

INDIA AND THE GREAT DIVERGENCE: AN ANGLO-INDIAN COMPARISON OF GDP PER CAPITA, 1600-1871

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Abstract: This paper provides estimates of Indian GDP constructed from the output side for the pre-1871 period, and combines them with population estimates to track changes in living standards. Indian per capita GDP declined steadily during the seventeenth and eighteenth centuries before stabilising during the nineteenth century. As British living standards increased from the mid-seventeenth century, India fell increasingly behind. Whereas in 1600, Indian per capita GDP was over 60 per cent of the British level, by 1871 it had fallen to less than 15 per cent. As well as placing the origins of the Great Divergence firmly in the early modern period, the estimates suggest a relatively prosperous India at the height of the Mughal Empire, with living standards well above bare bones subsistence.

JEL classification: N10, N30, N35, O10, O57

Key words: Indian GDP, comparison, Britain

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I. INTRODUCTION

Recently, there has been much progress in reconstructing the historical national accounts of a number of European countries during the early modern and even the late medieval periods (Blomme and van der Wee, 1994; Malanima, 2011; Krantz, 2004; Álvarez-Nogal and Prados de la Escosura, 2007; Broadberry, Campbell, Klein, Oveeton and van Leeuwen, 2011; van Zanden and van Leeuwen, 2011). This paper applies similar methods to Asia, providing estimates of Indian GDP for the period before 1871. There is a strong need for estimates of Indian GDP during the early colonial period, to assess the strong revisionist claims about Indian economic performance made recently in the context of the Great Divergence debate. Parthasarathi (1998) has made the most striking claims for south India during the eighteenth century, arguing that living standards were just as high as in Britain, while Bayly (1983) has painted a picture of a thriving north Indian economy during the eighteenth century.

This paper presents estimates of GDP constructed from the output side for the pre-1871 period, and combines them with population data. We find that Indian per capita GDP declined steadily during the seventeenth and eighteenth centuries before stabilising during the nineteenth century. As British living standards increased from the mid-seventeenth century, India fell increasingly behind. Whereas in 1600, Indian per capita GDP was over 60 per cent of the British level, by 1871 it had fallen to less than 15 per cent. These estimates support the claims of Broadberry and Gupta (2006), based on wage and price data, that the Great Divergence had already begun during the early modern period. They are also consistent with a relatively prosperous India at the height of the Mughal Empire, although much of this prosperity had disappeared by the

eighteenth century. Projecting back from Maddison's (2003) widely accepted estimates of GDP per capita for the late nineteenth century in 1990 international dollars, we arrive at a per capita income in 1600 of \$682, well above the bare bones subsistence level of \$400, or a little over a dollar a day. This is more in line with the recent revisionist work on Europe, which suggests that Maddison (2003) has substantially underestimated living standards in the pre-modern world (Broadberry, Campbell, Klein, Overton and van Leeuwen, 2011).

The paper proceeds as follows. We begin in Section II with a brief survey of the existing literature on India's long run economic performance. This is followed in Section III by an overview of methods, drawing on previous work reconstructing national income in Britain and Europe before 1800. Section IV then applies those methods to India, describing the procedures for estimating output in agriculture, industry and services, before aggregating the sectoral outputs into real GDP for India during the period 1600-1871. In Section V, these GDP estimates are then combined with data on population to derive estimates of Indian GDP per capita, and used to compare living standards in India and Britain. A new benchmark estimate of comparative GDP per capita in 1600 is also constructed, and used as a cross-check on the time series projections from the 1871 benchmark. Section V concludes.

III. INDIA'S LONG RUN ECONOMIC PERFORMANCE

India's economic performance since the late sixteenth century has been the subject of enduring controversy. The travelogues of Europeans to India in the sixteenth and seventeenth centuries often described great wealth and opulence, but it is not difficult to see this as reflecting their contact with the ruling classes, who enjoyed a luxurious

lifestyle with consumption of high quality food, clothing and ornaments, as well as imported luxury products. The middle class merchants and rich peasants that European travellers most frequently came into contact with also enjoyed a comfortable life-style. However, most travel accounts of Mughal India and the Deccan also noted that the majority of Indians lived in poverty (Chandra, 1982; Fukazawa, 1982). The labouring classes were seen as living in mud huts with thatched roofs, eating inferior grains, wearing rudimentary clothing and the use of footwear was relatively unknown (Moreland, 1923: 197-203). While cultural and climatic conditions may explain some of the consumption differences between India and Europe, most writers were in little doubt that the average Indian lived in poverty.

Furthermore, there is a substantial literature which attempts to chart trends in Indian living standards over time, starting from 1595. The reign of Akbar is usually seen as the peak of economic well being, and is well documented in Abū 'l-Fazl's [1595] *Ā' īn-i-Akbarī*, which meticulously reported wages and prices in the region of Agra. This has provided a reference point for real wage comparisons with later years. Desai (1972) made the striking claim that at best, the average standard of living in 1961 was no higher than in 1595, when although a labourer could afford less industrial goods such as clothing, he could buy more food, with the changing relative prices reflecting the changing productivity trends in agriculture and industry. The paper provoked some controversy over the details of the calculations (Heston, 1977; Moosvi, 1977; Desai, 1978). Nevertheless, most writers seem to accept the idea of a downward real wage trend during the seventeenth and eighteenth centuries before recovery during the twentieth century, a pattern first suggested by Mukerjee (1967).

This view of Mughal India as a relatively backward economy has been challenged recently by the work of revisionist economic historians, whose work must be assessed within the wider context of changing views on the Great Divergence of living standards between Asia and Europe. Parthasarathi's (1998) characterisation of south Indian real wages as on a par with English real wages in during the eighteenth century is strikingly at variance with the older literature, but fits well with the claims of Pomeranz (2000), Frank (1998) and other global historians that the most developed parts of Asia were on the same development level as the most developed parts of Europe such as Britain and the Netherlands as late as 1800. Bayly (1983) has painted a picture of a thriving market economy in north India during the eighteenth century, which leaves a similar impression.

Broadberry and Gupta (2006) compare silver and grain wages in Britain with those in India and China during the seventeenth and eighteenth centuries, which casts doubt on the revisionist position, suggesting that the Great Divergence was already under way during the early modern period. However, a full assessment, encompassing the ruling elites and middle classes as well as the labouring classes requires the reconstruction of national income in European and Asian countries. This paper makes a start on that process by deriving estimates of GDP and population in India between 1600 and 1870, and comparing GDP per capita between India and Britain. This is the first time series of national income estimates for India before the mid-nineteenth century, which can be seen as joining up with Heston's (1983) estimates for the period after 1870. Our comparative results are also broadly consistent with Roy's (2010a) point estimates of GDP per capita in Bengal and Britain around 1800.

III. AN OVERVIEW OF METHODS

The first phase of historical national accounting focused on reconstructing national income for a small number of relatively rich countries in Western Europe and North America, and starting around 1870, at the beginning of the modern statistical age (Kuznets, 1946; Clark, 1957; Maddison, 1982). A natural development was the application of this approach to other parts of the globe, and many non-western countries now have historical national accounts reaching back to around 1870 (Maddison, 1995). For the period before 1870, there has now been a substantial period of experimentation, beginning with the study of British economic growth back to 1688 by Deane and Cole (1967).

Deane and Cole's (1967) study was remarkable for the way in which the authors made efficient use of the limited range of processed data series that were available at the time. Subsequent research by many authors has dramatically extended the range of data now available, with the revised estimates of Crafts and Harley (1992) proving an important staging post. Broadberry, Campbell, Klein, Overton and van Leeuwen (2011) have now succeeded in producing annual estimates of GDP for Britain over the period 1270-1870.

Deane and Cole's (1967) approach now seems remarkably simple in the light of the vast amount of subsequent research. Nevertheless, its simplicity and modest demands on data makes it particularly suitable as a starting point for Asian historical national accounting in the period before the wide availability of official statistics at a national level. We focus here on Deane and Cole's (1967) method for the eighteenth century, where they constructed an index of total real output, based on industry,

agriculture and services. The sector that was most firmly grounded in the data was industry. For the export industries, such as cotton, output was assumed to grow in line with exports, for which abundant data were available. For home industry, production was assumed to move in line with the physical quantities of output of leather, beer, candles and soap. Finally, since Deane and Cole had no independent data on commerce, the index of industrial output was assumed to apply also to the commercial sector. It is not much of an exaggeration, therefore, to say that the whole of the industrial and commercial sector was dependent on the export data.

For agriculture and services, by contrast, the key data series was population. For agriculture, an index of production was derived by assuming that agricultural demand grew in line with population, which amounted to assuming constant per capita corn consumption. An adjustment was then made for known imports and exports of grain, to convert demand to domestic production. For services, even in modern national accounts it is not uncommon to assume that real output moves in line with employment. Since for the eighteenth century Deane and Cole had only fragmentary evidence on employment, they assumed that service output grew in line with population. For the government sector, however, it was possible to obtain direct estimates of output from government budget sources. Finally, the individual series were combined into an index of GDP using weights for agriculture, industry and services derived from Gregory King's [1696] social tables.

It should by now be clear that Deane and Cole's (1967) estimates of British GDP in the eighteenth century are overwhelmingly dependent on the path of population and exports, with a minor role for government expenditure and a restricted

set of volume indicators for home industry. It would not be difficult to assemble a similar data set for India between 1600 and 1871, and that is what we proceed to do in the next section. However, we will not stop there, because work conducted since Deane and Cole's (1967) study suggests a number of ways of improving upon this approach, and again in ways which can be replicated with the data available for India.

First, subsequent work on the agricultural sector has allowed for a more sophisticated treatment of demand. Crafts (1976) criticised Deane and Cole's assumption of constant per capita corn consumption while real incomes were rising and the relative price of corn was changing, and Crafts (1985) recalculated the path of agricultural output in Britain with income and price elasticities derived from the experience of later developing countries. The approach was developed further by Allen (2000) using consumer theory. Allen (2000: 13-14) starts with the identity:

$$Q^A = rcN \quad (1)$$

where Q^A is real agricultural output, r is the ratio of production to consumption, c is consumption per head and N is population. Real agricultural consumption per head is assumed to be a function of its own price in real terms (P^A/P), the price of non-agricultural goods and services in real terms (P^{NA}/P), and real income per head (y).

Assuming a log-linear specification, we have:

$$\ln c = \alpha_0 + \alpha_1 \ln(P^A / P) + \alpha_2 \ln(P^{NA} / P) + \beta \ln y \quad (2)$$

where α_1 and α_2 are the own-price and cross-price elasticities of demand, β is the income elasticity of demand and α_0 is a constant. Consumer theory requires that the own-price, cross-price and income elasticities should sum to zero, which sets tight constraints on the plausible values, particularly given the accumulated evidence on elasticities in developing countries (Deaton and Muellbauer, 1980: 15-16, 60-82).

For early modern Europe, Allen (2000: 14) works with an own-price elasticity of -0.6 and a cross-price elasticity of 0.1, which constrains the income elasticity to be 0.5. Allen also assumes that agricultural consumption is equal to agricultural production. For the case of India, where more limited information is available, we implement a more limited version using the grain wage (the daily wage divided by the price of grain) and an assumed income elasticity of 0.4.¹

Second, a number of authors have used the share of the population living in towns as a measure of the growth of the non-agricultural sector. This approach began with Wrigley (1985), and has recently been combined with the demand approach to agriculture to provide indirect estimates of GDP in a number of European countries during the early modern period (Malanima, 2011; Álvarez-Nogal and Prados de la Escosura, 2007; Pfister, 2008). With the path of agricultural output (q_a) derived using equations (1) and (2), overall output (q) is derived as:

$$q = \frac{q_a}{1 - (q_{na}/q)} \quad (3)$$

where the share of non-agricultural output in total output (q_{na}/q) is proxied by the urbanisation rate. The approach can be made less crude by adjusting the urbanisation rate to deal with rural industry or agricultural workers living in towns.

IV. ESTIMATING INDIAN NATIONAL INCOME

¹ One way to justify this would be if the cross-price elasticity is zero and real income is the wage divided by the overall price level. The own-price elasticity must then equal the negative of the real wage elasticity. But then the overall price level used to deflate the wage cancels out with the overall price level used to deflate the grain price, leaving a single term in the grain wage. The slightly lower income elasticity of 0.4 is consistent with estimates for staple grains in poor societies (Bouis, 1994).

In this section we derive estimates of Indian GDP by sector, following the basic approach of Deane and Cole (1967), but incorporating demand effects into agriculture and urbanisation effects into services.

1. Population

The first full census of India was conducted non-synchronously between 1867 and 1872, but is usually presented as the first decennial census for 1871. This provides the starting point of our population estimates in Table 1. For the period 1801-1871, we use the decadal estimates of Mahalanobis and Bhattacharya (1976), who assembled information collected by the British for the three Presidencies of Bengal, Madras and Bombay, and supplemented this with assumptions about the rate of population growth in the non-enumerated regions. For earlier years, we have drawn on the estimates collected together by Visaria and Visaria (1983: 466), based on a 50-year frequency. We use the Bhattacharya estimates for 1751-1801, the mean Datta estimates to link 1600 and 1750, the Wilcox estimates to link 1600 with 1650, and log-linear interpolation for 1700.

Given the hybrid nature of the series projected back from the 1871 benchmark, it is worth noting that Habib (1982a: 164-166) provides a useful cross-check for the absolute population level in 1600, on the basis of three alternative methods of estimation. One approach, based on the cultivated area, yields an estimate of 142 million, while an alternative approach based on land revenue suggests a population of 144.3 million. A third method, based on the size of armies, suggests a population of 140 to 150 million. All three estimates are broadly consistent with our population figure of 142 million in 1600.

Indian population grew at an annual rate of 0.22 per cent over the whole period 1600-1871. However, growth was faster in the nineteenth century than during the seventeenth and eighteenth centuries. The effect of famines is easier to identify in the nineteenth century because of the higher frequency of observations, but crises were equally prevalent in the seventeenth and eighteenth centuries.

2. Agricultural output

Rather than following Deane and Cole's (1967) assumption of constant per capita grain consumption, we estimate agricultural consumption using a demand function which allows consumers to respond to wage and price changes. However, this demand-based approach is then cross-checked against the long run increase in output between 1600 and 1910, drawing on well-established estimates of the acreage and yields of the main crops.

The implementation of the demand approach requires data on wages and prices as well as the population estimates from Table 1. Table 2 sets out an index of wages for unskilled labourers in India, together with indices of grain and cloth prices. The wage and grain price series are derived from Broadberry and Gupta (2006) for the seventeenth and eighteenth centuries, supplemented by additional information for the nineteenth century from Mukerjee (1967), and provide the most widely used index of real wages in India, the grain wage. Although the precise magnitude of the fall in the grain wage from its high level in the early seventeenth century is a matter of controversy, most scholars have acknowledged the downward trend (Desai, 1972; 1978; Moosvi, 1973; 1977; Heston, 1977). Furthermore, it is interesting to note that

the scale of the Indian grain wage decline is similar to that suggested by van Zanden (1999) and Allen (2001) for early modern southern and eastern Europe, where a long period of decline steadily eroded the post-Black Death doubling of real wages.

The cloth price series are derived from the records of the East India Company for the period before 1833 and from Parliamentary Papers for subsequent years (Chaudhuri, 1978; Bowen, 2007; Twomey, 1983; Sandberg, 1974). Note that the cloth wage declined by less than the grain wage during the seventeenth and eighteenth centuries and increased substantially during the nineteenth century as the price of cloth declined relative to the price of grain. As a result, the real consumption wage declined by much less than the grain wage, which has often been taken as an easily available index of living standards. Our real consumption wage is a weighted average of the grain wage and the cloth wage, with a weight of two-thirds given to former, consistent with budget studies for India during this period (Allen, 2009).

An index of agricultural production for the domestic market is provided in Table 3A, derived from the grain wage with the income elasticity of demand set at 0.4. The growth of demand caused by population expansion was tempered by the declining grain wage, so that total agricultural consumption increased more slowly than population. This is consistent with a Malthusian picture of diminishing returns to food production.

Turning to the impact of foreign trade, however, we see that the diminishing returns to food production were offset in the nineteenth century by the expansion of non-food agricultural crops. Table 3b provides an index of agricultural exports,

derived by obtaining the value of total exports in current prices and the share of agricultural crops from Chaudhuri (1983), and deflating the resulting series of agricultural exports in current prices by the agricultural price index from Mukerjee (1967). For the seventeenth and eighteenth centuries, we have assumed that agricultural exports grew in line with domestic agricultural production. Weights for the export and domestic components of agricultural production in 1871 are obtained by projecting the share of exports in total production in 1901 back in time. Although the share of exports in total agricultural production in 1871 was only around 10 per cent, agricultural exports nevertheless had a significant impact on the path of total agricultural production in the nineteenth century, as exports of crops such as raw cotton, opium and indigo offset the diminishing returns in food production. As we shall see in the next section, the export of these non-food crops also offset a substantial decline in exports of cotton piece goods, as India's comparative advantage shifted away from manufactures.

For the case of India, it is not possible to estimate directly an output based series for agriculture such as that provided by Broadberry *et al.* (2011) for Britain, or Bassino *et al.* (2012) for Japan. However, it is possible to reconstruct the acreage and yields of all the main crops in 1600 and 1910, to cross-check the long run increase in output. First, note that in the demand-based approach of Table 3, agricultural output increased between 1600 and 1871 from 67.8 to 100.0, or by a factor of 1.475 . This can then be extended to 1910 using the agricultural output series from Heston (1983), as in Broadberry and Gupta (2010), which increased by a factor of 1.51. This implies an increase of agricultural output between 1600 and 1910 by a factor of 2.23. This can

be compared with the increase in output derived from data on the cultivated acreage and the yields of the main crops in 1600 and 1910.

In Table 4A, the cultivated area from Moosvi (1987) has been presented in terms of acres, converted from the original data in bigha. The calculations are based on Moosvi's careful reconstruction of the acreage in 1600 and 1910 for the United Provinces, the agricultural heartland of the Mughal Empire. Moosvi demonstrates an increase in the acreage of 89 per cent between 1600 and 1910. Table 4B provides data on the yields of the ten main crops, taken largely from Moosvi (1987: 80) for 1600 and Department of revenue and Agriculture (1912) for 1910. In addition, data on rice yields for 1600 are taken from Abū 'l-Fazl [1595], while cotton yields are taken from Moosvi (1987: 82) and refer to 1545-1595 and the 1870s, as the figures for 1910 from Department of Revenue and Agriculture (1912) are available only for cleaned cotton. The increase in yields between 1600 and 1910 was relatively modest, at 16 per cent taking an unweighted average. Using data on the distribution of crops in 1910 produces a weighted average increase in yields of just 8 per cent. Table 4C derives the increase in output as the product of the increase in acreage and the weighted increase in yields, which suggest an approximate doubling of output. This increase in output by a factor of 2.04 is within 10 per cent of the increase by a factor of 2.23 obtained using the demand approach. The calculation is restricted to the geographical area of the United Provinces, but the agreement between the two approaches is reassuring.

3. Industrial Output

Table 5 sets out the data for estimating the output of industry oriented towards the home market. As with agriculture, we have used a demand function approach, which

can be cross-checked against other estimates of per capita cloth consumption available for the nineteenth century. We have allowed cloth consumption per capita to move in line with the cloth wage from Table 2 and an assumed income elasticity of demand of 0.5. The absolute level of cloth consumption per capita in the base year of 1871 has been set at 8.2 square yards from Roy (2011b). Roy also provides estimates of cloth consumption per capita for a number of other years, and our figure of 0.5 for the income elasticity of demand has been chosen to be consistent with these estimates.² We find per capita consumption of cloth fell between 1600 and 1811 as wages failed to keep up with rising cloth prices. However, after 1811 the price of cloth fell sharply while money wages continued to increase. Per capita cloth consumption then increased with the rising cloth wage.

Nevertheless, domestic production did not move simply in line with consumption after 1801 because of the growing penetration of the Indian home market by imports from Britain, shown in Table 5B. In line with Roy (2011b), we find that the growing import penetration was consistent with a slight upward trend in domestic production for the home market, because of population growth. This provides quantitative support for the interpretation offered by Morris (1968) that colonialism did not lead to an absolute decline of the traditional Indian cotton textile sector.

However, before we can address fully the issue of deindustrialisation, we need to quantify developments in the export section of Indian industry. Table 6 and Figure

² Roy (2011b) reports figures of 8.0 square yards for 1860, 5.7 square yards for 1840, 5.1 square yards for 1820 and 5.2 to 6.7 square yards for 1795.

1 provide data on Indian textile exports to Britain for the period 1665-1834 from Chaudhuri (1978) and Bowen (2007). Although we lack data for Indian exports to other countries, it is possible to make an allowance for the growing share of Britain as an export destination using data on regional shares of bullion inflows to India from Haider (1996: 323), since the purchase of Indian textiles was financed largely with silver. The data in Figure 1 capture the healthy state of the Indian cotton textile export industry during the seventeenth and eighteenth centuries. After 1801, however, the industry went into decline, particularly with the growing British competition after the end of the Napoleonic Wars (Broadberry and Gupta, 2009). Table 7 charts the continued decline of the Indian textile export industry until the establishment of a modern factory based industry in Bombay during the 1850s (Morris, 1983: 572-583; Farnie, 2004: 400-405). The current price data for the period 1851-1871 have been converted to constant prices using an index of imported cotton cloth prices from Sandberg (1974: 260), which tracks well the price of domestically produced cloth for overlapping years from Mitra (1978: 207). During this period, the price of cloth rose by just 6.3 per cent, so the deflation makes only a small difference to the nominal data.

Returning to the issue of deindustrialisation, we have to balance a sharp absolute decline in export industry against a small upward trend in domestic industry. Despite the relatively small weight of the export section by 1871, the scale of the decline was so catastrophic that the net effect was an absolute decline in Indian industrial production in the first three decades of the nineteenth century, rather than just a reduction in the share of industry in economic activity, consistent with Clingingsmith and Williamson's (2008) definition of strong rather than weak

deindustrialisation. Nevertheless, the scale of Indian deindustrialisation shown here is in line with that suggested by Twomey (1983) rather than the more catastrophic domestic industrial collapse claimed by Bagchi (1976) on the basis of evidence from the state of Bihar.

4. The service sector

For domestic services and housing, Deane and Cole (1967) assumed growth in line with population. However, recent work on the long run development of the European economy suggests that service sector growth moves more closely in line with the urban population (Broadberry, Campbell, Klein, Overton and van Leeuwen, 2011). Estimates of the urban share of the population in India are presented in Table 8 for benchmark years, suggesting a decline in the share of the population living in cities of more than 5,000 inhabitants. Multiplying the population by the urban share, with interpolation between benchmark years, yields an estimate of the urban population, which remained fairly stable despite the growing total population.

For government services, Deane and Cole (1967) used current expenditure on government services from the budgetary accounts deflated by a price index. In the case of India, we can only measure the size of the government sector from the revenue side, but it is reasonable to assume that government expenditure moved broadly in line with revenue at least over the periods of time between the observations considered here (half centuries during the Mughal period and decades during the British period). Current price revenues are assembled from the sources listed in the notes to Table 9 and deflated using the weighted average of the grain price and cloth price indices presented in Table 2. Since the territory from which the revenue was

collected varies, we have converted the revenues to a constant territorial basis by using real revenue per square mile as our indicator of the size of the government sector. Real government revenue per square mile in Table 9 fell as the Mughal Empire declined before increasing again under British rule during the nineteenth century, but surpassing the peak revenue (at the time of Akbar) only during the mid-nineteenth century. Note that the revenue per square mile was at its low point in the mid-eighteenth century whether viewed from the declining Mughal or the rising British perspective.

5. Sectoral shares

To aggregate the time series for output in each of the major sectors into a total real output index, we require value added weights. The earliest sectoral value added weights for India are for 1900/01 from the work of Sivasubramonian (2000). However, these can be projected back to circa 1871 using changes in employment structure, following the procedure used by Hoffmann (1965: 389) for Germany. Essentially, this involves assuming that the sectoral distribution of value added per employee in 1900/01 acts as a good indicator of the sectoral distribution of value added per employee in 1871.

The sectoral weights for India circa 1871 are set out in Table 10. The largest sector was agriculture, and industry was largely geared towards the domestic market. Commerce accounted for 5.5 per cent of GDP, but is combined here with industry. Government, domestic services and housing together accounted for the remaining 10.3 per cent of GDP.

6. Total real output

Table 11 sets out the time series for all the major sectors and the aggregate output or gross domestic product (GDP) index obtained using the 1871 sectoral weights from Table 10. Industry and commerce grew rapidly between 1650 and 1801, driven particularly by exports. Agriculture also expanded, but less rapidly. Since agriculture was the largest sector, the growth of total output was also quite modest before 1801. Total output stagnated between 1801 and 1841 as modest agricultural growth was offset by deindustrialisation. There was a return to modest total output growth between 1841 and 1871 as industrial growth returned and agricultural growth accelerated.

V. PER CAPITA GDP

1. Time series projections

The GDP series from Table 11 can be combined with the population data from Table 1 to establish in Table 12 the path of GDP per capita in India. Per capita GDP declined during the seventeenth and eighteenth centuries before stabilising during the nineteenth century. Table 13 puts India's per capita GDP performance in an international comparative perspective. Benchmarking on the comparative India/GB per capita GDP level for 1871 from Broadberry and Gupta (2010), we see that India's comparative position deteriorated from a GDP per capita of more than 60 per cent of the British level in 1600 to just 14.5 per cent by 1871. The relative decline occurred fairly steadily throughout the period.

Table 14 converts the GDP per capita information in index number form from Table 13 into absolute levels of 1990 international dollars, as has become standard

since the work of Maddison (1995). This enables us to gauge how far above bare bones subsistence India was. The World Bank's "dollar-a-day" definition of poverty suggests a per capita income level of around \$400 as a minimum, and Maddison (1995) finds a number of third world countries at this level in the modern world. Note, however, that Mughal India was well above this level. Although some decline had occurred by the mid-eighteenth century, it was only during the early nineteenth century that Indian per capita incomes fell close to bare bones subsistence.

Tables 13 and 14 have important implications for the debate over the Great Divergence. First, Parthasarathi (1998) uses a comparative real wage study of Britain and India to support the "California School" view that living standards in the most developed parts of Asia were on a par with the most developed parts of Europe as late as the end of the eighteenth century (Frank, 1998; Pomeranz, 2000). The evidence presented in Table 13, however, suggests that Indian living standards were already substantially below the British level during the seventeenth century. This supports the view of Broadberry and Gupta (2006) that the Great Divergence was already well underway during the early modern period.

Second, although Table 14 provides evidence of a prosperous India at the height of the Mughal Empire at the time of Akbar, much of this prosperity had disappeared by the eighteenth century. However, with per capita incomes of more than 600 international dollars in 1990 prices, India was still sufficiently prosperous in the early eighteenth century to be consistent with the scale of market activity described by Bayly (1983). It is only by the beginning of the nineteenth century that most Indians were reduced to what Allen (2009) calls "bare bones" subsistence.

2. A cross sectional benchmark check

The results in Tables 13 and 14 are based on time series projections from a benchmark estimate of comparative GDP per capita levels in 1871. This potentially raises serious index number problems, so it is helpful to calculate an additional benchmark estimate for comparative GDP per capita levels in 1600 to check for consistency with the levels suggested by the time series projections. Although Prados de la Escosura (2000) and Ward and Devereux (2003) claim that these index number problems are serious enough to call into question the whole validity of the time series projection methodology, Broadberry (1998; 2003; 2006) finds broad consistency between time series projections and direct benchmarks in a number of detailed case studies during the period since the mid-nineteenth century. This is the first study to extend this methodology back to the early modern period, enabling us to confirm Broadberry's (2006) pragmatic conclusion that although index number problems exist, with careful treatment of the data it is still possible to bring time series projections and direct benchmarks together to tell a consistent story.

Nominal GDP data for the Mughal Empire circa 1600 have been constructed by Moosvi (2008), built up on a sectoral basis. The total GDP of 22,387 million dams has been converted to rupees and divided by the population, obtained by applying Moreland's [1923] ratio of 60 per cent of the total Indian population to Habib's (1982a) figure of 142 million, used here in Table 1. Dividing nominal GDP by population results in a figure of Rs 6.57 for GDP per capita in Mughal India. Nominal GDP and population data for England are taken from Broadberry, Campbell, Klein, Overton and van Leeuwen (2011), yielding a GDP per capita figure of £5.66.

Comparing the Mughal and English GDP per capita figures at the silver exchange rate of £1 = Rs 8 yields an Indian per capita GDP figure in 1600 that was just 14.5 per cent of the English level. This is broadly in line with Broadberry and Gupta's (2006) result that the Indian silver wage was just 21 per cent of the English level at the end of the sixteenth century.

However, Broadberry and Gupta (2006) also noted that at the same time, the Indian grain wage was 83 per cent of the English level. Comparing the price of wheat in India with the price of wheat in England yields a purchasing power parity (PPP) of £1 = Rs 1.63, a long way from the silver exchange rate. Using the wheat price PPP rather than the silver exchange to compare Indian and English per capita incomes yields a much smaller difference, with Indian GDP per capita now 71.2 per cent of the English level. This is much closer to the time series projection in Table 13, where Indian GDP per capita was 61.5 per cent of the British level. Allowing for differences in territorial units (Mughal Empire versus India and England versus Great Britain) and smaller deviations from PPP for other prices suggests a broad consistency between the time series projections and the 1600 benchmark.

VI. CONCLUDING COMMENTS

This paper provides estimates of Indian GDP constructed from the output side for the pre-1871 period, and combines them with population estimates to track the path of living standards. Indian per capita GDP declined steadily during the seventeenth and eighteenth centuries before stabilising during the nineteenth century. As British living standards increased from the mid-seventeenth century, India fell increasingly behind.

Whereas in 1600, Indian per capita GDP was over 60 per cent of the British level, by 1871 it had fallen to less than 15 per cent.

These estimates cast further doubt on the extent of the recent revisionist work which seeks to date the origins of the Great Divergence of living standards between Europe and Asia only after the Industrial Revolution (Frank, 1998; Parthasarathi, 1998; Pomeranz, 2000). The GDP per capita data, as well as the wage and price data surveyed by Broadberry and Gupta (2006), suggest strongly that the Great Divergence had already begun during the early modern period. They are also consistent with a relatively prosperous India at the height of the Mughal Empire, although much of this prosperity had disappeared by the eighteenth century. Nevertheless, India did not sink close to the bare bones subsistence level of living standards before the early nineteenth century.

TABLE 1: Indian population, 1600-1871

Year	Population level (millions)	Period	Annual growth rate (%)
1600	142	1600-1650	0.00
1650	142	1650-1700	0.29
1700	164	1700-1750	0.29
1750	190	1750-1801	0.17
1801	207	1801-1811	0.38
1811	215	1811-1821	-0.48
1821	205	1821-1831	0.52
1831	216	1831-1841	-0.19
1841	212	1841-1851	0.91
1851	232	1851-1861	0.51
1861	244	1861-1871	0.48
1871	256		
		1600-1801	0.19
		1801-1871	0.30
		1600-1871	0.22

Sources: Mahalanobis and Bhattacharya (1976: 7); Visaria and Visaria (1983: 466).

TABLE 2: Real wages of Indian unskilled labourers, 1600-1871 (1871=100)

Year	Wage	Grain price	Cloth price	Grain wage	Cloth wage	Real consumption wage
1600	37.7	18.3	57.1	205.9	65.9	159.7
1650	72.3	40.9	127.6	176.8	56.7	137.2
1700	78.3	46.6	150.6	168.1	52.0	129.8
1750	83.5	61.4	168.3	136.0	49.6	107.5
1801	80.3	67.6	166.7	118.9	48.2	95.5
1811	68.1	70.4	182.6	96.7	37.3	77.1
1821	69.9	67.9	180.4	103.0	38.7	81.8
1831	71.1	73.1	171.8	97.3	41.4	78.8
1841	72.3	61.3	110.3	117.9	65.5	100.7
1851	72.9	63.3	89.0	115.1	81.9	104.1
1861	98.8	105.6	100.0	93.6	98.8	95.3
1871	100.0	100.0	100.0	100.0	100.0	100.0

Source: Broadberry and Gupta (2006: 14); Mukerjee (1967: 58); Chaudhuri (1978); Bowen (2007); Twomey (1983); Sandberg (1974).

TABLE 3: Indian agricultural output, 1600-1871 (1871=100)**A. Agricultural consumption**

Year	Population	Grain wage	Consumption per capita	Total consumption
1600	55.5	205.9	133.5	74.0
1650	55.5	176.8	125.6	69.7
1700	64.1	168.1	123.1	78.9
1750	74.2	136.0	113.1	83.9
1801	80.9	118.9	107.2	86.6
1811	84.0	96.7	98.7	82.9
1821	80.1	103.0	101.2	81.0
1831	84.4	97.3	98.9	83.4
1841	82.8	117.9	106.8	88.5
1851	90.6	115.1	105.8	95.9
1861	95.3	93.6	97.4	92.8
1871	100.0	100.0	100.0	100.0

B. Agricultural exports and total production

Year	Agricultural exports	Agricultural production for domestic market	Total agricultural production
1600	11.2	74.0	67.8
1650	10.5	69.7	63.8
1700	11.9	78.9	72.2
1750	12.7	83.9	76.8
1801	13.3	86.6	79.3
1811	14.0	82.9	76.0
1821	19.8	81.0	74.9
1831	23.7	83.4	77.5
1841	32.0	88.5	82.8
1851	51.8	95.9	91.5
1861	56.4	92.8	89.2
1871	100.0	100.0	100.0

Sources and notes: Domestic agricultural production: derived from Tables 1 and 2, with the income elasticity of demand set at 0.4. Agricultural exports in current prices: Chaudhuri (1983: 828-837, 842-844), converted to constant prices using the grain price index from Table 2. Before 1801, agricultural exports are assumed to grow in line with domestic production. Share of agricultural exports in agricultural production in 1901 from Sivasubramonian (2000) projected back to 1871.

TABLE 4: A cross-check on the increase in agricultural output, United Provinces, 1600-1910

A. Cultivated acreage

	1600	1910	Ratio, 1910/1600
North-West UP	4,271,444	5,256,754	1.23
Delhi	2,190,147	3,100,982	1.42
Rohilkhand	1,275,231	4,625,738	3.63
Middle Doab	1,445,490	1,936,627	1.34
Agra	1,423,929	1,448,720	1.02
Lower Doab (Yamuna)	1,713,414	2,059,471	1.20
Lower Doab (Ganga)	1,408,014	2,354,156	1.67
Lucknow	3,642,809	6,212,866	1.71
North-East UP	849,372	1,936,471	2.28
Gorakhpur	362,486	6,440,737	17.77
South-East UP	2,284,659	5,352,556	2.34
Allahabad	2,390,070	3,293,179	1.38
Total UP	23,257,064	44,018,258	1.89

B. Crop yields (lb per acre)

	1600	1910	Ratio, 1910/1600	1910 weights
Wheat	1,242	1,250	1.01	21.2
Barley	1,191	1,300	1.09	16.8
Rice	1,064	1,053	0.99	19.8
Jowar	697	650	0.93	8.3
Bajra	462	550	1.19	8.4
Gram	894	950	1.06	16.1
Sesame	368	280	0.76	1.6
Rape and mustard	472	600	1.27	0.6
Sugarcane	1,082	2,600	2.40	3.3
Cotton	472	469	0.99	3.9
Unweighted average			1.16	
Weighted average			1.08	

C. Change in agricultural output

	Ratio, 1910/1600
Acreage	1.89
Yield	1.08
Output	2.04
Demand	2.23

Sources and notes: Acreage: Moosvi (1987: 67-69); Crop yields: rice 1600: Abū 'l-Fazl (1993, vol.II: 70), cotton 1600 and 1870/1910 Moosvi (1987: 82); all other crop yields: 1600: Moosvi (1987: 80); 1910: Department of Revenue and Agriculture (1912: 386); weights 1910: Department of Revenue and Agriculture (1912: 120-127); Change in agricultural output derived as the product of the changes in acreage and

yield. Measurement conversions: 1 bigha = 0.67 acres; 1 man = 55 lb in 1600 and 47 lb in 1910.

TABLE 5: Cotton textile production for the domestic Indian market

A. Cloth consumption

Year	Population (millions)	Cloth wage (1871=100)	Cloth consumption per capita (1871=100)	Cloth consumption per capita (sq yds)	Cloth consumption (m yds)
1600	142	65.9	81.2	6.7	946
1650	142	56.7	75.3	6.2	876
1700	164	52.0	72.1	5.9	970
1750	190	49.6	70.5	5.8	1,098
1801	207	48.2	69.4	5.7	1,178
1811	215	37.3	61.1	5.0	1,076
1821	205	38.7	62.2	5.1	1,046
1831	216	41.4	64.3	5.3	1,139
1841	212	65.5	81.0	6.6	1,407
1851	232	81.9	90.5	7.4	1,722
1861	244	98.8	99.4	8.2	1,989
1871	256	100.0	100.0	8.2	2,099

B. Imports and domestic production

Year	Cotton consumption (m yds)	Imports from Britain (m yds)	Domestic production (m yds)	Domestic production (1871=100)
1600	946	0	946	72.4
1650	876	0	876	67.1
1700	970	0	970	74.3
1750	1,098	0	1,098	84.0
1801	1,178	0	1,178	90.2
1811	1,076	1	1,075	82.3
1821	1,046	20	1,026	78.6
1831	1,139	38	1,101	84.3
1841	1,407	141	1,266	97.0
1851	1,722	348	1,374	105.2
1861	1,989	514	1,475	112.9
1871	2,099	793	1,306	100.0

Sources: Population: Table 1. Cotton consumption per head in 1871 from Roy (2011) and projected to other years with the cloth wage and an income elasticity of demand assumed to be 0.5. This produces estimates of per capita cloth consumption in other years broadly in line with the estimates surveyed in Roy (2011b). Imports from Britain: Sandberg (1974: 142).

TABLE 6: Indian textile exports to Britain, 1665-1831

Year	Pieces	Years	Pieces
1665	291,666	1665-69	139,677
1700	868,095	1700-04	597,978
1750	701,485	1750-54	632,174
1801	1,037,440	1800-04	1,355,304
1811	691,640	1810-14	901,745
1821	758,397	1820-24	542,117
1831	287,814	1830-34	192,965

Sources: 1665-1761: Chaudhuri (1978: Tables C.20-C.22); 1761-1834: Bowen (2007).

FIGURE 1: East India Company imports of textiles from India (pieces)



Sources: Chaudhuri (1978: Tables C20-C.22); Bowen (2007).

TABLE 7: Total Indian textile exports, 1831-1871

Year	Thousand pieces	Value of cotton goods (Rs 000, in 1851 prices)
1831	3,000	
1841	2,606	
1851	2,279	7,355
1861		8,365
1871		14,865

Source: Piece goods exports from Twomey (1983: 42); value of cotton goods exports from Chaudhuri (1983: 833-834, 844), converted to 1851 prices using unit values of imported cotton cloth sold in the Indian market from Sandberg (1974: 260).

TABLE 8: Urban population in India

Year	Population (millions)	Urban share (%)	Urban population (millions)
1600	142	15	21.3
1650	142	15	21.3
1700	164	14	23.0
1750	190	13	24.7
1801	207	13	26.9
1811	215	13	28.0
1821	205	12	24.6
1831	216	12	25.9
1841	212	11	23.3
1851	232	11	25.5
1861	244	10	24.4
1871	256	8.7	22.3

Sources: Population: Table 1. Urban share: 1600, 1801: Habib (1982a: 166-171); 1871: Visaria and Visaria (1983: 519); Other years: interpolation.

TABLE 9: Trends in the size of the government sector

Year	Government revenue in current prices (Rs million)	GDP deflator (1871=100)	Real government revenue (Rs million in 1871 prices)	Territory (1,000 square miles)	Real revenue per square mile (Rs in 1871 prices)
1600	145.9	31.1	469.1	979	479.1
1650	228.8	69.5	329.2	1,200	274.3
1700	333.5	80.9	412.1	1,200	343.4
1750	181.8	96.7	188.0	1,200	156.7
1766	16.0	96.7	16.5	98	168.4
1801	104.9	100.3	104.5	247	423.4
1811	166.8	107.4	155.3	353	440.4
1821	213.5	105.0	203.3	506	401.7
1831	220.2	105.7	208.4	514	405.4
1841	208.5	77.5	269.2	597	450.8
1851	276.3	71.8	384.9	771	499.3
1861	429.0	103.8	413.5	837	494.0
1871	514.1	100.0	514.1	904	568.7

Sources and notes: Government revenue: 1600-1700: Habib (2000: 454); 1750-1871: Banerjea (1928: 78-82, 85-86, 373-373); India Office (various years); Revenues reported in pounds from the mid-eighteenth century have been converted to rupees using an exchange rate of £1 = Rs 8 from Chaudhuri (1978) for 1750, and a rate of £1 = Rs 10 from Roy (2011a) for later years. The territory from which the revenue was raised has been derived for the Mughal period from Habib (1982b: viii) and Richards (1995: 1) and for the British period from Roy (2010b: 23); Colebrooke (1804: 16); Schwartzberg (1978: 55-56); Phillimore (1945: plate 1); Martin (1839: 273, 289, 332); Return to the House of Commons (1857: 16); India Census Commissioner (1893: 17); Bartholomew (1909: 28); Waterfield (1875: 5); India Office (various years). GDP deflator: weighted average of grain price and cloth price from Table 2.

TABLE 10: Indian sectoral weights, 1871

	%
Agriculture	67.5
Domestic industry	21.5
Export industry	0.7
Total industry and commerce	22.2
Services and housing	8.0
Government	2.3
Total economy	100.0

Sources: Employment structure in 1875 from Heston (1983: 396); adjusted for value added per employee in current prices using 1900/01 data from Sivasubramonian (2000: 38, 405-408).

TABLE 11: Indian real output (1871=100)

Year	Agriculture	Home industries	Export industries	Total industry and commerce	Rent and services	Government	Total real output
1600	67.8	72.4	148.6	80.0	95.5	84.3	71.9
1650	63.8	67.1	148.6	75.3	95.5	48.2	67.3
1700	72.2	74.3	202.0	87.0	103.0	60.4	75.7
1750	76.8	84.0	213.6	97.0	110.8	27.6	80.9
1801	79.3	90.2	457.9	127.0	120.7	74.5	87.5
1811	76.0	82.3	304.7	104.6	125.3	77.3	82.9
1821	74.9	78.6	183.2	89.0	110.3	70.6	79.2
1831	77.5	84.3	65.2	82.4	116.2	71.3	81.8
1841	82.8	97.0	56.6	92.9	104.6	79.3	87.3
1851	91.5	105.2	49.5	99.6	114.4	87.8	95.9
1861	89.2	112.9	56.3	107.3	109.4	86.9	95.6
1871	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Agriculture: Table 3B, total agricultural production; Home industries: Table 6; Export industries: Tables 6 and 7, adjusted for the growing share of British exports during the seventeenth century using data on bullion inflows by region from Haider (1996: 323); Rent and services: Tables 1 and 8; Government: Table 9; Sectoral shares: Table 10.

TABLE 12: Indian per capita GDP (1871=100)

Year	GDP	Population	Per capita GDP
1600	71.9	55.5	129.7
1650	67.3	55.5	121.2
1700	75.7	64.1	118.2
1750	80.9	74.2	109.0
1801	87.5	80.9	108.2
1811	82.9	84.0	98.7
1821	79.2	80.1	98.9
1831	81.8	84.4	97.0
1841	87.3	82.8	105.5
1851	95.9	90.6	105.8
1861	95.6	95.3	100.3
1871	100.0	100.0	100.0

Sources: GDP from Table 11; population from Table 1.

TABLE 13: Comparative India/GB GDP per capita

	Indian GDP per capita	GB GDP per capita	India/GB GDP per capita	India/GB GDP per capita
	1871=100			GB=100
1600	129.7	30.5	424.4	61.5
1650	121.2	29.9	405.2	58.8
1700	118.2	42.5	278.0	40.3
1750	109.0	46.5	234.3	34.0
1801	108.2	56.6	191.3	27.7
1811	98.7	56.2	175.8	25.5
1821	98.9	58.0	170.4	24.7
1831	97.0	63.9	151.7	22.0
1841	105.5	71.1	148.4	21.5
1851	105.8	81.5	129.8	18.8
1861	100.3	90.1	111.4	16.2
1871	100.0	100.0	100.0	14.5

Sources and notes: Indian GDP per capita from Table 12; GB GDP per capita 1600-1870: from Broadberry, Campbell, Klein, Overton and van Leeuwen (2011); 1870-1871 from Deane (1968: 106); GB population: Mitchell (1988: 9-12). Comparative India/GB GDP per capita level in 1871 derived from Broadberry and Gupta (2010), adjusting from a UK to a GB basis using Irish shares of GDP and population from Crafts (2005: 56) and Feinstein (1972: Table 55).

TABLE 14: Indian and British GDP per capita, 1600-1871 (1990 international dollars)

Year	Indian GDP per capita	GB GDP per capita
1600	682	1,123
1650	638	1,100
1700	622	1,563
1750	573	1,710
1801	569	2,080
1811	519	2,065
1821	520	2,133
1831	510	2,349
1841	555	2,613
1851	556	2,997
1861	528	3,311
1871	526	3,657

Source: Derived from Table 12 and Maddison (2003).

TABLE 15: A benchmark estimate of India/GB GDP per capita, circa 1600

Mughal Empire	
Nominal GDP (Rs m)	559.68
Population (m)	85.2
GDP per capita (Rs)	6.57
England	
Nominal GDP (£m)	23.28
Population (m)	4.11
GDP per capita (£)	5.66
Exchange rates	
Silver exchange rate (Rs per £)	8.00
Wheat price PPP (Rs per £)	1.63
Comparative GDP per capita	
At silver exchange rate	14.5
At wheat price PPP	71.2

Sources and notes: Mughal Empire: Nominal GDP in dams from Moosvi (2008: 2-3), noting that a rupee is 40 dams (Habib, 2000: 440); Population obtained by applying Moreland's [1923] ratio of 60 per cent of total Indian population to Habib's (1982a) figure of 142 million; England: nominal GDP and population from Broadberry, Campbell, Klein, Overton and van Leeuwen (2011); Silver exchange rate: Chaudhuri (1978: 471); PPP: Indian wheat price from Abū'l-Fazl (1595: 65. Price of Rs 0.30 per man of 55.32 lb is equal to Rs 0.005424 per lb (Heston, 1977: 393); English wheat price of 32 s per quarter of 480 lb from Mitchell (1988: 754) is equal to £0.00333 per lb. An Indian price of Rs 0.005424 per lb and an English price of £0.00333 per lb yields a wheat price PPP of £1 = Rs 1.63.

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