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## **Credit Concentration of Brazilian Rural Activities from 2000 to 2008**

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**Abstract:** This paper aims to analyze the degree of concentration of loans allocated to agricultural and livestock activities in Brazil from 2000 to 2008 and to assess the distribution pattern of rural credit among the Brazilian states. The major motivation is to investigate if the volume of available credit is proportional to states share of agricultural production and harvest areas, and states share herd regarding livestock. The results suggest that rural credit still remains concentrated in states of the Southern and Southeastern regions, although there has been credit decentralization during the current decade in favor of agricultural frontier in parts of Central and North regions of Rural Brazil. The conclusions suggest that transport and energy infra-structure promoted by local and national governments have been fundamental to expand the potential economic growth as well as the demand for rural credit in those regions.

**JEL classification:** E51, G21, L11

**Key words:** rural credit, concentration, distribution, Theil index.

### **1. Introduction**

The creation of the National System of Rural Credit (NSRC) in 1965, according to Coelho (2001), was to mark the modernization of the Brazilian agriculture. At that time, following the creation of the NSRC, the Policy Guarantee of Minimum Prices (PGMP) was also created.

Until the mid-1980s, the resources from National Treasury, plus the Resources Required<sup>1</sup>, represented approximately 96% of the Brazilian rural credit system (Gasques et.al.,2000).

Hoffman and Kageyama (1987) found that the rural credit concentration, throughout the 1970s, favored some outputs, mainly in terms of export and/or industrialization, favoring the Southern and Southeastern states.

The 80's were characterized by the exhaustion of the Brazilian industrialization process via import substitution, the debt crisis and the consequent disruption of the flow of foreign investments. The capacity of the public sector to generate resources was exhausted and inflation rates reached levels politically unsustainable (Barros & Araújo, 1991). Then, the official credit supply declined dramatically and there was a need to search for financing alternatives, with priority for non-inflationary financing resources.

In the 1990s the Brazilian agriculture financing had to adjust to changes in rural credit policy and cope with a new scenario faced by the market, with the gradual removal of government. With the macroeconomic context further characterized by the exchange rate appreciation there was a new ingredient represented by high interest rates in that decade. Furthermore, with the economic opening, there were still low import tariffs on some agricultural products. The compensatory variables were the increasing international prices from 1994 to 1997, the reduction<sup>2</sup> of input prices and the increase of the agricultural productivity through research and technology developed by universities and other research institutions and technology such as Embrapa (Brazilian Enterprise of Agricultural Research) (Homem de Melo, 1998).

Over the recent decades, the amount of credit distributed by the NSRC has been reduced, and reached its lowest level between 1996 and 1997. The reasons for this reduction, the macroeconomic situation and the changes in funding sources have been widely studied in the literature of agricultural policy in Brazil, such as studies of Coelho (2001) and Gasques et. al. (2000). However, the credit supplied by the NSRC still plays an important role as an instrument of agricultural policy although new instruments for financing agriculture and micro credit programs have been developed. The amount of credit to agriculture has grown consistently, reaching in 2008 the amount of R\$ 66 billions or so, which represented an increase of 154% between 2000 and 2008. This paper aims to verify if, despite the increase in

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<sup>1</sup> The rural credit legislation requires that commercial banks allocate a percentage of the savings to finance the agricultural sector.

<sup>2</sup> This reduction was caused by exchange rate appreciation and price reductions of pesticides, fertilizers and machinery.

<sup>4</sup> This is a trend not only related to rural credit, but to the whole financial market (Pequenos sem crédito, 2002).

rural credit amount, the pattern of the credit concentration, as observed in the 1970s and 1980s, has remained in the current decade.

## **2. Literature Review**

The credit market is characterized by rationing, which is more severe in sectors where there are significant risks (in the case of rural sector), or that require long-term maturity (real estate mortgage). The solution to this problem, historically, has been the provision of credit for these operations by government programs and resources. The resources from the National System of Rural Credit (NSRC) at Banco do Brasil and the special financing line from the National Bank for Economic and Social Development (BNDES), the main sources of long-term loans, are examples of the structure of the credit market in Brazil.

The formal agricultural credit, supplied by the NSRC participating institutions, has a division between public and private bank activities<sup>4</sup>. Private banks work with a small number of borrowers at large volumes (i.e. high average value of contracts); while other institutions negotiate large number of contracts (low average). This indicates that resources from private banks may be limited to a few farmers and not to the agricultural sector as a whole (Lima, 2003).

The economic literature presents the hypothesis that rural credit could be an important determinant in adopting new technologies and in agricultural production growth, as demonstrated by Conceição (et al., 1998), Sperl & Araújo (1995), Vicente (1999) and Kageyama (et al., 1990). The positive correlation between agricultural production and rural credit in Brazil is attributed to, according to these authors, the availability of credit to purchase machinery and modern inputs<sup>5</sup>. It is worth noting that there is no empirical evidence for this hypothesis, and, as Araújo(1983) states "even if certain raw materials related to gains in productivity have increased, the main variable to explain the agricultural production growth continues to be the intensified use of traditional factors."

Thus, during the 70s, expectations were created about a possible concentration of rural credit to produce exports to the detriment of the credit for food production. Contrary to what is expected, the commodities market had a slight increase in the participation of the total cost of credit; however it was enough to even out credit distribution in terms of the production value between agricultural export products and foods (Hoffmann & Kageyama, 1987). Among the explanations for this fact, the authors of the current study include: (a) on the supply side, the increase – with more access to credit – of capitalist enterprises for crops

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<sup>5</sup> The fact that technical assistance was required from the rural credit borrowers, favoring the contact between technicians and producers, has also encouraged the use of modern inputs.

production, traditionally managed by family firms (as in the case of rice farms in the Midwest) and; (b) on the demand side, the increase in domestic consumption (mainly in urban areas) of processed food by income and substitution effects, led to an increasing share of agricultural production which was classified as tradable<sup>6</sup> to be effectively consumed in the domestic market .

Analyzing the period from 1970 to 1993, it is observed that the regional concentration of rural credit was strong. The sum of the resources supplied to the South, Southeast and Midwest amounted roughly 90% of the total. To the North and Northeast, quantities with little significance to agricultural financing<sup>7</sup> were supplied (Sperl & Araújo, 1995). This situation can be explained partially by the commercial production distribution. Soon after the establishment of NSRC there was greater concentration in the South and Southeast. Only from the late 70s on, with the displacement of the agricultural frontier, the volume of credit granted to the Midwest increased (Hoffmann and Kageyama, 1987). In addition, the regional credit concentration operations were affected by the following reasons: the small degree of internalization of the Brazilian banking system, the concentration of this network in more prosperous regions of the country, and the type of crops that predominate in the south (such as soybeans and wheat), which require more fertilizers and pesticides (Agroanalysis, 1979). Data from the Agricultural Census of 1995/96 show that only 5.3% of landowners borrowed loans for the development and expansion of their activities and only 4.1% demanded credit to finance the costs.

Lima and Campos (2001), as well as Almeida (et al., 2008), showed the reduction of the credit concentration in Brazil although the first authors have found a decline in the value of agricultural production and the rural activities in the Northeast, while the South showed increases in the two variables in between 1986 and 1997.

Almeida (et al., 2008) presented recent estimates on rural credit concentration, between 1999 and 2003. The authors focused their analysis only on the State of Bahia, and its regions but results indicated that there is uneven credit distribution between each geographic region of this state.

## **2.1 Credit Evolution for Agriculture from 2000 to 2008**

The rural credit, supplied by the NRCS, is divided into two activities: agriculture and livestock. Table 1 shows the data regarding agricultural credit from 2000 to 2008 in which

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<sup>6</sup> Cotton, peanuts, cocoa, coffee, sugar cane and soybean (Hoffmann & Kageyama, 1987).

<sup>7</sup> Even with the creation of the Northeast Constitutional Financing Fund (FNE) and North (NOF) in 1988, there was no change in the distributive pattern of rural credit in Brazil (Sperl & Araújo, 1995).

there were small changes in the distribution of agricultural credit among the Brazilian States. The states with the highest participation in NSRC were: Sao Paulo, Rio Grande do Sul, Parana and Minas Gerais.

Table 1. Percentage values of agricultural credit distributed among Brazilian States – 2000 to 2008.

<b>States</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
Acre	0.16	0.04	0.05	0.09	0.05	0.05	0.05	0.05	0.03
Amapá	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.00	0.01
Amazonas	0.12	0.37	0.10	0.10	0.09	0.13	0.07	0.14	0.07
Pará	0.78	0.41	0.31	0.64	0.68	0.53	0.52	0.42	0.29
Rondônia	0.90	0.34	0.23	0.36	0.35	0.37	0.26	0.21	0.19
Roraima	0.06	0.03	0.02	0.04	0.07	0.13	0.03	0.03	0.02
Tocantins	0.48	0.37	0.33	0.79	1.00	0.77	0.56	0.55	0.63
Alagoas	0.21	0.46	0.34	0.34	0.21	0.48	0.79	0.56	0.44
Bahia	2.02	1.93	2.25	2.54	2.89	3.42	3.25	3.27	3.50
Ceará	1.16	1.21	0.75	0.47	0.63	0.44	0.63	0.67	0.58
Maranhão	0.55	0.45	0.46	0.75	0.66	1.51	1.07	0.98	1.16
Paraíba	1.03	0.82	0.66	0.45	0.46	0.35	0.43	0.57	0.54
Pernambuco	0.23	0.20	0.13	0.31	0.50	0.57	0.74	0.78	0.63
Piauí	0.41	0.33	0.27	0.40	0.51	0.68	0.65	0.57	0.65
Rio Gde. do Norte	0.19	0.22	0.33	0.17	0.14	0.25	0.29	0.26	0.21
Sergipe	0.20	0.21	0.16	0.17	0.14	0.22	0.43	0.24	0.30
Espírito Santo	1.41	1.07	1.02	0.88	0.80	1.56	2.01	2.46	2.03
Minas Gerais	10.94	9.84	9.52	8.92	8.34	11.51	14.29	15.45	14.86
Rio de Janeiro	0.29	0.39	0.24	0.16	0.17	0.23	0.34	0.26	0.23
São Paulo	19.22	19.43	18.93	15.44	15.36	15.23	19.89	20.43	17.20
Paraná	18.09	18.42	19.14	19.12	19.57	18.90	16.13	17.36	19.48
Rio Gde do Sul	18.37	19.27	20.14	20.13	19.47	17.28	17.06	15.92	17.69
Santa Catarina	7.69	7.42	6.79	7.21	6.52	6.72	7.21	6.81	7.06
Distrito Federal	0.21	0.20	0.21	0.22	0.32	0.41	0.24	0.23	0.24
Goiás	6.90	6.44	7.10	7.20	8.11	7.08	5.04	4.56	4.63
Mato Grosso	5.76	7.16	7.34	8.89	8.77	7.52	5.19	4.38	4.51
Mato Grosso Sul	2.63	2.94	3.18	4.19	4.20	3.64	2.82	2.84	2.83
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100,00</b>

Source: Central Bank (2008) and authors' elaboration

Tables 2 and 3 show the share of each Brazilian state in the total agricultural production for temporary and permanent crops, also in the period from 2000 to 2008. Again, major changes are not observed along the time and states with greater participation in permanent crop production were: Sao Paulo, Minas Gerais, Bahia and Espirito Santo. In temporary crops, the states with the highest participation were: Sao Paulo, Paraná, Rio Grande do Sul and Mato Grosso.

Table 2. States share in total agricultural production – permanent crop – 2000/2008.

<b>States</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
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Rondônia	2.83	1.01	1.13	2.38	1.36	1.58	0.92	1.35	1.57
Acre	0.21	0.18	0.16	0.16	0.12	0.10	0.09	0.14	0.11
Amazonas	0.54	0.45	1.20	1.15	0.89	0.53	0.52	0.48	0.39
Roraima	0.06	0.07	0.05	0.07	0.07	0.08	0.06	0.07	0.07
Pará	4.67	4.22	4.85	3.56	2.83	3.02	3.01	3.70	3.20
Amapá	0.04	0.03	0.02	0.02	0.01	0.03	0.04	0.06	0.05
Tocantins	0.08	0.16	0.14	0.14	0.12	0.14	0.11	0.12	0.11
Maranhão	0.28	0.94	0.46	0.49	0.40	0.43	0.35	0.43	0.37
Piauí	0.44	0.28	0.20	0.27	0.32	0.22	0.23	0.16	0.24
Ceará	1.75	1.79	1.86	2.07	1.93	1.71	1.94	1.72	2.06
Rio Gde. do Norte	0.58	0.54	0.57	0.79	0.78	0.84	0.67	0.86	0.69
Paraíba	0.87	0.96	0.76	0.94	0.67	0.83	0.67	0.71	0.72
Pernambuco	2.29	3.02	2.31	2.72	2.61	3.13	2.86	2.99	3.20
Alagoas	0.30	0.31	0.34	0.24	0.21	0.21	0.18	0.18	0.22
Sergipe	1.09	1.06	1.25	1.40	1.02	1.22	1.30	1.23	1.24
Bahia	11.46	12.35	13.83	13.40	12.12	12.86	12.35	13.73	12.94
Minas Gerais	22.95	16.38	20.13	16.44	23.79	21.84	24.25	18.85	24.16
Espírito Santo	10.64	6.78	6.54	7.14	8.32	9.61	9.26	11.12	9.92
Rio de Janeiro	1.40	1.44	1.11	1.18	1.04	1.14	0.93	0.93	0.85
São Paulo	17.53	32.90	29.15	29.05	26.43	25.80	25.46	26.59	23.37
Paraná	6.91	3.47	3.55	4.49	3.85	3.52	4.01	3.38	4.26
Santa Catarina	3.51	2.41	2.50	2.96	2.43	2.55	2.90	2.93	2.78
Rio Gde. do Sul	6.90	6.56	6.05	6.96	6.71	6.38	5.99	6.33	5.49
Mato Grosso Sul	0.24	0.16	0.16	0.17	0.19	0.16	0.10	0.11	0.10
Mato Grosso	1.30	1.35	0.66	0.75	0.74	0.81	0.62	0.65	0.73
Goiás	1.01	1.02	0.90	0.94	0.93	1.15	1.06	1.05	1.04
Distrito Federal	0.12	0.14	0.13	0.13	0.11	0.10	0.11	0.11	0.11
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: IBGE (2009) and authors' elaboration

Table 3. States share in total agricultural production – temporary crop – 2000/2008.

States	2000	2001	2002	2003	2004	2005	2006	2007	2008
Rondônia	0.39	0.29	0.37	0.37	0.41	0.51	0.54	0.52	0.55
Acre	0.34	0.22	0.20	0.19	0.14	0.21	0.17	0.18	0.18
Amazonas	0.59	0.63	0.41	0.26	0.22	0.44	0.47	0.37	0.33
Roraima	0.15	0.13	0.13	0.13	0.16	0.16	0.16	0.12	0.12
Pará	1.71	1.52	1.33	1.44	1.47	1.71	1.74	1.55	1.28
Amapá	0.06	0.07	0.08	0.03	0.05	0.07	0.09	0.10	0.08
Tocantins	0.53	0.56	0.51	0.81	0.84	0.97	0.76	0.75	0.99
Maranhão	1.50	1.40	1.42	1.49	1.54	1.75	1.62	1.44	2.15
Piauí	0.58	0.44	0.29	0.57	0.61	0.77	0.78	0.58	0.95
Ceará	1.35	0.80	1.09	1.08	0.82	0.93	1.41	1.01	1.25
Rio Gde. do Norte	0.49	0.35	0.59	0.56	0.57	0.59	0.76	0.53	0.41
Paraíba	0.93	0.71	0.69	0.68	0.63	0.70	0.92	0.61	0.57
Pernambuco	1.68	1.50	1.60	1.21	1.24	1.57	1.66	1.41	1.28
Alagoas	2.40	2.22	1.66	1.12	1.09	1.25	1.39	1.18	1.15
Sergipe	0.31	0.25	0.27	0.33	0.27	0.30	0.39	0.37	0.43
Bahia	5.95	4.67	6.49	4.72	5.56	5.30	4.98	5.93	5.36
Minas Gerais	8.41	7.45	7.42	7.02	7.24	8.72	7.88	7.89	8.00

Espírito Santo	0.53	0.44	0.47	0.41	0.41	0.51	0.48	0.39	0.33
Rio de Janeiro	0.86	0.68	0.57	0.43	0.55	0.59	0.61	0.42	0.38
São Paulo	16.46	17.76	17.29	13.75	12.66	15.32	19.20	17.11	13.82
Paraná	14.53	15.81	15.76	17.69	16.47	14.47	14.60	16.21	17.23
Santa Catarina	5.16	4.51	4.09	4.58	4.47	4.48	4.25	4.20	4.34
Rio Gde. do Sul	13.98	17.18	14.30	16.84	14.27	10.15	13.96	14.18	13.81
Mato Grosso do Sul	3.29	3.77	3.79	4.71	3.94	3.50	3.60	4.10	4.14
Mato Grosso	10.50	9.81	10.70	12.18	16.35	17.39	10.75	11.83	13.20
Goiás	7.05	6.60	8.21	7.11	7.80	7.36	6.55	6.74	7.37
Distrito Federal	0.28	0.23	0.27	0.27	0.24	0.30	0.27	0.27	0.32
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: IBGE (2009) and authors' elaboration

A preliminary tabular analysis on the data suggests concentration of credit because some states like Bahia, Espírito Santo and Mato Grosso have a credit share, from NSRC, much lower than what their crops represent in the Brazilian agricultural production. Section 4 of this paper will present a more consistent analysis on credit concentration among the states.

Rural credit is divided according to the following purposes: running expenses, investment and commercialization. Over the period from 2000 to 2008 the three credit purposes had the volume allocated for them increased, showing the trend to increase total credit supply. Running expenses received most credit, accounting for approximately 60% of the funds from the NSRC. Each of the other two purposes, investment and commercialization, has something around 20% of the official credit granted to the farmers and cooperatives through NSRC.

## 2.2 Credit Evolution for Livestock from 2000 to 2007

Table 4 shows the credit values for Brazilian livestock activity. The data suggest that in the period from 2000 to 2008 there were small changes in the distribution of credit among the States. The states with the highest participation in NSRC resources were: São Paulo, Minas Gerais, Rio Grande do Sul, Goiás, Mato Grosso do Sul, Mato Grosso, Paraná and Santa Catarina.

Table 4. Percentage values of livestock credit distributed among Brazilian States – 2000 / 2008.

States	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acre	0.46	0.51	0.52	0.72	0.65	0.75	0.35	0.32	0.25
Amapá	0.02	0.02	0.03	0.02	0.07	0.09	0.05	0.03	0.01
Amazonas	1.23	1.36	0.38	0.28	0.34	0.38	0.32	0.42	0.50
Pará	5.97	2.97	2.91	4.20	4.51	3.76	4.32	3.34	3.37
Rondônia	2.12	1.68	2.14	3.61	4.21	3.24	1.59	1.70	1.32
Roraima	0.03	0.02	0.04	0.05	0.13	0.22	0.24	0.10	0.08
Tocantins	4.73	2.92	2.42	2.96	2.38	2.08	1.96	2.47	2.70



Alagoas	0.22	0.40	0.34	0.33	0.46	0.57	0.66	0.49	0.40
Bahia	1.99	2.31	2.74	2.53	3.83	3.43	3.52	2.96	2.55
Ceará	0.47	0.49	0.47	0.94	1.28	1.34	2.16	1.61	1.55
Maranhão	0.96	0.88	1.01	1.32	2.07	3.00	2.75	2.25	1.86
Paraíba	0.33	0.40	0.31	0.44	0.79	0.95	1.17	0.67	0.42
Pernambuco	1.20	0.61	0.48	0.62	0.93	1.09	1.91	1.68	1.16
Piauí	0.28	0.29	0.40	0.50	0.69	1.05	0.97	0.71	0.40
Rio Gde. do Norte	0.23	0.60	0.64	1.23	1.38	1.44	1.23	1.02	0.73
Sergipe	0.32	0.42	0.37	0.38	0.56	0.67	0.72	0.54	0.37
Espírito Santo	0.63	0.86	0.83	0.96	1.08	1.27	1.10	1.08	1.23
Minas Gerais	10.83	10.47	11.08	12.15	11.64	13.14	14.47	13.82	15.34
Rio de Janeiro	0.42	0.39	0.36	0.41	0.47	0.48	0.38	0.33	0.40
São Paulo	14.40	16.02	15.48	16.23	14.68	11.18	12.24	13.21	13.87
Paraná	6.94	8.79	8.28	8.51	6.78	7.49	8.37	9.27	9.00
Rio Gde do Sul	11.02	10.39	10.94	9.77	8.75	8.21	8.12	10.20	11.34
Santa Catarina	10.21	9.70	9.98	9.03	7.44	6.61	7.71	7.21	6.87
Distrito Federal	0.26	0.32	0.61	0.55	0.33	0.43	0.27	0.15	0.11
Goiás	10.47	11.21	10.80	8.25	9.99	12.48	10.37	9.89	11.00
Mato Grosso	6.30	7.83	8.43	7.03	6.72	6.79	6.19	7.15	6.00
Mato Grosso Sul	7.95	8.14	8.02	6.98	7.83	7.86	6.88	7.37	7.19
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Central Bank (2008) and authors' elaboration

Running expenses have received most credit for livestock, representing approximately 50% of the funds from the NSRC. Each of the two other purposes, investment and commercialization, holds something around 40% and 10%, respectively, of the official credit granted to producers and cooperatives through NSRC.

Table 5 lists percentage values of the state livestock production in domestic production in the period from 2000 to 2007. It is noted that production is concentrated mainly in the states: Minas Gerais, Sao Paulo, Rio Grande do Sul, Paraná and Goiás. It should be noted that the proportions shown in Table 5 do not reflect the size of the each state herd because the percentages were calculated from production values for the type of products of animal origin, as announced by the Municipal Livestock Research (PPM).

Table 5. States share in total livestock production – 2000 / 2008.

States	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acre	0.25	0.41	0.38	0.37	0.42	0.34	0.30	0.25	0.24
Amapá	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.03	0.02
Amazonas	0.55	0.55	0.61	0.54	0.51	0.55	0.60	0.41	0.51
Pará	2.14	2.03	2.26	2.06	2.09	2.38	2.48	2.27	2.14
Rondônia	1.12	1.06	1.18	1.44	1.63	1.66	1.48	1.64	1.60
Roraima	0.16	0.11	0.09	0.09	0.08	0.07	0.07	0.07	0.06
Tocantins	0.63	0.64	0.64	0.68	0.71	0.75	0.87	0.89	0.84

Alagoas	1.08	1.32	1.12	1.03	1.00	0.92	0.90	0.85	0.76
Bahia	4.22	4.28	3.95	4.15	4.01	4.00	4.18	4.01	4.08
Ceará	2.87	2.82	2.80	2.77	2.68	2.74	2.80	2.65	2.62
Maranhão	1.13	1.01	4.63	1.11	1.25	1.35	1.45	1.26	1.32
Paraíba	0.95	1.05	0.92	0.87	0.85	0.94	0.93	0.88	0.91
Pernambuco	2.78	2.89	2.83	2.50	2.44	2.95	3.37	3.34	3.44
Piauí	0.85	0.87	0.80	0.84	0.79	0.78	0.77	0.65	0.64
Rio Gde. do Norte	1.22	1.40	1.30	1.48	1.48	1.48	1.62	1.23	1.33
Sergipe	0.56	0.56	0.64	0.71	0.74	0.90	1.00	0.93	1.03
Espírito Santo	1.63	1.66	1.76	2.07	1.94	2.14	2.05	1.88	1.97
Minas Gerais	24.90	24.57	23.47	24.23	24.85	25.06	24.47	26.13	25.89
Rio de Janeiro	2.06	1.84	1.70	1.63	1.62	1.48	1.48	1.40	1.34
São Paulo	14.34	13.50	12.67	13.31	12.20	11.48	11.05	10.79	10.13
Paraná	8.83	8.92	8.86	9.24	9.70	9.95	9.78	9.46	9.15
Rio Gde do Sul	10.20	10.30	9.90	10.18	10.02	9.42	9.48	10.05	10.55
Santa Catarina	5.11	5.47	5.09	6.07	6.12	6.20	6.52	6.41	6.76
Distrito Federal	0.57	0.49	0.41	0.42	0.42	0.33	0.28	0.33	0.24
Goiás	8.13	8.30	8.34	8.51	8.47	8.28	8.40	8.49	8.68
Mato Grosso	2.07	2.25	1.99	2.09	2.30	2.40	2.29	2.31	2.33
Mato Grosso Sul	1.62	1.66	1.62	1.60	1.65	1.43	1.36	1.39	1.42
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: IBGE (Brazilian Institute of Geography and Statistics) and authors' elaboration

### 3. Methodology

The research was conducted with secondary information sources and the period of analysis is restricted to the years between 2000 and 2008.

The data for the agricultural credit was collected from the Statistical Yearbook of Rural Credit published by the Brazilian Central Bank (BCB). In addition to the total amount of credit for the agricultural and livestock activities, it collected information on the credit purposes (running expenses, investment and commercialization) for Brazil as a whole and for the States.

Data on gross production value (GPV) and planted area were collected from the Municipal Agricultural Production (PAM), the IBGE. The data expressed in monetary units have been deflated by the General Price Index - Internal Availability (IGP-DI), calculated by the Getúlio Vargas Foundation (FGV), whose base is 2007 (base = 100).

Finally, agricultural credit database was compared with agricultural production data and planted area (permanent and temporary crops); and data on credit for livestock were compared

with data on livestock production (production of animal origin by the type of product expressed in thousands of Reais – R\$).

### 3.1 The Theil index<sup>8</sup>

To calculate the Theil index between agricultural credit and agricultural production values, and also the area planted, we used contemporaneous variables because the purpose of this work is only to measure the agricultural credit concentration in the current year. The livestock index of credit concentration was calculated from the value credit for the livestock and the value of livestock production.

There are, in the literature, some types of indexes to measure credit concentration or inequality, these concepts are often used as synonyms. According to Shirota (1988, p. 114), the most commonly used indexes are the Gini coefficient, the entropy index, and the Theil index. The Gini index is widely used to measure income concentration of the population. The index of entropy and Theil index are used in cases where the data are grouped by some criteria such as region, stratum area, among others. The concentration indexes provide important information for the analysis of credit distribution and its effectiveness as an instrument for rural development.

Lemos (et al., 1984) used the entropy index to study the rural credit concentration among products and among regions, however, as reported by Shirota (1988, p.119) and Lima and Campos (2001), the entropy index measures the distribution of elements, while the Theil index provides a relationship of distribution between the variables studied, or strictly speaking, it determines the concentration in the distribution of the variables in relation to the distribution of another variable.

The Theil index decomposes the credit concentration into two components: the first consists of the concentration measured between regions<sup>9</sup> (inter - region) and the second refers to credit concentration in the regions (intra – regions). According to Hoffmann (2006, p.355), an analysis using the Gini index is more complex and difficult to interpret, so there is greater convenience using the Theil T index.

The total Theil index (T) can be described as follows:

$$T = \sum_{h=1}^k \sum_{i=1}^{n_h} \left[ y_{hi} \cdot \log \left( \frac{y_{hi}}{\pi_{hi}} \right) \right] \quad (1)$$

<sup>8</sup> A methodological description in greater detail can be found in Hoffman and Kageyama (1987), Shirota (1988) and Hoffmann (1998). The Theil index, or redundancy, can be expressed in bits, when using the logarithm to the base 2 or nits, when using the natural logarithm, and 1 bit = 0.693 nit 1 and nit = 1.443 bit.

<sup>9</sup> North, Northeast, Southeast, South and Midwest.

Where:

$k$  = is the number of regions;

$n_h$  = is the number of states of the  $m$ th region;

$y_{hi}$  = is the participation of the  $i$ th state of the  $m$ th region in agricultural or livestock credit value;

$\pi_{hi}$  = is the participation of the  $i$ th state of the  $m$ th region in agricultural production or livestock production values (or planted area in the case of agricultural analysis).

As mentioned above, the total Theil index can be divided into the Theil index between regions (Te) and inside each region (Th). Thus, we have the Theil index between regions expressed by:

$$Te = \sum_{h=1}^k \left[ y_h \cdot \log \left( \frac{y_h}{\pi_h} \right) \right] \quad (2)$$

Where:

$y_h$  = is the participation of the  $h$ th-region in agricultural or livestock credit value;

$\pi_h$  = is the participation of the  $m$ th-region in agricultural or livestock production value (or in the area planted in the case of agricultural analysis);

Redundancy intra groups (Regions) is expressed by:

$$Th = \sum_{i=1}^{n_h} \left\{ \left( \frac{y_{hi}}{y_h} \right) \cdot \log \left[ \frac{(\pi_h \cdot y_{hi})}{(y_h \cdot \pi_{hi})} \right] \right\} \quad (3)$$

According to Theil (1967) apud Hoffmann and Kageyama (1987), "The total redundancy is the result of adding the redundancy between regions to a weighted average of redundancy within regions". According to Shirota (1988), the weighting factors are the relative shares of different groups in the variable in question. The redundancy, or total Theil index, can be expressed by:

$$T = Te + \sum_{h=1}^k (y_h \cdot Th) \quad (4)$$

Following Hoffman and Kageyama (1987), it would not be reasonable to assume the absence of inequality in credit distribution when each region receives the same amount of credit. As an example, the authors considered the states of Minas Gerais and Sergipe arguing that if both received the same credit allocation there would be concentration in the state of Sergipe. A possibility of the inequality absence, argued by the authors, would be the rural credit distribution proportionally to the value of the agricultural production of the each region, but they do not defend this strategy, because in that case the Theil index would be zero and

that is not necessarily the best situation. An uneven distribution of rural credit can be triggered by the government in a situation in which it wishes to develop a certain activity in a determined region in detriment to other activities in other regions.

According to the authors, lack of concentration is verified when the Theil index reaches its minimum value (zero). This situation would occur if each region received values of rural credit proportionally to their participation in the production value, ie  $(y_{hi} = \pi_{hi})$ . In contrast, the Theil index is maximum when all credit is targeted to the region with the lowest production value (planted area, in the case of agricultural credit) - the least productive region. In this situation, the Theil index would be  $\{\log[1/\min(\pi_{hi})]\}$ , where  $[\min(\pi_{hi})]$  means the smallest share of the production value (or planted area). We use the same idea to designate the boundaries for the Theil index between regions.

Based on these arguments the Theil index can be considered, in this case, as an index of efficiency in the allocation of rural credit identifying regions more or less efficient regarding credit allocation.

#### **4. Results and Discussion**

##### **4.1 Credit Concentration for Agriculture**

Given the increased volume of resources of NSRC, the increase of credit supply was not uniform among the Brazilian states, and even among the states in the same region. Over the period from 2000 to 2008 in the North, for example, the total credit distributed was constant among the states of Acre, Amapá, Amazonas, Roraima, Pará, while Tocantins obtained more resources in the same period. In Rondonia, after strong reduction in the first year (2000 to 2001), the volume of agricultural credit remained at around R\$ 100 millions.

In the Northeast, all states had an increase in agricultural credit granted in the period, with emphasis to the state of Bahia, which in 2000 received in real terms, R\$ 0.4 billion in resources and in 2008 this figure was R\$ 1.7 billion. A similar situation occurred in the South and Midwest. In the south, the states of Parana and Rio Grande do Sul received in 2000 around R\$ 4 billions credit each, and in 2008 this value was approximately R\$ 9,8 billions for the Paraná and R\$ 8.9 billions to Rio Grande do Sul; Santa Catarina increased the credit from \$ 1.7 billion to \$ 3.5 billions. In the Midwestern Region, where, also, all states have increased the amount of credit received, the states of Goiás and Mato Grosso had the highest amounts of credit in the region, obtaining in 2008 from R\$2.3 billions and R\$ 2.2 billions, respectively (the peak in the volume of resources occurred in 2004, when these states received, respectively, R\$ 3.3 billions and R\$ 3.6 billions).

The most significant amounts of credit received by the NSRC occurred in the Southeastern region, especially in the states of Sao Paulo and Minas Gerais. In Sao Paulo, in 2000, the total resources by NSRC were R\$ 4.4 billions and in 2008, R\$ 8.7 billions, which corresponded to a real increase of 97%. In Minas Gerais, in 2000, the volume of agricultural loans was R \$ 2.52 billions, reached in 2008 the value of \$ 7.53 billions, which represents an increase of 198% in the period.

The volume of agricultural credit for running expenses and commercialization, shows a pattern quite similar in granted credit for each state. Regarding credit for running expenses, again, the states of Paraná and Rio Grande do Sul (followed by São Paulo and Minas Gerais) were the States that increased resources in the period from 2000 to 2008.

Considering the purpose of investment credit, an important aspect to highlight is that the states of the Northern region (Pará and Tocantins, prominently) and in the Northeast (Bahia, Maranhão, Pernambuco, Piauí) not only did they have a greater participation on this type of lending, but they also managed to increase the total annual credit received between 2000 and 2008.

From the values deflated by 2008 prices, the contracts average values in the period from 2000 to 2008 was computed, by State, for each purpose of credit in each of the years analyzed. From these results, the arithmetic mean values of the contracts from 2000 to 2008 was obtained. There is a wide range in values of contracts, ranging from R\$ 4,087.56 (for investment in Paraíba state) to R\$ 2.140.316,09 (for commercialization in the same state, Paraíba). Overall, the contracts average values in the Midwestern region are higher; while in the Northeast, averages are lower. Note that there is a weak correlation between the contracts average values and the production value of each state. The same is compared with the planted area.

Table 6 presents the results of the Theil index for the period 2000/2008, with calculations based on the production value and the planted area. It is observed that the credit concentration evolution had different results according to the basis used, if we consider credit distribution based on production value. It is observed that there was devolution of credit in the period. Now, when the planted area is used as a basis concentration growth is observed. The exception occurs with the investment purpose in which there is strong devolution independently from the basis.

A possible explanation for this difference in the results is the proportional reduction in the credit previously supplied to the Southeastern and Southern regions. In both regions there is predominance of small farms with high productivity. Thus, the credit may have migrated to

regions with lower production (devolution of production) and predominance of large properties (concentration per area).

Table 6 – Brazil: agricultural credit concentration evolution, by States, measured by the Theil index, from 2000 to 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Production Value</b>									
Running expenses	0.150	0.131	0.162	0.102	0.125	0.163	0.125	0.112	0.122
Investment	0.115	0.130	0.152	0.090	0.105	0.114	0.081	0.050	0.048
Commercialization	0.293	0.197	0.239	0.195	0.161	0.134	0.168	0.193	0.183
<i>Total</i>	<i>0.113</i>	<i>0.091</i>	<i>0.119</i>	<i>0.066</i>	<i>0.089</i>	<i>0.112</i>	<i>0.076</i>	<i>0.085</i>	<i>0.098</i>
<b>Área</b>									
Running expenses	0.206	0.200	0.212	0.172	0.170	0.192	0.232	0.229	0.224
Investment	0.169	0.149	0.136	0.119	0.104	0.076	0.056	0.094	0.109
Commercialization	0.369	0.307	0.365	0.331	0.238	0.172	0.389	0.390	0.313
<i>Total</i>	<i>0.175</i>	<i>0.163</i>	<i>0.175</i>	<i>0.140</i>	<i>0.133</i>	<i>0.132</i>	<i>0.185</i>	<i>0.208</i>	<i>0.199</i>

Source: The authors

The uneven distribution of credit can be analyzed by focusing on the regions (North-N, Northeast-NE, Southwest-SE, South-S and Midwest-CO) and on the concentration within each of these regions. Despite the basis of calculation, it appears that the distribution inequality among the regions is an important component in agricultural credit concentration in Brazil. Some exceptions have occurred occasionally. In 2007, inequality among regions was not relevant to the investment purpose, which can be explained by the reduction of loans for the Midwestern Region, which, in total, reduced its share from 22% (in 2006) to 16 % (in 2007).

In Tables 7 and 8 are the results of credit concentration within their respective regions, according to the purpose of credit. Based on the production value (Table 7), the Th index shows that the running expenses purpose increased its concentration of credit Midwest. In the investment purpose, the concentration decreased in the Southeast, unlike what occurred in the other regions. In the commercialization purpose an increase of the concentration was not observed. In relation to the total credit volume in their respective regions there was concentration increase only in the North, South (at low intensity) and Midwest.

Table 7 - Evolution of the Theil index T inside each region (Th), based on the production value of agriculture.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Running expenses</b>									
N	0.493	0.661	0.500	0.284	0.274	0.300	0.356	0.334	0.397

NE	0.221	0.162	0.225	0.181	0.100	0.133	0.114	0.068	0.071
SE	0.020	0.026	0.017	0.020	0.018	0.015	0.024	0.035	0.015
S	0.001	0.005	0.001	0.002	0.000	0.001	0.005	0.005	0.001
CO	0.047	0.033	0.026	0.035	0.100	0.146	0.106	0.070	0.084
<b>Investment</b>									
N	0.083	0.069	0.102	0.085	0.092	0.103	0.063	0.181	0.133
NE	0.038	0.179	0.116	0.185	0.141	0.272	0.093	0.106	0.047
SE	0.089	0.012	0.004	0.005	0.012	0.021	0.010	0.023	0.017
S	0.002	0.015	0.014	0.008	0.015	0.027	0.031	0.042	0.038
CO	0.003	0.014	0.012	0.005	0.003	0.005	0.031	0.003	0.007
<b>Commercialization</b>									
N	0.824	1.248	1.288	0.732	0.476	0.183	0.819	1.044	0.511
NE	0.981	0.961	1.332	0.774	0.532	0.246	0.257	0.393	0.216
SE	0.180	0.062	0.082	0.066	0.106	0.045	0.034	0.026	0.029
S	0.063	0.029	0.020	0.041	0.009	0.014	0.010	0.020	0.025
CO	0.123	0.102	0.089	0.067	0.142	0.127	0.053	0.108	0.098
<b>Total</b>									
N	0.165	0.195	0.230	0.141	0.183	0.163	0.191	0.196	0.224
NE	0.225	0.224	0.157	0.043	0.051	0.071	0.045	0.048	0.025
SE	0.032	0.011	0.011	0.014	0.026	0.012	0.012	0.020	0.010
S	0.001	0.007	0.003	0.005	0.001	0.003	0.006	0.006	0.004
CO	0.034	0.008	0.006	0.010	0.055	0.083	0.025	0.044	0.050

Source: The authors.

Table 8 shows credit concentration measured by Th index based on planted area. Credit concentration of running expenses purpose increased in the Southeast, South and Midwest. As for investment purposes, only in the South there was an increase in the concentration of credit. Regarding the commercialization purpose, the concentration of credit was reduced in all regions.

Table 8 - Evolution of the Theil index T inside each region (Th), based on planted area.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Running expenses</b>									
N	0.642	0.539	0.368	0.342	0.276	0.269	0.241	0.204	0.319
NE	0.133	0.162	0.256	0.222	0.151	0.150	0.101	0.085	0.105
SE	0.010	0.014	0.017	0.013	0.017	0.008	0.012	0.013	0.025
S	0.011	0.011	0.011	0.016	0.009	0.021	0.032	0.022	0.016
CO	0.050	0.040	0.046	0.039	0.056	0.089	0.136	0.087	0.092
<b>Investment</b>									
N	0.188	0.066	0.093	0.080	0.082	0.138	0.029	0.079	0.102
NE	0.069	0.087	0.217	0.180	0.118	0.172	0.065	0.021	0.056
SE	0.070	0.053	0.024	0.014	0.014	0.024	0.013	0.042	0.039
S	0.024	0.041	0.029	0.031	0.038	0.067	0.084	0.085	0.075
CO	0.017	0.008	0.001	0.003	0.009	0.005	0.022	0.001	0.003



<b>Comercialization</b>									
N	0.862	1.645	1.579	0.769	0.502	0.223	0.677	1.272	0.757
NE	0.759	0.732	1.057	0.725	0.390	0.254	0.342	0.411	0.197
SE	0.155	0.130	0.153	0.114	0.118	0.038	0.033	0.017	0.016
S	0.148	0.070	0.049	0.083	0.033	0.005	0.046	0.057	0.058
CO	0.178	0.120	0.130	0.071	0.143	0.124	0.097	0.155	0.153
<b>Total</b>									
N	0.286	0.225	0.160	0.171	0.183	0.166	0.104	0.109	0.187
NE	0.118	0.110	0.104	0.052	0.037	0.051	0.041	0.033	0.041
SE	0.018	0.026	0.032	0.024	0.029	0.006	0.005	0.006	0.016
S	0.027	0.022	0.017	0.025	0.015	0.020	0.038	0.030	0.026
CO	0.045	0.015	0.022	0.012	0.031	0.053	0.046	0.061	0.062

Source: The authors

#### **4.2 Concentration of Credit for Livestock**

We observe that given the increase of resources from NSRC the credit supply increase was not uniform among the Brazilian states, and even among the states in the same region. Over the period from 2000 to 2008 in the North, for example, the total credit remained constant in the states of Acre, Amapá, Amazonas and Roraima, while Para and Tocantins had their resources increased in the period. In Rondonia, after a strong growth between 2003 and 2004, the volume of credit for livestock decreased and remained around R\$ 220 millionn.

In the Northeast all states had an increase in credit for livestock especially the state of Maranhão where there was an increase of approximately R\$ 64 millions for the credit received in the period, rising from R\$57 million in 2000 in real terms, to R\$310 millions in 2008. A similar situation occurred in the South and Midwest. In the South, the states of Santa Catarina and Rio Grande do Sul each received in 2000 a little more than R\$ 600 millions of credit, and in 2008 it was approximately \$ 1.14 billion for Santa Catarina and R\$ 1.14 billion for Rio Grande do Sul; Paraná jumping from R\$0.47 billion in 2000 to R\$ 1.50 billion in 2008. In the Midwestern Region, where all states also increased the amount of credit received, the states of Goiás and Mato Grosso do Sul had the highest amounts of credit in the region, whose values in 2008 were R\$1.83 billion and R\$1.20 billion respectively.

The most significant amounts of credit received from the NSRC occurred in the Southeast, specifically in the states of Sao Paulo and Minas Gerais. These two states accounted 27% of all credit for livestock in 2007. In Sao Paulo, in 2000, the total resources by NSRC was R\$0.97 billion and, in 2008, R\$2.31 billions, which corresponded to a real increase of 138%. In Minais Gerais, in 2000, the credit for livestock was R\$0.73 billion, and it reached in 2008 the amount of R\$2.56 billions, which represented an increase of 250% in the period.

The running expenses, investment and commercialization show different patterns in the distribution of credit for each state. The running expenses credit has a strong focus on the

South and Southwest regions, especially the states of Sao Paulo, Minas Gerais and Rio Grande do Sul. The states of Northern and Northeastern regions showed strong growth in percentage terms over that period, but remained below the other regions in absolute volumes. In the Northern Region, Pará, Rondônia and Tocantins received 91% of resources for running expenses approximately. Bahia, Maranhão and Rio Grande do Norte were the main destinations of credit for the Northeast, representing 72% of the total approximately. For investment credit, an important aspect to highlight is that the Northern states (Pará and Tocantins, prominently) and the Northeastern (Bahia, Maranhão, Pernambuco and Ceará) not only do they have a greater participation in this credit line but they also increased the total annual credit received between 2000 and 2008. Rural credit for livestock commercialization has been increasing in the Southeast, resulting in high concentration in 2008: 62.54% of the total credit for this mode is allocated to the Southeast. Sao Paulo received 38% of total loans, while Minas Gerais received 23%.

We also calculated the average value of contracts in the period 2000 / 2008, by State, for each type of credit for livestock in each of the years analyzed. Overall, the average values of the contracts in the Midwest and the South are higher, while in the Northeast, there are the lowest averages.

Table 9 presents the results of the Theil index for the period 2000 / 2008, with calculations based on production value. It is observed that there was devolution in the period for the purposes of running expenses and commercialization. As for the investment credit for livestock, there was increase in concentration.

Table 9 – Brazil: livestock credit concentration evolution, by States, measured by the Theil index, period 2000 / 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Running expenses	0.291	0.275	0.279	0.233	0.230	0.204	0.244	0.255	0.235
Investment	0.139	0.200	0.207	0.222	0.218	0.201	0.170	0.226	0.215
Commercialization	0.815	0.970	0.886	0.847	0.514	0.477	0.343	0.483	0.413
<i>Total</i>	<i>0.313</i>	<i>0.265</i>	<i>0.282</i>	<i>0.214</i>	<i>0.204</i>	<i>0.194</i>	<i>0.142</i>	<i>0.170</i>	<i>0.161</i>

Source: The authors

The inequality distribution among regions is an important component in the concentration of livestock credit in Brazil, mainly for running expenses. Inequality among regions has not been relevant in the investment purpose, but it increased its importance over the period of analysis for the commercialization purpose.

In Table 10 are the results of credit concentration within their respective regions, according to the credit purpose. The Th index shows that the running expenses credit increased the credit concentration in the Midwestern Region. In other regions, especially

North and Northeast, there was devolution. A similar situation occurred for commercialization credit. The investment credit increase is concentrated in North region. In relation to the total credit in its respective regions, there was reduction of concentration in all regions.

Table 10 - Evolution of the Theil index T inside each region (Th), based on production value of livestock.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Running expenses</b>									
N	0.247	0.206	0.1612	0.098	0.056	0.075	0.124	0.085	0.155
NE	0.407	0.397	0.2738	0.346	0.285	0.238	0.158	0.243	0.181
SE	0.078	0.096	0.0777	0.046	0.118	0.056	0.058	0.069	0.074
S	0.095	0.096	0.1092	0.053	0.067	0.044	0.021	0.016	0.003
CO	0.168	0.159	0.1908	0.205	0.200	0.180	0.243	0.230	0.198
<b>Investment</b>									
N	0.040	0.166	0.1568	0.117	0.251	0.191	0.202	0.217	0.181
NE	0.136	0.168	0.2909	0.119	0.157	0.147	0.112	0.170	0.116
SE	0.113	0.227	0.1919	0.177	0.139	0.163	0.202	0.262	0.020
S	0.012	0.034	0.0307	0.050	0.041	0.027	0.043	0.050	0.009
CO	0.290	0.279	0.2553	0.353	0.392	0.413	0.301	0.333	0.134
<b>Commercialization</b>									
N	2.069	2.160	2.1363	2.018	0.182	0.235	0.210	1.505	1.569
NE	2.564	2.482	0.4805	1.379	0.416	0.367	0.383	0.435	0.346
SE	0.578	0.743	0.8093	0.654	0.395	0.172	0.158	0.319	0.276
S	0.355	0.243	0.1319	0.006	0.038	0.004	0.028	0.015	0.014
CO	0.266	0.245	0.3065	0.436	0.203	0.245	0.196	0.377	0.218
<b>Total</b>									
N	0.158	0.129	0.1268	0.099	0.055	0.051	0.070	0.067	0.121
NE	0.113	0.121	0.1601	0.103	0.095	0.143	0.068	0.078	0.088
SE	0.101	0.139	0.1251	0.109	0.113	0.049	0.057	0.092	0.090
S	0.067	0.034	0.0460	0.022	0.023	0.009	0.010	0.001	0.001
CO	0.183	0.170	0.1936	0.228	0.181	0.136	0.167	0.212	0.165

Source: The authors

## 5. Conclusions and recommendations

The results of this study show that in absolute terms, the largest volume of agricultural credit remains for the states of Sao Paulo and Minas Gerais in southeastern Brazilian and Parana and Rio Grande do Sul, in the South. This reflects the participation of the four states mentioned in crop (permanent or temporary) production: all these states together represent approximately 55% of each type of crop.

The credit for livestock, according to the results obtained in this research, is concentrated in the states of Sao Paulo and Minas Gerais in the Southeast. It reflects the relevance of these

two states in the national livestock production value: 25.89% (Minas Gerais) and 10.13% (Sao Paulo). The states in the South and Midwest follow next, as important destinations of livestock credit.

Another issue raised in this study, which should be researched on in future works, is whether there is a causal link between the expansion of agricultural frontier and the demand for credit, as it is the case for the credit devolution in the North and Northeast. Possibly, the credit devolution in the mentioned regions results from the livestock activities expansion in these regions, previously unexplored, which have led to the increase of demand for credit, and in addition, to the devolution of rural credit. The results suggest that transport and energy infra-structure promoted by local and national governments in favor of agricultural frontier in parts of Central and North regions of Rural Brazil over the past decades have been fundamental to expand the potential economic growth as well as the demand for rural credit in those regions. Some recent studies of Brazilian agriculture modernization show that the occupation of unexploited areas brought to Central and North regions new capital-intensive, labor-saving and human capital intensive technology. Actually, the rural credit supply has been sufficient to meet the demand; a different scenario from the decades of 1980 and 1990. In recent decades, Brazilian agricultural growth was important to meet the urban population demand for foods and the international commodities markets demand. In addition to credit supply, the agricultural policy focus should be the investments in R&D, to guarantee the increase in the agricultural productivity and the production of the unexploited areas in the Center and North regions. The governmental investments in energy and transport infra-structure have been relevant on the agricultural frontier, to create conditions for the producers to develop their activities.

From the perspective of agricultural policy and regional economic development of the country, results are encouraging because there has been credit decentralization during the current decade in favor of agricultural frontier in parts of the Central and North regions. Access to credit and the agricultural activities development will allow income growth and, consequently, greater opportunities for the economic development in these regions.

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