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The Maddison Project: collaborative research on historical national accounts[1]

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The Maddison Project, initiated in March 2010 by a group of close colleagues of Angus Maddison, aims to develop an effective system of cooperation between scholars to continue Maddison's work on measuring economic performance in the world economy. This article is a first product of the project. Its goal is to explain the aims and approach of the project, and, as a first result of this 'collaboratory', to inventory recent research on historical national accounts. We also briefly discuss some of the problems related to these historical statistics and we extend and where necessary revise the estimates published by Maddison in his latest overviews. Most new work relates to the period before 1820; it leads to a reassessment of levels of GDP per capita in western Europe in the early modern period, and to a confirmation of Maddison's previous estimates of Asian levels of real income.

This article introduces the Maddison Project and its first results. The Maddison Project was initiated in 2010 and builds on the legacy of Angus Maddison. 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 share the idea that it is important to continue to render this kind of service and acknowledge that this can only be achieved by combining forces. Nobody has the authority, the expertise, and the determination to do this work on his (or her) own any more. Therefore, the Maddison Project involves cooperation between scholars who are specialists on different regions, topics, and periods.

The main goal of the Maddison Project is to continue Maddison's work by creating new generations of estimates of GDP, population, and GDP per capita in the world economy between (preferably) Roman times and the present. The project aims to generate these statistics in the tradition and spirit of Angus

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[1] This article is the first result of the Maddison Project. The current members of the Maddison Project are (in alphabetical order) Bart van Ark, Leticia Arroyo Abad, Luis Bertola, Derek Blades, Jutta Bolt, Stephen Broadberry, Nick Crafts, Pierre van der Eng, Giovanni Federico, Ewout Frankema, Kyoji Fukao, Robert Gordon, Mark Harrison, David Henderson, Alan Heston, André Hofman, Morten Jerven, Herman de Jong, Peter Lindert, Debin Ma, Branko Milanovic, Sevket Pamuk, Leandro Prados de la Escosura, Albrecht Ritschl, Tirthankar Roy, Lennart Schön, Harry Wu, and Jan Luiten van Zanden. We thank all the members for their commitment to the project, their generous supply of data, and their valuable comments on earlier drafts of this article. Furthermore we are grateful to all other scholars who have kindly provided their data to the project, and we thank the three anonymous referees and the participants of the session 'The Maddison Project, an international collaboratory to continue the work of Angus Maddison on measuring economic performance across time and space', at the XVIth World Economic History Congress (Stellenbosch, 2012) for their comments. The usual disclaimer applies.

Maddison's work, which he built on pioneering work by scholars such as Clark, Kuznets, and Bairoch. This involves creating estimates on the basis of historical conjectures, in-depth analysis of the available data, and a rooting in the modern tradition of national income accounting. Lastly, the emphasis is placed more on international comparability of the estimates than on their consistency over time. Simultaneously, the project aims to incorporate new techniques and technology to improve the quality of the series and to enhance the distribution of the results to the broader research community.

To coordinate this extensive form of academic cooperation, the Maddison Project is organized in a two-tier structure. A small working party consisting of four scholars coordinates the actual work on the new generation of GDP and population estimates. To obtain scale effects and benefits of expertise across the profession, there is a complementary advisory board consisting of experts working on different regions and time periods. This larger group of experts roots the project in the wider academic community. This enables the Maddison Project to keep track of new work in the field which can be used as an input into new sets of estimates, and to test the reliability and plausibility of the research results.

This article focuses on an inventory of new work carried out on estimating national accounts since the publication of Maddison's synthesis in 2001/2003 and the subsequent online updates. It presents many extensions and a few revisions of the original estimates of GDP per capita (for a full list of the changes made, see appendix I); 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 his original estimates have been kept intact, except in those cases for which more and better information on national income estimates is now available. This means that the original population estimates have not been revised in this update. However, total GDP for each country can still be calculated using the updated GDP per capita estimates and multiplying them by the original population estimates available on the original Maddison website.[2]

In view of the new research that has been carried out, many of the pre-1820 per capita income 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 carry out 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; yet, thanks to his pioneering work and the many responses to it, it is now possible to present a much more detailed overview of long-term economic growth than when he started his project in the 1960s.

The rest of this article is organized as follows. It begins with a brief discussion of the transparency of the estimates, and how to indicate the provenance of the new data. Section II discusses recent research integrated into the new database, and section III briefly reviews the recent work done on real wages. Section IV discusses the new results of the update per time period. This is followed by the conclusion, and an agenda for future research within the Maddison Project.

[2] See http://www.ggdc.net/maddison/maddison-project/orihome.htm. In the future the Maddison Project also aims to update the population estimates provided by Maddison.

I

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 of error will probably be, but there may be important exceptions to this rule (perhaps data for medieval England are better than, for example, nineteenth-century Sub-Saharan Africa, or pre-Colombian Latin America).

Feinstein and Thomas have argued that it is possible to estimate such margins of error.[3] Their method has been applied in a few studies on the topic.[4] Members of the Maddison Project have also experimented with various margins of error; the most detailed study was carried out by the members of the Hitotshibashi team working on Asian national accounts.[5] However, these margins of error suggest a certain degree of objectivity, whereas they are actually based on rather subjective estimates of the possible margins of error of the underlying data.

An alternative approach to signal the quality and reliability of the estimates (as suggested by Broadberry) is to make explicit the provenance of the various estimates and ways in which they have been derived.[6] This leads to the following four groups: first, official estimates of GDP, made by national statistical offices or by international agencies (the United Nations, for example); second, historical estimates based on the same methods and broad range of data; third, historical estimates based on indirect proxy variables; and fourth, guestimates.

In principle this is a much more objective classification, which still informs the user of the data about differences in the quality of the estimates, although there may be very weak 'official estimates' (see the discussion by Jerven about African GDP) and high-quality historical estimates.[7] 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 can be given at the moment (it was also adopted by the associated Clio Infra project).[8]

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 Maddison's framework. He made many corrections for (minor) changes in borders, an overview of which can be found in appendix II. However, moving back in time sometimes means that we have only estimates for northern Italy (instead of Italy as a whole), for Holland (instead of the Netherlands), or for the Cape Colony (instead of South Africa). When those smaller regions represented less than two-thirds of the population and/or the GDP of the modern country (within current borders), the estimates are presented in italics to warn users.

This obviously does not really solve the problem of changing borders. Therefore, the Maddison Project also aims to supply in the near future a set of GDP estimates within historical boundaries, and that not only report GDP in 1990 international

[3] Feinstein and Thomas, 'Plea for errors'.
[4] For example, van Zanden and van Leeuwen, 'Persistent but not consistent'.
[5] Kyogi Fukao and Harry Wu, personal communication, 7 March 2011.
[6] S. N. Broadberry, personal communication, 8 March 2011.
[7] Jerven, 'Relativity of poverty'.
[8] See http://www.clio-infra.eu/

prices, but also in current prices of the country concerned (see the agenda for future research below). This will supply a denominator for scholars' local-currency magnitudes relating to many kinds of behavior; for example, fiscal history, or government debt.

II

The goal of the Maddison Project is to continue Maddison's work on measuring the 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, once it has been shown to withstand scientific scrutiny, is integrated on a regular basis into the existing dataset. In this section we will discuss recent research integrated into the new dataset. The structure will follow the (somewhat Eurocentric) organization of Maddison's original 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 Trust made it possible to estimate annual series of British (before 1700 English) GDP going back to 1270, and of Holland's GDP between 1348 and 1807.[9] This project was part of a much larger research effort to estimate pre-1850 GDP, which includes much new work done on Spain,[10] Portugal,[11] Belgium,[12] Sweden,[13] Germany,[14] and updated work on Italy.[15] The most important conclusion drawn from this new work is that growth in western Europe was probably more gradual than implied by Maddison's synthesis. Europe before 1800 was much richer than previously assumed; for example, Maddison estimated an average income per capita of 771 dollars (1990 international dollars) in western Europe around 1500. The new work strongly suggests that it must have been higher, perhaps as high as 1,200 dollars or more; the unweighted average of the six countries for observations available for 1500 is 1,255 dollars. Even the poorest country among them, Spain, was richer than the average of 771 dollars per capita included in the original Maddison dataset. 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.[16] Between 1300 and 1800 growth did occur but was mainly concentrated in the North Sea area. England and Holland grew from about 900 dollars in around 1300 to more than double that level—2,100 (Great Britain) to 2,600 (Holland) dollars—in 1800. In contrast, Spain in 1800 was not wealthier than in 1300, and in (northern) Italy GDP per capita even declined during this period. Nor was there much growth in Sweden, Germany, or Portugal.

[9] Broadberry, Cambell, Klein, Overton, and van Leeuwen, 'British economic growth'; van Zanden and van Leeuwen, 'Persistent but not consistent'.
[10] Álvarez-Nogal and Prados de la Escosura, 'Rise and fall of Spain'.
[11] Reis, Martins, and Costa, 'New estimates'.
[12] Buyst, 'Towards estimates of long term growth'.
[13] Schön and Krantz, 'Swedish economy'.
[14] Pfister, 'Economic growth in Germany'.
[15] Lo Cascio and Malanima, 'Ancient and pre-modern economies'.
[16] Federico, 'World economy 0–2000 AD'; van Zanden, 'Early modern economic growth'.

Moreover, a number of revisions of nineteenth-century and early twentieth-century growth have been added: for Switzerland,[17] Germany,[18] Sweden,[19] Italy,[20] Greece,[21] Russia,[22] and Bulgaria.[23] However, these do not fundamentally change our view of growth in this period.

The second main result of the current update concerns the debate on the 'great divergence' between Europe and Asia and the relative level of economic development of east and south Asia during the eighteenth century, which 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 is whether the level of economic development (in terms of GDP per capita) in China (and India and Japan) before industrialization was comparable to that of western Europe.[24] 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 1,200 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 bring to light more details of the matter. In a detailed case study of real incomes in Bengal in 1763, Roy demonstrates that these were much lower than those in England; moreover, he also finds no income growth between the early eighteenth century and the final decades of the nineteenth century, which is consistent with Maddison's estimates.[25] Broadberry, Custodis, and Gupta are even more pessimistic about the long-term trajectory of Indian GDP.[26] They chart an almost continuous decline from 1600 to 1870, based on (among other things) the development of the urbanization ratio, real wages, and industrial exports. Their estimates, which show higher income levels especially in the seventeenth century compared to Maddison's figures, have been integrated into the new dataset. New work has also been carried out for Indonesia and for Java in the nineteenth century.[27] A comparison of these estimates with those for western Europe in the nineteenth century also confirm the large income gap between these regions.[28] New work on Japan goes back in time until the eighth century and shows a slow rise of GDP per capita from 400 dollars in 720 to almost 700 dollars in 1850. These estimates again confirm the view that there was indeed a large income gap between Asia and western Europe at the onset of the industrial revolution.[29] Finally, for China, Li has produced a detailed set of estimates of the structure and

[17] Halbeisen, Müller, and Veyrassat, *Wirtschaftsgeschichte der Schweiz*.
[18] Burhop and Wolf, 'Compromise estimate'.
[19] Schön and Krantz, 'Swedish economy'.
[20] Baffigi, 'Italian national accounts'.
[21] Kostelenos, Petmezas, Vasiliou, Kounaris, and Sfakianakis, 'Gross domestic product'. 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 nineteenth century (as wealthy as Spain).
[22] Markevich and Harrison, 'Great War'; Gregory, *Russian national income*.
[23] Ivanov, 'Bulgarian national income'. We also added new data for the former Yugoslavia and its successor states between 1952 and 2008 provided by Branko Milanovic (personal communication, 10 Nov. 2010).
[24] Pomeranz, *Great divergence*.
[25] Roy, 'Economic conditions'.
[26] Broadberry, Custodis, and Gupta, 'India and the great divergence'.
[27] van der Eng, 'Sources of long-term economic growth'; van Zanden, 'Economic growth in Java'.
[28] van Zanden, 'Rich and poor'.
[29] Bassino, Broadberry, Fukao, Gupta, and Takashima, 'Japan'.

level of GDP in the most advanced part of the empire, the Yangzi Delta (in fact, in a part of that region, the Hua-Lou district) in the 1820s.[30] 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 per cent.[31] On this basis the estimate made by Maddison of China's GDP per capita of 600 dollars in 1820 is again accepted.

Besides incorporating this new research on very long-run income developments, a new set of estimates on Singapore's more recent GDP (per capita) provided by Sugimoto has been included.[32]

For the Americas new work carried out by Prados de la Escosura has been included, based on estimates for eight Latin American countries published in 2009 (Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Uruguay, and Venezuela).[33] Most importantly, the income estimates now go back to 1800 for these countries. Additionally, for Peru, Ecuador, and Jamaica the new estimates extend the original series well into the nineteenth century and for the first time offer an insight into their relative position in terms of per capita income on the continent during the nineteenth century. For Latin America, new work by Bèrtola and Ocampo on the period 1870–1920 has also been incorporated.[34] This has resulted 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 Argentina, Mexico, and Venezuela appear to have been slightly richer prior to 1900.

For the US it was possible to make use of the new set of estimates published as part of the Historical Statistics of the United States project produced by Sutch for the period 1790–1870, and by McCusker for the colonial period.[35] This extends the estimates for the US back to 1650, and shows rapid growth between 1650 and 1800, resulting in a doubling of GDP per capita (although apparently McCusker assumed that before 1700 growth was close to that found in England at the time).

For Africa, most of the available income estimates start only in 1950. However, much work is currently being carried out on various countries on the continent. For example, new research carried out by Fourie and van Zanden makes it possible to chart the GDP of the Cape Colony (1701–1910) and link it to estimates for South Africa (from 1910 onwards).[36] Jerven, in a working paper, estimates growth in Ghana between 1892 and 1954 based on expenditure data.[37] In a paper on human development, Prados de la Escosura indirectly estimated GDP per capita for all African countries for benchmark years between 1870 and 1950, based on the theoretical relationship between income terms of trade per head and GDP per capita.[38] Finally, the increased interest in real wages following Allen's 2001 paper

[30] Li, *Zhongguo de zaogi jindai jingji*; idem, 'Early modern economy in China'.
[31] Li and van Zanden, 'Before the great divergence?'
[32] Sugimoto, *Economic growth of Singapore*.
[33] Prados de la Escosura, 'Lost decades?'.
[34] Bèrtola and Ocampo, *Economic development of Latin America*.
[35] Sutch, 'National income and product'; McCusker, 'Colonial statistics'.
[36] Fourie and van Zanden, 'GDP in the Dutch Cape Colony'.
[37] Jerven, 'Comparing colonial and post-colonial output'.
[38] Prados de la Escosura, 'Human development in Africa'. Terms of trade per head is calculated as the value of current exports deflated by the price of imports, which was then divided by each country's population; ibid., p. 14.

on real wages also spurred studies on real wages in Africa.[39] Frankema and van Waijenburg, for example, estimate real wages between 1880 and 1965 for British Colonial Africa, and present new insights into living standards in various parts of the African continent.[40] Furthermore van Leeuwen et al. provide regional estimates of GDP per capita based partly on already existing sources, but also to a large extent on real wage data, deflated with indigenous crop prices.[41] Work on ways to integrate this new research into the Maddison framework is still in progress—this version only contains the new time series for South Africa (the Cape Colony).

The general trends in income for most African countries between 1870 and 1950 differ quite substantially between Prados de la Escosura and van Leeuwen et al. except for northern Africa.[42] For Malawi and Kenya, for example, the estimates from van Leeuwen et al. suggest that the income was below the subsistence level of 250 to 300 international dollars for some decades prior to 1900, whereas Prados de la Escosura shows a stable trend at or well above subsistence. For Sierra Leone, and to a lesser extent Nigeria and Zambia, the trends from both sources even move in the opposite direction. Prados de la Escosura suggests that income in Sierra Leone decreased from 1,600 to 646 international dollars between 1870 and 1950, whereas van Leeuwen et al. indicate an increase from 348 to 556 dollars in the same period. Both sources do agree that Mauritius, with an income close to or above 2,000 dollars for the whole period, is the wealthiest country of the region.

In the Near East/northern Africa, new work by Pamuk and Shatzmiller allows us to chart the long-term trajectory of Egypt, Iraq, and Byzantium in the period 700–1500, also building on the work of Milanovic who estimated GDP in Byzantium in *c.* 1000.[43] They find long-term stagnation in the region: in Egypt, for example, real income hardly increased during the period between 720 and 1780 (at between 700 and 800 dollars); similar or somewhat lower levels are found in Iraq and Byzantium. They fit into a pattern: the most recent and most thorough overview of the debate by Scheidel and Friesen puts Roman GDP per capita at about 700 dollars, with large margins (600–800 dollars).[44] They convincingly criticize estimates which are much higher (for example, those of Lo Cascio and Malanima, who estimate per capita income of the Roman Empire to be up to 1,000 dollars).[45] 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, which is 800 dollars. This is exactly the same as Maddison's original estimate for peninsular Italy and the islands.[46] Newly acquired regions (France, Belgium, Spain) were estimated to be at the bottom of this scale (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). The average for the whole empire was

[39] Allen, 'Great divergence'.
[40] Frankema and van Waijenburg, 'Structural impediments'.
[41] van Leeuwen, van Leeuwen-Li, and Foldvari, 'Education'.
[42] Ibid.; Prados de la Escosura, 'Human development in Africa'.
[43] Pamuk and Shatzmiller, 'Real wages and GDP per capita'; Milanovic, 'Estimate'.
[44] Scheidel and Friesen, 'Size of the economy'.
[45] Lo Cascio and Malanima, 'Ancient and pre-modern economies'.
[46] Maddison, *Contours of the world economy*, p. 54.

estimated to be about 700 dollars.[47] Scheidel and Friesen's estimate is comparable to the estimate for Byzantium of about 680 dollars (range 640–720) in the year 1000.[48] 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 Geary-Khamis dollars in around 500 BC (these estimates were not included in the dataset).[49]

III

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 seminal paper on real wages in Europe between 1300 and 1914, a large number of studies have been published which measure the level and development of real wages in a more or less systematic way.[50] Moreover, these studies often show long-term trends that are quite similar to the changes found in GDP per capita; we therefore think that it is useful 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. First, 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 nineteenth century); whereas, on the other hand, real wages in the 'periphery' (in Germany, Italy, and Spain) began to fall after the fifteenth century and returned to some kind of subsistence minimum during the 1500–1800 period.[51] 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 (or even a decline) between 1500 and 1800, whereas in Holland and England real income continued to rise and more or less doubled in this period.

Second, the high real wages attained in England and Holland also stand out in a wider international comparison: in the eighteenth and nineteenth century real wages in various parts of China, India, Japan, and Indonesia were at best half the level attained in north-western Europe, thereby confirming the GDP estimates which suggest a (similar) gap between these parts of the world.[52]

[47] We estimated smaller differences between Italy and the rest of the empire than Maddison, *Contours of the world economy*, 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, 'Taxes and trade'.

[48] Scheidel and Friesen, 'Size of the economy'; Milanovic, 'Estimate'.

[49] Foldvari and van Leeuwen, 'Comparing per capita income'.

[50] Allen, 'Great divergence'.

[51] Ibid.

[52] Allen, Bassino, Ma, Moll-Murata, and van Zanden, 'Wages, prices, and living standards'; de Zwart, 'Labour relations in Ceylon'.

Table 1. *GDP per capita estimates: Roman Empire to 1348*

Year	*Northern Italy*	*Spain*	*England*	*Holland*	*Western Europe*[a]	*Byzantium*	*Iraq*	*Egypt*	*Japan*
1	800	600	600	600	699	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			

Note: a Population weighted regional average.
Sources: Year 1, Roman Empire estimates from the original Maddison estimates and Scheidel and Friesen, 'Size of the economy'; Northern Italy from Malanima, 'Long decline'; Spain from Álvarez-Nogal and Prados de la Escosura, 'Rise and fall of Spain'; England from Broadberry et al., 'British economic growth'; Holland from van Zanden and van Leeuwen, 'Persistent but not consistent'; Byzantium from Pamuk and Shatzmiller, 'Real wages and GDP per capita', and Milanovic, 'Estimate'; Iraq and Egypt from Pamuk and Shatzmiller, 'Real wages and GDP per capita'; Japan from Bassino et al., 'Japan'.

Third, similarly, high real wages in the eighteenth-century Cape Colony are consistent with the high real GDP per capita estimates for that region.[53]

Fourth, likewise, Arroyo Abad et al. show that the regional structure of real wages in Latin America at about 1820 is correlated with the structure of GDP per capita.[54]

The new real wage evidence therefore tends to support the new estimates of GDP per capita for large parts of the world economy. This is not to deny that trends in real wages and GDP per capita may be very different—as appears to be the case 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 ratios, working hours, and structural composition of the economy.[55]

IV

In this section, the new results from the current update are reviewed by period. We start with the period before 1350, followed by a discussion of new results for the 1350–1820 period. Finally the benchmark year 1820, as it can now be reconstructed, is analysed.

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 eighth-century Iraq. These estimates for the early middle ages are by and large also consistent with those for Spain, England, and Holland after 1200, where real incomes also hovered around 900 dollars per annum. We think that Italian real GDP for 1300 (actually 1310) may be somewhat overestimated by Malanima (a similar problem occurred with his and Lo Cascio's estimates of GDP in Roman times, which was also considered to be too high by Scheidel and Friesen).[56] Still, these Italian estimates are kept because of the lack of alternatives. The other

[53] de Zwart, 'South African living standards'.
[54] Arroyo Abad, Davies, and van Zanden, 'Between conquest and independence'.
[55] Broadberry et al., 'British economic growth'; Allen and Weisdorf, ' "Industrious revolution" '.
[56] Lo Cascio and Malanima, 'GDP in pre-modern agrarian economies'; Scheidel and Friesen, 'Size of the economy'

country that really stands out is Japan, where income levels are much lower than in other pre-industrial societies—in particular, the very tentative estimate for 730 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 1990 international dollars).

Table 2 shows income per capita for various parts of the world after 1350. A number of patterns can be observed. 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 2,000 dollars in about 1800, making it into the most prosperous part of the world economy at that time (even averaging over the whole of western Europe clearly shows this to be the wealthiest region in the world during that period); real income in North America develops similarly, and shows continued 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 rather a continuation of the growth record since the late middle ages.[57]

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 for Cuba and Barbados in 1700 point in the same direction. Sokoloff and Engerman estimated that in 1700 these islands had a GDP per capita which was respectively 67 per cent and 50 per cent higher than the average income in the US at that time.[58] Two factors are relevant in explaining relatively 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 almost a doubling of the total population—given the size of the productive, male labour force).[59] 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 seventeenth and eighteenth 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, and Germany—only Spain is 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 1,100–1,300 dollars between 1400 and 1800, which is much higher than (for example) the Roman Empire, Iraq in the eighth 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 Mughal Empire, leading to an increased divergence with Europe.[60] The Ottoman Empire showed (perhaps surprisingly) almost continuous growth in the very long run, at a level somewhat higher than that of Japan.

[57] van Zanden, *Long road*.
[58] Sokoloff and Engerman, 'History lessons', p. 219.
[59] Fourie and van Zanden, 'GDP in the Dutch Cape Colony'.
[60] Broadberry, Custodis, and Gupta, 'India and the great divergence'.

Table 2. *GDP per capita in various parts of the world, 1348–1800*

Year	*Northern Italy*	*Holland*	*England*	*Spain*	*Western Europe*[a]	*US*	*Japan*	*India*	*Cape Colony*	*Ottoman Empire*
1348	1486	876	919	907			527 (1280)			580
1400	1716	1195	1205	819			527			
1500	1503	1454	1134	846	1305					660
1600	1336	2662	1167	892	1139	587 (1650)	574 (1450)	793		
1700	1447	2105	1540	814	1312	900	629	729	1703	700
1800	1336	2609	2200	916	1473	1296	641	648	959	740 (1820)

Note: a Population weighted regional average.
Sources: Northern Italy from Malanima, 'Long decline'; Holland from van Zanden and van Leeuwen, 'Persistent but not consistent', and Smits, Horlings, and van Zanden, *Measurement*; England from Broadberry et al., 'British economic growth'; Spain from Álvarez-Nogal and Prados de la Escosura, 'Rise and fall of Spain'; US from McCusker, 'Colonial statistics', and Sutch, 'National income and product'; Japan from Bassino et al., 'Japan'; India from Broadberry et al., 'India and the great divergence'; Cape Colony from Fourie and van Zanden, 'GDP in the Dutch Cape Colony'; Ottoman Empire from Pamuk and Shatzmiller, 'Real wages and GDP per capita', and Milanovic, 'Estimate'.

Now that all available new work has been integrated into the Maddison Project database, the question is to what extent this changes the picture of long-term global development. Generally speaking, the world economy in 1820, as we can reconstruct it now, does not look very different from the picture put together by Maddison—it is only the road up to 1820 that is probably somewhat different than he thought. The 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 1,400 dollars) and the rest of the world. Within western Europe substantial differences existed—ranging from 2,075 dollars in Great Britain to 780 dollars in Finland. Northern America (US: 1,360 dollars) and the southern cone of Latin America (Argentina: 998; Uruguay: 1,165) came very close to the western European average (or even surpassed it, as in the case of the US). The average for the whole of Latin America was much lower, however (about 630 dollars; Mexico: 627 dollars). The other southern cones did not fare much better (the Cape Colony: about 750 dollars; Australia: only 518 dollars). The most populous parts of the world—China, India, and Indonesia—ranged between 530 and 600 dollars, about half the western European level. Japan had a somewhat higher real income (660 dollars), as had the Ottoman Empire (740 dollars). Global inequality was still modest: the most wealthy country (the UK) was 'only' about four times as rich as the poorest one in 1820 (Java: 528 dollars, or Australia: 518 dollars).

V

In order to produce and update the global datasets that are required for contemporary economic historical research, we need collaborative projects to standardize and peer review new estimates. The Maddison Project is an attempt to experiment with such a 'collaboratory' (as such projects are called in the sciences). The aim of this project is to continue the important work started by Maddison on creating an international comparative dataset on long-term economic growth. This article contains the first results of this project, which are also available on the Maddison Project website.[61]

The overview demonstrates the amount of new work that has recently been done in this field. Most new results are generally consistent with the picture Maddison put forward in his 2001/2003 synthesis. The most severe criticism of his estimates, as put forward by Pomeranz and other specialists on Asian economic history, is that Maddison systematically underestimated real incomes in large parts of Asia in the eighteenth and early nineteenth century.[62] This has generally been proven wrong: detailed research by scholars working on India, Indonesia, Japan, and China show that the magnitude of the real income gap as estimated by Maddison was by and large correct. Another important result discussed in this article is that Maddison might have overestimated growth in Europe between 1300 and 1800. We find that levels of real income in this region were already quite high during the late middle ages. Lastly, this updated dataset incorporates new information on long-term trends in real incomes in western Europe (England, Holland, Spain, Germany, and so on), the US, Japan, India, and South Africa.

[61] http://www.ggdc.net/maddison/maddison-project/home.htm
[62] Pomeranz, *Great divergence*.

Having presented the first phase of the Maddison Project, which focused on updating the estimates of GDP per capita, the Maddison Project will now turn its attention to other, perhaps more difficult issues, such as including the new International Comparison Programme 2005 or 2011 results, to matters concerning the consistency of time series and benchmarks, to the possibility of revising the original population estimates, and to the large gaps in the available estimates for various regions (for example, Africa before 1950, or China before 1913).

The inclusion of more recent PPPs in the Maddison Project database will have major implications, mainly for rapidly growing developing countries such as China and India, as more recent PPPs will change the level of their income significantly. As there are some reservations about the quality of the 2005 PPP results especially for China, the Maddison Project is awaiting the new 2011 PPPs, and integrating those results will be part of its future work.[63]

The Maddison database, by combining both time series and spatial comparison, inevitably faces the (in)consistency of benchmarks and time series estimates. Time series often aim at comprehensive coverage of as many parts of aggregate output as possible. In contrast, benchmark studies require precise matches of quantity and price to avoid biases in the spatial comparisons. These issues differ depending on the specific cases that are compared. As noted above, the Maddison Project database places the emphasis more on the international comparability of the estimates than on their consistency over time. In future work, the Maddison Project will reconsider the balance between time series and benchmarks.

Another very important topic for future research is whether and how to revise the original population statistics within the Maddison Project. As noted above, the present update keeps the original population estimates of Maddison intact. These can be used to convert the updated income per capita estimates into total GDP estimates. We are aware that the population estimates especially for Africa and Latin America are probably the weakest estimates, and in future work the Maddison Project aims to revise these estimates.

Finally, the current update still has large gaps in available estimates for various regions, especially Africa before 1950 and China before 1913. Although much new work has been devoted to these regions, we have only been able to integrate part of this work in the current update.[64] However, the recent surge in new work on determining historical patterns of well-being in these regions leaves us very optimistic about the possibility of charting the comparative historical income patterns of these regions in the near future.

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[63] Deaton and Heston, 'Understanding PPPs', pp. 2, 21.

[64] See, for example, for Africa, Fourie and van Zanden, 'GDP in the Dutch Cape Colony'; Frankema and van Waijenburg, 'Structural impediments'; de Zwart, 'South African living standards'; Prados de la Escosura, 'Human development in Africa'. See also Li, *Zhongguo de zaogi jindai jingji*; idem, 'Early modern economy in China'; Li and van Zanden, 'Before the great divergence?'; Allen et al., 'Wages, prices, and living standards'.

Footnote references

Allen, R. C., 'The great divergence in European wages and prices from the middle ages to the First World War', *Explorations in Economic History*, 38 (2001), pp. 411–47.

Allen, R. C., Bassino, J.-P., Ma, D., Moll-Murata, C., and van Zanden, J. L., 'Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India', *Economic History Review*, 64, S1 (2011), pp. 8–38.

Allen, R. C. and Weisdorf, J. L., 'Was there an "industrious revolution" before the industrial revolution? An empirical exercise for England, *c*. 1300–1830', *Economic History Review*, 64 (2011), pp. 715–29.

Álvarez-Nogal, C. and Prados de la Escosura, L., 'The rise and fall of Spain (1270–1850)', *Economic History Review*, 66 (2013), pp. 1–37.

Arroyo Abad, L., Davies, E., and van Zanden, J. L., 'Between conquest and independence: real wages and demographic change in Spanish America, 1530–1820', *Explorations in Economic History*, 49 (2012), pp. 149–66.

Baffigi, A., 'Italian national accounts, 1861–2011', Banca d'Italia economic history working paper, 18 (2011).

Bassino, J.-P., Broadberry, S., Fukao, K., Gupta, B., and Takashima, M., 'Japan and the great divergence, 730–1870', London School of Economics working paper (2011) http://www2.lse.ac.uk/economicHistory/pdf/Broadberry/JapanGreatDivergence.pdf (accessed on 10 Jan. 2013).

Bèrtola, L. and Ocampo, J. A., *The economic development of Latin America since independence* (Oxford, 2012).

Broadberry, S., Campbell, B., Klein, A., Overton, M., and van Leeuwen, B., 'British economic growth, 1270–1870: an output-based approach', Department of Economics, Univ. of Kent working paper, Studies in Economics 1203 (2012).

Broadberry, S., Custodis, J., and Gupta, B., 'India and the great divergence: an Anglo-Indian comparison of GDP per capita, 1600–1871', London School of Economics working paper (2013).

Burhop, C. and Wolff, G. B., 'A compromise estimate of German net national product, 1851–1913, and its implications for growth and business cycles', *Journal of Economic History*, 65 (2005), pp. 613–57.

Buyst, E., 'Towards estimates of long term growth in the southern low countries, *ca*.1500–1846', paper presented at the Conference on Quantifying Long Run Economic Development, Venice (22–4 March 2011).

Conference Board, *Total Economy Database*, http://www.conference-board.org/data/economydatabase/ (accessed on 16 Sept. 2013).

Deaton, A. and Heston, A., 'Understanding PPPs and PPP-based national accounts', *American Economic Journal: Macroeconomics*, 2, 4 (2010), pp. 1–35.

van der Eng, P., 'The sources of long-term economic growth in Indonesia, 1880–2008', *Explorations in Economic History*, 47 (2010), pp. 294–309.

Federico, G., 'The world economy 0–2000 AD: a review article', *European Review of Economic History*, 6 (2002), pp. 111–20.

Feinstein, C. H. and Thomas, M., 'A plea for errors', Univ. of Oxford discussion papers in economic and social history, 41 (2001).

Foldvari, P. and van Leeuwen, B., 'Comparing per capita income in the Hellenistic world: the case of Mesopotamia', *Review of Income and Wealth*, 58 (2012), pp. 550–68.

Fourie, J. and van Zanden, J. L., 'GDP in the Dutch Cape Colony: the national accounts of a slave-based society', *South African Journal of Economics* (forthcoming), doi: 10.1111/saje.12010.

Frankema, E. H. P. and van Waijenburg, M., 'Structural impediments to African growth? New evidence from real wages in British Africa, 1880–1965', *Journal of Economic History*, 72 (2012), pp. 895–926.

Fukao, K., Ma, D., and Yuan, T., 'Real GDP in pre-war East Asia: a 1934–36 benchmark purchasing power parity comparison with the US', *Review of Income and Wealth*, 53 (2007), pp. 503–37.

Gregory, P. R., *Russian national income, 1885–1913* (Cambridge, 1982).

Halbeisen, P., Müller, M., and Veyrassat, B., *Wirtschaftsgeschichte der Schweiz im 20. Jahrhundert* (Basel, 2012).

Hopkins, K., 'Taxes and trade in the Roman Empire (200 BC–AD 400)', *Journal of Roman Studies*, 70 (1980), pp. 101–25.

Ivanov, M., 'Bulgarian national income between 1892 and 1924', Bulgarian National Bank discussion paper, 54 (2006).

Jerven, M., 'The relativity of poverty and income: how reliable are African economic statistics?', *African Affairs*, 109, 434 (2009), pp. 77–96.

Jerven, M., 'Comparing colonial and post-colonial output: challenges in estimating African economic change in the long run', Utrecht University, Centre for Global Economic History working paper ser., 10 (2011).

Kostelenos, G., Petmezas, S., Vasiliou, D., Kounaris, E., and Sfakianakis, M., 'Gross domestic product 1830–1939', in *Sources of economic history of modern Greece: quantitative data and statistical series 1830–1939* (Athens, forthcoming).

van Leeuwen, B., van Leeuwen-Li, J., and Foldvari, P., 'Was education a driver of economic development in Africa? Inequality and income in the twentieth century', Munich Personal RePEc Archive working paper, 43574 (2012).

Li, B., *Zhongguo de zaogi jindai jingji: 1820 niandai Huanting-Louxian diqu GDP yanjiu [An early modern economy in China: a study of the GDP of Huating-Lou area, 1820s]* (Beijing, 2010).

Li, B., 'An early modern economy in China: a study of the GDP of the Huating-Lou area, 1823–1829', in B. K. L. So, ed., *The economy of Lower Yangzi Delta in Late Imperial China: connecting money, markets, and institutions* (Oxford, 2013), pp. 133–46.
Li, B. and van Zanden, J. L., 'Before the great divergence? Comparing the Yangzi Delta and the Netherlands at the beginning of the nineteenth century', *Journal of Economic History*, 72 (2012), pp. 956–89.
Lo Cascio, E. and Malanima, P., 'GDP in pre-modern agrarian economies (1–1820 AD). A revision of the estimates', *Rivista di Storia Economica*, 25 (2009), pp. 391–420.
Lo Cascio, E. and Malanima, P., 'Ancient and pre-modern economies: GDP in the Roman Empire and early modern Europe', paper presented at the Conference on Quantifying Long Run Economic Development, Venice (22–4 March 2011).
McCusker, J. J., 'Colonial statistics', in S. B. Carter, S. S. Gartner, M. R. Haines, A. L. Olmstead, R. Sutch, and G. Wright, eds., *Historical statistics of the United States: earliest times to the present*, pt. E (New York, 2006), pp. 627–772.
Maddison, A., *Monitoring the world economy, 1820–1992* (Paris, 1995).
Maddison, A., *The world economy: a millennial perspective* (Paris, 2001).
Maddison, A., *The world economy: historical statistics* (Paris, 2003).
Maddison, A., *Contours of the world economy 1–2030 AD: essays in macro-economic history* (Oxford, 2007).
Malanima, P., 'The long decline of a leading economy: GDP in central and northern Italy, 1300–1911', *European Review of Economic History*, 15 (2011), pp. 169–219.
Markevich, A. and Harrison, M., 'Great War, Civil War, and recovery: Russia's national income, 1913 to 1928', *Journal of Economic History*, 71 (2011), pp. 672–703.
Milanovic, B., 'An estimate of average income and inequality in Byzantium around year 1000', *Review of Income and Wealth*, 52 (2006), pp. 449–70.
Pamuk, Ş. and Shatzmiller, M., 'Real wages and GDP per capita in the medieval Islamic Middle East in comparative perspective, 700–1500', paper presented at the 9th Conference of the European Historical Economics Society, Dublin (2–3 Sept. 2011).
Pfister, U., 'Economic growth in Germany, 1500–1850', paper presented at the Conference on Quantifying Long Run Economic Development, Venice (22–4 March 2011).
Pomeranz, K., *The great divergence: China, Europe, and the making of the modern world Economy* (Princeton, NJ, 2000).
Prados de la Escosura, L., 'Lost decades? Economic performance in post-independence Latin America', *Journal of Latin America Studies*, 41 (2009), pp. 279–307.
Prados de la Escosura, L., 'Human development in Africa: a long-run perspective', Centre for Economic Policy Research discussion paper, 8586 (2011).
Reis, J., Martins, C. A., and Costa, L. F., 'New estimates of Portugal's GDP per capita, 1500–1850', paper presented at the Conference on Quantifying Long Run Economic Development, Venice (22–4 March 2011).
Roy, T., 'Economic conditions in early modern Bengal: a contribution to the divergence debate', *Journal of Economic History*, 70 (2010), pp. 179–94.
Scheidel, W. and Friesen, S. J., 'The size of the economy and the distribution of income in the Roman Empire', *Journal of Roman Studies*, 99 (2009), pp. 61–91.
Schön, L. and Krantz, O., 'The Swedish economy in the early modern period: constructing historical national accounts', *European Review of Economic History*, 16 (2012), pp. 529–49.
Smits, J. P., Horlings, E., and van Zanden, J. L., *The measurement of gross national product and its components 1800–1913*, Groningen Growth and Development Centre Monograph ser., no. 5 (Groningen, 2000).
Sokoloff, K. L. and Engerman, S. L., 'History lessons: institutions, factor endowments, and paths of development in the new world', *Journal of Economic Perspectives*, 14 (2000), pp. 217–32.
Sugimoto, I., *Economic growth of Singapore in the twentieth century: historical GDP estimates and empirical investigations*, Economic Growth Centre Research Monograph ser., 2 (2011) http://www.worldscibooks.com/economics/7858.html (accessed on 30 Jan. 2013).
Sutch, R., 'National income and product', in S. B. Carter, S. S. Gartner, M. R. Haines, A. L. Olmstead, R. Sutch, and G. Wright, eds., *Historical statistics of the United States: earliest times to the present*, pt. C (New York, 2006), pp. 23–5.
van Zanden, J. L., 'Early modern economic growth: a survey of the European economy, 1500–1800', in M. Prak, ed., *Early modern capitalism: economic and social change in Europe, 1400–1800* (2001), pp. 67–84.
van Zanden, J. L., 'Rich and poor before the industrial revolution: a comparison between Java and the Netherlands at the beginning of the 19th century', *Explorations in Economic History*, 40 (2003), pp. 1–23.
van Zanden, J. L., *The long road to the industrial revolution: the European economy in a global perspective, 1000–1800* (Leiden, 2009).
van Zanden, J. L., 'Economic growth in Java 1815–1939: the reconstruction of the historical national accounts of a colonial economy', Maddison Project working paper, WP-3 (2012).
van Zanden, J. L. and van Leeuwen, B., 'Persistent but not consistent: the growth of national income in Holland 1347–1807', *Explorations in Economic History*, 49 (2012), pp. 119–30.
de Zwart, P., 'Labour relations in Ceylon, ca. 1650', Global Collaboratory on the History of Labour Relations, 1500–2000 (2011) collab.iisg.nl/web/labourrelations/ceylon (accessed on 16 Sept. 2013).

de Zwart, P., 'South African living standards in global perspective, 1835–1910', *Economic History of Developing Regions*, 26 (2011), pp. 49–74.

APPENDIX I: NEW WORK INCLUDED

Below we list the changes we have made to the original estimates per country. We follow the somewhat Eurocentric order of inclusion in the original Maddison dataset, starting with Europe (Austria) and ending with Africa (Zimbabwe).

All pre-1820 figures have been removed from the original dataset, and wherever possible replaced by new and better estimates. For year 1, we have included estimates for the Roman Empire based on work by Scheidel and Friesen,[65] and distinguish various regions within the Roman Empire following Maddison's original estimate.

For nearly all countries included in the Conference Board *Total Economy Database* (TED), we have replaced the original post-1990 GDP per capita estimates of Maddison with the TED estimates.[66] The only exceptions are China, Germany, and Sweden. See the country notes below for the exceptions.

Western Europe

Belgium

Pre-1820: year 1, Roman Empire.
1500–1846: estimates are taken from Buyst, 'Towards estimates of long term growth'.

France

Pre-1820: year 1, Roman Empire.

Germany

1500–1850: from Pfister, 'Economic growth in Germany'. For Germany we keep the original Maddison figures to 2008, and update to 2010 with growth figures from the Conference Board TED.

Italy

Year 1: Roman Empire.
1300 (1310)–1861: from Malanima, 'Long decline'. Data prior to 1861 refer to central-north Italy.
1861–1990: from Baffigi, 'Italian national accounts'.

Netherlands

1348–1807: from van Zanden and van Leeuwen, 'Persistent but not consistent'. Figures prior to 1807 apply to Holland only.
1807–1913: from Smits, Horlings, and van Zanden, *Measurement*.

[65] Scheidel and Friesen, 'Size of the economy'.

[66] The Conference Board *Total Economy Database*™ (TED) is a comprehensive database with annual data covering GDP, population, employment, hours, labour quality, capital services, labour productivity, and total factor productivity for about 123 countries in the world.

Sweden

1550 (1560)–1950: from Schön and Krantz, 'Swedish economy'.
1950–2010: from the Conference Board TED.

Switzerland

Year 1: Roman Empire.
1851–1948: from Historical Statistics of Switzerland Online, http://www.fsw.uzh.ch/histstat/main.php, tabs. Q.1a, Q.17a, and Q.17b. See Halbeisen, Müller, and Veyrassat, *Wirtschaftsgeschichte der Schweiz*, pp. 1173–7, 1185–214. This source provides GDP estimates only. We have divided these estimates by population from Maddison to gain GDP per capita. The authors link their own data to Maddison's 1948 level. We have done likewise and have obtained the same result.

Great Britain/UK

Year 1: Roman Empire.
1280–1870: from Broadberry et al., 'British economic growth'.
Figures before 1700 apply to England. In 1700 the England to Great Britain ratio was 1.0430. Figures from 1850 onwards apply to the UK; the Great Britain to UK ratio was 1.1665 in 1850.

Greece

Year 1: Roman Empire.
1833–1913: from Kostelenos et al.K, 'Gross domestic product'. We use both population and GDP data from this source.

Portugal

Year 1: Roman Empire.
1500–1850: from Reis et al., 'New estimates'.

Spain

Year 1: Roman Empire.
1270–1850: from Álvarez-Nogal and Prados de la Escosura, 'Rise and fall of Spain', using their annual benchmarks.

Western offshoots

US

1650–1790: from McCusker, 'Colonial statistics', p. 671.
1790–1870: from Sutch, 'National income and product'.

Eastern Europe

Bulgaria

1892–1945: from Ivanov, 'Bulgarian national income'.

Former Yugoslavia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Bosnia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Croatia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Macedonia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Slovenia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Montenegro

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Serbia

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Kosovo

1952–2008: unpublished estimates supplied to the Maddison Project in 2011 by Branko Milanovic.

Former Soviet Union

1885–1913: from Gregory, *Russian national income*.
1913–28: from Markevich and Harrison, 'Great War', tab. 6, p. 684.

Latin America

Argentina

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.
1870–1900: from Bèrtola and Ocampo, *Economic development of Latin America*.

Brazil

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.

Chile

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.

Colombia

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.
1870–1923: from Bèrtola and Ocampo, *Economic development of Latin America*.

Mexico

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.
1870–1901: from Bèrtola and Ocampo, *Economic development of Latin America*.

Peru

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.
1870–1901: from Beèrtola and Ocampo, *Economic development of Latin America*.

Uruguay

1800–70 from updated data based on Prados de la Escosura, 'Lost decades?'.

Venezuela

1800–70: from updated data based on Prados de la Escosura, 'Lost decades?'.
1870–1901: from Bèrtola and Ocampo, *Economic development of Latin America*.

Cuba

1800–1929: from updated data based on Prados de la Escosura, 'Lost decades?'.

Ecuador

1833–1938: from updated data based on Prados de la Escosura, 'Lost decades?'.
We use the growth rate between 1933 and 1938 from ibid., and link that to the 1939 level of Maddison's original estimates.

Jamaica

1850–1938: from updated data based on Prados de la Escosura, 'Lost decades?'.

Asia

China

Maddison's original estimates up to 2008.
2008–2010: growth rate from the Conference Board TED.

India

1600–1871: from Broadberry, Custodis, and Gupta, 'India and the great divergence', p. 38, tab. 14 column 2.

Indonesia/Java

1815–1880: estimates for Java from van Zanden, 'Economic growth in Java'.
1880–2008: from van der Eng, 'Sources of long-term economic growth'. Estimates are updated to include 2009–10. In 1880 the Java to Indonesia ratio was 0.8211.

Japan

730–1870 (1872): from Bassino et al., 'Japan', p. 20, tab. 6; column 2.

Singapore

1900–50: from Sugimoto, 'Economic growth of Singapore'.

South Korea

1820–1940: trend from original Maddison estimates applied to benchmark for 1934/6 from Fukao, Ma, and Yuan, 'Real GDP in pre-war East Asia'.

Taiwan

1820–1940: trend from original Maddison estimates applied to benchmark for 1934/6 from Fukao et al., 'Real GDP in pre-war East Asia'.

North Korea

Prior to 1813: estimates equal to new South Korea data (as in the original Maddison dataset).

Iran

Year 1: Roman Empire.

Iraq

Year 1: Roman Empire.
700–1500: from Pamuk and Shatzmiller, 'Real wages and GDP per capita'.

Israel

Year 1: Roman Empire.

Jordan

Year 1: Roman Empire.

Turkey (Byzantium/Ottoman Empire)

Year 1: Roman Empire.
700–1820: from Pamuk and Shatzmiller, 'Real wages and GDP per capita'; Milanovic, 'Estimate'.

Africa

Egypt

Year 1: Roman Empire.
700–1500: from Pamuk and Shatzmiller 'Real wages and GDP per capita'.

South Africa

1700(1701)–1910: from Fourie and van Zanden, 'GDP in the Dutch Cape Colony'.
Until 1910 estimates apply to Cape Colony only. In 1910 the Cape Colony to South Africa ratio was 1.3032.

APPENDIX II: BOUNDARY CHANGES

In the current Maddison Project dataset, we rely on the territorial adjustments made by Maddison,[67] except for Italy.[68] All figures refer to the 1998 boundaries, except for Germany and the UK.[69] The general approach to adjusting for boundary changes was to calculate the coefficient for the year where the break occurred and to apply that to all the preceding years.[70] Furthermore, Maddison assumed that the impact of boundary changes on GDP would be proportionately the same as that on population, except for the countries for which separate estimates of the GDP effect were available (Austria, the Czech Republic and Slovenia, Denmark, the UK, Canada, Bangladesh, Pakistan, Korea, and Israel and Gaza and the West Bank).[71]

Again, we follow the somewhat Eurocentric order of inclusion in the original Maddison dataset, starting with Europe (Austria) and ending with Africa (Zimbabwe).

Europe

Austria

Austria has experienced a large amount of territorial change. All figures refer to present-day Austria; in 1911–13, present-day Austria represented only 37.4 per cent of the Austro-Hungarian Empire.

[67] Maddison, *Monitoring the world economy*; idem, *World economy: historical statistics.*
[68] See Baffigi, 'Italian national accounts'.
[69] Maddison, *World economy: a millennial perspective*, p. 1777.
[70] Maddison, *Monitoring the world economy*, p. 229.
[71] Ibid.; idem, *World economy: historical statistics.*

Belgium

Figures are adjusted to exclude the effect of the acquisition of Eupen and Malmedy from Germany in 1925, which added 0.81 per cent to the population and (it is also assumed) to GDP.

Denmark

Figures are adjusted to offset the acquisition of North Schleswig in 1921 which added 4.5 per cent to GDP.

France

Figures are adjusted to offset the acquisition of Savoie, Haut Savoie, and part of the Alpes-Maritimes in 1861 (which raised GDP by 1.797 per cent) and the loss of Alsace and Lorraine between 1871 and 1918 (which lowered GDP by 4.25 per cent).

Germany

Territorial changes have been multiple and very complicated. From 1950 onwards, the figures refer to the 1991 boundaries. From 1918 to 1946, figures refer to Germany within its 1936 boundaries, and from 1850 to 1918 to Germany within its 1913 boundaries. For details of adjustments for boundary changes from 1500 to 1850, see Pfister, 'Economic growth in Germany', p. 4. Table A1 shows the impact of frontier changes between 1870 and 1991.

Table A1: *The impact of frontier changes on German GDP, 1870–1991*

	West Germany (1990 frontiers)	*East Germany (1990 frontiers)*	*Germany within 1991 boundaries*	*Germany within 1936 boundaries*	*Germany within 1913 boundaries excluding Alsace-Lorraine*
	GDP in millions of 1990 international dollars				
1870	44,094				71,429
1913	145,045			225,008	237,332
1936	192,911	74,652	267,563	299,753	
1950	213,942	51,412	265,354		
1973	814,786	129,969	944,755		
1990	1,182,261	82,177	1,264,438		
1991	1,242,096	85,961	1,328,057		

Source: Maddison, *World economy: a millennial perspective*, p. 178.

Italy

In 1861 Italy became a nation, and all estimates are adjusted to offset changes in geographic boundaries and refer to Italy within its present frontiers. For details, see Baffigi, 'Italian national accounts', and his forthcoming book.

UK

The 1801–31 estimates for Great Britain are adjusted to a UK basis assuming that Irish output per head in 1830 was half of that in Great Britain, and stagnant from 1800 to 1830.

Estimates between 1820 and 1920 include the whole of Ireland. Figures from 1920 onwards are increased by 3.8 per cent to offset the exclusion of output in the area that became the Irish Republic. Estimates from 1950 onwards include Northern Ireland.

Greece

In 1820 Greece became independent, and all figures are adjusted to offset the following changes: the acquisition of the Ionian Islands in 1864; of Thessaly in 1881; of Crete in 1898; of Eprius, Macedonia, Thrace, and the Aegean Islands in 1919; and of the Dodecanese in 1947.

Ireland

The figures refer to the present territory of the Irish Republic. The 1920 per capita GDP level was taken to be 54 per cent of that of the UK (excluding Southern Ireland). This proportion was assumed to be valid for 1820, 1900, and 1913.

Eastern Europe and the former USSR

Russia/former USSR

In 1991 the constituent republics of the USSR became independent. Their relative size in terms of GDP in that year is given table A2.

Table A2: *Relative size of 15 successor states of the former USSR*

Armenia	1.0%
Azerbaijan	1.8%
Belarus	3.9%
Estonia	0.8%
Georgia	1.7%
Kazakhstan	5.8%
Kyrgyzstan	0.8%
Latvia	1.3%
Lithuania	1.6%
Moldova	1.2%
Russia	58.7%
Tajikistan	0.8%
Turkmenistan	0.7%
Ukraine	15.2%
Uzbekistan	4.7%

Czechoslovakia/Czech Republic/Slovakia

In 1993 the Czech and Slovak republics became separate countries. Their respective shares of the total GDP in 1992 were as follows: 71 per cent was produced in the Czech Republic, and 29 per cent was produced in Slovakia. GDP per capita was estimated to be 15 per cent higher in the Czech Republic than in Slovakia in the late 1980s.[72]

[72] Maddison, *Monitoring the world economy*, p. 141.

Former Yugoslavia

The republican borders became the borders of the of the successor countries (Bosnia, Croatia, Macedonia, Slovenia, Montenegro, Serbia, and Kosovo) in 1992. Up until 1992 (that is, when Yugoslavia was united), the national accounts were always also expressed at the republican level.

Western offshoots

Canada

Figures are adjusted to offset the incorporation of Newfoundland in 1949, which added 1.3 per cent to GDP.

US

Figures are adjusted to offset the incorporation of Alaska and Hawaii in 1960, which added 0.294 per cent to GDP.

East Asia

India

Up to 1947, figures include Bangladesh and Pakistan. The 1947 ratio of divided to undivided India is 0.82.

Indonesia

No adjustments were made to GDP and population for the period when Irian Jaya was not part of Indonesia (1950–62) and not part of Indonesia's national accounts (1950–72), nor for the period when East Timor was part of Indonesia (1975–2001) and part of Indonesia's national accounts (1983–99). Irian Jaya was included (most probably) in 1973, when there was a revision and a change of reference year to disguise the 'Irian Jaya effect' in the national accounts. Likewise East Timor was included with the 1983 revision and change of reference year.

Japan

In 1946, Japan lost Okinawa, for which a 0.66 per cent GDP upward adjustment was made. Figures from 1952 are from the OECD. It was assumed that the official figures of the OECD were adjusted to exclude the effect of the reacquisition of Okinawa in 1973.

Korea/South Korea/North Korea

In 1945, Korea was divided into two separate countries. Their relative sizes in terms of GDP in 1940 were that 54.8 per cent of the total GDP was produced in South Korea, and 45.2 per cent was produced North Korea.

Bangladesh

In 1947, Bangladesh became independent from India and England. In 1946, 10.5 per cent of the GDP of undivided India was produced in Bangladesh.

Pakistan

In 1947, Pakistan became independent from India and England. In 1946, 6.7 per cent of the GDP of undivided India was produced in Pakistan.

Western Asia

Israel/West Bank and Gaza

From 1922 to 1947, all figures refer to the area of Mandatory Palestine.
In 1950, the share of Israeli GDP in the total was 79 per cent. The share of the West Bank and Gaza in total GDP was 21 per cent.