



The Maddison Project

Historical National Accounting

Maddison-Project Working Paper WP-12

Herman J. de Jong and Nuno Palma

June 2018

Historical National Accounting¹

Herman J. de Jong and Nuno Palma

The reconstruction of national income and production levels (per capita) over the long run is a prerequisite to testing competing hypotheses about why economies grow over the long run – or fail to do so. Economic historians have been actively building such estimates over the last few decades with considerable success. These reconstructions have already born fruit, for instance by showing that economic growth in Europe started earlier and was more gradual than previously thought, and that Europe’s divergence with respect to other parts of the world dates from the early modern period (1500-1800).

Angus Maddison was one of the first scholars to compare income and production levels across countries and over time. In particular for the period before 1950, his was the only database that provided systematic and broad cross-country information on comparative income and production levels (Maddison 1995, 2001, 2007). Since Maddison’s death in 2010, the development of the Maddison Project Database (MPD) has moved to a new generation of scholars (Bolt et al. 2018).

In this chapter we review recent developments in historical national accounting, and provide a short introduction to their methodologies. We can make a distinction between reconstructions for three periods of history. For the period after 1950, we can use official estimates of gross domestic product (GDP) made by the statistical agencies of individual countries. Between 1850 and 1950 we rely on reconstructions based on historical statistical data that are reasonably solid in most developed countries (see e.g. Feinstein (1972) for the UK). Such data include production series, price data, wages and employment. For less-developed countries we still have to rely on indirect measures based on, for example, import or export statistics of major products. For the period before 1850 more indirect methods and stronger assumptions have to be applied to arrive at plausible data, as we discuss in the second part of this chapter.

¹ Forthcoming in: *An Economist's Guide to Economic History*, edited by M. Blum and C. L. Colvin. Palgrave Macmillan. We are grateful to Chris Colvin and Diane Coyle for discussions. The usual disclaimer applies.

Post-Statistical Age Reconstructions

GDP can be defined as the sum of the values of all marketed goods and services within an economy. This measure of economic performance was developed during the 1930s (Kuznets, 1934). Because these values are expressed in prices of a certain currency and for a specific year, we need to make adjustments if we want to make comparisons of GDP between countries and across time. Central to the reconstruction of historical national accounts is therefore the measurement and comparison of proper price levels in order to get a price index for national inflation. For comparisons between countries, values of production or income need to be expressed in a common converter. We can use nominal exchange rates but these may only be representative for traded products. Prices of non-traded products are generally lower in low income countries.² As a result, differences in income levels would be substantial if the comparison were to be based on exchange rate-converted expenditure. Therefore the objective should be to estimate real GDP per capita based on a comparison of prices of traded and non-traded goods and services, so-called purchasing power parities or PPPs (Deaton and Heston 2010).

A price converter between two countries can be calculated by taking the average of two estimates, where we combine the price of a good in country A with the volume of output in country B and vice versa (Bolt et al. 2018). A similar methodology can be applied for within-country estimates of price developments where we can compare prices in year 1 with the volume of output in year 2 and vice versa. The conceptual difficulty with this procedure is that the basket of known products for which there is information on quantities and prices in a specific country or year needs to be representative of the production structure or consumption pattern of the total economy. But products and their quality change across countries and over time. Moreover, production and consumption patterns differ between countries. This potentially may lead to measurement error.

The concept of real GDP per capita refers to a series being based on a common set of prices across countries. In Maddison's work, such data were compiled by starting from a modern-day income comparison (1990) and then using growth rates of real GDP per capita from reconstructed historical national accounts to make comparisons for earlier years. An attractive feature of these data is that the change in real GDP per capita

² This is sometimes known as the Balassa-Samuelson effect, or alternatively the "Penn" effect.

over time matches the growth rate from the national accounts estimations. This internal consistency can come at the expense of distorted real GDP per capita comparisons for earlier years – standalone benchmark comparisons or independent estimates of relative income for earlier periods can diverge substantially from the backward-extrapolated time series (see for instance Ward and Devereux 2018).

While time series of GDP per capita growth from the national accounts (or reconstructions) may be considered reliable in modern times for many countries, periods like the world wars, or periods of economic instability or large price volatility, may diminish the reliability of statistics. This was illustrated by Prados de la Escosura (2000), who argued that PPPs based on extrapolations from a recent year (say 1990) led to implausible results for the years before 1950. His solution was to rely on the regularity of the price-income relationship to estimate what relative prices would have been if we had been able to observe them historically.

Another approach to this issue is to rely on historical benchmarks, that is, independent real GDP per capita benchmarks from historical studies. This methodology has also been developed in the Penn World Tables (PWT), where long-term income series are tied to relative income levels, thereby taking into account relative price changes between the different benchmark years (Feenstra et al. 2015).

The number of available historical benchmarks between and across countries has increased significantly in recent times. Various methods have been employed, making use of the output/value added approach, the income approach, and the expenditure approach. Usually, these studies compare the leading economy (US/UK) with one or more other economies (e.g., Germany, France, or Japan; see Broadberry 1998; Fukao et al. 2007). Applying the results of all known benchmark studies make it possible to re-anchor historical time series following the PWT methodology, so that the comparisons no longer depend solely on one present-day benchmark, as is the case with the original approach by Maddison.

A new combination of the multiple historical benchmarks with the long time series of per capita income from the new MPD changes the pattern compared to the original series produced by Maddison. Sometimes this is the result from the switch to a new set of relative prices, but it could also result from new estimates or updates of

national accounts statistics. Figure 1 shows GDP per capita by world region.³ It illustrates a Great Divergence period, with very low East Asian income levels until the 1950s. It also shows volatile patterns of relative improvement and relative decline, as in Western Asia in the 1980s, Eastern Europe in the 1990s and Africa in both the 1980s and 1990s.

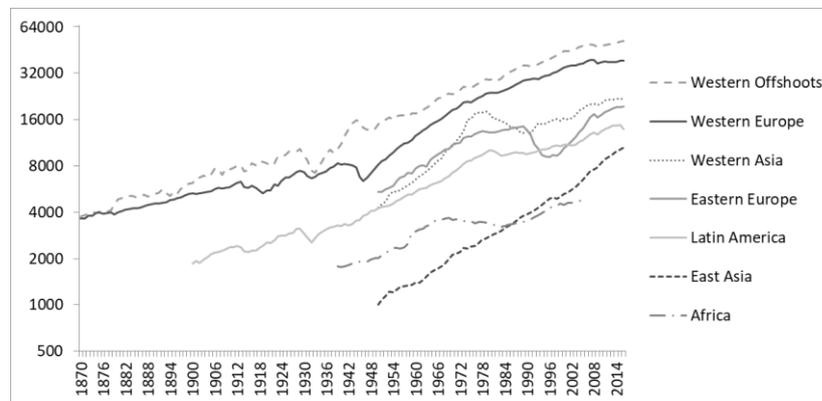


Figure 1. GDP per capita in constant 2011 USD prices (log scale of base 2). Source: Bolt et al. (2018).

Reconstructions for the Pre-Statistical Age

Recent work on the pre-statistical period is producing more time series of per capita GDP. In the literature, two methods have been used to quantify historical GDPs for this period. The first is an output-side approach, which has been used, for instance, for Britain (Broadberry et al. 2015) and the Netherlands (van Zanden and van Leeuwen 2012). These countries have a sufficient research tradition in quantitative history such that it is possible to calculate the different yearly components of output at current prices, which are then aggregated and transformed in real values by using a weighted index of prices. Proxies are used to calculate the value of services, for which less information typically survives.

For countries with a poorer track record of research in quantitative economic history, the data required to produce output-side estimates are not available. The alternative is an indirect, consumption-based method. The countries for which such estimates now exist, going back to the sixteenth century or before, include Italy, France,

³ In dividing the world into regions, we follow the usual labelling convention here, though there is no good reason why countries such as the USA or Australia are classified as Western offshoots but Argentina or Brazil are in a different category.

Spain, Portugal, and Poland.⁴ The method first produces an estimate for the agricultural product,⁵ which has been calculated in a relatively standard way across these studies. Alternative methods have been used to estimate other sectors of each of these economies, finally leading to GDP.

It is hence important to realize that the demand-side estimates are themselves the result of a model, and rely on several assumptions. Domestic consumption of agricultural products is assumed to be equal to agricultural production (the external sector can be adjusted for if necessary). This is then deflated to arrive at constant prices of a given year.

The basic input across all demand-side studies is real wages. Plenty of data exist with which to construct nominal wage series for many occupations, for both skilled and unskilled workers, and for both urban and rural occupations. A prominent source of difficulty is that historical wages are most frequently registered as day wages.⁶ This means that assumptions about work time are needed to calculate annual income or productivity statistics. Real wages are determined by dividing the nominal wage by a Consumer Price Index, usually calculated as in Table 1.⁷

This basket is based at the conditions in mid-eighteenth century Strasbourg.⁸ But relative prices changed over time, so by using a fixed basket, consumer demand is implicitly assumed to be price and income⁹ inelastic, an assumption which is only defensible on pragmatic terms, due to the data limitations that this kind of studies face.¹⁰ But across time and space, relative prices changed due to different agricultural conditions related to land quality, technology, organization, available crops, and weather. Allen (2001, p. 421) made some substitutions in the form of olive oil and wine consumed in the South of Europe instead of butter and beer in the North.¹¹

⁴ Malanima (2010), Ridolfi (2016), Álvarez-Nogal and Prados de la Escosura (2013), Palma and Reis (2019), Malinowski and van Zanden (2016).

⁵ Deaton and Muellbauer (1980), Crafts (1984), Wrigley (1985), Allen (2000).

⁶ See, however, Humphries and Weisdorf (2015).

⁷ A more restrictive, “barebones” basket is considered by Allen et al. (2012).

⁸ Strasbourg was chosen by Allen (2000) for reasons of convenience due to data availability. Allen (2017) improves on this basic methodology by allowing food baskets to vary with respect to local conditions in modern developing nations.

⁹ There is no response as suggested by Engel’s law. With more income people are here simply assumed to buy more baskets under the same proportions and excluding luxuries not included.

¹⁰ Also, no housing costs are considered (Allen 2001, p. 422).

¹¹ As is the case for modern economies, it is hard to control for quality changes and the appearance of new goods, many of which appeared for the first time in Europe in the early modern period, including maize, potatoes, and tomatoes. Some studies have made adjustments to local and time-specific consumption patterns to mitigate for these problems (Palma and Reis 2019).

Once an index for real wages is obtained, a short-cut method is applied to arrive at an estimate for agricultural production (see, for instance, Palma and Reis 2019 for details). The next step aims to arrive from this measure of agricultural product to an index for GDP. Two alternative methodologies have been used. The first uses an intersectorial productivity gap calculated at a moment T, when it is known. Year T should take place before modern economic growth with significant structural transformation and changes in relative prices took place. This is then assumed to be a constant which can be extrapolated back in time, and combined with the relative share of labor and land income at any point in time in order to calculate per capita GDP for previous periods (Palma and Reis 2019). A second methodology consists of a regression which uses as a main input the size of the urban sector (Malanima 2012; Álvarez-Nogal and Prados de la Escosura 2013). With these real volume indices at hand, real GDP per capita levels for any given year can be obtained by going backwards from the first available solid benchmark at constant prices (e.g. 1850 or even 1820).¹²

Table 1. Respectability CPI Basket

	Quantity per person per year	Spending share (%)	Calories per day	Grams of protein
Bread	182kg	30.4	1223	50
Beans/peas	52 liter	6.0	160	10
Meat	26kg	13.9	178	14
Butter	5.2kg	4.3	104	0
Cheese	5.2kg	3.6	53	3
Eggs	52 units	1.3	11	1
Beer	182 liters	20.6	212	2
Soap	2.6kg	1.8	-	-
Linen	5m	5.3	-	-
Candles	2.6kg	3.1	-	-
Lamp oil	2.6 liter	4.7	-	-
Fuel	5.0 millions of BTU	5.0	-	-
Total		100	1941	80

Source: Allen (2001, p. 421).

¹² An important alternative method to arrive to PPPs to the Geary-Khamis 1990 “international” dollars method just described is the short-cut method proposed by Prados de la Escosura (2000).

Concluding Thoughts

Having good data on long-term development and economic performance at the level of national or regional economies is a prerequisite for theoretical and empirical growth studies and for convergence analysis. Nonetheless, the concept of GDP has limitations. One problem relates to the appearance of new products, and the quality adjustments to existing products, which may not be fully reflected in the estimated price levels.¹³ Another limitation is that non-market services – especially government services – are difficult to measure.¹⁴ Finally, GDP relates to an economy's productive, income-generating capacity for a given year. There may be a relationship with the standard of living in a country or with the wellbeing of its population, but it is not the same concept, because GDP excludes the non-monetary dimensions of wellbeing. It also does not consider matters related to the distribution of income. Hence, GDP per capita is a measure that can diverge from more specific measures of living standards of consumers and workers, or more comprehensive measures of welfare, that account for differences in health, leisure and inequality. However, an important benefit of GDP per capita is that it can be used not only as an indicator of living standards, but also as the basis for productivity comparisons, which have the potential to shed light on the sources of income differences across countries.

References

- Allen, R. C. (2017). Absolute poverty: When necessity displaces desire. *American Economic Review*, 107(12), 3690-3721.
- Allen, R. C., Murphy, T. E., and Schneider, E. B. (2012). The colonial origins of the divergence in the Americas: a labor market approach. *Journal of Economic History*, 72(4), 863-894.
- Abidrahman, Mo., Diane Coyle, Richard Heys and Will Stewart (2017). A Comparison of Approaches to Deflating Telecoms Services Output. *ESCoE Discussion Paper 2017-04*

¹³ For three recent papers which tackle some of these problems, see Aghion et al. (2017), Abidrahman et al. (2017), and Coyle (2018).

¹⁴ This is a problem that exists with not only historical but also modern national accounts, and is perhaps worse for modern economies give the much larger size of their public sector. Strong assumptions to estimate value are typically made using cost data.

- Aghion, Philippe, Antonin Bergeaud, Timo Boppart, Peter J. Klenow, Huiyu Li (2017). Missing Growth from Creative Destruction. *Federal Reserve Bank of San Francisco Working Paper 2017-04*
- Allen, R. C. (2000). Economic structure and agricultural productivity in Europe, 1300–1800. *European Review of Economic History* 4(1), 1-25.
- Allen, R. C. (2001). The great divergence in European wages and prices from the Middle Ages to the First World War. *Explorations in Economic History* 38(4), 411-447.
- Álvarez-Nogal, C., and De La Escosura, L. P. (2013). The rise and fall of Spain (1270–1850). *The Economic History Review* 66(1), 1-37.
- Bolt, J., Inklaar, R., and de Jong, H. (2018). Rebasings Maddison: Relative Prices and the Shape of Long-Run Global Development. (GGDC Research Memorandum, vol.: GD-174. Groningen; Groningen Growth and Development Centre.
- Broadberry, S.N. (1998), How did the United States and Germany overtake Britain? A sectoral analysis of comparative productivity levels, 1870-1990. *Journal of Economic History* 58 (2): 375-407.
- Broadberry, S., Campbell, B. M., Klein, A., Overton, M., and Van Leeuwen, B. (2015). *British Economic Growth, 1270–1870*. Cambridge University Press
- Coyle, D. (2018). Do-it-yourself Digital: the Production Boundary, the Productivity Puzzle and Economic Welfare. *Economica*, forthcoming
- Crafts, N. F. (1984). Patterns of development in nineteenth century Europe. *Oxford Economic Papers*, 36(3), 438-458.
- Deaton, A., and Muellbauer, J. (1980). An almost ideal demand system. *The American Economic Review* 70 (3): 312-326.
- Deaton, A., and Heston, A. (2010). Understanding PPPs and PPP-based National Accounts. *American Economic Journal: Macroeconomics* 2: 1-35.
- Feenstra, R.C., R. Inklaar and M.P. Timmer (2015), The Next Generation of the Penn World Table. *American Economic Review* 105 (10): 3150-82.
- Feinstein, Ch. (1972). *National income, expenditure and output for the United Kingdom, 1855-1965*. Cambridge University Press, Cambridge.
- Fukao, K., D. Ma, and T. Yuan (2007). Real GDP in pre-war East Asia: a 1934-36 benchmark purchasing power parity comparison with the US. *Review of Income and Wealth* 53 (3): 503-537.

- Kuznets, S. (1934). *National Income 1929-1932*. National Bureau of Economic Research, New York.
- Maddison, A. (1995), *Monitoring the World Economy 1820–1992*. Paris: Organisation for Economic Cooperation and Development.
- Maddison, A. (2001), *The World Economy: a Millennial Perspective* Paris: Organisation for Economic Cooperation and Development.
- Maddison, A. (2007), *Contours of the World Economy, 1-2030 AD*. Oxford University Press.
- Malanima, P. (2011). The long decline of a leading economy: GDP in central and northern Italy, 1300–1913. *European Review of Economic History* 15(2), 169-219.
- Malinowski, M., and van Zanden, J. L. (2017). Income and its distribution in preindustrial Poland. *Cliometrica*, 11(3), 375-404.
- Palma, N., and Reis, J. (2019). From convergence to divergence: Portuguese economic growth, 1527-1850. Forthcoming, *Journal of Economic History*
- Prados de la Escosura, L. (2000). International comparisons of real product, 1820–1990: an alternative data set. *Explorations in Economic History* 37(1), 1-41.
- Ridolfi, Leonardo (2016). “The French Economy in the Longue Durée. A Study on Real Wages, Working Days and Economic Performance from Louis IX to the Revolution (1250-1789).” Ph. D. diss., IMT School for Advanced Studies Lucca
- Van Zanden, J. L., and Van Leeuwen, B. (2012). Persistent but not consistent: The growth of national income in Holland 1347–1807. *Explorations in Economic History* 49(2), 119-130
- Ward, M. and J. Devereux (2018). Prices and Quantities in Historical Income Comparisons – New Income Comparisons for the late Nineteenth and Early Twentieth Century. *Maddison-Project Working Paper WP-9*
- Wrigley, E. A. (1985). Urban Growth and Agricultural Change: England and the Continent in the Early Modern Period in *Population and Economy: From the Traditional to the Modern World*. *Journal of Interdisciplinary History* Cambridge, Mass., 15(4), 683-728.