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Convergence, conflict and the historical transition of bioenergy for transport in Brazil: The political economy of governance and institutional change

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ABSTRACT

The history of liquid bioenergy in Brazil is a meaningful source of information vis-à-vis the political economy dynamics that underlie low-carbon energy transitions. By studying the political economy of bioenergy under a historical long-run perspective, this research seeks to shed light on the interplay between governance and bioenergy transition. Understanding governance as the dynamic interface between private and public interests, in turn conditioned by the natural, institutional and technological context, we explore the sources of institutional and economic change regarding bioenergy development. Using an analytical framework designed to study bioenergy governance in the US, this inquiry addresses the Brazilian bioenergy transition. The analysis reveals that beyond the incremental learning process of institutional and industrial transformation, the historical patterns of bioenergy evolution result from the dynamics of governance between the agro-industry and the government, a historical process of convergence and conflict of opportunity costs regarding bioenergy penetration. Thus, by altering the expected gains of the key actors, contextual factors related to energy and agricultural markets affects the decision-making process at the private and public dimension of governance, determining by convergence or by conflict, the pace of institutional change, the development of markets and the historical transition of liquid bioenergy in Brazil.

1. Introduction

Given its high reliance on road transportation, as well as natural, institutional and political contingencies, Brazilian fuel mix has been a matter of dispute between fossil and low-carbon fuels obtained from biomass since the early XX century. Although this represents a valuable source about how the political economy works concerning energy transitions, the literature thereon have omitted the historical dynamics related to governance, institutions, and markets of liquid bioenergy. From a long-term approach and anchored in institutional theory [1], this political economy analysis resorts to the history of governance in order to trace the causal mechanisms of institutional and economic change behind bioenergy transition in Brazil.

In line with North [3], this inquiry focus on the sources of change, as the perceived opportunities that determine the choices of the key actors. Unlike other approaches to the political economy of transitions [2], this work pays attention to how the interactions of gains as for bioenergy governance affect the incremental pace of institutional change, namely, how historical contingencies that affect the payoffs of players, sway governance decision-making and determine the transitions of bioenergy [3]. Accordingly, the methodology encompasses theoretical elements of historical and rational choice institutionalism to

evaluate how bioenergy governance has been structured and how this has determined the market development over time.

Based on an analytical framework developed to study the case of liquid bioenergy in the US [4], I assert that the evolution of the Brazilian bioenergy sector is mainly the outcome of the interplays between two strategic players of governance: the government and the sugar cane agro-industry. The political economy that arises from the energy use of sugar cane biomass reveals a contested process of governance that have given rise to phases of market expansion and contraction. More contingent on special conditions and factors, than predictable in terms of stability and change, the historical governance process of sugar cane bioenergy is strongly linked to the interdependence between the agriculture and the energy sector, especially to the demand and supply of fuels in the transport sector. As a substitute of oil and as a food commodity, sugar cane in Brazil echoes the sway that the economic, institutional and resource environment exerts on energy (and agricultural) governance [5]. Yet, this transition should not be understood as a chaotic set of events and contingencies totally devoid of any rationality that can explain this contextual interdependence.

While contingencies and context are relevant, the distinctive interface between energy and agriculture show certain patterns of development when it comes to governance issues. Accordingly, the

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interdependence of the agricultural and energy sector has been incremental and contingent on several factors, but bioenergy development responds also to the political economy of the fuel market. Although the contextual environment has affected the decision-making process of bioenergy governance, the source of institutional change and market expansion reveals patterns of interdependence based on the conflict and convergence of interests between the agro-industry and the government. I consider that these patterns of interdependence are certainly important to understand the historical levels of bioenergy penetration in the fuel mix.

Thus, the main goal of this paper is to develop a reasonable explanation about Brazilian bioenergy transition in terms of governance, institutions and markets. Consistent with Williamson [6], I have developed a historical inquiry of the institutional environment and the institutions that govern transactions at the sugar cane markets [6]. The long-term perspective is useful to observe the trade-offs concerning the decisions of bioenergy expansion, namely, the opportunity costs in which the agro-industry and the government incur when they adopt decisions regarding bioenergy development. This political economy reveals the connection between governance, institutional change and market expansion over time, and is explained in section II. Following this logic, I formulate and explain our hypotheses on the principal features of bioenergy governance for each historical period that I call “scenarios of conflict” or “convergence”, which are briefly developed in section III.

In section IV, I complement the governance analysis testing the validity of these hypotheses by means of an Interrupted Time Series Analysis, which contributes to comprehend the connection between governance, institutional change, and the historical evolution of markets. This empirical exercise allows us to model the impact of governance on the market development of liquid bioenergy over time, as well as to forecast the future trajectory of sugar cane bioenergy under the current conditions of governance. Finally, I present the conclusions of this inquiry in section V, summing how the long-term analysis reveals the logic behind bioenergy governance and the historical transition in Brazil.

2. Analytical framework

From a broad perspective, the assemblage of institutions, markets and other attributes of society interacts dynamically with the restrictions that technology and nature impose on human behavior. This interplay of conditions sways energy choices at different levels of decision-making, which does not necessarily converge to an immutable notion of energy security that guides government action over time [7]. It changes in accordance with the political economy of energy governance, which can be understood as the numerous processes whereby a group of people sets and enforces the rules needed to achieve desired outcomes [8], and whose structure is composed of a number of institutions with certain features of resilience and adaptability that are part of the socio-technical regime of the energy sector, a concept that emphasizes the interdependence between society and technology [9]. Consequently, the governance process may include different levels of competition between political goals and economic rents; depending on the levels of interaction, especially convergence or conflict, it may or may not lead to institutional changes.

The historical analysis indicates that the political and economic decisions concerning bioenergy have been adopted in temporal contexts defined by certain institutional, economic, and technological vectors, as well as certain natural-resource endowments, which shape the contingency of the decision-making process of governance. By affecting the political and economic rents of the key actors, different factors can encourage or discourage the political or economic decisions regarding bioenergy expansion. This finally gives rise to scenarios of conflict or convergence of interests that describe the distinctive nature of the periods of bioenergy governance. Consequently, the pace of

institutional change and market expansion is affected by the changes in the attributes of conflict or convergence that depict bioenergy governance during a certain historical period.

Thus, given similar conditions in the agricultural sector as for the potential of large-scale biomass and biofuels production, as well as comparable features of energy demand at the transport sector, we can expect like behaviors of the decision-makers before the variations of the contextual factors over time. Furthermore, we can also expect analogous penetration rates of liquid bioenergy in different jurisdictions, insofar, the factors and contingencies that affect political and economic rents point towards the same direction, namely, towards the conflict or convergence of interests regarding bioenergy expansion.

In the case of the US and Brazil, there have been certain similar contingencies that have surrounded bioenergy governance over history. For example, those related to natural resource endowments, production scale of biomass, agro-industrial productivity, issues about over-production of cereals and sugar, the predominance of road-transport technology adapted to fossil fuels, road infrastructure inertias as well as the development of local capacities vis-à-vis the production and refining of oil products, among others. Accordingly, given similar conditions related to biomass production as well as regarding energy and transport, bioenergy governance in the US and Brazil have followed an analogous rationale in their patterns of development.

Under similar departing conditions, contextual factors can affect the rents of the government and the agro-industry similarly; therefore, conflict and convergence can be the characteristics of bioenergy governance and the political sources of institutional change. This does not imply similar trajectories in bioenergy evolution, because this is contextual dependent, however, it reveals similar patterns concerning the decision-making process of governance. Thus, the convergence and divergence of trade-offs in time relating to the energy use of food biomass, explain how, after the international oil crisis during the 1970 s, only Brazilian bioenergy grew up exponentially while US bioenergy didn't, and how during the early 2000 s, the liquid bioenergy expands significantly in both countries [10]. Hence, it is possible to use the same analytical framework to understand both cases.

Accordingly, the historical analysis is focused on the decision-making process of the government and the agro-industry. Because making decisions requires trading off one goal against another, this process of governance has shown that bioenergy's expansion has historically implied an opportunity cost for both agents, which is affected by variations of external factors and internal learning that corresponds to their mental models of maximization. This process triggers the choices that affects the pace of institutional change [3].

On one hand, the government embodies the public dimension of governance with the regulatory capacity to determine energy policy for transport. Here, the decision-making involves a political opportunity costs between liquid bioenergy penetration and oil displacement. On the other hand, the sugar cane industry represents the private dimension of governance and embodies the production and organization capacity of markets as for alternative energy sources. The decision-making involves an economic opportunity cost between the production levels of food products, mainly sugar, and the production of liquid bioenergy.

History shows that besides the incremental learning, many factors have affected the opportunity cost of both actors over time. Government decision-making is swayed by the positive or negative perception of fuel markets' performance regarding some relevant goals at the historical public agenda of Brazil. Although the most relevant factors are those related to energy prices, as the balance of payments, public deficit, external debt crisis, inflation and its fiscal effects, political rents concerning fuel prices for retail consumers etc., there have been other important contextual conditions that also explain the decision-making process. Imports substitution and industrialization policies, institutional changes related to interventionism and the liberalization of the economy, competition policy preferences, equity concerns

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