



The Impacts of Rural Credit on Agricultural Outcomes and Land Use

An Analysis by Credit Lines, Producer Types and Credit Uses

Brazil is the world's largest net exporter of agricultural products (FAO, 2016). The national rural credit system is crucial for financing agribusiness, with annual credit volume corresponding to nearly 40% of the national agricultural production value. Brazil's rural credit policy comprises a complex set of funding sources and programs, with a policy framework that dates back to the 1960s, when farmers' needs were quite different than they are today.

Previous analysis conducted by Climate Policy Initiative/Pontifical Catholic University of Rio de Janeiro's (CPI/PUC-Rio) researchers has evaluated the impacts of rural credit on agricultural outcomes and land use. The empirical evidence shows how rural credit positively boosts production and crop yields, increases intensification, and reduces pastureland in such a way that it decreases pressures for deforestation.¹ CPI/PUC-Rio's work has also highlighted rural credit's limitations and areas for improvement. Understanding how this important policy affects farmers' decisions is critical for designing better financial instruments for agriculture in Brazil.

This analysis aims to provide policymakers with a deeper understanding of rural credit's impact along three important dimensions: credit lines, producer types, and types of credit use.

Results from this disaggregated analysis show that the patterns of increasing productivity with reduced deforestation is stronger for smaller farmers. The credit associated with large farmers, while contributing to increased production and yields, is also associated with expansions of both cropland and pastures, leading to higher deforestation. Moreover, productivity increases are also more relevant for credit associated with small farmers compared to large farmers. These results suggest that for large landowners increased demand for land is observed when resource efficiency increases.² This is not true for small and medium farmers.

Brazil subsidizes rural credit and thus should ensure that society reaps broader benefits. Evidence from this analysis suggests policymakers should prioritize the distribution of rural credit to small farmers as resources for this group increase production and mitigate adverse impacts on the environment. Tailoring the rural credit policy towards small producers aligns subsidies with forest conservation.

¹ See Assunção and Souza (2019), available at <https://www.inputbrasil.org/publicacoes/o-impacto-do-credito-rural-na-agricultura-brasileira-e-no-meio-ambiente/?lang=en>

² In economics, the so-called *Jevons paradox* occurs when the efficiency with which a resource is used increases (reducing the amount necessary for its use), but the use of that resource rises due to increased demand.

RECOMMENDATION

To increase agricultural production and mitigate adverse impacts on the environment, Brazil's policymakers should revise the rural credit policy so that credit distribution prioritizes small farmers.

This will better align rural credit subsidies both with the needs of financially constrained farmers and national efforts to increase forest conservation.

Moreover, medium and large farmers are more likely to be served by unsubsidized credit, especially with the current lower interest rates in the Brazilian economy. The analysis in this work also indicates that credit for larger producers is associated with higher levels of deforestation. This highlights the need for other instruments and policies to help conserve Brazil's natural capital, especially because the large producers occupy most of the agricultural land.

THREE DIMENSIONS OF THE RURAL CREDIT ANALYSIS

This analysis evaluates the impacts of rural credit from three perspectives: credit lines (PRONAF, PRONAMP, Rural Savings, and Compulsory Resources),³ producer types (individuals and firms) and credit uses (working capital, investments and trade).⁴ Figure 1 shows the number of credit contracts, the credit amounts, and the distribution of area covered by the credit contracts in each category for each of these three perspectives.

The analysis by credit line focuses on the four largest programs and funding sources: PRONAF, PRONAMP, Rural Savings (Restricted), and Compulsory Resources. Figure 1 shows that these four credit lines account for 91% of the number of contracts, 64% of the credit amount, and 84% of the area that receives rural credit in Brazil. Notice that the difference in the distribution of the number of contracts and credit amounts demonstrates how unequal the size of the contracts is across categories. For instance, PRONAF, which is the primary credit source for small farmers, represents 74% of the number of contracts, but only 14% of the credit amount and 16% of the area.

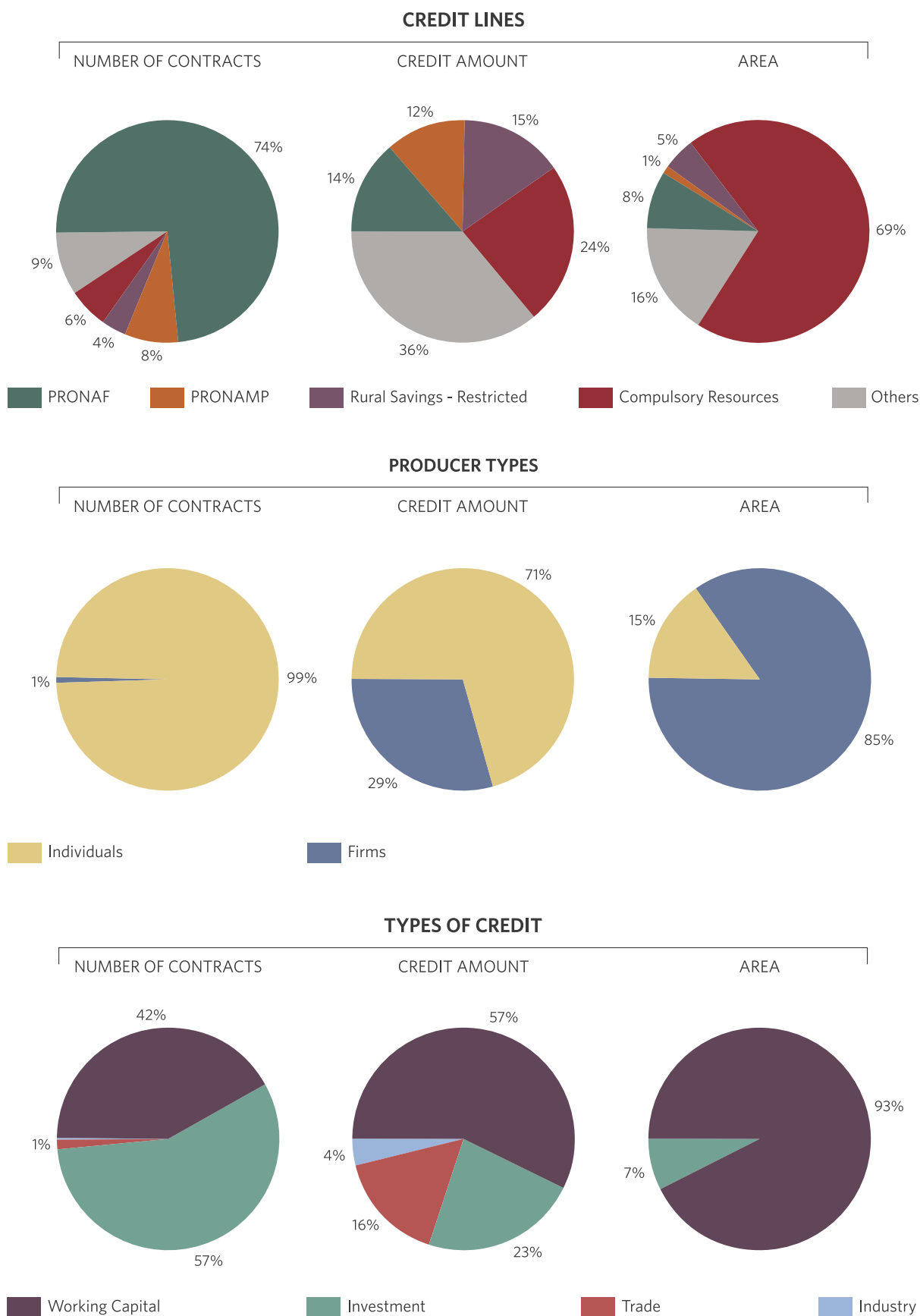
The next dimension of analysis focuses on the types of producers: individuals and firms. The high costs of starting a new business in Brazil and a special tax regime encourage agricultural producers to organize and present themselves to the tax authority as individuals rather than firms. Again, the unequal allocation of resources across categories stands out: while only 1% of producers are firms, they account for 29% of the credit amount and 85% of the area that receives credit (see Figure 1).

Finally, the analysis looks at the use of credit. The rural credit policy in Brazil supports three major uses of credit: working capital, investment, and trade. Working capital makes up the major use of credit considering credit amounts. Figure 1 also shows the credit use for investment is still quite limited in terms of amount (23%) and covered area (7%) compared to working capital (57% and 93%, respectively).

3 The PRONAF program is the National Program for Family Farming (*Programa Nacional de Fortalecimento da Agricultura Familiar*). The PRONAMP program is the National Program to Support Medium Producers (*Programa Nacional de Apoio ao Médio Produtor Rural*). Rural Savings - Restricted (*Poupança Rural - Controlados*) and Compulsory Resources (*Recursos Obrigatórios - MCR 6.2*) are funding sources with their own financing conditions. The analysis considers loans from Rural Savings-Restricted and Compulsory Resources that are not linked to specific rural credit programs.

4 Although "industry" is also a category for "uses of capital" in 2017, it is a small one considering the number of contracts and the credit amounts. Besides that, it only appears in recent years. Therefore, an econometric analysis using panel data for the period 2002-2017 is not possible.

Figure 1: The Distribution of Rural Credit in Credit Lines, Producer Types and Types of Credit in 2017



Source: Climate Policy Initiative with data from the Brazilian Central Bank

METHODOLOGY

Estimating the impact of credit on agricultural production and land use is a challenging task. It requires disentangling cause and effect and isolating the impacts that credit actually has. On the one hand, credit allows farmers to fund the upfront costs and investments necessary for increasing production. On the other hand, banks tend to focus their operations on farmers with better prospects. Therefore, a positive correlation between credit and economic outcomes does not necessarily imply that credit causes the observed changes.

In order to address these issues and build reliable estimates of the impacts of credit, the researchers use a shift-share methodology on a dataset with all of Brazilian municipalities for the period of 2002-2017. The econometric procedure focuses on the variation of the availability of credit that is the interaction of two components: the distribution of bank branches across municipalities and the aggregate variation in the source of funding for each bank. For instance, if Bank of Brazil (Banco do Brasil) has more resources from rural savings in a given year, the method considers that those municipalities with Bank of Brazil's branches are more likely to have more credit available. These variations, implemented at scale for all municipalities and banks in the period, allow for the estimation of the impacts of credit supply on the outcome variables (e.g., productivity, land expansion, deforestation, etc.). This strategy for identifying causal impacts is widely used in recent academic literature.

IMPACT OF RURAL CREDIT

This analysis considers the impacts of credit on two sets of outcomes: agricultural production and land use change. The evidence on production reveals how better credit access allows farmers to expand their operations. The analysis on productivity reveals whether increased credit supply changes how farmers operate. A change in farming decisions suggests farmers are financially constrained. If farmers did not face any financial constraints, credit would not change production decisions since farmers would simply use the increased access to cheaper credit to reduce their cost of capital with no implications on production. The evidence from this work is that, in most cases, credit has an impact on production decisions. However, the results show substantial differences on productivity across the different categories analyzed.

The second part of the analysis looks at the impacts of credit on land use. The results reveal striking variation in how different farmers use the funds provided by rural credit. The credit for small farmers tends to reduce the pressures on deforestation while credit for large farmers leads to increased deforestation.

AGRICULTURAL PRODUCTION

The results of the estimation of the impacts of rural credit on production outcomes are presented in Figures 2-4, covering all municipalities in the country for the 2002-2017 period. Since the impacts are associated with how changes in credit supply affect the outcome variables, all graphs represent the estimated impact of a 1% increase in the municipal credit supply for each case. In technical terms, the estimates are interpreted as elasticities.

The analysis by credit line focuses on the impact of a 1% increase in municipal rural credit supply of PRONAF, PRONAMP, Rural Savings-Restricted, and Compulsory Resources. PRONAF and PRONAMP are associated with small and medium farmers respectively, while Rural Savings -Restricted and

Compulsory Resources are mostly associated with large landholders. Figure 2 shows that, in the case of PRONAF, a 1% increase in credit supply leads to the increase in both production (0.19% in crop production, 0.02% in head of cattle) and productivity (0.10% in crop production per hectare and 0.14% in head of cattle per hectare). For PRONAMP, the impacts are not statistically significant and slightly negative for cattle production. The observed differences across small and medium farmers suggest that PRONAF is alleviating credit constraints for small farmers, while medium farmers do not significantly change their production decisions with the increase in the availability of resources. This differential effect of PRONAMP might be because the target farmers are less financially constrained.

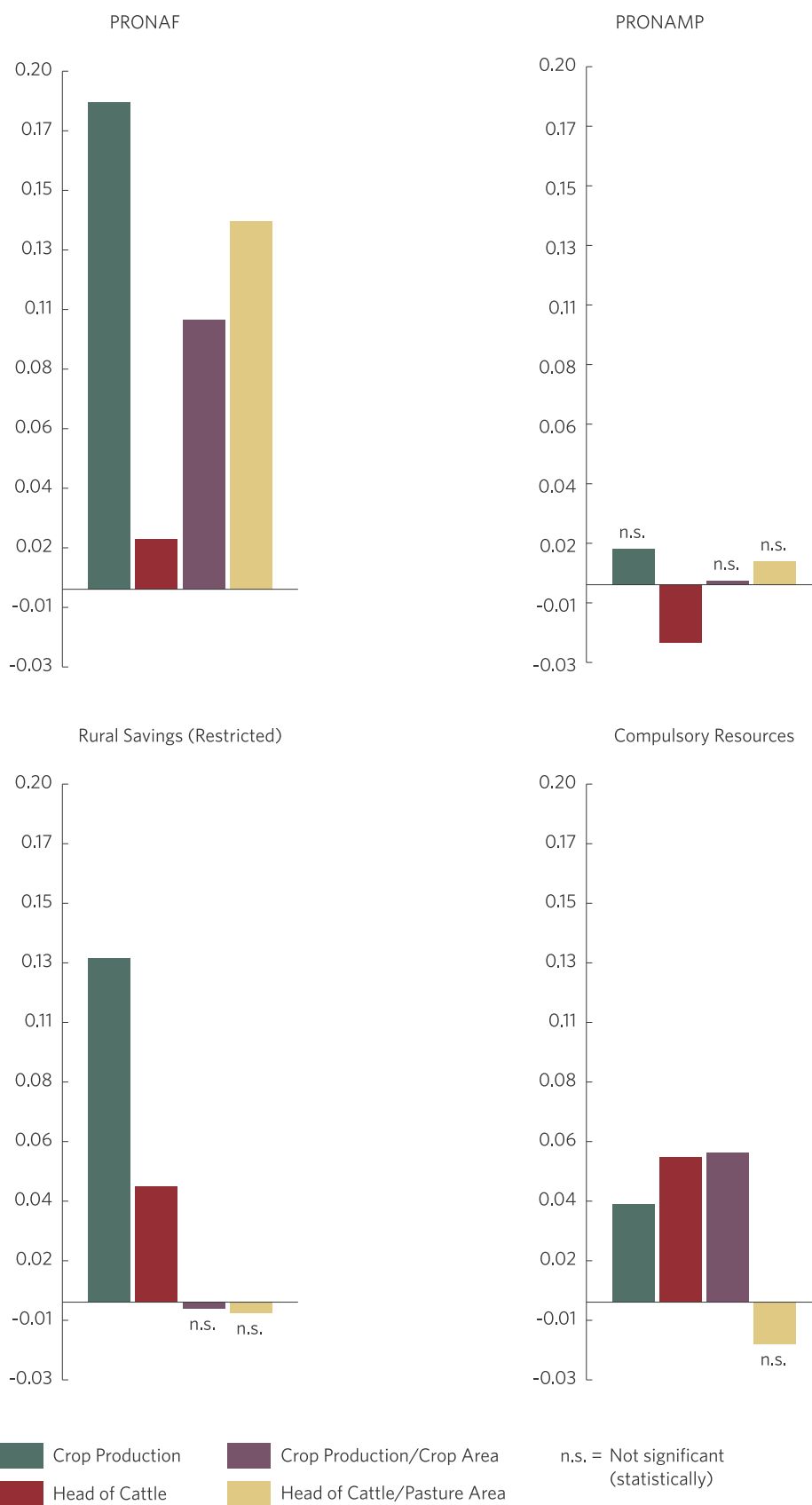
In the case of Rural Savings-Restricted, the increase in credit supply has a positive impact on production (0.13% in crop and 0.04% in head of cattle) but no impact on land productivity, which is a sign that the borrowers seem to use the funding to increase the extent of their activities rather than changing how they farm their land. Finally, the results of Compulsory Resources point to an increase in production (0.04% in crops and 0.06% in head of cattle) and a slightly higher crop productivity (0.04%), but no impact on the measure of cattle productivity. Thus, the analysis of Rural Savings - Restricted and Compulsory Resources, which are funds primarily channeled to large farmers, seem to alleviate financial constraints that prevent farmers from expanding their operations, but have much less impact on how they cultivate their land. Notice that the only impact on productivity is much smaller than those observed in the case of PRONAF.

The analysis on types of producers considers how the impact of credit varies according to the way farmers are organized (see Figure 3). Interestingly, rural credit affects production and productivity for farmers who operate as individuals, while those who operate as firms are not affected by the increased credit. These results suggest that farming enterprises are not financially constrained. Farmers who organize as individuals, on the other hand, experience both an increase in production (0.23% in crop and 0.10% in head of cattles) and productivity (0.15% in crop per hectare and 0.23% in head of cattle per hectare) for a 1% increase in credit supply.

The analysis on uses of credit focuses on three categories: working capital, investment, and trade credit (see Figure 4). Working capital credit is short run, typically with a duration of less than 12 months, and used to fund operational expenditures (opex), while investment credit has a longer duration and is typically used for capital expenditures (capex). Trade credit is also short run, designed mostly to support farmers to better deal with price fluctuations and avoid selling their products in periods with low prices.

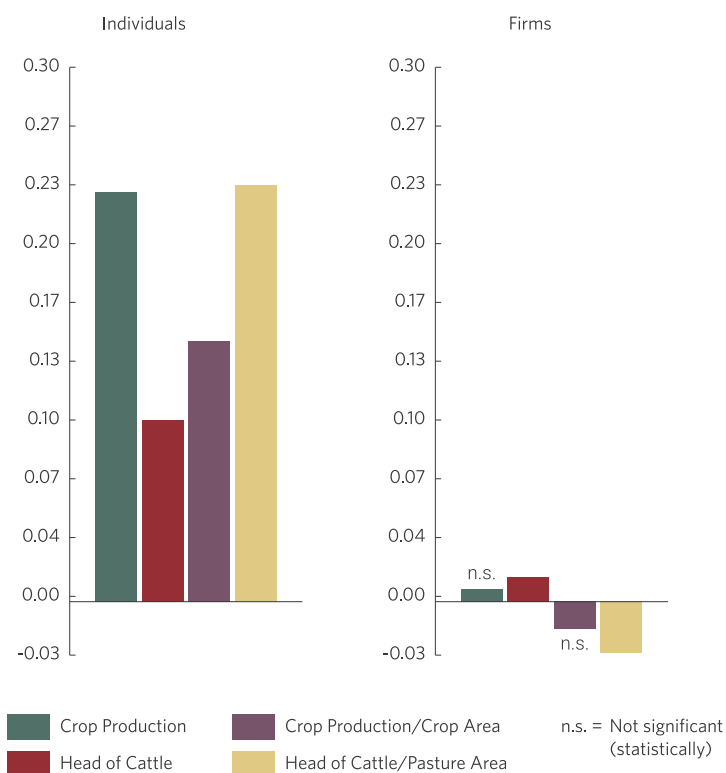
The analysis of different credit uses reveals important differences. The impacts of working capital and investment credit supply vary between crops and cattle ranching. In the case of crops, both working capital and investment credits affect crop production and crop productivity, suggesting these resources are supporting farmers to both expand their business and change how they cultivate, improving yields. In the case of cattle ranching, credit does not induce an expansion in production, but rather, an increase in productivity, especially in the case of investment (a 1% increase in credit for investment leads to a 0.19% increase in cattle productivity). As expected, trade credit does not have relevant impacts on agricultural production or productivity.

Figure 2: Impact of Rural Credit on Agricultural Production by Credit Lines



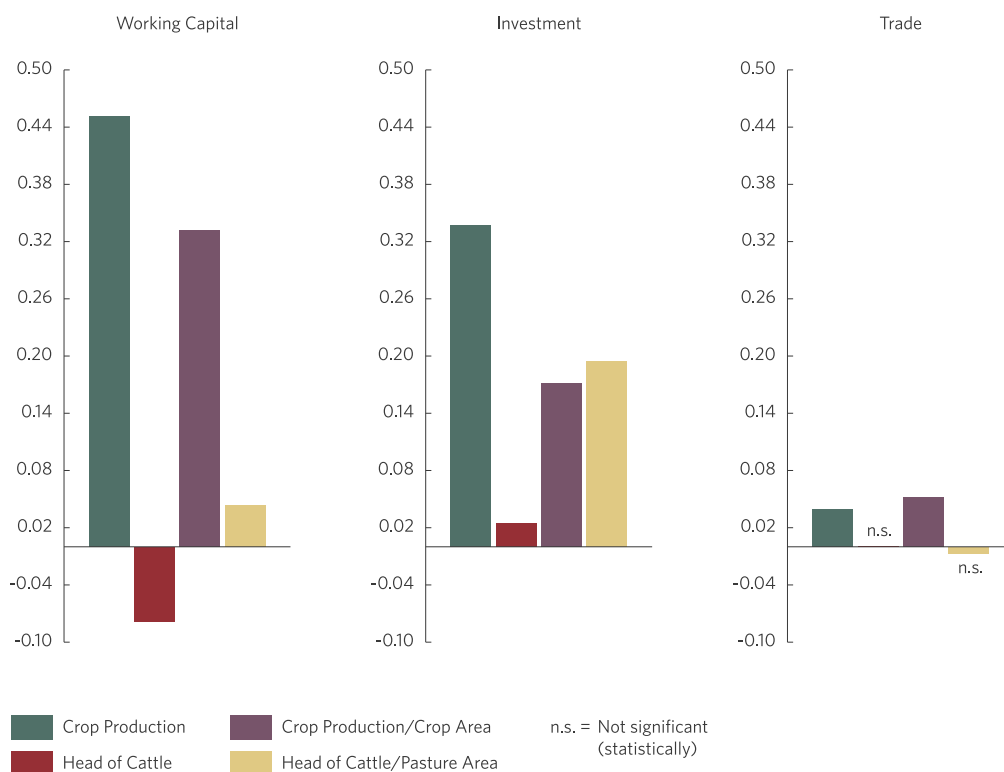
Source: Climate Policy Initiative with data from the Brazilian Central Bank

Figure 3: Impact of Rural Credit on Agricultural Production by Type of Client



Source: Climate Policy Initiative with data from the Brazilian Central Bank

Figure 4: Impact of Rural Credit on Agricultural Production by Type of Credit



Source: Climate Policy Initiative with data from the Brazilian Central Bank

LAND USE

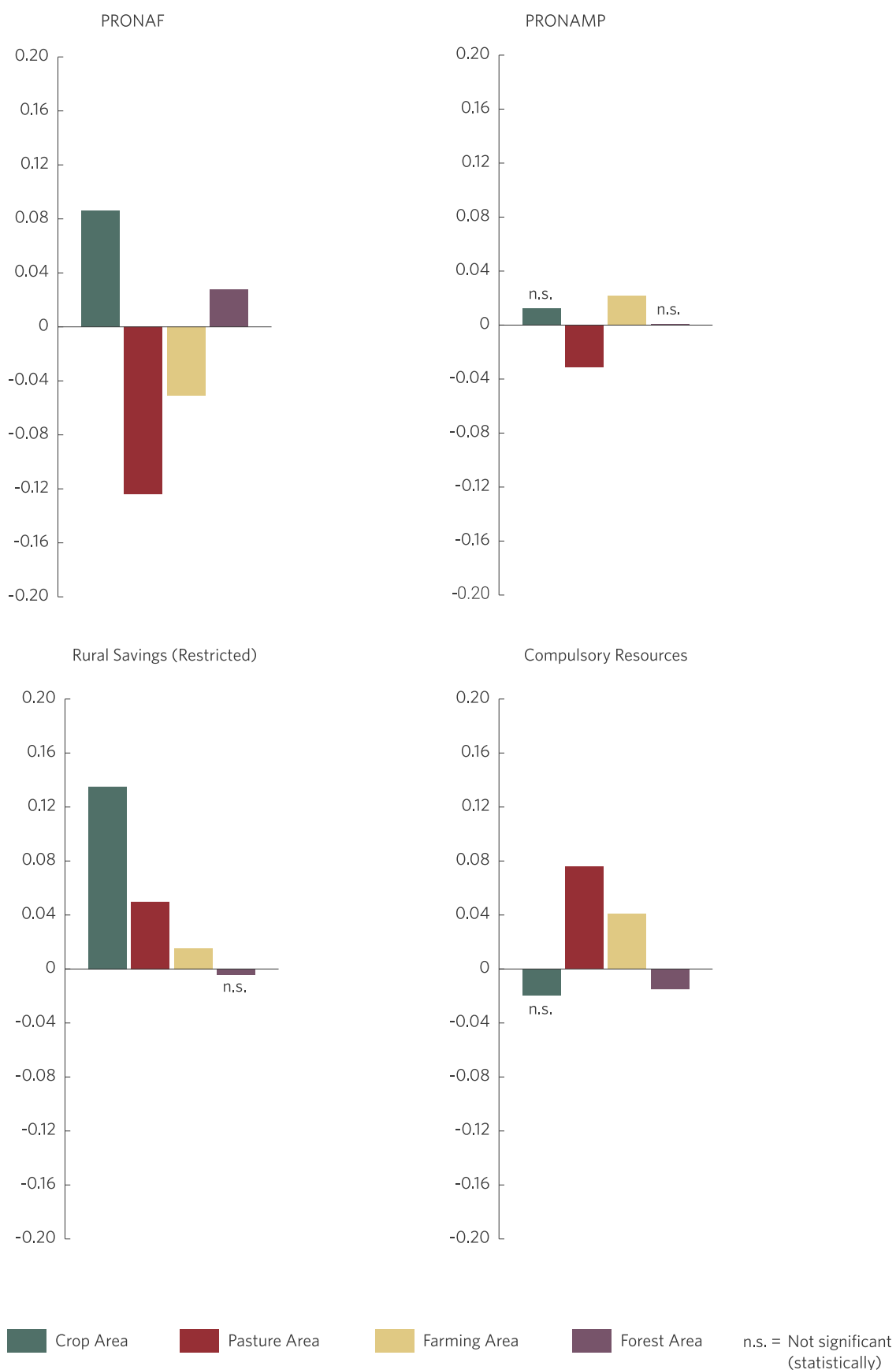
The results of the econometric analysis of the impacts of credit on land use reveal marked differences in how farmers use rural credit resources on areas dedicated to crops and pasture. For PRONAF, an increase in rural credit leads to the conversion of pastures to croplands and results in a decrease in total farming area, showing that credit associated with small producers leads to more intensive agriculture and reduces deforestation pressures (see Figure 5). Consequently, credit associated with PRONAF leads to a (slight) increase in preserved forest areas. More specifically, a 1% increase in PRONAF credit at the municipal level leads to an expansion in crop area by 0.09% and a decrease in pasture area by 0.12%. The result is a 0.03 increase in forest area, which is likely a consequence of lower deforestation. Therefore, credit for small producers is associated with more efficient land use and higher environmental conservation, which is beneficial for society.

In contrast, this positive effect on forest area is not observed for the other three credit lines analyzed (PRONAMP, Rural Savings-Restricted, and Compulsory Resources). Farming areas expand for PRONAMP (0.02%), Rural Savings-Restricted (0.02%) and Compulsory Resources (0.04%).

In the same direction of the results for credit lines, the impact of rural credit on land use shows a very different pattern for individuals and firms (see Figure 6). A 1% increase in rural credit for individuals leads to a 0.09% increase in crop area and a 0.13% decrease in pasture area, resulting in a small increase in forested area (0.01%). However, an increase in rural credit for firms, which are large borrowers, leads to an expansion of both crop (0.02%) and pasture (0.04%) areas. Therefore, the positive results in terms of environmental conservation are associated with rural credit for individual borrowers, not for firms.

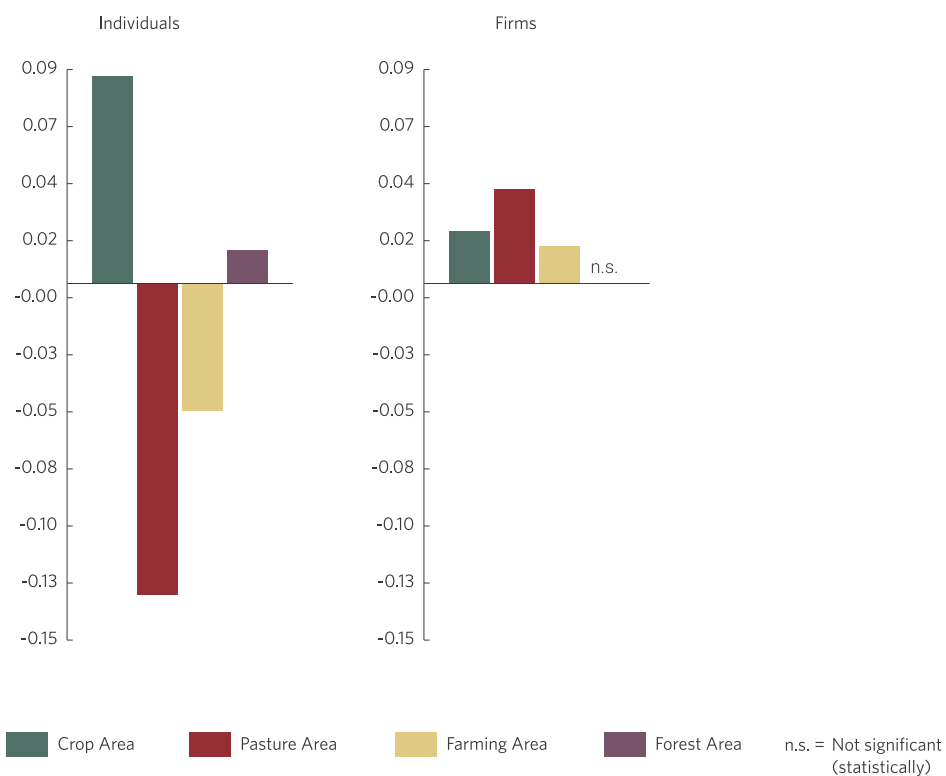
Finally, considering the uses of capital, the impacts of credit on land use are similar for working capital and investments (see Figure 7). In both cases, an increase in rural credit is associated with the conversion of pastures into cropland, resulting in reductions in farming area and increases in forest preservation. Land use change is not seen in credit used for trade.

Figure 5: Impact of Rural Credit on Land Use by Credit Lines



Source: Climate Policy Initiative with data from the Brazilian Central Bank

Figure 6: Impact of Rural Credit on Land Use by Type of Client



Source: Climate Policy Initiative with data from the Brazilian Central Bank

Figure 7: Impact of Rural Credit on Land Use by Type of Credit



Source: Climate Policy Initiative with data from the Brazilian Central Bank

CONCLUSION

This policy brief builds on previous evidence from CPI/PUC-Rio that shows that rural credit in Brazil boosts production and crop yields and intensifies agricultural production in such a way that deforestation pressure decreases. Here, the impacts of rural credit are detailed across three relevant dimensions: credit lines, types of producers, and uses for credit.

Results show that the average impacts of Brazilian rural credit—with patterns of increasing productivity while reducing deforestation—are more predominant for credit associated with small farmers. The credit for large farmers, while contributing to increasing production and yields, also leads to an expansion of cropland and pastures, resulting in higher deforestation. Moreover, productivity increases are more relevant for credit associated with small farmers compared to larger farmers.

Policymakers should prioritize small farmers in the rural credit policy to increase production and land productivity and mitigate adverse impacts on the environment. Tailoring the rural credit policy toward this goal aligns subsidies with forest conservation and fits in a scenario in which medium and large farmers are more likely to be served by unsubsidized credit, especially in the Brazilian context of lower interest rates. Moreover, since credit for large producers is associated with higher deforestation and this group occupies most of the country's agricultural land, other instruments and policies are necessary to encourage forest conservation.

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