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The First World War and the Latin American transition from coal to petroleum

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ABSTRACT

While it is true that the precise nature of the future energy transition is uncertain, and no standardized transition is expected as such, it is also true that the energy transition phenomenon can only be described as an historical phenomenon. The Latin American early adoption of petroleum as principal energy source during the first quarter of the 20th century challenged the universality of the energy transition observed for the advanced economies and the associated features regarding pace, irreversibility and the sequence within the energy transition. This paper deepens on the analysis of this episode marked by the disruptions created by First World War to show how economic, geographical and political aspects defined the shape and pace of the early switch to oil of the Latin American republics. The aim is to develop a more nuanced understanding of socio-spatial contexts, scale, and the global–local relationships that constitute core elements of socio-technical systems.

1. Introduction

As defined by (Geels, 2005) socio-technical systems consist of a cluster of elements, including technology, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks and supply networks. At times, those elements struggle with specific circumstances that limit their leeway forcing them into alternative courses of action. For the purposes of this paper, the historical contingency of the First World War represents one of those circumstances affecting almost all the elements of the socio-technical system defining the world energy supply.

(Murphy, 2015, pp. 87–88) established that both, technological innovation system (TIS) and multi-level-perspective (MLP) scholars, have highlighted the value of considering space and scale to more effectively capture the complex dynamics through which innovation systems might occur. Therefore, he asked for more emphasis on 'the precise roles that socio-spatial embeddedness and relations play in determining the path and significance of TIS evolution'. To yield further insights regarding the spatial dimensions and dynamics of socio-technical change, he also appealed to shift the empirical focus away from the European, North American, and Australian context. Taking up his plead, this paper looks into Latin America's transition out of coal into petroleum.

Rubio et al. (2010) established the methodology for reconstructing the historical energy consumption data of Latin America and used their estimates to gauge the economic evolution of the region from 1890 to 1925. Rubio and Folchi (2012) extended the database to almost one hundred years to cover 1856 to the 1950s and showed that Latin American early adoption of petroleum as principal energy source, replacing coal, during the first quarter of the 20th century challenged the universality of the energy transition observed for the advanced economies and the associated features regarding pace, irreversibility and the sequence within the energy transition. However, (Rubio and Folchi, 2012) only advanced general hypotheses for the proxy causes of the Latin American particular energy transition, loosely pointing at path dependence, factor endowments, trade energy network and the role of First

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World War as the probable causes. Building on these, this paper deepens on the analysis of this episode marked by the disruptions created by First World War to show how economic, geographical and political aspects defined the shape and pace of the early switch to oil of the Latin American republics, providing new evidence for the whole subcontinent.

With our analysis, we aim at developing a more nuanced understanding of socio-spatial contexts, scale, and the global–local relationships that constitute core elements of socio-technical systems.

The First World War was responsible for the rapid maturity of the petroleum industry worldwide. While it is true that both the USA and Great Britain began the conversion of their naval fleets from coal to oil burners just before the war started, it is also true that as the war progressed, petroleum use increased, providing fuel for such military innovations as the submarine, the tank and the airplane (DeNovo, 1956). The use of fuel oil and diesel engines as prime movers and as electricity generators in places with either little hydraulic resources or coal, together with the necessary lubricants for the machinery, also increased the demand for petroleum products during the war. These uses superseded kerosene for illumination, the major market in the early days of the petroleum industry (Yergin, 1991). Fuel oil was principally used for bunkering ships and as locomotive fuel, for which coal, supplied largely by Great Britain to the world, was formerly used.

Nevertheless, the contribution of petroleum to the world energy supply after the end of the Great War must not be exaggerated. In 1925, solid fuels still supplied 82,9% of the energy consumed worldwide, liquid fuels, 13.2%, natural gas 3.2% and hydroelectric power 0.7% (Rubio, 2006). Most of the world kept using coal as major energy carrier for few more decades. As it is often explained, the replacement of a technological system (coal and its steam engine) for another one (petroleum and its combustion engine) often happens in a gradual fashion, because the creation of a new socio-technical regime takes time (Geels, 2005). Yet it was not the case in the shift out of coal into oil in Latin America.

What is special about Latin American transition out of coal? According to (Rubio and Folchi, 2012) first and foremost, that the prevalence of petroleum over coal occurred in Latin America in the 1920s, that is, 30 or 40 years in advance of the industrialised nations (see Table 1). It also happened at much lower level of average income per capita, putting a grain of salt on the energy ladder hypothesis. Second, most Latin American countries made their transitions from coal dominance to oil dominance in a short period of time, within a decade, often in less than 5 years. Finally, Latin American countries present models of energy transition not found elsewhere: revertible and inverse transitions. In revertible transitions countries could go for few years altering between one or the other as principal energy source, taking a while to settle for petroleum as the wining choice. The inverse transitions saw some small Central American republics going from kerosene pre-eminence to a small phase of coal, to finally turn to oil for good. According to (Rubio et al., 2010) 'the fact that for the Central American countries, coal was mostly irrelevant already by 1925 provides an interesting hint. Had they been involved in the technologies of the first industrial revolution, they would have used coal. It seems these countries never made use of the classic steam engine, but made a jump straight to combustion engines, thus to petroleum products.'

While it is true that the precise nature of the future energy transitions is uncertain, and no standardized transition is expected as such, it is also true that the energy transition phenomenon can only be described as an historical phenomenon. Studying this historical case and boiling down causes and effects to their spare fundamentals, we may be able to understand the hows and whys; It may tell us where to look and where not to look for evidence. It may also help us to identify conditions that are necessary and/or sufficient for past choices and outcomes to influence the present. The next section sets out the scenario of the socio-spatial contexts of the Latin American energy supply in order to understand the changes brought by the Great War, where we argue that geography played a major role. The third section takes up the issues of scale and the question of whether it is possible to distinguish the effect of path dependence from the effect of the inertia of the energy systems. The final section looks at the global–local relationships that eventually also played a role in the early and swift transition out of coal in Latin America. Through the paper we use the databases of Latin American energy consumption and trade compiled over the years – originally constructed by (Rubio et al., 2010), later updated and extended by Rubio and Folchi (2012) to provide the evidence required. Minor amendments to the coal consumption data by Yáñez et al. (2013) and the latest data of the hydroelectricity consumption by Rubio and Tafunell (2016) converted to equivalent tons of oil at heat value (toe) complete the data used for the estimates of energy consumption used throughout the paper.

2. The socio-spatial contexts of the Latin American energy supply

The coal trade in Latin America began at the end of the nineteenth century. The almost complete absence of this resource in the region made imports necessary, despite the fact that some coal had been produced in Chile and Mexico since 1890, in Peru since 1900, in Brazil since 1912, and in Venezuela in 1913 (Yáñez et al., 2013). Coal external dependence was a regional phenomenon: the sum of production of all the countries the region would not have been sufficient to supply the regional requirements of coal at any point. At best, only about a third of the coal consumption could had been covered domestically (see Fig. 1).

The countries of the Southern Cone which initiated their industrialization process during the nineteenth century, tied their energy consumption patterns to the prevailing technology existing at the time: coal and the steam engine (see for instance (Badia-Miró and Ducoing, 2013; Bertoni and Willebald, 2016) for Chile and Uruguay respectively). (Badia-Miró and Carreras-Marín, 2008) showed that although coal importation was imposed by the practical absence of the resource, there was some choice over coal suppliers. In the international market of the beginning of the 20th century there were only three large coal exporters: the USA, Great Britain, and Germany. Although German coal had a marginal presence in Latin America. Using a gravity model, (Badia-Miró and Carreras-Marín, 2008) find that transport costs, represented by distance, had the usual negative impact so that countries closer to the USA tended to import their coal from there rather than from the UK. Thus, for example, for Cuba, Ecuador, El Salvador, Guatemala, Haiti, Mexico, Nicaragua and the Dominican Republic, imports from the USA coal represented between 85% and 100% of total coal imports, while