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industrial Europe, 1300-1800?**

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Accounting for the ‘Little Divergence’

What drove economic growth in pre-industrial Europe, 1300-1800?

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Abstract: The Little Divergence is the process of differential economic growth within Europe in the period between 1300 and 1800, during which the North Sea Area developed into the most prosperous and dynamic part of the Continent. We test various hypotheses about the causes of the Little Divergence, using new data and focusing on trends in GDP per capita. The results are that institutional changes (in particular the rise of active Parliaments), human capital formation and structural change are the primary drivers of the growth that occurred, which contrast sharply with previous findings by Robert Allen (who however focused on real wages as dependent variable). We also test for the role of religion (the spread of Protestantism): this has affected human capital formation, but does not in itself have an impact on growth. Moreover, we find an insignificant effect of the land-labour ratio, which shows the limitations of the Malthusian model for understanding the Little Divergence.

Keywords: Europe, economic growth, Little Divergence, institutional change.

JEL Codes: N13, N33, O40, O52.

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INTRODUCTION

The Industrial Revolution is arguably the most important break in global economic history, separating a world of at best very modest improvements in real incomes from the period of ‘modern economic growth’ characterized by rapid growth of GDP per capita. The debate about this phenomenon has recently been linked to the study of long-term trends in the world economy between 1300 and 1800. One of the issues is to what extent growth before 1750 helps to explain the break that occurs after that date; the idea of a ‘Little Divergence’ within Europe has recently been suggested as part of the explanation why the Industrial Revolution occurred in this part of the world. This ‘Little Divergence’ is the process whereby the North Sea Area (the UK and the Low Countries) developed into the most prosperous and dynamic part of the Continent. Studies of real wages – the classic paper is by Robert Allen (2001) – and of GDP per capita (e.g. Broadberry et al 2011, Van Zanden and Van Leeuwen 2012, Alvarez-Nogal and Prados de la Escosura 2012) charting the various trajectories of the European countries in detail, demonstrated that the Low Countries and England witnessed almost continuous growth between the 14th and the 18th century, whereas in other parts of the continent real incomes went down in the long run (Italy and Spain), or stagnated at best (Portugal, Germany, Sweden and Poland). This ‘Little Divergence’ is also quite clear from data on levels of urbanization (De Vries 1981), book production and consumption (Buringh and Van Zanden 2009) and agricultural productivity (Slicher van Bath 1963a, Allen 2000). The idea of a comparable divergence in institutions (in the functioning of Parliaments) has also been suggested (Van Zanden et al 2012). In sum, the ‘Little Divergence’ between the North Sea area and the rest of the continent is now a well-established fact, which is also relevant for debates about the ‘Great Divergence’ (it is not Europe as a whole that diverged from the rest of EurAsia, but ‘only’ the north-western part of it), and obviously for understanding the roots of the Industrial Revolution (which was to some extent a continuation of trends going back to the late Middle Ages).

The question about the causes of this divergent development of north-western part of Europe is therefore highly relevant for our interpretation of its specific growth path. Why were the Low Countries and England already long before 1800 able to break through Malthusian constraints and generate a process of almost continuous economic growth? In 1750, at the dawn of the Industrial Revolution, the level of GDP per capita of Holland and England had increased to 2355 and 1666 (international) dollars of 1990 respectively, compared with 876 and 919 dollar in 1347 (just before the arrival of the Black Death), and 1454 and 1134 in 1500 (Bolt and Van Zanden 2013). What made possible this doubling or nearly tripling of real incomes in the pre-industrial world? Various hypotheses have been suggested: institutional change (two versions: socio-political institutions such as Parliaments, demographic institutions such as the European Marriage Pattern), the impact of the growth of overseas – in particular – transatlantic trade (Acemoglu et al 2005), and the effect of human capital formation (Baten and van Zanden 2008).

The most comprehensive test of these various hypotheses was published by Robert Allen (2003). He set out to explain the Little Divergence in terms of real wages (of skilled workers), comparing the performance of a set of 9 countries (Spain, England and Wales, Italy, Germany, Belgium, the Netherlands, France, Austria-Hungary and Poland) in the period 1300-1800. Real wages, agricultural productivity, urbanization, proto-industrialization, and population growth are explained by each other and six exogenous variables: land-labour ratios, enclosure movements, trade levels, representative governments, rates of literacy and productivity in the manufacturing industry. The reported regression results explaining the development of real wages show a positive effect of land-labour ratios (according to Malthusian expectations), and also generally positive coefficients for urbanization and

agricultural productivity. But neither growing literacy nor the expansion of international trade appears to contribute directly to real wage growth. The international trade boom and agricultural productivity do however help to explain trends in the rate of urbanization, and via this link also affect real wages. Finally, by combining regression results into one simulation model, Allen finds a large effect of international trade on the development of north-western Europe, whereas representative governments and rates of literacy are unable to explain economic success: ‘The intercontinental trade boom was a key development that propelled north-western Europe forwards’ (p. 432), but ‘the establishment of representative government has a negligible effect on government in early modern Europe’ (p. 433) and ‘likewise, literacy was generally unimportant for growth’ (p. 433). This conclusion – the rise of the North Sea area is due to international trade and not caused by human capital formation and/or institutional change – has moreover been the starting point of his analysis of the causes of the Industrial Revolution (Allen 2009).

The aim of this paper is to explain the process of differential growth in early modern Europe on the basis of new data that have become available recently. We first of all focus on the explanation of trends in GDP per capita of the countries concerned, which is a better proxy of economic performance than the real wage estimates (see the discussion below). We have also detailed and reliable estimates of the various independent variables used in the regression analysis; this includes new data for human capital formation, the quality of political institutions, overseas trade, the cultivated area and agricultural productivity. On top of this, more countries are added to the basic sample of Allen (i.e. Sweden, Norway, Denmark, Portugal, Switzerland and Ireland), so as to increase the number of observations from 55 to 81. We apply Fixed Effect regression techniques to explore the basic correlation between the independent variables and per capita GDP. To deal with endogeneity issues, we conduct Two-Stage least-squares regression analyses. Finally, we standardize the coefficients of the main independent variables to estimate their relative impact on early modern growth. Our empirical results lead to different conclusions: GDP growth (where it occurs) is basically driven by political institutions, paradoxically one of the factors that was not contributing to real wage growth in the Allen (2003) regressions.

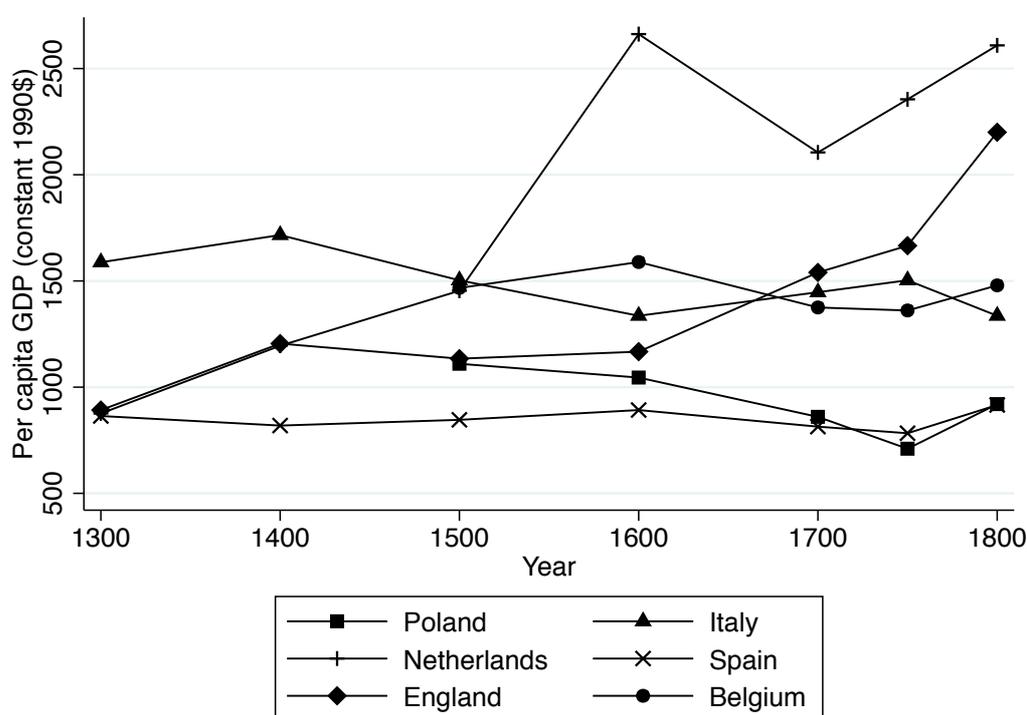
THE LITTLE DIVERGENCE: PER CAPITA GDP

A major difference of our approach is that we try to explain patterns of GDP growth in Western Europe between 1300 and 1800, whereas Allen focused on real wages of craftsmen. Recently, much new research charting the long-term evolution of GDP per capita in various parts of Europe has been carried out, which now makes it possible to systematically analyse patterns of real income growth. Moreover, we think that GDP is a better proxy of economic performance. Real wages are affected by systematic changes in income distribution, and trends between 1400 and 1800 are strongly influenced by the ‘Black Death bonus’, the sudden increase in real wages after 1348, due to increased labour scarcity. As a result, in most countries the trend in real wages between 1400 and 1800 is downward, whereas GDP per capita is stagnant or growing. A similar situation of labour scarcity is affecting real wages in Eastern Europe as a result of which, for example, the highest real wages in the Allen dataset are found in Vienna in 1400, not the region that comes to mind first as being highly successful (Allen 2003, p. 407).

Thanks to studies carried out by Broadberry et al (England/Britain), Van Zanden and Van Leeuwen (Holland), Buyst (Belgium), Krantz (Sweden), (Germany), Malanima (Italy), Alvarez-Nogal and Prados de la Escosura (Spain), Reis (Portugal), Pamuk (Ottoman Empire) (see the overview in Bolt and Van Zanden 2013) we now have a more or less complete set of estimates of GDP per capita for those countries. To complete the dataset, we used previous

estimates by Maddison for France, Austria, Switzerland, Ireland, Denmark and Norway, but we also carried out a robustness check for including these data by assuming that these countries grew at the same rate as their closest neighbours.¹ The pattern that emerges from this is the well-known ‘Little Divergence’: Figure 1 shows the development of real per capita GDP for six European countries between 1300 and 1800. No advances in levels of GDP were made in southern and central Europe between 1500 and 1800 – although income levels were high in Italy between 1300 and 1500, there was no growth after the 15th century. By contrast, per capita GDP in England and Holland grew after 1500, such that it more than doubled between 1300 and 1800. The timing of the Little Divergence is dependent on the country: the Netherlands already has a much higher level of GDP than the rest of the continent at about 1600, but England only distances itself from the other European countries during the 18th century, but it is also the country that grows consistently during the whole period.

Figure 1. Gross Domestic Product per capita, 1300-1800



Notes and sources: See main text.

To explain these trends we test a number of alternative (or to some extent supplementary) theories and ideas about why certain parts of Western Europe experienced relatively rapid pre industrial economic growth. The hypotheses we test are derived from institutional economics (stressing the importance of political institutions constraining the executive), and new/unified growth theory (focusing on human capital formation). Moreover, we link GDP growth to land/labour ratios (to take care of the Malthusian dimension), to the

¹ The new per capita GDP series, which are based on more and better information, show that per capita GDP must have been higher than the previous estimates of Maddison suggest: he estimated the average income of Western Europe in 1500 at 771 dollars, whilst the updated database of Bolt and van Zanden (2013) shows that it must have been around 1200 dollars. We therefore performed robustness checks assuming that countries grew at the same rate as their closest neighbours: per capita GDP of France is put equal to the average of Germany and Spain, that of Austria and Switzerland to the average of Italy and Germany, and that of Denmark and Norway to Sweden. The average income levels of these 5 countries are now higher than the estimates of Maddison. The regression outcomes are fairly similar to those reported in the empirical section (upon request from the authors).

growth of international trade (the Smithian dimension), to agricultural productivity, and finally we try to establish if Protestantism had a significant effect on growth (indirectly via its effect on human capital formation). We will now review these various explanations and discuss the various improved datasets we have collected to test them.

EXPLANATIONS OF THE LITTLE DIVERGENCE

Intermediate causes

International trade has often been identified as the main driver of the growth of north-western Europe (Acemoglu et al 2005). Reliable data on the growth of international trade are however not available. Allen's conclusion was based on estimates of the value of imports and exports of the countries active in the Atlantic trade that were however highly 'tentative': he only made estimates of international trade for Spain (1600-1800), France (1750-1800), England (1700-1800) and Netherlands (1700-1750), and assumed that in other years trade was zero. This concerns, for example, all observations for Italy, Germany, Austria, Belgium and Poland, and all observations about 1300-1500 - and even the Netherlands for 1800 is set at zero. This procedure is problematic in our view – it ignores, for example, that the Italian/Venetian fleet dominated the Mediterranean market around 1500, as did the German (Hanse) and Dutch fleets the trade of north-western Europe. Thanks to the research by Unger (1992) and others, we have relatively good estimates of the size of the merchant fleet of various regions and Europe as a whole, which can be used as a proxy of the growth of overseas trade. Table 1 shows these estimates, converted into tonnage per capita. The size of merchant fleets captures more general trade flows, and it is for that reason a better measure of international trade. Moreover, it is available for more countries and a longer period.²

Table 1. Per capita size of the merchant fleet, 1500-1800

Year	1500	1700	1800
England	5.9	18.7	84.0
Netherlands	55.6	210.0	198.9
Italy	5.0	6.9	16.4
Iberia	5.2	12.0	21.9
Germany	5.0	8.1	8.6
France	1.7	5.3	25.2
Scandinavia	-	21.0	158.0

Notes and sources: See appendix I. Iberia: Spain and Portugal; Scandinavia: Sweden, Norway and Denmark.

Although the Italian fleet dominated the Mediterranean area during the 15th century, its per capita size was equal to that of Spain, England and Germany. The Dutch fleet was ten times as large by then, and it kept this leading position until the 18th century. After 1500 stagnation occurred in Venice and Genoa, whilst the Dutch managed to quadruple per capita tonnage between 1500 and 1700. Rapid expansion in English and French shipping started after 1670s, although the French fleet was rather small compared to England and Holland by the 18th century. Increases in European shipping were even faster after 1750, since the Scandinavian and English fleet managed to catch-up with the Dutch. By the year 1800,

² The size of the merchant fleet is available for the following countries and periods. Germany, France, Italy, England: 1300-1800; Netherlands, Spain and Portugal: 1500-1800; Ireland, Norway, Sweden and Denmark: 1700-1800. There is no data for Austria, Switzerland, Poland, and Belgium. Austria, Switzerland, and Poland are landlocked, and it is for that reason assumed to have had no merchant fleet. Belgium is set fixed at zero, because it did not engage in shipping during the early modern period.

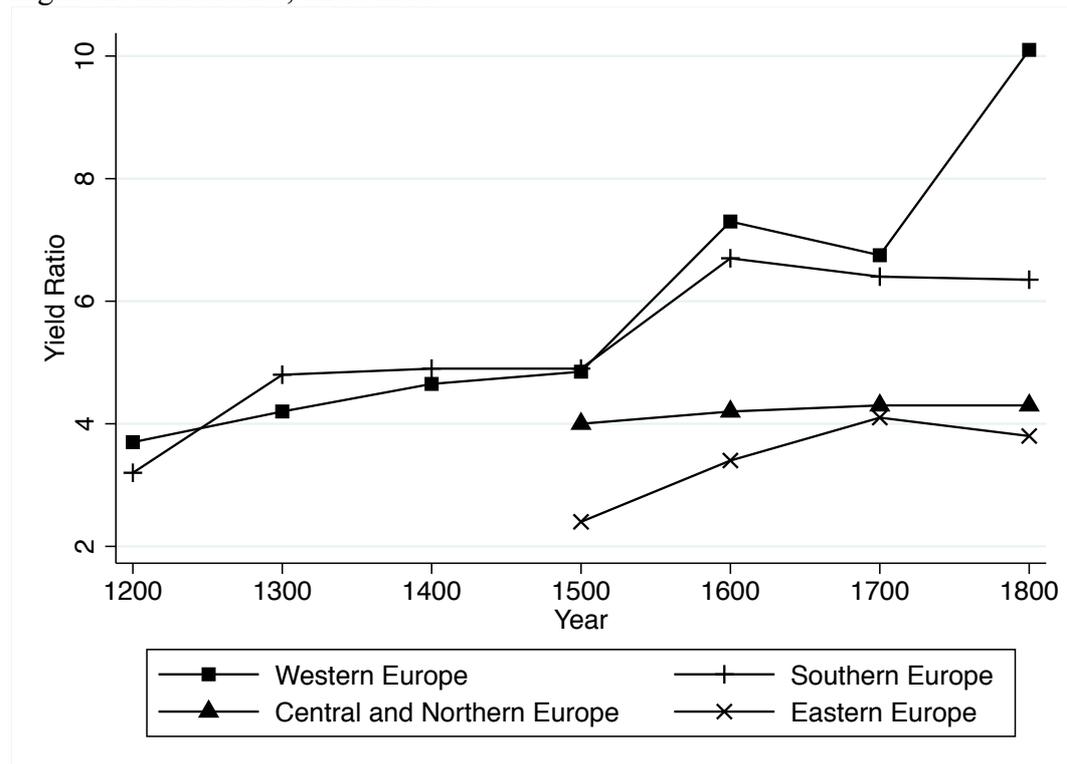
tonnage in Europe's merchant fleet not only surpassed anything seen before, but the rise of north-western Europe in shipping was obvious too: the Dutch, English and Scandinavian fleets were by far the leading ones.

Agriculture was the most important input in the process of economic development before the 19th century, as it produced by far the largest share of GDP. Population growth, and especially the increase in urban demand, raised the demand for food, which required higher levels of agricultural production. Increases in production were possible by expanding land use, but the amount of land that can be used was limited in the long run. Rising agricultural productivity was therefore necessary to feed a growing population. It worked in the opposite direction as well: productivity growth in agriculture contributed to development, because it supplied the manufacturing industry with raw materials and labour (Overton 1996).

To find out how important increases in agricultural productivity were for explaining the Little Divergence Allen uses an index of agricultural productivity to compute gains in efficiency (Allen 2000). This measure of technological progress however depends on the process of urbanization, real wages and the land-labour ratio, which means that it is already correlated with these variables. Consequently, it is therefore not a surprise that it gives positive regression results. We therefore do not use Allen's 'endogenous' proxy of agricultural productivity, but prefer an older indicator, the yield ratio, of which Slicher van Bath has collected a large dataset in the 1960s. He demonstrated that an increase in the yield ratio more or less reflects progress in the efficiency of farming.

Figure 2 presents the yield ratios for different parts of Europe. Levels of productivity in Western and Southern Europe were more or less similar until the 17th century. The yield ratios of Central and Eastern Europe were lower and almost constant over time – i.e. indicating little advances in productivity. Agricultural productivity stagnated in Southern Europe after the 17th century, whilst an increase in efficiency is visible for Western Europe. Countries bordering the North Sea thus ended up with the highest yield ratios at the end of the 18th century. Productivity in Eastern and Central Europe was just as high as Western Europe during the middle ages.

Figure 2. Yield ratios, 1200-1800

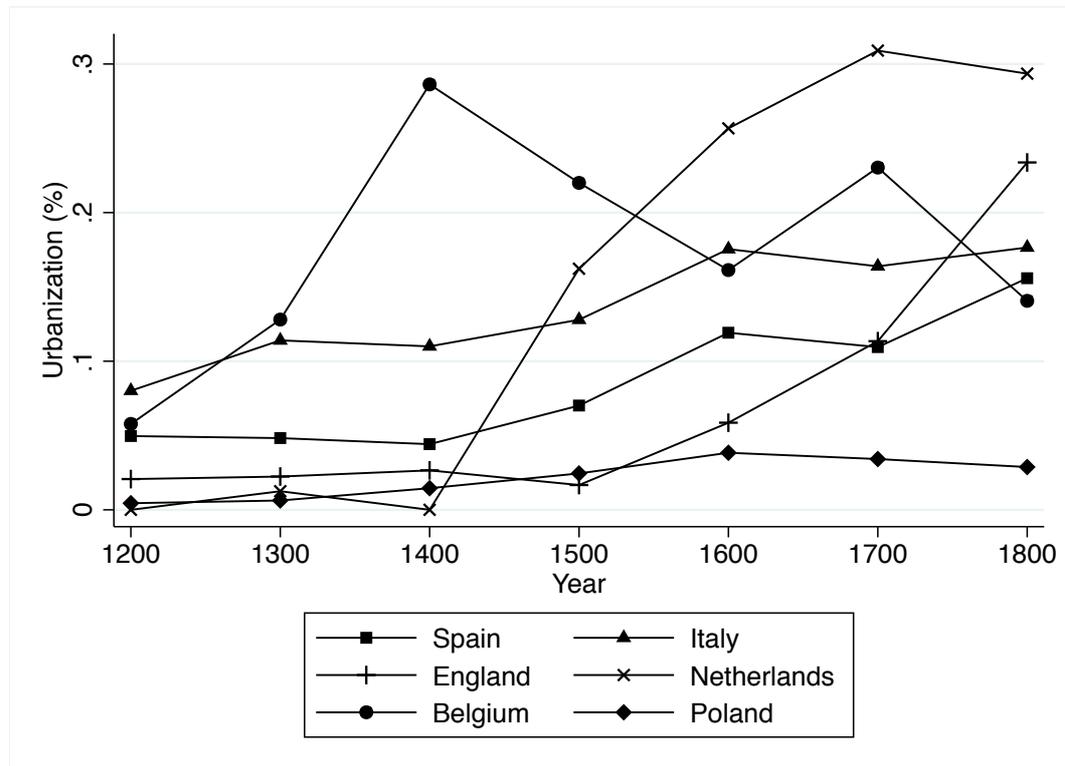


Notes and sources: Slicher van Bath (1963a, 1963b). Observations concern unweighted averages of wheat, rye and barley. See appendix I for the construction of this series. Western Europe: Great Britain, Ireland, Belgium and the Netherlands; Southern Europe: France, Italy, Spain and Portugal; Central and Northern Europe: Germany, Switzerland, Austria, Denmark, Sweden and Norway; Eastern Europe: Poland. Central, Northern and Eastern Europe enter the dataset in 1500.

The estimates of the historical development of the agricultural land area are derived from the (updated version of) the study by Klein Goldewijk and Ramankutty (2004) (as part of the Hyde database of environmental indicators), which shows that the supply of land was more elastic than previously assumed. We furthermore measure structural change of the economy by urbanization rates, which are given in Figure 3.³ Urbanization rates were relatively high in Italy and Belgium during the middle ages. After the 15th century, however, the Netherlands became the most urbanized country in Europe. More people moved to cities in England after 1700, so that it approximated Holland by the end of the 18th century. Other parts of Europe, such as Poland, had no growth in the share of people living in cities.

³ The original study of Allen measures ‘structural change’ by the share of people living in cities (levels of urbanization) and the degree of proto-industrialization (the share of people engaged in rural, non-agricultural activities), but we were unhappy with the quality of the data on proto-industrialization. The proxy of proto-industrialization shows patterns that we find difficult to reconcile with the qualitative information on this process (for example 39% of the Polish population was engaged in rural, non-agricultural activities; this was 35% in Austria/Hungary, 25% in the Netherlands, 29% in Belgium, and 36% in England by the 18th century). It was therefore decided not to include this variable in the regression analysis.

Figure 3. Urbanization rates, 1200-1800



Notes and sources: Cities are defined as settlements with more than 10.000 inhabitants. Absolute number of people living in cities is taken from Bosker et al (2012). Population levels are taken from the same source. Belgium includes Luxemburg and observations for England refer to the United Kingdom.

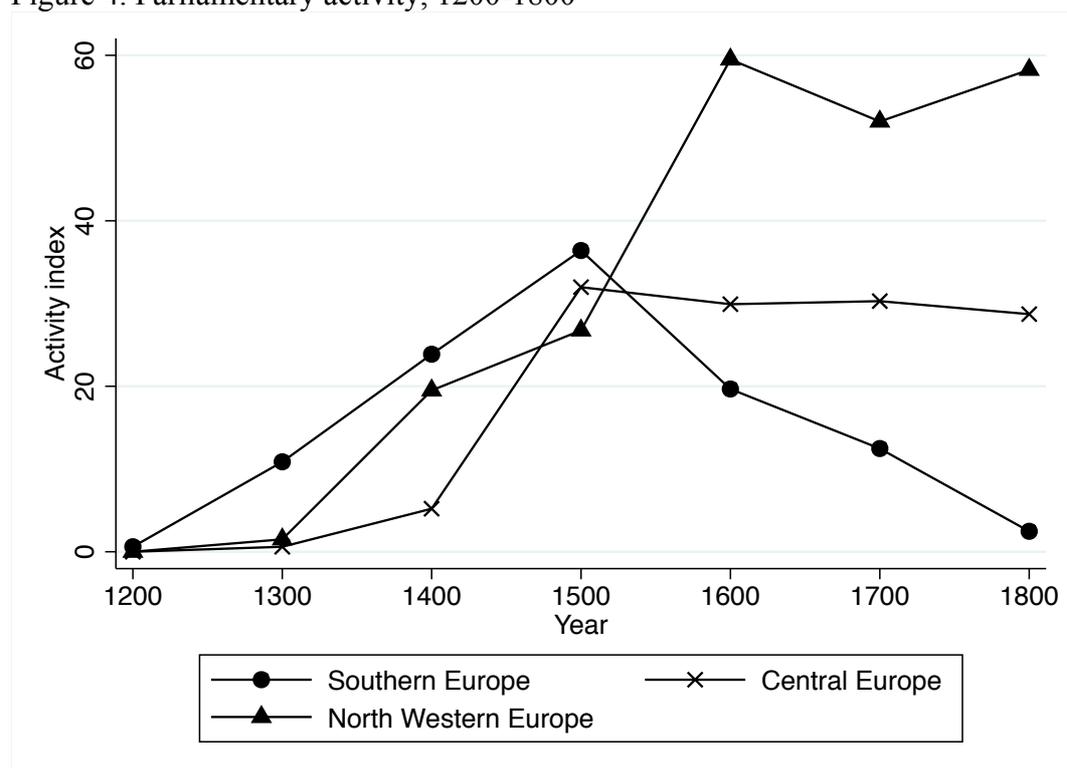
The variables considered so far, the size of the merchant fleet, agricultural productivity and structural change, can be considered as ‘intermediate’ causes of the Little Divergence. We now turn to a number of ‘ultimate’ causes, such as the quality of political institutions, demographic changes (resulting into more human capital formation) and religion, which in the literature play an important role as root causes of economic growth.

Ultimate causes

An influential body of literature argues that it is the specific political economy of Western Europe and in particular the balance of power between sovereigns and societal interests represented in Parliaments that created the right institutional conditions for Europe’s specific growth pattern. Two versions of this hypothesis can be distinguished. The first one stresses the Glorious Revolution as the watershed between ‘absolutism’ and some form of ‘parliamentary’ government, and sees this event as the main cause of the Industrial revolution of the 18th century (North and Weingast 1989, Acemoglu and Robinson 2012). The other one argues that these institutions that resurfaced in 1688 has a much longer history and that forms of power sharing between the Prince and his (organized) subjects go back to the Middle Ages and are rooted in the feudal power structures of that period (Van Zanden et al 2012). Allen used dummy variable derived from De Long and Shleifer (1993) to distinguish states governed by ‘Princes’ and those without (absolute) monarchs, the ‘Republics’. He however classified Poland as a ‘Republic’ which may help to explain why this variable turned out to be insignificant in his regressions (Allen, p. 415-416). We use the activity index of the various Parliaments (defined as the number of years they were in session during a century) as the proxy for the quality of political institutions. As demonstrated by Van Zanden et al (2012) this

measure varies from zero (in the 13th century, before the first ‘modern’ Parliament was convened in Leon in 1188) to close to 100 for post-Glorious Revolution England and the Dutch Republic. The averages of the south, central and north-western parts of Europe show a clear ‘institutional divergence’ within the continent: parliamentary activity contributed to growth in the north-west, but declined due to the rise of absolutism in particular in the south, but also in the central parts of Europe (with the exception of Switzerland) (see Figure 4). The question we address therefore is to what extent this institutional divergence within Europe helps to explain the growing economic disparities observed.

Figure 4. Parliamentary activity, 1200-1800



Notes and sources: Variable taken from Van Zanden et al 2012. Southern Europe: Portugal, Spain and France; Central Europe: Poland, Switzerland, Austria and Germany; Northern Europe: England, Netherlands, Belgium and Sweden. Observations include century averages (e.g. 1300 refers to activity between 1200 and 1300).

An equally influential body of literature suggests that the root causes of ‘modern economic growth’ should be found in an interplay of demographic and economic changes, affecting the ‘quality-quantity’ trade off (Becker 1981, Galor 2011), and resulting in on the one hand, limitations on fertility and population growth, and on the other hand in increased human capital formation. The emergence of the European Marriage Pattern in the North Sea area in the Late Middle Ages has been hypothesized as the crucial demographic change, which also resulted in increased investment in education of the (less) children (Hajnal 1965, De Moor and Van Zanden 2010a, Voigtländer and Voth 2012). An important part of the mechanism was the increase in the average age of marriage of women (and men), which both limited fertility and increased opportunities for human capital formation. Ideally, we would like to have a dataset of ages of marriage in various regions and centuries as determinant of long-term economic growth to test this hypothesis, but data limitations are particularly severe here. Instead, we focus on the results of the switch from quantity to quality, that is on developments in human capital formation. Allen used highly tentative estimates of literacy as measures of the increase in human capital that occurred. For 1500, for example, his ‘guestimates’ were directly based on the urbanization ratio, assuming that 23% of the urban

and 5% of the rural population was literate (p. 415); and most of the estimates between 1500 and 1800 were then based on intrapolation. This resulted in highly problematic figures, which do not correspond with the more qualitative knowledge of trends in human capital formation (for example: he estimated that only 10% of the Belgians and the Dutch were literate in 1500, whereas the literature suggests this was much higher) (De Moor and Van Zanden 2010b). Instead, we use much more robust estimates of book consumption per capita as our measure of human capital formation. This measure has already proven itself as a reliable guide to changes in human capital (Baten and Van Zanden 2008), and the underlying data (of actual book production) are, especially for the earlier period, much better than the proxies for literacy. Moreover, book consumption also measures more advanced reading and writing skills than just literacy rates do. Table 2 shows book consumption for European countries and underlines differences between the regions. During the middle ages, Flanders and Italy, the two core areas of Western Europe, had relatively high levels of book consumption. The Netherlands, Germany, France and Switzerland approximated or even surpassed Belgian and Italian levels of consumption by the early 16th century, whereas England, Ireland, Spain, Poland and Sweden lagged behind. The picture is different for the 18th century. Levels of book consumption were highest in Holland, followed by England and Sweden, whilst Belgium and Italy fell behind. The large increases of book consumption per capita presented in Table 2 are the results of two changes, the growth of human capital (resulting in a shift of the demand curve) and the decline of book prices, following a.o. the invention of moveable type printing (resulting in a move along the demand curve).

Table 2. Book consumption per thousand inhabitants, 1300-1800

Year	1300/99	1500/49	1750/99
England	0.3	18.0	196.4
Netherlands	0.2	19.5	501.5
Belgium	0.8	35.4	45.3
Iberia	0.4	5.7	29.0
Italy	0.8	29.3	88.7
Sweden	-	1.1	214.1
Ireland	-	-	79.5
Switzerland	0.1	71.6	33.6
France	0.3	40.3	120.8
Germany	0.3	28.6	125.3
Poland	-	0.3	23.1

Notes and sources: Book consumption is taken from Buringh and van Zanden (2009) and Baten and van Zanden (2008). England refers to Great Britain and Iberia to Spain and Portugal. Ireland enters the sample in 1600. There are no observations for Norway and Denmark.

A third ‘ultimate’ cause of growth is possibly religion. Since Max Webers writings on ‘The Protestant ethic and the spirit of capitalism’ (1905/1930) the link between religious change and economic development has been much debated. Recently this debate has received new attention as a result of econometric research trying to confirm such a relationship. Becker and Woessmann (2009) have tested this relationship for early 19th century Prussia, and concluded that Protestantism may have had a strong positive effect on human capital formation. In our approach such an effect would be included in the book production estimates

(which are indeed strongly correlated with Protestantism). We will test for this indirect effect, by including, starting in 1600, dummies for Protestantism.⁴

EMPIRICAL ANALYSIS

What accounts for the process of differential economic growth in pre-modern Europe? To find out, we explain per capita GDP by the ‘candidates’ discussed above: the land-labour ratio, the quality of political institutions, structural change, agricultural productivity, international trade, and human capital formation. The unit of observation are countries at intervals of approximately a century. The years include 1300, 1400, 1500, 1600, 1700, 1750 and 1800. Observations in 1300 and 1400 are only available only for Spain, Italy, England and the Netherlands. Germany, France, Austria, Poland, Belgium, Switzerland, Denmark, Ireland and Norway enter the dataset in 1500; Sweden and Portugal enter the sample in 1600. The logarithm of the variables is used in the regressions to ensure that extreme values do not play a disproportionate role.⁵ Unless otherwise noted we control for unobserved country-specific heterogeneity by using country Fixed Effects (FE).⁶

We first of all report on the Fixed Effect estimation results to discuss the basic correlation between our candidates and per capita GDP. There are, however, three reasons for not interpreting these results as causal. First, there might be reverse causality that biases the estimates upwards. Relatively successful economies such as Holland and England might have had larger cities, higher levels of productivity in agriculture, larger merchant fleets and/or more human capital formation, as rich countries may have been able to afford these higher levels. A second issue is related to the omission of other determinants of per capita GDP that may be correlated with our independent variables. Third, the estimates might be biased downwards due to measurement error in the independent variables. For instance, our indicator of human capital formation, book consumption, captures only part of the “true” human capital formation that occurred. All independent variables are lagged for one period in the regressions to somewhat limit the reverse causality problems, e.g. agricultural productivity in 1800 refers to the average level of productivity between 1750 and 1800.⁷ We furthermore report on the Two-Stage least-squares (2sls) estimation results where we treat urbanization, productivity in agriculture, international trade and human capital as endogenous. We follow the existing literature by treating the land-labour ratio and parliamentary activity as exogenous (Allen 2003, van Zanden et al 2012).⁸

To estimate the effect of the endogenous variables on per capita income levels, we need a set of instruments. First, we use Protestantism as an instrument for book consumption. We hypothesise that Protestantism had a strong and positive effect on human capital formation, whilst having no direct effect on economic success (Becker and Woessmann 2009). Second, there was persistence in the growth of cities in the early modern period, and urbanization in century $t-1$ is therefore correlated with urbanization in century t . Third, we

⁴ The variable takes values 1 for countries that are more or less fully protestant (England, Netherlands, Denmark, Sweden, Norway) and 0.5 for Germany and Switzerland which are about 50% protestant.

⁵ An exception is the urbanization ratio.

⁶ The descriptive statistics of the variables can be found in appendix II.

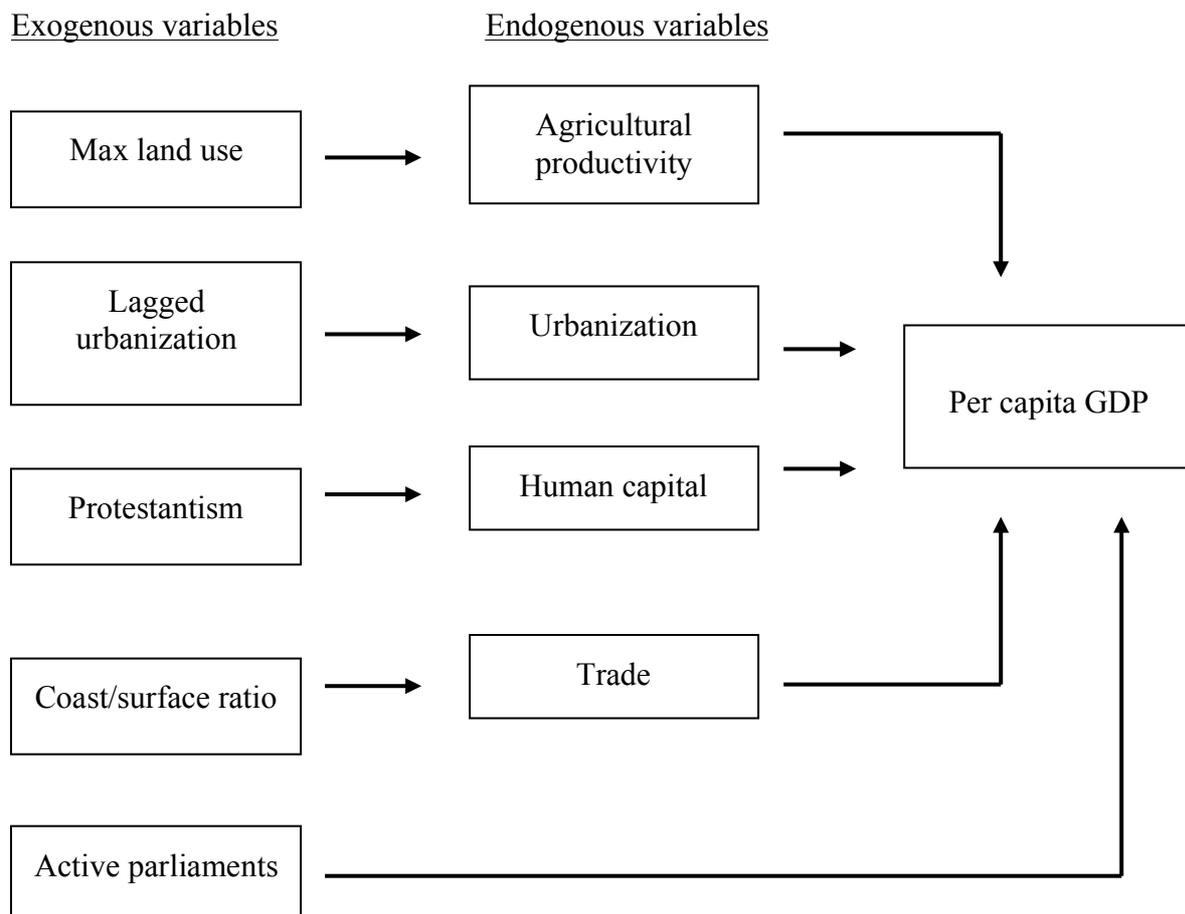
⁷ An exception is the size of the merchant fleet for which we have only point estimates: see the discussion in appendix I.

⁸ As an additional robustness check, we have also run these regressions assuming the parliamentary activity index to be endogenous. Parliaments gradually spread over the Latin west between 1200 and 1500, thereafter, however, parliaments declined in influence in Central and Southern Europe and further gained in importance in the North of Europe (see the discussion above). In this set of robustness-checks we therefore have instrumented the parliamentary activity index in century t with the activity index in century $t-1$. The F-statistic after the first stage is 24.43. The obtained regression results lead to similar conclusions (available upon request).

calculated the maximum surface of land that could potentially be used for agricultural production for the 15 countries in our dataset and adjusted it to population levels.⁹ This measure is adjusted to soil, vegetation and climate conditions. The maximum of agricultural land serves as an instrument for productivity in agriculture. Our hypothesis rests on the premise that growing populations increased the demand for food, which, in turn, reduced the share of land that could be put in productive use. In the long run this created the need for technological progress in agriculture. Finally, we follow the literature (e.g. Sachs and Warner 1997) that uses the coastline-to-area ratio as an instrument for international trade. Our theory is that these instruments work via the corresponding independent variables.

Figure 5 presents the various hypotheses in a schematic way. The exogenous factors that drive GDP growth are, firstly, Protestantism and demographic change (the rise of the EMP) – both via human capital formation – and, secondly, parliamentary institutions and geography (which are in their turn linked to the working of such institutions), of which parliaments have a direct impact on growth, and the geographical factors (and again parliaments) work via their effect on agricultural productivity and international trade.¹⁰ We now turn to the first set of regressions that explain per capita income levels.

Figure 5. Overview of hypotheses



⁹ This is based on a study of Buringh et al (1975) that computes the absolute maximum food production of the world.

¹⁰ See main text for the role of the land-labour ratio.

FE regression results

The equation including the land-labour ratio ($\ln land_{it}$) and the parliamentary activity index ($\ln par_{it}$) serves as baseline model throughout this section, to which we add the endogenous candidates separately to avoid collinearity problems in the 2sls estimates.¹¹ The baseline equation is,

$$\ln gdp_{it} = \alpha_i + X_{it} \beta + \gamma_1 \ln land_{it} + \gamma_2 \ln par_{it} + \varepsilon_{it}, \quad (1)$$

where $\ln gdp_{it}$ denotes the log of per capita GDP in century t , γ_1 and γ_2 capture the effects of the land-labour ratio and active parliaments on income levels. X_{it} is a vector that includes the endogenous variables: the urbanization ratio (urb_{it}), the yield ratio ($\ln yield_{it}$) the size of the merchant fleet ($\ln fleet_{it}$), and book consumption ($\ln book_{it}$). Finally, ε_{it} captures all other unobserved variables related to per capita GDP. We control for the possibility that it is serially correlated, by clustering our standard errors at the country level.

Table 3 reports on the Fixed Effect regressions explaining log per capita GDP between 1300 and 1800. Column (1) depicts a positive relation between active parliaments and per capita income levels. The R^2 of the regression in column (1) suggests that about 46% of the variation in per capita GDP is associated with variation in the land-labour ratio and parliamentary activity. Column (2) adds the urbanization ratio to the equation. Its coefficient is statistically significant at the 1% level, which points to a strong association between the growth of cities and economic success. The coefficient of parliamentary activity in column (2) is slightly smaller than the coefficient reported in column (1), reflecting the impact of active parliaments on urbanization (see discussion below). The regression results in column (3) include the yield ratio. Its coefficient, however, turns out to be insignificant, indicating that there has been no positive correlation between progress in agriculture and per capita income levels. Column (4) introduces international trade to the baseline model. The results are indicative of a positive correlation among the size of the merchant fleet and economic success: its coefficient has the right sign and is significant at the 5% level. Finally, Column (6) shows an insignificant association between book consumption and GDP per capita. It should be stressed, however, that the coefficient of book consumption becomes significant when excluding the observation for Switzerland in the 16th century.¹² This single observation is an outlier in our sample (see table 2): Switzerland became the centre of the Reformation, and the highest numbers of book production in 1600 are therefore to be found in this country (see Buringh and Van Zanden 2009).

¹¹ Some of the independent variables are highly correlated (e.g. the urbanization and yield ratio), which may bias the coefficients downwards. See appendix II for an overview.

¹² Regression results available upon request from the authors.

Table 3. FE and RE regressions of per capita GDP

Estimator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FE	FE	FE	FE	RE	FE	RE
Dependent variable is log per capita GDP							
<i>ln land</i>	-0.64*** (0.16)	-0.28 (0.19)	-0.46** (0.21)	-0.48** (0.19)	-0.32** (0.14)	-0.32 (0.25)	-0.26 (0.19)
<i>ln par</i>	0.74*** (0.22)	0.41* (0.20)	0.74*** (0.23)	0.64*** (0.18)	0.63*** (0.19)	0.79*** (0.25)	0.76*** (0.24)
<i>urb</i>		2.02*** (0.48)					
<i>ln yield</i>			0.23 (0.15)				
<i>ln fleet</i>				0.18** (0.06)	0.23*** (0.06)		
<i>ln book</i>						0.25 (0.15)	0.28* (0.15)
Constant	10.98*** (1.09)	8.52*** (1.31)	9.44*** (1.55)	9.85*** (1.30)	8.73*** (0.92)	8.62*** (1.77)	8.16*** (1.31)
R ²	0.46	0.59	0.49	0.52	0.51	0.48	0.48
No of obs	81	81	81	81	81	70	70
No of countries	15	15	15	15	15	13	13

Notes: Standard errors are clustered at the country level to control for serial correlation in the unobservables. Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, 1% level respectively. The regression measuring the impact of book consumption on log per capita GDP has no observations for Denmark and Norway.

IV regression results

In sum, the results in table 3 depict a positive correlation between active parliaments, structural change, international trade and per capita GDP. We cannot however interpret these relationships as causal due to reverse causality, omitted variables, and measurement error. To estimate the effect of our endogenous variables on per capita income levels, we introduce the set of instruments that we have discussed at the beginning of this section. The first stage regressions are given by equations (2) – (5),

$$urb_{it} = \alpha_i + \eta_1 lag\ urb_{it} + X_{it} \beta + \varepsilon_{it} \quad (2)$$

$$\ln\ yield_{it} = \alpha_i + \eta_2 \ln\ maxland_{it} + X_{it} \beta + \varepsilon_{it} \quad (3)$$

$$\ln\ book_{it} = \alpha_i + \eta_3 prot_{it} + X_{it} \beta + \varepsilon_{it} \quad (4)$$

$$\ln\ fleet_{it} = \alpha_i + \eta_4 \ln\ coast_{it} + X_{it} \beta + \varepsilon_{it} , \quad (5)$$

where the lag of the urbanization ratio (*lag urb_{it}*) serves as an instrument for urbanization; maximum agricultural land (*ln maxland_{it}*) for the yield ratio; Protestantism (*prot_{it}*) for book consumption; and, finally, the coast-to-area ratio (*ln coast_{it}*) for the size of the merchant fleet. η_1 to η_4 capture the effect of the instruments on the endogenous variables. The exclusion

restriction is that the instruments do not appear in the second stage regression as given in equation (1).

Century dummies (*Centdum*) are included in the specification when they were jointly significant to allow for unobserved century-specific heterogeneity. We control for unobserved country-specific heterogeneity by using Fixed Effects (FE) in estimating the effect of urbanization and agricultural productivity on per capita GDP. Those regressions introducing international trade and human capital formation to the baseline model are estimated with Random Effects (RE), as the instruments – i.e. the coast-to-area and Protestantism variables – are time-invariant. We therefore have, as an additional set of robustness checks, included the results of the basic Random Effects (RE) regressions in table 3. The estimation results of columns (5) and (7) do not deviate much from the Fixed Effects estimates as reported in columns (4) and (6): the coefficient of the land-labour ratio decreases, and the coefficients of the yield ratio and book consumption slightly increase. The coefficient of book consumption becomes statistically significant at the 10% level in the RE specification. We also have, very tentatively, performed several Hausman tests. The results indicate that the coefficients estimated by the RE estimator are the same as the ones estimated by the FE estimator.¹³ We therefore conclude that it is safe to use Random Effects to measure the effect of international trade and human capital formation on per capita income levels.

Panel I of table 4 presents the 2sls estimates of the coefficients of our candidates and panel II shows the corresponding first stages. Column (1) adds century dummies to the baseline Fixed Effects model of table 3. The coefficient of parliamentary activity increases from 0.74 to 1.17. Its coefficient is highly significant with a standard error of 0.28. Column (2) measures the effect of the urbanization ratio on per capita income levels. The outcomes from the first stage show that urbanization in time period $t-1$ explains a large part of the variation in urbanization in time period t as indicated by the R^2 . What is more, parliamentary activity contributed to the growth of cities as column (2) in panel II shows. This finding supports the evidence presented in van Zanden et al (2012) that parliamentary activity contributed to urban economic development. The corresponding 2sls estimates of the impact of urbanization on income per capita are in line with those reported in column (2) of table 3. The difference in coefficients can be attributed to the inclusion of century dummies, as this adjusts them downwards. Column (3) adds the yield ratio to the baseline model. Panel II indicates a strong negative effect of the availability of agricultural land ($\ln \text{maxland}$) on the yield ratio. This outcome supports our hypothesis that growing populations reduced the share of land that could potentially be used for crop production, which in turn created additional incentives to implement new technologies to increase agricultural production. The coefficient of the yield ratio in the corresponding 2sls estimates is significant at the 1% level, suggesting that increases in agricultural productivity contributed to early modern growth. Column (4) measures the impact of international trade. The first stage results depict a positive effect of the coast-to-area ratio on international trade. This confirms our premise that countries with a relatively large coast-to-area ratio were more likely to have relatively large merchant fleets than countries with small coast-to-area ratios. The related 2sls estimates show however an insignificant effect of international trade on per capita GDP. Finally, column (5) estimates the contribution of human capital formation to early modern growth. Panel II shows a positive association between Protestantism and book consumption, which adds additional evidence to the empirical results of Becker and Woessmann (2009). Moreover, the estimation results of

¹³ Test results available upon request. Omitting the observation for Switzerland in 1600 does not change the conclusions from the Hausman test.

the second stage indicate that human capital formation contributed to early modern growth, as its coefficient is significant at the 5% level.¹⁴

Table 4. IV/FE and IV/RE regressions of log per capita GDP

Estimator	(1) FE	(2) FE/2sls	(3) FE/2sls	(4) RE/2sls	(5) RE/2sls
Panel I: Two-Stage Least Square estimates					
<i>ln land</i>	-0.15 (0.23)	-0.16 (0.19)	-0.07 (0.24)	-0.27** (0.12)	-0.03 (0.20)
<i>ln par</i>	1.17*** (0.28)	0.79*** (0.27)	0.72*** (0.22)	0.63*** (0.21)	0.72*** (0.21)
<i>urb</i>		1.71** (0.84)			
<i>ln yield</i>			0.74*** (0.26)		
<i>ln fleet</i>				0.20 (0.21)	
<i>ln book</i>					0.63** (0.26)
<i>Centdum</i>	Yes	Yes	No	No	No
Constant	7.58*** (1.59)	7.71*** (1.21)	5.99*** (1.97)	8.45*** (0.83)	6.38*** (1.50)
R ²	0.57	0.66	0.36	0.51	0.43
Panel II: First Stages					
<i>ln land</i>		0.05 (0.04)	-0.15 (0.13)	-0.30 (0.20)	-0.15** (0.07)
<i>ln par</i>		0.12*** (0.05)	0.18 (0.21)	0.66 (0.54)	-0.19 (0.40)
<i>lag urb</i>		0.57*** (0.10)			
<i>ln maxland</i>			-0.37*** (0.07)		
<i>ln coast</i>				1.82*** (0.32)	
<i>prot</i>					0.36*** (0.11)
Constant		-0.27 (0.22)	5.31*** (0.66)	19.3 (13.4)	19.1 (4.91)
R ²		0.83	0.60	0.22	0.49
No of obs	81	81	81	81	70
No of countries	15	15	15	15	13
F-statistic		33.38	29.18	31.78	11.04

Notes: Standard errors are clustered at the country level to control for serial correlation in the unobservables. Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, 1% level respectively. The F-statistics report on the strength of the instrument. The regression measuring the impact of book consumption on log per capita GDP has no observations for Denmark and Norway.

¹⁴ The coefficient increases from 0.63 to 0.66 when excluding Switzerland in 1600. It remains significant at the 5% level and the F-statistic on Protestantism after the first stage indicates that it is a relevant instrument.

The correlation between the land-labour ratios and per capita GDP is ambiguous. The first set of equations in table 3 suggest a negative relationship between land-labour ratios and income levels, which is in stark contrast with the existing Malthusian theory that predicts a positive correlation (Clark 2007). This different outcome may be caused by letting the amount of agricultural land vary over time, instead of assuming it to be constant at its 1945 level (as Allen did assume). Assuming the resource base to be fixed gives declining land-labour ratios for all countries included in the sample, because the European population increased between 1400 and 1800. The amount of cropland was not constant; more land was put into productive use between 1300 and 1800.¹⁵ Countries such as Poland and Spain were able to cultivate more land to feed their growing populations. The decline in the land-labour ratio is thus less strong for these countries than it was for Holland and Belgium whose land-labour ratios show the sharpest decline between 1300 and 1800 (they more than halved). Consequently, the most successful economies were characterized by having the lowest land-labour ratios, and it is therefore not surprising to find a negative association between the land-labour ratio and income levels. This non-Malthusian result may however also be related to the fact that population growth, resulting in a decline in agricultural land per capita, had a negative effect on real wages but a positive effect on per capita GDP. We therefore have repeated the exercise taking the real wage of a craftsman as dependent variable (upon request from the authors). Although the coefficients appear with the expected positive sign in the Fixed Effects estimates, none of the coefficients is found to be statistically significant. This conclusion adds further support to a process of ‘modern economic growth’ that is not constrained by a limited supply of land as in the Malthusian model. Increased population density made it possible to profit from economies of scale and knowledge spillovers, creating the process of growth that we find in, for example, the Dutch Republic and England (De Vries and van der Woude 1997). We therefore conclude that population growth and high population density had a positive effect on economic outcomes.

¹⁵ See discussion in second session.

Testing for the decisive factors

Particular interest lies in the magnitude of the coefficients of the candidates on early modern growth. We therefore have, as a final step, standardized the coefficients of the significant variables and included them in a single Fixed Effect model to examine their relevance impact on log per capita GDP. Table 5 reports on the outcomes.

Table 5. FE regressions with standardized coefficients

Estimator	(1)	(2)	(3)	(4)
	FE	FE	FE	FE
Dependent variable is log GDP per capita				
<i>urb</i>	0.48*** (0.14)	0.48*** (0.13)		
<i>ln yield</i>	0.07 (0.14)	0.07 (0.15)		
<i>ln par</i>	0.23** (0.12)	0.35** (0.14)	0.42*** (0.13)	0.57*** (0.12)
<i>ln book</i>	-0.01 (0.12)	-0.04 (0.11)	0.28*** (0.09)	0.16* (0.10)
<i>Centdum</i>	No	Yes	No	Yes
R ²	0.56	0.64	0.46	0.55
No of obs	70	70	70	70
No of countries	13	13	13	13

Notes: Standard errors are clustered at the country level to control for serial correlation in the unobservables. Standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, 1% level respectively.. Omitting the observation for Switzerland in 1600 does not change our results.

Column (1) includes our proxies for structural change, productivity in agriculture, political institutions and human capital formation. The regression results show an insignificant association between the yield ratio and per capita GDP. The coefficients of the urbanization rate and parliamentary activity index are highly significant, where the relative impact of structural change is stronger than that of political institutions. However, the inclusion of century dummies in column (2) increases the magnitude of parliamentary activity on log per capita GDP relative to that of the urbanization ratio. The regressions in columns (3) and (4) exclude the urbanization and yield ratios. Both variables are highly correlated with book consumption (correlations of 0.5 and 0.49 respectively); with each other (correlation of 0.65); and, finally, the urbanization rate is closely related to per capita GDP (correlation of 0.82). As a result, this may suppress the effect of human capital on income levels. The estimates omitting the urbanization and yield ratio show a significant correlation between human capital and early-modern growth. The inclusion of century dummies in column (4) increases the relative magnitude of active parliaments to that of book consumption, which indicates that the effect of active parliaments became stronger over time.¹⁶ Overall the analysis suggests that structural change, political institutions, and, to a lesser extent, human capital formation, mattered for pre-1800 economic development.

The evidence presented above conveys several interesting messages. First, our empirical result that human capital formation contributed to pre-modern growth contrasts with earlier conclusions of Mitch (1993), Allen (2003) and Reis (2005) that are indicative of an insignificant relationship. These studies focus on literacy rates as a proxy of human capital,

¹⁶ We derive at similar conclusions when only excluding the urbanization ratio or yield ratio from the analysis.

which suffers from the disadvantage of measuring only very basic skills (reading and writing abilities). Our empirical results lend ample support to recent findings that use estimates for more advanced skills: book production (Baten and van Zanden 2008) and secondary schooling (Boucekkine et al 2007, 2008). The increases human capital formation, which was a result of the emergence of the EMP after the Black Death, contributed to the rise of the North Sea region. This conclusion supports growth theories that stress the importance of human capital formation for the onset of modern growth (Nelson and Phelps 1966, Schultz 1975, Galor 2011). Second, a finding of equal importance is the effect of culture/religion on human capital formation. Protestantism had no direct effect on per capita income levels, but it worked via the channel of human capital formation. Finally, we find that parliamentary institutions explain the Little Divergence as it occurred in Western Europe between 1300 and 1800, which adds further evidence to the empirical findings of Acemoglu et al (2005) and Van Zanden et al (2012). Constraints on the executive, such as an active Parliament, contributed to economic development via the protection of property rights (North 1981, North and Weingast 1989).

CONCLUSION

What were the causes of the Industrial Revolution? It is one of the key questions of economic history that is debated intensely. Almost all recent interpretations however take as their starting point an economy that is already highly developed, and characterized by a high level of urbanization, a well-developed commercial infrastructure, a skilled labour force, by international standards high real wages, low interest rates and relatively ‘modern’ institutions, although they may identify different factors which lead to the real industrial break through (Allen 2009, Mokyr 2009). The issue of this paper was to explain how the relatively advanced economy of the 18th century North Sea area came about. This explanation focuses on the Little Divergence, in particular the strong performance of the North Sea region that drove this process. For the first time in recorded history, levels of GDP per capita surpassed the 1500 dollars (of 1990) threshold, thanks to a process of consistent growth that began in the 14th century. The Industrial Revolution of the late 18th century can be seen as a culmination of this development path.

We have tested various hypotheses about the causes of the Little Divergence, using new data of, amongst others, human capital formation and the quality of political institutions, and focusing on the explanation of trends in GDP per capita. The results are that institutional changes (in particular the rise of active Parliaments), human capital formation and structural change are the primary drivers of the growth that occurred, which contrast with previous findings by Robert Allen, who however focused on real wages as dependent variable. We also test for the role of culture/religion (the spread of Protestantism): this has strongly affected human capital formation. Moreover, we find no or a small negative effect of the land-labour ratio, indicating that population growth and high population density is perhaps positively related to growth, which shows the limitations of the Malthusian model for understanding the Little Divergence. Growth before 1800 was, as already argued by De Vries and Van der Woude (1997) in their book on the Dutch economy between 1500 and 1800, caused by the same drivers as the modern economic growth of the 19th and 20th centuries.

APPENDIX I: DATA CONSTRUCTION

Per capita GDP

Observations for Germany, Spain, Italy, Belgium, the Netherlands, England, Sweden, Poland, and Portugal are taken from Bolt and van Zanden (2013). GDP estimates of France, Austria,

Switzerland, Ireland, Denmark and Norway are derived from Maddison (2001). The datasets of Maddison gives per capita GDP in 1700 and 1820. The observation for 1750 is interpolated.

Yield ratios

Data is available with intervals of 50 years in Slicher van Bath (1963a, 1963b). Observations in the sample thus refer to century averages (e.g. the average yield ratios for 1200-49 and 1250-99 gives the observation for 1300). It was required to make several assumptions. Western Europe: There is no evidence for the period 1700-49. Data for the year 1800 is therefore based upon the yield ratio of 1749-99; Southern Europe: Most assumptions were necessary for this sub-set of countries, since data is lacking for periods 1350-99, 1450-99 and 1550-1649. The observation of 1300 refers to the average yield ratio between 1300-49, 1400 to 1400-49, 1500 to 1400-49, 1600 to 1500-49 and 1700 to 1650-99. Yield ratios of these countries do not vary much over time, which makes these assumptions plausible in our view; Central, Northern and Eastern Europe: Evidence for 1500 is based upon average yield between 1500 and 1549.

Merchant fleets

Estimates of the growth of the European merchant fleet between 1500 and 1800 are taken from Van Zanden (2001). The size of the total fleet (in thousand tons) was 200-250 in 1500, 600-700 in 1600, 1.000-1.100 in 1700 and 3.372 in 1800. The estimates of Unger (1992) are slightly higher, as he approximates its total tonnage at 1.000 in 1600 and 1.500 in 1670. It is decided to choose the lower bound estimates of van Zanden and to take averages (i.e. the size of the total fleet was 225 in 1500). Van Zanden gives regional and national shares of the fleet, which can be found in table 6. These shares are used to calculate individual century observations:

Table 6. Regional and national share of the merchant fleet, 1500-1800

Year	c. 1500	c. 1600	c. 1670	1780
Southern Europe	40?	25?	20?	15
Netherlands	16	33	40	12
Great Britain	10-12	10	12	26
France	?	12	8-14	22
Hanseatic towns	20?	15	10	4
Unspecified	-	5	10-4	21

Notes and sources: Van Zanden (2001). Southern Europe: Spain, Portugal and Italy.

1800: Observations are taken from Romano (1962) that was also the original source of van Zanden (2001). It refers to the year 1786-7. There were no individual observations for Norway and Denmark. These countries are assigned to have had the same amount of tonnage per capita; 1700: Estimations for the Netherlands, Great Britain, France, Germany and southern Europe are based upon the shares in table 6. This is compared with the estimates of Vogel (1915) for the year 1670. Vogel estimates the Dutch fleet around 600 tons, which is too high as 420 tons is more likely. To calculate tonnage of the French fleet, the average of Van Zanden's estimate is taken (i.e. 11%). The share of the fleet in Southern Europe is assumed to be 20% (210 ton in absolute terms). The Venetian fleet increased from 20 tons in 1450 to 60 tons in 1780. The observation for 1700 is linearly interpolated. Unger (1992) assigns the Venetian fleet to 32 tons in 1567, which is in line with the interpolation exercise. Unger measures the fleet of Genoa at 30 tons in 1450 and Romano estimates it at 42 tons in 1786-7, which makes it possible to interpolate the years in-between. Combining the fleet of Venice

and Genoa gives the observation for Italy for 1700. Subtracting this from the total fleet of southern Europe offers the estimates for Spain and Portugal. Nonetheless, it should be noted that there are no individual estimations, although it is adjusted to their population levels. 7% of the European fleet is unspecified, of which 5% is assigned to Scandinavia (taking a 2% margin of error into account). Taking the ratio of 1800 for division of tonnage between Sweden at the one hand, and Denmark and Norway on the other hand, provides the total tonnage of Sweden. The rest is attributed to Denmark and Norway; 1600: Observations are conducted in a similar way by using the shares given in table 6. Unger gives the observation for Venice, and Genoa is interpolated. Taking these two together, gives the observation for Italy. That what remains (94 tons) is distributed between Spain and Portugal according to their population level. To follow Unger, the Scandinavian fleet increased remarkably after 1670. Since its tonnage was still relatively low at the end of the 17th century, it is assumed that there was no Scandinavian fleet before 1700; 1500: Observations for Germany, southern Europe and Britain are calculated with the help of table 6. In doing so, it is decided to take an average for Britain (11%). Vogel estimates the Dutch fleet around 60 tons by the 1470s, which is too high according to van Zanden. Holland went through a deep recession at the end of the 15th century, and it is therefore likely that the size of the merchant fleet decreased. As this study works with century averages, it is decided to take the average (50 tons) to correct for the depression. Unger provides estimates of the Italian fleet. This is subtracted from the total southern European share and the remaining is assigned to Portugal and Spain. Subtracting all individual observations from the total European tonnage gives the estimate for France (25 tons); 1400 and 1300: Evidence for the middle ages is scarce. Unger however gives estimates based on wine and beer trade that provides observations for England, France and Germany.

APPENDIX II: DATA

Table 7 lists the descriptive statistics of the main variables used in the analysis. Table 8 reports on the basic correlation between variables.

Table 7. Descriptive statistics

	Average	Standard deviation
Ln per capita GDP	6.96	0.34
Ln land-labour ratio	6.59	0.52
Ln parliamentary activity index	2.52	1.66
Urbanization ratio	0.09	0.07
Ln yield ratio	1.66	0.29
Ln size of the merchant fleet	5.68	4.95
Ln book consumption	9.43	2.42

Table 8. Correlations

	Lngdp	Lnland	Lnpar	Urb	Lnyield	Lnfleet	Lnbook
Lngdp	1						
Lnland	-0.33	1					
LnPar	0.34	-0.19	1				
Urb	0.82	-0.27	0.31	1			
Lnyield	0.49	-0.41	0.34	0.65	1		
Lnfleet	0.44	-0.06	0.11	0.42	0.27	1	
Lnbook	0.33	-0.29	0.16	0.50	0.49	0.35	1

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