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The Role of Market Institutions in Reducing Amazon Deforestation: The Case of the Soy Moratorium.

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RESUMO

As altas taxas de desmatamento observadas na Amazônia fazem necessário uma ação conjunta da sociedade civil, do governo e do setor privado para preservar este patrimônio. Em vista da significante participação da agricultura no processo de desmatamento, a Moratória da Soja aparece como uma promessa de um modelo de negociação em governança ambiental. Baseada na estimação do um modelo com dados em painel com 382 municípios no bioma Amazônia, este artigo destaca o fato que mecanismos de governança em mercados altamente verticalizados, como o caso da soja, podem contribuir para a resolução de problemas ambientais. Neste contexto, é responsabilidade de outras cadeias produtivas na região em se adaptar a este novo contexto com padrões internacionais de sustentabilidade e colaborar com o governo na redução do desmatamento.

Palavras-chave: Soja, Dados em Painel, Sustentabilidade, enforcement, Governança.

JEL: Q00, Q20

ABSTRACT

The high deforestation rates observed to date in the Amazon make it essential to undertake joint action by civil society, government, and the private sector in order to preserve this heritage. In view of the significant share of agriculture in the deforestation process, the Soy Moratorium appears as a promise of a negotiated model of environmental governance. Based on the estimation of panel data models with 382 municipalities in the Amazon biome, this article highlights the fact that governance mechanisms in highly verticalized markets, as in the case of soybeans, may contribute to solving environmental problems. In this context, it is the responsibility of other supply chains in the region to adapt to the new international sustainability standards and collaborate with the government in reducing deforestation.

Keywords: Soybean, panel data, sustainability, enforcement, governance.

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1. Introduction

Despite a general decrease in the rate of population growth, global demand for agricultural products has risen significantly in recent years. For example, the world production of soybeans rose from 161.3 million tons in 2000 to 249.9 million tons in 2012. In the same period, the production of beef rose from 56 million tons to 63.1 million tons (FAO, 2016). These statistics illustrate the ongoing global process of increasing demand for plant foods and their conversion into animal protein to meet the new levels of consumption, especially in emerging countries. The consequences of this process in Brazil are evidenced by the rapid expansion of commodity production in the midwest and northeast areas of *Cerrado* (savannah) in the past 30 years, reaching and threatening the Brazilian Amazon rainforest. This process intensifies deforestation with the replacement of native forest for pasture or monocultures (Barona, Ramankutty, Hyman, & Coomes, 2010).Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam eget ligula eu lectus lobortis condimentum. Aliquam nonummy auctor massa. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Nulla at risus. Quisque purus magna, auctor et, sagittis ac, posuere eu, lectus. Nam mattis, felis ut adipiscing.

The growth of commodity production in the Amazon is reflected in the rise of environmental concerns, with this activity being a risk to its biodiversity (Barlow et al., 2007; Soares-Filho et al., 2006) and to rainfall in other regions. The manner in which agricultural production takes place, the areas into which it expands, and methods of controlling its negative externalities have all been subjects of investigation. Both economic agents and the government have sought to regulate economic activities both directly and indirectly, leading to institutional changes in the relation to the environment.

Since the mid-20th century, worldwide discussion about the future of forests has grown significantly. As a result of the UN Conference on Environment and Development held in Rio de Janeiro (Eco-92), Agenda 21 emphasizes the conservation and sustainable development of forests, signaling that reduction of deforestation is a priority strategy to achieve global sustainability. In practice, it proposes that governments create rules and exercise command and control (law enforcement); that companies develop and implement methods and practices that reduce impacts on the environment; and that consumers choose products derived from sustainable practices.

From the 2000s, there has been growing pressure from consumers in many countries, especially in Europe, against the major international conglomerates operating in the production, purchase, and sale of Brazilian soybeans. Mato Grosso, as the largest Brazilian soybean producer, and with its locations at forest edges, remains a focus of international attention. The Brazilian government has intensified its efforts on the main issue of deforestation in the Amazon since 2008, implementing control and monitoring operations to reduce the annual rates of deforestation, mainly arising from illegal activities. Although it has significantly reduced the rates, deforestation persists. This control mechanism is limited by the scarcity of public resources and by the natural difficulties in inspecting the huge forest areas involved, which puts at risk the effectiveness and continuity of the program. Encouraging sustainable economic

activities while combating illegal deforestation in the Amazon involves not only the Brazilian government, but also those economic agents that are able to take the opportunity to combine preservation and production (Nepstad, Stickler, & Almeida, 2006).

The Soy Moratorium is an example of a market institution able to intervene in the decision making of farmers. In practice, the large conglomerates (trading companies) dealing in soy products undertake not to fund or acquire soybeans from deforested areas. Therefore, this article aims to analyze the main causes of deforestation in the Amazon in the 20th century, with special attention to the role of the Soy Moratorium in reducing deforestation in the Brazilian Amazon as a response to the demands of society. Our hypothesis considers that control mechanisms based on institutional change of the market itself are able to contribute in reducing deforestation in the Brazilian Amazon.

2. Economic growth and deforestation in the Brazilian Amazon

Agricultural activities in the Amazon have intensified from the 1960s, with public policies to encourage its productive expansion (Andersen & Granger, 2007; Jepson, 2006). Cardille and Foley (2003) found a large increase in areas of pasture and agriculture between 1980 and 1995, mainly in the states of Mato Grosso and the west of Pará. Among the different activities, livestock is considered as having the greatest impact on deforestation in the region; with reduced demand for capital, but extensive in requirements for land, it quickly converts areas of native forest to pasture (Hecht, 1985; Walker, Moran, & Anselin, 2000). Facing a fragile institutional environment, conflicts arose in the region, and livestock acted as a guarantee for land tenure (Araujo, Bonjean, Combes, Combes Motel, & Reis, 2009) and received tax and credit incentives. Different interpretations of laws are related to non-compliance (Schmidt & McDermott, 2014), leading to economic inefficiencies, increased environmental fines and lawsuits.

Soybean cultivation, however, is concentrated in areas where the market is already developed and possesses the logistic conditions and capital required to achieve economies of scale (Andersen, Granger, Reis, Weinhold, & Wunder, 2002). Thus, it expands into areas that are already deforested, replacing existing activities such as raising livestock. Jasinski et al. (2005) also emphasize that the mechanization of agriculture in Mato Grosso is associated with the paving of roads and planned soil areas, conditions that allow the use of appropriate machinery. On this point, Fearnside (2001) argues that as soybean cultivation develops in a region, it ultimately displaces other activities to new areas, leading to further deforestation. This so-called "dragging effect" thus constitutes a threat to the preservation of the Amazon.

Actions to combat deforestation in the region have intensified since 2004 with the implementation of *Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal* (PPCDAm), which contributed greatly to reducing deforestation (Gollnow & Lakes, 2014). Complementary actions such as the demarcation of indigenous lands and the creation of reserves, such as Conservation Units, guaranteed property rights over vast areas in the Brazilian Amazon and reduced the expansion of illegal activities in these areas. Examples such as *Operação Curupira* in 2006, *Operação Arco de Fogo* (Arc of Fire) in 2008, and *Operação*

Ouro Verde in 2013 represent enforcement actions to reduce illegal activities with respect to Brazilian environmental legislation. Decentralization was an institutional change to reduce deforestation, delegating to states environmental competences (Schmitt & Scardua, 2015).

In addition to action by the government itself, the market may also develop institutions capable of reducing deforestation. The change in behavior of consumers worldwide is reflected in the demand for more sustainable methods of production to be adopted by companies. Activities that cause evident environmental impacts need to change their quality and production standards to stay in business, with conservation opportunities arising with the new demands of consumers (Nepstad et al., 2006). Pressed by growing international concern, the soybean supply chain companies have begun a movement with the main objective of preventing the expansion of agriculture into forest areas in the Amazon.

The Soy Moratorium is an example of an institution that originated in the market in response to the mounting demands to preserve the Amazon rainforest. In signing this document, industries affiliated to ABIOVE (Brazilian Vegetable Oil Industries Association) and ANEC (National Grain Exporters Association) in Brazil pledged not to purchase or finance soy from deforested areas in the Amazon Biome from July 2006. The latest extension maintains the moratorium until May 2016. Some findings demonstrate that this action has produced significant effects in combating deforestation (Rudorff et al., 2011). Gibbs et al. (2015) argue that surveillance and monitoring by the government alone (federal enforcement) is not enough to contain deforestation. While government action operates to ensure compliance with the law, market mechanisms can achieve a faster and more efficient response. Similarly, Hayes and Ostrom (2005), in an investigation based on numerous empirical studies in regions including Brazil, highlight the importance of institutions created by local players to forest conservation.

Market-based approaches to reduce deforestation in Amazon should also engage the adaptive capacity of agents to promote the new production standards. Small farmers are often vulnerable to institutional changes when they do not receive the necessary support (Pokorny, Johnson, Medina, & Hoch, 2012); as a result, some development strategies are ineffective in combining environmental preservation, economic growth, and social progress. The conservation goals should be constructed democratically, with the participation of the stakeholders (government, farmers, companies, and civil society), where each has a certain role in implementing the defined strategies. While public policies have a limited impact in controlling deforestation, licensing mechanisms and law enforcement can yield long-term effects on the market's perceptions regarding environmental conservation (Eve, Arguelles, & Fearnside, 2000).

These market mechanisms play an even more important role in agricultural activities. Since the initial occupation of this region, these activities have promoted the Amazon's economic growth; however, the unsustainable exploitation of natural resources increased deforestation rates. The rules have been changed in the 21st century to ensure the preservation of the Amazon rainforest. Consumers are now also more aware of the origins of products, requiring that supply chains review the practices of all their economic agents.

3. Materials and Methods

3.1 Data

To investigate the relation of deforestation, the practice of agricultural activities in the Brazilian Amazon, and the role of market institutions, we use a database for 382 municipalities of the Amazon Biome[5] in the states of Mato Grosso (86), Pará (142), Rondônia (52), and Maranhão (102), considering only those municipalities impacted by the Soy Moratorium, including the fact that major agricultural producers are also the largest deforesters in the Amazon during the period analyzed in this study (the base extends from 2001 to 2012). Data for deforestation (in km² of deforested area) were obtained from the Brazilian Space Research Institute (Inpe, 2016). The planted area of soybeans, livestock density, and GDP per capita were obtained from the Brazilian Statistical Office database (Ibge, 2017). The values for GDP per capita have been updated to December 2012 based on the implicit GDP deflator.

3.2 Panel data model

To measure if market institutions are effective in combating deforestation, we use a panel data regression model—fixed effects model 1—to the 382 municipalities selected for this study. The variables used were transformed using the natural logarithm for statistical purposes.

$$DESMT_{it} = \alpha_i + X'_{it}\beta + D'_{it}\theta + \varepsilon_{it} \quad (1)$$

Accumulated deforestation for each municipality i is given by the dependent variable $DESMT_{it}$, with $i = 1, 2, \ldots 382$ and $t = 2002, 2003, \ldots 2012$. X'_{it} is the matrix of explanatory variables, these being the total area of soybean production, total cattle, and GDP per capita. The coefficients for all of these variables are expected to be positive, implying that an increase in economic activity in the Amazon is reflected by an increase in deforestation. D'_{it} is a matrix of dummy variables, with two selected dummies for this research. The first, designated D_p, is a group of municipalities with the highest deforestation in the period analyzed. The second, designated D_m, is intended to clarify the objective of this work, representing market action on deforestation in the Legal Amazon through the Soy Moratorium. From 2006, all municipalities that had variations in soybean production area received the value one for the dummy. It is expected that the coefficient of this variable will be negative, showing that market institutions can contribute to combat illegal deforestation.

Estimations obtained through the fixed effects model result in a constant α_i for each municipality. For the purpose of measuring the effects of annual variations in deforestation due to its regressors, the model was transformed through the use of first differences between the variables, thus eliminating the fixed effect term for each municipality. The new estimable equation (2) keeps the values for the dummy variables:

[5] The municipalities that belong to Amazon Biome are given by Decree 6.321, December 21, 2007.

$$\Delta DESMT_{it} = \Delta X'_{it}\beta + D'_{it}\theta + \epsilon_{it} \qquad (2)$$

We performed the calculation of robust standard errors for the independent variables after heterocedasticity detection in the error term. A second model for comparison purposes was developed using the fully modified ordinary least squares (FMOLS) method after checking for long run cointegration between the variables. In this model, we used a sample of 129 municipalities from the 382 initially selected. This group comprises all the municipalities that had variation in soybean production for the analyzed period, contributing to the verification of the effects of the Soy Moratorium.

The unit root search was completed for all variables with the Levin-Lin-Chu test, finding stationarity in the first differences (Table 1), thus maintaining the model presented in equation 2. The tests for cointegration (Table 1) were performed in two sets: the panel cointegration, which consists of four statistics, and the cointegration group, with three statistics.

Table 1: Unit Root Test and Panel Cointegration Tests.

Unit Root Test: Levin-Lin-Chu			
Variable		**Statistic (lags)**	
$LN\ \Delta Deforestation$		–41,4159 (1) **	
$LN\ \Delta Soy\ area$		–66,5510 (1) **	
$LN\ \Delta Cattle$		–17,4566 (1) **	
$LN\ \Delta GDP\ per\ capita$		–13,3234 (1) **	
Panel Cointegration			
Within-Dimension test statistics		**Between-Dimension test statistics**	
Panel *v*-Statistic	–5.447 †	Group rho-Statistic	9.708 †
Panel rho-Statistic	1.370 †	Group PP-Statistic	–4.776 **
Panel PP-Statistic	–7.126 **	Group ADF-Statistic	–3.173 **
Panel ADF-Statistic	–9.088 **		

**, * denote significance at 1%, 10% levels respectively. † denotes not significant.

The results of the test rejected the null hypothesis of no cointegration for four statistics (Panel PP-Statistic; Panel ADF-Statistic; PP-Statistic Group; and Group ADF-Statistic) at the 1% significance level. The analysis of panel data for this group of 129 municipalities was also performed with the method of ordinary least squares (OLS), which permits a comparison of both models.

4. Results and Discussion

The new institutional economics completes the vision of neoclassical theory by incorporating the analysis of transaction costs and issues related to human behavior. This positioning considers the genesis of the institutions in question and the role they play in society. This, when combined with theory of production, allows the evaluation of the economic performance of companies and even national economies over time (North, 1990).

The governance structure is an "institutional matrix within which transactions are negotiated and executed" (Williamson, 1979, p. 239), including rules, the institutional environment, institutional arrangements, and agents. In this study, both soy producers and the trading companies are the economic agents. The institutional arrangement consists of the rules and norms that define the behavior of agents, so that transactions occur in accord with the relevant production quality and specification standards. In this institutional environment, the Soy Moratorium is inserted as a constraint that restricts soybean purchases originating from illegally deforested areas, thus contributing to the preservation of the forest.

The above approach differs from government action; rather than employing legislation, police power, and interventions on the market, here economic agents develop mechanisms to impose restrictions on themselves. This is a constraint mechanism agreed to by these agents that does not follow pre-established criteria. The certification of the production methods employed by agents involved in the mechanism is the instrument used to identify infringers of production standards. Embargoes and restrictions on the part of the public can be added to these practices.

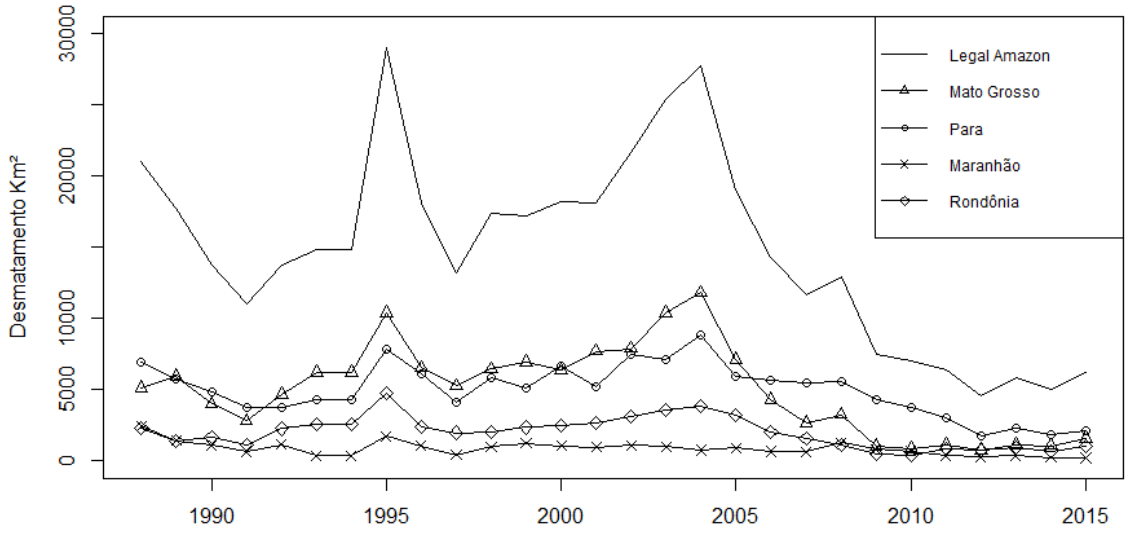
The effectiveness of such regulatory institutions rises with the integration level of the agents engaged in collective action. In the case under consideration, the coordination is centralized in agricultural companies, this hierarchy allowing them to impose restrictions on the other chain members. The Soy Moratorium, by tying the trading of this product to the non-clearing of forest areas, raises the cost of illegality, thus contributing to the reduction of deforestation rates. Then prescinds the assimilation of the rules by soy producers who would otherwise be excluded from the supply chain.

Deforestation rates in the Brazilian Amazon have been falling since 2004 – when deforestation reached 27772 km² – but more strongly in recent years, following the intensification of command and control from the Brazilian government (Figure 1), reflecting a higher efficiency of the monitoring mechanisms. Pará and Mato Grosso lead the ranking of states with the highest rates of deforestation.

Price is a very important factor in allocating resources to a particular activity (Hargrave & Kis-Katos, 2013). In fact, a rise in commodity prices leads to the clearing of new areas for cultivation and may cause adverse effects to society's aspirations for the preservation of forests. Between 2005 and 2007, the decline of soybean prices significantly impacted domestic production. However, the recovery in prices since 2008 led again to a rise in production and the consequent expansion of cultivation into new areas. In this scenario, it is neces-

sary to create new mechanisms to control deforestation in the face of market pressures, preferably involving the industry agents, making the Soy Moratorium exemplary.

Figure 1: Deforestation (km²) in Legal Amazon and states from 1988 to 2015. Source: INPE (2016)



The reduction in deforestation rates is a result of the new governance mechanisms in the Brazilian Amazon territory in the 21st century. Not only the government, but also the private sector and civil society play an important role in this process. Although the agents of the soybean supply chain have highlighted the possibility of developing institutional mechanisms to reduce deforestation, other economic sectors can implement actions and mechanisms for the same purposes.

In order to verify whether market institutions can help in combating deforestation in the Amazon, we estimate a panel data model that considers the variation of the municipalities of deforestation in the Legal Amazon states of Maranhão, Mato Grosso, Pará, and Rondônia (Table 2), being a function of the activities mainly presented in literature as causing deforestation (soy production and cattle ranching) and GDP per capita. A dichotomous variable was added to the model in order to capture the effects of the Soy Moratorium on the municipalities of the Brazilian Amazon that would be restricted from trading products from deforested areas.

Table 2: OLS estimation for equation 2.

Dependent: LN $\Delta Deforestation$	Model 1 **Coefficient** **(Std. Error)**	Model 2 **Coefficient** **(Std. Error)**
$LN\ \Delta S\ oy\ area$	0.0100**	0.0003†

	(0.0024)	(0.0012)
$LN\ \Delta\ Cattle$	0.1522**	0.4051**
	(0.0406)	(0.0444)
$LN\ \Delta GDP\ per\ capita$	0.2906**	0.2376**
	(0.0745)	(0.0292)
D_p	0.0119 *	0.0025†
	(0.0067)	(0.0072)
D_m	–0.0220**	–0.0087 *
	(0.0068)	(0.0040)
R-squared	0.564	0.871
Observations (municipalities)	4202 (382)	1419 (129)

Model estimated with OLS and robust standard error. **, * denote significance at 1%, 10% levels respectively. † denote not significant.

Our results show that the coefficient for soybean production was positive in model 1 and its statistical significance confirms that soybean production contributes to deforestation in the Amazon. However, this impact is extremely limited, given that the elasticity obtained was only 1%. Thus, soybean production concentrated in savanna areas does not represent a risk to the Amazon. The absence of favorable soil and climate conditions such as regular water regimes and plans soils restricts the expansion of soybean cultivation into the rainforest area (Campos, 2012). For model 2, soybeans did not reach statistical significance. This condition will be compared with the FMOLS model results.

The livestock coefficient, in turn, was significant in both models with an elasticity of 15.2% in the first model and 40.5% in the second. We conclude that this activity continues to be the main cause of deforestation in the Amazon (Margulis, 2003). Low capital intensity, combined with the necessity of implementing an economic activity in order to assure the productive use of land, gives rise to extensive livestock raising with low levels of productivity per unit area. Implementing incentives to intensify livestock production by itself cannot necessarily be an effective strategy to contain the spread of deforestation caused by this activity in the Amazon (Fearnside, 2002).

GDP per capita was the third variable analyzed; this also proved positive and significant in both models. Income growth is an incentive to deforestation as it encourages new projects in the Amazon that can lead to the clearing of new areas, whether rural or urban. New infrastructure projects are installed, creating considerable impacts on the environment, like hydroelectric plants, or providing better logistical conditions, such as the paving of roads (Nepstad et al., 2001).

The variable D_p in the model represents the municipalities that have the greatest impact on deforestation in the Amazon. It corresponds to a group of 29 municipalities that showed a high increase in deforested area between 2001 and 2012, with 38.5% (54,900 square

kilometers) of the total deforested area of all 382 municipalities. This group accounted for 32.8% of the variation of livestock in the same period, which also shows a strong correlation with deforestation for this group (0.846[6]). It is evident the concentration of deforestation in a few municipalities, driven mainly by livestock, reinforces the conclusion that this activity continues to be primarily responsible for deforestation in the Amazon. In the second model, this variable was not statistically significant. These results will also be compared with the estimated FMOLS model.

The Soy Moratorium's impact on deforestation in the Amazon was measured with the introduction of D_m and in both models it was negative and significant. The results demonstrate that market institutions can contribute to the reduction of deforestation. In model 1, the coefficient indicates that the moratorium is able to reduce deforestation by 2.20% in soy producing municipalities. The second model shows a lower value (0.87%).

Seeking to compare the effects of agricultural activities and the Soy Moratorium on deforestation, a new model was estimated using the FMOLS method (Table 3) with data obtained from the cointegration check between variables (Table 1) and the unit root test. When compared with the second model estimated by OLS, this methodology has proved better in explaining deforestation in the Amazon.

Table 1: Panel FMOLS long run estimation for equation 2.

Dependent: $LN\ \Delta Deforestation$	Model (FMOLS) **Coefficient** **(Std. Error)**
$LN\ \Delta\ Soy\ area$	0.0396** (0.0023)
$LN\ \Delta\ Cattle$	0.4937** (0.0084)
$LN\ \Delta\ GDP\ per\ capita$	0.2192** (0.0136)
D_p	0.4336** (0.0268)
D_m	–0.1105** (0.0226)
R-squared	0.617
Observations (municipalities)	1419 (129)

Model estimated with FMOLS. **, * denote significance at 1%, 10% levels respectively. † denotes not significant.

[6]Significance 1%.

There was a change in the elasticity of livestock (49.37%) and soybean area (3.96%) for this model estimated with FMOLS for 129 municipalities. Therefore, the elevated contribution of livestock to deforestation reinforces the conclusion that this activity remains the main threat to the preservation of Amazon rainforest. Soy does not have such a significant impact on deforestation. The Soy Moratorium, explained via D_m, had a high negative value (–11,05%), demonstrating that market institutions are able to combine conservation and production. Municipalities that are located in the Amazon biome and have soybean production now face a constraint in trading products from deforested areas.

Intervening in economic agents' decisions is the reason for the success of this market institution. Soybean producers are constrained from continuing their extensive activities in replacing the native forest and will adopt new ways to increase their production when they find they can no longer trade the product. The use of degraded areas and larger investments per unit area are alternatives available to producers. In this respect, the government can contribute further by providing instruments to encourage legal operations, while reducing the costs required to prevent illegality with command and control. Payments for Environmental Services (PES) and Reduced Emissions from Deforestation and Degradation (REDD) are important initiatives to prevent deforestation in addition to command and control (Börner et al., 2010; Wunder, 2007).

Other supply chains may also develop deforestation control mechanisms implemented by economic agents through institutions, which could make the cost of illegality sufficiently unfavorable. Following the current rules then becomes the best option. The more vertical the chain, the greater is the capacity of intermediates to constrain agents below them in response to the demand that arises from the top of the chain (consumers). A non-vertical supply chain must make use of other forms of organization to encourage the practices of its agents, such as associations and unions.

Mechanisms of governance, as vertical integration, reinforce the efficiency of market institutions in reducing Amazon deforestation. In the case of the timber industry, the spatial distribution of the producers and the lack of a linkage with a verticalized supply chain make it difficult to implement a strategy of sustainable use of natural resources (McDermott, Irland, & Pacheco, 2015). In these cases, law enforcement, command and control, and forest certification are the main forms of action against illegal activities. Others commodities, including soybeans, biofuels, and beef are part of global supply chains (D. C. Nepstad, Boyd, Stickler, Bezerra, & Azevedo, 2013) that need to meet the social demands for products obtained through sustainable methods. The soybean supply chain is connected to these demands, and the result of the roundtable with the stakeholders was the Soy Moratorium, while the beef industry is still evolving this process as big companies start to introduce these market dynamics in some areas of the Brazilian Amazon. Since large companies constitute the main route of trading commodities, social pressure can change its focus from geographically dispersed farmers to a few large companies that have a public image to uphold (Butler & Laurance, 2008).

Certifications and production quality standards diffuse in the market from the social demand for products that meet sustainability criteria (Anton, Deltas, & Khanna, 2004). The government may use market incentives to encourage producers to respect the legislation, biodiversity, and conservation, in order to move beyond merely punishing those who engage in illegal activities. Nepstad et al. (2004) show that timber industry initiatives with local communities mediated through the relationship between industry and landowners make it possible to perform legal and sustainable logging in the region, with benefits for both parties and with respect for the environment.

The dynamics of local stakeholders is a crucial factor for the institutional development of appropriate governance structures, which can combine the sustainable use of natural resources with the maintenance of existing activities (Fearnside, 2008). Many governance structures present in the Amazon are designed to reduce deforestation. The most common of these is the demarcation of territories to be protected, such as the creation of national parks, protected areas, or even indigenous lands (Joppa & Pfaff, 2011; Nolte, Agrawal, Silvius, & Soares-Filho, 2013; Schwartzman & Zimmerman, 2005).

The Soy Moratorium establishes a governance structure that limits the exploitation of natural resources, adding to the other existing initiatives. However, it is possible that new governance structures may be developed to circumvent the law (Rausch & Gibbs, 2016). Enforcement actions must constantly monitor the compliance with the law, including loans, arrests and other measures.

The Brazilian government acted for years with its policing powers in order to reduce deforestation rates in the Amazon. However, as Gibbs et al. (2015) argue, enforcement alone may be insufficient to combat deforestation. The Amazon is a vast area and monitoring involves excessive costs for the government. What is currently seen is a stabilization of deforestation rates after a few years of decline (Malingreau, Eva, & Miranda, 2012), demonstrating the limits of the actual mechanism of control. Encouraging the market to organize against deforestation does not mean delegating the government's control function, but rather increasing its reach by sharing this responsibility with the whole society.

5. Conclusion

This paper examines the role of market institutions in preventing deforestation in the Brazilian Amazon. Market institutions have been developed in addition to federal enforcement, corresponding to the social demands for new sustainability standards and looking beyond price mechanisms. Our results show that the Soy Moratorium is an important mechanism of governance against illegal soybean farmers, contributing to reducing deforestation in Amazon Biome municipalities in Brazil. The vertical integration of the soybean supply chain allows control over economic agents.

Cattle ranching is still the major cause of environmental problems in the Brazilian Amazon rainforest. The spatial distribution of farmers and industry, low level of coordination and integration in the supply chain, and rising global demand for meat, make it impossible to

create governance mechanisms to avoid environmental impacts. New policies should encourage compliance with environmental legislation and restrictions on illegality, as in the case of rural credit. Yet, society must continue to demand sustainability standards, avoiding products from areas in violation of the law.

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