The Maddison Project

The First Update of the Maddison Project
Re-Estimating Growth Before 1820

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Abstract

The Maddison Project, initiated in March 2010 by a group of close colleagues of Angus Maddison, aims to develop an effective way of cooperation between scholars to continue Maddison's work on measuring economic performance in the world economy. This paper is a first product of the project. Its goal is to inventory recent research on historical national accounts, to briefly discuss some of the problems related to these historical statistics and to extend and where necessary revise the estimates published by Maddison in his recent overviews (2001; 2003; 2007) (also made available on his website at http://www.ggdc.net/MADDISON/oriindex.htm).

Introduction

Angus Maddison's estimates of GDP and population in the world economy between Roman times and the present are of great value to the academic community. The members of the Maddison project, which started in 2010 to continue Maddison's work after his death, share the idea that it is very important for the profession to continue to render this kind of service. This cannot be done by one single person (anymore) – nobody has the authority, the expertise and the determination to do this work on his (or her) own. Therefore the Maddison project is a team effort, involving cooperation between scholars who are specialists on different regions and periods (see the full list of participants on http://www.ggdc.net/maddison/maddison-project/index.htm)..

A first conference on the importance of his work and the issues to be resolved when continuing it, was held in Amsterdam in November 2010. During this conference, the following topics were discussed:

1. New work that has been done on estimating national accounts, in particular on the pre 1800 period;

2. The possible consequences for the Maddison dataset of the new ICP 2005 round and corresponding 2005 PPPs;

3. The consistency of benchmarks and time series estimates;

4. The large gaps in the available estimates for various regions (Africa before 1950; China before 1913 etc.);

5. The possibility of providing greater transparency in the estimates: should the new estimates contain margins of error, or indicate the provenance of the new data?

This paper is a first product of the Maddison project, and will focus on the first topic: an inventory of new work done since the publication of Maddison's synthesis in 2001/3 and the subsequent online updates. It presents many extensions and a few revisions of his work; often this new research was carried out by scholars inspired by and indebted to Maddison's grand synthesis.

The starting point of this update of the Maddison database is that we keep his original estimates intact, except in those cases for which we now have more and better information[1]. In view of the new research that has been done, many of the pre 1820 estimates (and all the pre 1600 figures) had to be modified. Maddison was of course aware of this: his strategy was to produce numbers even if a solid basis for them did not always exist, expecting that scholars might disagree and do new work to show that he was wrong. In this way he induced many scholars to work on these themes and to try to quantify long-term economic development. This was a highly successful strategy, but not always understood and appreciated by his colleagues; thanks to his pioneering work and the many, many reactions to it, we can now present a much more detailed overview of long-term economic growth than when he started his project in the 1960s.

The second and third item on the list above will be part of future work (see also few preliminary remarks on the various ICP rounds in the third section). By integrating new work, we have also tried to deal with the fourth item on the agenda, the large gaps in current knowledge. We will start here with a brief discussion of the fifth topic, the transparency of the estimates.

Are all estimates equal, or some more equal than others?

Estimates of the national accounts of countries in the past − and in particular in the more distant past − are subject to certain margins of error. They are often based on partial data and certain assumptions about the links between these data (for example the proceeds of a certain tax) and the economic activities they represent. The further one goes back in time, the larger the margins or error will probably be, but there may be important exceptions from this rule (perhaps we know more about Medieval England than, for example, 19th century Sub-Saharan Africa, or pre-Colombian Latin America).

Feinstein and Thomas (2001) have some time ago argued that it is possible to estimate such margins of error in detail, a method which has been applied in a few studies on the topic (for example Van Zanden and Van Leeuwen 2012). Members of

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[1] For nearly all countries included in the Total Economy Database of the Conference Board, we used the 1990 -2010 estimates from the Conference Board. For exceptions, see Appendix 1.

the Maddison project have also experimented with various margins or error; the most detailed study was carried out by the members of the Hitotshibashi team working on Asian national accounts (we reprint their results in the separate data appendix to this study). After reviewing various attempts to estimate these margins of error, it was decided however to take another approach to this issue. The problem is that the margins of error suggest certain objectivity, whereas in fact they are based on rather subjective estimates of the possible margins of error of the underlying data.

An alternative approach (suggested by Steve Broadberry) is to make explicit the provenance of the various estimates and the ways in which they have been derived. This lead to the following four groups:

- official estimates of GDP, made by national statistical offices or by international agencies (UN, for example) (in spreadsheet printed in black)

- historical estimates based on the same methods and broad range of data (in blue)

- historical estimates based on indirect proxy variables (in orange)

- guestimates (in red)

In principle this is a much more objective classification, which still informs the user of the data about differences in quality of the estimates, although there may be very weak 'official estimates' – see for example Jerven's paper on African GDP (Jerven 2009) – and high-quality historical estimates. Also the distinctions between the three types of historical estimates are not always clear cut. Yet, this classification is probably the best index of reliability that we can supply at the moment (it was also adopted by the Clio Infra project).

A related issue is that historical estimates often refer to different territorial entities than the countries within the borders of 1990, the basic unit of account used in the Maddison framework. He made many corrections for (minor) changes in borders (an overview will be provided in future work). However, moving back in time sometimes means that we have only estimates for Northern Italy (instead of Italy as a whole), for Holland (Netherlands) or for the Cape Colony (South Africa). When those smaller regions represented less than two-third of the population and/or the GDP of the modern country (within current borders), we have presented the estimates in italics to warn users.

New data/new research on national accounts.

The ultimate goal of the Maddison project is to continue Maddison's work on measuring economic performance of the world economy. To be able to provide the scientific community with a relevant, up to date dataset on income and population covering all continents, it is essential that new work is, once it withstood scientific scrutiny, integrated on a regular basis into the existing dataset. In this section we will discuss recent research integrated in the new dataset. The structure will follow the (somewhat Eurocentric) organization of the original Maddison dataset: we start with Europe, and end with Africa (Zimbabwe).

A large part of the new work on **Europe** has focused on extending the estimates of GDP (per capita) into the pre-1850 period. An important research project funded by the Leverhulme Foundation made it possible to estimate annual series of British (before 1700 English) GDP going back to 1270, and of GDP of Holland between 1348 and 1807 (Broadberry et.al. 2011; Van Zanden and Van Leeuwen 2012). This project was part of a much larger research effort to estimate pre 1850 GDP, which includes much new work done on Spain (Alvarez-Nogal and Prados de la Escosura 2011), Portugal (Reis 2011), Belgium (Buyst 2011), Sweden (Schön and Krantz 2012), Germany (Pfister 2011) and updated work on Italy (Lo Cascio and Malanima 2011). The most important finding from this new work is that probably growth in Western Europe was more gradual than was implied by the previous Maddison-synthesis. For example, Maddison estimated average GDP per capita of Western Europe in 1500 at 771 dollars (1990 international dollars), the new work strongly suggests that it must have been higher, perhaps as high as 1200 dollars or more; the unweighted average of the six countries for which we have observations is 1255 dollars, and even the poorest country among them, Spain, was richer than the 771 dollars of the previous Maddison estimate. This revision of pre industrial growth is not entirely new however; that European growth before 1800 was slow has already been pointed out by several authors in the recent past (Federico 2002, Van Zanden 2001). Between 1300 and 1800 growth did occur, however, but it was mainly concentrated in the North Sea area, where England and Holland grew from about 900 dollars at about 1300 to more than double that level – 2100 (Great Britain) to 2600 (Holland) dollars – in 1800. But Spain in 1800 was not wealthier than in 1300, and in (Northern) Italy GDP per capita

even declined in this period. Nor was there much growth in Sweden (observations for 1560 and 1800), Germany or Portugal.

We added a few revisions of 19th century and early 20th century growth, for Switzerland (David et al., 2011), Germany (Burhop and Wolf, 2005), Sweden (Schön and Krantz, 2012), Italy (Baffigi, 2011), Greece (Kostelenos),[2] Russia (Markevich and Harrison, 2011; Gregory, 1982) and Bulgaria (Ivanov, 2006).[3]

The debate on the "Great Divergence" between Europe and Asia and the relative level of economic development of East and South **Asia** during the 18th century has stimulated much new research on the level and development of GDP in this part of the world. One of the central questions in this literature was whether the level of economic development (in terms of GDP per capita) in China (and India and Japan) before industrialization was comparable to Western Europe (Pomeranz 2000). Maddison's estimates for that period have been criticized because they show an already substantial gap in real incomes between the different parts of EurAsia; in Western Europe the average GDP per capita was about 1200 dollars, whereas China and India were estimated at between 500 and 600 dollars. Recent studies on this topic generally confirm Maddison's interpretation, but they add more information about long-term trends that shed a more detailed light on the matter. In a detailed case study of real incomes in Bengal in 1763 Roy (2010) demonstrates that these were much lower than those in England; moreover, he also finds no income growth between the early 18th century and the final decades of the 19th century, which is consistent with the Maddison estimates. Broadberry and Gupta (2012) are even more pessimistic about the long term trajectory of Indian GDP. They chart an almost continuous decline from 1600 to 1870, based on (amongst others) the development of the urbanization ratio, real wages and industrial exports. Their estimates, which show higher income levels in especially the 17th century compared to the Maddison figures, have been integrated into the new dataset. New work has also been carried out for Indonesia (Van der Eng 2010) and, for the 19th century, for Java (Van Zanden 2012). A comparison of these estimates with those for Western Europe in the 19th century also confirmed the big income gap between these regions (Van Zanden 2003). New

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[2] We linked the new Greece series to the Maddison estimates in 1914; the new series show less growth for Greece than the previous estimates as a result of which Greece now seems to be more wealthy during the middle decades of the 19th century (as wealthy as Spain).
[3] We also added new data for the former Yugoslavia and its successor states between 1952 and 2008 (Milanovic 2011).

work on Japan goes back in time until the 8th century and shows a slow rise of GDP per capita from 400 dollars in 720 to almost 700 dollars in 1850, again a set of estimates in accordance with the view that there was a large income gap with Western Europe (Bassino et al. 2011). Finally, for China Li (2010, 2011) has produced a detailed set of estimates of the structure and level of GDP in the most advanced part of the empire, the Yangzi Delta (in fact, in a part of that region, Hua-Lou district) in the 1820s. The comparison of this region with the Netherlands (representative of the more advanced parts of Western Europe) shows a real income gap of about 40-50% (Li and Van Zanden 2010). On this basis we continue to accept the estimate made by Maddison of China's GDP per capita of 600 dollars in 1820.

Besides incorporating this new research on the very long run, we also included a new set of estimates on Singapore's more recent GDP (per capita) provided by Sugimoto (2011).

For the **Americas** we included new work done by Prados de la Escosura, based on estimates for 8 Latin American countries published in 2009[4]. Most importantly, our income estimates now go back to 1800 for eight countries. Moreover, for Cuba, Ecuador and Jamaica the new estimates extend the original series well into the 19th century and for the first time offer an insight into their relative position in terms of per capita income on the continent during the 19th century. We also included new work on the period 1870-1920 carried out by Bertola and Ocampo (2012) resulting in more detailed, often annual estimates for Argentina, Colombia, Peru and Venezuela. The new estimates do not radically change the overall picture of the distribution of income over the continent, although Argentine, Mexico and Venezuela appear to have been slightly richer prior to 1900.

For The United States we could include the new set of estimates published as part of the Historical Statistics of the United States project, more specifically Sutch (2006) for the period 1790-1870, and McCusker (2006) for the colonial period. They bring the estimates back to 1650, and show remarkable rapid growth between 1650 and 1800 resulting in a doubling of GDP per capita (a rate of growth very similar to that found in England at the time).

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[4] For sources see Appendix A2

For **Africa**, most of the available income estimates start only in 1950. But currently much work is done on various countries on the continent. For example new research carried out by Fourie and Van Zanden (2012) makes it possible to chart GDP of Cape Colony (1701-1910) and link it to estimates for South Africa (from 1910 onwards). Jerven (2011) in a working paper estimates growth in Ghana between 1892 until 1954 based on expenditure data. Prados de la Escosora (2011) in a paper on human development, indirectly estimated GDP per capita for all countries for benchmark years between 1870 and 1950, based on the theoretical relationship between income terms of trade per head[5] and GDP per capita. And finally, the increased interest in real wages following Allen's 2001 paper on real wages also spurred studies on real wages in Africa. Frankema and van Waijenburg (2011) for example estimate real wages between 1880 and 1940 for British Colonial Africa, and present new insights in the living standards in various parts of the African continent. And Van Leeuwen et al. (2012) provided regional estimates of GDP per capita based partly on already existing sources, but to large extend also on real wage data, deflated with indigenous' crops prices. We are still working on ways to integrate this new research into the Maddison framework – this version only contains the new time series for South Africa (the Cape Colony) although we include the estimates by Prados de la Escosura (2011) and Van Leeuwen et al. (2012) in the separate data appendix. The general trends in income for most African countries between 1870 and 1950 differ quite substantially between Prados de la Escosura (2011) and van Leeuwen et. al (2012), except for Northern Africa. For Malawi and Kenya for example, the estimates from Van Leeuwen et al (2012) suggest that the income was below the subsistence level of 250 to 300 international dollars for some decades prior to 1900, where Prados de la Escosura shows a stable trend up or well above subsistence. For Sierra Leone, and to a lesser extend Nigeria and Zambia, the trends from both sources even move in the opposite direction. Prados de la Escosura (2012) suggests that income in Sierra Leone decreased from 1600 to 646 int. dollars between 1870 and 1950, whereas van Leeuwen et al. (2012) indicate an increase from 348 to 556 dollars in the same period. Both sources do agree on the richest country on average over the whole period: Mauritius with an income close to or above 2000 dollars (1990 international dollars)

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[5] The value of current exports deflated by the price of imports, which was then dived by each country's population (Prados de la Escosura 2011: 14).

for the whole period between 1870 and 1950, although also Gabon performs very well during the same period (Prados de la Escosura 2011).

In the **Near East/Northern Africa** new work by Pamuk and Shatzmiller (2011) allows us to chart the long term trajectory of Egypt, Iraq and Byzantine in the period 700-1500, also building on Milanovic (2006) who estimated GDP in Byzantine at about 1000. In the long term they find stagnation here: in Egypt, for example, real incomes in 720 are as high in 1480 or 1780 (at between 700 and 800 dollars); similar or somewhat lower levels are found in Iraq and Byzantine. They fit into a pattern: the most recent and most thorough overview of the debate by Scheidel and Friesen (2009) puts Roman GDP per capita at about 700 dollars, with large margins (600-800 dollars). They convincingly criticize estimates which are much higher (for example those of Lo Cascio and Malanima (2011) who estimate per capita income of the Roman Empire to be up to 1000 dollars). Following Maddison's original estimates we differentiated various regions within the Roman Empire: its core region, Italy, was estimated to be at the maximum level estimated by Scheidel and Friesen (2009), that is at 800 dollars, which is exactly the same as the estimate made by Maddison (2007: 54) for Peninsular Italy and the islands. Newly acquired regions (France, Belgium, Spain) were estimated to be at the bottom of this scale, eg. 600 dollars, whereas the more highly developed and urbanized eastern parts of the empire (Greece, Egypt, Iraq, Turkey) were estimated at an intermediate level (700 dollars), which gave an average for the whole empire of about 700 dollars.[6] The Scheidel and Friesen (2009) estimate is comparable with the estimate for Byzantium in 1000, by Milanovic (2006) of about 680 dollars (range 640-720). Going even further back in time: for Mesopotamia, located in what is nowadays Iraq, Foldvari and Van Leeuwen calculated a GDP of about 600 1990 GK dollars at around 500 BC (these estimates were not included in the dataset).

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[6] We estimated smaller differences between Italy and the rest of the empire than Maddison did (see Maddison 2007) who assumed that Italian GDP per capita was about twice the level of the other provinces. Italy profited from large inflows of taxes (Rome's bread supply came from agricultural surpluses produced and taxed in Egypt) which implies that differences in real incomes were probably much larger than of real output per capita on which we concentrate here; cf. Hopkins (1980).

Real wages

Angus Maddison had his doubts about using information on real wages to infer changes in GDP per capita growth, for the obvious reason that the real remuneration of labour is only part of GDP, and changes in the structure of the labour force, in working hours or in income distribution may result in a divergence in trends between these two indices. However, since Allen's (2001) paper on real wages in Europe between 1300 and 1914, a large number of studies has been published which measure the level and development of real wages in a more or less systematic way. Moreover, these studies often show long-term trends which are quiet similar to the changes found in GDP per capita; we therefore think that it makes sense to include a brief review of this work here, and use some of the new results to extend the dataset.

The recent research on long term changes in real wages has produced a number of important new insights:

- there was a 'little divergence' within Europe between 1300 and 1800: real wages in the North Sea area more or less stabilized at the level attained after the Black Death, and remained relatively high (above subsistence) throughout the early modern period (and into the 19th century); whereas, on the other hand, real wages in the 'periphery' (in Germany, Italy, Spain) began to fall after the 15th century and returned to some kind of subsistence minimum during the 1500-1800 period (Allen 2001); this 'little divergence' in real wages mirrors a similar divergence in GDP per capita: in the 'periphery' of Europe there was almost no per capita growth between 1500 and 1800 (or even decline), whereas in Holland and England real income continued to rise and more or less doubled in this period;

- the high real wages attained in England and Holland also stand out in a wider international comparison: in the 18th and 19th century real wages in various parts of China, India, Japan and Indonesia were at best half the level attained in North-Western Europe, thereby the confirming GDP estimates which suggest a (similar) gap between these parts of the world (Allen et.al. 2011; see also De Zwart 2011a for Sri Lanka);

- similarly, high real wages 18th century Cape Colony are consistent with high real incomes earned there (De Zwart 2011b);

- likewise, Arroyo Abad et.al. (2012) show that the regional structure of real wages in Latin America at about 1820 is correlated with the structure of GDP per capita.

The new real wage evidence therefore tends to support the new estimates of GDP per capita for large parts of the world economy – in some cases (for example Pamuk and Shatzmiller's (2011) work on pre 1800 Ottoman Empire/Near East) these various estimates are integrated into one consistent set of income figures. This is not to deny that trends in real wages and GDP per capita may be very different − as appears to happen in pre 1800 Europe (where in all regions there is a divergence between real wages and real incomes). But such divergences can be explained via a more detailed analysis of participation ratio's, working hours and structural composition of the economy (Broadberry et.al. 2011; Allen and Weisdorf 2011).

New results

We will now briefly review new results, per period. We start with the period before 1350, followed by the discussion of new results for the 1200-1820 period. Finally we will analyse the benchmark year 1820.

Table 1 GDP per capita estimates Roman Empire – 1348

	Northern Italy	Spain	England	Holland	Byzantium	Iraq	Egypt	Japan
1	800	600	600	600	700	700	700	
730						920	730	402
1000					600	820	600	
1150					580	680	660	520
1280							670	527
1300	1588	864	892				610	
1348	1486	907	919	876	580			

Table 1 contains the new estimates for the period before 1350. The estimates for the Roman Empire are more or less consistent with those for Medieval Byzantium, Iraq and Egypt; it is also clear that before 1000 the highest incomes were (probably) earned during the blossoming of the Islamic economy in 8th century Iraq. These estimates for the early Middle Ages are by and large also consistent with those for Spain, England an Holland after 1200, where also real incomes at about 900 dollars

per annum were being earned. We think that Italian real GDP for 1300 (actually 1310) may be somewhat overestimated by Malanima (2011) (a similar problem occurred with his and Lo Cascio's estimates (2009) of GDP in Roman times, which was also consider to be too high by Scheidel and Friesen 2009). Still, we keep the Italian estimates because of the lack of alternatives. The other country that really stands out is Japan, where income levels are much lower than in other pre industrial societies – especially the very tentative estimates for 720 is perhaps too low. The overall conclusion is however that those pre-industrial societies were able to achieve income levels that were much higher than subsistence (which is considered to be between 250 and 300 dollars of 1990).

Table 2 GDP per capita in various parts of the world, 1348-1800

	Northern Italy	Holland	England	Spain	USA	Japan	India	Cape Colony	Ottoman Empire
1348	1486	876	919	907		527 (1280)			580
1400	1716	1195	1205	819		527 (1450)			
1500	1503	1454	1134	846					660
1600	1336	2662	1167	892	587 (1650)	574	793		
1700	1447	2105	1540	814	900	629	729	1703	700
1800	1336	2609	2200	916	1296	641	648	959	740 (1820)

Table 2 shows income per capita for various parts of the world after 1350. We observe a number of patterns. To begin with, there is consistent growth of GDP per capita in the North Sea area from c 900 dollars before the Black Death, to more than 2000 dollars at about 1800, making it into the most prosperous part of the world economy at that time; real incomes in North America develop similarly, and show continues growth between 1650 and 1800. The Industrial Revolution that began in the UK (and quickly spread to Western Europe and North America) was therefore not a sudden break in economic performance, but a continuation of the growth record since the Late Middle Ages (Van Zanden 2009).

Slave-based societies were in this period also characterized by high levels of real GDP – we included the Cape Colony as a typical example, but tentative estimates of GDP per capita of Cuba and Barbados in 1700 point in the same direction. Sokoloff and Engerman (2000: 219) estimated that these islands in 1700 had a GDP per capita 67% and 50% higher than the USA at the time. Two factors are relevant in explaining relative high levels of income: the low dependency ratios of slave-importing societies (for the Cape Colony it was estimated that a 'balanced' population structure would imply an almost doubling of total population – given the size of the productive, male labour force (Fourie and Van Zanden 2012). Moreover, these slave societies were also highly capital-intensive and commercialized – almost completely geared to the export market - which also helps explain their high productivity. Of course, in these cases, success in the 17th and 18th century was not a guarantee for success in the post emancipation/post Industrial Revolution world.

The rest of Europe is characterized by no growth (Spain, Sweden, Portugal, Belgium, Germany – only Spain included in the table), or by an initial rise in income followed by a strong decline (Italy). However, levels of GDP per capita are quite high in large parts of Western Europe (Sweden may be the exception here); the average for Western Europe was about 1100-1300 dollars between 1400 and 1800, which is much higher than (for example) the Roman Empire, Iraq in the 8th century or any other pre 1800 society. In particular the gap with Japan was large – but Japan was also growing consistently during the centuries, both in GDP per capita and in population. The gap with India was relatively small in 1600, but real incomes there began to fall during and after the disintegration of the Moghul Empire, leading to an increased divergence with Europe (Broadberry and Gupta 2012). The Ottoman Empire showed (perhaps surprisingly) almost continuous growth in the very long run, at a level somewhat higher than that of Japan.

Now that we have integrated all available new work in the Maddison database, the question is to what extend this changes the picture of long term global development. Generally speaking, the world economy in 1820 as we can reconstruct now, does not look very different from the one put together by Maddison – it is only the road up to 1820 that is probably somewhat different than he thought. Our new estimates (and checks on the old estimates) confirm that there was a large gap in real income between Western Europe on the one hand (where the average income was nearly 1400 dollars) and the rest of the world. Within Western Europe substantial differences

existed – ranging from 2075 dollars in Great Britain to 780 dollars in Finland. Northern America (USA 1360 dollars) and the southern cone of Latin America (Argentine: 1016, Uruguay: 1165) came very close to the Western European average (or even surpassed it, as in the case of the USA). The average for Latin America was much lower, however (about 640 dollars; Mexico: 627 dollars). The other southern cones did not much better: Cape Colony: about 750 dollars, Australia only 518 dollars. The most populous parts of the world – China, India, and Indonesia – range between 530 and 600 dollars, about half the Western European level. Japan has a somewhat higher real income (660 dollars), as has the Ottoman Empire (740 dollars). Global inequality is still modest: the most wealthy country (GB) is 'only' about 4 times as rich as the poorest one in 1820 (Java: 528 dollars, or Australia : 518 dollars).

Conclusion

Summing up, a substantial amount of new work has been published in the past ten years which is generally consistent with the picture Maddison put forward in his 2001/2003 framework. The most severe criticisms at his estimates by Pomeranz (2000) and other specialists on Asian economic history, that he systematically underestimated real incomes in large parts of Asia in the 18th and early 19th century, has generally been proven wrong: detailed research by scholars working on India, Indonesia, Japan and China has shown that the magnitude of the real income gap as estimated by Maddison was about right. Another important result is that Maddison might have overestimated growth in Europe between 1300 and 1800, and that levels of real income were already quite high during the late Middle Ages. We now also know much more about long term trends in real incomes in Western Europe (England, Holland, Spain, Germany etc.), in the United States, in Japan, India and South Africa than we knew ten years ago.

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Appendix A1

1990-2010 data from the Total Economy Database Conference Board

For most countries, the 1990-2008 data are replaced by the 1990-2010 data from the TED of the Conference Board.
For China, we keep Maddison's original estimates up to 2008 and use the growth rate between 2008-2010 from the TED to update the series for China to 2010.
For Germany, we keep Maddison's original estimates up to 2008 and use the growth rate between 2008-2010 from the TED to update the series for Germany to 2010.
For Sweden, we use the 1950-2010 data from the TED. From 1550-1950 we use Schön and Krantz (2012).

Appendix A2
Sources for Long-run GDP in Latin America

Per capita GDP levels in 1990 Geary-Khamis dollars from A. Maddison (2009), *Statistics on World Population, GDP and Per Capita GDP, 1-2006 AD*, last update: March 2009, horizontal file http://www.ggdc.net/maddison/, have been projected backwards with volume indices derived from the following sources:

Argentina, 1884-1950, Gerardo Della Paolera, Alan M. Taylor, and Carlos Bózolli, 'Historical statistics', in G. Della Paolera and A. M. Taylor (eds.), *A New Economic History of Argentina* (Cambridge, 2003), pp. 376-85 (plus CD-Rom), assuming the rate of growth over 1870-84 was identical to that for 1884-90. The alternative option of projecting backwards the level for 1884 to 1875 with Cortés Conde (1997), *La economía argentina en el largo plazo*, Buenos Aires: Editorial Sudamericana/ Universidad de San Andrés, casts too low a figure. I assumed the level for 1870 was identical to that of 1875.
1820-1870, C. Newland and B. Poulson (1998), 'Purely Animal: Patoral Production in early Argentine Economic Growth 1825-1865', *Explorations in Economic History* 35, 3, pp. 325-345, p. 328, estimated Argentina's littoral agricultural output per head grew at 2 percent per year over 1825-1865. I have assumed that this sector was representative of the littoral's economy as a whole, and that there was no per capita growth in Argentina's interior provinces. A population- weighted average casts a per capita GDP rate of growth of 0.8 percent per year. Population data comes from Newland, 'economic development', pp. 212 and 218.
1810, projection of the 1820 level with the average growth rate of cattle and land per person over 1810-1825, taken from C. Newland and J. Ortiz (2001), "The Economic Consequences of Argentine Independence", *Cuadernos de Economía* 38, 115, PP. 275-290.
1800, assuming no growth between 1800 and 1810.

Brazil, 1850-1950, Richard W. Goldsmith, *Brasil 1850-1984: Desenvolvimento financeiro sob um século de inflaçao* (Sao Paulo, 1986).
1800-1850, Zero per capita income growth for the early nineteenth century as suggested by Nathaniel H. Leff, *Underdevelopment and Development in Brazil* (London, 1982), 2 vols.,Vol. I, p. 33, was adopted. A lower initial level and, subsequently, a higher growth rate would result if Angus Maddison, *Monitoring the World Economy, 1820-1992* (Paris 1995), p. 143, assumption that per capita income growth in 1820-50 grew at the same pace as in 1850-1913 were accepted.

Chile, <u>1810-1950</u>, J. Díaz, J., R. Lüders, and G. Wagner (2007), 'Economía Chilena 1810-2000. Producto total y sectorial. Una nueva mirada', Pontificia Universidad Católica de Chile, Documento de trabajo 315.
<u>1800</u>, assuming no growth between 1800 and 1810.

Colombia, <u>1800-1905</u>, S. Kalmanovitz Krauter and E. López Rivera (2009), *Las cuentas nacionales de Colombia en el siglo XIX*, Bogotá: Universidad de Bogotá Jorge Tadeo Lozano, and data kindly provided by Salomón Kalmanovitz in private communication.
<u>1905-1950</u>, GRECO GRECO (Grupo de Estudios de Crecimiento Económico) (2002), *El Crecimiento económico colombiano en el Siglo XX*, Bogotá: Banco de la República–Fondo de Cultura Económica.

Cuba, <u>1800-1902</u>, Santamaría, A. (2005), 'Las cuentas nacionales de Cuba, 1690–2005' Centro de Estudios Históricos, Centro Superior de Investigaciones Científicas (mimeo). The level for 1800 assumed to be identical to that for 1792.
<u>1902-1958</u>, Ward, M. and J. Devereux (2009), "The Road Not Taken: Pre-Revolutionary Cuban Living Standards in Comparative Perspective" (mimeo)
<u>1958 onwards</u>, Maddison, A. (2009), *Statistics on World Population, GDP and Per Capita GDP, 1-2006 AD*, last update: March 2009, horizontal file http://www.ggdc.net/maddison/.
An important caveat is that Maddison (2006) level for 1990 has not been accepted. The reason is that given the lack of PPPs for Cuba in 1990 Maddison (2006: 192) assumed its per capita GDP was 15 percent below the Latin American average. Since this is an arbitrary assumption, I started from Brundenius and Zimbalist's (1989) estimate of Cuba's GDP per head relative to six major Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela, LA6) in 1980 (provided in Astorga and Fitzgerald 1998) and applied this ratio to the average per capita income of LA6 in 1980 Geary-Khamis dollars to derive Cuba's level in 1980. Then, following Maddison (1995: 166), I derived the level for 1990 with the growth rate of real per capita GDP at national prices over 1980-1990 and reflated the result with the US implicit GDP deflator to arrive to an estimate of per capita GDP in 1990 at 1990 Geary-Khamis dollars. Interestingly the position of Cuba relative to the US in 1929 and 1955 is very close to the one Ward and Devereux (2009) derived with a different approach.

Mexico, <u>1800-1896</u>, Coatsworth, J.H. (1989), 'The decline of the Mexican economy, 1800-1860', in R. Liehr (ed.), *América Latina en la época de Simón Bolívar. La formación de las economías nacionales y los intereses económicos europeos 1800-1850*, Berlin: Colloquium, pp. 27-53.
Following J. H. Coatsworth, 'Mexico', in Joel Mokyr, ed., *The Oxford Encyclopedia of Economic History* (New York, 2003), III, pp. 501-7, I accepted a mild rise in GDP per capita over 1820-1845.
<u>1896-1950</u>, INEGI (1995), *Estadísticas Históricas de México*, México D.F.: INEGI.

Uruguay, <u>1870-1938</u>, Bértola and asociados (1998), *El PBI de Uruguay 1870-1936 y otras estimaciones*, Montevideo: Universidad de la República.
<u>1810-1870</u>, I assumed that Uruguay evolved as Argentina's littoral between 1850 and 1870, and as Argentina as a whole over 1810-1850.
<u>1800</u>, assuming no growth between 1800 and 1810.

Venezuela, <u>1820-1950</u>, Baptista, A. (1997), *Bases cuantitativas de la economía venezolana, 1830–1995*, Caracas: Fundación Polar.
<u>1800</u>, assuming Venezuela evolved as Colombia over 1800-1820.

Ecuador, <u>1870-1890</u>, I assumed it evolved as Peru over 1890-1900 yielding $470 for 1890 and I arbitrarily assumed a per capita GDP of $400 for <u>1870-1880</u>.

Peru, Seminario (private communication), <u>1896-1950</u>. I assumed the level for 1890 was the same as for 1896. I also arbitrarily assumed GDP per head for 1870-1880 was $400.

Central America (Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua): I derived the level for 1913 by assuming the growth over 1913-20 was identical to that of 1920-25, the latter derived from OxLAD database (Astorga *et al*. 2003).

Caribbean

Bahamas, Barbados, Belize, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Suriname, Maddison (2006, 2009), Conference Board (2010), and Bulmer-Thomas (personal communication), 1950 onwards

Trinidad-Tobago, Maddison (2009), 1950-70;

Jamaica, Eisner (1961), 1850-1930; Maddison (2009), 1938 onwards

Puerto Rico, Maddison (2009), since 1950.