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# India and the great divergence: An Anglo-Indian comparison of GDP per capita, 1600–1871

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**Abstract**

Estimates of Indian GDP are constructed from the output side for 1600–1871, and combined with population data. Indian per capita GDP declined steadily during the seventeenth and eighteenth centuries before stabilising during the nineteenth century. As British growth increased from the mid-seventeenth century, India fell increasingly behind. Whereas in 1600, Indian per capita GDP was over 60% of the British level, by 1871 it had fallen to less than 15%. These estimates place the origins of the Great Divergence firmly in the early modern period, but also suggest a relatively prosperous India at the height of the Mughal Empire. They also suggest a period of "strong" deindustrialisation during the first three decades of the nineteenth century, with a small decline of industrial output rather than just a declining share of industry in economic activity.


*JEL classification:* N10; N30; N35; O10; O57
*Keywords:* Indian GDP; Comparison; Britain

## 1. 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 (Broadberry et al., 2011, 2013; van Zanden and van Leeuwen, 2012; Malanima, 2011; Álvarez-Nogal and Prados de la Escosura, 2013). 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, 2011) 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. Since the estimates of GDP are constructed from the output side, they also shed light on the extent to which India's colonial experience was characterised by de-industrialisation as

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cotton textiles manufactured in Britain first displaced Indian exports in Britain before taking an increasing share of India's other export markets and ultimately the Indian home market.

This paper presents estimates of GDP 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% of the British level, by 1871 it had fallen to less than 15%. A number of conclusions follow. First, 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. Second, 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 (2010) estimates of GDP per capita for 1871 in 1990 international dollars, which are widely accepted as giving an accurate picture of living standards for the period after 1870, 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 consistent with the recent revisionist work on Europe, which suggests that Maddison (2010) has substantially underestimated living standards in the pre-modern world (Broadberry et al., 2011). Third, the disaggregated results suggest that there was an absolute fall in Indian industrial production during the first three decades of the nineteenth century, rather than just a reduction in the share of industry in economic activity, although the scale of the fall was less than suggested by some nationalist authors (Bagchi, 1976).

The historical national accounting methodology adopted in this paper combines all the major data series currently available for India during this period and builds in a number of cross-checks to ensure consistency. The major data series include wages, grain prices, cloth prices, agricultural and industrial exports, crop yields and cultivated acreage, cloth consumption per capita, urbanisation rates, and government revenue. Agricultural output is estimated from both the demand and supply sides, using information on wages and prices to estimate domestic demand and exports for foreign demand, and cross-checked over the long run by estimating agricultural supply using data on the cultivated acreage and crop yields. Industrial production for the domestic market is initially estimated also from information on wage and prices, but it too is cross-checked against independent data on cloth consumption per capita from Roy (2012). These cross-checks verify the income elasticities of demand taken from the development literature, which suggests elasticities substantially below one. This means, in turn, that India's per capita GDP falls significantly less than real consumption wages. Finally, the projection of comparative India/GB GDP per capita back in time from 1871 is cross-checked against another benchmark estimate for 1600, which ensures consistency between growth rates and levels of GDP per capita.

The paper proceeds as follows. We begin in Section 2 with a brief survey of the existing literature on India's long run economic performance. This is followed in Section 3 by an application of the latest historical national accounting 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 4, 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 5 discusses the main results while Section 6 concludes.

## 2. 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.

### 2.1. Trends in Indian living standards

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 late 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 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 middles 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 late-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 (2010) point estimates of GDP per capita in Bengal and Britain around 1800.

### *2.2. Did colonial India experience strong deindustrialisation?*

An enduring theme of the nationalist literature is that colonialism led to Indian deindustrialisation as Indian cotton textile exports were blocked from the protected British market and India was kept open to cheap imports from Britain (Dutt, 1956: 256–269). It will be helpful in addressing this question to keep in mind Clingingsmith and Williamson's (2008) distinction between strong and weak deindustrialisation. Whereas weak deindustrialisation requires merely a declining share of industry in overall economic activity, strong deindustrialisation requires an absolute fall in industrial output. The issue was first raised by Morris (1963: 613), who argued that the demand for cloth in India was elastic so that the supply shock of imported cloth from England increased quantities sold as well as reducing prices. With the demand curve for textiles in India also shifting out because of strong population growth, changes in custom and a shift away from inferior fabrics to cotton, the level of Indian cotton textile production stayed about the same with the increase in quantity accounted for largely by the imports. For Morris, then, colonial India was a case of weak rather than strong deindustrialisation.

Following hostile assessments of Morris's argument by Chandra (1968) and Raychaudhuri (1968) on largely ideological grounds, Desai (1971) tried to assemble some data on imports and prices to infer the price elasticity of demand for cotton textiles, but was unable to draw firm conclusions without data on population and income. Bagchi (1976) also assembled empirical evidence to argue for the collapse of Indian industry on a catastrophic scale, based on a study of Bihar where he claimed that the share of the occupied population in secondary activities declined from 18.6% in 1809/13 to just 8.5% by 1901. However, Bagchi's evidence was based on a comparison of two surveys that were not comparable, a selective survey conducted by Sir Francis Buchanan Hamilton for parts of Bihar and a later full census of the entire region (Vicziany, 1979; Robb, 1981: 512–513). In addition, it is likely that the scale of deindustrialisation was greater in Bihar than in India as a whole, on account of the high concentration of employment in cotton textiles in the Bengal region (Twomey, 1983: 49).

Twomey (1983) improved upon the work of Desai (1971) by examining the data on Indian exports as well as imports and by making an allowance for income and domestic consumption, concluding that there was no absolute decline in output before 1850, and only a modest decline between about 1850 and 1870, followed by recovery. However, Twomey's data on the income

variable covered only the period 1857–1900, while his data on domestic consumption started only in 1880, so his results are highly conjectural, particularly for the first half of the nineteenth century. Our approach within a national accounting framework provides a way of pinning down the key magnitudes and deriving the net effect on industrial output during the whole colonial period.

## 3. Estimating Indian national income

In this section we derive estimates of Indian GDP by sector, following the latest methods of historical national accounting, incorporating demand effects into agriculture and urbanisation effects into services (Broadberry et al., 2011, 2014a,b). The starting point is the estimation of the population, which is used to derive the domestic demand for goods and services, as well as to provide the denominator for the series on GDP per capita. The growth of agricultural demand can be checked against the growth of the grain supply over the long run to provide the first of the key cross-checks highlighted in the Introduction. In the industrial sector, the growth of demand for cotton cloth can also be cross-checked against independent data on consumption of cloth per head of the population. Foreign trade data are also incorporated into output estimates of both the agricultural and industrial sectors. For the services sector, private services are assumed to grow in line with the urban population, while data on the size of the government are also incorporated.

The estimates that follow are for the territory of the Indian sub-continent, including Pakistan and Bangladesh as well as modern India, for the whole period 1600–1871. In places, however, estimates are presented for the territory of the Mughal Empire and other sub-regions, particularly for cross-checking rates of change and per capita levels.

### 3.1. 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. These estimates are based on evidence that is mostly regional, incomplete and subject to differing territorial coverage.

Table 1
Indian population, 1600–1871.
Sources: Mahalanobis and Bhattacharya (1976: 7) and Visaria and Visaria (1983: 466).

| 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 |

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, derived from the wealth of data in Abū'l-Fazl (1595). This methodology of providing cross checks on the consistency of levels and growth rate information will be applied also to the GDP per capita data. For population in 1600, 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. Although Guha (2001: 64) points out that Habib's methodology assumes that the share of the population in the north was the same in 1600 as during the nineteenth century, he is unable to provide any reliable evidence to the contrary. Habib's estimates are therefore preferred here.

Indian population grew at an annual rate of 0.22% 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.

### 3.2. Agricultural output: demand and supply-based estimates

Agricultural output is derived from the demand for food, with an allowance for foreign trade, and this is cross-checked against the long run growth of supply. The demand approach builds on the work of Crafts (1976), who criticised Deane and Cole's (1967) early work on eighteenth century Britain, which assumed constant per capita corn consumption while real incomes were rising and the relative price of corn was changing. 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:

$$Q^A = rcN \tag{1}$$

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:

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

where $\alpha_1$ and $\alpha_2$ are the own-price and cross-price elasticities of demand, $\beta$ is the income elasticity of demand and $\alpha_0$ 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. 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).

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). 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. Furthermore, Allen (2007) shows that these Indian wages were still just about sufficient to provide the roughly 2000 kcal per person needed for survival and reproduction at their low point in the early nineteenth century.

The cloth price series is 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

Table 2
Real wages of Indian unskilled labourers, 1600–1871 (1871 = 100).
Sources: Broadberry and Gupta (2006: 14), Mukerjee (1967: 58), Chaudhuri (1978), Bowen (2007), Twomey (1983) and Sandberg (1974).

| 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 |

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 the 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, consistent with the work of Bouis (1994) on staple grains in poor societies. Although there must inevitably be some degree of uncertainty about the precise value of the income elasticity of demand, we do not think that any plausible value could have a very large effect on our results. Malanima (2011) has also worked with a value of 0.4 for Italy over the period 1300–1913, while Allen's (2000) influential study of early modern Europe worked with a value of 0.5. The lowest value that we have found for the income elasticity of demand for food as a whole is 0.3 in the study by Álvarez-Nogal and Prados de la Escosura (2013) of the rise and fall of Spain. In the context of modern India, Sivasubramanian and Deaton (1996) report a range of 0.3 to 0.5 for the income elasticity of demand for food. Working with this range has only a small effect on the scale of the decline of agricultural output per head.[1] We prefer the value of 0.4 for the income elasticity because, as we demonstrate below in Table 4, this is consistent with the growth of supply over the long run, derived from information on the cultivated land area and crop yields. Although there is a literature which claims to have found a lower value than 0.3 for the income elasticity of demand for food in modern India, Deaton and Drèze (2002, 2009) convincingly argue that this arises from a combination of working in terms of the demand for calories and shifting demand for different types of food as a result of changes in the level of physical activity and the health environment. During the period under study here, between 1600 and 1871, 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 in food production, as less fertile land was brought into cultivation.

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.

Turning to the impact of foreign trade, however, we see that the diminishing returns in 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

[1] With an income elasticity of demand of 0.4 in Table 3A, per capita consumption drops from 133.5 in 1600 to 100.0 in 1871. With an income elasticity of 0.3, the decline would be from 124.2 to 100.0, while with an income elasticity of 0.5 it would be from 143.5 to 100.0.

Table 4
A cross-check on the increase in agricultural output, territory of the Mughal Empire, 1600–1910.

A. Cultivated acreage

| | 1600 | 1910 | Ratio, 1910/1600 |
|---|---|---|---|
| United Provinces | 23,257,064 | 44,018,258 | 1.89 |
| Gujarat | 7,854,145 | 13,553,827 | 1.72 |
| Punjab | 18,483,618 | 47,173,912 | 2.55 |
| Total | 49,594,827 | 104,745,997 | 2.11 |

B. Crop yields (lb per acre)

| | 1600 | 1870 | 1910 | Ratio, 1910/1600 | 1910 weights |
|---|---|---|---|---|---|
| Wheat | 1242 | 1295 | 1250 | 1.01 | 21.2 |
| Barley | 1191 | 1321 | 1300 | 1.09 | 16.8 |
| Rice | 1064 | 1053 | 1053 | 0.99 | 19.8 |
| Jowar | 697 | 711 | 650 | 0.93 | 8.3 |
| Bajra | 462 | 692 | 550 | 1.19 | 8.4 |
| Gram | 894 | 945 | 950 | 1.06 | 16.1 |
| Sesame | 368 | 227 | 280 | 0.76 | 1.6 |
| Rape and mustard | 472 | 665 | 600 | 1.27 | 0.6 |
| Sugarcane | 1082 | 1755 | 2600 | 2.40 | 3.3 |
| Cotton | 472 | 469 | 469 | 0.99 | 3.9 |
| Unweighted average | | | | 1.16 | |
| Weighted average | | | | 1.08 | |

C. Change in agricultural output

| | Ratio, 1910/1600 |
|---|---|
| Acreage | 2.11 |
| Yield | 1.08 |
| Output | 2.28 |
| Demand | 2.23 |

Sources and notes: Acreage: Moosvi (1987: 65); crop yields: rice 1600: Abū'l-Fazl (1595, 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 1870 and 1910.

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%, 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.

It is important to cross check the agricultural demand series with the availability of output estimated from the supply side. For the case of India, it is not possible to estimate directly on a high-frequency basis 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 between 1871 and 1910. 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, Gujarat and the Punjab, the agricultural heartland of the Mughal Empire. Moosvi demonstrates a more than doubling of the acreage between 1600 and 1910. Table 4B provides data on the yields of the ten main crops between 1600 and 1910, taken largely from Moosvi (1987) and Department of Revenue and Agriculture (1912). 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. Although there has been a suggestion by Blyn (1966) of a downward trend in yields during the twentieth century, Moosvi's (1987) data suggest broadly stable yields between 1600 and 1910. Scattered regional data on yields in 1830 and 1870 from Guha (1992: 46) are also consistent with this pattern. Table 4C derives the increase in output as the product of the substantial increase in acreage and the barely discernible increase in the weighted yield, which suggests an approximate doubling of output as well as acreage. This increase in output by a factor of 2.28 is very close to the increase by a factor of 2.23 obtained using the demand approach. The calculation is restricted to only a part of the Mughal Empire, but the agreement between the two approaches is reassuring.

A further cross-check on the agricultural output growth estimates of Table 3 is provided by the work of Clingingsmith and Williamson (2008: 215–216) on the frequency of drought years in India between 1525 and 1900. The incidence of drought years was unusually low between 1650 and 1800, and unusually high during the first quarter of the nineteenth century. This corresponds with our findings of output growth between 1650 and 1800 and declining output during the early nineteenth century.

### 3.3. 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 (2012). 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 that 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 (2012), 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.

To derive a series for overall industrial output, we need to quantify developments in the export section of Indian industry to add to our estimates of production for the domestic market. Table 6 provides 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), Table 6 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%, so the deflation makes only a small difference to the nominal data.

[2] Roy (2012) 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.

Table 5
Cotton textile production for the domestic Indian market.
Sources: Population: Table 1. Cotton consumption per head in 1871 from Roy (2012) 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 (2012). Imports from Britain: Sandberg (1974: 142).

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 | 1098 |
| 1801 | 207 | 48.2 | 69.4 | 5.7 | 1178 |
| 1811 | 215 | 37.3 | 61.1 | 5.0 | 1076 |
| 1821 | 205 | 38.7 | 62.2 | 5.1 | 1046 |
| 1831 | 216 | 41.4 | 64.3 | 5.3 | 1139 |
| 1841 | 212 | 65.5 | 81.0 | 6.6 | 1407 |
| 1851 | 232 | 81.9 | 90.5 | 7.4 | 1722 |
| 1861 | 244 | 98.8 | 99.4 | 8.2 | 1989 |
| 1871 | 256 | 100.0 | 100.0 | 8.2 | 2099 |

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 | 1098 | 0 | 1098 | 84.0 |
| 1801 | 1178 | 0 | 1178 | 90.2 |
| 1811 | 1076 | 1 | 1075 | 82.3 |
| 1821 | 1046 | 20 | 1026 | 78.6 |
| 1831 | 1139 | 38 | 1101 | 84.3 |
| 1841 | 1407 | 141 | 1266 | 97.0 |
| 1851 | 1722 | 348 | 1374 | 105.2 |
| 1861 | 1989 | 514 | 1475 | 112.9 |
| 1871 | 2099 | 793 | 1306 | 100.0 |

Cotton cloth was overwhelmingly India's main industrial export, and there are no consistent data series for other industrial exports. Nevertheless, for the period after 1757, Chaudhuri (1983) has reconstructed the Indian balance of payments, and finds that non-agricultural exports were driven by cotton textiles. As noted in Section 3.2, the collapse of Indian cotton textile exports in the nineteenth century was offset by an increase in agricultural exports rather than other industrial exports.

Table 6
Indian textile exports to Britain, 1665–1831.
Sources: 1665–1761: Chaudhuri (1978: Tables C.20–C.22) and 1761–1834: Bowen (2007).

| 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 |

### 3.4. The service sector

For domestic services and housing, Deane and Cole (1967) assumed output growth in line with population. However, recent work on the long run development of the European economy suggests that service sector output growth moves more closely in line with the urban population (Broadberry et al., 2011). 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

Table 7
Total Indian textile exports, 1831–1871.

| Year | Thousand pieces | Value of cotton goods (Rs 000, in 1851 prices) |
|---|---|---|
| 1831 | 3000 | |
| 1841 | 2606 | |
| 1851 | 2279 | 7355 |
| 1861 | | 8365 |
| 1871 | | 14,865 |

Sources and notes: 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).

countries during the early modern period (Malanima, 2011; Álvarez-Nogal and Prados de la Escosura, 2013). With the path of agricultural output ($q_a$) derived using Eqs. (1) and (2), overall output ($q$) is derived as:

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

where the share of non-agricultural output in total output ($q_{na}$ / $q$) is proxied by the urbanisation rate. Here, the approach is made less crude by providing independent estimates for industry and government services, thus using the urban population to track only private services and housing.

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 5000 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. Note that this does not necessarily imply differential population growth amongst different castes, since the link between caste and occupation was not as rigid as is sometimes assumed, particularly before codification by British administrators during the late colonial period (Cohn, 1996). Indeed, although some caste-based occupations such as cleaning and working at funeral pyres are rigid, other castes have historically self-selected into more than one occupation. Furthermore, there is no simple mapping between occupational and industrial classifications, with some occupations such as labourer able to work in agriculture, industry or services.

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

Table 8
Urban population in India.
Sources: Population: Table 1. Urban share: 1600, 1801: Habib (1982a: 166–171); 1871: Visaria and Visaria (1983: 519); and other years: interpolation.

| 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 |

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 declined during the first half of the seventeenth century from its peak level at the time of Akbar. After a revival in the second half of the seventeenth century under Auranzeb, revenue declined again as the Mughal Empire collapsed during the first half of the eighteenth century. Revenue increased again under British rule from 1757, but surpassed the peak revenue at the time of Akbar only during the mid-nineteenth century. Note that the real revenue per square mile was at its low point in the mid-eighteenth century whether viewed from the declining Mughal perspective in 1750 or the rising British perspective in 1766. Since the government sector was only a small part of GDP, it was not a key driver of the overall level of output or GDP per capita.

### 3.5. 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

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 (1000 mile$^2$) | 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 | 1200 | 274.3 |
| 1700 | 333.5 | 80.9 | 412.1 | 1200 | 343.4 |
| 1750 | 309.7 | 96.7 | 320.3 | 1200 | 267.0 |
| 1766 | 30.5 | 96.7 | 31.5 | 98 | 321.8 |
| 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: 1600–1750 (Mughal Empire): Habib (1999: 454–455) and British Parliamentary Papers (1812: 221); the trend for 1700–1750 is based on the trend in Bengal. 1766–1871 (British India): British Parliamentary Papers (1773: 535), Banerjea (1928: 78–82, 85–86, 372–373) and India Office (various years); revenues reported in pounds from the British period have been converted to rupees using an exchange rate of £1 = Rs 10 from Roy (2011). 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 (2013: 1141), Colebrooke (1804: 16), Schwartzberg (1978: 55–56), Phillimore (1945: plate 1), Martin (1839: 273, 289, 332), Return to an Order of the House of Commons (1857: 16), India Census Commissioner (1893: 17), Bartholomew (1909: 28), Waterfield (1875: 5) and India Office (various years). GDP deflator: weighted average of grain price and cloth price from Table 2.

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% of GDP, but is combined here with industry. Government, domestic services and housing together accounted for the remaining 10.3% of GDP. It is important to realise that the use of 1871 weights does not imply that sectoral output shares are assumed to have remained constant from 1600 until 1871. For example, since export industries grew much faster than other sectors between 1600 and 1801, and then declined sharply while other sectors continued to grow, the share of export industries in total output first increased from 1.4% in 1600 to 3.7% in 1801 before falling back to 0.7% by 1871. The index number theory underlying this issue is discussed in Crafts and Harley (1992: 706–7, 722). As will be apparent, this makes the export industries sector large enough for its decline to bring about deindustrialisation, but not large enough to be a key driver of GDP per capita, which is driven largely by agriculture and home industries. Indeed, export industries were booming during the period of declining GDP per capita, and collapsed just at the time that GDP per capita stabilised.

Table 10
Indian sectoral weights, 1871.
Sources and notes: 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).

| | % |
|---|---|
| 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 |

### 3.6. 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

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 | 46.9 | 81.3 |
| 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 and notes: Agriculture: Table 3B, total agricultural production; Home industries: Table 5; 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: Table 8; Government: Table 9; Sectoral shares: Table 10.

was a return to modest total output growth between 1841 and 1871 as industrial growth returned and agricultural growth accelerated.

## 4. Per capita GDP

### 4.1. 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% of the British level in 1600 to just 14.5% by 1871. The relative decline occurred fairly steadily throughout the period.

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 | 81.3 | 74.2 | 109.6 |
| 1801 | 87.5 | 80.9 | 108.2 |
| 1811 | 82.9 | 84.0 | 98.8 |
| 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 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 in historical national accounting 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.

### 4.2. 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

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 | 109.6 | 46.5 | 234.3 | 34.2 |
| 1801 | 108.2 | 56.6 | 191.3 | 27.7 |
| 1811 | 98.8 | 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 et al. (2011); 1870–1871 from Feinstein (1972: T18); 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).

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.

The data for the benchmark cross-check in 1600 are given in Table 15. 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% 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 et al. (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

Table 14
Indian and British GDP per capita, 1600–1871 (1990 international dollars).
Sources: Derived from Table 13 and Maddison (2010).

| Year | Indian GDP per capita | GB GDP per capita |
|---|---|---|
| 1600 | 682 | 1123 |
| 1650 | 638 | 1100 |
| 1700 | 622 | 1563 |
| 1750 | 576 | 1710 |
| 1801 | 569 | 2080 |
| 1811 | 519 | 2065 |
| 1821 | 520 | 2133 |
| 1831 | 510 | 2349 |
| 1841 | 555 | 2613 |
| 1851 | 556 | 2997 |
| 1861 | 528 | 3311 |
| 1871 | 526 | 3657 |

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, 1999: 440); Population obtained by applying Moreland's (1923) ratio of 60% of total Indian population to Habib's (1982a) figure of 142 million; England: nominal GDP and population from Broadberry et al. (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.

capita GDP figure in 1600 that was just 14.5% of the English level. This is broadly in line with Broadberry and Gupta's (2006) result that the Indian silver wage was just 21% 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% 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% of the English level. This is much closer to the time series projection in Table 13, where Indian GDP per capita was 61.5% 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.

## 5. Discussion of the main findings

### 5.1. When did the Great Divergence begin?

Our results have important implications for the debate over the timing of the Great Divergence. 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), based on silver wage and grain wage data, that the Great Divergence was already well underway during the early modern period. Fig. 1 plots Indian per capita GDP as a percentage of British per capita GDP, together with the data on comparative per capita incomes as measured by the grain wage and the silver wage. Broadberry and Gupta (2006) argued on theoretical grounds that the grain wage provides an upper bound on India's comparative position, while the silver wage provides a lower bound. Fig. 1 shows that indeed, taking account of the whole range of economic activities, the GDP per capita data lie between these two bounds.

### 5.2. Was India always poor?

Maddison's (2010) data, plotted in Fig. 2 suggest that India was always very poor, with a per capita GDP of just $550 in 1990 prices in the year 1500, dropping to $533 in the early nineteenth century. Our data in Table 14, also plotted in Fig. 2 for comparison, suggest a substantially higher GDP per capita in 1600, of the order of $700. Although this suggests a prosperous India at the height of the Mughal Empire during the time of Akbar, much of this prosperity had disappeared by the eighteenth century.

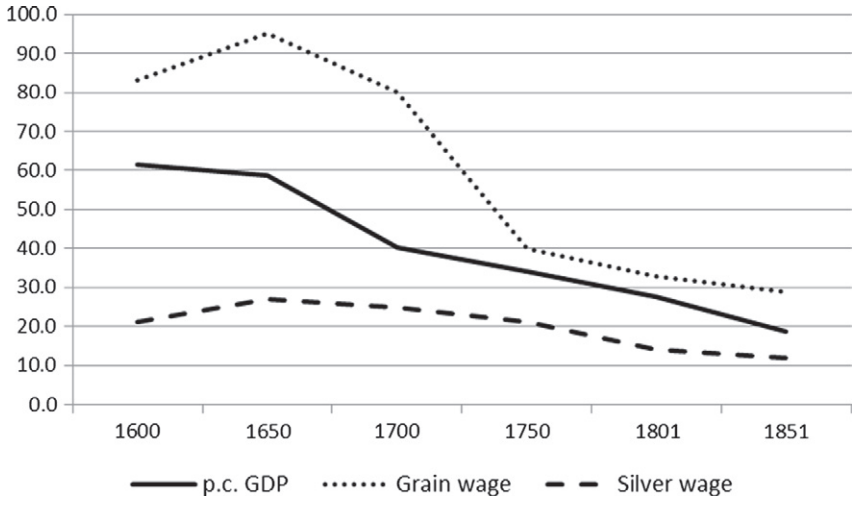


Fig. 1. Indian per capita incomes as a percentage of British per capita incomes (GB = 100).
Sources: Table 13 and Broadberry and Gupta (2006).

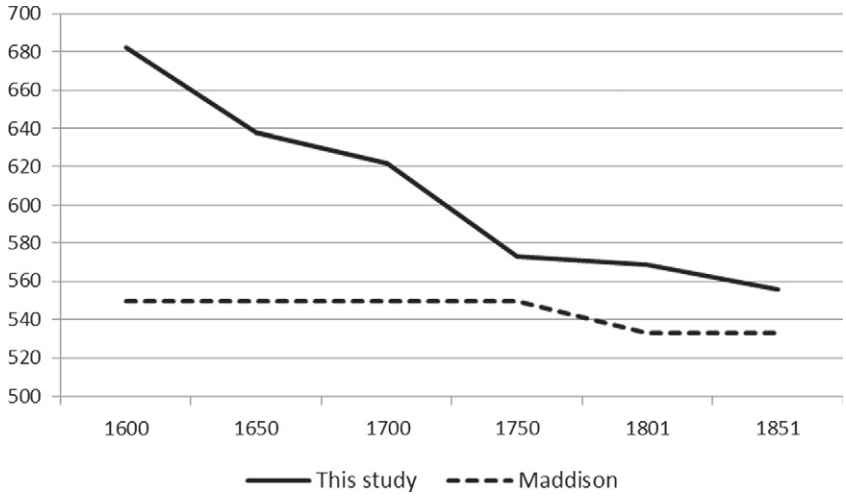


Fig. 2. Alternative estimates of Indian GDP per capita (1990 international dollars).
Sources: Table 14 and Maddison (2010).

However, with per capita incomes of more than $600, 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.

### 5.3. Did colonial India experience strong deindustrialisation?

We have already noted that there was a small upward trend in domestic industrial production for the home market, which might be interpreted as offering support for the position of Morris (1963), who argued that import penetration of cotton textiles from Lancashire did not lead to the absolute decline of the traditional Indian cotton textile sector because of increasing demand as a result of positive population growth and the falling price of imported cotton textiles. However, in assessing the issue of deindustrialisation, we have to balance a sharp absolute decline in exports against a small upward trend in domestic output. 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.

Our findings therefore suggest that colonial India experienced strong deindustrialisation during the early nineteenth century, not just weak deindustrialisation. Nevertheless, the scale of Indian deindustrialisation shown here is more modest than the catastrophic domestic industrial collapse claimed by Bagchi (1976). Although Twomey (1983) also suggests a modest absolute decline of industrial output on the basis of trends in cotton textiles, the timing of the decline is rather different from that suggested here. Despite his lack of income data before 1857, Twomey (1983: 53) speculates that output was stable between 1800 and 1850, then declined to the 1870s. By contrast, the estimates presented here suggest an absolute decline during the first three decades of the nineteenth century, followed by recovery to the 1870s.

## 6. 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% of the British level, by 1871 it had fallen to less than 15%.

Relative to the existing literature, we make the following contributions. First, our estimates cast further doubt on 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 show for the whole economy, not just the wage-earning class surveyed by Broadberry and Gupta (2006), that the Great Divergence had already begun during the early modern period. Second, these data are also consistent with a relatively prosperous India at the height of the Mughal Empire, as suggested by Bayly (1983), 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. Third, however, the new estimates do suggest that India experienced an absolute decline of industrial output during the first three decades of the twentieth century, rather than just a declining share of industry in economic activity. This is contrary to the suggestion of Morris (1963), but the modest scale of the absolute decline is also inconsistent with Bagchi's (1976) claim of a catastrophic collapse of industrial employment.

This paper has set out to document what happened, and explaining these developments is clearly the subject of another paper. Nevertheless, it is worth making some final concluding comments in this area. First, India shared the pattern of declining GDP per capita during this period with China, although the decline started from a higher level and occurred at a faster rate in China (Broadberry et al., 2014a,b). Second, in India, as in China, the decline was driven mainly by what happened in agriculture, with the growth of population outstripping the growth of the cultivated area, and crop yields rising insufficiently to offset the decline in cultivated acreage per head. Third, in common with most of the world at this time, and in strong contrast to Britain and Holland, Indian workers remained on the land, with negative consequences for agricultural labour productivity and the relative size of the industrial and service sectors. Fourth, again in common with much of the rest of the world at this time, India lacked the state institutions needed to underpin the investment and innovation which allowed Britain and Holland to break out of the Malthusian trap, allowing both population and per capita incomes to increase (Parthasarathi, 2011; Broadberry, 2013). Fifth, although India's decline continued during the colonial period, it had already started during the Mughal Empire, and so cannot be attributed solely to colonialism. This conclusion is reinforced by the more rapid decline of China.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.eeh.2014.04.003.

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