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by

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Abstract

The endogenous growth literature has explored the transition from a Malthusian world where real wages, living standards and labor productivity are all linked to factor endowments, to one where (endogenous) productivity change embedded in modern industrial growth breaks that link. Recently, economic historians have presented evidence from England showing that the dramatic reversal in distributional trends – from a steep secular fall in wage-land rent ratios before 1800 to a steep secular rise thereafter – must be explained both by industrial revolutionary growth forces and by global forces that opened up the English economy to international trade. This paper explores whether and how the relationship was different for Spain, a country which had relatively poor productivity growth in agriculture and low living standards prior to 1800, was a late-comer to industrialization afterwards, and adopted very restrictive policies towards imports for much of the 19th century. The failure of Spanish wage-rental ratios to undergo a sustained rise after 1840 can be attributed to the delayed fall in relative agricultural prices (due to those protective policies) and to the decline in Spanish manufacturing productivity after 1898.

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1. Growth and Distribution: How Was Spain Different?

A large literature has emerged over the past fifteen years in which economic theorists (Goodfriend and McDermott 1995; Hansen and Prescott 2002; Lucas 1999, 2002; Galor and Weil 2000; Jones 2001; Doepke 2004; Cervellati and Sunde 2005; O'Rourke, Rahman and Taylor 2007) have attempted to model the dramatic structural break in European living standards which occurred at some point between 1750 and 1850. Real wages and labor productivity were relatively stagnant before the late 18th century, when it appears that both depended positively on land-labor ratios and when population growth depended positively on real wages, all of which is consistent with the famous model offered by Thomas Malthus (1826). After 1850, real wages and labor productivity enjoyed a sustained and impressive increase that continues to this day, experience clearly inconsistent with Malthusian thinking since population has continued to increase, and at a faster rate. The prevailing view is that the industrial revolution must have been responsible for the abrupt secular change in these productivity trends.

However, a recent paper by two of the present authors (O'Rourke and Williamson 2005) exploited new data documenting relative factor price trends over the very long run, and pointed out that there was another, equally dramatic change in income distribution trends which occurred in northwest Europe at about the same time. Prior to the 19th century, there had been a long epoch during which the wage-land rent ratio declined, implying a rise in inequality (since land owners were at the top of the income distribution while landless laborers were at the bottom: Hoffman et al. 2002). This trend is consistent with a Malthusian world in which an increasing population pressed on a fixed

endowment of land, to the benefit of landlords. At some point in the 19th century this pattern reversed dramatically in England, the Lowlands and the rest of northwest Europe: wages started to rise relative to land rents, implying a decline in inequality. This more modern trend is inconsistent with a Malthusian world in which wage-rent ratios were determined by the land endowment per worker, since the land-labor ratio continued to decline over the two centuries following 1800.

In short, the ancient link between factor prices and factor endowments was broken in the early 19th century, at least in northwest Europe. What explains the break? One obvious explanation is that it was caused by the same industrial revolutionary forces underlying the break in living standards and labor productivity trends. While not everyone agrees on the exact timing, all scholars agree that the rate of technological advance accelerated in English industry about this time (Clark 2007; Crafts and Harley 1992; Mokyr 1990, 2002, 2005). In a specific factors model in which two commodities are produced – agricultural products (using land and labor) and manufactured goods (using capital and labor), productivity advance and accumulation in English industry should have drawn workers out of agriculture and into the cities, raising wages, lowering agricultural land rents, and inflating the ratio of the two.

These industrial revolutionary forces are the focus of the theoretical papers cited earlier, and they were certainly important in explaining the reversal in distributional trends as well. However, that reversal can also be explained by an epochal change in the world economy that coincided with the Industrial Revolution: Europe became dramatically more open to trade in the decades following the French Wars (O'Rourke and Williamson 1999, 2002a, 2002b; Findlay and O'Rourke 2007). Only in the 19th century

did intercontinental trade have its effects on commodity and factor price convergence which was the focus of those two famous Swedish economists, Eli Heckscher and Bertil Ohlin (Flam and Flanders 1991). Thus, global market integration helped cut the links between domestic factor prices and domestic land-labor ratios. For England at least, globalization and the industrial revolution made equally important contributions to the dramatic change in secular distribution trends (O'Rourke and Williamson 2005).

But what about other parts of Europe where the industrial revolution came late, where the modern commitment to free trade was less passionate, and where modern pro-global transport revolutions might have been more modest? And what about those parts of Europe where productivity growth and population increase were both slower in the pre-modern, closed-economy era? In this paper, we ask whether wage-rent ratios behaved the same way in Spain as in England and the rest of northwest Europe between 1500 and 1913, and whether industrialization and global forces played the same roles there as they did in the leading European economies. Given that Spain and the rest of the European periphery were much more protectionist than the industrial core, we expect to find a less dramatic rise in the wage-rental ratio and we expect that trade policy played a big role in accounting for the difference.

We use the specific factors trade model (Jones 1971), with exogenous endowments and technology, to explore Spanish experience in a comparative context. Section 2 reviews just how Spain differed from England and the rest of northwest Europe in terms of globalization experience and productivity performance in the very long run. Section 3 documents Spanish relative commodity and factor price experience over the four centuries before 1913, and compares it with England and Holland. Section 4 exploits

the price dual to extract estimates of Spanish total factor productivity growth in both agriculture and industry. It also compares these new (quantitative) estimates with the traditional literature, based as they are on older, more qualitative evidence, especially for the pre-1800 period. Section 5 explores the determinants of relative commodity and factor prices before and after the early 19th century transition, sorting out the influence of domestic endowments, domestic productivity and global forces. Section 6 explores some counterfactuals that allow us to make explicit comparisons between Spain and England. Section 7 concludes.

2. Globalization and Productivity Growth: Spain versus Northwest Europe since 1500

Going Global: Comparing Spain with the Leaders

An extensive literature now documents clearly the timing and importance of the first global century, the 19th century. It is not our purpose to review this evidence in detail, but only to show that while Spain was certainly part of that global century, there were powerful anti-global forces at work there that made a difference. Where countries had liberal attitudes toward trade, commodity prices converged between trading markets as global market integration took place (O'Rourke and Williamson 1999, 2002a) and world trade boomed (O'Rourke and Williamson 2002c, Estevadeordal et al. 2003). Furthermore, there was nothing like this move towards world market integration between 1500 and 1800, an era of discovery and enterprise without liberal trade policy and cheap

transport. The economic leaders in the Atlantic economy – Great Britain and Holland – were, of course, central actors in this globalization drama.

The mainstream literature divides Spanish foreign trade experience since Columbus in to three periods. Up to the 1820s, American domestic and re-export trade had an important impact on total Spanish trade. The loss of the colonies introduced a short but difficult period of adjustment from the 1820s to the 1840s when Spanish trade contracted dramatically as it struggled to shift from American to European markets. During the century and a half after the 1840s, Spain underwent an impressive increase in trade.

In the first period, the Spanish traded goods sector shrank: many commodities in which Spain was once self-sufficient -- such as corn, rice, and sugar -- became imports; and even those goods Spain previously exported -- such as leather manufactures, iron, and alum -- began to be imported by the early 17th century. Mauricio Drelichman (2005) attributes this collapse in traded goods sectors to a Dutch disease caused by the massive influx of precious metals from America. Spanish monarchs developed a series of mercantilist policies to control their returns on this trade: several privileged trade monopolies were established, only a few ports were allowed to participate in the American trade, and most of it remained in hands of merchants in Cadiz. While a very large share of Spanish exports to America were European re-exports, Spain also exported wool, spirits, wine, raisins and other primary products to Europe and imported cotton yarn, linen and wool textiles and flour in return (Prados de la Escosura 1988). Restrictive mercantilist trade policies were reinforced by wartime disruptions at the end of the 18th century (Findlay and O'Rourke 2007: Chp. 7): total exports declined by one third from

1784 to 1820. Spanish foreign trade did not grow again until the 1840s. Thereafter, Spanish exports grew at rates similar to the rest of Europe (Prados de la Escosura 1988: 183). As in earlier centuries, 19th century Spain mainly exported food, raw materials and semi-finished goods and imported raw materials and manufactures (Prados de Escosura 1988: Table 5.5). About 60 percent of Spanish trade involved Western Europe, Britain and France being the major trading partners (Tena 2005: Table 8.7).

Was the evolution of Spanish trade policy different? Not on the basis of the pre-1800 anti-global policies just summarized, since they were common throughout Europe. Yet, Spain went global with much less enthusiasm during the first global century up to 1913. Consider trade shares: for the UK, the share of exports and imports in GDP rose from 52 to 55% over the 55 years between 1855-59 and 1910-14 (Mitchell 1988: 453, 836); for Spain, the trade share also rose, from 7.9 to 21.3% over the sixty years between 1850-54 and 1910-14 (Tena 2005: Table 8.8). While trade boomed in both countries, Spain was clearly much less open than Britain, in the sense that it had much lower trade shares. And while Spanish commercial policy got increasingly liberal across the late 19th century -- the average tariff rate fell from 14.9% in 1865 to 8.2% in 1913 (Williamson 2006b), it was still much more protectionist than free trade Britain.

The big difference between free trade Britain and protectionist Spain lay with agriculture and the grain trade. The Spanish government imposed an embargo on grain imports in 1802, and it was used many times up to 1869, after which protection of local wheat producers was achieved instead by relatively high tariffs (Montañés 2006). In contrast, over the same period Britain removed its embargo soon after the French Wars, reduced the tariff on grain over the two decades prior to Corn Law Repeal in 1846, and

then stuck to free trade thereafter. As we shall see, this difference in policy had a very big impact on trends in the relative price of agricultural products in 19th century Spain and Britain (Figure 10).

When Did They Go Global?

Let us start with the leader. Were English commodity prices more closely linked to English endowments prior to the 19th century? And if so, when did this traditional, closed economy relationship break down? A previous paper explored the question of when the structural break took place (O'Rourke and Williamson 2005: Figure 6): it assumed a simple relationship between relative commodity prices (agricultural vs manufacturing) and the land-labor ratio, and plotted Chow test statistics for every year between 1502 and 1935 to see where a structural break in this relationship was most likely to have taken place. There was a slow, hardly noticeable rise in the test statistic between 1500 and 1700, followed by a significant rise from 1700 to 1750, and a larger rise from 1750 to 1800. This timing coincides well with what we know about the gradual opening of the English economy to international trade during the course of the 18th century. While the Chow tests suggested that traditional links between relative commodity prices and endowments were already breaking down during the 18th century, the sharpest acceleration in the test statistic occurred between about 1800 and 1840. The best candidate for a structural break was the second quarter of the 19th century, with the peak in the series occurring in 1838. Strikingly, this 1838 peak is very similar to the timing of decline in both the Atlantic freight index (Harley 1988: Figure 1) and the grain price gap between the US and Britain (O'Rourke and Williamson 2005: Figure 3).

Furthermore, it is consistent with qualitative accounts regarding the liberalization of British trade policy which have long been a staple in the economic history literature. That is, prior to 1828, grain imports were prohibited if domestic prices fell below a certain 'port-closing' level, and during the early postwar years grain imports were effectively excluded much of the time. In 1828, the Duke of Wellington's government replaced these import restrictions with tariffs which varied with the domestic price, a policy that not only lowered British grain prices but also increased the integration of British with Continental grain markets. Moreover, this adoption of the sliding scale tariff came when several other moves towards freer trade were in motion: a reform of the Navigation Acts in 1822; tariff reductions across the board; and the repeal of more than 1,100 tariff acts in 1825. Of course, prior to 1815 the French Wars had severely restricted international trade (O'Rourke 2006). In short, by 1838 there had already been a radical liberalization of British commercial policy (Williamson 1990), and Britain stuck with that pro-globalization policy stance up to the more famous 1846 Repeal of the Corn Laws and beyond.

Was Spanish pro-global experience any different? Let us begin by exploring the same Chow test statistic that emerges from the simple closed economy regression, as in the British case. In order to see if the answers we obtain depend on the specification of this regression, we provide four versions. The first is the specification given in equation (4) of Table 1 below, in which relative commodity prices are regressed not just on the land-labor ratio, but on total factor productivity in agriculture and manufacturing, as well as on a time trend, with an AR(1) term added as well to correct for serial correlation. The second excludes the time trend and AR(1) correction; the third further excludes TFP in

manufacturing (so that relative commodity prices are taken to be a function of the land-labor ratio and agricultural TFP alone); and the fourth lets relative commodity prices depend solely on the land-labor ratio, as in previous work on England. All variables are expressed in logs. Figure 1 plots the Chow test statistics for every year. In each of the four cases, the Chow statistic rises slowly over the two centuries before 1800, and then leaps dramatically upwards after 1800 or so. The large Chow statistics peak in the late 1840s and early 1850s, a little later than Britain. In what follows, we will take 1840 as a benchmark year after which an open economy specification is more appropriate for the Spanish economy, but Figure 2 shows clearly that it was a long transition.

Thus, Spain underwent very much the same kind of pro-global transition as did the European leader, or at least so say the statistics. As Leandro Prados de la Escosura (1988) points out, however, the 19th century trade boom was not without slumps. Furthermore, we have already seen that trade shares were much lower in Spain and tariffs much higher. A break in the Spanish export series is clearly observable after the 1830s and 1840s (as Spain struggled with the loss of her American colonies), two decades during which they grew at a rate half of those typical of Europe. Over the half century 1853-1899, exports accelerated and grew at rates (3.3 percent per year) that exceeded those in Europe. Finally, between 1899 and 1913 trade growth fell below the European average, partly as a consequence of the loss of the Cuban, Puerto Rican and Philippine colonies in 1898, and partly as a consequence of rising protection, domestic regulation, and diminished competitiveness. In short, while Spain was clearly less pro-global than Britain, its transition to openness followed much the same timing as Britain, except that Spain underwent a late 19th century anti-global backlash which Britain did not.

What about Comparative Productivity Performance?

Section 4 will estimate total factor productivity for Spanish agriculture and industry over the very long run. Here we ask what the traditional literature tells us so that later we can gauge our estimates against that standard .

With the exception of late 19th century agriculture and industry, estimates of Spanish sectoral total factor productivity growth are relatively scarce. However, the qualitative literature argues that productivity advance in these two sectors was limited, or even negative, from the 16th to the 19th century. The mainstream view is that an absence of technological change was produced by anti-growth institutions and ecological constraints. While the Spanish economy only underwent *extensive*, as opposed to *intensive,* growth during the 16th century, even that was followed by a dramatic decline in the 17th century, before an 18th century recovery. On net, therefore, the standard view is that very little, if any, productivity growth took place in Spain across the three centuries, while there was significant productivity growth in Britain.

A lively debate has emerged regarding the evolution of agricultural total factor productivity over the long 19th century. Employing controversial and scarce quantitative evidence, Jaume Vicens Vives (1977) was the first to assert that land productivity stagnated over the century, thus delaying Spanish economic development. Nicolás Sánchez-Albornoz (1977), Jordi Nadal (1974) and other economic historians supported this pessimist argument emphasizing the absence of technological innovation. Several authors have also emphasized the ecological limits to Spanish agricultural development due to limited (and uncertain) rainfall and poor soil (Huguet del Villar 1969; Tortella 1981, 1994).

In the 1980s, a new generation of economic historians began to express some doubts about this pessimist view of the 19th century. The GEHR (1983, 1989) concluded that a notable increase in productivity took place between 1891/95 and 1931, while Ramón Garrabou and Jesús Sanz (1985) estimated that cereal productivity grew by 57 percent from 1800 to 1895. More recently, Prados de la Escosura (1988, 1989) estimated that labor productivity grew at 0.4 percent per year from 1800 to 1910, while land productivity grew between 0.2 and 0.6 percent per year. Thus, he concluded that agricultural output grew decidedly faster than population over the 19th century, although less than in other European countries. James Simpson (1989, 1995) is more pessimistic, arguing that agricultural output only grew a bit faster than Spanish population, and that significant technological change had to wait for the second half of the 20th century. Finally, Bringas Gutierrez (2000) has employed both the primal and the dual TFP measures, concluding that productivity advance in Spanish agriculture from 1800 to 1905 was 0.49 percent per year, although his estimates suggest that a large part of this progress was concentrated in the last third of the century.

Comparative studies underline the relative backwardness of Spanish agriculture. Recent work by Robert Allen (2000) has found that Spanish *relative* agricultural labor productivity declined between 1500 and 1800: in 1500, Spanish labor productivity was 89 percent of England, while it was 70 percent in 1800. Allen concludes that Spain missed the agricultural revolution. The situation had not changed much by the end of the 19th century: Spanish labor productivity was 62 percent of Britain in 1890 and 68 percent in 1910 (O'Brien and Prados de la Escosura 1992).

Opinions about the evolution of Spanish industrial productivity can also be divided into optimists and pessimists, and, like agriculture, the debate is also plagued by the absence of quantitative evidence. Nadal (1974) has forcefully argued for a rapid productivity advance over the 19th century. More recently, Albert Carreras (1990) advanced a similar view stressing the importance of progress during the 1830-1860 period. Pessimists have sharply challenged this view (Tortella 1994; Prados de la Escosura 1988; Fraile Balbín 1991), stressing instead the relative backwardness of Spanish industry.

3. Relative Commodity and Factor Prices: Spain versus Northwest Europe since 1500

Figure 2 reports secular income distribution trends as measured by the ratio of the wage to land rent (w/r: 1900=100). The experience between 1568 and 1913 is plotted for three countries, two economic leaders in the European northwest – England and Holland – on the one hand, and Spain, on the other.[1] The difference between them is striking.

The first notable difference is in their secular trends before the modern era. The northwest underwent a great secular fall in w/r, or equivalently a great secular rise in inequality over the 300 years between the mid-16th century and the mid-19th century. True, the spectacular fall in the English w/r up to the early-17th century was not quite so dramatic in Holland, and the latter underwent a partial rebound in the first half of the 18th century which England did not share. Still, the big secular fall in w/r over the 300 years before the mid-19th century was common to both: in England, it fell by 76% between

[1] While the Spanish series in Figure 2 may appear to be more volatile, this is simply because the w/r data for Spain are reported by year, while the data for England and Holland are averaged over longer periods. See Appendix 1 and 2.

1568-1588 and 1848-1868, while in Holland it fell by 57% over the same three centuries. It fell by only 9% in Spain over the same period, or hardly at all. Up to the mid-19th century, the European northwest underwent an impressive rise in inequality favoring the landed rich while Spain did not.

The second notable difference between Spain and the northwest lies with the modern era of globalization and industrial revolutions. Industrially-leading northwest Europe underwent a complete reversal in distribution trends after the mid-19th century, recording an egalitarian rise in w/r up to 1913 (and beyond). Spain did not. Whatever it gained between mid-century and the 1880s, it lost from then to 1913. While there is volatility in the Spanish w/r series 1850-1913, there is none of the secular trend reversal we see in northwest Europe, or at least if there was, then it was sharply reversed in the 1880s.

Figure 3 reports secular trends in the price ratio of agricultural to industrial products (P_A/P_M: 1750=100), using annual data wherever possible (the English data are however decadal up to the early 19th century, which explains why they are smoother than the other series). Figure 4 presents smoothed versions of these three series, generated using the Hodrick-Prescott filter, with a smoothing parameter of 300. England underwent a steady and impressive rise in the relative price of farm products (alternatively, a fall in the relative price of manufactures), recording about a tripling in P_A/P_M over the three centuries before 1800. The relative price of farm products also rose in Holland over the same period, although the magnitude of the increase was somewhat smaller, less than a doubling. There was also an increase in Spain between 1500 and 1800, although the long swings in relative prices were so pronounced there that it is hard to be sure that this was

in fact a trend. In both Spain and Holland there was an increase for the first century or so, followed by a decline, and then another rise during the 18th century. Relative agricultural goods prices seem to have fallen sharply during the Napoleonic Wars in both Spain and the Netherlands, which can presumably be attributed to the trade-destroying effects of that conflict making manufactures scarcer on the Continent (O'Rourke 2006). By the middle of the 19th century, relative commodity prices were stabilizing in all three countries, with declines in relative food prices in the Netherlands after the 1850s or so, in Spain after the 1880s, and (less obviously) in England after the 1840s, declines which might plausibly be attributed to the effects of declining transoceanic freight rates. However, in the Spanish case this eventual decline was preceded by several decades of rising relative food prices, which might perhaps reflect the somewhat later integration of Spanish markets with those of the rest of the world.

4. Estimating Spanish Productivity Advance 1568-1913 from the Price Dual

Using the Price Dual to Infer Productivity Trends

In order to assess the impact of Industrial Revolutionary forces on Spanish factor prices, we need some measure of industrial technological progress. Moreover, since Spain was primarily an agricultural economy for all but the very end of our period, we also need a measure of technological progress in agriculture if we want to explain trends in income distribution. To obtain such a measure, economic historians typically estimate total factor productivity growth, or the share of output growth not explained by the growth in factor inputs. In order to compute this, one needs data on such inputs as capital

stocks, which are increasingly difficult to obtain the further back in history we reach. Fortunately, price data offer an alternative called the dual (for a recent example, see Antràs and Voth 2003): total factor productivity can be calculated as the rate at which output prices decline relative to an appropriately weighted average of factor input prices. Since there exist relatively abundant factor and commodity price data for early modern Spain, we can calculate total factor productivity back to the late 16th century, for both agriculture and manufacturing.

More formally, let

(1) $Y = \mathrm{A}\ F(K, L)$

where Y is output, K and L are inputs of capital and labor respectively, and A is a measure of total factor productivity. If payments to capital and labor exhaust output, then it is a straightforward to show that

(2) $\Delta A = \Delta Y - \eta_K \Delta K - \eta_L \Delta L$

where Δ indicates growth rates, and the η_i are the shares of income going to factor i. Alternatively,

(3) $\Delta A = \eta_K \Delta r + \eta_L \Delta w - \Delta P$

where r represents real profits, and w is real wages. Equation (2) is the usual (primal) expression for the Solow residual or TFP growth: the difference between the growth rate of output and a weighted sum of the growth rates of factor inputs, with the weights being the shares of each input in total output. Equation (3) is our dual measure of total factor productivity growth: the difference between the growth in (value added) output prices and the weighted sum of the growth rates of *real* factor prices.

For agriculture, we take the two inputs to be labor and land. We have combined these using a Divisia Index, weighting land rents and agrarian wages by 0.35 and 0.65 respectively. Data on rents came from a variety of sources (see Appendix). In order to generate a national series we have weighted each regional rent series by the share of that region in total cultivated land.

Our manufacturing TFP series is based on the textile industry, the most important manufacturing activity during the period. The first step was to obtain a Divisia Index of value added, as opposed to gross output, prices. This was done by subtracting the growth rate of intermediate input prices from the growth rate of textile prices, with a weight for intermediate inputs of 0.35. As for factor prices, we have only used textile wages (with a weight of 0.65 in value added) up to 1850. Therefore, we implicitly assume that profits were constant over this early period. For the period after 1850, however, we have combined data on wages (with a weight of 0.65 in value added) and data on interest rates (with a weight of 0.35) using a Divisia price index.

The first panel of Figure 5 shows the evolution of TFP in Spanish agriculture from 1568 to 1913. The figure appears to correspond closely with the pessimistic view of Spanish agriculture surveyed in Section 2. Four periods are clear: (1) an initial contraction that lasted up to 1650; (2) a subsequent period of expansion over the following eighty years (1650-1730); (3) a second contraction that lasted up to the end of Napoleonic Wars; and (4), finally, a moderate 19th century expansion of TFP. Productivity gains in agriculture seem inversely related to the expansion of Spanish population up to the 19th century, perhaps indicating that when population grew, marginal and less productive land was exploited.

The second panel of Figure 5 documents the evolution of TFP in Spanish textiles from 1568 to 1913. Once again, the figure corresponds quite closely with the qualitative accounts of the Spanish economy reviewed in Section 2. The rate of growth of TFP in textiles was moderate up to the early 18th century, after which it experienced a slow acceleration, particularly during the second half of the 18th century. TFP stagnated during the turbulent first third of the 19th century, but then it increased dramatically as a consequence of the arrival of British machinery and the adoption of the factory system (Rosés 1998). After the cotton famine of the 1860s, textiles experienced a second phase of dramatic TFP growth before it was choked off by a crisis produced by the loss of colonial markets and consequent excess capacity.

5. What Determined Spanish Commodity and Factor Price Trends 1580-1913?

If sustained global commodity market integration only began in the 19th century, then it follows that while the distributional implications of international trade should not have been manifested in the centuries before, they should have afterwards. This hypothesis has been successfully tested using English factor endowments, commodity prices, productivity and factor prices from 1500 to 1936 (O'Rourke and Williamson 2005). Now we want to do the same for Spain. To do so, we have constructed time series 1580-1913 for land-labor ratios (LANDLAB, agricultural land in hectares divided by population), the ratio of agricultural prices to industrial prices (PAPM), the ratio of daily wage rates to farm land rents per hectare (WAGERENT), total factor productivity in agriculture (TFPAG), and total factor productivity in manufacturing (TFPMAN). The

sources of the total factor productivity data have already been discussed in the previous section, while the rest can be found in Appendix 2. Figures 6 and 7 present these five series as they are entered into the regressions below, that is in logarithmic form.

What Determined Spanish Commodity and Factor Price Trends Prior to 1800?

For the closed economy between 1580 and 1800, Table 1 estimates a simple log-linear OLS regression[2] of PAPM on land-labor ratios, TFP in agriculture, and TFP in manufacturing, Since LANDLAB is trend stationary, we include a time trend in all regressions. All coefficients have the signs that economic theory suggest they should, and typically have very high t-statistics: whenever there was population pressure on the land, it raised the relative price of farm products (the elasticity of PAPM with respect to the land-labor ratio ranges from -0.7 to -0.9); whenever there were improvements in agricultural total factor productivity, it lowered that relative price (the elasticity of PAPM with respect to TFPAG lies between -1.2 and -1.3); and whenever there were improvements in manufacturing total factor productivity, it raised that relative price (the elasticity of PAPM with respect to TFPMAN lies between 0.8 and 0.9).

In equation (1) we just include the land-labor ratio on the right hand side of the regression, and here the coefficient on the land-labor ratio is statistically significant at conventional levels. However, when an AR(1) correction is included in equation 2, as the Durbin-Watson statistic suggests it should be, the coefficient on the land-labor ratio becomes statistically insignificant. Part of the reason for this may be seen in Figure 6. Over the first 150 years or so, the land-labor ratio and PAPM appear to rise and fall

[2] Ordinary Least Squares is acceptable since logPAPM, logTFPAG, logTFPMAN and logWAGERENT are all stationary, while logLANDLAB is trend-stationary.

together, whereas they should be negatively related, *ceteris paribus*. In order to explain this apparent anomaly, we need to appeal to other factors, such as movements in total factor productivity in agriculture. Agricultural TFP declined and then rose over these first 150 years, which may explain the initial rise and then fall of PAPM. When TFPAG is included in the regression, the coefficient on land-labor ratios becomes statistically significant regardless of whether we correct for serial correlation (equation 3) or not (equation 4). Equation (4) is our preferred specification. Note that the R^2 is 0.97, suggesting that the closed economy model works very well, and that exogenous world market conditions had little influence on P_A/P_M over those three pre-modern centuries.

We can use the estimates in Table 1 to decompose the sources of those long cycles in P_A/P_M before 1800 (Figures 2 and 3), namely its sharp rise over the 16th century, its equally sharp fall across the 17th century, and the rise again to 1800. Figure 8 presents the movements in PAPM that according to equation (4) should have occurred as a result of changes in land-labor ratios and TFP in the two sectors. As can be seen, the most important influence on P_A/P_M appears indeed to have been total factor productivity in agriculture. As mentioned above, movements in the land-labor ratio were working to lower PAPM during the first fifty years of our sample, and to raise it thereafter, whereas in fact PAPM rose and then fell. Similarly, movements in TFPMAN served to lower and then raise PAPM, and were thus working in the 'wrong direction' for most of the period as well. The rise and fall in PAPM is thus completely accounted for by the fall and rise of TFPAG, at least until 1720 or so, when all three factors were serving to raise relative food prices.

What about wage-rent ratios in pre-19th century Spain? In a closed economy, a decline in land-labor ratios should lead to a fall in the wage-rent ratio, and for standard Malthusian reasons. Rising industrial productivity, due either to rising capital-labor ratios or to better industrial technology, should raise wage-rent ratios. The impact of better agricultural productivity on wage-rent ratios will depend on whether it was labor-saving or land-saving. Table 2 estimates these relationships by regressing the wage-rent ratio (WAGERENT) on endowments (LANDLAB), industrial productivity (TFPMAN), and agricultural productivity (TFPAG), for the years 1580-1800. (Once again, all variables are expressed in natural logarithms.) As hypothesized, the wage-rent ratio is positively related to the land-labor ratio (with an estimated elasticity of over 2.3 and a very high t-statistic). On the other hand, industrial TFP had no economy-wide impact on wage-rent ratios, consistent with the heavily agricultural orientation of the Spanish economy at that time. The wage-rent ratio *was* positively related to agricultural productivity (with an estimated elasticity of about 0.9 and with very high t-statistics), suggesting that farm-based productivity-enhancing technical change, organizational change or output mix change between arable and livestock tended to be labor-using and land-saving in pre-modern Spain. Interestingly, it was labor-saving and land-using for England during the same period (O'Rourke and Williamson 2005), a result which is consistent with the traditional literature on England, including the writings of Marx and Dobb. We urge others to offer explanations for this difference in English and Spanish factor-saving experience in agriculture.

What Determined Spanish Commodity and Factor Price Trends After 1840?

Now consider the determinants of relative commodity and factor prices after Spain went global some time in the 19th century. We analyze the issue econometrically for the period 1840-1913. As we argued in section 2, this period was chosen since it seems likely that the transition from a relatively closed economy to a relatively open one, in which relative commodity prices were effectively de-linked from domestic endowments, was only complete by about 1840. Our econometric analysis thus ignores the 40 years or so during which Spain underwent this globalization transition.

As before, stationarity tests (both augmented Dickey-Fuller and Phillips-Perron) indicate that wage-rent ratios, the relative price of food, and TFP in both manufacturing and agriculture were stationary during this period. However, the same tests unambiguously indicate that the land-labor ratio was non-stationary. The implication is that the land-labor ratio cannot have been a determinant of either PAPM or WAGERENT during this period. If relative commodity prices were no longer influenced by domestic endowments, this was presumably because, in the relatively open Spanish economy of the time, PAPM was primarily driven by world prices, and possibly Spanish tariff policies as well. The question thus becomes, what was the impact of these exogenous relative commodity prices on Spanish wage-rent ratios?

Table 3 estimates a (log-linear) open-economy model of the wage-rent ratio over the period 1840-1913. Once again simple OLS regressions are valid, given that all variables are stationary, although in regressions (1) and (3) we include a time trend to take account of any omitted variables, and in regressions (1) and (2) we include an AR(1) correction for serial correlation. In an open economy, WAGERENT could still be a

function of TFPAG and TFPMAN, but it should also be a function of relative commodity prices PAPM, which are now taken as exogenous in a newly globalized world. The specific factors trade model predicts that as the relative price of food declines, resources should be transferred out of agriculture, and land rents (returns to the immobile factor) should fall relative to wages (returns to the mobile factor): thus WAGERENT should be a negative function of PAPM. The model is confirmed: the estimated elasticity of WAGERENT with respect to PAPM ranges from -1.5 to -2.6, with very high t-statistics. TFPMAN now has a positive impact on WAGERENT, with estimated elasticities ranging from 1.3 to 2.8 and again with very high t-statistics. The fact that TFPMAN was now having an effect on economy-wide factor prices is consistent with the growing importance of manufacturing in Spain during this period: the share of Spanish employment accounted for by manufacturing, mining and construction rose from 12.8% in 1798 to 17.3% in 1860. Another important difference between the regression results for the pre-1800 and post-1840 periods concerns the impact of TFPAG, which had a positive impact on wage-rent ratios before 1800, but a negative impact after 1840, as Table 3 shows. This suggests that technological progress in agriculture switched from being labor-using and land-saving to being labor-saving and land-using, as was the case in England. The new results are consistent with conventional narratives of the Industrial Revolution, suggesting that unbalanced productivity growth favoring manufacturing should have raised WAGERENT.

6. Historical Counterfactuals

We can now turn to the issue of what explained the post-1840 trends in Spanish wage-rent ratios, in particular the rise through 1880 or so followed by the gradual decline until the outbreak of World War I. In order to do this, we take our preferred econometric specification in Table 3 (equation 1), and use it to ask three counterfactual questions. First, how would Spanish wage-rent ratios have behaved if the relative price of agricultural products (P_A/P_M) had remained constant between 1840 and 1913, rather than rising until the mid-1880s and then declining? Second, what would have happened if total factor productivity in Spanish manufacturing had remained constant after 1840, rather than rising as it actually did (with notable interruptions in the early 1860s and following the Spanish-American War)? And third, what would have happened if total factor productivity in Spanish agriculture had remained constant after 1840, rather than fluctuating as it did?

Figure 9 provides the answers to these questions. The top panel plots the actual movements in Spanish wage-rent ratios over the period (or more precisely, the predicted values emerging from equation 1), as well as the three counterfactuals also generated using that equation. 'Constant TFPAG' keeps TFPAG fixed at its 1840 level; 'Constant TFPMAN' keeps TFPMAN fixed at its 1840 level; and 'Constant PAPM' keeps PAPM fixed at its 1840 level. By comparing these three counterfactual with the actual series, the contribution of each of these three independent variables to Spanish wage-rent ratios can be assessed. These contributions are measured by the vertical distances between the actual and counterfactual series, and are given in the lower panel of Figure 9.

The first point is that it would have made little difference to Spanish wage-rent ratios if TFPAG had remained constant. This can be seen from the fact that the actual and 'Constant TFPAG' series are extremely close to each other throughout. The only point when the two diverge significantly is around 1880-85, when agricultural TFP was at its post-1840 nadir (Figure 7). The fact that the 'Constant TFPAG' series lies below the actual series in the 1880s indicates that the agricultural TFP slump was *raising* wage-rent ratios (as the negative coefficients on agricultural TFP in Table 3 indicate). For most of the period, however, the movements in agricultural TFP were simply too modest to matter much for economy-wide relative factor prices.

TFP in manufacturing, on the other hand, seems to have had an important impact on Spanish wage-rent ratios after 1840. Since TFPMAN was, for the most part, rising, WAGERENT should have risen due to this effect alone (the coefficient on Textiles TFP in Table 3 is positive). Thus, if manufacturing TFP had instead remained constant, Spanish wage-rent ratios would have been lower than they actually were, and Figure 9 suggests that this effect was very large. The vertical distance between the actual and 'Constant TFPMAM' series (plotted separately in the lower panel of the Figure) rises to a peak in 1860, before collapsing during the cotton famine; and then rises to another peak just before the turn of the century, before narrowing again. Industrial progress was serving to raise wage-rent ratios in Spain between 1840 and 1860, and again between the mid-1860s and 1880. It continued on balance to contribute to rising wage-rent ratios between 1880 and 1898, but then served to lower them thereafter. Movements in industrial TFP can thus help explain wage-rent ratio growth between the mid-1860s and 1880, and declining wage-rent ratios after 1898, but in other periods industrial TFP

movements were swamped by off-setting movements in PAPM. This was true between 1840 and 1860, and between 1880 and 1898.

PAPM trends were broadly upward until the mid-1880s, and broadly downward thereafter. Movements in PAPM should therefore have served to lower wage-rent ratios between 1840 and 1885 or so, and to raise them thereafter. Between 1840 and 1860, it seems that this negative PAPM effect was offset by the positive effect of TFP growth in manufacturing, and the net effect was a relatively stable wage-rent ratio. Between 1865 and 1885, the increase in PAPM served to lower wage-rent ratios sharply, as evidenced by the growing gap between the actual and 'Constant TFPAG' series in Figure 9. However, this effect was dominated by the rising industrial TFP between 1865 and 1880, with the agricultural TFP slump of the late 1870s and early 1880s playing a supporting role. The net impact was thus rising wage-rent ratios. From 1880 until 1898, buoyant PAPM put some slight downward pressure on wage-rent ratios, while it appears from the bottom panel of Figure 9 that movements in TFPAG and TFPMAN were canceling each other out. The net impact was thus a slight decline in wage-rent ratios. After 1898, falling PAPM was serving to raise wage-rent ratios, but this was dominated by the off-setting effects of falling manufacturing TFP.

It appears that Spanish and English experience after 1840 was different in one crucial respect: in Spain, movements in relative commodity prices and in industrial TFP were nearly always having opposite effects on wage-rent ratios, whereas in England rising industrial productivity and falling relative food prices both served to raise wage-rent ratios. In the Spanish case, there are four distinct phases. In the first phase (1840-60), industrial TFP growth raised WAGERENT, but PAPM rose in Spain sufficiently that

there was no great movement in WAGERENT either way. In the second phase (1865-1880), a rising PAPM continued to lower WAGERENT, but this effect was swamped by the combined effects of a rising TFPMAN and a *falling* TFPAG, with the result that Spanish wage-rent ratios rose during this period. In the third phase, movements in sectoral TFPs cancelled each other out, and the slight fall in Spanish wage-rent ratios was due to a continued high level of relative food prices (they rose prior to 1885 or so, and fell thereafter). From 1898 onwards, falling Spanish food price should have raised wage-rent ratios, like in Britain, but this effect was swamped by the economic effects of Theodore Roosevelt's implementation of his American manifest destiny, Spain's loss of her final American and Pacific possessions, and the resulting slump in Spanish manufacturing as her old markets evaporated.

Finally, what would have happened if 19th century Spanish relative prices and manufacturing productivity had behaved as they did in Britain? Figure 10 plots PAPM and TFPMAN (in log form) for both countries between 1840 and 1913. As can be seen, the long run trend in TFPMAN was very similar in the two countries, although the Spanish series is far more volatile.[3] It follows that the long run trend in Spanish wage-rent ratios would have been much the same if it had experienced British manufacturing productivity growth. Figure 11 shows that this is indeed the case where the 'English TFPMAN' counterfactual series is generated by substituting the English TFPMAN series for the Spanish one in equation (1) of Table 3. As can be seen, this counterfactual series is very close to the actual series (which repeats Figure 9).

[3] The TFPMAN levels are not in the same units, so the higher TFPMAN for Spain is an artifact. Britain, of course, had the technological edge in manufacturing at this time.

Relative prices are another matter. While PAPM fell in England after 1840, it rose dramatically in Spain, at least until the 1880s (Figure 10). The implication is that Spanish wage-rent ratios would have been much higher and would have increased after 1840 had Spanish relative agricultural prices fallen as they did in Britain. Figure 11 shows this to be the case (e.g. compare the 'English prices' counterfactual with the 'actual' series).

7. Concluding Remarks and an Agenda

We began this paper by asking whether Spain's relatively late industrial revolution, and her far more hesitant embrace of freer trade, might have mattered for Spanish income distribution trends, especially during the 19th century when countries like Britain made such a dramatic break with the past. The answer is most definitely yes. Just as with England, the sector-specific factors model provides a very good guide as to how endowments and technology determined the evolution of relative commodity and factor prices in Spain before 1800. Just as with England, endowments stopped determining Spanish commodity and factor price trends some time in the mid-19th century, indicating that Spain had switched to being a more open economy. Just as with England, industrial revolutionary forces helped push wage-rent ratios up in Spain during the 19th century, and just as with England wage-rent ratios were inversely related to the relative price of food, yet another indication of the relevance of Heckscher-Ohlin and Stolper-Samuelson economics for this phase of global economic history.

Why, then, did Spain not experience the same dramatic egalitarian rise in wage-rent ratios between 1840 and 1913 that Britain and the Netherlands did? The answer lies

with the fact that relative commodity prices and productivity growth in manufacturing had *off-setting* effects on wage-rent ratios in Spain, while in Britain they were *reinforcing*. For most of the post-1840 epoch, PAPM rose in Spain, instead of falling, and this exerted a drag on Spanish wage-rent ratios, which counteracted the positive effect of rising manufacturing productivity. When PAPM finally started falling after the 1880s, Spanish manufacturing went into a slump. Why did Spanish relative food prices rise so steeply up to the 1880s? Why did Spanish industrial productivity fall so sharply after the 1890s? Finally, to what extent was Spanish experience typical of the southern and eastern European peripheries during this first great age of globalization? We need answers to all three questions to understand the evolution of Spanish income distribution in the century before 1913.

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Data Appendix 1

1. Holland 1500-1913

1.1 Dutch Wage-Rent Ratio Series

Nominal Rents per Hectare (guilders): Holland 1500-1830 [1]. Background data to Graph 2, p. 74 in Jan Luiten van Zanden, "The Development of Agricultural Productivity in Europe 1500-1800," *NEHA-jaarboek* 61 (1998): 66-85. Data sent by van Zanden to the authors July 3, 2000 as an email attachment.
Nominal Rents per Hectare (guilders): the Netherlands, 1820-1910 [2]. Five-year averages starting 1820-24, average for all of the Netherlands, farm land and pasture, sent July 6, 2000 as an email attachment (along with description) from Arthur van Riel.
Nominal Land Prices per Hectare in Groningen (guilders): northern Netherlands, 1713-1914 [3]. Prices of farmland in Groningen, sent July 6, 2000 as an email attachment (along with description) from Arthur van Riel.
Nominal Daily Wage (Amsterdam, building trades), 1500-1910 [4]. H. Nusteling, *Welvaart en Werkgelegenheid in Amsterdam 1540-1860* (Amsterdam: De Bataafsche Leeuw 1985), Table 5.2, index R3 (weighted average of R1, carpenters, and R2, painters), pp. 255-7.
Nominal Daily Wage (Amsterdam), 1910-1939 [5]. D. J. van der Veen and J. L. van Zanden, "Real-Wage Trends and Consumption Patterns in the Netherlands, c.1870-1940," in P. Scholliers (ed.), *Real Wages in 19th and 20th Century Europe: Historical and Comparative Perspectives* (New York: Berg 1989), Table 8.6, pp. 227-8.
Linking the Wage-Rent Series 1500-1913. For 1500-1830, we construct wage-rent series as [4]/[1], interpolating over missing years. For 1820-1910, we construct the series as [4]/[2], interpolating over missing years. The two series are linked at the decade average over 1820-1830 = 1825. For 1910-1913, we construct wage-rent series [5]/[3], linking this extension to the previous series at 1910.

1.2 Dutch P_A/P_M Series

Nominal P_A and P_M: Holland 1500-1800. From Jan Luiten van Zanden, "What Happened to the Standard of Living before the Industrial Revolution? New Evidence from the Western Part of the Netherlands," in R. Allen, T. Bengtson, and M. Dribe (eds.), *The Standard of Living before the Industrial Revolution* (Oxford: Oxford University Press, 2005).
Nominal P_A and P_M Holland 1800-1913. From data file constructed by Arthur van Riel, *Prices of Consumer and Produced Goods, 1800-1913*.

2. England 1500-1913

2.1 English Wage-Rent Series

Nominal Rents per Acre (£): England 1**500-1831**. From G. Clark, "Land Rental Values and the Agrarian Economy: England and Wales, 1500-1912," *European Review of Economic History* 6, 3 (December 2002), pp. 281-308, Table 8; values are given for 1500-39 (taken to be 1520), 1540-59 (1550), 1560-79 (1570) and 1580-99 (1590); reported by decade for the 17th century; reported at 5 yearly intervals from 1700 onwards; interpolated geometrically to get annual; rents are assumed constant from 1500-1520, in line with the data on land and farmhouse rental values in G. Clark, "The Secret History of the Industrial Revolution," mimeo, October 2001, Table 2, p. 15.; and also in line with the data in R. C. Allen, "The Price of Freehold Land and the Interest Rate in

the Seventeenth and Eighteenth Centuries," *Economic History Review* XLI, 1 (February 1988), pp. 33-50.
Nominal Rents per Acre (£): England 1831-1870. From J. Thompson, "An Inquiry into the Rent of Agricultural Land in England and Wales during the Nineteenth Century," *Journal of the Royal Statistical Society*, LXX (December 1907), Appendix, Table A, p. 612.
Nominal Rents per Acre (£): England 1871-1900. An unweighted average of Thompson (1907) and H. A. Rhee, *The Rent of Agricultural Land in England and Wales* (London: Central Landowners Association, 1949), Appendix Table 2, pp. 44-5.
Nominal Rents per Acre (£): England 1900-1913. Rhee (1949).
Nominal Daily Wage (pence): England 1500-1670. Male day wages in agriculture, pence per day; reported decadal, interpolated geometrically to get annual. From G. Clark, "The Long March of History: Farm Laborers' Wages in England 1208-1850," mimeo, University of California, Davis (n.d.), Table 4, p. 26.
Nominal Daily Wage (pence): England 1670-1851. "Winter" farm wages, pence per day; annual. From G. Clark, "Farm Wages and Living Standards in the Industrial Revolution: England, 1670-1850," *Economic History Review* 54, 3 (August 2001), pp. 477-505.
Nominal Weekly Wage (shillings): England 1851-1902. Average weekly cash wages of ordinary laborers paid at 67 farms in England and Wales, shillings per week. From A. Wilson Fox, "Agricultural Wages in England and Wales During the Last Fifty Years," *Journal of the Royal Statistical Society* 66, 2 (1903), pp. 273-359 and Appendix II, pp. 331-2.
Nominal Weekly Wage (shillings): England 1902-1913. Bowley and Wood's index of average agricultural wages, England and Wales, in a normal week. Taken from B. R. Mitchell, *British Historical Statistics* (Cambridge: Cambridge University Press, 1988), pp. 158-9.

2.2 English P_A/P_M Series

Nominal P_A: England 1500-1640. "Average - all agricultural products," including grains, other arable crops, livestock and animal products; reported decadal, interpolated geometrically to get annual. From J. Thirsk (ed.), *The Agrarian History of England and Wales, Volume IV: 1500-1640* (Cambridge: Cambridge University Press, 1967), Table XIII, p. 862.
Nominal P_A: England 1640-1749. "Average - all agricultural products," including grains, other field crops, livestock and animal products; reported decadal, interpolated geometrically to get annual. From J. Thirsk (ed.), *The Agrarian History of England and Wales, Volume V: 1640-1750* (Cambridge: Cambridge University Press, 1985), Table XII, p. 856.
Nominal P_A: England 1749-1805. Wheat; reported decadal, interpolated geometrically to get annual. From P. Deane and W. A. Cole, *British Economic Growth 1688-1959*, 2nd ed. (Cambridge: Cambridge University Press, 1962),Table 23, p. 91.
Nominal P_A: England 1805-1913. Total agricultural products; annual. From Mitchell and Deane (1962), pp. 471-3.
Nominal P_M: England 1500-1640. "Industrial products"; reported decadal, interpolated geometrically to get annual. From Thirsk (1967), Table XIII, p. 862.
Nominal P_M: England 1640-1749. "Industrial products"; reported decadal, interpolated geometrically to get annual. From Thirsk (1985), Table XII, p. 856.
Nominal P_M: England 1749-1796. "Other prices" (equals unweighted average of Schumpeter's producer goods); annual. From Deane and Cole (1962), Table 23, p. 91.
Nominal P_M: England 1796-1913. Price indices of merchandise exports, annual (equals Imlah and Board of Trade). From Mitchell and Deane (1962), pp. 331-2.

Data Appendix 2

1. Spanish Wage-Rent Series 1568-1913

1.1 Nominal Rents: 1568-1820

The sources are: J. A. Álvarez Vázquez, *Rentas, precios y crédito en Zamora en el Antiguo Régimen* (Zamora: Colegio Universitario de Zamora, 1987); L. J. Coronas Vida, *La economía agraria en tierras de Jaén 1500-1650* (Granada: Universidad de Granada, 1994); M. Duran, *Renda i producció agraria a Catalunya, segles XVI-XVIII* (Barcelona: Phd Dissertation, 1984); A. García Sanz, *Desarrollo y crisis del Antiguo Régimen en Castilla la Vieja. Economía y Sociedad en tierras de Segovia, 1500-1814* (Madrid: Akal, 1977); M. González Mariscal, "Propiedades y rentas territoriales del cabildo de la catedral de Sevilla, 1524-1606. Primeros resultados y reflexiones" (Santiago: Congreso de la Asociación de Historia Económica, 2005); E. Llopis (personal communication); J. A. Sebastián Amarilla, "La renta de la tierra en León durante la Edad Moderna. Primeros resultados y algunas reflexiones a partir de fuentes monásticas," *Revista de Historia Económica* 8 (1).
The procedure for constructing the series is: First, the original regional series, commonly for wheat, have been converted into grams of silver with price data from E. J. Hamilton, *American Treasure and the Price Revolution in Spain, 1501-1650* (Cambridge, Mass.: Harvard University Press, 1934) and *War and Prices in Spain, 1651-1800* (Cambridge, Mass.: Harvard University Press, 1947) and G. Feliu, *Precios y salarios en la Cataluña moderna* (Madrid: Banco de España, 1991), and silver content of coins from Feliu. Second, we have taken log-growth rates of silver rents. Finally, we split these series into a national Divisia rent index with weights based on the distribution of cultivated land by regions in Spain from J. Simpson, *Spanish Agriculture: the Long Siesta, 1765-1965* (New York: Cambridge University Press, 1995). When several series are available for the same region (particularly Castile), we have taken an unweighted average of them.

1.2 Nominal Rents: 1820-1913

Average agricultural land prices are taken from M. A. Bringas Gutiérrez, *La Productividad de los Factores en la Agricultura Española, 1752-1935* (Madrid: Banco de España, 2000). These prices are converted into yearly series with data from M. A. Bringas Gutiérrez, I. Moral Arce, and M. J. Roca Castro, "Una estimación del precio de la tierra en Cantabria, 1860-1936. Primer ensayo" (Santiago: Congreso de la Asociación de Historia Económica, 2005). When data are not available on a yearly basis, we interpolate linearly to get annual. Finally, the land price data has been converted to rents by multiplying them by long-run interest rates. Interest rates are from P. Tedde de Lorca, *El Banco de San Carlos 1782-1829* (Madrid :Banco de España, 1988), P. Tedde de Lorca, *El Banco de San Fernando, 1829-1856* (Madrid: Alianza, 1999), and A. Carreras and X. Tafunell , *Historia Económica de la España Contemporánea* (Barcelona: Ariel, 2003).

1.3 Nominal Daily Wage in Agriculture: 1568-1913

1568-1756: Unskilled building workers taken from D. Reher and E. Ballesteros, "Precios y salarios en Castilla la Nueva: la construcción de un índice de salarios reales, 1509-1991," *Revista de Historia Económica*, XI, 1 (1993), pp. 101-151. All data were converted into silver content with data from Feliu.

1756-1913: Average wages for male agrarian journeymen taken from Bringas Gutiérrez. When data are not available yearly, we have used the Reher and Ballesteros data on unskilled wages to generate an annual series by means of Fisher indices.

1.4 Nominal Daily Wage in Textiles: 1568-1913

1568-1773: Barcelona's bricklayers wages in silver taken from Feliu.
1773-1830: Average wage for cotton printing in Barcelona taken from N. Mora, "El poder adquisitiu dels treballadors d'indianes a Barcelona, 1770-1816," in S. Castillo and R. Fernández (eds), *Campesinos, artesanos, trabajadores* (Lleida: Milenio, 2000), spliced with skilled building wages taken from Reher and Ballesteros, then converted to silver with data taken from Feliu.
1830-1850: Average wages in Catalan textile industry from J. R. Rosés, *The Early Phase of Catalan industrialisation, 1830-1831* (Phd. Dissertation, European University Institute, Florence: 1998).
1850-1913: Average male and female wage in cotton textiles taken from *La formación del mercado de trabajo industrial en la Cataluña del siglo XIX* (Madrid: Ministerio de Trabajo y Seguridad Social, 1995).

1.5 Benefit Rates in Textiles: 1850-1913

Wage rate series augmented with data on benefits taken from Carreras and Tafunell.

2. Spanish P_A/P_M Series 1568-1913

2.1 Agricultural Price Indices (P_A): 1568-1913

1563-1800: Price data are from Hamilton, *American Treasure* and *War and Prices,* converted into silver using Feliu.
1800-1850: Price data are from Reher and Ballesteros and J. Moreno, "El nivel de vida en la España atrasada entre 1800 y 1936. El caso de Palencia," *Investigaciones de Historia Económica* 4 (2006), pp. 9-51, converted into silver using Feliu.
1850-1913: Price data are from L. Prados de la Escosura, *El progreso económico de España, 1850-2000* (Madrid: Fundación BBVA, 2003).

2.2 Textile Price Indices (P_M): 1568-1913

1563-1800: Textile prices throughout. We have constructed value added price indices by subtracting from output prices intermediate prices multiplied by 0.35. Price data for outputs and intermediates are from Hamilton, *American Treasure* and *War and Prices,* converted into silver using Feliu.
1800-1850: Textile prices throughout. We employ the same method as with the earlier period. Output price data are from Moreno and J. R. Rosés, "Industrialización regional sin crecimiento nacional: La industrialización catalana y el crecimiento de la economía española (1830-1861)," *Revista de Historia Industrial,* vol.45 (2004), pp. 49-80. Intermediate prices are from Rosés and *Estadísticas Históricas de España* (Madrid: Fundación BBVA, 2005).
1850-1913: Price data are from L. Prados de la Escosura, *El progreso económico de España, 1850-2000* (Madrid: Fundación BBVA, 2003).

3. Spanish Population and Land Endowment 1580-1913

David Reher furnished us with his new calculations for Spanish population. Land endowments are obtained from Bringas Gutiérrez. When data are not available on a yearly basis, we linearly interpolated to get annual.

Table 1. Explaining Spanish Relative Price Trends, 1580-1800

	(1)	(2)	(3)	(4)
C	8.559157	9.086219	11.26068	11.34949
	(6.787755)	(2.522)	(31.11615)	(14.94844)
Land-labor ratio	-0.819977	-0.928576	-0.70076	-0.69853
	(-3.068204)	(-1.22603)	(-10.77433)	(-4.405322)
Agricultural TFP			-1.229826	-1.274845
			(-55.47668)	(-52.86637)
Textiles TFP			0.837795	0.878796
			(22.13732)	(22.43639)
Time trend	-0.002632	-0.002886	-0.002024	-0.002103
	(-4.188118)	(-1.504265)	(-10.92797)	(-5.509129)
AR(1)		0.737271		0.690661
		(14.73356)		(12.66281)
R-squared	0.057676	0.570168	0.940191	0.967626
Adjusted R-squared	0.049031	0.564199	0.939083	0.96687
S.E. of regression	0.343616	0.233137	0.086968	0.06428
Sum squared resid	25.73973	11.74018	1.633705	0.884242
Log likelihood	-75.99639	10.20064	228.6726	294.6652
F-statistic	6.671526	95.50749	848.8677	1279.254
Prob(F-statistic)	0.001541	0.00000	0.00000	0.00000
Mean dependent variable	4.557683	4.557495	4.557683	4.557495
S.D. dependent variable	0.352363	0.353156	0.352363	0.353156
No. of observations	220	220	220	220
Durbin-Watson stat.	0.524848	1.925827	0.655162	2.124138

Source: see text.

Table 2. Explaining Spanish Wage-Rent Ratio Trends, 1580-1800

	(1)	(2)	(3)
C	-10.62067	-10.68236	-10.32006
	(-8.58837)	(-8.769393)	(-13.95386)
Land-labor ratio	2.37889	2.379865	2.321565
	(9.457569)	(9.446505)	(16.37483)
Agricultural TFP	0.88101	0.879191	0.914572
	(15.86841)	(15.94741)	(20.72791)
Textiles TFP	-0.025411		-0.091084
	(-0.276703)		(-1.043521)
Time trend	0.001473	0.001388	0.001443
	(1.992187)	(2.065221)	(3.004587)
AR(1)	0.490084	0.491991	
	(8.226769)	(8.29993)	
R-squared	0.835424	0.835365	0.783284
Adjusted R-squared	0.831578	0.832302	0.779271
S.E. of regression	0.148305	0.147986	0.169395
Sum squared resid	4.706794	4.70846	6.198014
Log likelihood	110.7418	110.7028	81.33427
F-statistic	217.2618	272.7306	195.1741
Prob(F-statistic)	0.00000	0.00000	0.00000
Mean dependent variable	4.336815	4.336815	4.336887
S.D. dependent variable	0.361374	0.361374	0.360553
No. of observations	220	220	220
Durbin-Watson stat.	2.002592	2.002626	1.029213

Source: see text.

Table 3. Explaining Spanish Wage-Rent Ratio Trends, 1840-1913

	(1)	(2)	(3)	(4)
C	14.83904	18.8875	13.69862	19.14153
	(15.31393)	(17.19979)	(15.04668)	(21.64639)
PAPM	-2.001821	-2.170436	-1.52326	-2.629435
	(-10.06653)	(-11.10891)	(-7.633283)	(-14.29192)
Agricultural TFP	-2.249057	-2.292801	-2.047739	-2.553998
	(-15.04043)	(-15.78105)	(-12.74421)	(-18.66645)
Textiles TFP	1.773071	2.062152	1.248279	2.787771
	(7.187869)	(7.685314)	(5.977197)	(15.12632)
Time trend	0.013151		0.012335	
	(6.624447)		(9.625887)	
AR(1)	0.5489	0.89556		
	(5.155172)	(15.78971)		
R-squared	0.803718	0.763919	0.743965	0.842859
Adjusted R-squared	0.789285	0.750233	0.729123	0.836124
S.E. of regression	0.138221	0.150485	0.156716	0.121895
Sum squared resid	1.299146	1.562562	1.694632	1.040081
Log likelihood	44.5658	37.73487	34.73273	52.7949
F-statistic	55.68796	55.81822	50.1237	125.1529
Prob(F-statistic)	0.00000	0.00000	0.00000	0.00000
Mean dependent variable	4.34307	4.34307	4.34307	4.34307
S.D. dependent variable	0.301111	0.301111	0.301111	0.301111
No. of observations	74	74	74	74
Durbin-Watson stat.	2.263447	2.610977	1.139497	0.757638

Source: see text.

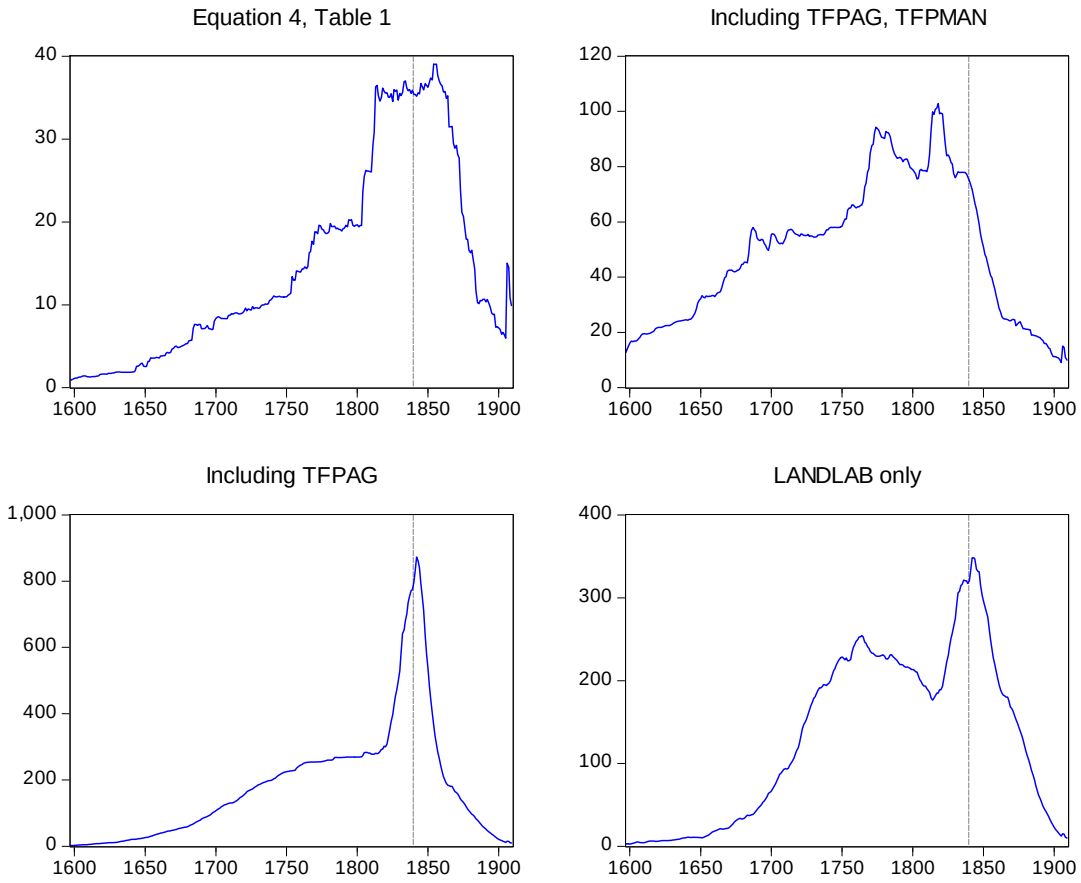


Figure 1. Chow test statistics, 1597-1909
Source: see text.

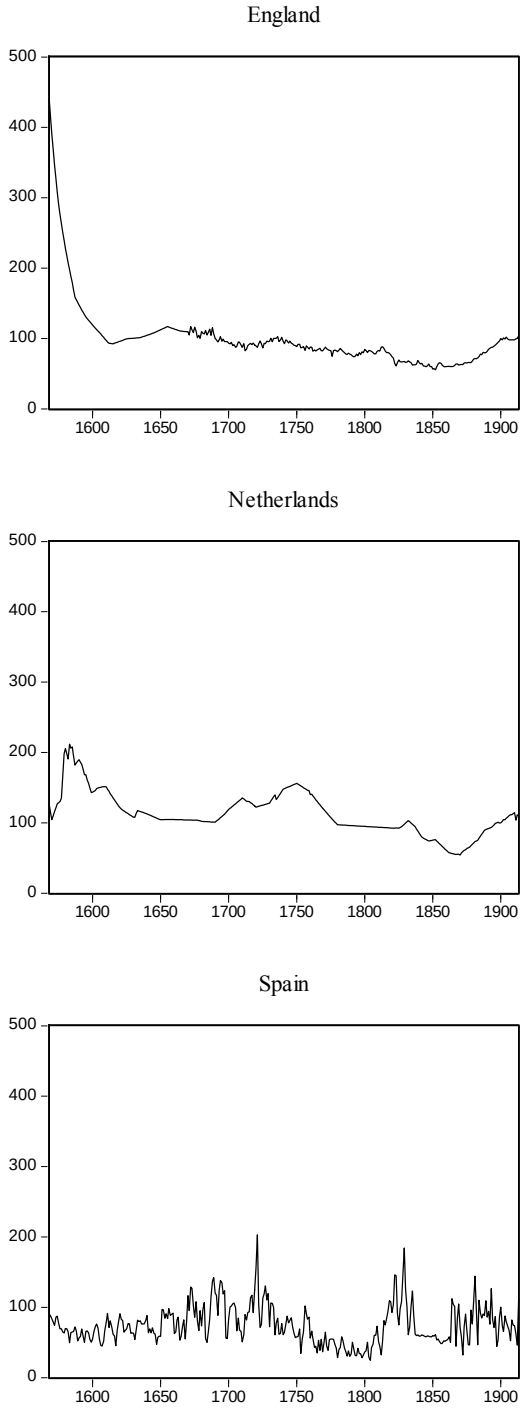


Figure 2. Secular trends in w/r: Spain vs. Northwest Europe, 1568-1913 (1900=100)
Source: Data appendices 1 and 2.

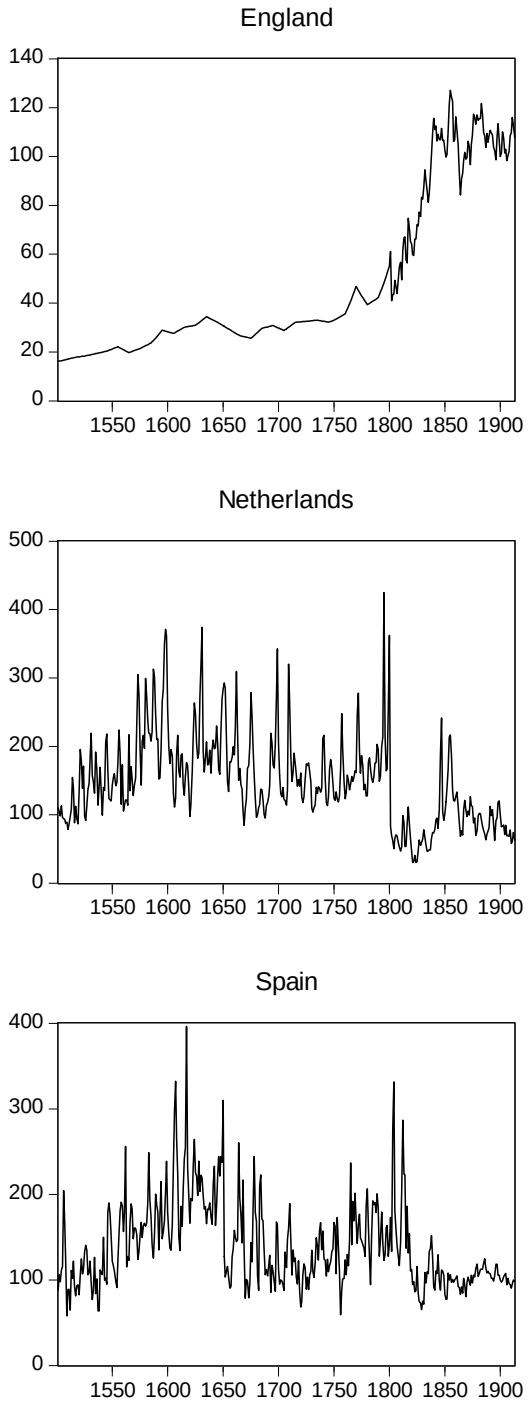


Figure 3. Trends in P_A/P_M, 1501-1913
Source: Data appendices 1 and 2.

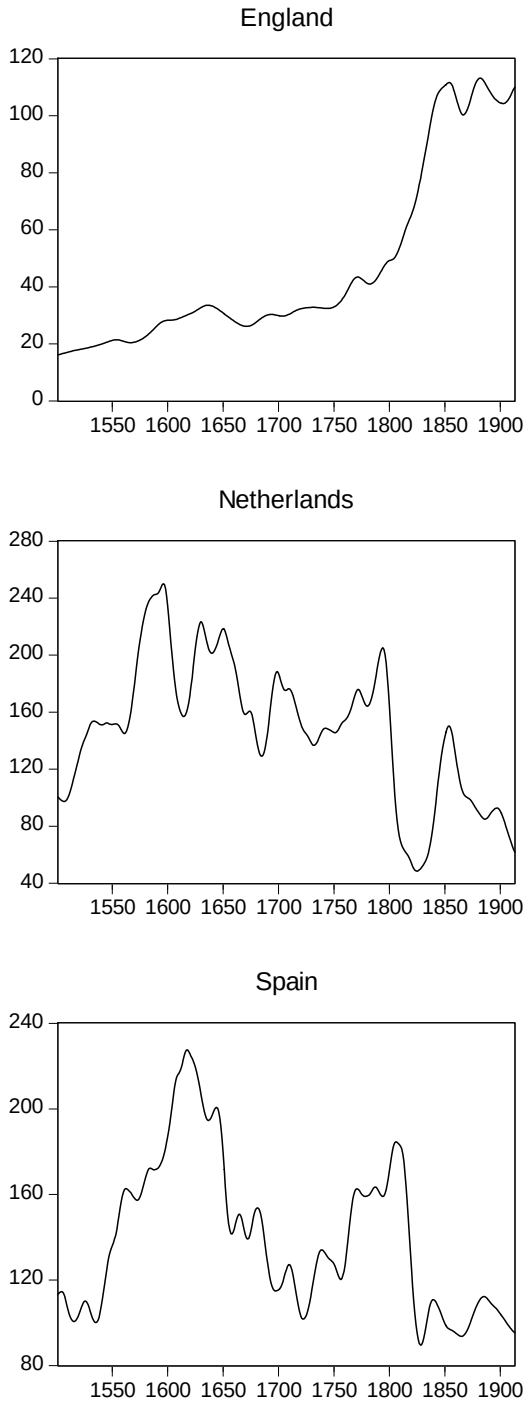


Figure 4. Smoothed trends in P_A/P_M, 1501-1913
Source: Data appendices 1 and 2.

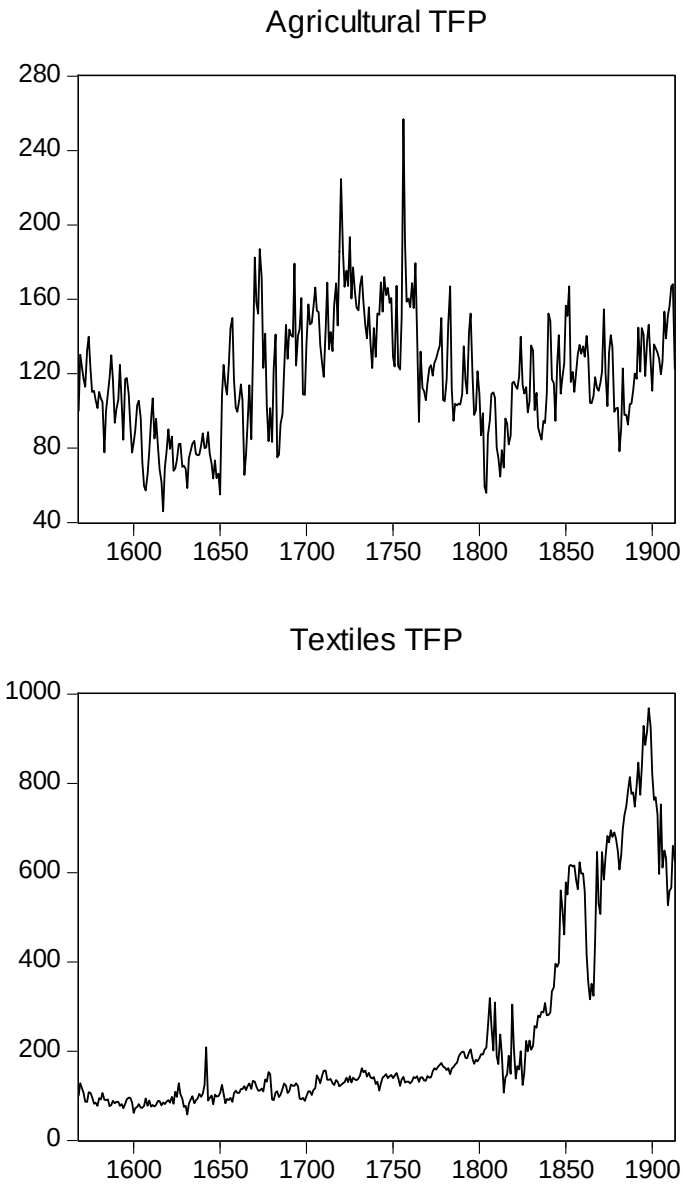


Figure 5. TFP in agriculture and textiles, 1568-1913 (1568=100)
Source: see text and data appendix 2.

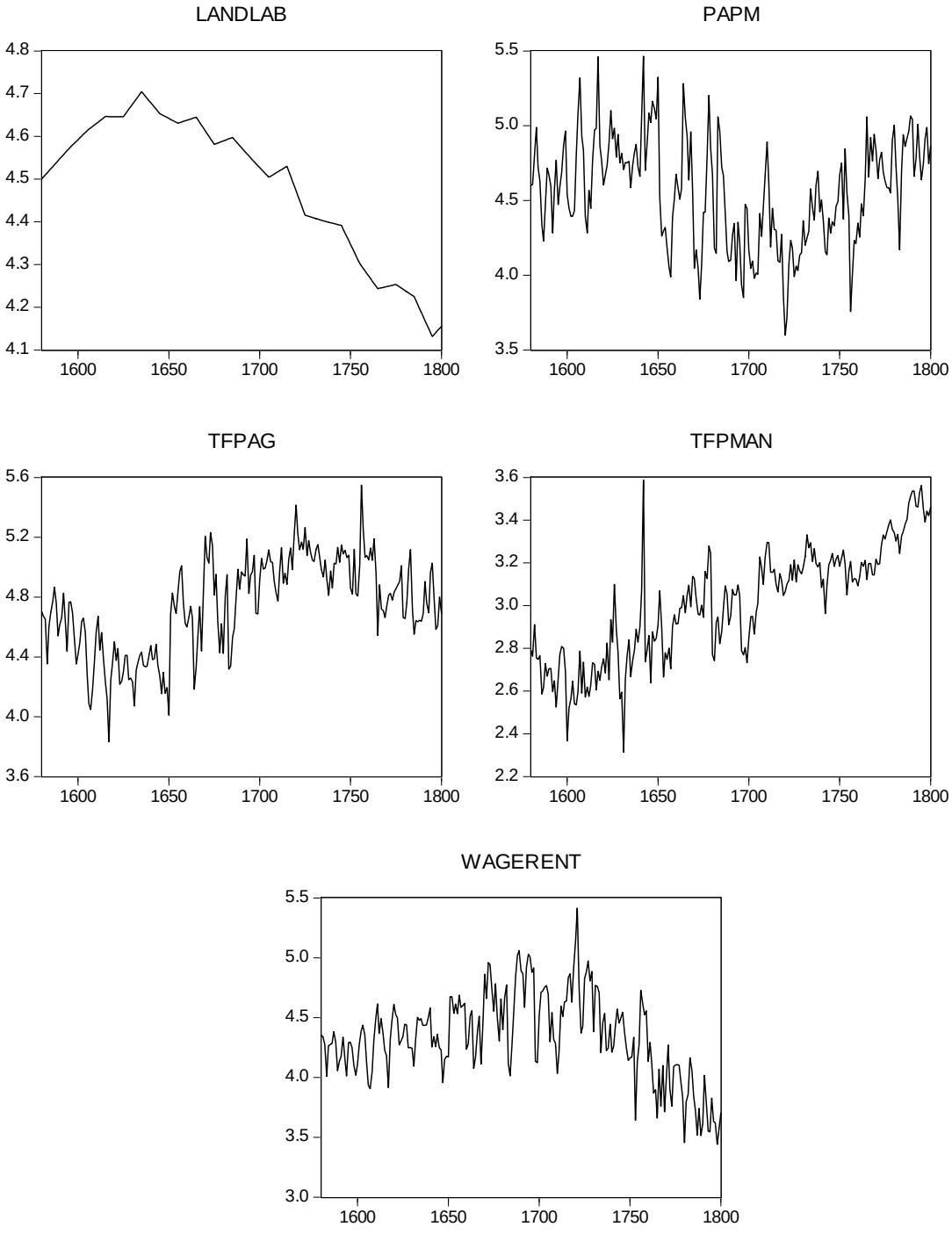


Figure 6. Regression data, 1580-1800 (logs)
Source: Data appendix 2.

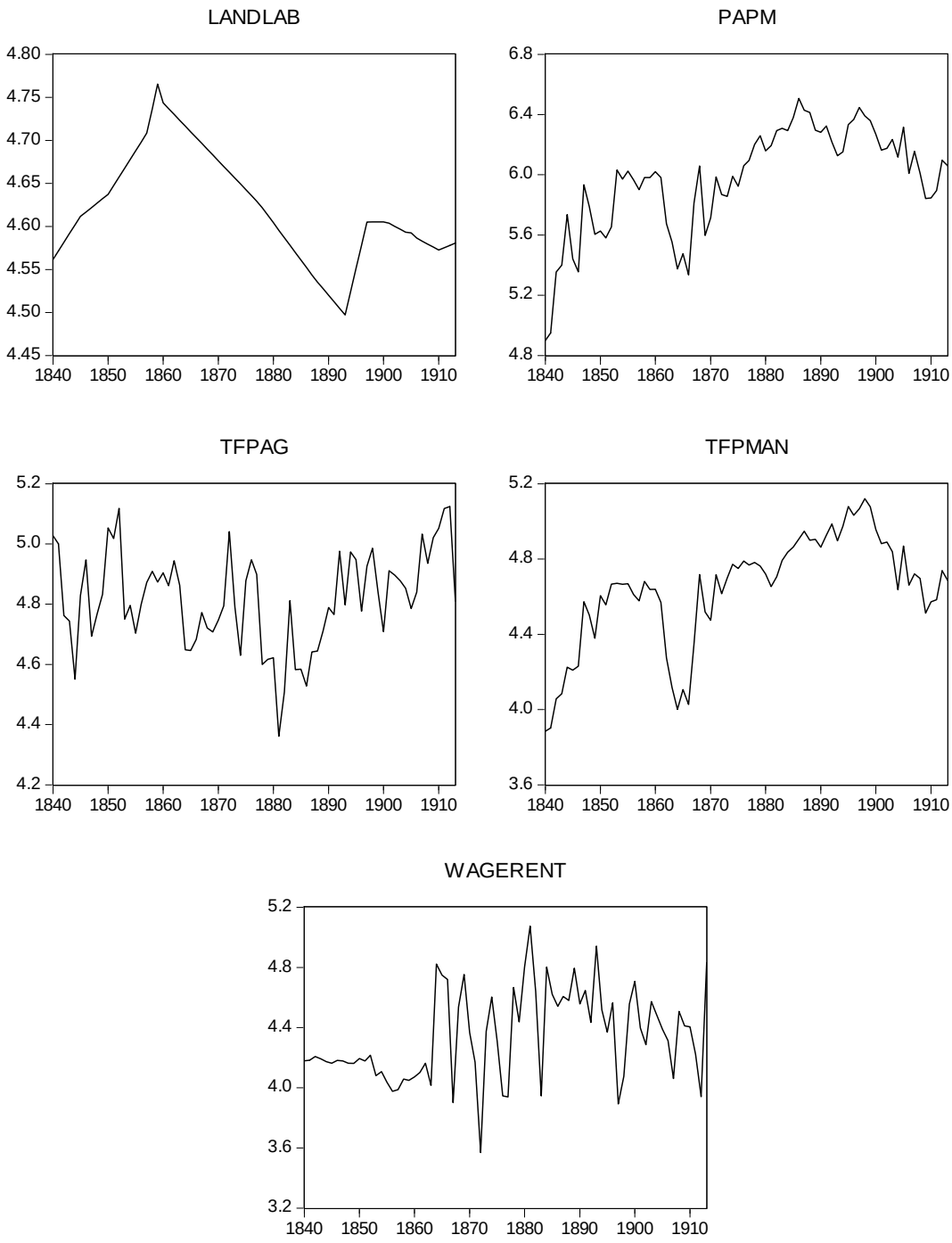


Figure 7. Regression data, 1840-1913 (logs)
Source: Data appendix 2.

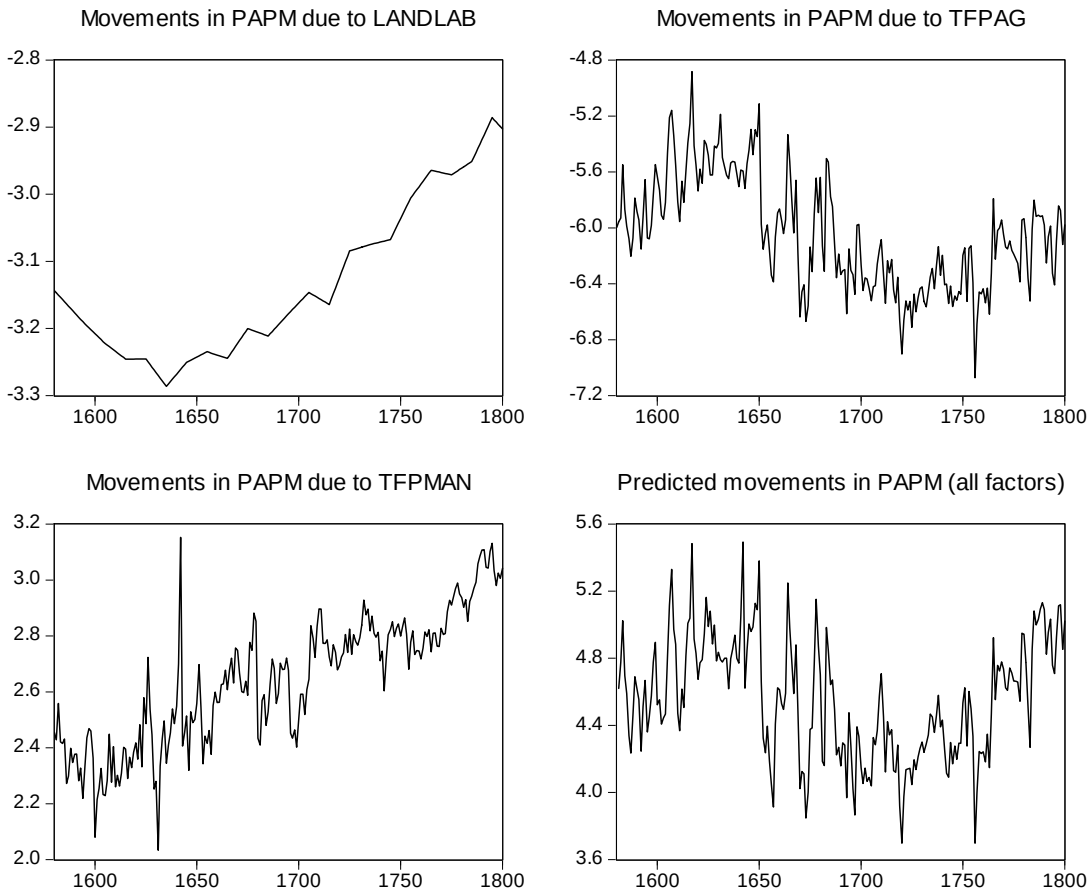


Figure 8. Decomposing trends in PAPM, 1580-1800
Source: see text.

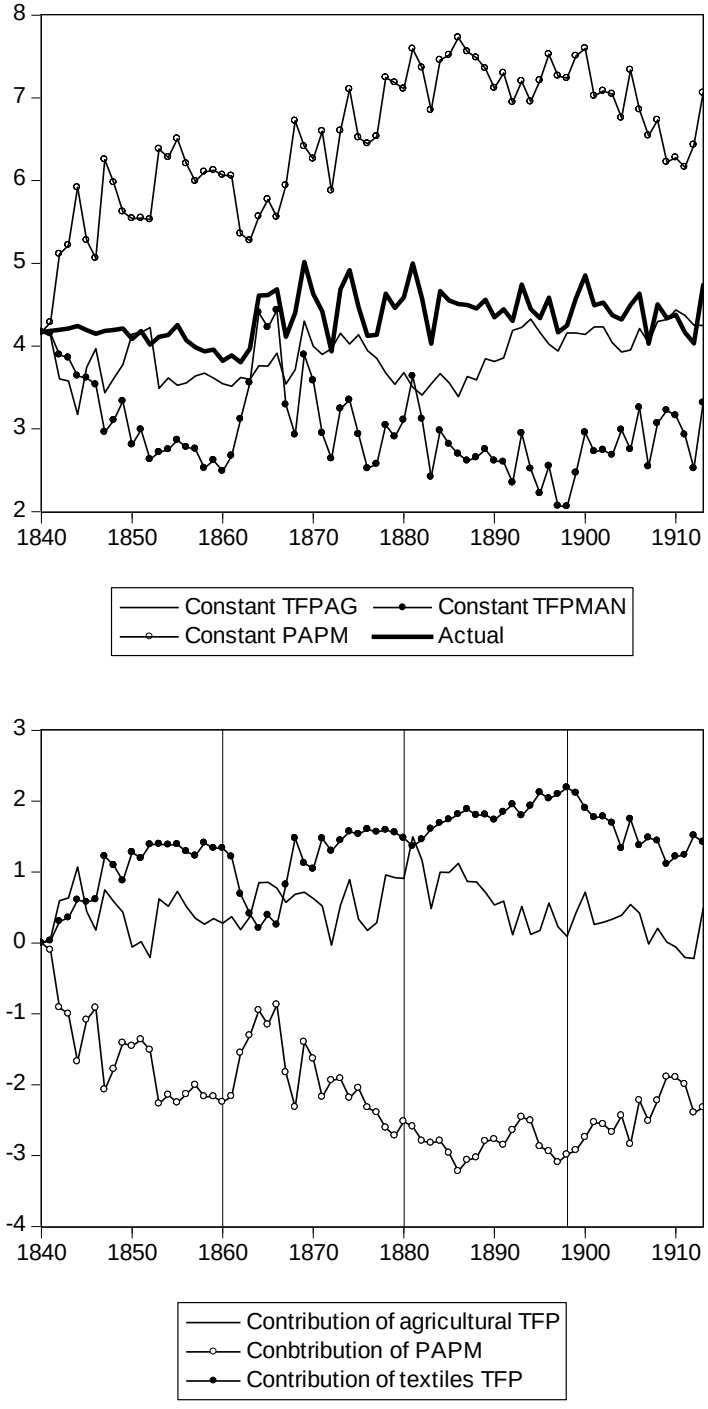
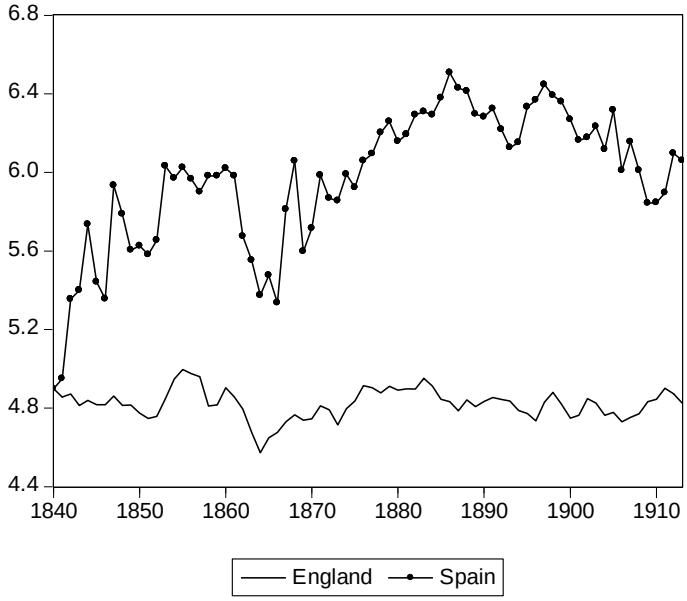


Figure 9. Counterfactual analysis and decomposing the sources of wage-rent ratio changes, 1840-1913
Source: see text.



PAPM

TFP in manufacturing

Figure 10. Spanish and English prices and productivity
Source: Data appendices 1 and 2.

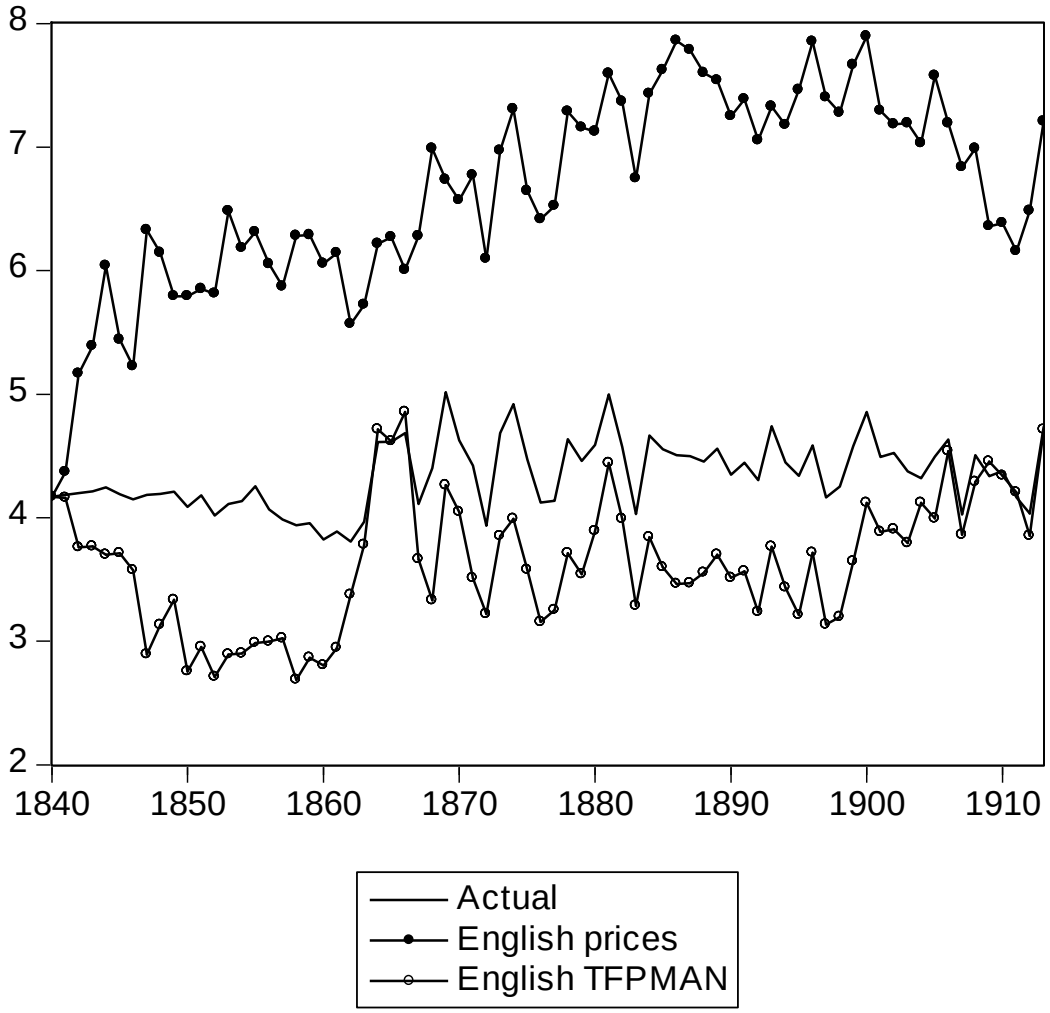


Figure 11. Counterfactual analysis: Spain vs England
Source: see text.

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