BRITISH BUSINESS CYCLES, 1270-1870

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Abstract: Annual estimates of real and nominal GDP constructed from the output side are used to analyse British business cycles between 1270 and 1870. Before 1700, business cycles were driven largely by agricultural fluctuations, but shocks to industry and commerce became more important over time as the structure of the economy changed. A number of severe recessions can be identified, associated with recurrent harvest failures, epidemics, wars or financial shocks. Although monetary factors played a role in a small number of these severe recessions, most business cycles were "real", with no systematic Phillips Curve relationship between changes in the price level and real economic activity.

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I. INTRODUCTION

A recent study by Broadberry et al. (2011) has used a new reconstruction of historical national accounts from the output side for Britain over the period 1270-1870 to analyse long run economic growth. This paper makes use of the same annual data database to analyse the changing nature of short run business cycles over this long period. Whereas the analysis of economic growth is normally conducted largely in real terms, monetary historians have also emphasised the role of prices and nominal incomes in business cycles.

Before 1700, business cycles were driven largely by agricultural fluctuations, but shocks to industry and commerce became more important over time. A number of severe recessions can be identified, associated with recurrent harvest failures, epidemics, wars or financial shocks. Although there is some evidence to suggest that monetary factors played a role in some of these severe recessions, most business cycles were "real", with little role for nominal variables. In particular, there is no evidence of a systematic Phillips Curve relationship between changes in the price level and real economic activity.

II. HISTORICAL NATIONAL ACCOUNTS FOR ENGLAND/BRITAIN, 1270-1870

This section provides a brief overview of the historical national accounts for England/Britain over the period 1270-1870. By indicating the types of information used in the main time series and their major sources, it will alert the reader to potential breaks in the series, which may be statistical artefacts rather than indicators of genuine change in the structure or cyclical behaviour of the economy. It will also

be helpful to keep in mind the long run evolution of the economy when considering the shorter run cyclical fluctuations associated with the business cycle. This analysis of business cycles within a growth framework is a distinctive feature of modern macroeconomics (Long and Plosser, 1983; Lucas, 1987; Plosser, 1989)

1. England, 1270-1700

Broadberry et al. (2011) provide a detailed description of the derivation of real GDP for England, 1270-1700. For agriculture, arable output is derived from information on land use and grain yields while pastoral output is based on animal stocking densities, production rates and animal yields. It is important to note here that the agricultural time series for the period 1270-1700 are based upon two major data sets covering the medieval and early modern periods, with a statistical dark age between about 1450 and 1550. For the medieval period, the main data source is the medieval accounts database assembled by Campbell (2000; 2007), which provides time series for land use, animal yields and animal stocking densities on a sample of demesnes. By contrast, the early modern probate inventories database assembled by Overton et al. (2004) provides no continuous runs of data for individual farms, which only appeared in the dataset when a farmer died. It will therefore be prudent to divide the cyclical analysis of the 1270-1700 period into two parts, covering the medieval (1270-1500) and early modern (1500-1700) periods, respectively. Caution should also be exercised over the interpretation of any changes in the cyclical properties of the real output series in the second half of the fifteenth century or the first half of the sixteenth century because of the paucity of firm statistical data during this statistical dark age.

For both industry and services, real output is estimated using volume indicators combined with value added weights. Aggregate real GDP is constructed from the sectoral volume indices for agriculture, industry and services using value added weights for a number of benchmark years. Real GDP is plotted together with the real output indices for agriculture, industry and services in Figure 1. Agriculture was the slowest growing sector over the period as a whole, while industry was the fastest growing sector. Although services grew almost as fast as industry from around 1500, the sector declined sharply across the Black Death, so that services track aggregate output more closely than the other two sectors over the period as a whole. In later sections of this paper, we will examine in detail the short run cyclical properties of these series

The price index for GDP is derived from information on the prices of the main goods and services provided in the English economy, again built up by sector. For agricultural and industrial goods, prices are taken largely from Clark (2004; 2006) and Thorold Rogers (1866-1902). The price data for services are based largely on wage rates and housing rents from Clark (2004), although information on transport prices from Thorold Rogers (1866-1902) has also been incorporated. For distribution, a weighted average of agricultural and industrial prices has been used, with the weights reflecting the relative size of the two sectors. Reflating real GDP with the aggregate price index produces the nominal GDP series.

Figure 2 plots real and nominal GDP together with the aggregate price level over the period 1270-1700. It is clear that most of the increase in nominal GDP over this long period resulted merely from the increase in the price level that occurred

between 1270 and 1700. While real GDP increased by a factor of 2.46 between 1270 and 1700, nominal GDP increased by a much greater factor of 14.84, as a result of the price level increasing by a factor of 6.02. Put like this, inflation sounds very high, but compared with the twentieth century, this was relatively mild inflation, at an annual rate of just 0.42 per cent.[1] Furthermore, it is clear that most of the increase in the price level occurred during the Great Inflation of the sixteenth century, a Europe-wide and possibly global phenomenon. In later sections, we will also consider shorter periods of falling prices, and the effects of deflation on real GDP.

2. Great Britain, 1700-1870

The cyclical analysis will also be broken at 1700, as well as at 1500. In this case, the main reason for the break is that before 1700 the data refer exclusively to England, whereas after 1700 they cover the whole of Great Britain, including Scotland and Wales as well as England, but excluding the whole of Ireland. However, there is also another potentially important break around 1720 in the main source of information for the agricultural sector. After 1720, the modern farm accounts database collected by Turner et al. (2001) again contains a strong time series element for a sample of farms, in contrast to the one-off observations from Overton et al.'s (2004) early modern probate inventories database, which is still used for the first two decades of the eighteenth century.

A detailed description of the derivation of real GDP for Great Britain, 1700-1870 is provided in Broadberry et al. (2011), as for England in the pre-1700 period. Information in the post-1700 period is rather more complete for all three main sectors,

[1] The annual rate of inflation reached 25 per cent in 1975 (Broadberry (2002: 385).

and aggregate real GDP is constructed from the sectoral real output series using current price sectoral value added shares for a number of benchmark years. Real GDP is plotted together with the real output indices for agriculture, industry and services in Figure 3. As during the pre-1700 period, agriculture was the slowest growing sector over the period as a whole, while industry was the fastest growing sector. Services again grew at an intermediate rate. The short run cyclical properties of these series will be examined in later sections of the paper.

The price index for GDP in the period 1700-1870 is again derived from information on the prices of the main goods and services provided. For agricultural and industrial goods, prices are taken largely from Clark (2004) and Beveridge (1939). For service sector prices, the key data are wage rates and house rents from Clark (2004), with some limited information on transport prices from Harley (1988) and Bogart (2005), and with distribution prices derived as a weighted average of agricultural and industrial prices.

Figure 4 plots real and nominal GDP together with the aggregate price level over the period 1700-1870. Most of the increase in nominal GDP was the result of real growth, with only a modest increase in the price level. Although there was a period of substantial inflation during the French and Napoleonic Wars, this was followed by a period of postwar deflation.

III. BUSINESS CYCLE CHRONOLOGY, 1270-1870

1. Identifying business cycles

One way of identifying the business cycle is to plot the annual growth rate of real GDP in Figure 5. This results in a stationary series and highlights boom years with rapid positive growth and slump years with high rates of negative growth. We have chosen to break the series into three periods, covering 1270-1500, 1500-1700 and 1700-1870 for a number of reasons. First, the three periods correspond to significant breaks in the major sources of data, particularly in the case of the agricultural sector, where medieval information is drawn largely from manorial accounts, early modern information from probate inventories and modern information from farm accounts. Second, in the case of the 1700-1870 period, the data refer to the territory of Great Britain rather than England. Third, the three periods conform roughly to the conventional divisions between medieval, early modern and modern economic history, so that the analysis can be cross-checked against substantial literatures on each period.

One particularly useful feature of the annual growth rate approach is that it facilitates a breakdown of the cycle into the components associated with agriculture, industry and services (Hills et al., 2010). Figure 6 provides this breakdown for the three sub-periods, while Figure 7 provides an overview for the whole period, but with the contributions of the three sectors to annual output growth averaged by decade. Figure 6 will be particularly helpful in discussing the cycle during the individual sub-periods, but it is worth pointing out here from Figure 7 that while agriculture was the dominant influence on the annual growth rate during the medieval period, industry and services were already becoming more important during the early modern period, and had become dominant by the nineteenth century.

A second way to make the real GDP series stationary and extract a cyclical component is to apply the Hodrick-Prescott (1997) filter. The basic idea is to decompose a time series variable (y_t) into a growth component (g_t) and a cyclical component ($c_t = y_t - g_t$) in such a way as to make the growth component more sensitive to long term than to short term fluctuations. This is done by setting the growth component to minimise:

$$\sum_{t=1}^{T}(y_t - g_t)^2 + \lambda \sum_{t=1}^{T}[(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \qquad (1)$$

The first term is the sum of squared deviations of the variable from the growth component, and hence penalises short term fluctuations, while the second term is λ times the sum of squares of the growth component's second difference, and hence penalises variations in the growth component. The larger the value of the smoothing parameter λ, the higher the penalty for variations in the growth component. The cyclical component of the log of the GDP index obtained by setting λ equal to 100, the value recommended by Backus and Kehoe (1992), is graphed in Figure 8, again split into three periods. Using a lower value of λ equal to 6.25, as suggested by Ravn and Uhlig (2002), reduces the amplitude but not the frequency of the business cycle.

For comparison with older business cycle chronologies based on visual identification of turning points in unfiltered time series, we have also reported the peaks and troughs of the cycle as measured by the Hodrick-Prescott filter. This is summarised in Tables 1 to 3 for 1270-1500, 1500-1700 and 1700-1870, respectively. In the following sections we discuss the cyclical properties of the GDP series in these three periods, as revealed by the approaches outlined above.

2. Business cycles, 1270-1500

Figures 5 and 8 present a consistent picture of the business cycle, with a large number of short cycles lasting on average 3 to 4 years peak to peak, with an amplitude of between plus or minus 5% and plus or minus 10%. However, there were a number of severe recessions where real GDP fell in at least three successive years or by substantially more than 10 per cent in a single year. Agricultural fluctuations driven by weather and disease can clearly be seen as having a dominant effect during much of this period. The 1280s stand out as a depressed decade, caused largely by a decline in wool yields, as a result of severe outbreaks of scab, which affected industrial output and commercial services as well as pastoral agriculture (Stephenson, 1988; Stratton, 1978; Carus-Wilson and Coleman, 1962). The half century culminating in the first outbreak of the Black Death was particularly harsh, with output falling for three consecutive years of harvest failure and sheep murrain in 1314-16 and a severe outbreak of bovine pestilence in 1319-21 before the plague struck in 1348-49 (Kershaw, 1973; Campbell, 2010). Although the Black Death clearly had a strongly negative effect on GDP, this was largely through the catastrophic decline in population, since the living standards of those who survived rose substantially (Pamuk, 2007; Broadberry, Campbell, Klein, Overton and van Leeuwen, 2011). In this sense, the Black Death recession was clearly very different from the recessions caused by the harvest failures and livestock epidemics of the preceding decades, which had an adverse effect on GDP per capita as well as on GDP.

Although Figures 6 and 7 suggest that agriculture was the most important driver of the business cycle during the medieval period, industry and services were affected by wars, the incidence of which varied over time. Perhaps the most direct impact of warfare was through government spending, which increased sharply during

the first half of the fourteenth century, and then remained on a higher plateau despite the dramatic fall in population after the Black Death. Initially, this increase in spending was driven by Edward I's campaigns in Wales and Scotland, but was taken to new heights by the Hundred Years War with France (1337-1453). The Hundred Years War had additional indirect effects on economic activity by disrupting commerce, particularly trade with the continent in wool and wine (Postan, 1942: 2-4; McFarlane, 1962: 8-9).

Monetary factors have also been seen by a number of authors as playing an important role in the real business cycle during this period. Nightingale (1990:560) argues that a drop in the output of the English mints between 1370 and 1400 was accompanied by a reduction of credit, with negative consequences for the level of real economic activity as well as a fall in the price level. Spufford (1988: 362) similarly argues that the reduction in mint output of the 1440s and 1450s, which occurred across almost the whole of Europe as well as in England, had a depressing effect on the level of both real output and prices. However, until now, the aggregate evidence needed to confront these arguments has not been available. As we shall see below, the evidence points to the late medieval bullion famines affecting prices without having a depressing effect on the level of real economic activity.

3. Business cycles, 1500-1700

During the period 1500-1700, the length of cycles continued to average 3 to 4 years peak to peak. Although the amplitude appears to have increased from around 1550, this may partly be a result of the nature of the data used to construct agricultural output. Whereas the manorial data base which was used for the medieval period was

comprised largely of long runs of data referring to the same location, the probate inventories data base used for the early modern period was derived from one-off observations when farmers in particular locations died. The lack of long runs of data on fixed locations is compounded by the fact that the sample size for each year was generally smaller than for the manorial data base, apart from during the late fifteenth century when the manorial sector was in terminal decline.

Figures 6 and 7 suggest that industry and services were beginning to have a larger effect on the annual growth rate during the early modern period, as their share of economic activity increased. Nevertheless, agriculture continued to be the dominant driver of the cycle, even during periods where commercial factors may have been expected to play a more important role, such as the five-year recession of 1547-52 at the end of the Great Tudor Debasement, and the recession at the end of the Civil War decade of the 1640s (Gould, 1970; Coates, 2004; Cunningham, 1907). Wrigley and Schofield (1989: 334) identify a number of severe mortality crises in the sixteenth and seventeenth centuries, all of which show up in our GDP data and can be linked to years of successive harvest failures. The most severe mortality crisis occurred in 1557-59, following a 25 per cent fall in agricultural output between 1553 and 1556. Further severe mortality crises occurred in 1623-26 and 1657-59 following sharp falls in output during 1621-23 and 1655-59 respectively.

War continued to be a contributor to the cycle both through the direct effects of government spending and the indirect effects of disruption to trade and industry. However, Nef (1942) points to the period 1540-1640 as one in which England was much less affected by warfare than continental Europe, where fighting was almost

uninterrupted. After the Civil War, however, England was engaged in a number of wars driven by commercial rivalry, such as the Anglo-Dutch Wars of 1652-54, 1665-67 and 1672-74 (Ormrod, 2003). Although the downturn at the end of the 1640s can be attributed at least in part to the disruption of the Civil War, Hindle (2008) points out that a series of bad harvests coincided with the constitutional crisis, and suggests that the mortality crisis may have been more severe than suggested by Wrigley and Schofield (1989) because of deficiencies in burial registration during this period.

4. Business cycles, 1700-1870

Business cycles continued to last 3 to 4 years peak to peak during the period 1700-1870. Although there appears to be a reduction in volatility from the 1720s, this should again be treated with a degree of caution because of the change in the agricultural database, this time away from the probate inventories and back to records with a degree of continuity over time, in the form of farm accounts. The amplitude from the 1720s was generally within plus or minus 5 per cent, but in contrast to the medieval period, the exceptions were largely in booms rather than slumps, as the growth rate increased substantially. This was partly due to the path of population, which grew rapidly from the eighteenth century rather than falling as after the Black Death, but it was also due to an increase in the trend growth of per capita GDP.

Harvest fluctuations continued to play an important role in the business cycle during the eighteenth and nineteenth centuries, but wars and commerce played a growing role as industry and services accounted for an increasingly large part of economic activity. The period 1727-30 appears as one of the most severe mortality crises in Wrigley and Schofield's (1989: 334) dataset, and followed a run of bad

harvests in 1723-24 and 1726-27. The high level of volatility in the early years of the eighteenth century was not just due to harvest fluctuations, but also coincided with the War of the Spanish Succession (1701-1714), which affected commerce and industry. Although the wars of the mid-eighteenth century appear to have had less impact on economic activity, there was a marked increase in volatility during the Revolutionary and Napoleonic Wars (1792-1815). The suspension of specie payments during the war led to inflation, which was followed by a postwar deflation to bring about the resumption of convertibility (Bordo and White, 1991). This postwar deflation created a sharp recession between 1817 and 1819. The cotton famine of the early 1860s also stands out as a sharp recession, as the American Civil War disrupted the supply of raw cotton to the Lancashire textile manufacturers, with an inevitable knock-on effect for the economy as a whole (Henderson, 1969).

For the period 1700-1870, we can check our business cycle chronology in Table 3 against earlier chronologies established by Ashton (1959) for the eighteenth century and by Gayer, Rostow and Schwartz (1953) and Rostow (1972) for the nineteenth century. Both of these chronologies were based on the NBER methodology of Burns and Mitchell (1946), which involved checking a large number of microeconomic time series and establishing turning points in "general business activity" as a "consensus of statistical data rather than turning-points in any particular magnitude such as national income" (Matthews, 1954: 2). The peak and trough years obtained with this methodology are shown in Table 4. The disagreements between these two chronologies over turning points in the overlap period can be put down to the difficulties of assigning tuning points on an annual basis when monthly data would be more appropriate. However, of the peaks and troughs identified by Gayer,

Rostow and Schwartz in Table 4, we find peaks and troughs in the same years in only around 53 per cent of cases, while in the case of Ashton, we find peaks and troughs in the same years in just 40 per cent of cases. The use of an aggregate GDP series to identify the cycle therefore makes a significant difference to the business cycle chronology.

In addition, it is worth mentioning two studies by Hoskins (1964; 1968), which tried to identify years of good and bad harvests in England for the periods 1480-1619 and 1620-1759, using data on the price of wheat. However, there are a number of good reasons to be sceptical about the agricultural cycles identified by Hoskins. First, Hoskins identified high and low price years as deviations from a 31 year moving average, a form of filtering which has fallen out of favour, because of the risk of introducing spurious cycles. Second, now that data are available on grain yields, it can be seen that the relationship between prices and quantities was more complex than Hoskins believed. In particular, when the data are presented as annual averages, there could be a lag in the relationship, with a fall in output leading to a rise in price only in the following year. Third, whether a harvest was good or bad could vary by crop and by region, so that arriving at an overall judgement without a properly weighted index of output is bound to be hazardous. Fourth, this problem is compounded by the fact that arable farming was only a part of the agricultural sector, and that in the large pastoral farming sector, outbreaks of disease moved independently of the harvest cycle, so that it would take a large leap of faith to move from Hoskins's cycle for wheat to the whole of agriculture, let alone the total economy.

Nevertheless, it can be helpful to check the agricultural cycle against Stratton's (1978) more general attempt to identify good and bad years in both pastoral and arable farming from agricultural records. The identification of severe mortality crises by Wrigley and Schofield (1989: 334) for the period 1541-1871 can also be linked to years of successive harvest failures.

V. NOMINAL ASPECTS OF THE BUSINESS CYCLE

So far we have focused on fluctuations in real GDP. However, writing in the aftermath of the 2008 financial crisis, our analysis of business cycles would not be complete without a consideration of nominal variables and the role of money and finance. We consider a number of episodes of inflation and deflation, and examine the extent to which they had consequences for the real economy.

1. The late medieval bullion famines

In assessing the effects of the bullion famines of the late fourteenth and the fifteenth centuries and the Great Inflation of the sixteenth century, it will be helpful to note a long running debate in the medieval and early modern economic history literature on the role of money. Whereas monetary historians such as Mayhew (1995; 2011), Spufford (1988) and Nightingale (1990) explain the movement of prices by the quantity of money, others such as Postan (1952: 210-217; 1972: 235-245) and Ramsey (1971) emphasise population movements. However, although an increase in population with a fixed supply of land may reasonably be expected to increase the relative price of food, it cannot be responsible for an increase in the general price level. Indeed, as McCloskey (1972: 1334) points out, in the quantity theory of money,

an increase in population increases the number of transactions and hence must lead to a fall in the price level, other things being equal.

If the persistence of the belief that population determined the price level is mysterious, as pointed out by Mayhew (2011), equally mysterious is the persistence of a view amongst some monetary historians that declines in the supply of money in the late fourteenth and fifteenth centuries depressed economic activity for sustained periods (Nightingale, 1990; Spufford, 1988). If the increase in bullion during the sixteenth century caused an increase in the price level over the long run, then it seems logical that the earlier declines in bullion caused a decrease in the price level over the long run. This property of the long run neutrality of money is consistent with shorter run effects of deflation or inflation on real economic activity, perhaps lasting a year or two before prices adjust in a world of nominal rigidities, but not with real effects lasting decades. What is perhaps most striking about this view of money as the key driver of the level of real activity is that during the fourteenth and fifteenth centuries, falling population after the Black Death provides a much more plausible explanation of falling output. We are thus faced with an unfortunate symmetry of Postan using population rather than money to explain prices and Spufford using money rather than population to explain real output.

2. The Great Inflation of the Sixteenth Century

It is clear from Figure 2 that the overall price level was stationary between the late thirteenth century and the early sixteenth century, then increased sharply during the sixteenth century, before returning to stationarity. One way to explain the Great Inflation of the sixteenth century is through the inflow of silver from the New World,

which increased the money supply. This argument, based on the quantity theory of money and the price-specie flow mechanism, was applied by Hamilton (1934) and Braudel and Spooner (1967) to the wider European experience, and reformulated in terms of the monetary approach to the balance of payments by Flynn (1978).

However, there is also a specifically English component to the inflation of the sixteenth century, due to the debasement of the coinage, culminating in the Great Tudor Debasement of 1542-1551 (Challis, 1967). This was accompanied by a five-year contraction during 1547-52. However, upon closer examination, this was driven largely by what was happening in agriculture rather than developments in commerce and industry. The Great Tudor Debasement does not therefore provide an early example of a financial crisis leading to a severe recession.

3. The South Sea Bubble

The case of the South Sea Bubble is more suggestive of a link between financial recklessness and the real business cycle. This was an extreme example of asset price inflation followed by a crash, with the South Sea Company shares rising during a speculative boom from little more than £100 at the beginning of 1720 to around £1,000 by August of the same year, before crashing back to £150 by the end of September (Temin and Voth, 2004: 1658). Real GDP peaked in 1720, fell sharply in 1721 and did not rise above the 1720 peak before 1736. This was partly the result of fluctuations in agriculture and there may have been other factors making for a downturn in industry and commerce, but it seems likely that the financial crash at least played a role in making matters worse.

4. The Napoleonic Wars and the suspension and resumption of specie payments

We have already seen that the suspension of specie payments during the Napoleonic Wars was accompanied by a period of sustained inflation and followed by a postwar deflation to enable the resumption of convertibility. The suspension began in 1797 as the Bank of England faced simultaneously an external drain on its gold reserves to finance war expenditure overseas and an internal drain caused by a run on the country banks by depositors fearful of a French invasion (Bordo and White, 1991: 311). By 1813, sterling had depreciated from par by 38.2 per cent, but thereafter appreciated as the British government retained credibility through an appropriate mix of fiscal and financial policies (Silberling, 1924: 227; Bordo and White, 1991: 310-314).

The postwar deflation was accompanied by real economic hardship as the economy experienced a slump, with real GDP falling 5.2 per cent in 1816 and surpassing its 1815 peak only in 1820, despite a brief rebound in 1817. As the general price level fell, upward pressure was brought to bear on grain prices through the Corn Laws, which imposed a duty on imported corn to protect domestic farmers. With wages falling and indirect taxes being raised to replace the revenue from the abolition of the income tax imposed during the war, the living standards of the poor were squeezed. The protests arising from these difficulties were suppressed harshly, with the Peterloo massacre in 1819 the most notorious example (Reid, 1989).

5. The Phillips Curve relationship

The above examples explore the relationship between episodes of inflation or deflation and real economic activity. There has been a large literature on this relationship since the claim of Phillips (1958) to have uncovered a positive

relationship between the rate of inflation and the level of economic activity in Britain during the period 1861-1957. Although the original Phillips Curve was couched in terms of a negative relationship between the rate of inflation and the rate of unemployment, it can equally be analysed in terms of a positive relationship between the rate of inflation and the cyclical component of GDP (Hills et al., 2010).

It is usual with annual data to work with a one-period lag in the growth rate to allow time for the economy to adjust to excess demand. Figure 9 therefore provides scatter plots of the rate of inflation against the rate of GDP growth lagged one year for the three sub-periods, 1270-1500, 1500-1700 and 1700-1870. We find very little evidence to support the idea of a Phillips Curve relationship over this long period. Although the slope of the regression line is slightly positive during the period 1700-1870, this seems to be driven by a small number of outliers. For the pre-1700 period the relationship is if anything negative rather than positive.[2]

If there is no general relationship between changes in the price level and real economic activity, then nominal variables such as the money supply are not the drivers of real business cycles, which must be explained by real developments, such as shocks to the weather, technology, wars or labour supply (Long and Plosser, 1983; Lucas, 1987). We thus concur with Mayhew's (2011) assessment that the primary impact of the quantity of money was on the determination of the price level.

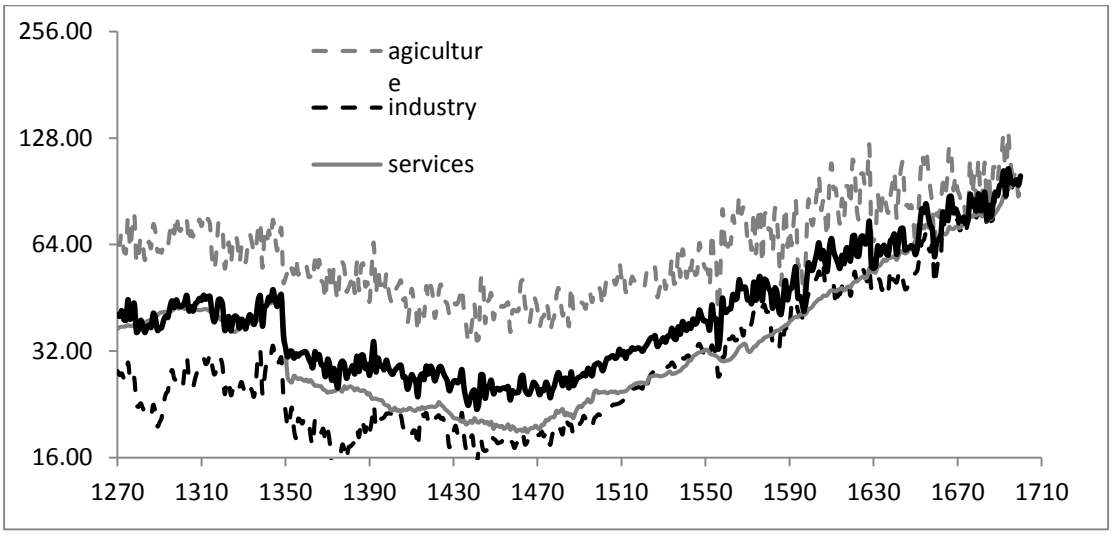
VI. CONCLUSIONS

[2] Working with the current rather than the lagged growth rate does not strengthen the relationship, which remains negative in two of the three periods.

Much of what is known about business cycles is based on relatively short runs of data. In this paper, we massively extend the range of business cycle analysis, using a new annual dataset of real and nominal GDP constructed from the output side to analyse business cycles in England between 1270 and 1700 and Great Britain between 1700 and 1870. Before 1700, business cycles were driven largely by agricultural fluctuations, but shocks to industry and commerce became more important over time as the structure of the economy changed.

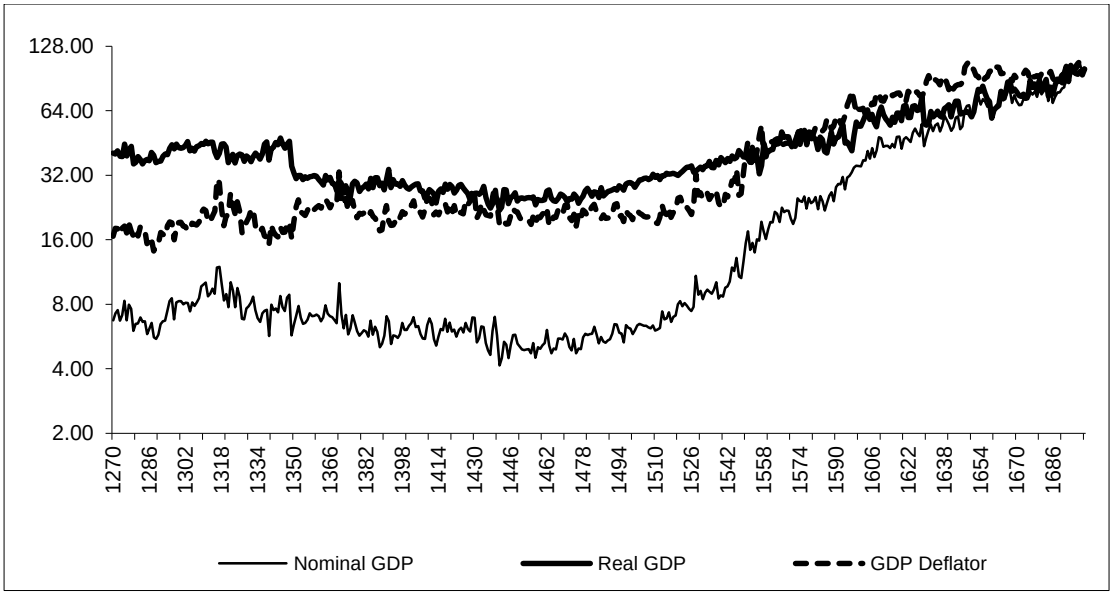
A number of severe recessions can be identified, associated with recurrent harvest failures, epidemics, wars or financial shocks. Although monetary factors played a role in a small number of these severe recessions, most business cycles were "real", with no general Phillips Curve relationship between changes in the price level and real economic activity.

FIGURE 1: English real GDP, 1270-1700 (log scale, 1700=100)



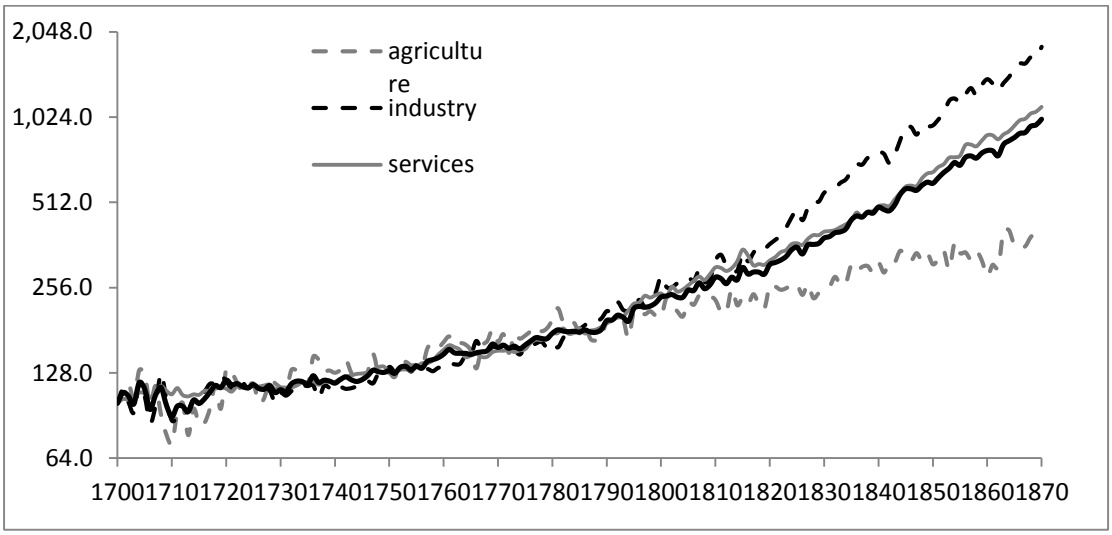
Source: Broadberry et al. (2011)

FIGURE 2: Real and nominal GDP, England 1270-1700 (1700=100, log scale)



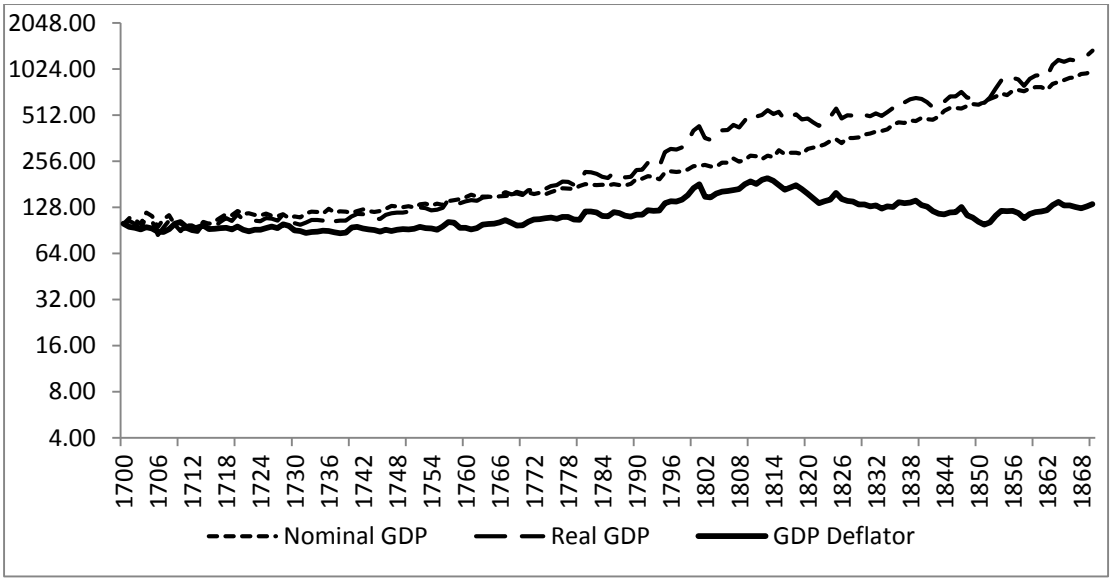
Sources: Broadberry et al. (2011).

FIGURE 3: British GDP in real terms, 1700-1870 (log scale, 1700=100)



Sources: Broadberry et al. (2011).

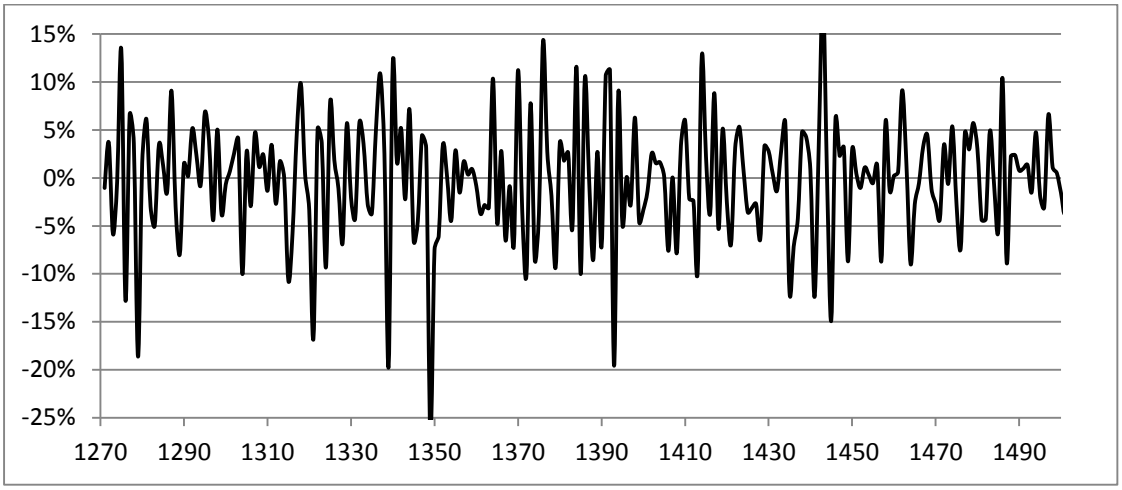
FIGURE 4: Real and nominal GDP, Great Britain 1700-1870 (1700=100, log scale)



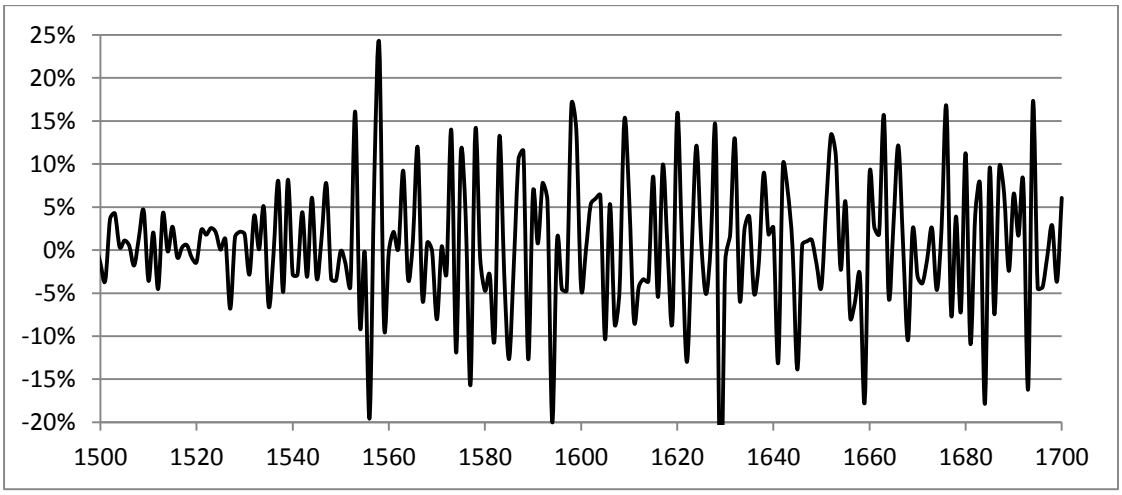
Sources: Broadberry et al. (2011).

FIGURE 5: Annual growth rates of GDP (%)

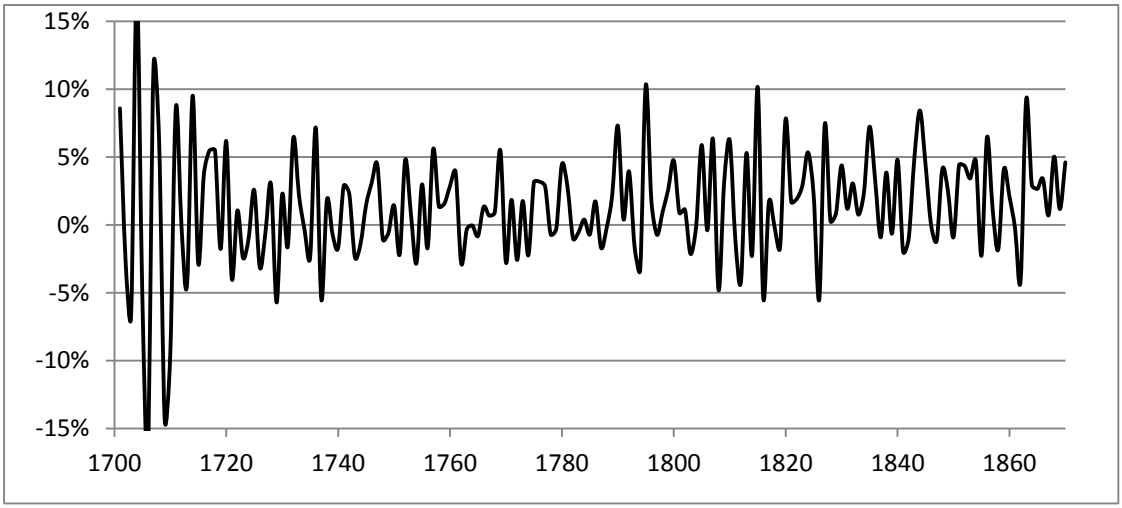
A. 1270-1500



B. 1500-1700



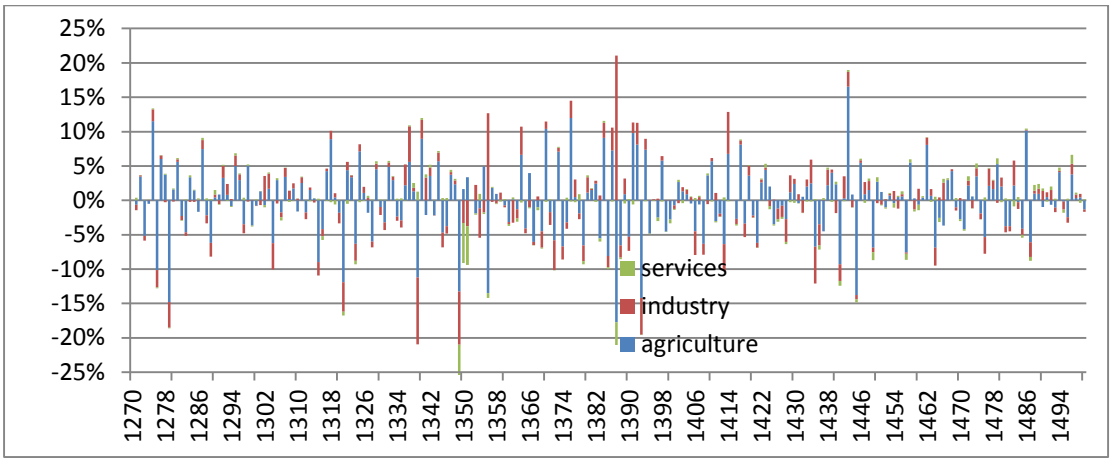
C. 1700-1870



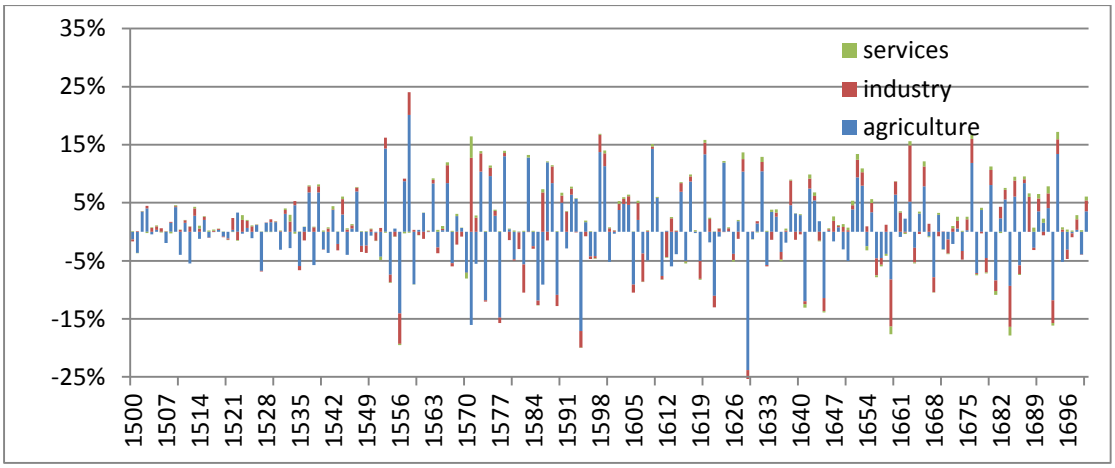
Sources: see text.

FIGURE 6: Contributions of agriculture, industry and services to annual output growth (percentage points)

A. 1270-1500



B. 1500-1700



C. 1700-1870

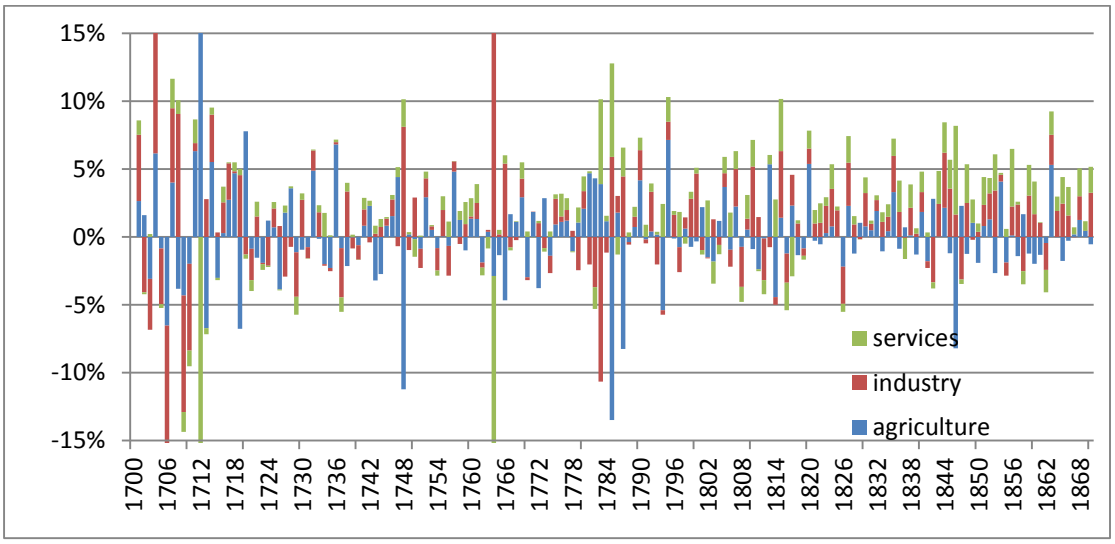


FIGURE 7: Contributions of agriculture, industry and services to annual output growth, averaged by decade (percentage points)

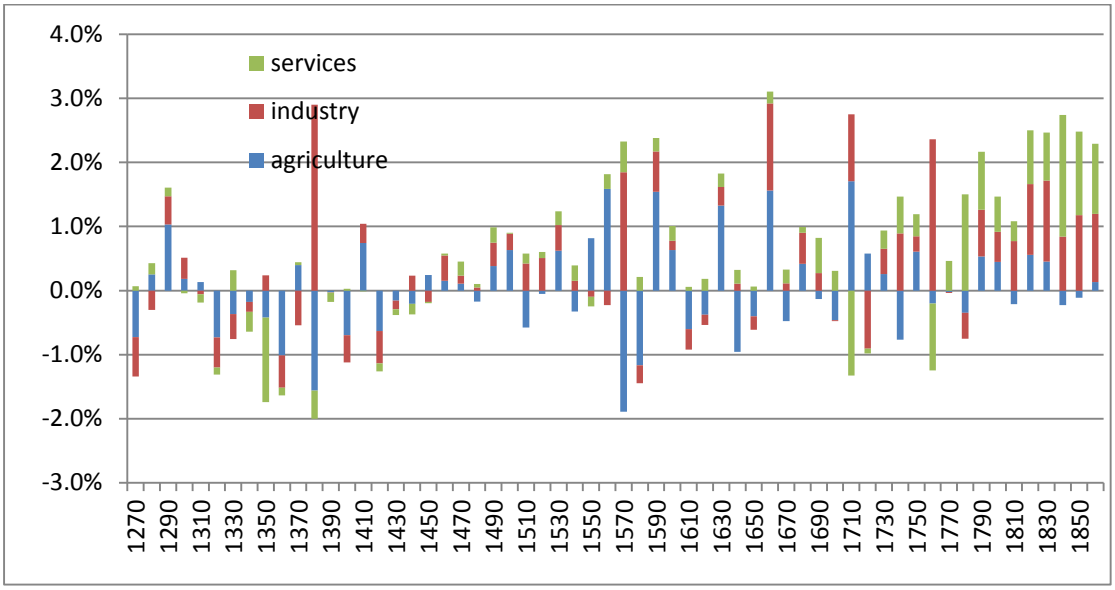
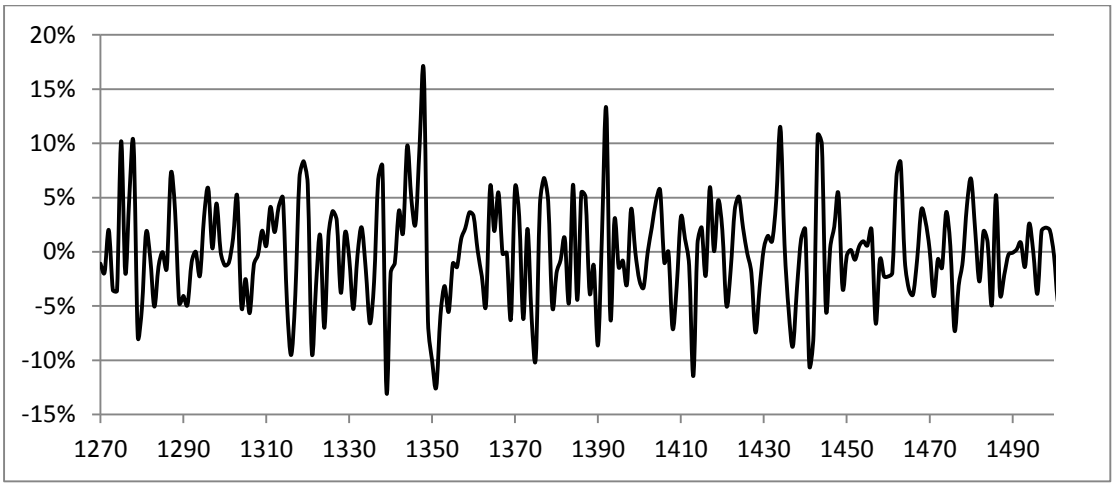
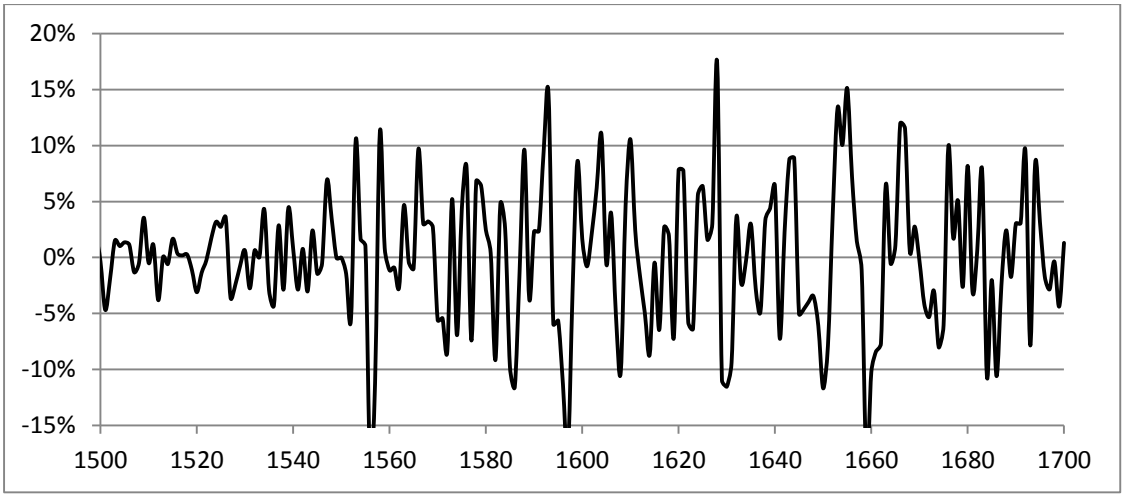


FIGURE 8: Cyclical component of the log of the GDP index after Hodrick-Prescott filter (λ=100)

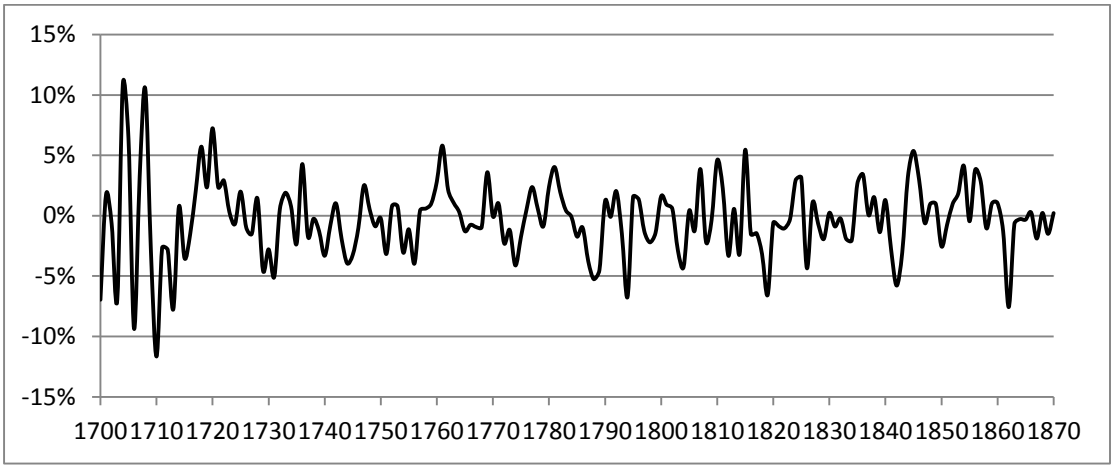
A. 1270-1500



B. 1500-1700



C. 1700-1870



Sources: see text.

TABLE 1: English business cycle chronology based on GDP series, 1270-1500

Peak	Trough	Peak	Trough	Peak	Trough
1272	1274	1348	1351	1419	1421
1275	1276	1353	1354	1424	1428
1278	1279	1355	1356	1431	1432
1281	1283	1359	1363	1434	1437
1285	1286	1364	1365	1440	1441
1287	1289	1366	1367	1443	1445
1290	1291	1368	1369	1448	1449
1293	1294	1370	1372	1451	1452
1296	1297	1373	1375	1454	1455
1298	1300	1377	1379	1456	1457
1303	1304	1382	1383	1458	1460
1305	1306	1384	1385	1463	1466
1309	1310	1386	1388	1468	1471
1311	1312	1389	1390	1472	1473
1314	1316	1392	1393	1474	1476
1319	1321	1394	1395	1480	1482
1323	1324	1396	1397	1483	1485
1326	1328	1398	1401	1486	1487
1329	1331	1405	1406	1492	1493
1333	1335	1407	1408	1494	1496
1338	1339	1410	1413	1498	1501
1342	1343	1415	1416		
1344	1346	1417	1418		

Sources: see text.

TABLE 2: English business cycle chronology based on GDP series, 1500-1700

Peak	Trough	Peak	Trough	Peak	Trough
1498	1501	1561	1562	1632	1633
1503	1504	1563	1565	1635	1637
1505	1507	1566	1567	1640	1641
1509	1510	1568	1570	1644	1645
1511	1512	1571	1572	1648	1650
1513	1514	1573	1574	1653	1654
1515	1517	1576	1577	1655	1659
1518	1520	1578	1582	1663	1664
1524	1525	1583	1586	1666	1668
1526	1527	1588	1589	1669	1672
1530	1531	1593	1594	1673	1674
1532	1533	1595	1597	1676	1677
1534	1536	1599	1601	1678	1679
1537	1538	1604	1605	1680	1681
1539	1541	1606	1608	1683	1684
1542	1543	1610	1614	1685	1686
1544	1545	1615	1616	1688	1689
1547	1549	1617	1619	1692	1693
1550	1552	1620	1623	1694	1697
1553	1556	1625	1626	1698	1699
1558	1560	1628	1630		

Sources: see text.

TABLE 3: British business cycle chronology based on GDP series, 1700-1870

Peak	Trough	Peak	Trough	Peak	Trough
1701	1703	1755	1756	1817	1819
1704	1706	1761	1765	1820	1822
1708	1710	1766	1768	1825	1826
1711	1713	1769	1770	1827	1829
1714	1715	1771	1772	1830	1831
1718	1719	1773	1774	1832	1834
1720	1721	1777	1779	1836	1837
1722	1724	1781	1785	1838	1839
1725	1727	1786	1788	1840	1842
1728	1729	1790	1791	1845	1847
1730	1731	1792	1794	1848	1850
1733	1735	1795	1798	1854	1855
1736	1737	1800	1804	1856	1858
1738	1740	1805	1806	1860	1862
1742	1744	1807	1808	1864	1865
1747	1749	1810	1812	1866	1867
1750	1751	1813	1814	1868	1869
1752	1754	1815	1816	1870	

Sources: see text.

TABLE 4: Alternative business cycle chronology based on sectoral indicators

A. Eighteenth Century

Peak	Trough	Peak	Trough
1701	1702	1751	1755
1704	1706	1761	1763
1708	1712	1764	1769
1714	1716	1771-72	1775
1717-18	1722	1777	1781
1724-25	1727	1783	1784
1728	1730	1787	1789
1733	1734	1792	1794
1738	1742	1796	1798
1743	1746	1799	1800
1746	1748	1802	

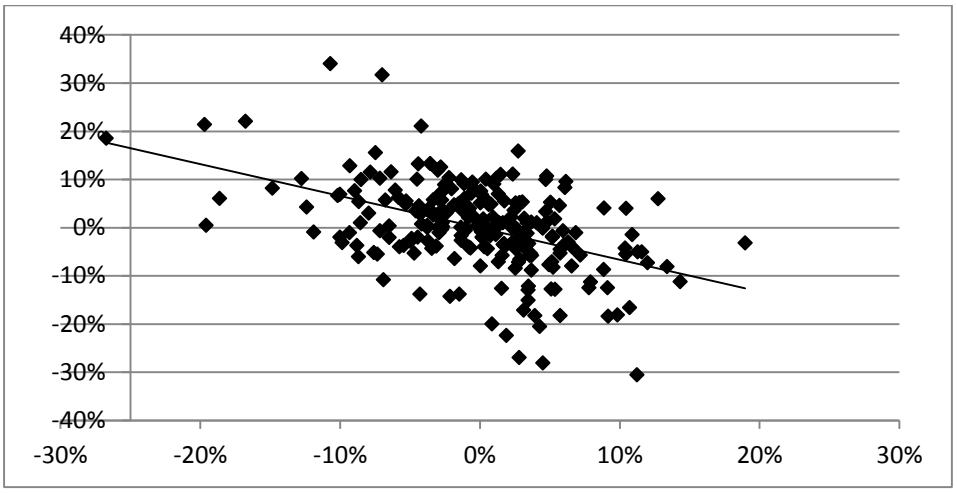
B. Nineteenth Century

Peak	Trough	Peak	Trough
1792	1793	1828	1829
1796	1797	1831	1832
1800	1801	1836	1837
1802	1803	1839	1842
1806	1808	1845	1848
1810	1811	1854	1855
1815	1816	1857	1858
1818	1819	1860	1862
1825	1826	1866	1868

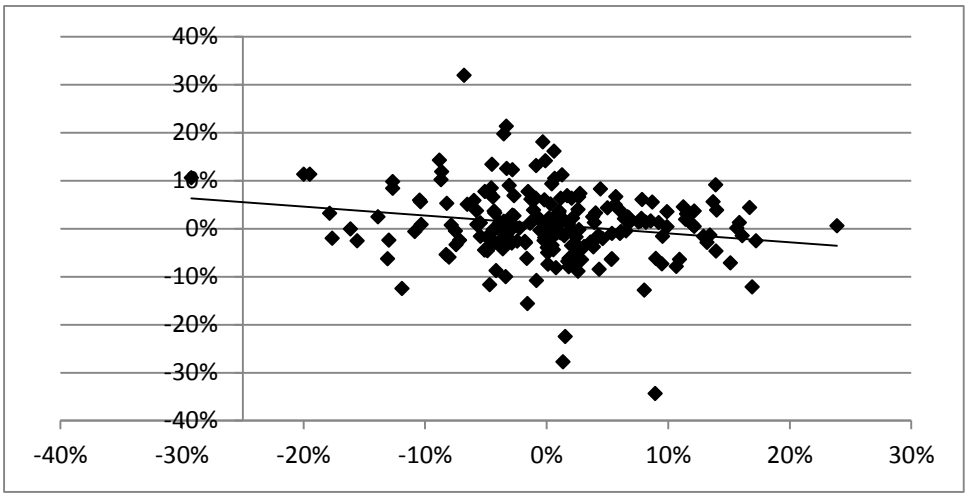
Sources: Ashton (1959: 172); Gayer, Rostow and Schwartz (1953: 348); Rostow (1972: 77).

FIGURE 9: The Phillips Curve relationship between the inflation rate (vertical axis) and the growth of real GDP lagged one year (horizontal axis)

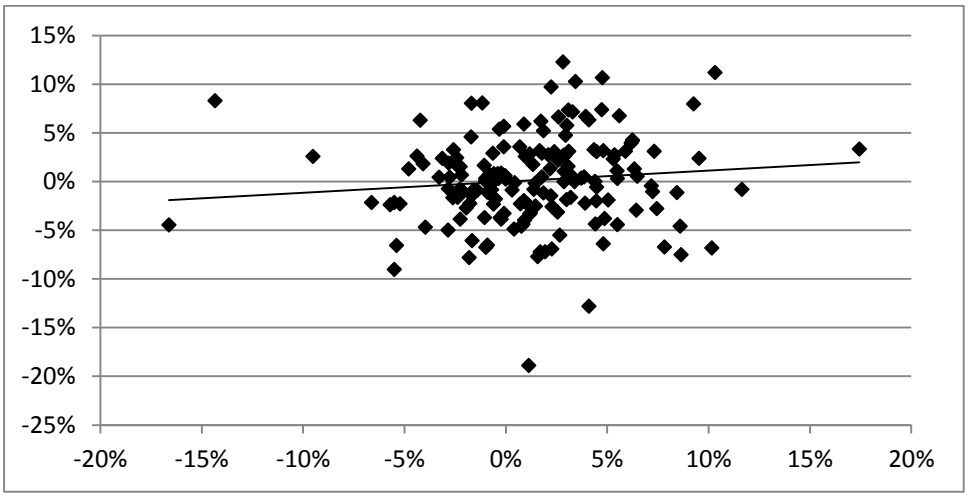
A. 1270-1500



B. 1500-1700



C. 1700-1870



REFERENCES

Ashton, T.S. (1959), *Economic Fluctuations in England, 1700-1800*, Oxford: Clarendon.

Backus, D.K. and Kehoe, P.J. (1992), "International Evidence on the Historical Properties of Businesss Cycles", *American Economic Review*, 82, 864-888.

Beveridge, W. (1939), *Prices and Wages in England from the Twelfth to the Nineteenth Century, Vol. I, Price Tables: Mercantile Era*, London: Longmans, Green.

Bogart, D. (2005), "Turnpike Trusts and the Transport Revolution in 18th century England", *Explorations in Economic History*, 42, 479-508.

Bordo, M. and White, E. (1991), "A Tale of Two Currencies: British and French Finance During the Napoleonic Wars", *Journal of Economic History*, 51, 303-316.

Broadberry, S.N. (2002), "Economic Policy", in Hollowell, J. (ed.), *Britain Since 1945*, Oxford: Blackwell, 383-403.

Broadberry, S.N., Campbell, B., Klein, A., Overton, M. and van Leeuwen, B. (2011), "British Economic Growth, 1270-1870: An Output-Based Approach", London School of Economics, http://www2.lse.ac.uk/economicHistory/whosWho/profiles/sbroadberry.aspx.

Braudel, F.P. and Spooner, F. (1967), "Prices in Europe from 1450 to 1750", in Rich, E.E. and Wilson, C.H. (eds.), *The Cambridge Economic History of Europe, Vol. IV: The Economy of Expanding Europe in the Sixteenth and Seventeenth Centuries*, (Cambridge: Cambridge University Press, 374-486.

Campbell, B.M.S. (2010), "Nature as Historical Protagonist: Environmnet and Society in Pre-Industrial England", *Economic History Review*, 63, 281-314.

Carus-Wilson, E.M. and Coleman, O. (1963), *England's Export Trade, 1275-1547*, Oxford: Clarendon.

Challis, C.E. (1967), "The Debasement of the Coinage, 1542-1551", *Economic History Review*, 20, 441-466.

Clark, G. (2004), "The Price History of English Agriculture, 1209-1914", *Research in Economic History*, 22, 41-125.

Clark, G. (2006), "England, Prices and Wages since 13th Century", Global Price and Income History Group, University of California, Davis, http://gpih.ucdavis.edu/Datafilelist.htm.

Coates, B. (2004), *The Impact of the English Civil War on the Economy of London, 1642-50*, Aldershot: Ashgate.

Crafts, N.F.R. (1985), *British Economic Growth during the Industrial Revolution*, Oxford: Clarendon.

Crafts, N.F.R. and Harley, C.K. (1992), Output Growth and the British Industrial Revolution: A Restatement of the Crafts-Harley View", *Economic History Review*, 45, 703-770.

Cunningham, W. (1907), *The Growth of English Industry and Commerce in Modern Times, Volume 2*, (6th edition), Cambridge: Cambridge University Press.

Deane, P. and Cole, W.A. (1967), *British Economic Growth, 1688-1959: Trends and Structure*, 2nd edition, Cambridge: Cambridge University Press.

Flynn, D.O. (1978), "A New Perspective on the Spanish Price Revolution: The Monetary Approach to the Balance of Payments", *Explorations in Economic History*, 15, 388-406.

Gayer, A.D., Rostow, W.W. and Schwartz, A.J. (1953), *The Growth and Fluctuation of the British Economy, 1790-1850*, Oxford: Oxford University Press.

Gould, J.D. (1970), *The Great Debasement: Currency and the Economy in Mid-Tudor England*, Oxford: Clarendon.

Hamilton, E.J. (1934), *American Treasure and the Price Revolution in Spain, 1501-1650*, Cambridge, MA: Harvard University Press.

Harley, C. K. (1988) "Ocean Freight Rates and Productivity, 1740-1913: The Primacy of Mechanical Invention Reaffirmed", *Journal of Economic History*, 48, 851-876.

Hatcher, J. (1996), "The Great Slump of the Mid-Fifteenth Century", in Britnell, R. and Hatcher, J. (eds.), *Progress and Problems in Medieval England: Essays in Honour of Edward Miller*, Cambridge: Cambridge University Press, 237-272.

Henderson, W.O. (1969), *The Lancashire Cotton Famine, 1861-1865*, (2nd edition), Manchester: Manchester University Press.

Hindle, S. (2008), "Dearth and the English Revolution: The Harvest Crisis of 1647-50", *Economic History Review*, 61, S64-S98.

Hills, S., Thomas, R. and Dimsdale, N. (2010), "The UK Recession in Context – What do Three Centuries of Data Tell Us?", *Bank of England Quarterly Bulletin*, 277-291.

Hodrick, R.J. and Prescott, E.C. (1997), "Postwar U.S. Business Cycles: An Empirical Investigation", *Journal of Money, Credit and Banking*, 29, 1-16.

Hoffmann, W.G. (1955), *British Industry 1700-1950*, Oxford: Blackwell.

Horrell, S., Humphries, J. and Weale, M. (1991), "Input-Output Table 1841: Notes on Construction", University of Cambridge.

Horrell, S., Humphries, J. and Weale, M. (1994), "An Input-Output Table for 1841", *Economic History Review*, 47, 545-566.

Hoskins, W.G. (1964), "Harvest Fluctuations and English Economic History, 1480-1619", *Agricultural History Review*, 12, 28-46.

Hoskins, W.G. (1968), "Harvest Fluctuations and English Economic History, 1620-1759", *Agricultural History Review*, 16, 15-31.

Kershaw, I. (1973), "The Great Famine and Agrarian Crisis in England, 1315-1322", *Past and Present*, 59, 3-50

Lee, C.H. (1986), *The British Economy since 1700: A Macroeconomic Perspective*, Cambridge: Cambridge University Press.

Lindert, P.H. and Williamson, J.G. (1982), "Revising England's Social Tables, 1688-1812", *Explorations in Economic History*, 19, 385-408.

Long, J.B., Jr. and Plosser, C.I. (1983), "Real Business Cycles", *Journal of Political Economy*, 91, 39-69.

Lucas, R.E. (1987), *Models of Business Cycles*, Oxford: Blackwell.

McFarlane, K.B. (1962), "War, the Economy and Social Change: England and the Hundred Years War", *Past and Present*, 22, 3-18.

McCloskey, D.N. (1972), "Review of 'The Price Revolution in Sixteenth Century England', by Peter H. Ramsey", *Journal of Political Economy*, 80, 1332-1336.

Matthews, R.C.O. (1954), "The Trade Cycle in Britain, 1790-1850", *Oxford Economic Papers*, 6, 1-32.

Mayhew, N. (1995), "Population, Money Supply, and the Velocity of Circulation in England, 1300-1700", *Economic History Review*, 47, 238-257.

Mayhew, N. (2011), "The Circulation of Money and the Behaviour of Prices in Medieval and Early Modern England", Ashmolean Museum, Oxford.

Nef, J.U. (1942), "War and Economic Progress 1540-1640", *Economic History Review*, 12, 13-38.

Nightingale, P. (1990), "Monetary Contraction and Mercantile Credit in Later Medieval England", *Economic History Review*, 43, 560-575.

Ormrod, D. (2003), *The Rise of Commercial Empires: England and the Netherlands in the Age of Mercantilism, 1650-1770*, Cambridge: Cambridge University Press.

Pamuk, S. (2007), "The Black Death and the Origins of the 'Great Divergence' Across Europe, 1300-1600", *European Review of Economic History*, 11, 289-317.

Phillips, A.W.H. (1958), "The Relationship Between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861-1957", *Economica*, 25, 283-299.

Plosser, C.I. (1989), "Understanding real Business Cycles", *Journal of Economic Perspectives*, 3(3), 51-77.

Postan, M.M. (1942), "Some Social Consequences of the Hundred Years' War", *Economic History Review*, 12, 1-12.

Postan, M.M. (1952), "The Trade of Medieval Europe: The North", in Postan, M.M. and Rich, E.E. (eds.), *The Cambridge Economic History of Europe, Volume II: Trade and Industry in the Middle Ages*, Cambridge: Cambridge University Press, 119-256.

Postan, M.M. (1972), *The Medieval Economy and Society: An Economic History of Britain, 1100-1500*, London: Weidenfeld and Nicolson.

Ramsey, P.H. (ed.), (1971), *The Price Revolution in Sixteenth-Century England*, London: Methuen.

Ravn, M.O. and Uhlig, H. (2002), "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations", *Review of Economics and Statistics*, 84, 371-375.

Reid, R.W. (1989), *The Peterloo Massacre*, London: Heinemann.

Rostow, W.W. (1972), "Cycles in the British Economy: 1790-1914", in Aldcroft, D.H. and Fearon, P. (eds.), *British Economic Fluctuations 1790-1913*, Basingstoke: Macmillan, 74-96.

Silberling, N.J. (1924), "Financial and Monetary Policy of Great Britain During the Napoleonic Wars", *Quarterly Journal of Economics*, 38, 214-233.

Snooks, G.D. (1995), "The Dynamic Role of the Market in the Anglo-Norman Economy and beyond, 1086-1300", in Britnell, R. and Campbell, B.M.S. (eds.), *A Commercialising Economy: England 1086 to c. 1300*, Manchester, Manchester University Press, 27-54.

Spufford, P. (1988), *Money and its Use in Medieval Europe*, Cambridge: Cambridge University Press.

Stephenson, M. J. (1988), "Wool Yields in the Medieval Economy", *Economic History Review*, 61, 368-91.

Stratton, J.M. (1978), *Agricultural Records, A.D. 220-1977*, (second edition), London: Baker.

Temin, P. and Voth, H.J. (2004), "Riding the South Sea Bubble", *American Economic Review*, 94, 1654-1668.

Thorold Rogers, J.E. (1886-1902), *A History of Agriculture and Prices in England*, Volumes 3-7, Oxford: Clarendon Press.

Wrigley, E.A. and Schofield, R.S. (1989), *The Population History of England, 1541-1871: A Reconstruction*, Cambridge: Cambridge University Press.