



Analysis

The effect of globalisation on water consumption: A case study of the Spanish virtual water trade, 1849–1935



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ABSTRACT

This paper aims to analyse the impact on water consumption of trade expansion in the first era of globalisation. To that end, we have chosen the case of Spain, a semi-arid country with significant cyclical water shortages. More specifically, we are interested in answering the following questions. What volume of water was required for exports of agricultural and food products? How did this variable evolve over time? Which factors drove this evolution? In short, we wish to understand the impact on water resources of Spain's entry into world agriculture and food markets.

Firstly, we examine virtual water trade flows in the long run. Secondly, we attempt to disentangle certain major driving forces underlying these trajectories. In order to establish the role played by trade in the final net balance of water, a Decomposition Analysis (DA) is applied. Our findings show the great pressures that the first globalisation imposed on not only domestic but also foreign water resources. Trade volumes as well as trade patterns were essential factors driving rising virtual water flows, while yield improvements contributed smoothly to moderation in the expansion of water flows.

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1. Introduction

Those countries which experienced intensive economic growth during the Industrial Revolution profoundly modified their relationship to the environment. Such economies have, throughout the last two hundred years, caused serious damage to their natural environments, whether by modifying them extensively or by generating serious problems of pollution (Krausmann et al., 2008; McNeill, 2000; Stern, 2005; Stern and Kaufmann, 1996). Water ecosystems have been gravely affected by these long-term changes, the global water crisis being one of the challenges to be faced in the XXI century. Whereas the changing uses of energy and of raw materials have been closely studied from a long-term perspective (Iriarte and Ayuda, 2008, 2012; Krausmann et al., 2009), water, another key resource for human subsistence and economic development, has traditionally received less attention from environmental history.

The seminal work of Shiklomanov (1998) was one of the first to perform estimates of long-term global water use trajectories by sectors and world regions, demonstrating their massive growth and the predominance of the agricultural use of water. This growth was basically driven by population growth but also, and very significantly,

by rising per capita income (Duarte et al., 2013 and 2014). The consumption of water has increased principally as a consequence of the formidable growth of agricultural production, leading to not only the use of more land but also the need to undertake significant water projects for the extension of irrigation in arid or semi-arid regions (Federico, 2005). Next to population growth and rising domestic demand for food and other biomass products, trade has been a major driving force. In this field, new studies presenting concepts such as virtual water or the water footprint have appeared over the last decade. First conceived by Allan (1997, 1999), virtual water has been defined as the volume of water required for the production of a commodity (Hoekstra and Hung, 2005; Yang et al., 2007; Zimmer and Renault, 2003). Thus, virtual water trade is the volume of water embodied in products exchanged internationally. While water itself is not a significant commodity in international trade, exchanges of agricultural commodities are related to large volumes of upstream water use (Hoekstra et al., 2011; Mekonnen and Hoekstra, 2011, 2012). In fact, Hoekstra and Hung (2005) have shown that international virtual water flows related to trade in crops amounted to 695 billion cubic metres (Gm³), on average, in the period 1995–1999, equivalent to 13% of all the water used for crop production. Currently, many studies of water resources tend to distinguish between green and blue water, since although they are interrelated in the hydrological system they present different characteristics. Green water refers to the volume of rainwater (stored in soil as moisture) evaporating during a production process and blue water is the volume of surface or groundwater evaporating as a result of the production of a commodity (Hoekstra and Chapagain, 2008). Blue

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water can be reallocated to agricultural, industrial, or urban use; by contrast, green water cannot be easily reallocated (Yang et al., 2007). Accordingly, blue water has greater opportunity costs (Hoekstra, 2010). Green water is particularly important for agricultural and forestry products; it consists of total rainwater evapotranspiration plus the water incorporated into the harvested crop or wood (Hoekstra et al., 2011).

Using this general framework, our paper aims to study the roles that international trade expansion and the process of economic globalisation have played in increasing global pressures on water resources. This historical analysis is relevant to the wider context of ecological economics. In fact, as Schandl and Schulz (2002) have stated, “understanding how a certain natural relation has been established in the course of history and which patterns and feedbacks were at work might enable society to consciously intervene in these natural relations and might even eventually foster our understanding of sustainability”. Addressing virtual water flows from a long-term perspective allows us to qualitatively and quantitatively study shifts in water sustainability in a period of important institutional and structural changes regarding trade and irrigation infrastructure. The increasing integration of Spain into the first globalisation meant that foreign demand for agricultural products was one of the most important driving forces behind the development of irrigation, and therefore behind early displacements of environmental burdens, particularly of water. Furthermore, the first globalisation laid the foundations for a much more intensive process of economic growth and environmental damage which occurred during the second globalisation.

Against this background, our study examines agri-food virtual water trade flows over time, their composition and their underlying economic factors. The period chosen coincides with the first globalisation, which occurred between 1850 and 1929 and collapsed following the crash in 1929. From 1849 to 1935, the exchange of agricultural raw materials and food was of enormous importance in world trade (Lewis, 1952). Trade in agricultural products and food increased worldwide between 1850 and 1902 at an average annual rate of 3.7%, and between 1903 and 1938 at a much slower pace, 1.4%. This deceleration was mainly due to the impact of the First World War, the collapse of the first globalisation produced by the crisis of 1929 and the measures adopted by various countries in its wake (Aparicio et al., 2009: 54).

As a case study, we have chosen Spain, which was an important exporter of agricultural products in the period analysed. The period chosen is quite meaningful for Spain. It commences with Spanish integration into international markets, producing intensive growth in agricultural exports, taking advantage of demand from the more developed European countries. This period ended in 1936 with the beginning of the Spanish Civil War. Beginning in 1939, Franco's dictatorship meant approximately 20 years of isolation. The first and second globalisation periods must be studied separately since they differ, among other elements, in their scale and in the share of agriculture in GDP. During the period under analysis, the Spanish economy embarked upon the long-term process of industrialisation which was abruptly interrupted in 1936, continued during the early years of Franco's dictatorship and ended in the 1960s. The study of the Spanish case can offer important lessons for developing countries whose integration in international markets is growing.

For this country and period, we are interested in answering the following questions. What volume of water was embodied in agricultural and food exports and imports? How did this variable evolve over time? What factors lay behind such evolution? Was virtual water trade a driving force for overall water consumption in Spain?

We relate the data to their historical context and establish the role played by trade composition, the increasing volume of trade, and water intensities in the final net balance of water. So far, no other study has analysed virtual water trade flows from a long-term perspective.

The article is organised as follows. Section 2 provides a stylised view of the evolution of Spanish foreign trade in agricultural products during the first wave of globalisation and the early years of its collapse. Section 3 reviews the methodology and the data used. Section 4

presents the main results of our analysis and is divided into two subsections: Section 4.1 focuses on the principal trends and composition of virtual water trade flows, while Section 4.2 performs a decomposition analysis of virtual water exports and imports. Finally, Section 5 closes the paper with a discussion of the results and our conclusions.

2. Spain's Position in the International Markets for Agricultural Products: Some Stylised Facts

From the middle of the XIX century onwards, the institutional changes promoted by Liberal governments were complete, making the development of a market economy possible. The deregulation of trade from 1869 onwards and the growth in agricultural exports, taking advantage of demand from the more developed European countries, increased the degree of integration of Spain into international markets.

Between 1850 and 1935, food and other agricultural products accounted for between 60% and 75% of total Spanish exports (measured in constant prices of 1910), and only the boom in mining exports, which took place between 1890 and 1920, caused this percentage to fall to approximately 50%.

Between 1850 and 1891, Spanish agricultural exports were concentrated on Mediterranean products, in which it had a clear competitive advantage. The growing demand for wine imports in France, as a result of the phylloxera plague that devastated French vineyards, provided an authentic export boom for Spain. Between 1870 and 1890, wine represented 53% of Spanish agricultural exports (measured in constant prices of 1910); when nuts and olive oil were added, this sector's share of total exports reached two thirds (Pinilla, 1995). The growth of exports was rapid between 1850 and 1890, as agricultural and food exports by volume increased at an average annual rate of 3.2%, thereby increasing by over 300% in four decades (Gallego and Pinilla, 1996: 396). These products were principally cultivated on rain-fed land, although they were also partly cultivated on irrigated land, creating a moderate pressure on the need for water for agricultural uses. These crops were very well adapted to their natural and climate conditions (land, hours of sunshine, temperature) whenever water was available. In the final decade of the XIX century, the expansion of traditional exports (wine and olive oil) was sharply halted. In the case of the most important product, table wine, the ending in 1891 of the wine trade agreement with France, and the French choice to import wine from Algeria, which had a more favourable tariff treatment, ended the golden age of Spanish wine exports (Pinilla and Ayuda, 2002). Alternative markets did not compensate for the loss of that of France, while further restrictions were due to lower levels of wine consumption, protectionist policies in Argentina and Uruguay, and Prohibition in the USA (Pinilla and Ayuda, 2008; Pinilla and Serrano, 2008). Exports of olive oil also encountered serious difficulties, due to the employment of other, cheaper oils for industrial use, and to the low level of consumption in non-Mediterranean countries (Ramón, 2000).

Consequently, the rate of growth of exports fell markedly and from 1890 to 1930 grew at an average annual rate of only 1.3%. The most important factor from the end of the XIX century onwards was the growth of Mediterranean horticultural products as the principal items in Spanish agricultural exports. Before 1890, these constituted no more than 15% of exports (measured in constant prices of 1910), but then became the most important element. At the turn of the century they represented 25% of Spanish agricultural exports (measured in constant prices of 1910), and by 1930 accounted for approximately 50%. The volume of exports of fresh fruit, the most important in this group, was 63 times greater in the 1930s than it had been in the 1850s (Pinilla and Ayuda, 2010). Between 1900 and 1935, Spain accounted for over one third of the world exports of Mediterranean horticultural products (Pinilla and Ayuda, 2009). For oranges alone, the share of Spain ranged between 50 and 60% of world exports (measured in constant prices of 1910).

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