SPATIAL DISCONTINUITY FOR IMPACT ASSESSMENT OF THE MATOPIBA BORDER INSTITUTION (BRAZIL)

Gisléia Benini Duarte
Doutora em Economia – PIMES/UFPE. Professor Adjunto – DECON/UFRPE. Endereço: Rua Dom Manuel de Medeiros, s/n. Dois Irmãos, 52171-900, Recife/PE. E-mail: gisleiaduarte@gmail.com. Tel: (81) 99263 6358.

Vitória Roberta Martins de Melo Galindo de Lima
Graduada em Economia – UFRPE. Mestranda em Administração e Desenvolvimento Rural – PADR/UFRPE. Endereço: Rua Dom Manuel de Medeiros, s/n. Dois Irmãos, 52171-900, Recife/PE. E-mail: galindodelimav@gmail.com. Tel: (81) 99427 9553.

Área 2 – Econometria espacial

Área 2 – Econometria espacial

SPATIAL DISCONTINUITY FOR IMPACT ASSESSMENT OF THE MATOPIBA BORDER INSTITUTION (BRAZIL)

Abstract

The socioeconomic impact of the MATOPIBA border institutionalization through the Matopiba Agricultural Development Plan (PDA-MATOPIBA) have not been exploited yet. This paper exploits this boundary as spatial discontinuity to estimate the causal effect of this institutional decision on employment per capita, GDP per capita and agricultural GVA per capita at the municipal level; and formal income at the individual observation. The analysis were developed in a border strategy framework (municipalities contiguous to the MATOPIBA boundary). Evidence shows zero effect of the border officialization on employment per capita, a positive effect of the magnitude of 8.8% on GDP per capita and 20.8% on agricultural GVA per capita when working with data aggregated by municipalities. Regarding individual observation, it appears that being part of MATOPIBA increases the income from formal labor by 13%.

Keywords: MATOPIBA, Impact Assessment, Geographic Discontinuity.

Resumo

O impacto socioeconômico da institucionalização da fronteira do MATOPIBA através do Plano de Desenvolvimento Agropecuário do Matopiba (PDA-MATOPIBA) ainda não foi explorado. Este artigo explora esse limite como descontinuidade espacial para estimar o efeito causal dessa decisão institucional sobre as variáveis emprego per capita, PIB per capita e VAB agropecuário per capita ao nível municipal; e renda formal no nível de observação individual. A análise foi desenvolvida em uma estrutura de estratégia de fronteira (municípios contíguos à fronteira do MATOPIBA). As evidências mostram efeito nulo da oficialização da fronteira sobre o emprego per capita, um efeito positivo da magnitude de 8,8% sobre o PIB per capita e de 20,8% sobre o VAB agropecuário per capita quando trabalha-se com dados agregados por municípios. Já em se tratando da observação individual, verifica-se que fazer parte do MATOPIBA aumenta a renda do trabalho formal em 13%.

Palavras-chave: MATOPIBA, Avaliação de Impacto, Descontinuidade Geográfica.

JEL: R15.

1 INTRODUCTION

The MATOPIBA region is an agricultural frontier in Brazil that covers locations in the states of Maranhão, Tocantins, Piauí and Bahia. Although the area has shown significant growth trends concerning agrarian production since the early 2000s (CRUZ et al., 2019), it was only in 2015, through the Presidential Decree N. 8,447 – supported by the Brazilian Agricultural Research Corporation (Embrapa) studies -, the Matopiba Agricultural Development Plan (PDA-MATOPIBA), as well as the delimitation of the region's border was made official. As part of its creation, the plan aimed to promote and coordinate public policies addressing agriculture and livestock to allow sustainable economic development in the region, enabling improvements in the population's quality of life (BRASIL, 2015).

A political and economic crisis that started in 2014 with the outbreak of *Lava Jato* operation[1] was the context of the establishment of PDA-MATOPIBA. However, even amidst a complex national scenario in Brazil, the economic performance of the agricultural sector surpassed the performance of the others during the years of crisis and depression. Moreover, the agribusiness industry and more specifically agriculture have significant participation in domestic production and Brazilian exports in international markets (IBGE, 2019a; CEPEA, 2019; TRABALHO, 2019).

The MATOPIBA region exhibited a similar trend of economic prosperity in the agricultural sector, even in political turmoil. From 2000 to 2018, the planted area in the states of Maranhão, Tocantins, Piauí and Bahia increased by approximately 217% (from 2.5 to 7.9 million hectares). The economic value of the agricultural production grew 208% in the same period (from approximately R$ 9 billion[2] to almost R$ 28 billion). The main crops, both in terms of planted area and production value in the four states included rice, soy, cassava, corn, cotton, and bean (IBGE, 2000, 2018).

The MATOPIBA area specifically consists of 31 micro-regions which is equivalent to approximately 73 million hectares, extension where 337 municipalities encompass 324,326 agricultural establishments, 42 conservation units, 28 indigenous lands, 865 agrarian reform settlements and 34 quilombola[3] areas (EMBRAPA, 2015; MIRANDA, 2015).

Several members of the government and the civil society, such as Embrapa, the Ministry of Agriculture, Livestock and Supply (MAPA), delegates of the business sector and employers' and workers' union entities, among others composed the Matopiba Regional Development Agency.

[1] Set of investigations on corruption and money laundering that fulfilled several warrants - including that negatively affected the economic performance of Petrobras (Brazilian state-owned oil and derivatives industry), as well as members of the Workers Party (PT) (who ruled the presidency at the time) - and has been in progress by the Federal Police of Brazil since 2014.

[2] Amount adjusted by the IPCA index (IBGE).

[3] A quilombola area is composed by inhabitants of rural black communities formed by descendants of enslaved Africans, who mostly live on subsistence agriculture on land donated, purchased or occupied for a long time.

This entity was supposed to act in this territory with resources provided for the 2016 Complementary Law N. 279-B, aimed at promoting infrastructure improvement, technical assistance and training, cooperatives and associations, implementation of certifications to add value to the product, rural credit, sales program in counter and a network of innovation and technological improvement (BRASIL, 2016b; MAPA, 2016b).

However, before the PDA-MATOPIBA was consolidated as agricultural regional policy, there was the impeachment of the ex-President Dilma Rousseff in 2016. The new president, Michel Temer, at the same year, launched the Decree N. 8852 which extinguished the Matopiba Agricultural Development Department from the organizational structure of MAPA. Despite this, the definition of the border proposed by Embrapa in 2015 continued to be used as a limit for investments.

Currently, agencies such as the Brazilian Development Bank (BNDES), the World Bank, the Federal Savings Bank (CEF), in addition to other public and private institutions, operate in the locality through investments, credit and research projects. Also, the governments of the four states work together to promote common interest mainly through the Secretariats of Agriculture and Rural Development. Together, those institutions spent at least around US$ 176 million[4] in the last five years (PIAUÍ, 2016, 2017; CARDOSO, 2020; REBECA, 2019; ESTADO DO PIAUÍ, 2020; SECAP, 2018; SOARES, 2020).

Given the objectives of the PDA-MATOPIBA and the importance of agriculture in the region as a potential factor for local socioeconomic development, as well as the volume of resources employed, the evaluation of this plan is relevant not only for Brazil but also for other countries where the agricultural sector constitutes one of the most important economic pillars. This essay aims to answer the follow question: what are the socioeconomic effects of the MATOPIBA agricultural frontier delimitation?

To achieve that goal, this research has as general objective to identify the effects of the definition of Matopiba's border on social and economic outcomes at the municipal and individual levels. This general objective has specific objectives: identify the PDA-MATOPIBA dynamic regarding legislation and its importance in current investments articulation; model the data using the proposed econometric strategy; and analyze the results in the light of the region's socioeconomic reality.

Previous works have already explored the MATOPIBA region to describe it in terms of economics and agricultural dynamics (BUAINAIN; GARCIA; FILHO., 2017), patterns of economic growth (RIBEIRO et al., 2016), HDI (CRUZ et al., 2019) and its insertion in a globalized agribusiness context (SOUZA; PEREIRA, 2019) among others. However, from the best of our knowledge, this is the first work that explores the officialization of the border as a cause of the effects on GDP per capita, the GVA per capita, and employment per capita at the municipal level; as well as formal

[4]Nominal amount, according to the dollar quote on Mar. 27th 2020.

income at the individual level.

Mata and Resende (2020), Becker, Egger, and Ehrlich (2010), Giua (2017) and Oliveira (2020) also used geographic discontinuity in its most traditional form, i.e., through Regression Discontinuity Design (RDD), to assess the effect of regional policies in certain areas that had the geographic discontinuity as a feature.

Although the PDA-MATOPIBA has not been consolidated as regional policy, it is hypothesized that the delimitation of the border facilitated the coordination of actions to develop the region. In this sense, a slight improvement in the explored outcomes is expected. Therefore, the presented method is still valid in the use of identifying the effects caused by the officialization of the MATOPIBA frontier in the context of the Plan creation.

In the next section, it is shown a brief overview of MATOPIBA trajectory and its socioeconomic scenario. Section 3 explains the MATOPIBA's characteristics for fitting in the spatial discontinuity approach. In section 4 it is detailed the methodological framework and the procedure limitations. In section 5 it is reported the results. Finally, in section 6 it is presented the conclusion.

2 MATOPIBA: FROM CREATION TO THE CURRENT SITUATION

The MATOPIBA presents a singularity concerning the other agricultural frontiers present in the country over the time as it encompasses municipalities in the states located in the poorest regions of the country at the moment, considering GDP per capita: the Northeast and North (IBGE, 2019b). The frontier was made official in 2015 by Presidential Decree N. 8447 of 2015, within the scope of the creation of the Matopiba Agricultural Development Plan (PDA), and covers municipalities selected by the Ministry of Agriculture, Livestock and Supply (MAPA) in partnership with the Brazilian Agricultural Research Corporation (Embrapa). The plan aimed to coordinate public policies to develop the region (BRASIL, 2015).

Since it houses the cerrado biome, in addition to a small part of the Amazônia and the Caatinga, the agricultural frontier of MATOPIBA is of great ecological importance on account of its biological diversity and because it is fundamental for eight of the twelve Brazilian hydrographic basins. Vegetation cover, however, essential for the maintenance of life in the locality, started to give way mainly to the cultivation of soybeans and the management of livestock (BUAINAIN; GARCIA; FILHO., 2017; WWF-BRASIL, 2017).

In addition to the delicate situation resulting from the dilemma between growth - in this case, through agricultural expansion - and environmental preservation, the region is still fortunate in terms of land ownership. Native inhabitants, such as indigenous people, quilombolas, family farmers, coconut breakers and farmers, do not have the title of the land, which make them vulnerable in this sense. Large landowners, in turn, use burning as a symbol of land demarcation, opening spaces

that become unusable, generating inefficient environmental destruction (WWF-BRASIL, 2017).

The disordered occupation of the territory is harmful not only for local communities and the environment, but also for the production of grains (AMAZÔNIA, 2018). In addition, MAPA identified at least twelve constraints in the region, related to precarious infrastructure, limitations in the reach of technical assistance, low efficiency in irrigation systems, low productivity of animals and plants, low quality in production - notably in small businesses -, relaxation regarding the use of the Geographical Indication, deficiency in the organization and cooperation of producers, informal processing, fluctuation in the supply of fruit, lack of qualified labor, barriers in accessing rural credit and insufficient food reserve (MAPA, 2016a).

The Plan aimed to remedy the limitations previously presented through the allocation of investments in public infrastructure, innovation and technology policies for the region, in addition to providing for the insertion of farmers into the rural middle class by improving income, employment and professional qualification (RURAL, 2015; MAPA, 2016a).

However, plans began to change even in 2016 with the Presidential Decree N. 8,852 that extinguished the Matopiba Regional Agricultural Development Department at the structure of MAPA (BRASIL, 2016a). With this decree, the planned regional policy through which the Union should invest massively in the region was interrupted in the Michel Temer government. Consolidating the Executive Power's lack of interest in maintaining the PDA, in 2019 President Jair Bolsonaro signed the decree N. 10,087 that revoked the act that established the Plan in 2015 (BRASIL, 2019a).

Even so, the efforts of Brazilian parliamentarians remained, in addition to those of the Executive of the four states. Currently, in the Federal Senate, draft the Resolution Project No. 32, which aims to institute a Parliamentary Front, which would debate the subject to improve the federal legislation and to act in defence and promotion of the MATOPIBA region (BRASIL, 2019b). In the Chamber of Deputies, the Project of Complementary Law that authorizes the Executive Branch to establish the MATOPIBA Development Agency has been underway since 2016 (BRASIL, 2016b). Besides, the Secretaries of Agriculture of the four states meet with some frequency to jointly achieve local demands and attract investment, as mentioned in the previous section.

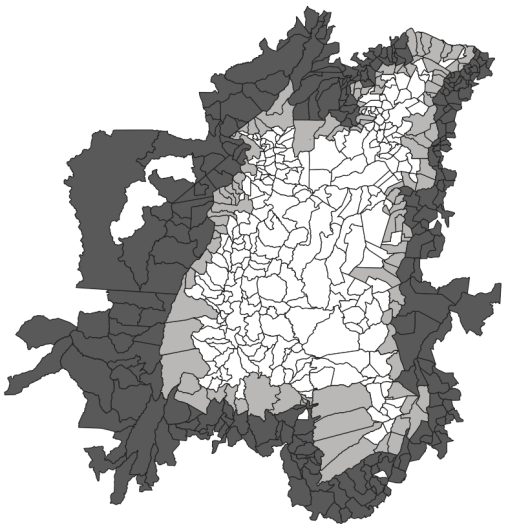
3 A SPATIAL DISCONTINUITY APPROACH FOR THE SOCIO-ECONOMIC EFFECTS OF THE MATOPIBA BORDER INSTITUTION

From a methodological perspective, we would ideally compare economic and social outcomes in the municipalities of the region when they are part of the plan and when they are not. However, in non-experimental settings like this, we can only observe one of the outcomes for each municipality; we either see the outcomes in a municipality when it is part of the plan or when it is not. As a consequence, researchers use alternative methods of impact assessment, specifically

quasi-experimental methods. That said, the intention is to use the institutional change of 2015 that selected 337 municipalities in the PDA-MATOPIBA based on geographic, climatic and socio-economic criteria.

The randomness and exogeneity of this unexpected inclusion allow the application of econometric strategies in order to quantify the isolated effect of the plan on certain variables of interest. In addition, the geographic discontinuity found at the MATOPIBA frontier illustrated in Figure 1 allows the appliance of methods which are able to identify causal effects.

Figure 1: Geographic discontinuity in MATOPIBA.



Source: own elaboration based on IBGE (2010) and MIRANDA (2015) data.

This possibility is due to the assumption that the border municipalities which do not belong to the region (municipalities in dark grey) have on average identical characteristics when compared to the municipalities within the MATOPIBA which are also on the border (municipalities in light grey), differing only by the condition of treatment.

In order to ensure this assumption fulfillment, a descriptive analysis was made for variables concerning socioeconomic, demographic and environmental aspects, such as education, employment, income, gross domestic product (GDP), gross value added (GVA), age, population and precipitation per trimester.

In Tables 1, 2 and 3 it is possible to check the variables means, as well as the difference between the means for t = 0 (the year before the border institution, i. e, 2014) for the municipalities that are on the border and belong to the MATOPIBA region, specified by T = 1 (105 observations for each point in time); and for the municipalities contiguous to the MATOPIBA border, as well

as its immediate neighbours[5], specified by T = 0 (235 observations for each point in time). The exception is precipitation data since the available data set included only the period between 1960 and 1990 when some municipalities had not existed yet; that is the reason for the fewer number of observations for those variables in Table 3.

Tables 1, 2 and 3 indicates that there is no statistically significant difference in means. Thus, descriptive statistics signalize that there seems to be no difference in socioeconomic, demographic or environmental observable characteristics between the municipalities in the control group and the treatment group in most variables.

Table 1: Descriptive analysis of outcomes.

Variable	N	Mean, T=1, t=0	Mean, T=0, t=0	Difference
Employment per capita	340	0.07	0.08	0.01
GDP per capita	340	10,454	11,233	779.48
Agricultura GVA per capita	340	2,683	4,011	1,328
Formal Income	340	1384.31	1594.48	210.17*

Note: * indicates that difference in means is statistically different from zero, at a significance level of 5%.
Source: own calculation based on IBGE (2014) and RAIS (2014).

Table 2: Descriptive analysis of control variables.

Variable	N	Mean, T=1, t=0	Mean, T=0, t=0	Difference
Age	340	37.38	36.81	-0.56
Illiterate	340	28.52	34.50	5.97
Incomplete Elementary	340	479.02	791.02	312
Complete Elementary	340	298.40	416.85	118.46
Incomplete High School	340	186.83	339.99	153.16
Complete High School	340	1217.69	1887.47	669.77
Incomplete College	340	63.74	107.19	43.45
Complete College	340	340.67	631.74	291.07
Graduate	340	5.16	55.93	50.76
Average income	340	1270.80	1319.79	48.99

Note: * indicates that difference in means is statistically different from zero, at a significance level of 5%.
Source: own calculation based on RAIS (2014).

[5] A second layer of municipalities was included over the immediate contiguous because of the results of statistics analysis concerning the means and, consequently, on account of their use as control group in the estimations. That said, Figure 1 shows also treatment and control groups for the estimation strategy (OLS), explained in 4.1.2.

Table 3: Descriptive analysis of aditional variables.

Variable	N	Mean, T=1	Mean, T=0	Difference
Spriger precipitation	262	75.28	84.39	9.11
Summer precipitation	262	204.32	213.07	8.74
Fall precipitation	262	182.19	173.82	-8.36
Winter precipitation	262	18.06	20.04	1.97
Population	340	21,995	25,354	3,359
Service GVA per capita	340	2,562	3,179	520
Industrial GVA per capita	340	959	2,263	140
Public Administration GVA per capita	340	3,707	876	-120

Note: * indicates that difference in means is statistically different from zero, at a significance level of 5%.
Source: own calculation based on IBGE (2014) and IPEADATA (1990).

4 METHODOLOGICAL PROCEDURES

4.1 DATA AND MODELS FOR THE EFFECTS ESTIMATION

4.1.1 DATA

The interest is specifically in employment per capita, gross domestic product (GDP) per capita, and agricultural gross value added (GVA) per capita at the municipal level[6]; and the formal income at the individual level. For this purpose, data with municipal aggregation and individual level from the Annual Social Information List (RAIS) are used regarding formal employment and income from formal employment, respectively; and from the Brazilian Institute of Geography and Statistics (IBGE) in terms of total gross domestic production and by sector (agriculture and livestock) at the municipal level, for the years 2014 (before the change) and 2016 (after the change).

For the purpose of comparing municipalities with closer profiles, control variables as age, education level (illiterate, incomplete elementary school, complete elementary school, incomplete high school, complete high school, incomplete college, complete college and graduate), and average income (described in Table 2) are used.

4.1.2 MODEL

In order to identify the causal effect of PDA-MATOPIBA on employment per capita, GDP per capita, GVA per capita, and income from formal employment a border strategy was adopted.

A linear regression is performed using the method of ordinary least squares (OLS) of the

[6]The variables of interest at the municipal level dividing the variables employment, GDP and agricultural GVA by the populations' estimations of each municipality, made available by IBGE.

variables of interest as a function of a variable that indicates the status of treatment. Then, control variables are added in order to check for changes in the explanatory variable's effects on the variable of interest. The regression model is specified in (1).

$$Y = \beta_0 + \beta_1 MATOPIBA + \varepsilon, \tag{1}$$

where Y is the socioeconomic variable of interest, MATOPIBA is the treatment dummy, assuming 0 for non-treated municipalities and 1 for treated municipalities, and ε is the error.

Figure 1 illustrates the selection of municipalities. The municipalities in white and light grey are the 337 that form the MATOPIBA region. Of these, only light grey municipalities (105 municipalities) constitute the treatment group for the evaluation proposed by this study, as they are located on the MATOPIBA frontier. Finally, dark grey municipalities (235 municipalities) are used as a control group, as they are adjacent to the MATOPIBA border (96 municipalities), or immediate neighbours of the contiguous municipalities (139 municipalities). Therefore, a total of 340 municipalities compose the sample of this study.

4.2 LIMITATIONS

There are two main limitations of this study: the eligible group may not receive treatment and the results found do not extend to municipalities that are not on the edge of MATOPIBA.

The former concerns that it is considered that all municipalities that are within the MATOPIBA border, that is, the group eligible to receive the treatment of government actions in fact receive it. However, it is not possible to ensure that all municipalities on the border receive investments equally. Nor can this be guaranteed when it comes to estimates with observations for the individual level. However, it is ensured that all the municipalities that are part of this study as a treatment group started to receive the status of MATOPIBA after the formalization of the border, in 2015 (and in this sense, the eligible municipalities are certainly treated as well).

The latter consists in the fact that the inferences made from the results obtained with the estimates can only be applied to the municipalities belonging to the border. It is not possible to cover all MATOPIBA with the results found.

These limitations, however, do not dwarf the relevance of the work, since it is an innovation for the literature to identify the effects of the MATOPIBA border institution, although it is not possible to extend these conclusions to all municipalities in the region.

5 RESULTS

Tables 4, 5, 6 and 7 below show the effects of being part of MATOPIBA on the variables employment per capita, ln of Gross Domestic Product per capita, ln of Gross Agricultural Value

Added per capita, and ln of formal income using the frontier strategy with the OLS method.

The results observed in Table 4 show a weak and negative effect of participating in MATOPIBA on per capita employment at a significance level of 10% only in column 2, when the average income variable per municipality is added as a control. This effect soon disappears when the other age, education and federative units controls are added.

Table 4: MATOPIBA effect on Employment per capita.

	Employment per capita			
	1	2	3	4
MATOPIBA	-0.0051	-0.0102*	-0.0043	0.0052
	0.0045	0.0043	0.0038	0.0033
Income		x	x	x
Age/Education			x	x
Federative Units				x
N	680	680	680	680
R^2	0.002	0.089	0.380	0.617

* p<0.10, ** p<0.05, *** p<0.01

In Table 5 the identified effect is also fragile, being negative in column 2 when adding the control for age and education, but positive in column 3, when adding the state dummies. Therefore, it cannot be denied at a significance level of 10% that being part of MATOPIBA increases the GDP per capita of the municipalities by 8.8%.

Table 5: MATOPIBA effect on GDP per capita.

	GDP per capita		
	1	2	3
MATOPIBA	0.0210	-0.0102*	0.0884*
	0.0570	0.0500	0.0422
Age/Education		x	x
Federative Units			x
N	680	680	680
R^2	0.001	0.273	0.636

* p<0.10, ** p<0.05, *** p<0.01

Table 6 shows that the effect of making the border official only appears on agricultural GVA when the control for the federative units is inserted. This effect is positive and indicates that at a sig-

nificance level of 5% it cannot be denied that being a member of MATOPIBA enlarges agricultural GVA by 20.8%.

Table 6: MATOPIBA effect on Agricultural GVA per capita.

	Agricultural GVA per capita		
	1	2	3
MATOPIBA	0.0498	0.167	0.208*
	0.109	0.101	0.0964
Age/Education		x	x
Federative Units			x
N	680	680	680
R^2	0.000	0.185	0.551

* p<0.10, ** p<0.05, *** p<0.01

When it comes to Table 7, the MATOPIBA effects on Formal Income are more consistent because they are positive for all specifications at a significance level of 1%. According to column 4, it cannot be denied that being includede in the MATOPIBA region raises formal income by 13%.

Table 7: MATOPIBA effect on Formal Income.

	Formal Income			
	1	2	3	4
MATOPIBA	0.0201***	0.0149***	0.00765***	0.130***
	0.00124	0.00118	0.00117	0.00131
Age/Education		x	x	x
Agricultural Labor Sector			x	x
Federative Units				x
N	2337594	2337594	2337594	2337594
R^2	0.000	0.181	0.188	0.211

* p<0.10, ** p<0.05, *** p<0.01

6 CONCLUSION

In this essay, the geographic discontinuity present in the MATOPIBA region is explored to identify the effects of border officialization with the background of the MATOPIBA Agricultural Development Plan, made official by presidential decree in 2015.

The main criterion for selecting the municipalities used by Embrapa and MAPA to establish the border was the biome. Most of the 337 municipalities that make up MATOPIBA are inserted in

the Cerrado biome, while a minority also houses the Caatinga and Amazônia biomes. The municipalities that are on the limit of MATOPIBA share these biomes or are in a transition zone, which makes them very similar in the environmental aspect. Descriptive statistics for other variables show that, on average, the municipalities adjoining the MATOPIBA frontier are also identical in demographic, social and economic aspects.

This allowed the appliance of an identification strategy exploring the difference in the treatment status of the municipalities. A group of 105 municipalities that compose the MATOPIBA frontier was used as a treated group while 235 contiguous or immediate neighbours to the contiguous ones were used as a control group.

The results showed a null effect of the officialization of the border on employment per capita and a positive effect at a significance level of 5% of the magnitude of 8.8% on GDP per capita and 20.8% on GVA agriculture per capita when working with data aggregated by municipalities. In the case of individual observation, there is a significance level of 1% that being part of MATOPIBA increases the income from formal work by 13%.

The smoothed result on the aggregate variables may be a consequence of the PDA-MATOPIBA non-consolidation or the aggregation of data by municipalities. The second hypothesis is due to the fact that a more robust result for formal work income was already expected since the number of observations increased, also increasing the sample variance.

Therefore, it cannot be denied that even though the PDA-MATOPIBA has not been consolidated, being part of the MATOPIBA frontier, at least at the border, represents a positive effect for three of the four outcomes explored. These results raise questions about the decision to extinguish the MATOPIBA Department in MAPA and to revoke the decree that instituted the Plan. It is possible that the targeted investments proposed in the PDA-MATOPIBA would result in even greater impacts than those currently identified. In addition, it reinforces the hypothesis that the officialization of borders has the role of guiding actions by public and private institutions and the government at the state level.

In the future, it is expected to continue exploring MATOPIBA's geographic discontinuity with advances in the identification strategy. It is intended to combine the difference in differences (DID) strategy and the regression discontinuity design (RDD), which is called Differences in Geographic Discontinuity (Diff-in-Geo-Disc). This strategy will serve to ensure that there is no other exogeneity giving municipalities characteristics that make them more likely to receive treatment, which certainly would affect the causal effect estimation of the MATOPIBA delimitation. The treatment and control groups are supposed to be selected through an algorithm that considers as a criterion the distances from the municipalities to the geographic discontinuity frontier, increasing the sample and consequently the variance and the results robustness.

REFERENCES

AMAZÔNIA, IPAM. **MATOPIBA.** 2018. 9 min e 14 seg, son., color. Available from: <https://bit.ly/2L48rJB>. Accessed on: Aug. 29th 2019.

BECKER, Sascha O; EGGER, Peter H; EHRLICH, Maximilian Von. Going NUTS: The effect of EU Structural Funds on regional performance. **Journal of Public Economics**, v. 94, n. 9-10, p. 578–590, Oct. 2010.

BRASIL. **Decreto-Lei nº 10.087, de 5 de novembro de 2020. Declara a revogação, para os fins do disposto no art. 16 da Lei Complementar nº 95, de 26 de fevereiro de 1998, de decretos normativos.** 2019a. Available from: <https://bit.ly/2MgwIf0>. Accessed on: Mar. 12nd 2020.

BRASIL. **Decreto-Lei nº 8.447, de 6 de maio de 2015. Dispõe sobre o Plano de Desenvolvimento Agropecuário do MATOPIBA e a criação de seu Comitê Gestor.** 2015. Available from: <https://bit.ly/2NXa4dn>. Accessed on: Nov. 4th 2019.

BRASIL. **Decreto-Lei nº 8.852, de 20 de setembro de 2016. Aprova a Estrutura Regimental e o Quadro Demonstrativo dos Cargos em Comissão e das Funções de Confiança do Ministério da Agricultura, Pecuária e Abastecimento, remaneja cargos em comissão e funções gratificadas e substitui cargos em comissão do Grupo Direção e Assessoramento Superiores - DAS por Funções Comissionadas do Poder Executivo - FCPE.** 2016a. Available from: <https://bit.ly/2Bc6wzW>. Accessed on: Mar. 12nd 2020.

BRASIL. **Projeto de Lei Complementar 279/2016.** 2016b. Available from: <https://bit.ly/2MFTjSw>. Accessed on: Mar. 12nd 2020.

BRASIL. **Projeto de Resolução do Senado n 32, de 2019.** 2019b. Available from: <https://bit.ly/37eWj1H>. Accessed on: Mar. 12nd 2020.

BUAINAIN, Antônio Márcio; GARCIA, Junior Ruiz; FILHO., José Eustáquio Ribeiro Vieira. **Dinâmica da economia e da agropecuária no Matopiba.** Rio de Janeiro, Mar. 2017. Texto para Discussão.

CARDOSO, Isabel. **Piauí vai sediar III Encontro dos secretários do Matopiba nesta quarta (22).** 2020. Available from: <https://bit.ly/3cvuTGF>. Accessed on: Mar. 12nd 2020.

CEPEA. **PIB do agronegócio brasileiro.** Piracicaba, 2019. Available from: <https://bit.ly/2OjIxlo>. Accessed on: Nov. 17th 2019.

CRUZ, Leon Nazaré da et al. Desenvolvimento socioeconômico na região de Matopiba, Brasil. **Brazilian Journal of Development**, v. 5, n. 8, p. 12538–12556, July 2019.

EMBRAPA. **GeoWeb MATOPIBA**. Campinas, 2015. Available from: <https://bit.ly/2V88NCt>. Accessed on: Aug. 28th 2019.

ESTADO DO PIAUÍ, Governo do. **Investimentos.** 2020. Available from: <https://bit.ly/2LsyU2P>. Accessed on: Mar. 12nd 2020.

GIUA, Mara. Spatial discontinuity for the impact assessment of the EU regional policy: The case of Italian objective 1 regions. **Journal of Regional Science**, v. 57, n. 1, p. 109–131, Jan. 2017.

IBGE. **Produção agrícola municipal: culturas temporárias e permanentes.** Rio de Janeiro, 2000. Available from: <https://bit.ly/2CYfmPr>. Accessed on: Nov. 19th 2019.

IBGE. **Produção agrícola municipal: culturas temporárias e permanentes.** Rio de Janeiro, 2018. Available from: <https://bit.ly/2CYfmPr>. Accessed on: Nov. 19th 2019.

IBGE. **Sistema de Contas Nacionais Trimestrais.** 2019a. Available from: <https://bit.ly/32TLHBD>. Accessed on: Nov. 17th 2019.

IBGE. **Sistema de Contas Regionais: Brasil 2017**. 2019b. Available from: <https://bit.ly/372Jo2M>. Accessed on: Jun. 5th 2020.

MAPA. **PDA-MATOPIBA. Plano de Desenvolvimento Agropecuário do Matopiba.** 2016a. 8 slides.

MAPA. **Plano de Desenvolvimento Agropecuário do Matopiba**. 2016b. 8 slides.

MATA, Daniel Da; RESENDE, Guilherme. Changing the climate for banking: The economic effects of credit in a climate-vulnerable area. **Journal of Development Economics**, Mar. 2020.

MIRANDA, Evaristo de. **Matopiba – Caracterização, agendas e agência**. v. 8.1. Campinas, 2015.

OLIVEIRA, Tassia Germano de. **Descontinuidades espaciais e políticas territoriais: uma avaliação do Fundo Constitucional de Financiamento do Nordeste.** 2020. chap. 2, s. 52–103. Doctoral Thesis – Universidade Federal de Pernambuco, Recife.

PIAUÍ. **Lei 6.752 de 29 de Dezembro de 2015 - Anexo IV.** 2016. Available from: <https://bit.ly/366dwdg>. Accessed on: Mar. 12nd 2020.

PIAUÍ. **PIB do agronegócio brasileiro.** 2017. Available from: <https://bit.ly/2WRRC96>. Accessed on: Mar. 12nd 2020.

REBECA, Tamyres. **Governador assina ordem de serviço para conclusão da BR 235.** 2019. Available from: <https://bit.ly/3dSgcgX>. Accessed on: Mar. 12nd 2020.

RIBEIRO, LUIZ CARLOS DE SANTANA et al. Padrões de crescimento econômico dos municípios do MATOPIBA. 2016.

RURAL, Canal. **MAPA divulga relação dos 337 municípios que vão integrar o plano do Matopiba.** 2015. Available from: <https://bit.ly/30wGsY9/>. Accessed on: Aug. 15th 2019.

SECAP. **Encontro com organizações internacionais garante apoio à construção de estrada na região do Matopiba.** 2018. Available from: <https://bit.ly/3dPb9hC>. Accessed on: Mar. 12nd 2020.

SOARES, Mariah. **Crédito Rural disponibiliza 5,2 bi para o setor agropecuário.** 2020. Available from: <https://bit.ly/3czEnR7>. Accessed on: Mar. 20th 2020.

SOUZA, Glaycon Vinícios Antunes de; PEREIRA, Mirlei Fachini Vicente. MATOPIBA: a Inteligência Territorial Estratégica (ITE) e a regionalização como ferramenta. **Revista NERA**, v. 22, n. 47, p. 22–45, 2019.

TRABALHO, MINISTÉRIO DO. **Cadastro Geral de Empregados e Desempregados (CAGED).** 2019. Available from: <https://bit.ly/2XkEd9F>. Accessed on: Novr. 17th 2019.

WWF-BRASIL. **Por dentro do Matopiba.** 2017. Available from: <https://bit.ly/2ZBT6Uh/>. Accessed on: Aug. 28th 2019.