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Keywords: The European Little Divergence, Early Modern Economic Growth, Economics of Empires
JEL Classification: N10, N13, N70, N74, O47, O57

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Newly assembled macroeconomic statistics for early modern Portugal reveal one of Europe's most vigorous colonial traders and at the same time one of its least successful growth records. Using an estimated model in the spirit of Allen (2009) we conclude that intercontinental trade had a substantial and increasingly positive impact on economic growth. In the heyday of colonial expansion, eliminating the economic links to empire would have reduced Portugal's per capita income by roughly a fifth. While the empire helped the domestic economy it was not sufficient to annul the tendency towards decline in relation to Europe's advanced core which set in from the 17th century onwards. We conclude that the explanation for Portugal's long-term backwardness must be sought primarily in domestic conditions.

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1. Introduction

> What new disaster dost thou here design?
> What horror for our realm and race invent?
> What unheard dangers or what deaths condign,
> Veiled by some name that soundeth excellent?
> What bribe of gorgeous reign, and golden mine,
> Whose ready offer is so rarely meant?
> What Fame has promised them? what pride of story?
> What palms? What triumphs? What victorious glory?
> (Camões/Burton 1572 [1880], 171)

Thus spoke the "old man of Restelo", an apocryphal character in *The Lusiads*, Portugal's national epic by Luis Vaz de Camões, concluded around 1556. In this fulmination against Fame and Glory, he gave voice to those who, in the early years of Empire, doubted the success of Portugal's overseas expansion and believed it would be detrimental to the development of the metropolis. His diatribe has not been forgotten since and resonates still throughout the historical literature.

In this paper, we test the "old man's" proposition with a study of the impact of Portugal's colonial trade on its economy throughout the Early Modern period. Our aim is to come up with a fresh answer to the question posed by O'Brien and Prados de la Escosura (1998a, p.33), as well as many others: just how important were colonies for the development of the home economies?

Towards this goal, we use an extensive new database for Portugal which includes three centuries of estimates of variables such as the real wage, urbanization rate, and intercontinental trade. Its development from scratch is necessary since previously available estimates are unsatisfactory in their methodology and insufficient in terms of the evidence on which they are based. Our first conclusion is that Portugal was a consistent leader among Early Modern colonial powers in terms of the value of per capita trade with its colonies. The second is that the impact of the empire on Portugal's economy was small in the early fifteen hundreds, grew steadily over time and reached a substantial level around 1800. The third is that, nevertheless, this boost to growth was insufficient for Portugal to converge to the leading nations of the time - Britain and the Netherlands - themselves great colonizers.[1]

It has been widely accepted, ever since the sixteenth century, that overseas empires were set up by Europeans principally with a view to material gain, a subject which has spawned a vast literature (Engerman 1998; Findlay and O'Rourke 2007). The part of this literature which focuses on the economic consequences for the mother countries has yielded a remarkable empirical harvest. Nevertheless, it has had limited success in establishing a consensus regarding the true nature of the relationship. Even in terms of the scale and direction of this effect, conclusions range widely, from negative to positive, and from small, or insignificant, to large and even critical to the economic performance of the colonizing nations.

According to the Marx-inspired analyses of the 1960s and 1970s, the outcome for the world's core economies was both large and beneficial. This enabled them to amass immense resources at the expense of their colonies and to channel them into long term growth and industrialization. For the lesser powers, however, the return was small

[1] For an overview of Portuguese imperial history, see Bethencourt and Curto (2007).

and possibly harmful (Wallerstein 1974; Braudel 1980). The cliometric response was to assemble an abundance of data and demonstrate that the value of transoceanic commerce was at best modest and that colonies were largely irrelevant as sources of raw materials, investment capital and demand for home manufactures (Thomas and McCloskey 1981; O'Brien 1982).

Lately, the pendulum has swung back towards recognition that colonies may have made a significant and positive difference. The once "discredited" notion (Mokyr 1985, p.74) of a strong association between overseas and home economic expansion has had its reputation restored thanks to the rediscovery that "the intercontinental trade boom was a key development that propelled North-western Europe forwards" (Allen 2003, p.432).

Yet from the standpoint of what were the ultimate causes, a good deal of disagreement remains. A political economy approach has emphasized the differential role of empire in the institutional development of the metropolis and the contrasting long run repercussions of this for the respective home economies (Davis 1973; Acemoglu et al. 2005). A related line of work has stressed the value of colonies in terms of the influence they conferred upon imperial nations in the European theatre of military and political competition (Findlay and O'Rourke 2007). Cliometricians, on the other hand, have focused on the direct linkages between colonial and home economies when they estimate the counterfactuals which are the kernel of their analyses. A recent strand within this has paid particular attention to the role of the *entrepôt* trade and its ramifications in driving structural change in the home countries (Daudin 2006).

The present case-study contributes in several ways to the "economics of empire" literature. First, while a great deal of research has concentrated on the Netherlands and Britain, typically seen as success stories, with Portugal we provide a much needed counterweight to this predominance of north-western European examples (O'Rourke, Prados de la Escosura and Daudin 2010). Secondly, we place ourselves firmly in the cliometric camp, but measure the impact of the empire on growth with a dynamic model, instead of with the habitual static, partial equilibrium method. Thirdly, our new and extensive macroeconomic database enables us to carry out this assessment for all the relevant countries and all the way back to 1500, over several benchmarks. This is better than concentrating only on a short period in the late 18th century, as usually occurs, since it allows us to grasp the long-run dynamics of empire better than if we relied on a single historical snapshot.

2. Portuguese economic performance: past interpretations, new data

The first requirement for a study such as this is to establish an accurate picture of Portugal's economic growth between 1500 and 1800. Unfortunately, few modern studies have focused explicitly on the country's long-term economic growth before the nineteenth century. Fewer still have used standard quantitative indicators, such as the real wage or GDP per capita, for this purpose. Notwithstanding, a consensus has emerged which considers that throughout the Early Modern period Portugal was chronically in the grip of economic stagnation and any gains in per capita economic growth were ephemeral and quickly dissipated. Godinho, the doyen of Portuguese economic historians, has stated that "the notion of decadence has shaped the great majority of historical studies on Portugal written during the nineteenth and twentieth centuries" (1968, II, p.232).

Explanations for this lacklustre performance fall into three categories.[2] One emphasizes the country's relegation, after 1500, to a semi-peripheral role in the international division of labour of the Modern World-System (Wallerstein 1974, 1980). This imposed an excessive reliance on foreign capital and commercial services (Mauro 1983, 1990), shipping (Rau 1954), and imports of manufactures (Sideri 1970), which inevitably stunted the most dynamic sectors. The second was the archaic and technically stagnant agricultural sector which struggled in vain to overcome the Malthusian trap and kept the mass of the population at the lowest levels of consumption (Justino 1981; Magalhães 2010; Oliveira 1980). The third was the empire.

The colonial system has been for many the most important determinant of long-term economic backwardness. Successive overseas booms diverted resources and entrepreneurship from home manufacturing and held back the diversification of the economy (Godinho 1955; Macedo 1982). Agriculture languished due to the drain of its labour caused by the attraction of employment conditions in the empire or in the major port cities which serviced it (Sérgio, [1927] 1984). Meanwhile, the riches which flowed from the colonies made foreign foodstuffs more accessible, which crowded out domestic agriculture and prevented its improvement (Pedreira 1994). The inflow of colonial wealth had further deleterious effect. It promoted the emergence of a bloated, parasitic tertiary sector. This discouraged the rise of a development-minded national bourgeoisie which was capable of spearheading a change in structure based on manufacturing rather than on intermediation (Godinho 1978).

Revisionist studies have lately suggested a less sombre portrayal. Serrão (2009) has argued that during the seventeenth and eighteenth centuries the expansion and market integration of agriculture increased its specialization, internationalization, and technical progress.[3] Pedreira (1994) and Madureira (1997) have similarly claimed significant extension and technical change in manufacturing, particularly from the 1770s, under the impulse of rising colonial demand. Pedreira (1995) has also drawn attention to the rise, in the late 18th century, of a dynamic new merchant class characterized by unprecedented levels of wealth and technical sophistication.

This approach has been reinforced by two recent efforts to quantify long run per capita GDP which have challenged traditional views on Portuguese economic stagnation. Maddison (2001) has estimated an increase of 52 per cent in this variable between 1500 and 1820 and Valério (2010) has obtained an even higher figure – a rise of 72 per cent for the period 1500-1800. Both findings are problematic, however. One reason is the weakness of their empirical support. Maddison's study uses an estimate of Castille's long run GDP to represent the whole of Spain and, by extension, of Portugal. Valério's employs one indicator alone – urbanization – to proxy GDP. This ignores the fact that long-run changes in economic structure or in sector productivity might have had a significant impact on the result of the exercise.

The second problem regards the plausibility of such a dynamic portrayal when it is compared to other nations. In particular, the study of Holland (van Zanden and van Leeuwen 2012) shows that during roughly the same period (1510-14 to 1807-8), GDP per capita grew to a similar extent, that is, by 60 percent. How likely is it that this "first modern economy" (de Vries and van der Woude 1997), with one of the highest

[2] For the most recent and up-to-date survey of Portuguese economic history, see Costa et al. (2011).
[3] Santos (2003) has argued the same for the large-scale, commercialized farming of southern Portugal and Oliveira (2002) has done so for the Beira Alta, a northern region of micro-farming.

levels of capitalist development of the Early Modern period, would have had a similar growth performance to that of Portugal?

To surmount these problems, we propose a new indicator of Portuguese macroeconomic performance. It is derived from an entirely new data set[4] comprises prices, wages and rents, and is drawn from the usual archival sources.[5]

Of the possible options for our purpose, ideally a GDP series would be best since if properly quantified, it captures the economic activity of all factors of production throughout the economy. In spite of this, for present purposes we use real wages as a proxy for real per capita income. There are three justifications for this. The most important is international coverage. For econometric reasons, the dataset we use to estimate our model (see section 4) must not be too small. In the case of real wages, data are available for the nine countries in Allen's original sample plus Portugal. In that of real GDP, thorough and comparable estimates of GDP, however, have yet to be undertaken for four of them: Poland, Austria, France and Belgium.[6]

The second reason is that while there is a wide consensus regarding the best way to calculate real wages in the Early Modern period, the same cannot be said for GDP. Estimating the latter calls for a larger and more important number of assumptions and consequently multiplies the degree of discretion involved in the process.[7] Finally, as Williamson has pointed out, the deflators for these two yardsticks can diverge appreciably and this "may matter a great deal" (1995, p.143), an argument echoed by Allen, when he concludes that, all things told, in this epoch "income [...] is best measured by the real wage" (2003, p. 406).

We construct real wage series for skilled and unskilled labour following a widely adopted methodology (Allen 2001; Malanima 2011). Nominal wages, which are mainly from the building sector, are drawn from Portugal's leading city – Lisbon – and deflated by a CPI constructed on the basis of a constant basket of consumables, which includes both foodstuffs and manufactures. The standard of reference consists of the price and consumption pattern of Strasbourg in the decade 1745-1755. This allows us to compare Portuguese real wages with those of other countries across Europe.

Figure 1 displays real wage indicators for Portugal from 1500 to 1800. The most salient feature is the pronounced decline in the standard of living in Portugal during the Early Modern period. Skilled labour performed slightly better than unskilled but severe deterioration - of the order of 50 percent - was experienced in both cases. This came about in three stages. The first occurred during the initial one hundred and fifty years. It was followed by a recovery from the mid-seventeenth to the mid-eighteenth centuries. Finally, in the last half century under consideration a sharp decline took place again. A second point is that these data amply corroborate the traditional view of an era of "decadence" in Portugal's macroeconomic fortunes. The third is that although the (implicit) skill premium is not constant over time, it has no trend. This suggests

[4] These data have been compiled in the context of the project "Prices, Wages and Rents in Portugal, 1300-1910" funded by the Portuguese Fundação para a Ciência e Tecnologia. The original figures can be consulted at http://pwr.dev.simplicidade.com.pt/000000/1/index.htm.

[5] To ensure homogeneity, data are expressed in grams of silver and standardized in the metric system.

[6] The remaining countries in this set are England, the Netherlands, Italy, Spain and Germany.

[7] Examples of this discretion are the choice of food demand elasticities; alternative ways of obtaining per capita income to use in the agricultural demand function; and different ways of interpolating a proxy for non-agricultural output.

that using one or the other wage series to represent per capita income makes little difference. We adopt the skilled labour wage for the sake of consistency with the international data set which we make use of here.

FIGURE 1 HERE

Figure 2 shows how the Portuguese economy fared in comparison with the international context. The country emerges as a member of the group of Early Modern "less successful" economies – along with Italy, Spain, Austria, Germany and France – which underwent substantial real wage deterioration, of around 50 per cent over the course of these three centuries. The "leading" ones – England and the Netherlands – failed to grow overall but withstood Malthusian pressures and consistently experienced relatively high wage levels (Allen et al. 2012). In a European mirror, Portugal's Early Modern economy was thus hardly a case of unusual backwardness. What makes it stand out is that it combined a low level of income with a significant colonial system and this raises the issue of whether the latter was a help or a hindrance to its long-term economic performance.

FIGURE 2 HERE

3. The contribution of empires to economic growth: how should we measure it?

In this section we consider two methodological choices. The first regards the best way to measure the material benefits accruing to European powers from their possession of empires. The second concerns which is the most appropriate model for estimating the quantitative nature of the relationship between these gains and national income.

3.1. The choice of metric

Colonies were beneficial to the home country in many ways. They allowed the mobilization of unused natural resources situated overseas, thereby creating some slack in Europe's Malthusian constraint. They helped to reallocate underutilised domestic resources to the same destination and thus enhanced their productivity. They created new markets to serve as outlets for domestic production and as a result promoted scale economies and the division of labour. Thanks to the use of political and military might, imperial powers were also able to earn rents by distorting price mechanisms in the markets strung out along the chains of supply which connected them to their ultramarine possessions.

To encompass this diversity within a simple metric is no easy matter. One solution is to calculate separately the gains and losses from the many relevant types of activity, and then weight and aggregate those using appropriate prices. The alternative is to employ as a proxy a value index of each country's total transoceanic trade and deflate it with a suitable set of commodity prices.

In order to cohere with the specifications of Allen's model (2003), we opt for the latter. This leads us to define our yardstick as total exports of products of the mother country to the colonies plus the commodities sent by the colonies to the mother country. Consequently, it excludes two major items of trade: exports to the colonies of goods produced in countries other than the metropolis, and re-exports of colonial commodities whether processed or not in the home economy. The assumption underlying this choice is that inter-oceanic trade was the principal conduit through

which the material benefits of empire were funnelled to the home country. Although this supposition does not appear far-fetched, it is important nevertheless to assess what it entails.

Our preferred approach has several advantages. It is simple, easy to construct and requires relatively small data inputs. On the negative side, two aspects have to be weighed. One is the exclusion of re-exports, which entails disregarding the profits of both the *entrepôt* trade and of processing of these commodities before re-export. Since both were high, the distortion might be significant.[8] Including re-exports, however, would also be distortive in the opposite direction, as it would mean double-counting on a similarly sizeable scale. It seems likely that the difference between the two scenarios will not be large, although this cannot be said with certainty.

The second drawback of a "simplified" trade-based proxy for the gains from empire is that it ignores non-trade items such as remittances, investment and income from capital. Whilst these are pertinent, direct evidence regarding them is not easy to come by. Given the nature of mercantilist relations and the consequent close integration of home and colonial markets, it seems probable that colonial development varied commensurately with the flows of capital and colonisers arriving from the mother country, as well as with their earnings. This makes it likely that these invisible flows would have been highly correlated with trans-oceanic trade and therefore reasonably proxied by it.[9]

In view of the decision to treat transoceanic trade flows as a key variable in our research strategy, it is important at this point to examine comparatively its main features. Figure 3 assembles the available data for Portugal and the four other principal colonial nations – England, France the Netherlands and Spain – and displays their respective values at 1700 prices for five different benchmarks. Observations are standardized by the respective metropolitan populations, to render them comparable. In the cases of Portugal and Spain, we show two versions of this indicator, one including precious metals (#1) and the other without them (#2). Recognition is thus given to the importance of these items in their overseas trades. At the same time, this allows for the point of view of those for whom American gold and silver should be treated as "loot" (Allen 2003; O'Brien 2005) and therefore left out of these calculations.

FIGURE 3 HERE

Several conclusions can be drawn from these data. The first is that over the Early Modern period, trans-oceanic trade volumes varied considerably across time and from empire to empire. The second is that inter-colonizer variations do not fit well into any logic either of metropolitan population size or of degree of economic development. The third is that before 1800 the per capita trade of Portugal with its colonies was consistently one of the most significant among the "Atlantic traders". It trended upward from the dawn of empire to the mid-18th century by a factor of 300 per cent (or 200 per cent without gold), and declined slightly (24 per cent) in the last fifty years

[8] For the late eighteenth century, Pedreira (1994, 273) estimates that the mark-up on the prices of colonial imports for the three most important Brazilian re-exports – sugar, hides and cotton – was around 50 percent. In terms of the share of imports from Brazil which were re-exported, the order of magnitude was, for sugar, at least 80 per cent and, for tobacco, circa 70 per cent (Mauro 1983; Macedo 1982).

[9] Empirical corroboration for this hypothesis for the Early Modern period is hard to come by but some is provided by Cuenca Esteban (2004, 48-9).

of the period. In the sixteenth century, when Spain was its only rival, it far outdistanced it. At the turn of the seventeenth to the eighteenth centuries, it was overtaken by the Netherlands but stayed ahead of England, Spain and France. It led all the colonial nations again in the mid-1750s and fell behind England and the Netherlands in the second half of this century.

3.2. The choice of model

Estimating the impact of colonies on imperial economies is normally carried out by means of counterfactuals. There are two ways of doing this. One is a static, partial equilibrium approach. The other is a dynamic, general equilibrium one.

The use of the first dates back to the early stages of the cliometric revolution. It compares the income of the mother country at a given historical moment with that of a hypothetical situation in which the empire did not exist. Once this has been standardized by a macroeconomic yardstick, the differential between them measures the empire's contribution to the welfare of the metropolis. Two procedures have been used to implement this strategy. One compares the social rate of return from the actual investment made by the home country in the colony with the yield obtainable elsewhere with the same stock of capital plus or minus an appropriate risk premium (Thomas 1968). The other follows the lines of a "natural experiment". It contrasts the economic achievement of two historical situations: a moment when the empire functioned normally, and another, shortly afterwards, when it no longer existed (Pedreira 1994; Prados de la Escosura 1993).

The literature based on the static approach has concluded that empires contributed only modestly to the economic development of their respective mother countries. Indeed, O'Brien and Prados have warned that "arguments that reify European expansion overseas into the engine of economic progress should be strongly qualified" (1998b, p. 5). In the case of Spain, between 1784/1796 and 1815/1820 the end of the empire entailed a loss of between 3.0 and 8.4 per cent of GDP (Prados de la Escosura 1988, 1993). In the case of Portugal, the loss of GDP in the interval 1796/1806 to 1827 was in a range from 3.4 to 8.0 per cent (Pedreira, 1994).[10] Results of a similar order of magnitude have been found for Britain (Thomas and McCloskey, 1981).

The alternative procedure which we espouse here is suggested by Allen's recent work on the factors of economic success or failure in Early Modern Europe (Allen 2003, 2009). This is a reduced form estimation of an underlying dynamic multi-country general equilibrium model[11]. Four equations are solved recursively over a succession of periods, in order to explain the dynamics of four endogenous variables which characterize the structure and performance of early modern economies. The variables interact with each other but also have as "prime movers" a number of exogenous variables, including transoceanic trade. This provides the opportunity for quantifying

[10] These large intervals are the result of the dispersion of GDP estimates available at the time when these studies were undertaken. According to Lains (1991), in the case of Portugal the reduction due to the emancipation of Brazil would have been between only 1.0 and 2.4 per cent, owing to his adoption of a considerably larger estimate for GDP.

[11] It is well known in the macro and finance literature that reduced form models often have better predicting capacity than attempts at structural modelling.

the link between the home economy and that of its overseas possessions at each benchmark and on a country by country basis.

A comparative evaluation of the two approaches suggests the superiority of the latter (O'Rourke, Prados and Daudin 2010, pp. 109-10). The most important aspect is that it is explicitly dynamic and takes into account a variety of causal factors, in contrast to its rival which is static, based on partial equilibrium and disregards explicit causal identification mechanisms. Consequently, the former takes external and inter-temporal effects into consideration, and this causes it to generate results which are not only different but systematically larger than those obtained from the older methodology.

Comparative static cost-benefit accounting does not consider how unutilized resources would be employed in a situation of no-empire. It is hence unable to quantify a part of the impact of trade on growth which is likely to be substantial (Findlay and O'Rourke 2007, p. 337). The counterfactual of "what would happen to a given economy without trade" ought not to correspond simply to wiping out trade and assuming all else equations stay unchanged, especially over longer periods of time.

Finally, the static cost-benefit analysis is at a practical disadvantage because it requires a greater amount of empirical knowledge concerning the relations between the components of the imperial system, as well as between the sectors of the colonial and domestic economies. As a consequence, followers of this approach seldom present findings for more than one point in time, given the highly onerous nature of the task. They often find that "the evaluation of the benefits of Empire is difficult both to describe and measure" (Engerman 1998, p. 216).

This is not to say that our own model has no limitations. The most obvious danger is that some of the identification assumptions may not be valid and if so the model's external validity can be open to question[12]. In this paper, we go beyond Allen's method and estimate the model using panel data methods. This should help attenuate omitted variable problems as long as the sources of idiosyncrasy are approximately constant in time. In the appendix (A.3) we show there is no substantive change in the results.

4. Estimation and simulation

As Allen (2003) notes, Portugal is a notable absence from his study. In this section we re-estimate several versions of his model of the early modern economy, now including newly minted data for Portugal. Using the coefficients thus obtained, we calculate two scenarios – the no-intercontinental trade counterfactual and the model's simulation of the historical situation.

The model considers a sequence of periods in which the real wage, agricultural productivity, urbanization and the share of labor in proto-industry are endogenous variables. These are complemented by a number of variables which are held to be exogenous, such as the land-labor ratio, manufacturing productivity, the extent of enclosure, real energy prices, the volume of colonial trade, lagged urbanization, and a 'prince' dummy for institutions. Lagged urbanization serves as the model's state

[12] Pleijt and van Zanden (2013) show that alternative econometric specifications can lead to some conclusions which are divergent to those of Allen, yet the link between intercontinental trade and urbanization is robust to their proposed changes.

variable. It tells us all we need to know about the past in the beginning of a new period. These variables are listed in table 1.

TABLE 1 HERE

The model is linear and further identified by a series of exclusion restrictions which apply to the endogenous variables. The wage is assumed not to affect proto-industry or urbanization directly (notice it can still do so indirectly through its effect on agricultural productivity). Proto-industry is assumed to influence only agricultural productivity directly. Urbanization is allowed to have an effect on both the wage and agricultural productivity directly, but not proto-industry. Finally, agricultural productivity can directly affect all three other endogenous variables. It is important to notice that all such restrictions are contemporaneous identification assumptions. With a one period lag, every variable can affect every other through its effect on past urbanization.

Estimation

In columns (1) and (2) of tables 2 and 3 we present OLS estimates for the model. These have no causal interpretation, but show partial correlations which are of interest for comparative purposes. In columns (3) and (4) we replicate Allen's 2SLS estimates.[13]

TABLE 2 HERE

TABLE 3 HERE

One way to improve the estimation is to take advantage of the panel data structure of the data. One possibility would be to use the fixed effects estimator, which allows controlling for time-invariant unobserved country-specific idiosyncrasies, something which could be leading the previous pooled methods to inconsistent parameter estimates[14]. However, using the fixed effects estimator does mean that we cannot use lagged urbanization as a dependent variable in a fixed effects estimation of the urbanization equation (Nickell 1981).

In keeping with the spirit of Allen's model, we want to include lagged urbanization as a covariate in the equation for urbanization, which means that we enter the context of a dynamic panel-data model. Consequently, we use the well-known Arellano-Bond estimator, which is a consistent GMM estimator for 'short' panels, and makes allowance for the fact that the unobserved panel-level effects are by construction correlated with the lagged dependent variables. This estimator allows for idiosyncratic heteroskedastic errors which are correlated within countries, but not across countries. Columns (5) and (6) of the same tables display the results of the Arellano-Bond GMM estimation.

[13] Subsequent data revision to Allen's original dataset means the estimates do not exactly match those in Allen (2003, 2009), but they are always very close.

[14] As is usually the case, the Hausman test strongly rejects the random effects model in favor of the fixed effects model.

Inspection of the results shows that the various estimated coefficients and standard errors do not change much, either when Portugal is included in the original sample or when alternative methods are used[15].

To simulate real wage levels for Portugal, we employ these coefficients and the historical data for the different explanatory variables. The next step is to repeat the exercise, with the same historical values, except that this time the volume of colonial trade is zero. The difference between the two outcomes measures counterfactually the impact on the home country's economy of having colonies, as opposed to not having them. This is carried out for every benchmark in the three centuries considered[16].

5. Results and implications

In this section, we go over the results of the simulations described above. We start by looking at their implications in terms of specific issues pertaining to Portuguese long term economic performance. We then broaden the perspective, placing them alongside the experience of other Early Modern colonizers, to obtain fresh comparative insights.

Figure 4 enables us to construct a time line for the direct impact on the Portuguese economy of the country's imperial endeavour. The upper line **(intercontinental trade inclusive of gold)** refers to the simulated real wage generated by the model when all its variables assume their respective historical values and transoceanic trade comprises precious metals as well as commodity exports and imports. The next line down **(simulation)** reflects the counterfactual values of the real wage in the benchmark scenario when precious metals have been removed but all else stays as historically observed. The lowest line **(no intercontinental trade**) represents the real wage in the event of a complete shut-down of colonial trade. The colonial impact on the home economy is given, in two versions, by the difference between the two first lines and the last one standardized by the real wage.

FIGURE 4 HERE

Four major findings emerge, all of which challenge widely-held views regarding the contribution to Portugal's economic growth of its empire before 1800. The first is that the colonies were consistently beneficial to the home economy: the real wage differential associated with having an empire was positive throughout the period. The second is that, instead of running out of steam, over time the trend of this impact never ceased to escalate.

At the dawn of the sixteenth century, when the empire concentrated on the Indian Ocean and the China Sea, the disparity between national income with and without colonies respectively was less than one per cent, an indication that the legendary riches of Orient were much exaggerated by contemporaries (Pedreira 1998). The gradual retreat from Asia, following the initial expansion and the ensuing repositioning to

[15] See appendix A2 for additional discussion, including formal tests and robustness procedures. In particular we test for, and reject, the possibility of a weak IV problem. Notice the often-used 'F-statistic greater than 10' rule of thumb from Staiger and Stock (1997) only applies to one endogenous variable being instrumented and, in any case, is now outdated. See the on-line appendix for a number of robustness tests, including the weak IV tests reviewed by Stock and Yogo (2005).

[16] This exercise can be performed additionally for the other endogenous variables – agricultural total factor productivity, urbanization and proto-industrialization. In the appendix we show the simulation results for these variables.

Brazil, changed Portugal's colonial vocation, from trade and navigation to tropical slave plantations and mineral extraction. It also increased relative gains from overseas activity significantly. By 1600, these had risen four-fold relative to the 1500 level and seven-fold by 1700. By 1800, the "historical" real wage was thirty per cent higher than if the empire had not existed.[17]

The third conclusion is that in spite of this positive contribution, the empire did not prevent the country's sustained long run economic decline. During the first two centuries the gains from overseas were insufficient to overcome the secular contraction of domestic per capita income. During the seventeen hundreds, notwithstanding a substantially increased boost, they were just enough to neutralize the negative impact of Malthusian pressures on the home economy.

The fourth outcome is methodological in nature. It confirms the initial expectation that a static model would lead to systematic underestimation. For 1800, the only benchmark which at present allows a precise comparison, the dynamic approach reveals gains from Empire which are three times those reached by Pedreira (1994) for the same period with a static approach. This suggests that earlier cliometric efforts probably missed significant effects.

While they reveal the empire's considerable contribution to Portugal's economic performance, these results leave two critical issues unresolved. One of them is whether Portugal's imperial effort would still look as impressive when compared with that of other colonial powers and using the same procedures as employed above for Portugal? The other is, in the event of Portugal passing this test, why were its colonies unable to promote the country's convergence to the leading economies of this epoch?

To answer them we need to consider these problems in the framework of a comparative economic history of empires. The current and well-established consensus provided by the latter claims that before 1800 the impact of colonial systems on their metropolitan economies varied widely. Britain and the Netherlands are supposed to have gained "disproportionately" from overseas expansion; Spain and Portugal "ended up as losers"; and France was somewhere in between (O'Brien 2005; Landes 1998). Several reasons have been cited for this distribution, namely the "late comer" status of the Anglo-Dutch "free riders" in the 18th century (O'Brien 2005); their superiority in terms of institutions (Acemoglu et al. 2005) or of corporate governance (Rei 2011); and the heavy investment costs endured by the Iberian "early starters", possibly beyond their means (O'Rourke et al. 2010).

We now turn to the verification of these assertions as a way to answer the first of our two questions. For this we repeat our earlier calculation of the relative economic impact of empire on the Portuguese economy, but applying it this time to all the other relevant countries as well. Table 4 displays the complete set of these estimates for the period 1500-1800. To our knowledge, it constitutes the first accurate, empirically well-founded and consistent description of how, over these three centuries, the five main imperial metropoles transformed the inputs accruing from their overseas possessions into national income increments.

[17] If gold is left out of the picture, the difference is around 22 per cent. This result helps to clarify the importance of Brazil's mining sector for Portugal's eighteenth century economy.

TABLE 4 HERE

The picture we obtain confirms the high degree of dispersion among nations recorded by the standard view. The latter, however, is almost entirely contradicted by this new evidence when it comes to ranking countries in terms of this indicator of colonial economic impact. Britain is somewhat of an exception in that it still appears as the most effective colonial power in the late eighteenth century, though not at all for the earlier benchmarks. The same is true for the Netherlands but, in this case, its performance is comparatively modest throughout the entire period. Despite its grand image of an expansionist past, France's unusually weak imperial achievement also denies the conventional wisdom, whichever century is considered. Spain is the only instance in which reality matches the popular belief, in this instance, of an empire without significant benefits.

What is unexpected is Portugal's persistent leadership in terms of this yardstick, ahead of all the "Atlantic traders" and even during the seventeen hundreds, an era when much greater and richer powers vied to impose their might overseas. What is still more remarkable, however, is the puzzle this poses. Why, in spite of this vigorous imperial success, Portugal's real per capita income gap with Britain, as shown in figure 2, proved impossible to narrow, and indeed even widened during the all-important eighteenth century?

The explanation is in fact simple and relies on an additional yardstick for colonial performance, namely the "empire extraction rate". This, as its name suggests, expresses the difference between the historical and the counterfactual real wage in absolute terms at a given point in time. It is expressed in "real wage units" and is therefore directly comparable to the real wage gap between any two economies. It is displayed in table 5, in the higher level of each cell, for all five countries and all benchmarks under consideration.

During the entire Early Modern period, Portugal's "extraction rate" nearly always led those of its colonial rivals. Portugal's real wage, being simultaneously among the lowest, the colonial economic impact described in table 4 - a relative measure – naturally comes out as one of the highest. Convergence with Britain driven by colonial expansion, however, would only occur if two conditions were satisfied. One was that Portugal's colonial extraction would have to be greater than that of the leading economy. This was normally the case, except for 1800. The other is that the difference between the respective extraction rates should come close to annulling the real wage discrepancy between the two countries. This was far from happening at any moment in the period considered. In order to allow us to grasp how these requirements were met, Table 5 also exhibits, in parenthesis, the ratio of the "empire extraction rate" differential between Portugal and Britain to their respective real wage gap.[18]

[18] This is calculated, for each country i ≠ Britain and each period t, as

$$\frac{\text{empire extraction rate}_{Britain,t} - \text{empire extraction rate}_{i,t}}{real\ wage_{Britain,t} - real\ wage_{i,t}}$$

For instance, the value for comparing Britain with France in 1700 is 18.5%. This is the percentage of the differential in real wages explainable by the differential effect of empires. For Portugal, the number is often negative because the empire is contributing towards convergence to Britain. The exceptions are 1600, when Portugal has a higher real wage than Britain, so Portugal's empire is contributing towards maintaining the divergence; and either 1750 or 1800, when Britain's empire extraction ratio for the first

TABLE 5 HERE

The eighteenth century is the time when, for Portugal, the catch-up hypothesis based on colonial expansion is the most plausible. The values we obtain in table 5 show unequivocally that a significant approximation to the British income standard then would have necessitated a Portuguese colonial expansion of an order of two or three hundred per cent given that growth would have to be mainly extensive. In a plantation-based economy, where barriers to technological improvement were probably insurmountable and production was labour-intensive to a high degree, such a scenario is unavoidable. However, it would also be historically unimaginable since it would have required an immense growth in the number of colonial inhabitants, both in slaves and in Portuguese settlers. Assuming proportionality, this would have implied a drain of at least a third of the mainland population, an altogether improbable scale of events[19]. The conclusion is that convergence, if it were to happen, could only have come from developments internal to the home economy, since those from overseas would never suffice.

6. Conclusion

This paper takes Portugal as a case study for assessing the benefits of seaborne empires for the economic development of early modern nations. The starting point and the puzzle come from the revision of the economic statistics for this country, which portray it as one of Europe's least successful macroeconomic performers of this period but also as one of the world's most vigorous colonial traders in per capita terms.

We conclude that in the long run Portugal's empire demonstrated a considerable degree of dynamism and contributed positively to the economic fortunes of the mother country. This goes against the common belief in a "long-term stagnation of the [Iberian] colonial economies" (Coatsworth 2005, 237). Our paper also diverges from the approach of the proponents of "modern world-systems" (Wallerstein 1980) in that we show semi-peripheral Portugal was able to gain as much or more from its empire in relative terms as the leaders of the Early Modern core. At the same time, Portugal's imperial strength did not translate into economic convergence to its colonial arch-rivals, which were also the richer economies of the day: England and the Netherlands.

There is an important sense in which it should not be surprising that Portugal's empire did not to lead to larger welfare effects. This is that in a Malthusian world, all returns from empires should be irrelevant over the long run. Any "windfall" gains (or losses) from the empire should be followed by the combined effect of preventive and positive checks on the labour market until the real wage is back to the 'subsistence' steady state level.

What is remarkable is that gains from the intercontinental trade associated with empire, in the case of England and the Netherlands, led to long-run effects on

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time surpasses that of Portugal (the exact benchmark depends on whether gold is accounted for; see table 5).

[19] In 1800, a high point of colonial expansion, Brazil's white population was about a million, while that of slaves was 1.6 million (Livi-Bacci 2002). To double output, we assume that both components would also have to double. The extra million Portuguese settlers required would thus represent a loss of one third of the home country's inhabitants and more, as a proportion of total adults.

urbanization, the real wage, and structural change (Allen 2003, 2009; de Vries and van der Woude 1997). For these nations, the empire apparently did help in achieving an early escape from Malthus. Hence one way to interpret our results is to emphasise that there was something 'special' about England and the Netherlands – but whatever the ultimate cause of it was, it could not have been just a high amount of trade per capita, since Portugal had just as high an amount, or even higher.

Indeed, despite considerable benefits from empire, Portugal's economy diverged. This was because while the positive effect of intercontinental trade was undoubtedly significant, it was only one among several proximate factors contributing to growth. In the sixteenth and seventeenth centuries, when the differential in real wages between England and Portugal was small, the contribution of empire to Portugal's real wage was diminutive too. By 1700, the wage differential between them had become much larger and thereafter never ceased to increase, to an extent that no realistic amount of additional colonial expansion could possibly erase.

In Portugal, some combination of institutional and Malthusian forces did not allow the empire to become a great escape towards modern economic growth. Portugal's empire was successful in a comparative perspective, but still the ultimate causes behind the economic growth in England and the Netherlands did not materialize there. The fact is that the problem lay elsewhere – on the home front.

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We owe particular thanks to Bob Allen for discussion and providing us with data and replication files. We have also benefitted from comments received in the course of seminars at the Universities of Oxford and Jyvaskylla and meetings of the Portuguese Association for Social and Economic History (Lisbon, 2012) and the European Historical Economics Society (London, 2013). We are grateful to Guillaume Daudin and Jan Luiten van Zanden for sharing data and useful information, and to Carlos Madeira and Franz Zobl for discussions. We are also grateful to the colleagues associated with the Prices, Wages and Rents in Portugal, 1500-1910 project. Without their database this paper would not have been possible. Our thanks also go to the Fundação para a Ciência e Tecnologia for financial support.

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Figures and tables

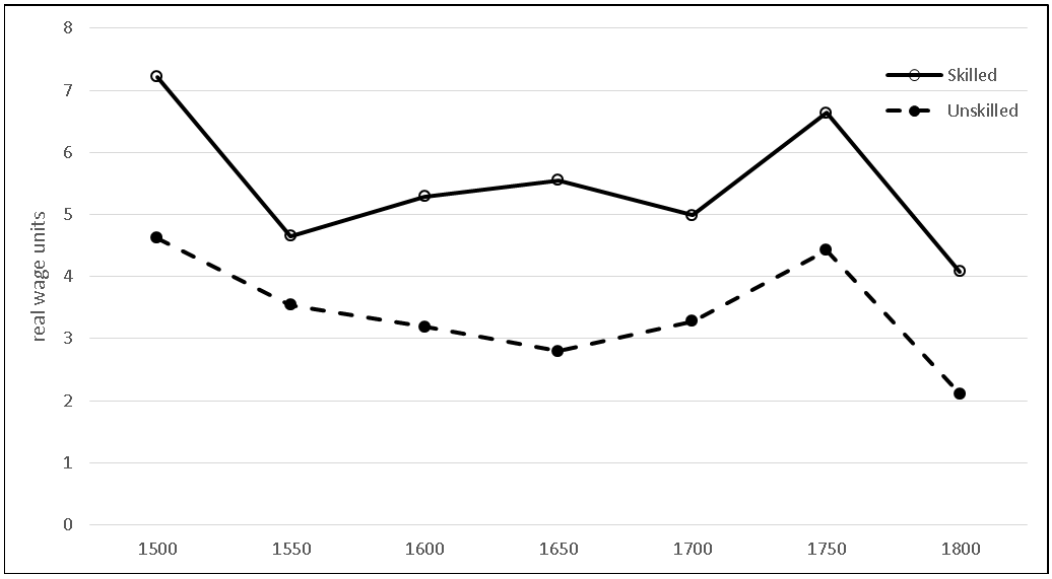

Fig 1.Real wages in Portugal, 1500-1800. Sources: see text.

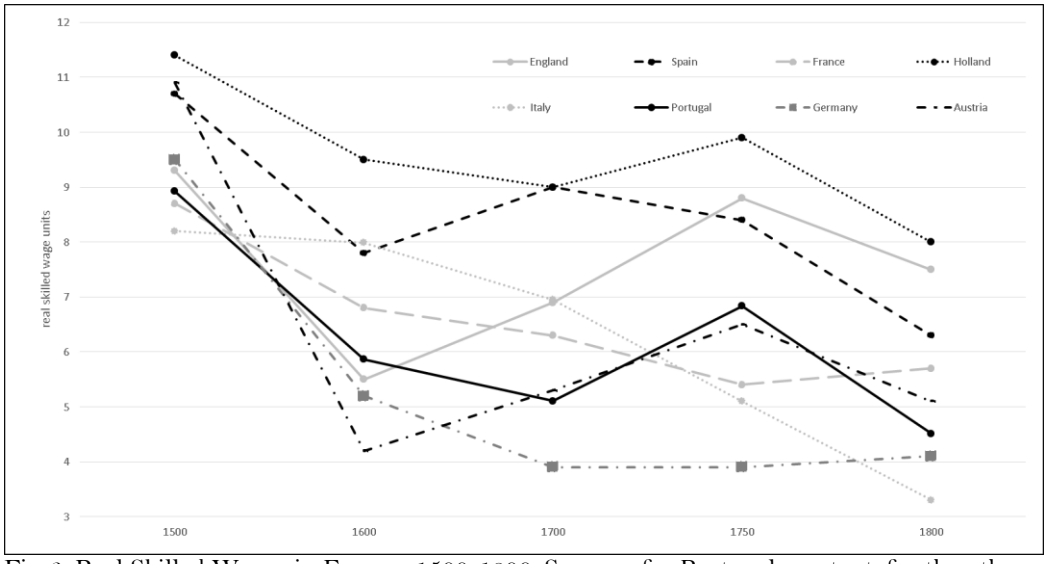

Fig 2. Real Skilled Wages in Europe, 1500-1800. Sources: for Portugal, see text; for the other countries, see Allen (2003)

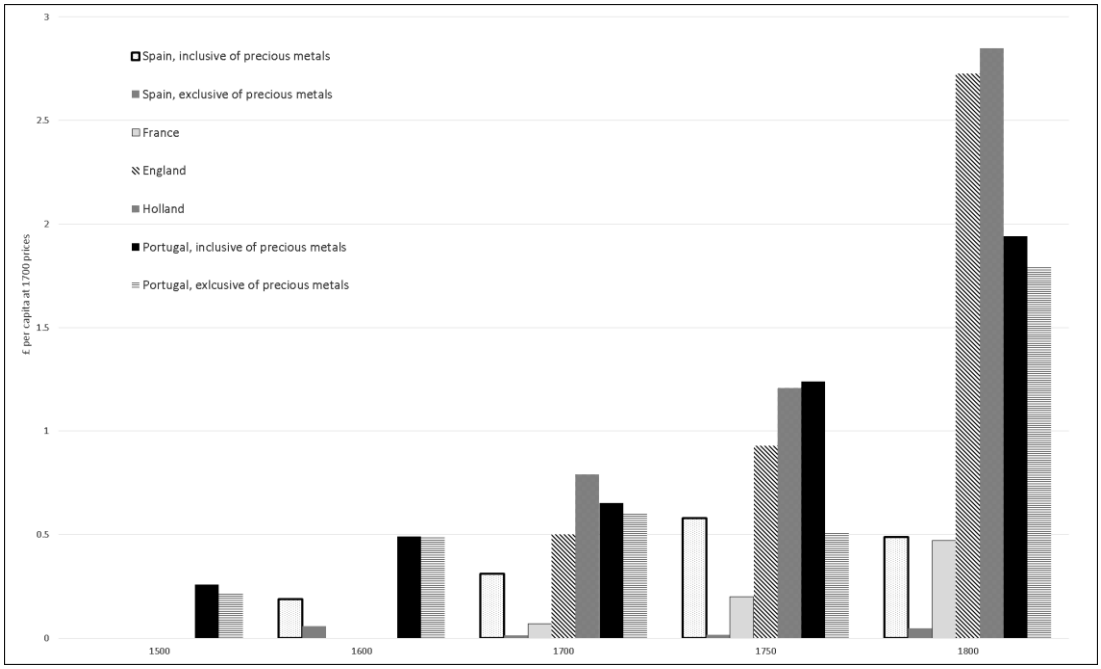

Fig 3. Intercontinental trade per capita, 1500-1800. 1800 trade values for France correspond to 1788 and those of the Netherlands to 1780. Sources: for Portugal, see the appendix A1; for France 1788, data kindly supplied by Guillaume Daudin, and converted at the exchange rate of one livres tournois equals 1/25th of a pound sterling; for the Netherlands 1780, van Zanden and van Leeuwen (2012), converted at the exchange rate of 10.5 guilders equals one pound sterling. For all other data, see Allen (2003).

Variable	Abbreviation	Type	Construction method	Sources
Natural log of the real wage	LNWAGE	Endogenous	As in Allen (2001)	PWR
Natural log of the urbanization ratio	LNURB	Endogenous	Towns over 5,000 inhabitants	Bairoch (1988)
Natural log of agricultural TFP	LNAGTFP	Endogenous	As in Allen (2003)	PWR
Natural log of the proto-industrial labour share	LNPROTO	Endogenous	-	See appendix A1
Natural log of the land-labour ratio	LNTL	Exogenous	As in Allen (2003)	See appendix A1
Institutions dummy	PRINCE	Exogenous	By analogy with Spain	De Long and Sheifler (1993)
Enclosure	ENCL	IV	By analogy with Spain	Allen (2003)
Natural log of the lagged urbanization ratio	LNURBLAG	IV	-	-
Intercontinental trade per capita	TRADEPOP	IV	See appendix A1	See appendix A1
Spanish empire dummy	SPANEMP	IV	-	-
British empire dummy	BRIT 18	IV	-	-
Energy price	ENERGY	IV	-	Allen (2009); PWR
Manufacturing TFP	MANPROD	IV	Dual method	PWR
Literacy	LIT	IV	By analogy with Spain	Allen (2003)

Table 1. List of variables

Dependent variable: LNWAGE	(1) Allen (2009) Excluding Portugal	(2) Allen (2009) Including Portugal	(3) Allen (2009)	(4) Allen (2003) including Portugal	(5) Allen (2009)	(6) Allen (2009) including Portugal
Estimator	OLS	OLS	2SLS	2SLS	Arellano-Bond dynamic panel GMM	Arellano-Bond dynamic panel GMM
LNTL	.5005796*** (.0749625)	.4774391*** (.0657473)	.5037174*** (.0925935)	.4440452*** (.0993357)	.5037174*** (.0993711)	.4440452*** (.0977022)
LNURB	.186653** (.0779664)	.1701439** (.0765936)	.2106674*** (.0651789)	.2503856*** (.0768954)	.2106674*** (.0734688)	.2503856*** (.0829489)
LNAGTFP	.9057842*** (.1733238)	.9239504*** (.1614099)	.8650677*** (.2410166)	.6748178** (.3236695)	.8650677*** (.2583074)	.6748178** (.3049374)
PRINCE	.1428545* (.0811696)	.1187834 (.077351)	.1357055 (.1098788)	.0592744 (.1196884)	.1357055 (.0916483)	.0592744 (.0992239)
Intercept	1.791651*** (.1844742)	1.77177*** (.176088)	1.848141*** (.2038102)	2.024367*** (.2707838)	1.848141*** (.2387889)	2.024367*** (.2779381)
IV first stage F-statistic	-	-	LNAGTFP: 34.89 LNURB: 97.78	LNAGTFP: 23.73 LNURB: 68.77	-	-
R^2	.6454	.6494	.6440	. 6270	-	-
observations	45	50	45	50	45	50

Table 2. The wage equation. Standard errors in (1)-(4) are robust and small sample adjusted. Trade volume for Portugal is exclusive of gold. In specifications (3)-(6) the endogenous variables LNAGTFP and LNURB are instrumented by Allen's eight instruments and two exogenous variables (Allen 2009). Sources: see text.

Dependent variable: LNURB	(1) Allen (2009)	(2) Allen (2009) including Portugal	(3) Allen (2009)	(4) Allen (2009) including Portugal	(5) Allen (2009)	(6) Allen (2009) including Portugal
Estimator	OLS	OLS	2SLS	2SLS	Arellano-Bond dynamic panel GMM	Arellano-Bond dynamic panel GMM
TRADEPOP	.1561592** (.0715075)	.1233145** (.0601684)	.1482911** (.0708036)	.1226452** (.0593506)	.1462312** (.0719882)	.1226452* (.0695084)
LNURBLAG	.8828436*** (.0561658)	.8221105*** (.0669604)	.8461266*** (.0638899)	.7664851*** (.0787729)	.8365135*** (.0686524)	.7664851*** (.0796605)
LNAGTFP	.0849642 (.1346501)	.2206201 (.144385)	.2348374 (.1955143)	.4461833* (.2591376)	.2740768 (.2044594)	.4461833* (.2410497)
PRINCE	-.0146355 (.0876832)	.0220204 (.0964598)	.0136305 (.0940653)	.0709099 (.1080748)	.021031 (.077972)	.0709099 (.0898252)
Intercept	-.2418042 (.1550246)	-.3920131 (.1811004)	-.3549791** (.1890826)	-.5674081** (.2391644)	-.3846102* (.1963014)	-.5674081** (.2309346)
IV first stage F-statistic	-	-	LNURB: 34.89	LNURB: 23.73	-	-
R^2	.9122	.8705	.9101	.8653	-	-
observations	45	50	45	50	50	50

Table 3. The urbanization equation. Standard errors in (1)-(4) are robust and small sample adjusted. Trade volume for Portugal is exclusive of gold. In specifications (3)-(6) the endogenous variable LNAGTFP is instrumented by Allen's eight instruments and two exogenous variables (Allen 2009). Sources: see text.

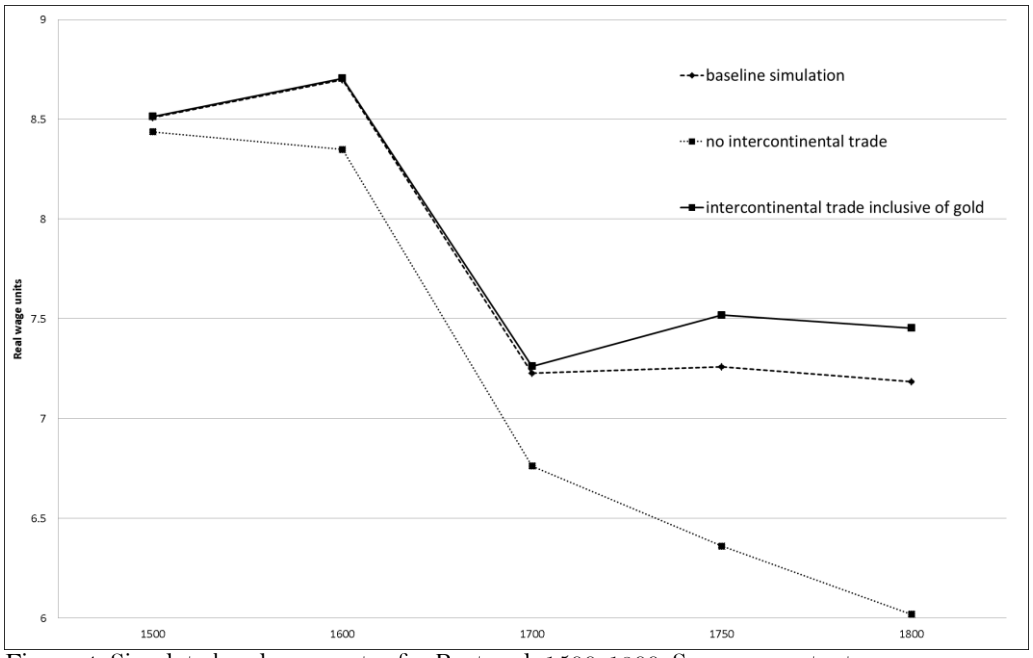

Figure 4. Simulated real wage rates for Portugal, 1500-1800. Sources: see text

	Portugal		Spain		England	Holland	France
	with gold	without gold	with gold and silver	Without gold and silver			
1500	0.9	0.8	0.4	0	0	0	0
1600	4.3	4.2	1.2	0.3	0	0	0
1700	7.4	6.9	1.4	0.3	2.3	3.7	0.3
1750	17.0	13.0	1.7	0.8	2.9	6.5	0.1
1800	22.8	18.4	1.9	0.9	16.1	5.4	0

Table 4. Share (per cent) of the real wage attributable to empire, 1500-1800. Sources: see text and figure 4.

	Portugal		Spain		Britain	Holland	France
	with gold	without gold (*)	with gold and silver	without gold and silver (*)			
1500	0.08 (-21.1)	0.07 (-18.4)	0.04 (-2.9)	0 (0)	0	0 (0)	0 (0)
1600	0.25 (67.6)	0.25 (65.8)	0.13 (-5.7)	0.02 (-0.9)	0	0 (0)	0 (0)
1700	0.38 (-8.94)	0.35 (-7.3)	0.11 (-5.2)	0.03 (-9.0)	0.22	0.33 (5.2)	0.22 (0)
1750	1.24 (-30.6)	0.30 (17.2)	0.14 (35.0)	0.025 (153.8)	0.64	0.72 (7.2)	0.01 (18.5)
1800	1.08 (10.0)	0.87 (17.1)	0.12 (10.0)	0.03 (112.5)	1.38	0.49 (74.1)	0.05 (73.9)

Table 5. Empire extraction rate in "real wage units", 1500-1800 in the upper line. In parenthesis, the ratio of the empire extraction rate differential Britain relative to of a given country divided by the real wage gap between them (per cent). Sources: same as for figure 3 and table 4. (*) Assuming invariance of real quantities to precious metal imports.

Appendix (for on-line publication only)

In this appendix we consider a variety of methodological details, robustness checks and additional information which, for space-saving reasons, we are unable to present in the body of the text. We also present additional data and figures.

A1. Methodology and sources for the construction of variables

Information is provided here on the construction of three variables for Portugal during the period from 1500 to 1850: intercontinental trade, the land-labour ratio, and the proto-industrial labor share.

1.1 Intercontinental trade

We build an index of intercontinental trade statistics which proxies the various flows generated within the framework of a colonial pact. In keeping with Allen (2003), we measure the effect of empire by means of the volume of total trade in both directions. This measure is given by the sum of exports to the colonies of goods produced in the mother country (therefore not including re-exports from other European countries) and of imports from the colonies to the mother country, whether for consumption or for re-export.

To make these statistics comparable with the data for England and the other countries in the Allen (2003) database, we convert their total values using sugar and linen prices in 1700, respectively for imports and exports. These are then converted into pounds sterling at the rate of exchange of 1 pound equals 3600 *reis*.[20]

The first official record of the Portuguese balance of trade dates back to 1776-7 and has the title of *Balança Geral do Comércio*. It was supposed to initiate a regular annual series but its production was very uneven for the first twenty years, until it started up again in regular fashion in 1796, always in manuscript form. It lasted until 1834.[21]

Prior to the start of this series, we compiled intercontinental trade data from a variety of other sources and organized them by main areas of origin, i.e. Africa, Asia and Brazil, and by export and import trades. In some instances, exact trade values were available but in others it was necessary to proxy from shipping volumes or figures given by different sources for the same year. The data comprise all merchandise as described and, when presented at current prices, the unit is *contos (*1 *conto*= 1,000,000 *reais;* 3,600 reais= £1 sterling*)*. Whenever mentioned in the source, the type of merchandise is identified.

1500

Africa

Exports: exclusively composed of *alambéis*, a coloured, striped textile produced in North Africa but also in southern Portugal and traded on the West coast of Africa.

[20] One pound equals nine *cruzados*, and one *cruzado* equals 400 *reis* (or *reais*). Hence one pound equals 3600 reis (Morineau 1985), p. 133.

[21] Before 1796, the Balanças Gerais do Comércio were compiled only for 1776-7, 1783 and 1789.

Values calculated from quantities in Pereira (2003, p. 283) and prices in Vogt (1979), p. 75.

Imports: recorded entirely as sugar. Values calculated from quantities in Godinho (1981-1983, vol. IV), p. 96, and prices in Serrão (1951), p. 15. Imports of precious metals (gold) are in Vogt (1979), appendix I, which include both imports by the crown plus an additional 20 per cent to account also for private imports.

Asia

Exports: no merchandise recorded.

Imports: quantities from Subrahmanyam (2012), p. 68 and values from Godinho (1981-3), vol. III, p. 194.

Brazil

Imports: exclusively brazil-wood. Values from Simonsen (1967), p. 61.

Exports: no trade recorded.

1600

Africa

No trade recorded.

Asia

Exports: no trade recorded.

Imports: in total value only, in Boyajian (1993), appendix II, based on data for the 'armada' of 1600.

Brazil

Exports: estimated from the per capita export values carried in 1650 by the ships of the monopolistic Brazilian trading company, according to Costa (2002), vol. II, p. 28, multiplied by the population of the colony in 1600, to obtain the aggregate value with respect to this year.

Imports: brazil-wood - value of the crown monopoly contract for 1602-1612 from Azevedo (1973) p. 250; sugar - quantities from unnumbered table entitled 'production-exportation' and prices from p. 298, in Mauro (1983).

1700

Africa

No traded recorded.

Asia

Exports: no trade recorded.

Imports: aggregate values in Godinho (1976), vol. p. 319.

Brazil

Exports: 30% of the total value in Morineau (1985), p. 169 based on Morineau's quotation of early eighteenth-century sources that 70 per cent of Brazilian imports were foreign goods re-exported from Portugal to Brazil.

Imports: aggregate value of commodities from Morineau (1985), table 74, p. 484.
Precious metals: values estimated from Morineau (1985), table 74, p. 484 and then deflated by the sugar prices using 1700 as the base year, for consistency with other imports.

1750

Africa

Exports: value from *Balança do Comércio* for 1776.

Imports: value from *Balança do Comércio* for 1776.

Asia

Exports: value from *Balança do Comércio* for 1776.

Imports: value from *Balança do Comércio* for 1776.

Brazil

Exports: calculated as 30 per cent of the total values, in Pinto (1979), pp. 173-4, for the fleets to Rio de Janeiro (1750), Bahia and Maranhão (1751), on the assumption that the remaining 70 per cent were foreign goods re-exported through Portugal to Brazil, according to Morineau (1985), p. 169.

Imports: value of total minted and un-minted gold, in Costa, Rocha e Sousa (2013), p. 192 ; other commodities in Morineau (1985), table 74, p. 484.

1800

Africa

Exports and imports: Average of respective values from 1799 to 1801, in *Balanças do Comércio* (1800 is missing in the source).

Asia

Exports and imports: Average of respective values from 1799 to 1801, in *Balanças do Comércio* (1800 is missing in the source).

Brazil

Exports and imports: bvalues of all commodities are from Alexandre (1988) vol. 3, Tables CLII; XCI; CXVIII; minted gold is the average of the values from 1799 to 1801 in Alexandre (1988), vol. 3, table XCII.

1.2 The land-labour ratio

Measuring agricultural land, the numerator in this ratio, for any economy during the Early Modern period is a considerable challenge. A reasonable solution employed in the literature is to assume that despite changes over the few last hundreds of years, the corresponding number of hectares has not changed much up to the present day, only their quality. In this perspective, what matters is the potential resource base, upgrades or changes of usage being assigned in the model to changes in "capital stock". This rule of thumb has been adopted for Europe as a whole from 1300 to 1800 by Allen (2003).

We follow this approach for Portugal and assume that by 1500 all usable land was under some form of husbandry, even if not necessarily the most efficient. This would include rough grazing and prolonged fallows. We therefore assume the stock of land was equal to the area of "agricultural land" measured by the UN-FAO in the 1950s, namely 4.13 million hectares.[22] The only available historical evidence for Portugal comes in a calculation made in 1875 by the geographer Gerardo Pery (cited in Fonseca 2005), who assessed the country's total "productive area" – also excluding forests, a concept close to "agricultural land" – as being 4.34 million hectares (Food and Agriculture Organization of the United Nations 1958, volume 12, p. 3).

As regards labour, we use the population as a proxy, similarly to the procedure followed for the other countries in the Allen (2003) sample given the lack of evidence concerning this variable. We construct a series for the total population of Portugal indirectly, on the basis of information from a variety of sources.[23] This becomes necessary given that it was not until 1801 that a proper census was carried out. Before this date, only head counts are available and these were reckoned in terms of "hearths" rather than of "souls". Residents have therefore to be inferred by applying a factor of conversion of inhabitants per hearth, a figure which enjoys relative only moderate consensus among Portuguese historians. Ratios vary in a range between 3.9 and 5.0. We use here a ratio of 4.0, as proposed by Serrão (1993) and Oliveira (2002) based on the 1801 census, the only source universally recognized as reasonably accurate. Where a hearth count was unavailable, we adopted a "round" guesstimate (e.g. 2 million) provided by one or more well-regarded sources.[24]

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[22] "Agricultural land" is defined as the sum of cropped land, meadow land, pasture and rough grazing. In pre-industrial times this would have included a sizeable portion of fallow land in crop rotations.

[23] The only full compilation of Portuguese mainland population statistics is by Rodrigues (2008). Unfortunately, its author does not explain how these data were arrived at, which, combined with some rather implausible benchmarks, makes this source difficult to use.

[24] In the case of Spain, Drelichman and Gonzalez Agudo (2012) use a ratio of 3.78 for the sixteenth century, on the basis of a number of micro studies.

The procedure is to start from the population in 1500. We then infer values for each successive fifty year benchmark by applying the rates of change proposed for each of these intervals by the most cogent and dependable sources available. Often these rates are based on micro-demographic studies, in combination with other social and economic evidence.

We begin with the population count carried out between 1527 and 1532 and usually attributed to the year 1530. This has been the object of extensive scholarly scrutiny and is considered quite trustworthy. It enables us to anchor our population series firmly, to our starting benchmark, in 1500. Our earliest guesstimate therefore is that which takes us back to 1500, retropolating from the total population of 1.2 million for 1530.[25]

The early 16th century is generally accepted as a time of fast population growth, in the wake of a longer demographic surge coming from the 15th century. Notwithstanding, we decided not to adopt the estimate by Dias (1988) of an increase of 84 % during the period 1497-1532. This was suggested by an examination of 10% of total Portuguese hearths concentrated in one region alone (Beira), which seems too narrow. Instead, we adopt the increase of 32% proposed by Henriques (2011), which is based on a smaller number of hearths but is taken from a more balanced set of counts covering localities in the north, centre and south of the country. This leads to an estimate of 0.906 million for 1500.

The rapid demographic growth of the 16th century is generally considered to have tapered off after 1580. Both Serrão (1993 and 1994) and Rodrigues (2008) allow a growth rate of 0.8% a year up to 1550 and then, continuing beyond to 1580, which implies, for 1550, a level of 1.35 million. For the end of the century and allowing for a slowing down to an annual rate of 0.4% (Serrão 1993), we get a population of 1.857 million for 1600.[26]

The common wisdom is that this population slow-down lasted from 1580 to 1620 and then gave way to a period of stagnation, which lasted until the 1660s.[27] The mid-17th century benchmark would thus have corresponded to a population of just over 2 million, the figure which has been espoused by the three greatest specialists for this period – Godinho (1980), Marques (1973) and Oliveira (1971).

Between the end of the war of independence from Spain (1668) and 1700, Portugal enjoyed some thirty five years of peace and relative freedom from epidemics. Rodrigues (2008) suggests that a population increase of 15% during this period would not have been implausible, a view that is endorsed by Magalhães (1993) and Pinto and Madeira (2001). The implication would be a total in 1700 of some 2.3 million, a figure which seems reasonable even though it contradicts Godinho's (1955) estimate of 2.1 million.

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[25] Rodrigues (2008) suggests that the population in 1530 was somewhere between 1.1 and 1.3 million, depending on the size of the average hearth. The figure chosen here is based on a value of 4.3 for this parameter (Serrão, 1993).

[26] The careful study by Santos (2003) of the Alentejo region adopts for the same period, as an outward bound figure, a rate of 0,67%, which is close to the one we have chosen. It also adduces qualitative evidence to support this strong population expansion.

[27] The exception is Rodrigues (2008) who prefers to locate the onset of this period of stagnation in 1580 and has it lasting until 1660.

The 18th century boasts a greater abundance of hearth counts and a higher degree of consensus among historians. There is agreement with regard to 1700-1732, a time of epidemics and strong emigration to Brazil (Godinho 1978), which led to a likely decline in population at an annual rate of 0.20%. A recovery is widely acknowledged for 1732-1776, at 0.68% a year, in contrast with a period of deceleration thereafter, at 0.24% down to 1801. The combined effect is a 1750 benchmark of 2.359 million and one of 2.912 million at the end of the century. The latter tallies with the figure derived from the 1801 census.

Summarizing, table A1 presents our population estimates for 1500-1850, as well as the sources from which they were derived.

Year	Population (m)	Source
1500	0.90	Castro Henriques
1550	1.35	Serrão; Rodrigues
1600	1.86	José V. Serrão
1650	2.00	Oliveira; Godinho; Marques; Rodrigues; Magalhães
1700	2.30	Rodrigues, Magalhães, Pinto/Madeira
1750	2.36	Serrão, Pinto/Madeira;
1800	2.91	Serrão, Pinto/Madeira;

Table A1. Portugal's population, in millions of individuals. Sources: see text.

1.3 Urbanization and proto-industrial labour

In this subsection we discuss the occupational structure and the urbanization rate of Portugal's population during this period. This is necessary in order to put together the proto-industrial labour share variable required by our model.

In table A2, column 2 we display, alongside total population, the best available figures for Portugal's population living in urban centres. It is defined as the total number of inhabitants of agglomerations of more than 5,000 residents. We employ for this a single source, namely Bairoch (1988). This has the advantage of offering complete coverage for all the sub-periods considered and has been compiled using a uniform methodology throughout.

The use of these data requires some care. Bairoch included in his benchmark totals all urban centres which were listed in his sources irrespective of size, and then simply added them up to obtain "urban population". Since we want to exclude from the category of 'urban' all towns having less than 5,000 inhabitants, we have left out all the locations which did not satisfy this requirement. At the same time, we have recovered the residents of the towns which Bairoch dropped from his count every time they were not mentioned in his sources for a particular benchmark, though they are known to have continued to exist during this time. When this happens, we assume that it was due to an error or omission, and not to a contraction of the population in question to a figure below our stipulated minimum. We have therefore interpolated the

'missing' inhabitants at the level observed in the count of the previous benchmark, as long as this was not less than 5,000. This inflates Bairoch's results somewhat[28].

Year	(1) Total population	(2) Urban population	(3) Agricultural population	(4) Proto-industrial population
1500	0.906	0.155 (0.171)	0.601 (0.663)	0.150 (0.166)
1600	1.857	0.242 (0.130)	1.148 (0.618)	0.468 (0.252)
1700	2.3	0.293 (0.127)	1.315 (0.572)	0.692 (0.127)
1750	2.359	0.429 (0.182)	1.250 (0.530)	0.680 (0.288)
1800	2.912	0.476 (0.163)	1.596 (0.548)	0.840 (0.288)

Table A2. Portugal's occupational structure 1500-1800. Unit: Millions of individuals. In parenthesis, per cent of total population. Sources: for column 1, see table A1. For column 2, Bairoch (1988), revised. For columns 3 and 4, see text.

How many people were associated with the proto-industrial economy in Portugal between 1500 and 1800? To provide the answer we follow the procedure used for the other countries in the sample (Allen 2000). We assume that rural dwellers were either involved in agriculture or then were non-urban residents living off non-agricultural occupations, but never both. Although the latter group encompassed manufacturing, transport, trade and administrative activities wherever carried out, we assimilate them all here, for the sake of simplicity, to the proto-industrial sector.

The next task is to identify benchmark years which offer reasonably reliable proto-industrial labour shares. The initial and terminal years of our set appear to satisfy this requirement. For 1500, we endorse the presumption (Wrigley, 1985; Allen, 2000) that the occupational structure of Europe, up to the early sixteenth century, was roughly homogeneous and that agriculture occupied some 80 per cent of the rural population. The remaining 20 per cent corresponded to the rural non-agricultural population.[29] At the end of the continuum, fairly dependable data for this ratio have been constructed by Reis (2005) for 1800 and by Sá (2005) for 1750.

The 1700 benchmark is also an independent estimate but rests on weaker evidence. It is based on three fiscal rolls pertaining to the "décima" tax and compiled around this date from municipal archive material. They contain detailed, reliable information on the occupations of the heads of households. They pertain to rural townships (i.e. with

[28] For different reasons, Alvarez-Nogal and Prados (2007) have established urbanization data for Spain which also departs from Bairoch's. Our correction is smaller than theirs, however.

[29] These proportions are confirmed by the scarce evidence available for late medieval Portugal. According to Godinho (1976), in Alenquer, a small provincial centre, at the end of the fourteen hundreds, those engaged in agriculture represented 74 % of the entire population. In the case of Torres Vedras, a small town and its hinterland, in 1381 the "non-agricultural population" came to 33% of the whole (Rodrigues (1989, p. 22). Further back, in 1369 in Arruda dos Vinhos, also not distant from Lisbon, 86% of all households were of farmers, the non-agricultural population representing therefore 14%. (Marques 1980), pp.126-31.

less than 5,000 inhabitants) and their respective hinterlands. One of them (Montemor-o-Novo) is in Alentejo, a thinly populated, predominantly rural province in the south, having several 'agro-towns', and as such not particularly representative of the country as a whole. The other two cases come from Algarve (Castro Marim and Tavira-Cacela), a coastal region further south, with a higher density of population, many small holders and a complete absence of "agro-towns". Altogether, it would have been much more like the rest of the country north of Lisbon.[30] Despite the differences between these two regions, in 1700 their respective shares of non-urban population engaged in agriculture were very similar. They fell within a narrow band from 64 to 67 per cent. Pending fresh evidence from additional sources, we have opted for the mean value of 65.5 per cent and consequently for a proto-industrial labour force ratio of 34.5 per cent.[31]

To complete the data in column 5 of table A2 regarding the size of the proto-indsutrial labour force, we have to interpolate a figure for 1600. This is done by assuming for Portugal a growth rate for the interval 1500-1600 which is identical to that estimated by Alvarez-Nogal and Prados de la Escosura (2007) for Spain. Column 4 can then be derived by subtracting the data in this column from total non-urban population, which in turn is obtained by subtracting column 2 from column 1.

The figures in parenthesis in table A2 correspond to the respective shares of total population. The advantage of having them lies in allowing us to perceive at a glance any shifts in socio-economic population categories and thus grasp structural change over time. They can show, for example, the long term weakness of the thrust towards urbanization which only picked up in the mid-18th century (column 2), a clear sign of delayed modernisation. It suggests equally that the Imperial surge of the 16th century did not impact significantly the weight of agriculture by draining large numbers ofthose employed in it to the emerging colonies (column 4).

In the same vein, Table A2 also brings to light the fact that the secondary and tertiary sectors (column 4) gained ground for two and a half centuries from 1500 and peaked in 1750 but slowed their contribution to economic modernisation, as Portugal approached the beginning of the era of Modern Economic Growth. It reveals the apparently steady ruralisation of manufacturing activity during the two first centuries considered here and its re-urbanization in the course of the following 150 years.

A2. Model limitations and robustness

The main question related to the model's identification is that some of the exclusion restrictions which identify it could be incorrect. For example, Allen (2009) argues that fast TFP growth was endogenous to England's high wage economy. Other countries,

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[30] The head town of the county of Montemor-o-Novo had a population of about 3,500 out of a total of 7,300 for both the town and its hinterland. (Fonseca 1986). In Castro Marim these figures were 632 and 1,928, while in Tavira-Cacela they were 1,848 and 2,660. Their agricultural populations were 64 and 67 % respectively (we include 74 fishermen in Tavira, an important fishing port, and treat "agriculture" here as the "primary sector". In 1725, Portalegre, the town of about 7,500 inhabitants (1480 households) had a rural hinterland of about 5,000, where 78% of them were engaged in agriculture. In the town itself, between 20 and 30 % of the labour force was also agricultural. In all these cases we have treated the usually fairly substantial category of individuals with a "non-identified occupation" as belonging to the category of those living off agriculture.

[31] A fourth tax roll is available for the county of Portalegre, also in Alentejo, for 1725. We have not used it because the head town had more than 5,000 inhabitants at this time.

such as Spain, had land-saving biased technical change as an endogenous response to different relative prices of capital and labor. This is inconsistent with assuming that enclosure is exogenous to the system, as Allen himself does in the model's estimation. International trade itself may have had an endogenous component, as richer empires may have been able to generate additional resources which may eventually have led to further riches. It may also be difficult to accept the land-labor ratio as exogenous in the benchmark estimation. In pre-modern economies and assuming a Malthusian scenario, the size of the population should respond to the real wage and hence the denominator of the land-labor ratio could be eventually affected by this as well. A counterbalancing argument is that, in the model, each period is never less than 50 years, which attenuates the danger of reverse causation. Indeed, Allen (2003) briefly considers an additional equation for population growth and shows the main result is not affected.

In the paper, we show our results are robust to a varied choice of estimation methods, but other than in the choice of the estimators, we have followed Allen's methodology and identification strategy. Our strongest assumption is the choice of endogenous variables and their instruments (Allen 2003, p. 416). We did not perform tests of over-identifying restrictions, since econometric theorists argue that these tests, while common, in fact cannot be used to test for instrument validity (Parente and Silva 2012).

In addition, we show the instruments are not weak, that is, they are strongly correlated with the endogenous variable of interest.[32] Notice the often-used "F-statistic greater than 10" rule of thumb from Staiger and Stock (1997) only applies to one endogenous variable being instrumented and in any case is now outdated (Stock, Wright and Yogo 2002). Using the cut-offs suggested by Stock and Yogo (2005) we conclude that a weak instrument problem in the real wage equation does not exist. We recognize that under some specifications the possibility of weak IV cannot be rejected for the urbanization equation at standard levels of significance (this could be simply a matter of low power).

While we are aware that there are limitations which qualify our results, we believe that the advantages of using a dynamic model nevertheless clearly outweigh its disadvantages.

Simulation: invariance to the inclusion of Portugal

In this section we justify our decision to use Allen's original estimates in the counterfactual exercises. In the paper (tables 2-4), we show that the estimation of the model inclusive of Portugal by alternative estimation methods does not change the substantive results.

Indeed, using a series of F tests we do not reject that at most standard levels of significance the coefficients of the model with Portugal are equal to those for Allen's original estimation. Even the few for which the formal test fails to reject a difference have a similar magnitude in economic terms. We only carry out the test for the same estimation methods since tests of equality of coefficients can only be performed either

[32] Allen (2003) does not show first stage estimates or discuss the possibility of a weak IV problem, but we include an "IV robust F-statistic" row in each of the regression tables.

for the same estimation method or across estimation methods if the underlying parameters are structural.

Observing the estimated coefficients, we can also see that the small differences which occur do so in the expected direction. For instance, a comparison between columns (3) and (4) of table 2 reveals that when Portugal is included in the sample the estimated coefficient for urbanization rises, thus increasing the 'all else constant' impact of urbanization on the real wage. We additionally note that the encouraging way in which Allen's model reacted to the inclusion of Portugal – a country which presents interesting variation in the data due to its unusual mix of very high levels of intercontinental trade associated with relatively low real wage levels – is reassuring as far as confidence about the model's external (out of sample) validity is concerned.

A3. Additional figures

In the paper we present the simulated real wage rates under the historical as well as no-trade counterfactual scenarios. Here we present the same simulations for the remaining endogenous variables.

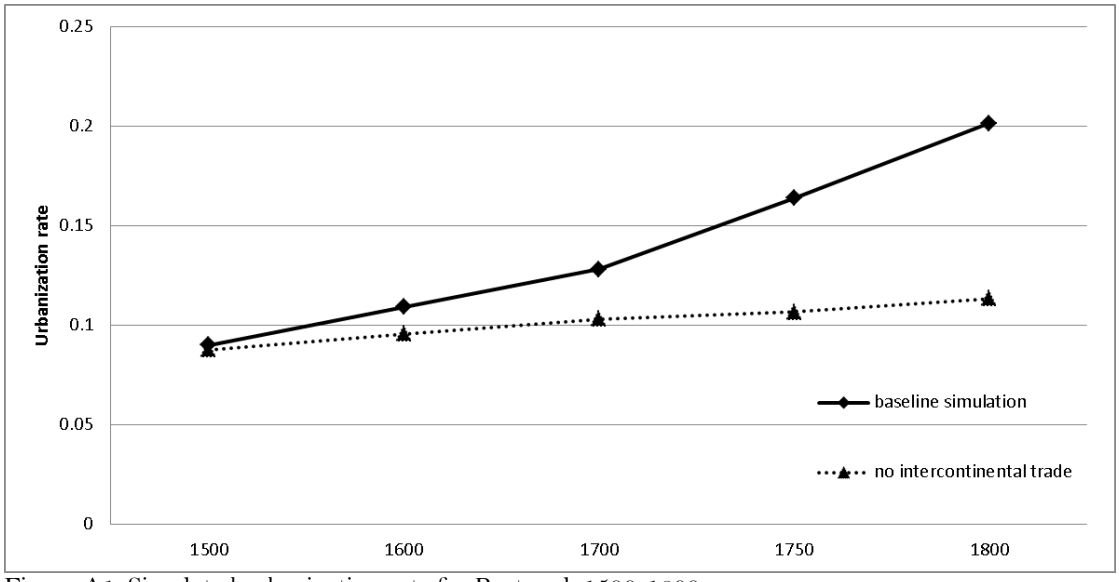

Figure A1: Simulated urbanization rate for Portugal, 1500-1800

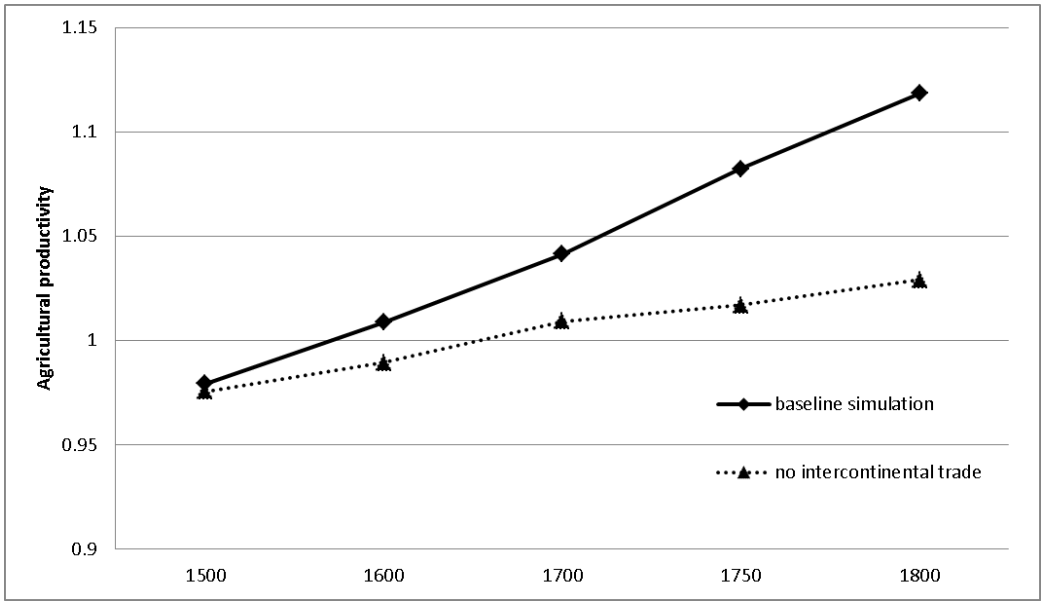

Figure A2: Simulated agricultural TFP for Portugal, 1500-1800

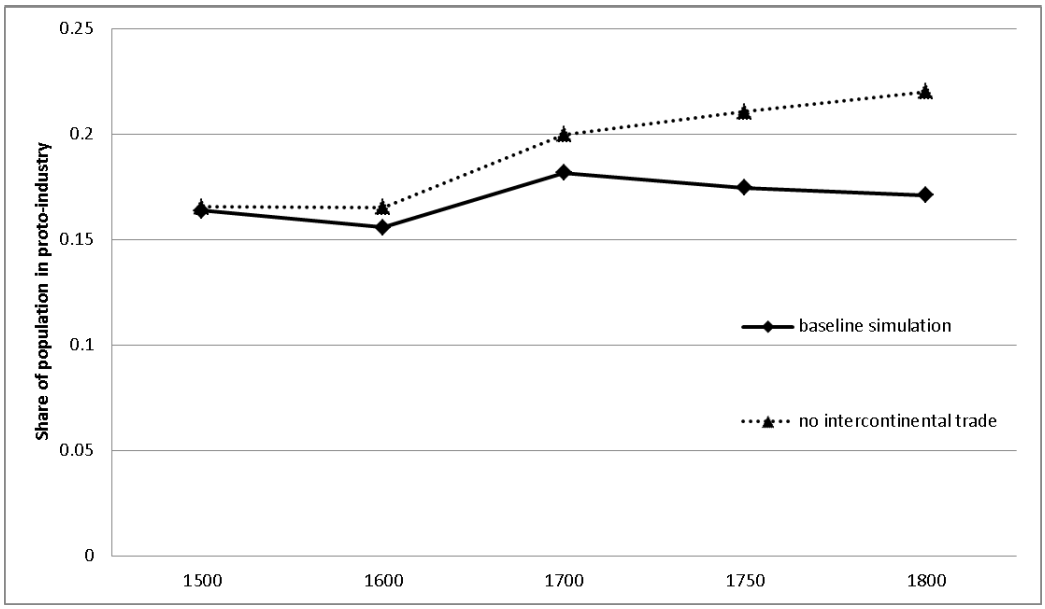

Figure A3: Simulated proto-industrial labour share for Portugal, 1500-1800

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