payoffs of different types of responses politicians can offer. Broadly, this paper aims to increase our knowledge on how representation takes place in dynamic societies. Specifically, my goal is to evaluate the relationship between state income inequality and legislative polarization in a developing country and take into consideration how the effect of the former on the latter depends on the presidents' policy agenda regarding redistribution (which can be understood by the timing a party with this agenda was inaugurated in the presidency).

The findings support the hypothesis that a state with higher levels of income inequality is more polarized, but this relationship is more severe after 2003. There is no significant support, however, to the hypothesis that as income inequality decreases in a state over time, polarization rises, but this relationship is more pronounced during the Worker's Party presidency. Legislators, overall, seem to respond to changes in their constituencies, although we still need to explore how they do it under different presidencies.

Given the evidence presented in this paper I hope to have achieved two main goals. First, this study increases our knowledge about the relationship between income inequality and political polarization, expanding the analysis beyond OECD countries and leveraging on information

from a country in which the states, and their trajectories, vary considerably in terms of socioeconomic features. Second, this paper pursue strategies to let the effects vary over time by focusing on the moment a government sets a policy agenda aiming to alleviate inequality. Taking into account the preferences of the executive is extremely important in multiparty party system in which the president (and its governing coalition) has agenda-setting powers.

Finally, my goals for the next phase of this research project are to review the control variables (adding a few more socioeconomic variables and indicators for local politics), consolidate a measure of legislative polarization, work with alternative indexes for income inequality, explore measures for the political agenda of the Brazilian president, and test stationarity for panel data.

## References

- Adams, James. 2012. "Causes and Electoral Consequences of Party Policy Shifts in Multiparty Elections: Theoretical Results and Empirical Evidence." *Annual Review of Political Science* 15(1):401–419.
- Aldrich, John H. 1995. *Why Parties? The Origin and Transformation of Political Parties in America*. 1st edition ed. Chicago: University of Chicago Press.
- Ames, Barry. 2001. *The Deadlock of Democracy in Brazil*. Interests, identities, and institutions in comparative politics Ann Arbor: University of Michigan Press.
- Barber, Michael and Nolan McCarty. 2013. Causes and Consequences of Polarization. In *Negotiating Agreement in Politics: Report of the Task Force on Negotiating Agreement in Politics*, ed. Jane Mansbridge and Cathie Jo Martin. APSA.
- Barth, Erling, Henning Finseraas and Karl O. Moene. 2015. "Political Reinforcement: How Rising Inequality Curbs Manifested Welfare Generosity." *American Journal of Political Science* 59(3):565–577.
- Beramendi, Pablo and Christopher J. Anderson. 2008a. Income Inequality and Democratic Representation. In *Democracy, Inequality, and Representation in Comparative Perspective*, ed. Pablo Beramendi and Christopher J. Anderson. New York: Russell Sage Foundation.
- Beramendi, Pablo and Christopher J. Anderson. 2008b. Inequality and Democratic Representation: The Road Traveled and the Path Ahead. In *Democracy, Inequality, and Representation*

- in Comparative Perspective*, ed. Pablo Beramendi and Christopher J. Anderson. New York: Russell Sage Foundation.
- Bonica, Adam, Nolan McCarty, Keith T. Poole and Howard Rosenthal. 2013. "Why Hasn't Democracy Slowed Rising Inequality?" *The Journal of Economic Perspectives* 27(3):103–123.
- Clinton, Joshua, Simon Jackman and Douglas Rivers. 2004. "The Statistical Analysis of Roll Call Data." *American Political Science Review* 98(02):355–370.
- Cox, Gary W. 1990. "Centripetal and Centrifugal Incentives in Electoral Systems." *American Journal of Political Science* 34(4):903–935.
- Cox, Gary W. and Mathew D. McCubbins. 2005. *Setting the Agenda: Responsible Party Government in the U.S. House of Representatives*. Cambridge University Press. Google-Books-ID: fm9qVy379AQC.
- Dalton, R. J. 2008. "The Quantity and the Quality of Party Systems: Party System Polarization, Its Measurement, and Its Consequences." *Comparative Political Studies* 41(7):899–920.
- Dettrey, Bryan J. and James E. Campbell. 2013. "Has Growing Income Inequality Polarized the American Electorate? Class, Party, and Ideological Polarization." *Social Science Quarterly* 94(4):1062–1083.
- Duca, John V. and Jason L. Saving. 2016. "Income Inequality and Political Polarization: Time Series Evidence Over Nine Decades." *Review of Income and Wealth* 62(3):445–466.
- Figueiredo, Argelina. 2007. "Government Coalitions in Brazilian Democracy." *Brazilian Political Science Review* 1(2).
- Figueiredo, Argelina and Fernando Limongi. 1999. *Executivo e Legislativo na nova ordem constitucional*. Rio de Janeiro: Editora FGV.
- Figueiredo, Argelina and Fernando Limongi. 2000. "Presidential Power, Legislative Organization, and Party Behavior in Brazil." *Comparative Politics* 32(2):151–170.
- Figueiredo, Argelina and Fernando Limongi. 2009. Poder de Agenda e Políticas Substantivas. In *Legislativo Brasileiro Em Perspectiva Comparada*, ed. Magna Inácio and Lúcio Rennó. Belo Horizonte: Editora UFMG.
- Freitas, Andréa. 2013. *Presidencialismo Da Coalizão* Doctoral dissertation Faculdade de Filosofia, Letras e Ciências Humanas, Universidade de São Paulo São Paulo: .

- Garand, James C. 2010. "Income Inequality, Party Polarization, and Roll-Call Voting in the U.S. Senate." *The Journal of Politics* 72(4):1109–1128.
- Gelman, Andrew, Lane Kenworthy and Yu-Sung Su. 2010. "Income Inequality and Partisan Voting in the United States." *Social Science Quarterly* 91(5):1203–1219.
- Imai, Kosuke, James Lo and Jonathan Olmsted. 2016. "Fast Estimation of Ideal Points with Massive Data." *American Political Science Review* 110(4):631–656.
- IPEA. 2016. "Ipeadata."
- Iversen, Torben and David Soskice. 2006. "Electoral Institutions and the Politics of Coalitions: Why Some Democracies Redistribute More Than Others." *American Political Science Review* 100(2):165–181.
- Kwon, Roy. 2015. "Does Radical Partisan Politics Affect National Income Distributions? Congressional Polarization and Income Inequality in the United States, 1913–2008\*." *Social Science Quarterly* 96(1):49–64.
- Laakso, Markku and Rein Taagepera. 1979. "'Effective' Number of Parties: A Measure with Application to West Europe." *Comparative Political Studies* 12(1):3–27.
- Leoni, Eduardo. 2002. "Ideologia, Democracia e Comportamento Parlamentar: A Câmara Dos Deputados (1991-1998)." *Dados* 45(3):361–386.
- Levendusky, Mathew and Jeremy Pope. 2011. "Red States vs. Blue States: Going Beyond the Mean." *Public Opinion Quarterly* 75(2):227–248.
- Maddala, G. S. and Shaowen Wu. 1999. "A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test." *Oxford Bulletin of Economics and Statistics* 61(S1):631–652.
- Mainwaring, Scott. 1993. "Presidentialism, Multipartyism, and Democracy The Difficult Combination." *Comparative Political Studies* 26(2):198–228.
- Mainwaring, Scott and Aníbal Pérez-Liñán. 1997. "Party Discipline in the Brazilian Constitutional Congress." *Legislative Studies Quarterly* 22(4):453–483.
- Martin, Andrew D. and Kevin M. Quinn. 2002. "Dynamic Ideal Point Estimation via Markov Chain Monte Carlo for the U.S. Supreme Court, 1953–1999." *Political Analysis* 10(2):134–153.
- McCarty, Nolan M, Keith T Poole and Howard Rosenthal. 2006. *Polarized America the Dance of Ideology and Unequal Riches*. Cambridge, Mass.: MIT Press.

- Meltzer, Allan H. and Scott F. Richard. 1981. "A Rational Theory of the Size of Government." *Journal of Political Economy* 89(5):914–927.
- Pontusson, Jonas and David Rueda. 2008. Inequality as a Source of Political Polarization: A Comparative Analysis of Twelve OECD Countries. In *Democracy, Inequality, and Representation: A Comparative Perspective*. New York: Russell Sage Foundation.
- Pontusson, Jonas and David Rueda. 2010. "The Politics of Inequality: Voter Mobilization and Left Parties in Advanced Industrial States." *Comparative Political Studies* 43(6):675–705.
- Samuels, David. 2003. *Ambition, Federalism, and Legislative Politics in Brazil*. Cambridge University Press.
- Stanig, Piero. 2011. Measuring Political Polarization in Comparative Perspective. In *APSA Annual Meeting*. Seattle: APSA.
- Voorheis, John, Nolan McCarty and Boris Shor. 2015. Unequal Incomes, Ideology and Gridlock: How Rising Inequality Increases Political Polarization. In *APSA Annual Meeting*. San Francisco: APSA.
- Zucco Jr., Cesar. 2009. "Ideology or What? Legislative Behavior in Multiparty Presidential Settings." *The Journal of Politics* 71(03):1076–1092.
- Zucco Jr., Cesar and Benjamin Lauderdale. 2011. "Distinguishing Between Influences on Brazilian Legislative Behavior." *Legislative Studies Quarterly* 36(3):363–396.

## **A Methodological appendix: dynamic IRT model**

In this paper I use a dynamic IRT model in order to account for the longitudinal data. Item response theory is a method to measure a latent variable from observed variables (or items) that offer different levels of information. IRT is widely used to estimate students ability (the latent variable) in educational testings based on a series of questions (the items) which vary in their level of difficulty and capacity to discriminate students' ability (the two item parameters). IRT has been modeled to measure latent variables of interest to political science following the same principles: not all items should have the same weight. The estimation of legislators' ideal points from roll call votes means that the former is the latent variable and the latter constitutes the items. If the data is cross-sectional (as it is in this paper since the vast majority of legislators

votes repeatedly across time) one could work with a dynamic model to account for the temporal dependence.

Martin and Quinn (2002), with their work on the changes on the preferences of the U.S. Supreme Court justices, implemented dynamic IRT models to estimate ideal points in political science research. They introduced a dynamic linear modeling approach, which is really flexible and allow them to explore the variation over time. They assume that the latent variable, justices' ideal points in this case, follows a random walk process. Martin and Quinn (2002, p. 140) argues that this approach is able to create “a balance between the overly strong assumption that ideal points are constant over time and the assumption that a justice's ideal points in a given time period are completely independent of that justice's ideal points in other time periods”. The temporal variation of the ideal points is modeled through a random walk prior for each individual casting votes,

$$\theta_{t,j} \sim \mathcal{N}(\theta_{t-1,j}, \Delta_{\theta_{t,j}}), \quad (1)$$

where  $t$  is the term the justice served in court and  $j$  is the individual justice. Each justice can serve in several terms, and their model accounts for the first and last term a justice was on court.  $\Delta_{\theta_{t,j}}$  “is an evolution variance parameter which is fixed a priori by the researcher. Its magnitude parameterizes how much borrowing of strength (or smoothing) takes place from one time period to the next” (Martin and Quinn, 2002, p. 140).

This flexible model is implemented using MCMC algorithm, which requires a lot of computational effort. For their paper more than 10 years ago Martin and Quinn (2002, p. 147) reported that the estimation of dynamic ideal points for all U.S. Supreme court justices over a period of 45 years took six days.

In order to create a faster technique to estimate dynamic ideal points that still keeps the balance between static ideal points and completely independence of the positions over time, Imai, Lo and Olmsted (2016, p. 643) “propose the variational inference that approximates the posterior inference by deriving the variational EM algorithm”. These authors estimated justices' ideal points using the same data as Martin and Quinn (2002), but they got their estimations in seconds (instead of days). Moreover, their algorithm “scales to a large data set while yielding the estimates that are similar to those obtained from the standard MCMC algorithm” (Imai, Lo and Olmsted, 2016, p. 643).

Their dynamic IRT model is detailed below following Imai, Lo and Olmsted (2016, p. 643-4).

Let  $y_{ijt}$  be a variable representing the observed choice/vote of a legislator  $i$  on a roll call  $j$  at session (or term, or time)  $t$  where the legislator  $i$  can choose between “yea” ( $y_{ijt} = 1$ ) or “nay”



( $y_{ijt} = 0$ ). It is important to notice that this model does not differentiate between absenteeism and not being in the legislature when the roll call is taken - both cases are considered missing. Let  $N$  represent the number of unique legislators,  $J_t$  represent the number of roll calls  $j$  in a determined time period  $t$ , and  $T$  the total number of sessions/terms. The dynamic model for unidimensional ideal points is defined as:

$$P(y_{ijt} = 1) = \Phi(\alpha_{jt} + \beta_{jt}x_{it}) = \Phi(\tilde{x}_{it}^T \tilde{\beta}_{jt}) \quad (2)$$

where  $x_{it}$  is the legislator's ideal point at session  $t$ , and  $\alpha_{jt}$  and  $\beta_{jt}$  constitute, respectively, the item difficulty and the item discrimination parameters for roll call  $j$  in session  $t$ . Lastly,  $\tilde{x}_{it}^T$  and  $\tilde{\beta}_{jt}$  are in vector notation representing, respectively,  $(1, x_{it})$  and  $(\alpha_{jt}, \beta_{jt})$ .

The model is rewritten by Imai, Lo and Olmsted (2016, p. 643) with the the latent propensity  $y_{ijt}^*$ :

$$y_{ijt}^* = \tilde{x}_{it}^T \tilde{\beta}_{jt} + \epsilon_{ijt} \quad (3)$$

where  $\epsilon_{ijt} \stackrel{i.i.d.}{\sim} \mathcal{N}(0, 1)$  and  $y_{ijt} = 1(y_{ijt} = 0)$  if  $y_{ijt}^* > 0(y_{ijt}^* \leq 0)$

A random walk prior for legislators  $i$  is specifies to introduce dynamics into the model:

$$x_{it}|x_{i,t-1} \stackrel{indep.}{\sim} \mathcal{N}(x_{i,t-1}, \omega_x^2) \quad (4)$$

for  $t$  encompassing the sessions in which the legislator  $i$  was voting form the first ( $\underline{T}_i$ ) to the last ( $\overline{T}_i$ ).

The joint posterior distribution, then, is defined by Imai et al. with the independent conjugate prior on  $\tilde{\beta}_{jt}$  and conditional on the roll call matrix  $Y$ :

$$\begin{aligned} p(Y^*, \{x\}_{i=1}^N, \tilde{\beta}_{jt}^T | Y) \\ \propto \prod_{i=1}^N \prod_{t=\underline{T}_i}^{\overline{T}_i} \prod_{j=1}^{J_t} (1\{y_{ijt}^* > 0\}1\{y_{ijt} = 1\} + 1\{y_{ijt}^* \leq 0\}1\{y_{ijt} = 0\}) \phi_1(y_{ijt}^*; \tilde{x}_{it}^T \tilde{\beta}_{jt}, 1) \\ \times \prod_{i=1}^N \left\{ \phi(x_i, \underline{T}_i; \mu_x, \Sigma_x) \prod_{t=\underline{T}_i}^{\overline{T}_i} \phi(x_{it}; x_{i,t-1}, \omega_x^2) \right\} \prod_{t=1}^T \prod_{j=1}^{J_t} \phi_2(\tilde{\beta}_{jt}; \mu_{\tilde{\beta}}, \Sigma_{\tilde{\beta}}) \end{aligned} \quad (5)$$

where  $x_i = (x_{i,\underline{T}_i}, \dots, x_{i,\overline{T}_i})$  for  $i = 1, \dots, N$ , and  $\phi_k(\Delta; \Delta)$  denotes the density of a k-variate Normal random variable, and  $\mu_x$  and  $\mu_{\tilde{\beta}}$  are the prior mean vectors, and  $\Sigma_x$  and  $\Sigma_{\tilde{\beta}}$  represent the prior covariance matrices.

The prior parameters are set basically following Martin and Quinn (2002), with necessary adaptations. The prior means matrix for legislators' ideal points ( $N \times 1$ ), which should help "to resolve the standard rotational invariance problem" (Martin and Quinn, 2002, p. 147), was set to be equal to zero to all legislators except two of them: ACM Neto (whose prior means were set to 1 given his conservative approach) and Jose Genoino (whose prior means were set to -1 given his known leftist policy preferences). The prior variance matrix for legislators' ideal points ( $N \times 1$ ) was set to be equal to 1 to all deputies. The prior means for all bill parameters  $\alpha_j$  and  $\beta_j$  were set to be equal to zero. The prior means matrix for all bill parameters  $\alpha_j$  and  $\beta_j$  was set to be equal to an identity matrix. Finally, the matrix with the evolutionary variance for each legislator ( $N \times 1$ ) - or the random-walk prior variance parameter  $\omega_{ix}^2$  - is set to be equal to 0.1 for all individuals.

To assign start values to ideal points and to both difficulty and discrimination parameters I previously ran static binary IRT models for each year. Then, the matrix ( $N \times T$ ) of starting values for the respondent ideal points is set using these static ideal points for each year. When the legislators was not in office the ideal point is set to be zero. The same logic apply to the matrices of  $\alpha_j$  and  $\beta_j$  - i.e., I filled them with the  $\alpha_j$  and  $\beta_j$  estimated with the static models for each year.

Imai, Lo and Olmsted (2016) formulate a variational EM algorithm for the dynamic ideal point model presented above. A detailed discussion and derivation of the algorithm can be found in their paper. To estimate the dynamic ideal points for 2449 legislator and 2981 items using Imai et al.'s model 163 iterations were necessary to achieve convergence using this technique - in a personal notebook the estimation process took less than 3 minutes.

In this paper the model is formulated to estimate ideal points only in a single-dimension. There are two main reasons for this decision. First, computational capacity. Multidimensional dynamic IRT models requires a lot of effort to be adequately estimated. Also the `emIRT` package is not yet prepare to deal with more that one dimension. Second, the literature on Brazilian legislators' ideal points emphasizes the unidimensionality of the political space (Leoni, 2002; Zucco Jr., 2009; Zucco Jr. and Lauderdale, 2011). Scree plots and corrected classifications obtained after running W-NOMINATE for different Congress terms showed that one dimension is adequate to recover the manifested preferences.