

Bajo-Rubio, Oscar

**Working Paper**

## Exports and long-run growth: The case of Spain, 1850-2017

GLO Discussion Paper, No. 461

**Provided in Cooperation with:**  
Global Labor Organization (GLO)

Suggested Citation: Bajo-Rubio, Oscar (2020) : Exports and long-run growth: The case of Spain, 1850-2017, GLO Discussion Paper, No. 461, Global Labor Organization (GLO), Essen

This Version is available at:  
<http://hdl.handle.net/10419/213431>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Exports and long-run growth: The case of Spain, 1850-2017\*

Oscar Bajo-Rubio  
(Universidad de Castilla-La Mancha)

## Abstract

We analyse in this paper the relationship between international trade and economic growth from the point of view of one of the most traditional hypotheses within this field, namely, the export-led growth hypothesis, for the case of Spain in a long-term perspective of almost 170 years. Exports seem to have played a positive, though modest, role in promoting economic growth in the Spanish economy over the whole period, mostly due to the higher productivity associated with the export sector. The contribution of exports to growth, however, seems to have been stronger in the final years of the 19th century, unlike the rest of the period, where it proved to be very small.

**Keywords:** Exports, Economic growth, Spanish economy

**JEL classification:** F41, F43, N10, O47

---

\* The author acknowledges financial support from the Spanish Ministry of Economy, Industry and Competitiveness through the project ECO2016-78422-R; and from the University of Castilla-La Mancha through the project 2019-GRIN-26952, co-financed by the European Union via the European Regional Development Fund.

## 1. Introduction

There is a large stream of literature that analyses the role of foreign trade and, in general, a higher degree of openness, as a driver of economic growth. For instance, there are a number of papers that have used cointegration analysis and Granger-causality tests between exports and GDP growth, obtaining mixed results; a non-exhaustive list would include Afxentiou and Serletis (1991), Kugler (1991), Marin (1992), Oxley (1993), Thornton (1996), Kónya (2006), Bajo-Rubio and Díaz-Roldán (2012) or Pistori and Rinaldi (2012), among many others. On the other hand, the development of endogenous growth theories has provided this line of research with some more solid theoretical foundations. In particular, more open countries have been assumed to have a greater ability to absorb new ideas or technological advances generated in the rest of the world, which would result in higher rates of growth. Some contributions along these lines include, e.g., Dollar (1992), Ben-David (1993), Sachs and Warner (1995), Edwards (1998), Frankel and Romer (1999), Noguer and Siscart (2005) or Wacziarg and Welch (2008). However, from a theoretical point of view, things are not so clear-cut. While it is true that integration would ease the transmission of knowledge across countries and avoid duplicating research, if a country had a comparative disadvantage in research-intensive sectors, higher integration might lead this country to a greater specialisation in low skilled-intensive sectors, resulting eventually in lower growth by deviating resources from research-intensive sectors (Grossman and Helpman, 1991).

On the other hand, and within the field of economic history, a long-standing debate has developed around the so called “tariff-growth paradox”. Starting from Bairoch (1972), who found a positive correlation between tariff protection and economic growth for several European countries over the period 1860-1913, some new evidence along these lines was obtained, e.g., by O'Rourke (2000) or Jacks (2006). However, although robust for the period before the First World War, the basic result does not seem to hold in more recent years, as shown by Vamvakidis (2002) or Clemens and Williamson (2004), and it has been also qualified in some more recent contributions. For instance, protection was found to be associated with higher growth in rich countries, but not in poor countries (which tend to give higher protection to low-skill-intensive sectors), in Tena-Junguito (2010); or, according to Lehmann and O'Rourke (2011), industrial tariffs, unlike agricultural tariffs, are those that would be positively correlated with growth.

This broad literature, stemming from both the economic growth tradition and economic history, has been surveyed, e.g., in Edwards (1992,1993), Bajo-Rubio (1998), Andersen and Babula (2009) or Singh (2010); and, with a longer term perspective, in Meissner (2014) or Lampe and Sharp (2016).

In last years, though, the unambiguously beneficial character of trade liberalisation has been nuanced. So, in Driskill's (2012) words, the standard argument in favour of free trade “is incoherent or makes implicit value judgements in as much as the argument simply says free trade is good for the nation because it creates a bigger pie, even though some members of the nation end up with less pie” (Driskill, 2012, p. 3). Certainly, the standard argument admits that some groups may win and some may lose under freer trade, although the general principle is still valid as far as the winners can compensate the losers. However, as trade liberalisation advances, redistributive effects get larger and tend to offset the gains from trade, at the same time that governments have lower incentives to compensate to those harmed by liberalisation, once this is underway (Rodrik, 2018).

In general, the evidence in favour of the hypothesis that lower barriers to international trade result in faster growth is somewhat mixed. Take, for instance, the detailed study of Lampe and Sharp (2013), who related per capita income and protection, measured by the ratio of tariff revenue to imports, for 24 countries over the years 1865-1913 and 1913-2000, using

cointegrated VAR models. Cointegration was not found in a substantial number of cases; and, when found, the relationship between the two variables was mostly negative for both periods. However, in the second part of the sample, Granger-causality ran from income to tariffs, i.e., countries would have liberalised trade as they got richer. In a similar vein, Federico, Sharp and Tena-Junguito (2017) have estimated, following the same methodology, cointegration relationships between per capita GDP and openness, measured by the ratio of exports to GDP, for 30 countries over the period 1830-2007. Again, cointegration was obtained in about half of the cases, but now the relationship between the two variables was both positively and negatively signed. Finally, they suggest that a positive relationship between openness and GDP seems more likely for poor countries.

Summing up, the relationship between external openness and economic growth seems to be far from unambiguous, as shown in the influential paper of Rodríguez and Rodrik (2001), and would depend on “whether the forces of comparative advantage push the economy’s resources in the direction of activities that generate long-run growth (via externalities in research and development, expanding product variety, upgrading product quality, and so on) or divert them from such activities” (Rodríguez and Rodrik, 2001, p. 269). In other words, the relationship between openness and growth would be rather a contingent one, relying on a number of particular characteristics, both country-specific and external; see Rodríguez and Rodrik (2001). And, among these particular characteristics, the role of institutional quality would be crucial (Crafts, 2004).

Thus, given the not always clear-cut nature of the relationship between external openness and growth, both theoretically and empirically, as well as the great heterogeneity of country experiences, it seems that a more promising empirical approach should be focusing on specific countries. This will be our approach in this paper, where we will perform an analysis of the case of Spain. In this regard, the Spanish economy can provide a relevant case study, given the steady process of growth she has experienced after the start of industrialisation in the first years of the 19th century. However, being a country with rather poor endowments of natural resources, and traditionally characterised by a relative backwardness as regards her neighbouring countries, the role that the external sector might have played in the long-term evolution of the Spanish economy appears to be of a particular interest.

The aim of this paper will be to analyse the relationship between international trade and economic growth from the point of view of one of the most traditional hypotheses within this field, namely, the export-led growth hypothesis, for the case of Spain in a long-term perspective. In particular, we will make use of a very long sample of almost 170 years, thanks to the recent availability of national accounts’ series over the period 1850-2015 due to Prados de la Escosura (2017), updated to 2017 by the author.

This paper tries to contribute to the literature by presenting a comprehensive and systematic analysis of the export-led growth hypothesis for a particular country, which means a more suitable approach to the issue, in a long-term perspective of almost 170 years. In addition, we carry out several formal tests of structural change in order to check whether the estimated relationship has changed over such a long period. Finally, for the sake of completeness, and since this is the approach followed in most of the available literature on the subject, the analysis is complemented by performing Granger-causality tests.

The rest of the paper is organised as follows: a brief account of the relationship between international trade and growth in the Spanish economy, together with a review of the available literature, is presented in Section 2; the theoretical framework in which the empirical analysis is

based, is developed in Section 3; the data and main empirical results are discussed in Section 4; and the main conclusions are summarised in Section 5.

## **2. International trade and economic growth in Spain, 1850-2017**

As mentioned in the introduction, the Spanish economy has shown a continuous and remarkable process of growth since the first steps of industrialisation at the start of the 19th century. This process, however, has experienced ups and downs over the last two centuries so that, though following a rather similar evolution to that of the rest of Western Europe, the GDP per capita of Spain at the end of the 20th century was still around three quarters of Western Europe's, roughly the same as one hundred years before (Prados de la Escosura, 2007). In any case, over the period 1850-2015 real GDP grew at an average cumulative rate of 2.4 percent per year; in per capita terms, the average rate of growth was 1.7 percent per year over the same period (Prados de la Escosura, 2017).

There has been a debate among economic historians about the reasons of the relative backwardness of Spain as regards the rest of Western Europe. For instance, the insufficient development of agriculture, unable to provide a large enough market for industrial production, has been largely emphasised; see, e.g., Nadal (1975). On the other hand, some authors have analysed in more depth the role of the foreign sector; see, e.g., Prados de la Escosura (1988), who stressed the importance of the external sector as a crucial modernising factor in the evolution of the Spanish economy, despite its small relative size. From this standpoint, and after losing most of her colonial empire at the start of the 19th century, the previous exports to the colonies and re-exports of colonial products to Europe were drastically reduced, so Spanish exports had to be redirected to the European markets, which led in turn to a great trade deficit. As a result, the Spanish foreign trade grew during the second half of the 19th century faster than in France or Britain (Tortella, 2000). Things seemed to change in the 1890s, however, following the implementation of a more protectionist policy stance, which led to the degree of openness, which had increased steadily since 1850, to decrease after 1895. Such a trend was reinforced after the Spanish Civil War, with external openness reaching a minimum in the 1940s. Only in the 1950s trade flows began to experience higher growth rates, especially after the 1970s, and even more once Spain joined the now European Union (EU) in 1986, when the Spanish economy can be considered as having definitely adopted an institutional framework comparable to that of the rest of her new partners. A thorough examination of the main developments of the Spanish foreign sector in the last two centuries can be found in Tortella (2000). Indeed, a pervasive empirical regularity is that the highest growth periods were those characterised by a greater external openness (as in, e.g., the 1960s, or the years after 1986), unlike those periods where a greater isolation against the rest of the world prevailed (such as the years 1890-1913, or 1930-1950), in which the Spanish economy fell behind in relative terms (Prados de la Escosura, 2007).

The available evidence on the subject for the Spanish case, on the other hand, is relatively scarce, in particular over the long run. We can first quote a paper by Pardos (2001), who analysed causality relationships between exports, imports and national income for the periods 1870-1935, 1940-1959 and 1964-1995, and found Granger-causality from exports to national income just in the second and third subperiods. Similar results, i.e., Granger-causality from exports to national income from 1959 on but not before, was obtained by Balaguer and Cantavella-Jordá (2001) in a study for the period 1901-1999. The role of export composition was examined in Balaguer and Cantavella-Jordá (2004) over the period 1910-2000, obtaining Granger-causality to GDP only after 1961, and from exports of food and agricultural products, and consumption goods; unlike the exports of energy products, capital goods and semi-manufactures, for which no significant relationship was found. Later on, for the period 1900-

2012, Balaguer, Florica and Ripollés (2015) again detected Granger-causality from exports (as well as energy imports) to GDP only after 1959.

A related issue refers to the possibility that foreign trade, and in general the balance of payments, might act as a constraint on the rate of growth of the economy, on putting a limit on the growth in the level of demand to which supply can adapt. Specifically, a higher domestic output, on increasing imports, could lead to an external deficit, which might require either a fall in demand or an exchange rate depreciation in order to assure the sustainability of the deficit. This question was examined in Bajo-Rubio (2012) for the period 1850-2000, through an estimation of the so-called balance of payments-constrained rate of growth (Thirlwall, 1979). The results obtained showed that the external deficit did not seem to have restrained growth over the long run, unless some shorter and specific subperiods, such as 1940-1959 and 1959-1974. In addition, the external balance was found to be sustainable over the long run, from the estimation of a long-run relationship between exports and imports of goods and services as ratios to GDP. Finally, we will mention the recent paper of Bajo-Rubio and Esteve (2019), where the possible optimality of the path followed by the current account balance of the Spanish economy over the period 1850-2016 was examined, according to the intertemporal approach to the current account and using a present-value model. Overall, the evidence was not particularly supportive of the model suggesting that, in periods of greater external openness, rather than being used to smooth consumption in the presence of shocks, current account deficits were financed by entries of foreign capital that contributed to foster growth.

### 3. Theoretical framework

Our theoretical framework will be based on the so-called export-led growth hypothesis, formally derived by Feder (1983) from previous intuitive ideas mostly aimed to empirical purposes. This author developed a model made up of two sectors: one producing export goods, and the other producing for the domestic market. Feder made two crucial assumptions: (i) the exportable sector yields positive externalities on the domestically-oriented sector (through the development of more efficient management techniques, the introduction of improved production technologies, the training of more skilled labour, and the like); and (ii) marginal factor productivities are higher in the exportable sector.

The model can be written as follows. Denote by  $Y$ ,  $N$ , and  $X$  aggregate output, non-exports, and exports, respectively. We assume that output in both sectors is produced using capital,  $K$ , and labour,  $L$ :

$$Y = N + X \quad (1)$$

$$N = F(K^N, L^N, X) \quad (2)$$

$$X = G(K^X, L^X) \quad (3)$$

Denoting partial derivatives by subscripts, the first assumption (i.e., the positive externality of exports on non-exports) would be given by  $F_X > 0$ . On the other hand, the second assumption (i.e., the productivity differential across sectors) would be represented by the following equation:

$$\frac{G_K}{F_K} = \frac{G_L}{F_L} = 1 + \delta \quad (4)$$

where  $\delta > 0$  measures the extent of the productivity differential in favour of exports.

Equations (1)-(4) make up the basic model. Differentiating (2) and (3) with respect to time and taking (4) into account, so that:

$$G_K \dot{K}^X + G_L \dot{L}^X = (1 + \delta)(F_K \dot{K}^X + F_L \dot{L}^X) = \dot{X}$$

replacing into the time derivative of (1), dividing by  $Y$  and rearranging, we obtain the following expression for the rate of growth of aggregate output:

$$\frac{\dot{Y}}{Y} = \alpha \frac{I}{Y} + \beta \frac{\dot{L}}{L} + \left( \frac{\delta}{1 + \delta} + F_X \right) \left( \frac{X \dot{X}}{Y \dot{X}} \right) \quad (5)$$

where dotted variables denote time derivatives. In this equation,  $I \equiv \dot{K} = \dot{K}^N + \dot{K}^X$  and  $\dot{L} = \dot{L}^N + \dot{L}^X$ , where  $I$ ,  $K$  and  $L$  denote total gross investment, capital and labour, respectively; and, following Feder, it is assumed that  $\alpha = F_K$  and  $\beta = F_L(L/Y)$ , where both  $\alpha$  and  $\beta$  are constants.

Equation (5) represents the basic formulation of the model. Notice that, in absence of the productivity differential ( $\delta = 0$ ) and of the externality related to exports ( $F_X = 0$ ), the last term disappears and (5) reverts to a standard neoclassical growth equation. It follows from this equation that the rate of growth of output is given by the contributions of factor accumulation (i.e., growth of capital and labour), plus the gains derived from a reallocation of resources into the (high productivity) exportable sector, and out of the (low productivity) domestically-oriented sector.

On the other hand, Feder assumes that exports affect the production of non-exports with a constant elasticity  $\theta$ . Replacing this assumption in equation (2) above we have:

$$N = X^\theta \psi(K^N, L^N) \quad (2')$$

so that, being  $F_X = \theta \left( \frac{Y}{X} - 1 \right)$ , we can disentangle the productivity and externality effects by estimating the following equation:

$$\frac{\dot{Y}}{Y} = \alpha \frac{I}{Y} + \beta \frac{\dot{L}}{L} + \left( \frac{\delta}{1 + \delta} - \theta \right) \left( \frac{X \dot{X}}{Y \dot{X}} \right) + \theta \frac{\dot{X}}{X} \quad (5')$$

The traditional export-led growth model has been restated in terms of the theory of endogenous growth by Ahumada and Sanguinetti (1995). In a model for an open economy with three sectors: exportable, importable, and non-tradable, the authors found that exports are the “engine” of economic growth. Specifically, the exportable sector sustains the continuing increase in per capita output by means of two channels: (i) the exportable sector yields positive externalities on the rest of the economy (as in Feder); and (ii) both human and physical capital in the exportable sector are not subject to diminishing returns.

Feder’s approach has been subject to some criticisms, yet. Bacha (1984) questions the existence of a linear relationship between export ratios and GDP growth rates since, he argues, for very high export ratios domestic investment will be crowded out by additional exports and hence a lower output growth rate will result, due to the internal savings constraint; see also Ocampo (1986) for a similar claim. Following this line of reasoning, Kohli and Singh (1989) introduce in Feder’s model the notion of “diminishing returns” with respect to the impact of the export sector, by allowing for a quadratic term in equation (5) above:

$$\frac{\dot{Y}}{Y} = \alpha \frac{I}{Y} + \beta \frac{\dot{L}}{L} + \left( \frac{\delta}{1 + \delta} + F_X \right) \left( \frac{X \dot{X}}{Y \dot{X}} \right) + \mu \left( \frac{X \dot{X}}{Y \dot{X}} \right)^2 \quad (5'')$$

with  $\mu < 0$ . Accordingly, this specification implies diminishing returns to the effects of exports on GDP growth, since  $\frac{\partial^2(\dot{Y}/Y)}{\partial(X/Y)^2} = 2\mu \left( \frac{\dot{X}}{X} \right)^2 < 0$  and  $\frac{\partial^2(\dot{Y}/Y)}{\partial(\dot{X}/X)^2} = 2\mu \left( \frac{X}{Y} \right)^2 < 0$ .

Finally, we will also mention the influential contribution of Jung and Marshall (1985), who raise the possibility that the causality between exports and growth might run the other way round, i.e. from output to exports. Take the case of a growing economy, where growth is mostly concentrated in a few sectors. Then, if domestic demand does not grow as much as the production of these dynamic sectors, producers are likely to turn to foreign markets to sell their goods. Therefore, in this case causality would run from output to exports.

In the next section, we will provide some tests of the export-led growth hypothesis for the case of Spain over the period 1850-2017, by estimating Feder's equation as well as Kohli and Singh's formulation. In addition, we will also perform Granger-causality tests to address Jung and Marshall's criticism.

#### 4. Data and empirical results

As mentioned before, our data source is the new set of historical national accounts for the period 1850-2017 of Prados de la Escosura (2017). In particular, we have used the data on GDP ( $Y$ ), exports ( $X$ ) and gross fixed capital formation ( $I$ ), in million €, from Table 1; whereas the amount of labour ( $L$ ) has been proxied alternatively by employment (full-time equivalent) and hours worked, both measured in million, from Table 16 and Table 20, respectively. In turn, the variables  $Y$  and  $X$  were converted into real terms, in order to compute their rates of growth, using the deflator of GDP (2010=100), taken from Table 7. All tables refer to the Electronic Appendix of Prados de la Escosura (2017), which can be accessed at <http://espacioinvestiga.org/bbdd-chne/?lang=en>.

To begin with, we have tested for the order of integration of the variables appearing in the model, by means of the tests proposed by Ng and Perron (2001). These tests are a modified version of the Phillips-Perron tests, designed to improve them with regard to both size distortions and power. The results are shown in Table 1, where  $L1$  and  $L2$  denote employment and hours worked, respectively. As can be seen, the null hypothesis of a unit root is rejected for all the variables, so they will be taken as stationary (in the case of  $\frac{I}{Y}$  around a linear trend).

[Table 1 here]

We present in Table 2 the results of the estimations of equations (5), (5') and (5'') above, for the two alternative proxies of the labour force, namely, employment and hours worked, shown in every first and second column for each equation, respectively. The estimation method is OLS, using the correction of standard errors for heteroscedasticity and autocorrelation proposed by Newey and West (1987). In addition, we include in the table, together with the coefficient of determination and the standard error of the regression, several validation tests: for serial correlation (the Breusch-Godfrey LM test, B-G, of 1st and 4th order), heteroscedasticity (the Breusch-Pagan LM test, B-P), and autoregressive conditional heteroscedasticity (the Engle test, ARCH, of 1st and 4th order), none of which show any sign of misspecification in the estimated model.

[Table 2 here]

Notice, first, that the results for the two proxies of the labour force are very similar. Beginning with the estimation of equation (5), both the ratio of investment to output and the rate of growth of labour appear with positive coefficients, significant at the conventional levels; however, the coefficient on the multiplicative variable  $\left(\frac{X}{Y} \frac{\dot{X}}{X}\right)$ , although positive, is only significant at the 13% level in both cases. When the rate of growth of exports is added as an additional regressor in equation (5'), the coefficient on the latter is positive and significant, at the same time that the coefficient on the multiplicative variable, although now more clearly significant, turns to be negative, but with a very small value. Finally, if the original equation is augmented to include the squared value of the multiplicative variable in equation (5''), its estimated coefficient is negative and significant, so supporting Kohli and Singh's (1989) hypothesis of "diminishing returns" of exports on growth.



In the next step, we compute the contributions of investment, labour growth and exports, to output growth over the period 1850-2017. Such contributions, shown in Table 3, have been obtained from the coefficient estimates of equation (5') in Table 2 and the mean values of the explanatory variables. In particular, the contributions of investment and the growth of the labour force are given by  $\alpha \frac{I}{Y}$  and  $\beta \frac{\dot{L}}{L}$ , respectively; whereas, following Feder (1983), the contribution of exports is split into two parts, namely, those due to (i) the beneficial externalities affecting the non-export sector, and (ii) other factors leading to a higher productivity in the export sector, given by  $\theta \left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$  and  $\left(\frac{\delta}{1+\delta}\right) \left(\frac{X}{Y} \frac{\dot{X}}{X}\right)$ , respectively.

[Table 3 here]

As can be seen, our estimated equations explain between 2.28 and 2.24 per cent (i.e., almost 90 per cent) of the actual average 2.55 per cent of GDP growth over our sample period. The most important source of growth would be capital investment followed by labour force growth, which explain 1.64 and 0.49 per cent of the average GDP growth (i.e., 64 and 19 per cent of total) when labour is measured by employment; and 1.86 and 0.23 per cent of the average GDP growth (i.e., 73 and 9 per cent of total) when labour is measured by hours worked. In turn, exports would explain in both cases around 0.15 per cent of the actual average GDP growth of 2.55 per cent (i.e., 6 per cent of total). This positive, albeit small, contribution of exports would be the result of a positive effect due to the higher productivity in the export sector, and a negative (rather than positive, as assumed by the model) effect from externalities on the non-export sector. Such negative externalities could be explained from the fact that the development of the export sector might have resulted in a diversion of resources from the non-export sector, leading to lower growth.

However, since we are dealing with a very long time period (i.e., 168 years), an analysis of the overall evolution over the long run might hide a differentiated behaviour across subperiods. To this end, we have performed a formal test of structural change to the equations estimated in Table 2. In particular, we have applied the tests of Bai and Perron (1998, 2003a), who proposed a sequential procedure method to detect endogenously multiple unknown breaks, as well as several test statistics in order to identify the possible break points, namely:

- (i) the *UD*max and *WD*max tests of the null hypothesis of no structural break versus the alternative of an unknown number of breaks given some upper bound,
- (ii) an *F*-type test of the null hypothesis of no structural break versus the alternative of a fixed (arbitrary) number of breaks, and
- (iii) a sequential *F*-type test of the null hypothesis of *l* breaks versus the alternative of *l* + 1 breaks.

When implementing these tests, we have allowed up to three breaks with a trimming percentage of 20%, so that each regime is restricted to have at least 33 observations; and let error distributions to differ across regimes.

The results of the Bai and Perron tests appear in Table 4, where we show the *UD*max and *WD*max tests, and the *F* statistics scaled by the number of varying regressors (all of them, in our case) for the other tests. Since the *UD*max and *WD*max tests are significant, at least one break is present. The scaled *F*(1), *F*(2) and *F*(3) tests are also significant at the 5% level, which means that there is at least one break. Finally, when labour is measured using employment figures, and for equation (5') when measured using hours worked, the scaled *F*(1|0) test is significant but *F*(2|1) is not, so the sequential procedure method selects one break, estimated at 1896. In turn, for equations (5) and (5'') when labour is measured using hours worked, both

the scaled  $F(1|0)$  and  $F(2|1)$  tests are significant unlike  $F(3|2)$ , so in these cases two breaks would be detected, estimated at 1896 and 1981.

[Table 4 here]

The break at 1896 can be justified in the context of the rising trend in protectionism that occurred in the final years of the 19th century, both in Spain and in most European countries. In particular, in the case of Spain a new and extremely protectionist tariff was approved in December 1891, which largely favoured the industrial sector; see Tena-Junguito (2006) for a discussion of protectionist policies in Spain in the final years of the 19th and the start of the 20th century. Indeed, such a rise in protection fell within a “nationalistic” policy stance implemented by the Spanish authorities in that time, addressed to preserve domestic markets to domestic producers through the intervention of the government in support of particular pressure groups. In turn, the break at 1981 seems to be somewhat more difficult to identify, although it can be related to the weak economic performance of the Spanish economy over the first 1980s, following the second oil shock. For that reason, and since we are particularly interested in equation (5'), which allows us to compute the contributions to output growth from the different explanatory variables, we are going next to re-estimate the model, both before and after 1896.

Accordingly, we have re-estimated equations (5), (5') and (5'') for the two subperiods 1850-1895 and 1896-2017. As can be seen in Table 5, for the first subperiod the only significant coefficients are those on the multiplicative variable  $\left(\frac{X}{Y} \frac{\dot{X}}{\dot{Y}}\right)$  and on the rate of growth of exports in equation (5'), even though with the opposite sign as compared to the whole period. In turn, the results for the second subperiod are rather similar to those for the whole period, especially for equation (5'). Again, the validation tests do not show any sign of misspecification in the estimated equations.

[Table 5 here]

Next, we proceed to compute the contributions to output growth from the explanatory variables using the coefficient estimates of equation (5') for the two subperiods, as shown in Table 6. The results for 1850-1895 should be taken with high doses of scepticism, since the coefficients on investment and labour growth are not statistically significant: equation (5') would explain around twice the actual output growth, with a more important role of exports than for the whole period, i.e., around 0.7 per cent of the actual average 1.48 per cent of GDP growth over the subperiod; even though the sign of the two channels would be now reverted, i.e., negative for productivity and positive for externalities. Finally, equation (5') would explain between 80 and 75% of the average output growth over the subperiod 1896-2017 (i.e., 2.54 and 2.44 per cent in each specification, of the actual average 3.23 per cent), with all the estimated coefficients being statistically significant in Table 5. As in the whole period, the highest contribution is that of investment, followed by labour growth: 1.95 and 0.54, and 2.18 and 0.21 per cent, of the actual average GDP growth of 3.23 per cent, when labour is measured by employment and hours worked, respectively, i.e., slightly less in percentual terms than for the whole period. However, the contribution of exports is now virtually nil: 0.05 per cent of the actual average GDP growth of 3.23 per cent; again, the signs of the externalities and productivity channels are negative and positive, respectively, with the latter slightly greater than the former.

[Table 6 here]

The above results can be confirmed from a different angle, by computing the recursive estimates of the coefficients on the effect of exports through externalities and productivity, i.e.,

$\theta$  and  $\left(\frac{\delta}{1+\delta}\right)$ , respectively, from the estimation of equation (5'). Recall that equation (5') can be rewritten as:

$$\frac{\dot{Y}}{Y} = \alpha \frac{I}{Y} + \beta \frac{\dot{L}}{L} + \left(\frac{\delta}{1+\delta}\right) \left(\frac{X \dot{X}}{Y X}\right) + \theta \left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$$

The results, together with  $\pm 2$  standard errors, are shown in Figure 1, and display a similar pattern for both coefficients, independently of the proxy used for the labour force. They start from negative values, and show an uneven profile, until the final years of the 19th century; to turn positive at a low level, and mostly stable over the rest of the sample. This would agree with the results of the Bai-Perron test for structural change, supporting the different role played by exports in the two parts of the sample.

[Figure 1 here]

To conclude, we have performed Granger-causality tests (Granger, 1969) on the variables growth of GDP and growth of exports, following the suggestion of Jung and Marshall (1985). Up to ten lags of the two variables were tried, and the best results were obtained with four lags. According to the results in Part A of Table 7, it is possible to reject the null hypothesis of no Granger-causality from export growth to GDP growth for the whole period at the 9% level, but not the other way round. Such result would roughly agree with that found in the econometric estimation of the model (see Tables 2 and 3), of a positive but weak effect of export growth on GDP growth. In turn, when performing the tests over the two subperiods 1850-1895 and 1896-2017, the null hypothesis of no Granger-causality from export growth to GDP growth is only rejected in the second subperiod, at the 5% level. On the other hand, no evidence of Granger-causality from GDP growth to export growth was found in any case. Finally, we have also analysed the possible Granger-causality between, on the one hand, GDP growth, and, on the other hand, the two components of export growth, namely,  $\left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$  and  $\left(\frac{X \dot{X}}{Y X}\right)$ , which proxy the externalities and productivity channels, respectively. As can be seen in Part B of Table 7, now the null of no Granger-causality was not rejected in all cases.

[Table 7 here]

## 5. Conclusions

In this paper, we have analysed the relationship between international trade and economic growth from the point of view of one of the most traditional hypotheses within this field, namely, the export-led growth hypothesis, for the case of Spain over the period 1850-2017. Given the not always clear-cut nature of the relationship between external openness and growth and the great heterogeneity of country experiences (see, e.g., Rodríguez and Rodrik, 2001), focusing on particular case studies for specific countries seems to be a more promising approach.

First, we estimated growth equations including the role of exports as an additional explanatory variable together with capital investment and labour growth. The estimated equations explained between 2.28 and 2.24 per cent (i.e., almost 90 per cent) of the actual average 2.55 per cent of GDP growth over our sample period. The most important source of growth was capital investment followed by labour force growth, whereas exports had a positive though small contribution of 0.15 per cent of the actual average GDP growth of 2.55 (i.e., 6 per cent of total). This positive, albeit small, contribution of exports was the result of a positive effect due to the higher productivity in the export sector, and a negative (rather than positive, as

assumed by the model) effect from externalities on the non-export sector. In addition, some evidence of diminishing returns of the impact of exports on growth was also found.

Next, and given the length of the sample period, we performed a formal test of structural change to the previously estimated equations, in order to check whether the results were homogeneous over the whole sample. Specifically, we applied the tests of Bai and Perron, aimed to detect endogenously multiple unknown breaks. After detecting a break at the year 1896, which could be justified in the context of the rise in protectionism and economic nationalism taking place in the final years of the 19th century, we re-estimated our growth equations for the two subperiods 1850-1895 and 1896-2017. The estimation results for the subperiod 1850-1895 were not good, with the coefficients on investment and labour growth being not statistically significant; if anything, the contribution of exports was higher than for the whole period: around 0.7 per cent of the actual average 1.48 per cent of GDP growth over the subperiod. In turn, the results for the subperiod 1896-2017 were rather similar to those for the whole period, even though the contribution of exports was now much lower: just 0.05 per cent of the actual average GDP growth of 3.23 per cent. This pattern of results was confirmed by computing the recursive estimates of the coefficients on the effect of exports through externalities and productivity, showing the different role played by exports in the two parts of the sample. Finally, some evidence of Granger-causality was found only from export growth to GDP growth, both for the whole period and the subperiod 1896-2017.

Summarising, exports seem to have played a positive, though modest, role in promoting economic growth in the Spanish economy over the period 1850-2017, mostly due to the higher productivity associated with the export sector. The contribution of exports to growth, however, seems to have been stronger in the final years of the 19th century, unlike the rest of the period, where it proved to be very small. These results would suggest that the role of exports was more important in the first stages of capitalist development, but not so much when the latter is underway. Notice that this hypothesis would be also supported by the evidence found on diminishing returns of the impact of exports on growth. Overall, the results of this paper would agree with the claim of Prados de la Escosura and Sánchez-Alonso (2019, p. 20) that “trade emerges not as the hegemonic element in the country’s economic modernization, but rather as a small but indispensable stimulus of development”.

To conclude, it should be stressed that we have focused in this paper just on the role of international trade, and more specifically exports, on economic growth. However, we did not consider several other aspects related to the foreign sector and, in general, external openness, which can also influence the growth pattern of a country. For instance, in a previous paper (Bajo-Rubio, 2012) we found that the external deficit did not seem to have restrained growth over the long run, other than some specific periods; and that, since the periods of higher growth had come together with current account deficits, the current account balance had been sustainable over the long run. In addition, the foreign capital inflows used to finance those current account deficits would have meant a significant contribution to higher growth, on complementing domestic savings and allowing the essential imports of capital goods and raw materials above the amount allowed by export revenues. The contribution from capital inflows from abroad has been particularly relevant in some periods, such as the second half of the 19th century (Prados de la Escosura, 2019), or the years following the integration of the Spanish economy into what is today known as the EU in 1986 (Bajo-Rubio and Torres, 1992).

## References

- Afxentiou, P. C. and Serletis, A. (1991): "Exports and GNP causality in the industrial countries: 1950-1985", *Kyklos* 44, 167-179.
- Ahumada, H. and Sanguinetti, P. (1995): "The export-led growth hypothesis revisited: Theory and evidence", *Estudios de Economía* 22, 327-355.
- Andersen, L. and Babula, R. (2009): "The link between openness and long-run economic growth", *Journal of International Commerce and Economics* 2, 31-50.
- Bacha, E. (1984): "Growth with limited supplies of foreign exchange: A reappraisal of the two-gap model", in Syrquin, M., Taylor, L. and Westphal, L. E. (eds.): *Economic structure and performance: Essays in honor of Hollis B. Chenery*, Academic Press, Orlando, FL, 263-280.
- Bai, J. and Perron, P. (1998): "Estimating and testing linear models with multiple structural changes", *Econometrica* 66, 47-78.
- Bai, J. and Perron, P. (2003a): "Computation and analysis of multiple structural change models", *Journal of Applied Econometrics* 18, 1-22.
- Bai, J. and Perron, P. (2003b): "Critical values for multiple structural change tests", *Econometrics Journal* 6, 72-78.
- Bairoch, P. (1972): "Free trade and European economic development in the 19th century", *European Economic Review* 3, 211-245.
- Bajo-Rubio, O. (1998): "Integración regional, crecimiento y convergencia: Un panorama", *Revista de Economía Aplicada* 6, No. 16, 121-160.
- Bajo-Rubio, O. (2012): "The balance-of-payments constraint on economic growth in a long-term perspective: Spain, 1850-2000", *Explorations in Economic History* 49, 105-117.
- Bajo-Rubio, O. and Díaz-Roldán, C. (2012): "Do exports cause growth? Some evidence for the new EU members", *Post-Communist Economies* 24, 125-131.
- Bajo-Rubio, O. and Esteve, V. (2019): "The current account of the Spanish economy, 1850-2016: Was it optimal?", *Revista de Historia Económica/Journal of Iberian and Latin American Economic History*, <https://doi.org/10.1017/S0212610919000223>, forthcoming.
- Bajo-Rubio, O. and Torres, A. (1992): "El comercio exterior y la inversión extranjera directa tras la integración de España en la CE (1986-90)", in Viñals, J. (ed.): *La economía española ante el Mercado Unico europeo. Las claves del proceso de integración*, Alianza, Madrid, 167-228.
- Balaguer, J. and Cantavella-Jordá, M. (2001): "Examining the export-led growth hypothesis for Spain in the last century", *Applied Economics Letters* 8, 681-685.
- Balaguer, J. and Cantavella-Jordá, M. (2004): "Export composition and Spanish economic growth: Evidence from the 20th century", *Journal of Policy Modeling* 26, 165-179.
- Balaguer, J., Florica, T. and Ripollés, J. (2015): "Foreign trade and economic growth in Spain (1900-2012): The role of energy imports", *Economía Política: Journal of Analytical and Institutional Economics* 32, 359-375.

- Ben-David, D. (1993): "Equalizing exchange: Trade liberalization and income convergence", *Quarterly Journal of Economics* 108, 653-679.
- Clemens, M. A. and Williamson, J. G. (2004): "Why did the tariff-growth correlation change after 1950?", *Journal of Economic Growth* 9, 5-46.
- Crafts, N. (2004): "Globalisation and economic growth: A historical perspective", *The World Economy* 27, 45-58.
- Dollar, D. (1992): "Outward-oriented developing economies really do grow more rapidly: Evidence from 95 LDCs, 1976-1985", *Economic Development and Cultural Change* 40, 523-544.
- Driskill, R. (2012): "Deconstructing the argument for free trade: A case study of the role of economists in policy debates", *Economics and Philosophy* 28, 1-30.
- Edwards, S. (1992): "Trade orientation, distortions and growth in developing countries", *Journal of Development Economics* 39, 31-57.
- Edwards, S. (1993): "Openness, trade liberalization, and growth in developing countries", *Journal of Economic Literature* 31, 1358-1393.
- Edwards, S. (1998): "Openness, productivity and growth: What do we really know?", *Economic Journal* 108, 383-398.
- Feder, G. (1983): "On exports and economic growth", *Journal of Development Economics* 12, 59-73.
- Federico, G., Sharp, P. and Tena-Junguito, A. (2017): "Openness and growth in a historical perspective: A VECM approach", Working Paper 118, European Historical Economics Society.
- Frankel, J. A. and Romer, D. (1999): "Does trade cause growth?", *American Economic Review* 89, 379-399.
- Granger, C. W. J. (1969): "Investigating causal relations by econometric models and cross-spectral methods", *Econometrica* 37, 424-438.
- Grossman, G. M. and Helpman, E. (1991): *Innovation and growth in the global economy*, The MIT Press, Cambridge, MA.
- Jacks, D. S. (2006): "New results on the tariff growth paradox", *European Review of Economic History* 10, 205-230.
- Jung, W. S. and Marshall, P. J. (1985): "Exports, growth and causality in developing countries", *Journal of Development Economics* 18, 1-12.
- Kohli, I. and Singh, N. (1989): "Exports and growth: Critical minimum effort and diminishing returns", *Journal of Development Economics* 30, 391-400.
- Kónya, L. (2006): "Exports and growth: Granger causality analysis on OECD countries with a panel data approach", *Economic Modelling* 23, 978-992.

- Kugler, P. (1991): "Growth, exports and cointegration: An empirical investigation", *Weltwirtschaftliches Archiv* 127, 73-82.
- Lampe, M. and Sharp, P. (2013): "Tariffs and income: A time series analysis for 24 countries", *Cliometrica* 7, 207-235.
- Lampe, M. and Sharp, P. (2016): "Cliometric approaches to international trade", in Diebolt, C. and Hauptert, M. (eds.): *Handbook of Cliometrics*, Springer, Heidelberg, 295-330.
- Lehmann, S. H. and O'Rourke, K. H. (2011): "The structure of protection and growth in the late nineteenth century", *Review of Economics and Statistics* 93, 606-616.
- Marin, D. (1992): "Is the export-led growth hypothesis valid for industrialized countries?", *Review of Economics and Statistics* 74, 678-688.
- Meissner, C. M. (2014): "Growth from globalization? A view from the very long run", in Aghion, P. and Durlauf, S. N. (eds.): *Handbook of Economic Growth* (vol. 2), North-Holland, Amsterdam, 1033-1069.
- Nadal, J. (1975): *El fracaso de la revolución industrial en España, 1814-1913*, Ariel, Barcelona.
- Newey, W. K. and West, K. D. (1987): "A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica* 55, 703-708.
- Ng, S. and Perron, P. (2001): "Lag length selection and the construction of unit root tests with good size and power", *Econometrica* 69, 1519-1554.
- Noguer, M. and Siscart, M. (2005): "Trade raises income: A precise and robust result", *Journal of International Economics* 65, 447-460.
- O'Rourke, K. H. (2000): "Tariffs and growth in the late 19th century", *Economic Journal* 110, 456-483.
- Ocampo, J. A. (1986): "New developments in trade theory and LDCs", *Journal of Development Economics* 22, 129-170.
- Oxley, L. (1993): "Cointegration, causality and export-led growth in Portugal, 1865-1985", *Economics Letters* 43, 163-166.
- Pardos, E. (2001): "Comercio y crecimiento en la economía española, 1870-1995", *Revista de Historia Económica/Journal of Iberian and Latin American Economic History* 19, No. S1, 153-174.
- Pistoresi, B. and Rinaldi, A. (2012): "Exports, imports and growth. New evidence on Italy: 1863-2004", *Explorations in Economic History* 49, 241-254.
- Prados de la Escosura, L. (1988): *De imperio a nación. Crecimiento y atraso económico en España (1780-1930)*, Alianza, Madrid.
- Prados de la Escosura, L. (2007): "Growth and structural change in Spain, 1850-2000: A European perspective", *Revista de Historia Económica/Journal of Iberian and Latin American Economic History* 25, 147-181.

- Prados de la Escosura, L. (2017): *Spanish Economic Growth, 1850-2015*, Palgrave Macmillan, London; available at <https://www.palgrave.com/la/book/9783319580418>.
- Prados de la Escosura, L. (2019): "Foreign capital in 19th century Spain's investment boom", *European Review of Economic History*, <https://doi.org/10.1093/ereh/hey026>, forthcoming.
- Prados de la Escosura, L. and Sánchez-Alonso, B. (2019): "Economic development in Spain, 1815-2017", Working Paper 163, European Historical Economics Society (forthcoming in *Oxford Research Encyclopedia of Economics and Finance*).
- Rodríguez, F. and Rodrik, D. (2001): "Trade policy and economic growth: A skeptic's guide to the cross-national evidence", in Bernanke, B. S. and Rogoff, K. (eds.): *NBER Macroeconomics Annual 2000*, 261-325.
- Rodrik, D. (2018): "Populism and the economics of globalization", *Journal of International Business Policy* 1, 1-22.
- Sachs, J. and Warner, A. (1995): "Economic reform and the process of global integration", *Brookings Papers on Economic Activity* 1, 111-118.
- Singh, T. (2010): "Does international trade cause economic growth? A survey", *The World Economy* 33, 1517-1564.
- Tena-Junguito, A. (2006): "Spanish protectionism during the *Restauración*, 1875-1930", in Dormois, J.-P. and Lains, P. (eds.): *Classical Trade Protectionism 1815-1914*, Routledge, London, 265-297.
- Tena-Junguito, A. (2010): "Bairoch revisited: Tariff structure and growth in the late nineteenth century", *European Review of Economic History* 14, 111-143.
- Thirlwall, A. P. (1979): "The balance of payments constraint as an explanation of international growth rate differences", *Banca Nazionale del Lavoro Quarterly Review* 128, 45-53.
- Thornton, J. (1996): "Cointegration, causality and export-led growth in Mexico, 1895-1992", *Economics Letters* 50, 413-416.
- Tortella, G. (2000): *The Development of Modern Spain: An Economic History of the Nineteenth and Twentieth Centuries*, Harvard University Press, Cambridge, MA.
- Vamvakidis, A. (2002): "How robust is the growth-openness connection? Historical evidence", *Journal of Economic Growth* 7, 57-80.
- Wacziarg, R. and Welch, K. H. (2008): "Trade liberalization and growth: New evidence", *World Bank Economic Review* 22, 187-231.



**Table 1**  
**Ng-Perron tests for unit roots**

|                                    | $MZ_{\alpha}$       | $MZ_t$              | $MSB$              | $MP_T$             |
|------------------------------------|---------------------|---------------------|--------------------|--------------------|
| $\frac{\dot{Y}}{\bar{Y}}$          | -80.08 <sup>a</sup> | -6.327 <sup>a</sup> | 0.079 <sup>a</sup> | 0.308 <sup>a</sup> |
| $\frac{I}{\bar{Y}}$                | -22.55 <sup>b</sup> | -3.328 <sup>b</sup> | 0.148 <sup>b</sup> | 4.224 <sup>b</sup> |
| $\frac{\dot{L1}}{\bar{L1}}$        | -60.73 <sup>a</sup> | -5.479 <sup>a</sup> | 0.090 <sup>a</sup> | 0.479 <sup>a</sup> |
| $\frac{\dot{L2}}{\bar{L2}}$        | -43.76 <sup>a</sup> | -4.669 <sup>a</sup> | 0.107 <sup>a</sup> | 0.582 <sup>a</sup> |
| $\left(\frac{X\dot{X}}{YX}\right)$ | -13.64 <sup>b</sup> | -2.530 <sup>b</sup> | 0.185 <sup>b</sup> | 2.114 <sup>b</sup> |
| $\frac{\dot{X}}{\bar{X}}$          | -10.48 <sup>b</sup> | -2.264 <sup>b</sup> | 0.216 <sup>b</sup> | 2.437 <sup>b</sup> |

**Notes:**

- (i) <sup>a</sup> and <sup>b</sup> denote significance at the 1% and 5% levels, respectively. The critical values are taken from Ng and Perron (2001, Table I).
- (ii) The tests for  $\frac{I}{\bar{Y}}$  include a linear trend.

**Table 2**  
**Estimation of growth equations, 1850-2017**  
(dependent variable:  $\dot{Y}/Y$ )

|                                      | Eq. (5)                       |                               | Eq. (5')                        |                                 | Eq. (5'')                           |                                     |
|--------------------------------------|-------------------------------|-------------------------------|---------------------------------|---------------------------------|-------------------------------------|-------------------------------------|
| constant                             | 0.429<br>(0.583)              | 0.443<br>(0.607)              | 0.233<br>(0.320)                | 0.245<br>(0.340)                | 0.556<br>(0.736)                    | 0.573<br>(0.766)                    |
| $\frac{I}{\bar{Y}}$                  | 0.096 <sup>b</sup><br>(2.006) | 0.112 <sup>b</sup><br>(2.212) | 0.118 <sup>a</sup><br>(2.616)   | 0.134 <sup>a</sup><br>(2.790)   | 0.086 <sup>c</sup><br>(1.773)       | 0.101 <sup>b</sup><br>(1.974)       |
| $\frac{\dot{L}}{\bar{L}}$            | 0.643 <sup>a</sup><br>(3.724) | 0.508 <sup>a</sup><br>(3.044) | 0.645 <sup>a</sup><br>(3.905)   | 0.511 <sup>a</sup><br>(3.246)   | 0.631 <sup>a</sup><br>(3.650)       | 0.499 <sup>a</sup><br>(3.056)       |
| $\left(\frac{X\dot{X}}{YX}\right)$   | 0.004<br>(1.530)              | 0.004<br>(1.503)              | -0.007 <sup>b</sup><br>(-2.427) | -0.007 <sup>b</sup><br>(-2.418) | 0.007 <sup>b</sup><br>(2.013)       | 0.007 <sup>b</sup><br>(2.045)       |
| $\frac{\dot{X}}{\bar{X}}$            | -                             | -                             | 0.125 <sup>a</sup><br>(3.532)   | 0.126 <sup>a</sup><br>(3.640)   | -                                   | -                                   |
| $\left(\frac{X\dot{X}}{YX}\right)^2$ | -                             | -                             | -                               | -                               | -5.44·10 <sup>-6c</sup><br>(-1.893) | -5.63·10 <sup>-6b</sup><br>(-1.960) |
| R <sup>2</sup>                       | 0.110                         | 0.101                         | 0.158                           | 0.149                           | 0.120                               | 0.111                               |
| σ                                    | 4.585                         | 4.609                         | 4.474                           | 4.498                           | 4.574                               | 4.597                               |
| B-G(1)                               | 1.775                         | 1.052                         | 2.282                           | 1.899                           | 1.081                               | 2.451                               |
| B-G(4)                               | 2.129                         | 2.965                         | 2.816                           | 2.098                           | 2.231                               | 2.748                               |
| B-P                                  | 4.801                         | 5.361                         | 4.900                           | 4.499                           | 5.119                               | 4.638                               |
| ARCH(1)                              | 0.685                         | 0.802                         | 0.539                           | 0.737                           | 0.851                               | 0.596                               |
| ARCH(4)                              | 3.689                         | 5.176                         | 3.254                           | 2.904                           | 4.339                               | 2.568                               |

**Note:** <sup>a</sup>, <sup>b</sup> and <sup>c</sup> denote significance at the 1%, 5% and 10% levels, respectively.

**Table 3**  
**Contributions to economic growth, 1850-2017**  
 (percentage points)

| Variable            | with employment | with hours worked |
|---------------------|-----------------|-------------------|
| Investment          | 1.635           | 1.857             |
| Labour growth       | 0.485           | 0.227             |
| Exports             | 0.154           | 0.152             |
| Externalities       | -4.400          | -4.412            |
| Higher productivity | 4.554           | 4.564             |
| <b>Total</b>        | <b>2.275</b>    | <b>2.236</b>      |
| <b>GDP growth</b>   | <b>2.546</b>    | <b>2.546</b>      |

Source: Own elaboration from Table 2 and Prados de la Escosura (2017).

**Table 4**  
**Bai-Perron tests for structural change**

| Tests                     | Eq. (5) |        | Eq. (5') |        | Eq. (5'') |        |
|---------------------------|---------|--------|----------|--------|-----------|--------|
| <i>UD</i> max             | 26.78   | 53.43  | 43.16    | 57.61  | 41.86     | 63.19  |
| <i>WD</i> max             | 38.93   | 77.67  | 43.16    | 81.72  | 59.37     | 89.64  |
| scaled <i>F</i> (1)       | 20.05   | 18.99  | 43.16    | 40.52  | 37.36     | 52.88  |
| scaled <i>F</i> (2)       | 13.04   | 33.81  | 32.96    | 31.23  | 20.01     | 46.55  |
| scaled <i>F</i> (3)       | 26.78   | 53.43  | 30.34    | 57.61  | 41.86     | 63.19  |
| scaled <i>F</i> (1 0)     | 20.05   | 18.99  | 43.16    | 40.52  | 37.36     | 52.88  |
| scaled <i>F</i> (2 1)     | 4.978*  | 47.70  | 17.43*   | 18.09* | 4.819*    | 24.62  |
| scaled <i>F</i> (3 2)     | -       | 5.385* | -        | -      | -         | 4.612* |
| Number of breaks selected | 1       | 2      | 1        | 1      | 1         | 2      |

Note: All the test statistics are significant at the 5% level, except those denoted with \*. The critical values are taken from Bai and Perron (2003b).

**Table 5**  
**Estimation of growth equations, 1850-1895 and 1896-2017**  
(dependent variable:  $\dot{Y}/Y$ )

**A) 1850-1895**

|  | Eq. (5)                       |                               | Eq. (5')                        |                                 | Eq. (5'')                        |                                  |
|--|-------------------------------|-------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|
| constant   | -2.239<br>(-0.994)            | -2.219<br>(-0.991)            | -2.156<br>(-0.991)              | -2.237<br>(-1.035)              | -2.437<br>(-1.112)               | -2.417<br>(-1.118)               |
| $\frac{I}{\bar{Y}}$                              | 0.376<br>(0.978)              | 0.421<br>(1.335)              | 0.293<br>(0.780)                | 0.398<br>(1.329)                | 0.338<br>(0.947)                 | 0.395<br>(1.363)                 |
| $\frac{\dot{I}}{\bar{I}}$                        | 1.092<br>(0.646)              | 0.555<br>(0.707)              | 1.539<br>(0.933)                | 0.414<br>(0.534)                | 1.313<br>(0.844)                 | 0.646<br>(0.837)                 |
| $\left(\frac{X\dot{X}}{\bar{Y}\bar{X}}\right)$   | 0.026 <sup>a</sup><br>(4.485) | 0.025 <sup>a</sup><br>(4.709) | 0.063 <sup>a</sup><br>(5.138)   | 0.059 <sup>a</sup><br>(5.001)   | 0.020 <sup>c</sup><br>(1.945)    | 0.019 <sup>c</sup><br>(2.001)    |
| $\frac{\dot{X}}{\bar{X}}$                        | -                             | -                             | -0.246 <sup>a</sup><br>(-3.593) | -0.221 <sup>a</sup><br>(-3.290) | -                                | -                                |
| $\left(\frac{X\dot{X}}{\bar{Y}\bar{X}}\right)^2$ | -                             | -                             | -                               | -                               | 4.61·10 <sup>-5</sup><br>(1.132) | 4.57·10 <sup>-5</sup><br>(1.153) |
| R <sup>2</sup>                                   | 0.284                         | 0.285                         | 0.333                           | 0.325                           | 0.304                            | 0.304                            |
| σ  | 4.470                         | 4.467                         | 4.368                           | 4.395                           | 4.463                            | 4.461                            |
| B-G(1)   | 1.135                         | 0.957                         | 1.432                           | 1.438                           | 0.991                            | 0.799                            |
| B-G(4)   | 5.246                         | 4.464                         | 6.318                           | 5.367                           | 5.686                            | 4.742                            |
| B-P  | 3.455                         | 2.199                         | 5.829                           | 2.455                           | 3.962                            | 2.717                            |
| ARCH(1)  | 0.006                         | 0.000                         | 0.004                           | 0.017                           | 0.021                            | 0.001                            |
| ARCH(4)  | 8.524 <sup>c</sup>            | 8.501 <sup>c</sup>            | 9.146 <sup>c</sup>              | 9.239 <sup>c</sup>              | 8.508 <sup>c</sup>               | 8.325 <sup>c</sup>               |

**B) 1896-2017**

|  | Eq. (5)                       |                               | Eq. (5')                        |                                 | Eq. (5'')                          |                                    |
|--|-------------------------------|-------------------------------|---------------------------------|---------------------------------|------------------------------------|------------------------------------|
| constant   | 0.390<br>(0.329)              | 0.451<br>(0.385)              | 0.415<br>(0.373)                | 0.475<br>(0.434)                | 0.524<br>(0.436)                   | 0.608<br>(0.512)                   |
| $\frac{I}{\bar{Y}}$                              | 0.111 <sup>c</sup><br>(1.845) | 0.125 <sup>b</sup><br>(1.998) | 0.117 <sup>b</sup><br>(2.049)   | 0.131 <sup>b</sup><br>(2.202)   | 0.102 <sup>c</sup><br>(1.659)      | 0.114 <sup>c</sup><br>(1.772)      |
| $\frac{\dot{I}}{\bar{I}}$                        | 0.625 <sup>a</sup><br>(3.599) | 0.464 <sup>a</sup><br>(2.824) | 0.632 <sup>a</sup><br>(3.739)   | 0.476 <sup>a</sup><br>(2.970)   | 0.620 <sup>a</sup><br>(3.584)      | 0.462 <sup>a</sup><br>(2.859)      |
| $\left(\frac{X\dot{X}}{\bar{Y}\bar{X}}\right)$   | 0.001<br>(0.716)              | 0.001<br>(0.704)              | -0.008 <sup>a</sup><br>(-2.781) | -0.008 <sup>a</sup><br>(-2.760) | 0.003<br>(0.889)                   | 0.003<br>(0.939)                   |
| $\frac{\dot{X}}{\bar{X}}$                        | -                             | -                             | 0.115 <sup>a</sup><br>(2.993)   | 0.116 <sup>a</sup><br>(3.078)   | -                                  | -                                  |
| $\left(\frac{X\dot{X}}{\bar{Y}\bar{X}}\right)^2$ | -                             | -                             | -                               | -                               | -2.26·10 <sup>-6</sup><br>(-0.898) | -2.67·10 <sup>-6</sup><br>(-0.984) |
| R <sup>2</sup>                                   | 0.108                         | 0.088                         | 0.152                           | 0.132                           | 0.110                              | 0.090                              |
| σ  | 4.467                         | 4.518                         | 4.375                           | 4.425                           | 4.481                              | 4.530                              |
| B-G(1)   | 1.936                         | 2.156                         | 0.800                           | 0.909                           | 2.048                              | 2.310                              |
| B-G(4)   | 3.013                         | 3.418                         | 1.658                           | 1.510                           | 3.096                              | 3.521                              |
| B-P  | 4.684                         | 4.553                         | 5.168                           | 5.047                           | 4.927                              | 4.767                              |
| ARCH(1)  | 0.592                         | 0.737                         | 0.732                           | 0.863                           | 0.590                              | 0.733                              |
| ARCH(4)  | 2.832                         | 2.250                         | 3.140                           | 2.539                           | 2.655                              | 2.100                              |

Note: <sup>a</sup>, <sup>b</sup> and <sup>c</sup> denote significance at the 1%, 5% and 10% levels, respectively.

**Table 6**  
**Contributions to economic growth, 1850-1895 and 1896-2017**  
 (percentage points)

**A) 1850-1895**

| Variable            | with employment | with hours worked |
|---------------------|-----------------|-------------------|
| Investment          | 1.745           | 2.373             |
| Labour growth       | 0.599           | 0.138             |
| Exports             | 0.740           | 0.720             |
| Externalities       | 5.695           | 5.103             |
| Higher productivity | -4.955          | -4.383            |
| <b>Total</b>        | <b>3.084</b>    | <b>3.231</b>      |
| <b>GDP growth</b>   | <b>1.483</b>    | <b>1.483</b>      |

**B) 1896-2017**

| Variable            | with employment | with hours worked |
|---------------------|-----------------|-------------------|
| Investment          | 1.946           | 2.177             |
| Labour growth       | 0.542           | 0.208             |
| Exports             | 0.051           | 0.052             |
| Externalities       | -6.021          | -6.091            |
| Higher productivity | 6.072           | 6.143             |
| <b>Total</b>        | <b>2.539</b>    | <b>2.437</b>      |
| <b>GDP growth</b>   | <b>3.227</b>    | <b>3.227</b>      |

Source: Own elaboration from Table 5 and Prados de la Escosura (2017).

**Table 7**  
**Granger-causality tests**

**A) Between  $\frac{\dot{Y}}{Y}$  and  $\frac{\dot{X}}{X}$**

1850-2017

| Null hypothesis  | F-statistic | Probability |
|--|-------------|-------------|
| $\frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 2.047       | 0.091       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\frac{\dot{X}}{X}$ | 0.754       | 0.557       |

1850-1895

| Null hypothesis  | F-statistic | Probability |
|--|-------------|-------------|
| $\frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 0.928       | 0.460       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\frac{\dot{X}}{X}$ | 0.823       | 0.520       |

1896-2017

| Null hypothesis  | F-statistic | Probability |
|--|-------------|-------------|
| $\frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 2.468       | 0.049       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\frac{\dot{X}}{X}$ | 1.393       | 0.241       |

**B) Between  $\frac{\dot{Y}}{Y}$ ,  $\left(1 - \frac{X}{Y}\right)\frac{\dot{X}}{X}$  and  $\left(\frac{X \dot{X}}{Y X}\right)$**

1850-2017

| Null hypothesis  | F-statistic | Probability |
|--|-------------|-------------|
| $\left(1 - \frac{X}{Y}\right)\frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.693       | 0.154       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(1 - \frac{X}{Y}\right)\frac{\dot{X}}{X}$ | 0.502       | 0.734       |

| Null hypothesis   | F-statistic | Probability |
|---|-------------|-------------|
| $\left(\frac{X \dot{X}}{Y X}\right)$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.797       | 0.132       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(\frac{X \dot{X}}{Y X}\right)$ | 0.436       | 0.783       |

**Table 7 (continued)**

1850-1895

| Null hypothesis   | F-statistic | Probability |
|---|-------------|-------------|
| $\left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.442       | 0.243       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$ | 1.031       | 0.407       |

| Null hypothesis   | F-statistic | Probability |
|---|-------------|-------------|
| $\left(\frac{X \dot{X}}{Y \dot{Y}}\right)$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.343       | 0.276       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(\frac{X \dot{X}}{Y \dot{Y}}\right)$ | 1.012       | 0.416       |

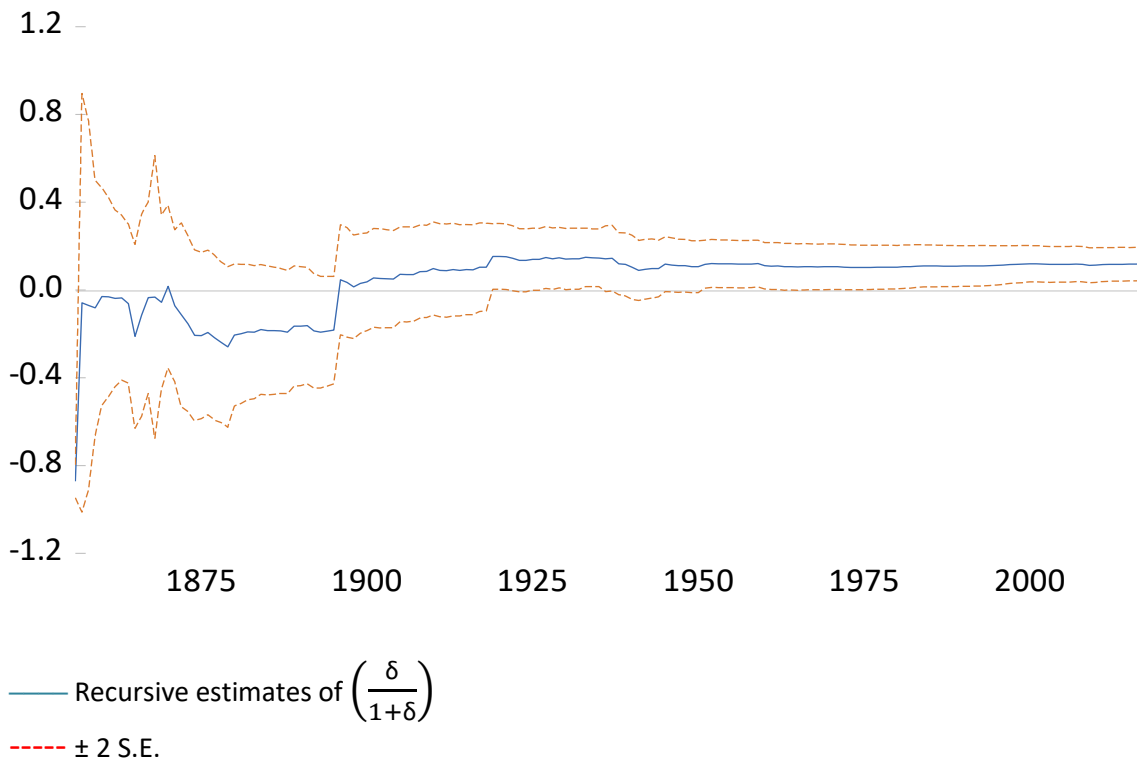
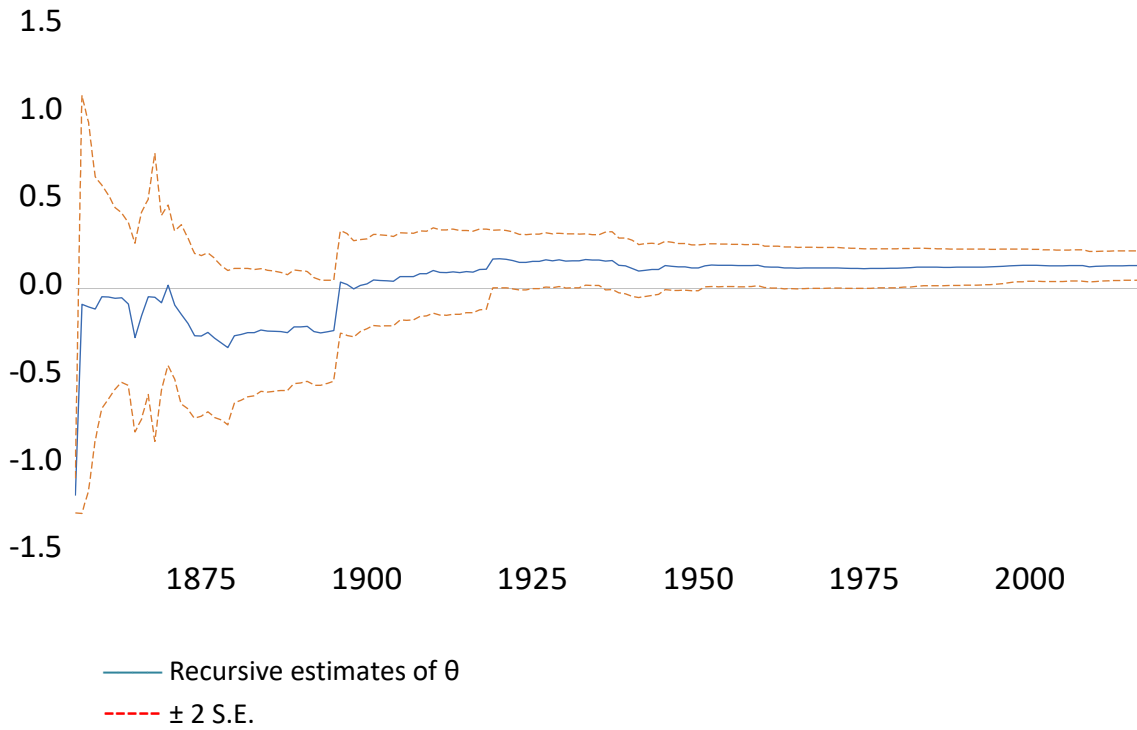
1896-2017

| Null hypothesis   | F-statistic | Probability |
|---|-------------|-------------|
| $\left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.476       | 0.215       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(1 - \frac{X}{Y}\right) \frac{\dot{X}}{X}$ | 0.493       | 0.741       |

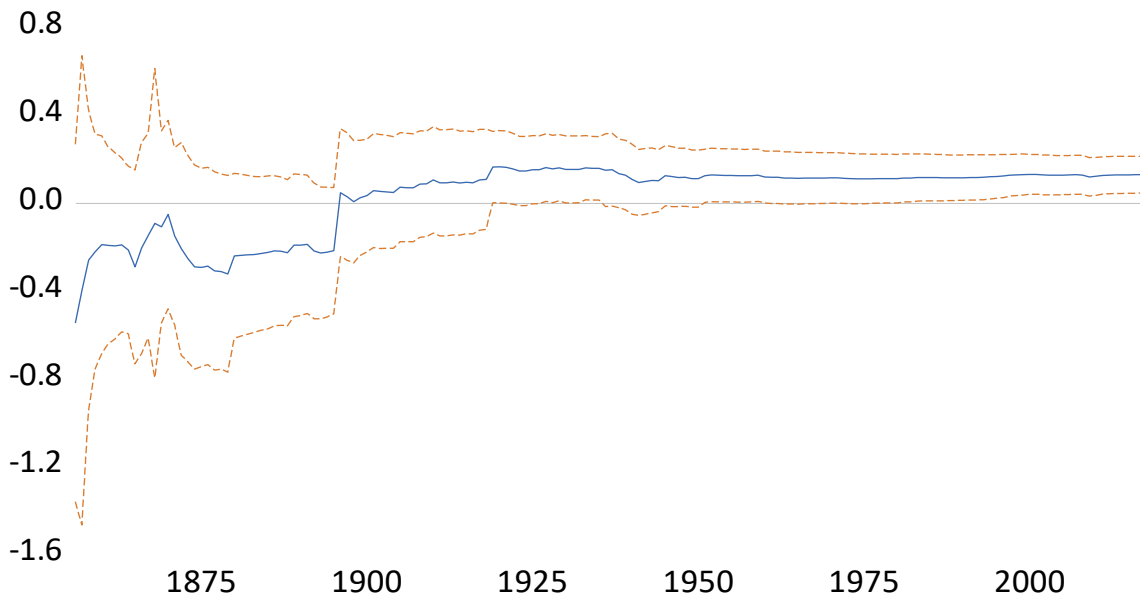
| Null hypothesis   | F-statistic | Probability |
|---|-------------|-------------|
| $\left(\frac{X \dot{X}}{Y \dot{Y}}\right)$ does not Granger-cause $\frac{\dot{Y}}{Y}$ | 1.596       | 0.181       |
| $\frac{\dot{Y}}{Y}$ does not Granger-cause $\left(\frac{X \dot{X}}{Y \dot{Y}}\right)$ | 0.483       | 0.749       |

**Figure 1**  
**Recursive estimates of the coefficients on the effect of exports**

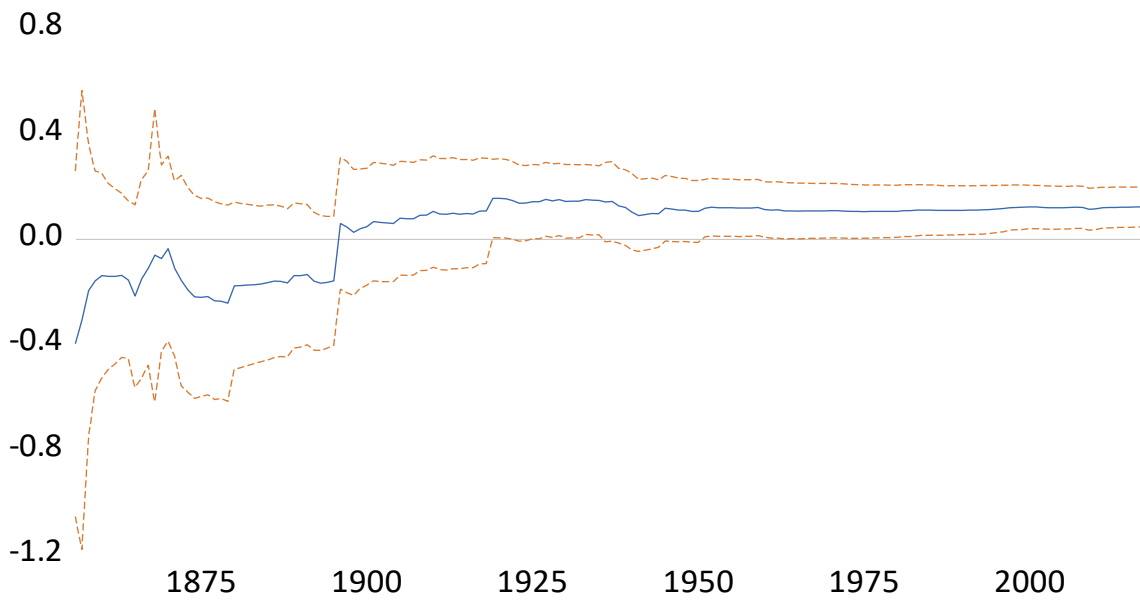
**A) With employment**



**B) With hours worked**



— Recursive estimates of  $\theta$   
- - -  $\pm 2$  S.E.



— Recursive estimates of  $\left(\frac{\delta}{1+\delta}\right)$   
- - -  $\pm 2$  S.E.