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# Seven centuries of European economic growth and decline

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September 2015

Centre for Climate Change Economics and Policy  
Working Paper No. 232

Grantham Research Institute on Climate Change and  
the Environment

Working Paper No. 206

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# Seven Centuries of European Economic Growth and Decline<sup>1</sup>

Roger Fouquet and Stephen Broadberry

*This paper investigates very long run pre-industrial economic development. New annual GDP per capita data for six European countries over the last seven hundred years paint a clearer picture of the history of European economic development. First, the paper confirms that sustained growth has been a recent phenomenon, but rejects the argument that there was no long run growth in living standards before the Industrial Revolution. Instead, the evidence demonstrates the existence of numerous periods of economic growth before the nineteenth century - unsustained, but raising GDP per capita. It also shows that many of these economies experienced substantial economic decline. Thus, rather than being stagnant, pre-nineteenth century European economies experienced a great deal of change. Finally, it offers some evidence that, from the nineteenth century, these economies increased the likelihood of being in a phase of economic growth and reduced the risk of being in a phase of economic decline.*

JEL codes: N13, O11, E01

Keywords: History of Economic Development, Economic Growth, Economic Decline

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<sup>1</sup> Please cite as: Fouquet, R. and S.N. Broadberry (2015) 'Seven Centuries of European Economic Growth and Decline.' *Journal of Economic Perspectives* 29(4). For the article and supplementary materials such as the datasets, see the article page at <http://dx.doi.org/10.1257/jep.29.4.1>

John Maynard Keynes (1931) wrote in his essay “Economic Possibilities for Our Grandchildren”:

From the earliest times of which we have record—back, say, to two thousand years before Christ—down to the beginning of the eighteenth century, there was no very great change in the standard of life of the average man living in the civilised centres of the earth. Ups and downs certainly. Visitations of plague, famine, and war. Golden intervals. But no progressive, violent change. Some periods perhaps 50 per cent better than others—at the utmost 100 per cent better—in the four thousand years which ended (say) in A.D. 1700.

Over the decades, his nuanced account of the past has become a great deal more stylized—the lack of “very great” or “violent” change became an absence of any change. Today, received wisdom holds that the western European countries did not experience major phases of economic growth (or decline) prior to the Industrial Revolution. As one example among many that could be cited, Hansen and Prescott (2002, p. 1214–15) write that “sustained growth has existed for at most the past two centuries, while the millennia prior have been characterized by stagnation with no significant permanent growth in living standards.” Yet, qualitative accounts of European histories indicate that the Renaissance in Italy and the Golden Age in Holland seem to have reflected phases of economic development – associated with the expansion of trade and urbanization, as well as developments in art and science - prior to the Industrial Revolution (Goldthwaite 2009; Acemoglu and Robinson 2012; de Vries and van der Woude 1997).

Building in part on Angus Maddison’s (1982, 1995, 2003) bold empirical research program to create very long-run data series for many countries, a generation of economic historians has been exploring archives and combining data sets to create more and better evidence. Over the last four years, a number of very long run time series have been completed for major economies of Europe, connecting the late medieval era with the present using annual data. The new time series have been looked at individually by the researchers that produced the data (Broadberry et al. 2011, Malanima 2011, van Zanden and van Leeuwen 2012, Schön and Krantz 2012, Alvarez-Nogal and Prados de la Escosura 2013, Reis et al. 2013). The main aim of this paper is to present this data together and offer an alternative interpretation of very long run European economic development.

The first section of this paper rejects the received wisdom that growth rates in pre-Industrial Revolution Europe were stagnant. The new data shows trends in GDP per capita in the key European economies before the Industrial Revolution, identifying episodes of economic growth in specific countries, often lasting for decades - ultimately, they were unsustainable, but noticeably raised GDP per capita. It also shows that many of these economies experienced substantial economic

decline. Thus, rather than being stagnant, pre-nineteenth century European economies experienced a great deal of change.

In the second section, the paper tentatively identifies that the likelihood of being in a phase of growth increased and the risk of being in a phase of decline decreased in the nineteenth and twentieth centuries. The discussion in the third section turns to evidence on patterns of divergence and convergence in Europe, showing that divergence occurred when a new economic leader moved ahead, followed by a period of convergence and catch-up by others. The fourth section presents the main data sources and methods used to construct the GDP per capita estimates from the Late Medieval and Early Modern era until the nineteenth century in six European economies: England/Great Britain, Holland, Italy, Spain, Sweden and Portugal.

Following the publication of successive editions of Maddison's (1982, 1995, 2003) data on long-run economic performance, understanding of long run economic growth and development advanced, as many economists exploited the new information. Baumol (1986), DeLong (1988) and Pritchett (1997) relate to work on convergence and divergence, based on Maddison's post-1870 OECD countries dataset, which helped to stimulate endogenous growth theory. Then, his work was a key inspiration for new theories of economic growth - for instance, Hansen and Prescott (2002) and Galor (2005) were stimulated by the later Maddison data set for the whole world during the second millennium.

The production of these new very long run data sets may spur an equivalent or greater wave of understanding of economic growth and development. For the first time, it is possible to investigate the annual changes in economic growth and development over several centuries, potentially identifying multiple major phases of economic growth and decline in one or a series of countries. This more detailed perspective of very long run European economic growth indicates that the Industrial Revolution was not an isolated event originating in Great Britain. Instead, it was a phase in a much longer process of economic transformation across Europe.

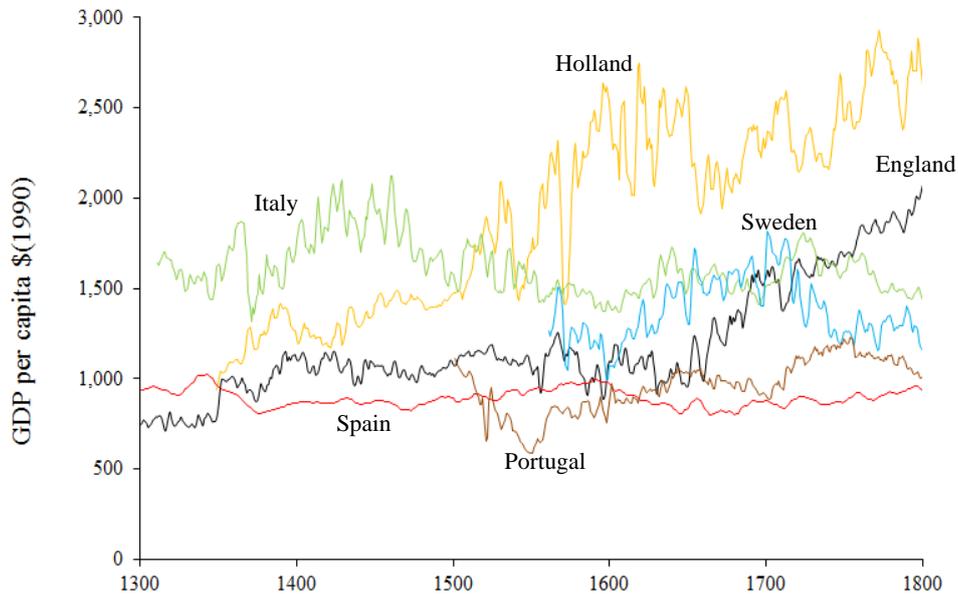
Given current concerns about limited growth in industrialized economies and thoughts about ways to stimulate a new industrial revolution, research based on this data can offer valuable insights about these underlying processes and are likely to be of great interest to economists in general. Since economic transformations on the scale of the Industrial Revolution are rare events, an understanding of the processes underlying such transformations will need to look back many centuries. Furthermore, comparisons of past experiences with more recent ones may suggest commonalities in the relationships with and determinants of economic development. This paper focuses on presenting basic facts and patterns to the best of our current abilities, and avoids the temptation of seeking more detailed

explanations. However, recent work, work in progress, and future papers seem certain to employ this data as the basis for new empirical and theoretical research.

## **Growth Episodes and Growth Reversals in Europe before 1800**

Economic growth before the nineteenth century was not stagnant, but had extended periods of growth and decline. Figure 1 presents GDP per capita for six European countries before the nineteenth century: England (from 1300 until 1700 and Great Britain afterwards), Holland (starting in 1348), Italy (specifically, Central and Northern Italian States from 1310), Spain (since 1300), Sweden (beginning in 1560) and Portugal (from 1500).

Figure 1 depicts four major “growth episodes” in specific European economies. Between the start of the fourteenth and the end of the eighteenth century, Italy was the first economy to have experienced a growth episode as population declined sharply after the Black Death, leaving survivors with more land and capital per person. Nevertheless, it was a period in which Italian cities prospered by expanding their pivotal role in trade links between Europe and Asia (Hodgett 2006). Between 1350 and 1420, the level of per capita income rose by 40 percent, which represents a modest but non-negligible growth rate of 0.8 percent per year over 70 years. Holland followed with a spectacular sixteenth century – per capita GDP rose by 70 percent from 1505 to 1595 as Dutch trade expanded rapidly and the economic structure shifted away from agricultural production towards higher value commodities - managing a growth rate of 1.3 percent per annum during this period. A decade later, Sweden started developing through its control of the Baltic trade and its per capita GDP grew 41 percent in the first half of the seventeenth century. In the second half of the century, England became the next vibrant economy - its per capita income growing by more than 50 percent during this time. This growth episode followed the end of a Civil War that marked an important step on the road to constitutional monarchy, culminating in the Glorious revolution of 1688 (North and Weingast 1989; Acemoglu and Robinson 2012). However, population stagnated during the second half of the seventeenth century, so it was only after 1700 that Great Britain achieved modern economic growth with the co-existence of population growth and per capita GDP growth.



Sources: England (Broadberry et al. 2011); Italy (Malanima 2011); Holland (van Zanden and van Leeuwen 2012); Sweden (Schön and Krantz 2012); Spain (Alvarez-Nogal and Prados de la Escosura 2013); Portugal: (Reis et al. 2013, Palma and Reis 2014). \* 3-year average; Spain: 11-year average.

**Figure 1. GDP per capita in Selected European Economies, 1300-1800<sup>2</sup>**

To ensure that these phases are not artifacts of selecting peaks and troughs in a volatile series, the total growth in GDP per capita is measured as the average value in the decade following the “growth episode” divided by the average value in the decade preceding this phase – although for reasons explained in greater detail in the section later in this paper, one should be careful about over-interpreting these estimates. Some might argue that, starting from a low base, a rise of 40 or even 70 percent may not be a great absolute increase, and is not very impressive when observed over 50 years or more. Nevertheless, these are unquestionably extended periods, covering a number of decades, in which certain economies grew substantially in both relative and absolute terms, providing major improvements in the average standards of living (although ideally distributional effects of these increases would also be taken into account). Clearly, these pre-nineteenth century European economies were not stagnant.

Interestingly, at some point during practically the entire sixteenth and seventeenth centuries at least one economy in Europe was experiencing a growth episode. It would be worth investigating in greater detail the scale of spillovers to

<sup>2</sup> The data will be available as additional material to Fouquet, R. and S.N. Broadberry (2015) ‘Seven Centuries of European Economic Growth and Decline.’ *Journal of Economic Perspectives* 29(4). <http://dx.doi.org/10.1257/jep.29.4.1>. When using the data, please also cite the original data sources.

trade partners and the degree of emulation in these early periods (Reinert 2011). Certainly, England was highly dependent on Swedish iron imports in the seventeenth century (King 2005) and sought to emulate Holland's economic policies (Thirsk 1976). At the same time, until the eighteenth century, no two economies of the six shown here experienced simultaneous major phases of economic growth. While this certainly does not support the dubious mercantilist belief that foreign trade was a zero-sum game—and in particular, the belief that only exporters gained from international trade—it might help to explain why the belief held traction for so long (Smith 1776).

Figure 1 also identifies the periods that can be categorized as economic “growth reversals.” Italy suffered most from periods of major economic decline, from its early period of glory. It experienced three periods of substantial decline of around 20 percent as population growth returned, markets remained fragmented between small states and the focus of European trade shifted from the Mediterranean to the Atlantic. Following the collapse of per capita incomes in Italy in the mid-fifteenth century, it took more than 400 years to regain these levels of GDP per capita. Portugal suffered a dramatic collapse of roughly 40 percent of per capita GDP in the first half of the sixteenth century, associated with poor weather conditions (Reis et al. 2013) – though it recovered partially in the subsequent two decades. The Spanish economy also declined from the end of the sixteenth century – which was associated with the resource curse resulting from silver mining in the colonies (Drelichman 2005; Alvarez-Nogal and Prados de la Escosura 2013). Sweden suffered a collapse in the early eighteenth century, as it lost its great power status, with per capita GDP dropping almost 30 percent in three decades. Finally, after a period of growth in the first half of the eighteenth century, Portugal lost 20 percent of per capita GDP in three years and then spiraled downwards following the Great Earthquake of Lisbon in 1755.

There is little understanding of major economic collapses, especially since they are such rare events. In *Anna Karenina*, Leo Tolstoy proposes that “[a]ll happy families are alike; each unhappy family is unhappy in its own way.” Certainly, there has been plenty of effort to find in what way successful economies are alike, but little to understand the ways in which unsuccessful economies decline. Economic declines deserve more analysis to complement studies of economic failure such as Easterly and Levine (1997), Rodrik (1999) and Acemoglu and Robinson (2012). These new long-run data sets hold the promise of shedding light on economically depressed phases in history.

## The Long Road to Sustained Growth

Each of the six European economies discussed here experienced phases of economic growth and decline at different times. Despite the different national patterns, did a general change in growth rates occur over time? In particular, one might provisionally expect that there were more phases of growth and fewer phases of economic decline in later centuries.

In looking at Figure 1, few obvious differences between centuries emerge. The seventeenth and eighteenth century perhaps show greater growth, but they also have more and better data. Many different criteria have been proposed for identifying phases of growth more formally, such as the frequency of consecutive years of growth (Hausman et al. 2005; Easterly 2006). However, identifying phases of growth is more difficult when analyzing mostly agrarian economies or periods before reliable statistical records existed, because of the high volatility in the GDP per capita series, either resulting from weather-sensitive agricultural production or the estimation methods, which inevitably display a great degree of uncertainty.

Not surprisingly, therefore, a more formal analysis does not identify any difference over these earlier centuries: for example, in each century before 1800, there was only a 1–2 percent chance for a country of being in a period of more than 1.5 percent annual growth in four consecutive years, as shown in Table 1, column 2. For comparison, this likelihood increased to a 5 percent chance in the nineteenth century, and a 40 percent likelihood during the twentieth century. So, for the six countries observed, there was a substantial difference in the likelihood of sustained periods of growth between the pre-1800 period and the nineteenth and twentieth centuries. As received wisdom suggests, sustained economic growth seems to be a more recent phenomenon.

Looking at the economic downturns, Figure 1 does not seem to display an obvious change in frequencies before 1800. However, Table 1 provides some evidence. Here, we use a criterion of three consecutive years of less than –1.5 percent growth to identify a downturn. Adding across the six countries, there were 47 downturns before the nineteenth century, and only eight after 1800. Between the fifteenth and eighteenth century, there was an average of two economic downturns per country per century ( $10 + 14 + 9 + 12$  episodes divided by 6 countries divided by 4 centuries), while the nineteenth and twentieth centuries experienced less than one economic downturn per country per century. In the fifteenth and sixteenth centuries, economic downturns occurred about 8 percent of the time; in the seventeenth and eighteenth centuries, they were experienced 4–5 percent of years; and, in the nineteenth and twentieth centuries, downturns occurred 2–3 percent of the time. Thus, there appears to have been a modest reduction in the likelihood of experiencing downturns over the centuries from the fifteenth century.

Of course, caution should be taken in interpreting these values. While, the nine 4-year stretches of pre-1800 economic growth in any of the six economies (see column 1 of Table 1) do coincide with broadly agreed-upon periods of economic improvements; the method used here to identify 4-year-phases of growth could easily include periods in which the economy did not improve or exclude periods in which the economy did improve.

**Table 1. Periods of Economic Growth and Decline, 1300-2000<sup>3</sup>**

	No. of Phases of 4 year consecutive 1.5% annual growth rate	% of Years in 4 year consecutive 1.5% annual growth rate	No. of Phases of 3 year consecutive -1.5% annual growth rate	% of Years in 3 year consecutive -1.5% annual growth rate
1300s	1	1.1%	2	1.6%
1400s	1	1.0%	10	8.0%
1500s	3	2.3%	14	8.7%
1600s	2	1.3%	9	4.3%
1700s	2	1.3%	12	5.8%
1800s	8	5.3%	4	2.0%
1900s	38	40.0%	4	3.2%

Source: Authors

Notes: Column 1 represents the number of times countries in the group had four consecutive years of at least 1.5 percent growth in GDP per capita. That is, if this were to happen once in one country and twice in another country within a certain century, it would equal three times in that century. Column 2 shows the same as a percentage of the total number of years (for which data exists) during the specified century. Column 3 represents the number of times a country had three consecutive years of -1.5 percent (or lower) growth rates. Column 4 shows the same as column 3 as a percentage of total number of years.

However, this evidence tentatively indicates that, before the nineteenth century, there was little apparent difference in growth phases and a possible reduction in the frequency of downturns. By comparing the data with the last two centuries, there do appear to be substantial increases in growth phases and reductions in the

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<sup>3</sup> It is important to reiterate that caution should be taken in interpreting these values. The nine phases of pre-1800 economic growth do coincide with broadly agreed-upon periods of economic improvements. Nevertheless, the method used here to identify phases could, especially for these mostly agrarian economies with varying degrees of measurement error, easily include periods in which the economy did not improve or exclude periods in which the economy did improve.

occurrence of downturns in the nineteenth and especially the twentieth centuries. Explaining the source of these differences could prove to be important for understanding how economies managed to generate sustained economic growth.

## **Very Long Run Cycles of Convergence and Divergence**

The convergence and divergence of GDP per capita in the very long run is a central question in the literature on economic development. For example, the classic Solow (1956) growth model predicts convergence of less-developed economies with leading economies (for discussion, see Mankiw et al. 1992; see also Lucas' (2000) model of convergence driven by the 'take-off' date). While some economies have caught up since the end of the nineteenth century, many have remained less developed and fallen behind relative to the leading economies (Easterlin 1981; Abramovitz 1986; Pritchett 1997). From a very long-run perspective there has been a great deal of debate about the Great Divergence, when European economies overtook Asian economies like China over the period from the sixteenth to the nineteenth century (Pomeranz 2000; Broadberry and Gupta 2006; Allen et al. 2011; Broadberry 2013). What does the very long-run data presented here have to say about the process of convergence?

With evidence for only a sub-set of economies, a very long run analysis of global divergence and convergence would suffer from the problems identified by DeLong (1988; see also Baumol 1986): Because a number of economies are not included in the analysis due to a lack of data, and there may be a relationship between the lack of data and a country's position at the low end of the income scale, reliable conclusions about convergence cannot be drawn from the sub-sample. Thus, it is important to emphasize that the focus is on regional European convergence or divergence. Amongst these six European economies, data availability does not reflect relative success, as there was considerable catching-up and falling behind of particular nations over this five hundred year period. Thus, at least tentative conclusions about convergence and divergence for European economies might be drawn from the data available.

A "Little Divergence" between Mediterranean and Northwest European economies has already been proposed using some of these new data sets. Broadberry (2013) focuses on explaining the Great Divergence between Europe and Asia and the Little Divergence between North-Western Europe and the rest of Europe from the sixteenth century, arguing that economic structure and institutions determined how particular economies reacted to and were affected by the pivotal shocks (or critical junctures of Acemoglu and Robinson 2012) associated with the Black Death in the mid-fourteenth century and the new trade routes between Europe, Asia and the

Americas that opened-up at the end of the fifteenth century. Thus, to some, the shocks were curses; to others, they were blessings in the long run.

However, some additional observations related to convergence and divergence across these countries are also possible. By comparing the relative position of the leading economy's GDP per capita with the following economies, it is possible to discern from Figure 1 the degree of convergence. Using a very limited number of countries, for much of the fourteenth and fifteenth century, the average economy in Europe had a GDP per capita of between 50 and 60 percent of the leading economy, Italy. By 1500, the average economy<sup>4</sup> was 75 percent of the leading economy. By 1600, when Holland had emerged as the new leader, the average economy had fallen to 42 percent of the leader. By 1700, with Holland stagnating and England catching up, this average was 61 percent of the leader. By 1800, with the Industrial Revolution and Great Britain's supremacy, the gap increased and the average was 50 percent of the leader. By 1900, for these average European countries, per capita GDP had fallen to 41 percent of the leader (Bolt and van Zanden 2014). In 2000, as other studies have shown (Baumol 1986, Pritchett 1997), the gap had once again dropped amongst these European countries, and the relative average was 84 percent of the leader, the Netherlands.

Thus, amongst the group of economies in Figure 1 and a slightly broader set of countries (and extending the evidence to the present), there appear to be cycles of divergence (in the fourteenth, sixteenth and eighteenth centuries) and convergence (in the fifteenth, seventeenth and twentieth centuries) over the very long run. Thus, these very long run cycles of economic divergence and convergence are linked with the emergence of new leaders, the waning of their momentum and the catching-up by followers. The fourteenth century was probably the beginning of a phase of divergence associated with the rise of Central and Northern Italy. By 1600, Holland was the new leading economy and the average relative level of followers declines, suggesting divergence (Broadberry 2013). In 1800, England was catching up with Holland and taking the lead shortly afterwards; thus, divergence occurred in the eighteenth century and was accentuated during the nineteenth century. Phases of convergence reflected the stagnation (or even decline) of the leader and the process of other economies learning from the leader and perhaps gaining from spillovers.

Finally, building on Quah's (1996, 1997) concept of income mobility, it is worth commenting on the ability of economies to move upwards relative to other followers, though not necessarily to become the leader. Figure 1 shows that there

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<sup>4</sup> For this calculation and subsequent calculations in this paragraph, we also include German states (Pfister 2011), France (Álvarez-Nogal and Prados de la Escosura 2013; see also Squicciarini and Voigtländer forthcoming) and what would today be known as Belgium (Buyst 2011), for which new data for each century are available.

was some mobility and opportunity for economies in Europe to improve their positions and status, which may have been important in determining the outcome of geopolitical tensions amongst European rivals. However, it also shows that there was a tendency for the leader to remain in its position as the wealthiest economy for a century or more, and for the poorest to be stuck for very long periods. Thus, within Europe there was a degree of stratification and the formation of clubs, with some mobility between them (as argued in Durlauf and Johnson 1995).

## The Data

How can researchers construct these GDP per capita estimates from the late Medieval and early Modern era until the nineteenth century? As discussed earlier, Figure 1 presents six original data sets constructed within the last four years: England/Great Britain, Holland, Northern and Central Italy, Spain, Sweden and Portugal. Each time series starts and ends in different years and uses a different combination of methods to estimate output. Table 2 summarizes the sources and methods of data construction for agricultural and non-agricultural sectors.

**Table 2**

A Broad Classification of Methods for Estimating GDP per capita in Selected European Countries

	Period	Agriculture	Industry	Service
England/Great Britain	1270-1870	Output	Output	Output/Proxies
Holland	1348-1510 1510-1807	Demand Output	Proxies Output	Proxies Output
Italy (Central & Northern Regions)	1310-1861	Demand	Proxies	Proxies
Spain	1254-1850	Demand	Proxies	Proxies
Sweden	1560-1800	Demand	Output	Proxies
Portugal	1500-1850	Demand	Proxies	Proxies

Sources: England: Broadberry et al. 2011; Italy: Malanima 2011; Holland: van Zanden and van Leeuwen 2012; Sweden: Schön and Krantz 2012; Spain: Alvarez-Nogal and Prados de la Escosura 2013; Portugal: Reis et al. 2013, and Palma and Reis 2014.

Three main methods have been used to construct historical estimates of GDP and GDP per capita – based on measures of income or of output, or using indirect methods. The first method involves estimating national income from data on individual incomes or, more commonly, wages – particularly by Clark (2007, 2010). However, when using wages, this approach needs to take account of changes in hours per day worked and days per year worked – or else, it offers only limited evidence on variation in living standards through time<sup>5</sup>. To create the six time series presented in Figure 1 and Table 1, either the second or third method was used, therefore, examples will be briefly given of how GDP estimates were generated using these methods.

### **England/Great Britain**

The second approach is to estimate national income using output measures. This is the generally preferred approach, provided sufficient information is available on the main sources of production (de Vries and van der Woude 1997 p.721, Maddison 2007 pp. 316-319, Broadberry 2011, p. 2). The rich accounts of English and British economic history since late medieval times offered an opportunity to estimate pre-1870 annual GDP using an output approach, separated into the agricultural, industrial and service sectors.

For medieval agriculture, three data sources are available: first, the Medieval Accounts Database of Campbell (2000, 2007) is based mainly on a large sample of manorial accounts, which were drawn up using a common template by the reeve who managed the demesne under close supervision of the lord's bailiff or steward and recorded detailed information on land use, crops, animals and livestock products. Second, the Early Modern Probate Inventories Database between the mid-sixteenth and the mid-eighteenth centuries assembled by Overton (1991; 2000) and Overton et al. (2004) pulls together similar information extracted from inventories drawn up by the Church Commissioners for the estates of farmers. Third, the Modern Farm Accounts Database of Turner et al. (2001), which runs from 1720 until 1913, is based on a large sample of accounts produced by farmers and kept in local record offices. Agricultural outputs were calculated by multiplying the acreage for each crop by the yield per acre. Broadberry et al. (2015) estimate the total acreage. The trends in yields were split into three main time periods, based on the data sources available. For pastoral output, a similar procedure was undertaken, multiplying the number of animals by the share

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<sup>5</sup> Without fully taking account of all factors, GDP estimates based on income and output approaches are likely to follow divergent trends over time. Angeles (2008) identifies three key factors determining the divergence: income distribution, per capita labor supply and relative price changes. He shows that there was considerable divergence in English GDP per capita and real wages between 1700 and 1820 due to increased inequality (Saito 2015), the Industrious Revolution (de Vries 1994) and the increasing relative price of food (Broadberry et al. 2015).

producing and their yields. Prices for individual arable and pastoral products are used to convert the output into current prices and create weights for the agricultural real output index.

Production estimates or indicators existed for the key English industries up to 1700, based on careful reconstruction from archival records by generations of scholars. Crucial sources included Carus-Wilson and Coleman (1963) for wool and woollen cloth, drawing on detailed records of exports of wool and woollen cloth; King (2005) for iron, based on a reconstruction of all blast furnaces, their capacity and knowledge of when they were in blast; and Hatcher (1973) for tin, based on receipts of coinage dues. Outputs related to leather and food processing, were estimated by Broadberry et al. (2015) on the basis of key inputs obtained from the reconstruction of the agricultural sector. Construction combines detailed information on cathedral building with an index of housebuilding based on population and urbanization, while the growth of book production is based on titles listed by the British Library. These series are combined to generate an index of industrial production from 1264 to 1700. Crafts and Harley (1992) offer an index from 1700 until 1870, to which Broadberry et al. (2015) add some new series.

The service sector followed the approach developed by Deane and Cole (1962), with some adjustments. The sector is broken down into commerce, housing, domestic services and government. The commerce indicator is based on combining estimates of domestic trade (the volume of agricultural and industrial output adjusted for the growing share that was marketed) and international trade (derived from the detailed records of trade that were kept for taxation purposes), freight transport (based on merchant shipping tonnage, distances travelled on the main trade routes and volumes shipped) and financial services (using the velocity of money, derived by comparing estimates of the stock of money with existing estimates of nominal, as opposed to real, national income). Housing and domestic services were assumed to grow at the same rate as population. Government activity was based on its revenue, which exists in detailed annual exchequer accounts back to the early twelfth century (O'Brien and Hunt 1999).

The three real output series for the agricultural, industrial and service sectors were combined using a set of sectoral weights which capture the changing structure of the economy. The starting point is an input-output table for 1841 from Horrell et al. (1994). The nominal value added shares for 1841 are projected back using the sectoral real output series reflatd to convert them into nominal series. The principal sources for the price series used include Clark (2004, 2005, 2006), Beveridge (1939) and Thorold Rogers (1866-1902). Value-added shares for each sector are derived in this way at roughly 50-year intervals, and used to create a chained index of GDP, following Feinstein (1972). To estimate GDP per capita, this aggregate GDP series is divided by population, taken from Wrigley and

Schofield (1989) and Wrigley et al. (1997) for the period since 1541, and derived from information on the number of tenants in a regionally representative sample of manors using the method of Hallam (1988) for the pre-1541 period.

## **Italy**

The third, and less reliable, indirect approach to estimating GDP per capita depends on modelling or using proxies to generate indicators of economic output. Particularly for agricultural production, where demand is deemed to be relatively stable, a model of agricultural demand is used. For example, the lack of evidence on agricultural production in Italy prior to the mid-nineteenth century led Malanima (2011) to use the demand approach. Estimates of agricultural production start with the assumption that they are equal to consumption. While there might be some imports and exports, Malanima (2011) argues that the net value of these imports and exports are negligible for Central and Northern Italy. Thus, estimates of agricultural consumption will provide a close indicator of production.

The exercise involved estimating per capita agricultural consumption based on a model of demand (including income and price elasticities) and data on consumer income levels and real prices of agricultural productions and industrial products (as substitutes). A number of other historical studies, pioneered by Crafts (1980) and more recently developed by Allen (2000), have used estimates of income elasticities of agricultural products ranging from 0.3 to 0.9. Guided by these previous studies, and Italian estimates from 1861 to 1910 (Federico 2003), Malanima (2011) selected an income elasticity of 0.4. The previous historical studies reviewed had used a cross-price elasticity of 0.1—in other words, agricultural and industrial products are seen as weak substitutes for one another. The sum of the income, own price and cross price elasticities are assumed equal to 0 (relying on the “adding-up” property in linear models described in Deaton and Muellbauer 1980, p.16), which helps to guide the value of the own price elasticity (-0.5). Thus, based on these elasticities, and on data for wages (acting as a proxy for income) and for the real prices of agricultural and non-agricultural products, Malanima (2011) estimated the per capita agricultural consumption and, hence, an indicator of production. Price and wage data were collected systematically from institutions such as schools, hospitals and government departments for many European countries reaching back to the medieval period.

For industry and service sectors, indirect production estimates often depend on long run trends in urbanization rates, with Bairoch’s (1988) data set of European towns greater than 5,000 inhabitants going back 1,000 years is crucial for this approach. Urbanization rates offer an indicator of the share of non-agricultural activities, since town and city dwellers are not likely to be involved in arable or pastoral activities. Naturally, an indirect approach is generally only used when the other direct two approaches are not possible due to a lack of data. However, given

the lack of detailed income and output data, indirect methods are starting to be used more in this area of research.

For Central and Northern Italy, the share of non-agricultural output between 1861 and 1936 was regressed on urbanization rates. The coefficient of the relationship was key to estimating output before 1861. However, without taking account of non-urban industry over the centuries, there would have been a risk of over-estimating late medieval output. Thus, combining the coefficient and the urbanization rates with an index of the share of non-urban workers (based on Allen 2000), the share of non-agricultural output was estimated back to 1310. With an estimate of per capita agricultural output and of the share of non-agricultural output, it was possible to construct a GDP per capita series from 1310 until 1861. For consistency, this series was linked to a series for Central and Northern Italy (Daniele and Malanima 2007). While Bolt and van Zanden (2014 p. 635) raise some questions about these estimate, this series provides a valuable (and the only) indicator of long run growth rates related to Italy.

Putting these various estimates together, with an estimate of per capita agricultural output and of the share of non-agricultural output (sometimes separated into industrial and service sectors), it is possible to construct a GDP series. This value is then divided by the geographical boundary's population to produce per capita GDP.

### **General Considerations**

As one might expect, there is considerable uncertainty about the margins of error surrounding the data. Readers seeking a guide to the accuracy of the data, can begin by considering the methodologies used. For instance, van Zanden and van Leeuwen (2012) propose that the data for Holland before 1510 is far less reliable than the data for Holland between 1510 and 1807, because the former was based on modelling agricultural demand and proxies for industry and services, whereas the latter was based on output measures. Thus, data based on output measures, such as those for England/Britain, Holland from 1510 and to a lesser extent Sweden, are likely to be more accurate.

Of course, the brief description offered here is a gross simplification of the complexities involved in the truly mammoth task of estimating historical GDP per capita. Generating these estimates includes identifying and pulling together hundreds of data sources and deciding upon historically justifiable assumptions. Great care must be taken in ensuring that prices and baskets of goods are comparable and benchmarked over time (Prados de la Escosura 2000, 2014).

For greater detail, the reader is encouraged to consult the original papers: that is, England/Great Britain: Broadberry et al. (2011, 2015); Italy: Malanima (2011); Holland: van Zanden and van Leeuwen (2012); Sweden: Schön and Krantz (2012); Spain: Alvarez-Nogal and Prados de la Escosura (2013); Portugal: Reis et al. (2013) and Palma and Reis (2014). Data for these countries (and many others) from the nineteenth century to the present are much better-known, and information about how they were constructed can be found in a number of sources – probably the most updated discussion of these sources, associated with the Maddison Project, is Bolt and van Zanden (2014).

## **Conclusion**

While the data presented here have notable limitations, it offers the first detailed picture of economic development in Western Europe for the 500 years before the Industrial Revolution. Clearly, the received wisdom that pre-industrial economies more than two centuries ago were stagnant is not true. These economies had major and minor phases of economic growth before the nineteenth century, some lasting more than 50 years, which often led to substantial long run improvements in per capita income – even if these growth rates were not ultimately sustained.

Subsequent research in this area will continue to check and re-estimate the very long-run data on per capita GDP for these economies and others. However, it will also move on to the challenges of explaining the patterns in the data theoretically and econometrically. For example, it will be useful to consider the pre-1800 growth episodes and reversals in European economies, changes in the likelihood of phases of growth and of decline over time, and periods and cycles of divergence and convergence. In addition to GDP per capita, there is more very long run data available on a number of traditional explanatory variables, such as institutions, human capital, and population changes, as well as shocks like plagues and wars.

Although research using this very long-run data is still in its early stages, it is already offering some insight and challenges for how we think about the processes of economic growth. For example, an economy in which per capita income stagnated for 500 years would have been very different from the pre-industrial European economies that experienced multiple peaks and troughs. Each substantial peak and trough in per capita income implied a process of change – of new technologies, institutions, beliefs and behavior. Each step in history sets the stage for the next step. Thus, the six pre-industrial European economies studied here were changing, agents adjusting to new incentives and constraints, and in some ways adopting a substantially new economic system roughly every 50 to 100 years. It seems very possible (even probable) that economies in other regions of the world experienced major peaks and troughs—as China did in the eleventh century (Broadberry et al. 2014). However, the dynamism of the rises and falls in European

economies from the fourteenth century may offer a clue to the Great Divergence between Europe and China during this time period (Broadberry 2013) – thus, a possible avenue of future research.

Pre-industrial Europe also showed patterns of divergence and convergence. Divergence was associated with a new leading economy. Convergence was associated with phases of economic stagnation or decline amongst leading economies. World economic leaders at one time often seem to struggle to grow beyond a certain range of economic development: for example, this described China in the eleventh century, Italy in the fifteenth century, Holland in the eighteenth century and even England in the late nineteenth century. In time, a few economies converged on the leader and then, when these catch-up economies developed new technologies and institutions, one of them overtook the leader. It is intriguing to speculate as to whether England, the world leader in per capita GDP in the late nineteenth century, might not have continued to grow had other economies—like the United States and later Germany— not overtaken it and had England then not been able to import new technologies, modes of management and institutions.

The very long-run historical evidence presented here resolves what had previously appeared to be a major difference between recent developing economy growth patterns and the received wisdom on pre-industrial patterns. Received wisdom held that European countries at low levels of economic development before the Industrial Revolution were stagnant. However, empirical studies of developing economies during the last century or so have indicated that GDP per capita has tended to be characterized by spurts of high growth, with periods of stagnation and decline, especially in sub-Saharan Africa (Easterly and Levine 1997; Pritchett 2000; Durlauf et al. 2006; Easterly 2006; Pinkovskiy and Sala-i-Martin 2014). The findings here suggest historical patterns of economic growth and decline in pre-Industrial Europe may have been broadly similar to those of present-day developing economies—another area of ongoing and future research.

Finally, many contending theoretical explanations for past GDP per capita start from the assumption of stagnant economies followed by an economic take-off. Such theories need adjustment to take account of the new evidence. For all of these questions, and many others, the next few years promise to offer exciting advances in our understanding of very long run economic growth.

### **Acknowledgements**

We would like to thank Simon Dietz, Baran Doda, Gordon Hanson, Ralph Hippe, Alexander Klein, Enrico Moretti, Suresh Naidu, Leandro Prados de la Escosura, Debraj Ray, Martin Stuermer, Tim Taylor and John van Reenen, as well as participants at the AEA annual meeting, for discussions related to this paper, and Bas van Leeuwen, Leandro Prados de la Escosura, Nuno Palma, Jaime Reis and Nico Voigtländer for their data. Support for this project from the Global Green Growth Institute (GGGI) and the ESRC is gratefully acknowledged.

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