Paper: Electorate choice and fertility variability in Brazil: a geo-statistical approach.

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Abstract

We study the relationship between electoral choice and fertility by using Brazilian data at a municipality level, during the military regime. We found a significant relationship between voting and fertility behavior, even after controlling for relevant confounding factors. We explain this relationship by interpreting electoral results as an indicator of a series of linked processes. First, the labor contracting system moves from family salary to individual basis payment. Second it can also be associated with a decline in the family norms, and the old communitarian cleavages ran by the power of colonel oligarchies that control the individual behavior; electoral changes may therefore indicate the beginning of a civil society with democratic values instead of the old "vote of cabresto". We additionally model the spatial dependency of the data, which we interpret as the consequence of a communitarian and social learn process that spreads new reproductive behavior across Brazilian municipalities.

1. Introduction

The importance of the relationship between electoral choice and social human behavior has been exhaustively explored in the social sciences. This literature started with Inglehart (1977), who showed the strong relationship between human behavior and values changes around the world, in the context of the so-called "silent revolution". According to this theory, societies are overseen by the dichotomy between materialism and postmaterialism values. Western societies, in contrast to other cultures, are covered by postmaterialist values moving into different political orientations. The typical pos-materialist orientations – against the establishment, pro the individual freedom of speech and social emancipation – go against the strongly family-oriented materialist values. This dichotomy is currently associated with different political ideologies and electoral outcomes.

Electoral outcomes are often considered in demographic studies, to test their influence on fertility levels. Lesthaeghe (1995) and van de Kaa and Lesthaeghe (1986), for example, show that electoral outcomes can be associated with different fertility levels in many parts of the Western World, by exploiting election results as empirical indicators of ideological and cultural changes, according to a secularization process.

Many empirical evidences of the voting-fertility association were found in Europe. Wolf (Wolf, 1928 apud Lesthaeghe and Neider, 2007) noted the significant correlation between the birth rates in German administrative areas (*Kreize*) and the electoral outcomes in favor of the Socialist party, immediately after World War I. Livi-Bacci (1971) was the first to establish the connection between the historical fertility transition and religious and political developments. An expressive contribution came from Lesthaeghe (1977), who showed that part of the fertility decline experienced in Belgium was basically the result of both economic and cultural changes. He concluded that not only industrialization – occurred in the XIX – but also the process of

secularization that initially took place in France spread to the Belgium's Cantons; and that this process affected directly the reproductive behavior of women. He could identify the effect of secularization by votes in non-conservative parties (votes to liberals or/and socialist parties). More recently, Lesthaeghe and Neidert (2007) pointed out how the different electorate in the United States had different aspirations and values, and how that can be translated in different reproductive behaviors as well. Although, little is known about the voting/fertility relationship in socio-political contexts that are very different of those touched by the existent literature. This is the principal motivation for the present paper, which focuses on the case of the military political regime in Brazil.

In contrast with the current literature that takes electoral outcomes to measure the stage of the secularization process, we assume that the electoral results during the Brazilian political military regime can be interpreted as an empirical indicator of a series of linked processes. The first process refers to changes in the means of production. The old social structure, common in the rural fellowships, loses room for a capitalist mean of production; being it typically associated with high levels of industrialization and urbanization, the labor contracting system moves from family salary to individual basis payment, and fertility tend to be lower in these arrangements (Paiva, 1987). This can also be associated with a decline in the norms that control the individual behavior, being the starting point for a process of behavior change, controlled by individual orientations instead of familiar rules and norms (Caldwell, 1978; Macfarlane, 1978 apud Rios-Neto, 1987). Finally, electoral outcomes can be an indicator of local and communitarian control of families, characterized by the old communitarian cleavages ran by the power of colonel oligarchies; electoral changes may therefore indicate the beginning of a civil society with democratic values instead of the old "vote of cabresto".

In order to study the influence of electoral outcomes on fertility levels, we focus on the bi-party system during the military regime, and look to the different fertility outcomes associated with it. During the military regime we can distinguish two different political agendas: the opposition party MBD (Democrat Brazilian Movement) and ARENA (National Renew Alliance), the party of the military regime (Lamounier & Cardoso, 1975, Canato, 2003). The period under the military regime – which took place between 1964 and the end of the '80s – is a privileged period to study the association between electoral results and fertility levels in comparison with previous and posterior periods; since the party schisms, in this country, are nowadays less clear.

The rest of the paper is organized as follows. We present the theoretical ground that gathers the rationale behind electoral outcomes (Section 2). Section 3 is devoted to a detailed description of the data, gathered at a municipality level, and to the presentations of the results that are obtained after regressing third parity on electoral outcomes and simultaneously controlling for relevant confounding factors. We also model the spatial dependence structure of the data to investigate communitarian and social learn processes that spreads new reproductive behavior across Brazilian municipalities.

2. Theoretical background

2.1. The Brazilian bi-party system e electoral segmentation

The Brazilian politic scenario during the XX was characterized by many changes. The first significant moment was the democracy and the experiences with the plural party system. This was the period characterizing the Thirty Republic, being it the period initiate

in 1945 until the establishment of the decree AL n. 2, in 27th October 1965, sealed by the sovereignty of military political regime established after the coup d'état in 1964.

The military control brought a new age of political interventions in Latin-America. The political framework changed to a model of hard sanctions and interventions in many aspects of the public life, it attempted to establish a new political model together with a legal rupture with the democracy (Trindade & Santamaria, 1983). The political framework in 1964, proceed until October 1965, this was forced into to bi-party system. On one side there was the ARENA, party which engaged almost 91% of the udenists (members of the former UDN party) sharing political engagement with some former rivals from PSD party. In initial stages of party formation, the ARENA was also built by 15% of ex PTB members. Such party took better profit from the former plural party system from 1945, and articulate themselves as a big party, with a large number of representatives and constituted by important figures from the older period of re-democratization initiated in 1945 (Canato, 2003). On the other side, the MDB though experienced difficulties to build up a competitive party. Initially it was formed by group of members from the former PSD e PTB. This party was not able to form opposition against the government party, until 1974, after then the MDB achieved a party organization capable to compete against the ARENA (Lamounier & Cardoso, 1975, Soares, 1982; Kinzo 1993 apud Canato 2003).

Despite the historical period of dictatorial regime, a number of social cleavages are deep in Brazilian society and politics, which no party system can solve. Soares (1982) believes that in any time, these cleavages will redirect the electoral support for different parties in any system. He also argues that for many decades Brazilian politics have been dominated by a number of cleavages, or lines of conflict, which divide political parties. First and foremost, Brazil is a very unequal society, creating a class cleavage; secondly, is an urban-rural cleavage, not unrelated to the former; thirdly, a local, interfamily cleavage, very important to understand politics at the local (municipality), regional, and state levels (Soares, 1982). Hence, the politics have traditionally orbited around these cleavages, which have not disappeared with the formation of MDB and ARENA. In more than one occasion, new parties were formed with the ostensive purpose of breaking away from these lines, sometimes claiming to be 'above them,' sometimes claiming to follow different cleavages.

The first cleavage is characterized by the ***class cleavage***. After the military coup in 1964, the old parties were extinguished and the new ones created by Executive decree, these alignments were lost. The first elections were met with considerable skepticism, and, at least as late as 1972, MDB had not yet convinced the electorate that it was a legitimate opposition party, let alone a political representative of the working class. The election for that year showed that the correlation between null votes and urbanization was higher than that between the MDB and urbanization (Soares, 1982; Kinzo 1993).

In 1966, 1970, and even in 1972 the MDB actually lost the elections in most urban states and in many metropolitan areas. Thus, the urban opposition to the regime had not accepted the MDB as its legitimate representative. Its showing in working-class districts was less than impressive. Nineteen seventy-four was the breaking point, and, after that, MDB became both a legitimate opposition party and the representative of the working class (Soares, 1982; Cardoso & Lamounier, 1978; Canato, 2003). Thus, after 13 years, MDB managed to state itself as the workers' party. This image brought the

working-class vote to MDB and in some working-class and peripheral districts, MDB candidates' defeated ARENA ones by an 8 to 1 margin or better. Wide victory margins in working-class districts alone ensured an easy MDB victory in most, if not all, Brazilian metropolitan areas (Cardoso & Lamounier, 1978, Soares, 1982). This success of the opposition party gives space for next political segmentation, namely the urban-rural cleavage.

The second cleavage is the ***urban-rural dimension*** that has always been an important line of cleavage in Brazilian politics. This importance derives from at least two issues. The first is a policy issue. Import substitution policies have often meant the transference of resources from the agricultural sector to the industrial and high service sectors, particularly the former (Soares, 1976a). It also implies a concentration of credit and investments (Soares, 1976b), and the use of subsistence agriculture, agricultural labor, and the so-called marginal urban sectors to increase urban- industrial capital accumulation (Sa Jr., 1972; Oliveira, 1972 apud Soares, 1982). The second is an electoral one, since the first Brazilian elections in the post-War period; different political parties have had a differentiated political appeal, some penetrating far more in the urban areas, whereas others appealed mainly to the rural ones. The electoral schism was demonstrated by Lima (1978 apud Soares, 1982), in a comparative study in the state of Rio de Janeiro in 1976.

Table 1: Urbanization and the Percentage of Mayors and of Chamber of councilman in which the MDB is the Majority Party, Estado do Rio, 1976.

Number of voters in the municipality	Mayors	Chamber of councilman
Less than 10.000	14%(22)*	0% (22)
10.000 to 20.000	33%(15)	18%(17)
Over 20.000	77%(22)	72%(25)

*Totals over which percentages were computed.
Adapted from Lima Jr. (1978:93)

As we can see in the table, the urban-rural basis of differentiation is very clear: MDB did not control a single Chamber in municipalities with less than 10,000 voters, controlled less than one in every five in municipalities with less than 20,000 voters (but more than 10,000), but controlled almost four out of every municipality with more than 20,000 voters. Similar results are obtained when mayors, and not councilman, are considered. For the Federal elections in 1978, the urban-rural cleavage was very strong. MDB obtained 62% of the total valid vote for the Federal Congress in the Southeast, essentially urban and industrial, but only 28% in the rural and more backward Northeast. Within each state these tendencies were also found, stronger in some, weaker in others (Soares, 1982). Thus, the party system created by decree in 1965 progressively acquired a strong urban-rural schism; with the ARENA party developing his political appeal in the rural areas, and MDB winning the major metropolitan areas.

The last segmentation characterizes the socio-political history of the country, the so-called ***coronelista politics***. The socioeconomic structure upon which the Old Republic's political system was based did not disappear with the 1930 revolution, not with the Vargas dictatorship neither after twenty years of democratic experience and is still present after eighteen years of military dictatorship (Soares, 1982). Although the country has undergone impressive socioeconomic transformations, particularly

urbanization and industrialization, the agrarian structure changed far slower; the most important change was not a transformation of the agrarian structure, which was limited, but the reduction of its meaning in the total economy and in the political system as well, caused mainly by urbanization and industrialization. This survival implies that old political patterns which characterized the Empire and the Old Republic also survived, particularly at local level, and sometimes even at the state level. The reduced population of many municipalities and their extreme degree of land concentration places a high share of the total power in the hands of very few families, sometimes of one family alone. It is creating room for so-called local politics. This means that political activism and leadership comes, actively and expectedly, with membership in these families. The structure of loyalties, political and otherwise, is largely determined by family ties and less by class, party, or ideological affiliations (Soares, 1982).

Election after election, over many decades and sometimes centuries, one leading family is pitted against another, in an endless struggle which is reproduced with different families at the municipality next door. State governments cannot afford to ignore this structure. First, because to be elected, they need the votes controlled by these families in each municipality; second, because since before the Republic many families from different municipalities were organized on a broader geographic basis along party lines. Thus, a special relationship developed between families in these municipalities and the state government through which these families support a given candidate to the state government and in return for a free hand in their own municipality against the competing family or families. This implied power to nominate the mayor, councilmen, the local judge, the local chief of police, civil servants who worked in the local state and federal offices, etc. Given that many of these family chieftains had, through purchase, the title of Colonel, this political arrangement between leading families in a municipality and the state government was called "o pacto coronelista" (Leal, 1948 apud Soares, 1982).

The importance of "coronelista (or the boss godfather)" politics in the state politics varies widely among the Brazilian states; in those states where a majority of the population is rural or lives in small towns state elections are largely determined by local arrangements, especially in areas where ARENA developed his political appeal.

The "colonel politics" was never to the liking of the Brazilian military; all forms of local power were seen as detrimental to a strong national state, which the military groped for since the Old Republic. In 1965, when the opportunity presented itself, they tried to impose a party system that would leave no room for local family politics. But the attempt to force all of conservative Brazil into one party and to accommodate the strong family cleavages which exist in thousands of Brazilian municipalities failed. Everywhere, conflicts erupted inside ARENA, and in scores of municipalities the same phenomenon could be observed again and again; feuding families wrestled for political control of the local ARENA organization. The MDB benefitted from this, not only at the local level but at the state and federal levels as well, as new state-local alliances were articulated. Conflicts were apparent at the state level as well, for the many groupings inside ARENA often could not agree to one and one candidate only. In the elections for the federal congress and the state assembly, this problem was far less important, as candidates are elected statewide and many candidates could run with only limited competition for room in the party slate. Thus, the competition in these elections was mainly for the vote and not for the nomination. To prevent the fragmentation of ARENA and the transfer of electoral

power to MDB in local elections, the military had to violate its own principle of party unity and establish the institution of the sub-legend, which allows more than one candidate per party for majority elections, the votes of the losers helping to elect the most voted in the party.

Party organization was changed to accommodate these differences, and in hundreds of municipalities ARENA was split in two, with two separate organizations, budgets, personnel, functioning in different buildings, supported by different newspapers. These local politics arrangements were very important to understand the political process of formation of a civil society. The next is to analyze the importance of voting behavior, exploring the many explanations that the electoral choice could represent.

2.2. The understanding of the electoral results

In this section, we explore the different meanings that the electoral results, which is centered in three major explanations. The first is established by Paiva in 1982. According to him, in contrast with Malthus theory applied in England, the transition to a capitalist economy led Brazil to a decline of fertility, due to the follow reason: the absence of social control and salaried relationships in a based agrarian system. For this reason, a ***process of proletarization*** will eliminate the stimuli to have many children, resulting in fall of fertility levels (Paiva, 1982). In keeping with him, in the agriculture economic organization of "*colonato*", regardless Malthus, there was a positive association between increases in family sizes and the family income. Notwithstanding the income levels – which were very low – the life standard was not close to the physiological limit; it thanks to the domestic activities which generate production surplus and further trade among the peasants. In this way, the local economic trade kept the system above the salary of subsistence. In this context, in contrast with Malthus, any increase in population growth does not result directly in reduction of life standard.

In the *coffee industry* (in the Southeast and Southern regions of the country) the employers stimulate their employees to early marriage and large family size, all in benefit of an increase production. This system it was called "boss godfather" or "colonel" of the community. Also in the Northeast part of the country, this system was the main social organization, nevertheless in this time with the *cotton industry*. However, this labor organization should also work together with high fertility levels. It thanks to a system of partnership between "land owner and the land worker". A relationship of indebtedness among both parts corroborates with a long run increase family size (Paiva, 1982).

Oliveira (1978) also points to many alterations in agricultural production organization, especially in the coffee culture in Southern parts of the country. For example: shifting to an alternative use of the land characterized by temporary crop instead of permanent harvest, introduction of rural labor laws and the end of easy land access and credit. All theses transformation led to the proletarization of the rural workers, migration out the rural locations, and increase in the number of agricultural workers living in urban dwelling. It characterized the last steps of the colonato in the coffee production, which after the end of 60's gradually presents its end. It perpetuated in migration from rural areas to urban places, given space to new form of laborers, who lives in cities and works in rural locations. In this context, the woman conquers her entrance in the labor market, becoming part of salaried labor force, no more connected with the familiar economic unit.

Hence, the break with the rural production way and the introduction of a capitalist economy system, created a ***proletarian class***, this new labor class lost the advantages of large number of offspring. Any increase in family sizes goes hand to hand with household deprivation; this is leading the Brazilian population to new social adjustments due to the new social conditions. Paiva (1982) concludes that the fertility decline, after the mid sixths, could be seen as a population adjustment in front to the new labor organization, and response to the emerging proletarian class. This process also declares ***the end of the colonel*** system of production, following the framework of Marxism and Institutionalism from production to reproduction (Rios-Neto, 1987). This last describes the shifts in production mean and its connection with the different fertility regimes, and distinguished institutional norms that reigning the individual behavior.

According to Caldwell (1978, apud Rios-Neto 1987) there are two modes of production with their specific economic motivations and demographic laws: ***familial mode*** and ***capitalist mode*** of production. The peasant economy mode based of production, with integrated work and consumption in the same unit. His hypothesis is that the conflict inside the family – in terms of fertility – is generational or vertical (with the appropriation of wealth by old members of the family). A set of moral and codes or cultural sets are applied to keep the family unit and cohesion and reduce the risks of family rupture. The family mode corroborate with high marital fertility. The capitalist production way plays a crucial role in so-called fertility transition. According to him, the shift to another production way leads to more "individualistic behavior". The end of material conditions of a vertical intergenerational wealth flow may lead to fertility decline. In this way, the necessary condition – for fertility transition and shift in intergenerational wealth flow – is the transition from familial to capitalist mode of production, from family exploitation to class exploitation.

In keeping with Macfarlane (1978, apud Rios-Neto 1987) there are two models of fertility: uncontrolled (associated with group behavior) and controlled (guide by possessive individualism). The peasant model of production characterized by integrated production and consumption activities at the family level – generally lead to uncontrolled fertility; the decision making process is set at the family level. While the production and consumption activities are set at the individual level then we have a controlled fertility mode.

These two contributions were important to the so-called institutionalist approach of fertility, since the focus in the drive forces behind the determination of fertility behavior. This dichotomy family-oriented/society-oriented refers to individuals who are socially integrated with institutions operating outside the family/kinship sphere, likely to behave on their own individual and/or society's norms and interest.

In this context the vote outcome can be seen an indicator of the proletarization process, the cutting-point with the rural production organization, in favor of a modern capitalist production mean, corroborating with low fertility levels. It can also find the place in the framework of Marxism and Institutionalism of production and reproduction, and the distinguished institutional norms reining the individual behavior, characterizing the shift from family-oriented to society-oriented individuals. Finally, the electoral outcome might also represent the end of the local and community production mean, "the end of colonel and boss godfather", given course to a new more individual-oriented instead of community-oriented. Notice that, however, these understandings do not

exclude each other, but they are complementary explanations of a same social phenomenon. They may describe the same socio-economical and political process which took place in Brazil during the middle sixths.

3. Empirical analyses

3.1. Data

Our empirical sources are the Brazilian micro-census data from 1980 and aggregated electoral data relating to councilmen elected in 1976, from the Dados Estatístico 12º volume – eleições municipais em 1976, published by the Tribunal Superior Eleitoral. We consider 1976 as a good year of reference, since the MDB broken through as really opposition party only after 1974 (Bolivar & Cardoso, 1978; Soares, 1982; Kinzo 1993 apud Canato 2003; Reis, 2000). In our empirical approach, we shall try to predict fertility variation by ponder our attention in the statistical association between the levels of fertility in each municipality, and the fraction of voting for each party in the same location. In other words, we consider the electoral results in 1976 and how it can predict fertility variability in 1980. Among the two data sets there were four years differences (1976-1980), and there were also some municipality emancipations between this period. In 1980 we have 3991 municipalities, and 3965 municipalities with electoral information to be analyzed in 1976.

The response variable in this study is the fertility level of each Brazilian municipality in 1980. To estimate this level, we use the information of the third parity and the number of women at age 25 to 29 as offset variable, i.e. the accumulated number of children ever born corresponding to the women in the third age-group of the whole fertility span. Due to the quality of Brazilian civil registers data in 1980, the estimation of standard fertility indicators, such as TFR are not always reliable for measuring fertility levels (Ferreira & Ortiz, 1982; Giraldelli & Rodriguez Wong, 1984). For this reason, we apply parity as fertility level estimator. According to Brass (1968) *cohort-fertility-measures*, for the second woman age group, are the best correcting factors for the period level of fertility, regardless of the shape of the distribution. Since we want to estimate the effect of vote in the fertility levels in 1980, we assume that, in each municipality, women who voted in 1976 were 20-24 and belong to the age group 25-29 in 1980.

The principal covariates of interest in this study are the vote, as measured by the proportion of votes to MDB or ARENA, and fraction of absent electorate in 1976. We control for a number socioeconomic covariates, already exploited by Potter et. al. (2002) to describe fertility decline in Brazil. Specifically, we included infant mortality, as measured by the proportion of children ever born who died until the time of the interview and related to women at ages 25-29 in each municipality. Municipality level of electrification was measured by taking the fraction of households in the municipality which had electricity (with and without a meter). Female labor force participation was included as the fraction of women at age 25-29 in the municipality who were labor force participants. Female education was measured as the average number of years of schooling completed by women aged 25-29 in the municipality, and the proportion of women illiteracy in each municipality. We also included the population size, i.e. the size of municipality as a sort of control for the degree of modernization. Latitude and longitude of each municipality were finally included in the study.

Figure 1 displays the spatial distribution of the 3965 municipalities centroids, coloured according to the level of fertility of each municipality. The most industrialized parts of the country are the Southeast and South regions, with high levels of education and a considerable number of European immigrants. It was in Southern and Southeastern cities that fertility first declined in Brazil (Carvalho 1974; Merrick and Berquó, 1983), and where fertility was lowest in 1980. In more rural and less industrialized parts of these regions, farther from the coast, fertility was somewhat higher.

In the North and Northeast regions, fertility in 1980 was much higher than in the South or Southeast. In the Northeast, a few large capital cities (mostly located on the coast) had a substantial industrial base and moderate levels of fertility by 1980. However, away from the coast fertility was still very high, living standards were low, and most people were dependent on either small scale farming or agricultural wage labor (Schmertmann et al., 2007). The North region contains the Amazon, with large areas of very sparse population, as well as a few moderately sized cities. The remaining region, the Center-West, was less densely populated than the Northeast, with more abundant agricultural resources and higher standards of living (Schmertmann et al., 2007). Although remote from the main poles of Brazilian development, Central-Western cities were better connected than those in the Amazon region with the rest of the country. Indeed, a new national capital, Brasília, was created in this region in the 1960s. Fertility decline in the Central-West began later than in the South and Southeast, but earlier than in much of the North and Northeast regions (Schmertmann et al., 2007).

Figure 1: Third Parity Fertility levels across municipalities

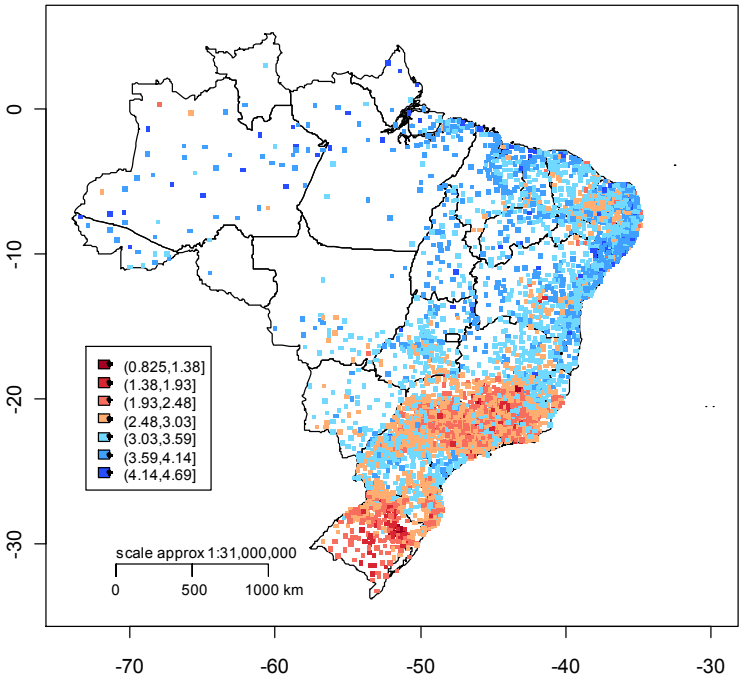


Figure 2 displays the spatial distribution of some of the explanatory variables. Conditionally on the fraction of household with electricity, and the levels of female education in each municipality, a higher the fraction of households with electrification

encompasses with a high level of female education. It is indicating that higher educated women are more likely to live in south regions of the country, where a higher level of modernization is present.

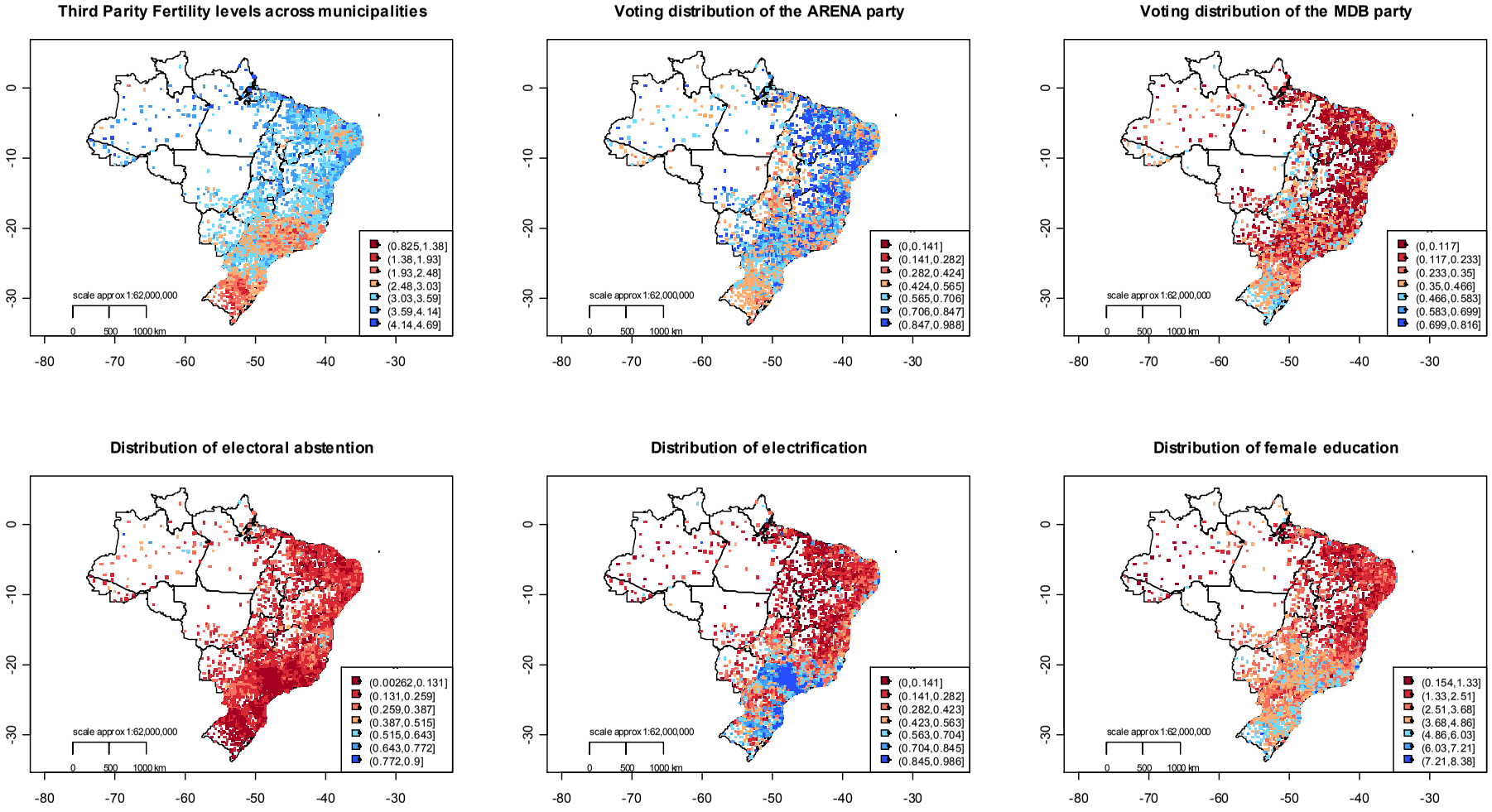
Comparing Figures 1 and 2, the voting for ARENA follows the opposite spatial pattern of third parity. ARENA has been successful in the North, Northeast and in the rural areas of the country, where fertility is somewhat higher. Besides, in the South and some Southeast areas of the country MDB found a greater electoral success than ARENA, and the fertility levels were somewhat lower. Other interesting finding is the spatial distribution of the electorate choice and the socio-economic covariates. The simple option for opposition party reflects a better female socio-economic status, and most probably dwelling in urban locations. This can be a result of the urban-rural dichotomy concerning the fertility variations in the country. Besides, in the bi-party system, the ARENA developed his political appeal in the rural areas of the country (North and Northeast); the MDB, however, won the major part of his electorate in the large metropolitan areas (South and Southeast) of the country (Soares, 1982, Canato 2003). For further analyses, our expectation is that these two electorates have indicated divergent fertility levels.

An additional remarkable finding concerns the lowest level of electoral abstention[1] (dark red locations) in many parts of South and Southeast locations of the country. It shows a similar spatial pattern of the vote for ARENA. The meaning of electoral abstention has been carefully explored by some authors. Souza (1976) considered the amount of electoral abstention as an indicator of political participation, due to the obligatoriness of the vote in the country. Other authors suggested the percentage of abstention and it association with blanco and null as the political expression of an anomic electorate, which at the same time is rational, because abstention depends on disapproval against the political regime and the electoral process (Lima Júnior, 1982). In this way, if the population believes that the elections are a legitimate manner to bring changes in political system, then the rates of abstention shall be very low. This was indentified between 1974 and 1978, during the process of political opening started in 1974 (Sant'Anna & Freire, 1983).

Lamounier (1980) and Souza (1976), however, believe that there is a combination of facts which can explain the electoral abstention. These include: political disinterest, unsatisfaction with current political situation, and difficult to vote due to inexperience, disinformation or impossibility to reach the electoral places. Further, Sant'Anna & Freire (1983) studied the political abstention process in Rio de Janeiro during the military regime. They concluded that, in 1974, the electoral abstention in Rio de Janeiro could be seen as an answer to a situation of no way out, being this more a connotation of protest then totally expression of political interest. In our case, we assume that the electoral abstention can be an empirical indicator of (functional) illiteracy and/or electoral disinformation, which is often, associated with high fertility levels (Lesthaeghe and Willems, 1999).

[1] Visually it seems that there is not much variability in electoral abstention across the municipality. One reason is that obligatoriness of vote is established in the country in 1932 and became constitutional in 1934. It made the electoral abstention variability less visible.

Figure 2: Distribution of covariates



Source: micro-census data 1980 and electoral results 1976

3.2. Poisson regression

In this section we discuss the results obtained after estimating five Poisson models, which account for various combination of the covariates. In the first model, besides the effect of voting, we selected a group of controlling variables that reflect the socio-economic development of each municipality. In the second model we discard infant mortality, since we consider that this last covariate is strong endogenous with respect to fertility levels. In the third model we introduce sex-ratio as a kind of nupciality control, because, unlike parity, TFR is a marital fertility measure. For this reason, we presume that parity is exogenous to any change in either the pattern of nuptiality or the number of single women. In the fourth model we control for the interaction between spatial coordinates. This interaction fits with the historical colonization process of the country, and the conquering in West direction. Additionally, we introduce a dummy covariate, indicating the effect of "no votes" for the opposition party. The reason is that in 1976 we verified a number of municipalities without electoral outcomes for the opposition party MDB (around 974 municipalities). This cannot be regarded as lack of data information, because the MDB – unlike the ARENA – was in process of party structuring, and it might not show political opposition in certain areas. Further, comparing the electoral data of 1972 with the vote outcomes of 1976, the number of municipalities without MDB electorate in 1972 was even higher. It also confirms the evidences of a better party structuring only after 1974 (Lamounier & Cardoso, 1975; Soares, 1982; Kinzo 1993 apud Canato 2003; Reis, 1975).

Thus, we also presume that these locations with no-vote MDB might be a confounder factor, since the effect of the covariate vote MDB has a positive sign (instead of negative) in models 1 to 3. The term confounder is commonly used by epidemiologists to describe a covariate that is associated with both the outcome variable of interest and an independent variable (Hosmer & Lemeshow, 2000). One way to solve the problem of a confounding effect is to work with stratified groups (Varkevisser et. al., 2003). For this reason, only in the final model, we estimate a Poisson model by discarding the municipalities with zero votes MDB. It brought us to a total of 2991 municipalities.

It is important to say that our interest is in the fertility levels variability. We are not claiming that the electoral results are responsible for any process of fertility decline, since we do not analyze this relationship in time due to the lack of available data. All the five Poisson regression models are estimated by assuming the number of ever born children from women at ages 25-29 in each municipality i is drawn from a Poisson distribution with expected value

$$E_i e^{\beta \mathbf{x}_i}$$

where E (exposure or risk population) is the number of women at ages 25-29 in each municipality and $\mathbf{x}_i$ is the covariate profile of that municipality.

The importance to stratify the data comes from the fact that the municipalities with no-vote in the opposition have particular characteristics. In other words, they belong to a selected group of municipalities, so as we can see in the table below. Generally, these are small localities, less economic developed than the rest, enclosed with low levels of female education, high levels of women illiteracy, and where the hegemony of the government party is fairly visible. Further, in these municipalities the ARENA party

scores somewhat higher. The average electorate who votes for the government party reaches fairly 88%, in the minimum score for ARENA still above 50%. It does not mean, however, that the electoral results do not have any effect of fertility levels. Although, our hypothesis is that the electoral behavior is much more apparent in a situation of "electoral competition". It means, while an electoral schism between the parties is observed. In other cases, while only the ARENA party has majority of the electorate, the electoral effect on fertility levels is not corrected captured.

Table 2: Descriptive of the data sets

Complete data			Data Zero vote		
Education			Education		
Min.	Mean	Max.	Min.	Mean	Max.
0.15	3.31	8.38	0.15	2.50	7.29
Illiteracy			Illiteracy		
Min.	Mean	Max.	Min.	Mean	Max.
0.01	0.46	1.02	0.02	0.34	1.00
Electrification			Electrification		
Min.	Mean	Max.	Min.	Mean	Max.
0.00	0.44	0.99	0.00	0.31	0.98
Population size			Population size		
Min.	Mean	Max.	Min.	Mean	Max.
732	29560	8493000	732	12220	110200
ARENA			ARENA		
Min.	Mean	Max.	Min.	Mean	Max.
0.00	0.66	0.99	0.52	0.88	0.99
ABS			ABS		
Min.	Mean	Max.	Min.	Mean	Max.
0.00	0.19	0.90	0.00	0.21	0.90

Source: micro-census data 1980 and electoral results 1976

3.3. Empirical Results

In the first model (table below) we see that the effects of all covariates in the model follow the fashion of modernization and economic development, which considers strong and consistent relationships between variability in fertility levels and social and economic circumstances (Potter et. al., 2002).

Lesthaeghe and Willems (1999) indicate two crucial elements to describe the changes in the pattern and fertility levels, namely the female labor market participation and educational-level. In Brazil 1980, we verify that both the female education and the female labor participation have a significant and negative effect of fertility. As we can see from the old social and economic cleavages in the Brazilian society still leads to different parity outcomes. This finding confirms Ramos et. al. (1987) hypothesis that identifies the faster increase in the female labor market participation as an important determinant of the fertility decline in Brazil. It also shows electrification as other important covariate. Potter et. al. (2002) point to electrification as the most important among all the transformations that occurred in Brazil during the period of 1960-1991. It serves as a gateway to and marker for consumer durables and the mass media. Consumer

aspirations for durable goods and exposure to television had substantial unintended and synergistic consequences for reproductive behavior in Brazil (Faria, 1998 and Faria and Potter, 1999).

The geographical location (trend) is strongly significant. The effect of the Y-coordinate is explained by the fact that Northern regions of the country are the less developed areas of Brazil, where we expect high fertility levels. In the same way, increases in the X coordinates (longitude) generally indicate shifts in the direction to the coast. These areas are also commonly represented by locations with low levels of fertility. Other striking finding is the highly significance effect of interaction between geographical areas, as we said before, it is fitting with the historical processes of populated and colonization of the country.

The infant mortality in the history of fertility decline symbolizes the same as woman related covariates. It express the level of socio-economic development of a region Caldwell 1982; Coale 1973; Easterlin and Crimmins 1985; Hirschman and Guest 1990; Mason 1997). Besides, this covariate has a historical synergy relationship with fertility (Galloway et. al., 1998; Reher, 1999). Therefore, we decided to build up a model without infant mortality. In model two, all the regression coefficients do not alter their effect, indicating that child mortality may be endogenous to fertility levels.

Table 3: Poisson regression controlling for all covariates

	Model 1		Model 2		Model 3		Model 4		Model 5[a]	
	Beta	sig	Beta	sig	Beta	sig	Beta	sig	Beta	sig
(Intercept)	1.05	***	1.08	***	1.06	***	1.09	***	1.10	***
Female Education	-0.11	***	-0.11	***	-0.11	***	-0.11	***	-0.11	***
Illiteracy level	0.15	***	0.15	***	0.15	***	0.15	***	0.16	***
Electrification	-0.01	***	-0.01	***	-0.02	***	-0.02	***	-0.02	***
Female Occupation	-0.25	***	-0.25	***	-0.25	***	-0.25	***	-0.29	***
Infant Mortality	0.31	***	–	–	–	–	–	–	–	–
Vote MDB	0.01	***	0.01	***	0.01	***	-0.04	***	-0.03	***
Zero vote MDB ref.										
Non-zero vote	–	–	–	–	–	–	0.05	***	–	–
Electoral Abstention	0.23	***	0.23	***	0.24	***	0.23	***	0.27	***
Sex ratio	–	–	–	–	0.03	***	–	–	–	–
Pop. Size by x 10^5	-0.002	***	-0.002	***	-0.002	***	-0.002	***	-0.001	***
x-coordinates	-0.01	***	-0.01	***	-0.01	***	-0.005	***	-0.01	***
y-coordinates	0.01	***	0.01	***	0.01	***	0.01	***	0.01	***
Interaction between coordinates	–	–	–	–	–	–	0.0001	***	0.00001	ns.

Source: micro-census data 1980 and electoral results 1976

a – the model was estimated without the 974 municipalities, where the MDB did not have electoral results.

In the third model, we introduce sex ratio as an additional control variable, i.e. the ratio of man between the ages of 20 to 29 and woman aged 15 to 24. With this covariate, we want to show that the parity do not suffer the same disturbing problems caused by nuptiality changes. As we can see, this model confirmed that the parity do not suffer any nuptial disturbed effect.

In the fourth model, we incorporate a dummy covariate, in order to catch the effect of non-electoral competition across municipalities. This dummy covariate

eliminates the previous confounding-effect among electoral outcomes and the other socio-economic covariates. Therefore, we observe that high MDB scores are correctly associated with low municipality fertility levels. Nevertheless, the dummy became a confounder factor itself, because we presume that non-zero vote in the MDB are associated with low fertility level. However, in model 4 the effect of the dummy is positive instead of negative. For this reason, we estimate model 5, considering a stratified municipality data with electoral outcomes for both parties.

Concerning the electoral results in model 5, a higher proportion of electoral abstention translates in a higher number of births. It can illustrate different electoral attributes: as political disinterest, unsatisfaction with current political situation, and difficult to vote due to inexperience, disinformation or impossibility to reach the electoral places (Lamounier, 1980; Souza 1976). However, the hypothesis of indirect indicator of socio-economic status is here discarding (Sant'Anna & Freire, 1983 & Farias, 1970), since we controlled for all other socio-economic covariates like: as women education, labor market participation, and even after controlling for the levels of women illiteracy; the effect of electoral abstention still persist. We presume that perhaps abstention may indicate the disinformation and/or functional illiteracy which are common associate with high fertility levels (Lesthaeghe and Willems, 1999).

The strike finding in the model is concerning the voting results which came out with a strongly statistical significance effect, even after controlling for all covariates. It is showing that most probably – besides the correlation with other socio-economic covariates – the idiosyncratic effect of electoral choice is associated with certain fertility outcome, even after controlling for all other possible socio-economic covariates. In this way, the electoral choice can be seen as an indicator of many processes, which spread through the country during the mid sixths. However, it may perhaps represent a new cultural indicator in itself. Subsequently, the hypothesis of cultural change might perchance be captured by the electoral results. In this way, the electoral results might indicate the end of period of colonato and client-colonel voting relationship, typical from the rural areas of the country, in favor of a civil society. Being it also the indication of a more individual political choice, favoring the end of the former communitarian relationships colonel-peasant; corroborating a more individualistic reproductive behavior as well.

Of course, we need to be careful with rush conclusions, since the fertility decline was already in process, even before the establishment of a bi-party system. However, it should be preferable analyze this process in time, considering more periods of analyses. In any case, the electoral choice seems to be a good predictor of variation in fertility levels during the process of Brazilian fertility transition in the sevenths and begin eights.

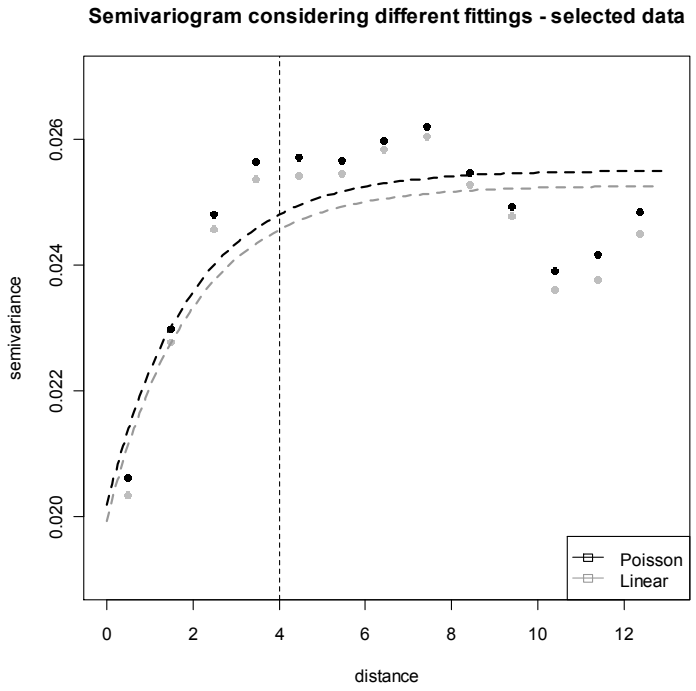
3.4. Spatial Analysis

In order to evaluate the goodness of fit of Model 5, we have estimated the empirical spatial semivariogram function of the residuals (dots in Figure 3) considering the Euclidean distances between centroids as measure for spatial dependency, as described in the formula below.

$$h(i,j) = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \qquad (2)$$

The semivariogram was interpolated by a spatial exponential semivariogram function (lines in Figure 3). A horizontal semivariogram function of the residuals (Cressie, 1993) indicates absence of spatial autocorrelation. The pattern exhibited by the semivariogram in Figure 2 is instead an indication of spatial autocorrelation between locations at a distance that is less than 380-400 Km. We have repeated this residual analysis for a linear model that includes all the variables of Model 5 and found a larger autocorrelation effect. On one side, this indicates that the Poisson regression model better captures the fertility spatial variation than the linear model. On the other side, although Model 5 fits adequately the fertility data on a large spatial scale, but it does not capture some small scale variation in the data.

Figure 3: Semivariogram function



This is in keeping with the results reported by Schmertmann et al. (2007) who recently appointed the possible process of social learning and diffusion in Brazil. They conclude that differences in local conditions are particularly good at explaining spatial correlations at distances > 500 km. At shorter distances, there remains some unexplained spatial correlation in fertility change that could be attributed to diffusion or social interaction. In our model we came to quite similar results, where this diffusion process can possibly itself extended to a maximum distance of 380 to 400Km.

4. Conclusion

In this work we aimed to explore the relationship between electoral choice and fertility in 1980, based on the electoral results from 1976. After controlling for relevant confounding modernization indicators, we found a significant relationship between voting outcome and fertility behavior. It is showed that, besides the correlation with other

socio-economic covariates, the electoral results from 1976 has an idiosyncratic effect associated with certain fertility outcome.

We conclude that these electoral outcomes might indicate to a series of connected process. First, it indicates the labor contracting system that moved from family salary to individual basis payment. Second it can also be associated with a decline in the family norms, and the old communitarian cleavages ran by the power of colonel oligarchies that control the individual behavior; electoral changes may therefore indicate the beginning of a civil society with democratic values instead of the old "vote of cabresto". Furthermore, a complementary spatial analysis showed the presence of a communitarian and social learn process that spreads new reproductive behavior across Brazilian municipalities.

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