

# **Portuguese lost Industrial Revolutions. Without coal in the age of steam, without dams in the age of electricity (1850-1950)**

Sofia Teives Henriques

Lund University

## **Abstract**

This thesis chapter explores the role of lack of energy resources in Portuguese economic growth from the very beginning of Portuguese industrialization, in the middle of the nineteenth century until the dawn of the golden age, looking into factor prices. It is discovered that energy costs were higher than in well endowed countries during the First Industrial Revolution, especially relatively to wages. Steam diffused well in the cities close to harbors, but not in the interior where alternative sources such as water or wood were used in substitution, but were only second best choices and had a very limited role to the escape to high energy costs. The lack of coal associated with the lack of other mineral resources such as ore, produced an industrial structure based in low energy intensive industries, which were mainly dependent on the domestic market demand.

The emergence of the Second industrial revolution was not an escape from high energy prices. It is found that real coal prices increased during the inter-war period. Unlike many poor coal endowed countries electricity did not make a difference, as hydro-power did not have a predominant role<sup>1</sup>. Relatively to both poor and rich endowed countries Portugal had very expensive electricity relatively to coal, which made possibilities to industrialize around electricity-intensive industries and engineering very small. This dictated an again very traditional specialization of Portuguese industry. The impacts of hydroelectricity by substitution of coal were much lower than Italy, Sweden, Spain or Canada.

In conclusion, relatively high energy costs in relation to other countries and to wages could well be the case for the low intensity of Portuguese industrial energy consumption. While industrial growth was higher than in some developed countries during this period it was not enough to lead to a real catch up, because they did not manage to develop the leading energy intensive industries of the Revolutions such as iron, steel, mining and electro chemicals.

Theoretically, the existence of low energy intensity countries versus high energy intensity countries has some implications from how we interpret the long-run energy intensity pattern

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of development. In general, the most common interpretation for lower energy intensities among late comers for the same levels of GDP, has been related with the evolution of technology both due to time (late comers benefit from general technological evolution) – relative *leapfrog* and better opportunities that late comers can have related with the development of new industries, efficient capital stock and energy carriers – absolute *leapfrog*. In a spatial comparison it seems that absolute *leapfrog* had scarce impact in Portugal. In fact, average efficiencies in hydraulic equipment, electrical utilities and steam machines were lower than in leading countries. As well, the fact that Portugal had peaked at extremely low levels of coal consumption does not mean that the country took an earlier advantage of the possibilities of electricity and oil.

The importance of the energy share of high intensive industries in Germany, UK or USA, could well be in the origin of inverted U-shaped curves for industrial energy intensity, reflecting changes in the international demand for a particular branch. The particular and persistent low energy intensity of Portugal, on the other hand, is very much related with specialization patterns. That does not mean that Portugal was a more energy efficient country, but only that they choose a different production function, well in pace with the Habakkuk/David/Allen models on factor costs. Imports were the solution for high-energy intensive goods.