

# The Baran Ratio, Investment, and British Economic Growth and Development

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## Abstract

Investment in capital, new technology, and agricultural techniques has not been considered an endeavor worthwhile in a medieval economy because of a lack of strong property rights and no incentive on the part of lords and barons to lend money to or grant rights to peasant farmers. Therefore, the medieval economy and standards of living at that time often have been characterized as non-dynamic and static due to insufficient investment in innovative techniques and technology. Paul Baran's concept of the economic surplus is applied to investment patterns during the late medieval, mercantile, and early capitalist stages of economic growth in England and the UK. This paper uses Zhun Xu's Baran Ratio concept to try to develop general trends to demonstrate and to reinforce other historical accounts of these times that a productive and sufficient level of public and private investment out of accumulated capital income, taxation, and rents does not have a real impact on economic per capita growth until around the 1600s in Britain. This would also be about the time of capitalism's ascent as the dominant economic system in England. Even then, dramatic increases in investment and economic growth do not appear until the late 18<sup>th</sup> Century when investment more consistently becomes more than one hundred percent of the level of economic surplus and takes in government spending. The types of investment, threshold amounts of investment out of profits and rents along with government spending seem to matter when it comes to a growth path raising GDP per capita and national income per capita to higher levels. Although much of this knowledge perhaps is embodied in current historical accounts, the Baran Ratio nicely summarizes and illustrates the importance of levels of investment to economic growth.

**JEL Codes:** B51, E11, E12, N13

**Keywords:** Baran Ratio, capitalism, economic growth, feudalism, investment

February 2022

## Introduction

Under capitalism, many businesses use part or all of the proceeds of their profits to buy more property, plant, inventory, and equipment if opportunities to expand and earn greater profits exist. Under feudalism, an economic system that is generally characterized as one that lacks the property rights to encourage producers to re-invest in or add to their productive capital (North and Thomas 1971 and 1973, McCloskey 1972, Brenner 1976 and 1985, Dimmock 2014), such investment is only expected to occur on a very small scale. There is little incentive for serfs to try to expand their efforts and output by reinvestment.<sup>1</sup> Production above a level of subsistence for the peasant farmers and their families would go to lords and barons as surplus, and the nobility usually could get more output from serfs through threat and/or force (Dobb 1947, Brenner 1976 and 1985). Surplus extracted from the work of serfs can be considered to be wasted mostly on “unproductive” expenditures by the aristocracy on large palaces, court jesters, minstrels, the military, and cathedrals, or items which do not create use value or expand labor productivity in a way that can benefit a society (Baran 1953 and 1957, Engels 1957, Smith 2000).

Acemoglu, Johnson, and Robinson (2004) and Acemoglu and Robinson (2012) argue that political institutions shape economic outcomes as opposed to the general Marxian view that economic and material circumstances mostly determine political and social institutions. They argue that the ownership of key resources is enabled by legal and political institutions which in turn dictate the dominant mode of production. Therefore, according to them, the lord’s or baron’s legal or political control over land and water and water mills gave rise to serfdom and feudalism rather than small scale subsistence farming leading to or reinforcing the system of demesnes and feudalism. The purpose of this paper is not to examine which comes first or which is more important but to look at the changes in economic

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<sup>1</sup>Sato (2018) points out that claims and rights to land and land usage were multi-layered under feudalism with lords holding political power over the land while serfs and other commoners of lower classes had rights to use it for subsistence farming, fishing, etc. as long as they shared in the proceeds of their harvests and catches. He argues that it is not until under capitalism that land becomes a commodity and then ownership and rights to land revert to just one person or group of owners who are part of one social class. Multi-layered ownership along class lines cease to exist.

circumstances over time regarding investment levels while noting some important historical developments in English and British history.

Feudalism probably began to unravel due to declining amounts of available land for agriculture, and plagues and famines<sup>2</sup>, which caused labor shortages and increasing labor costs. Since food production often could not keep up with increases in population due to shortages of arable land, petty producers, merchants, and yeoman farmers reinvested their profits back into their operations to finance more productivity, output, and expansion (Brenner 1976 and 1985, Heller 2011, Dimmock 2014). Colander (2020, 73-75) and others claimed that it was during the 1400s that mercantilism evolved from feudalism thanks to the growth of markets, trading, urban areas, global exploration and a larger presence of the government in economic activities through its support of guilds and global exploration. With the Industrial Revolution, capitalism had fully replaced mercantilism (Heller 2011, 89, Colander 2020, 74-75).

This paper's empirical research develops general trends that support the view that it probably is not until the 1600s and especially after 1780 that capital income, investment spending, and investment levels begin to reach a critical threshold of a society's economic surplus, that is, a surplus that is society's cumulative capital income and land income plus tax revenues (Baran 1957, Baran and Sweezy 1966, Foster 2014, Xu 2019, Lambert 2020a).<sup>3</sup> With this, standards of living dramatically begin to advance in England and the United Kingdom (UK) with the greatest advances being made in the 1800s. Productive outlets for investment make themselves available at this time which helps per capita economic growth, although capital income has to rebound as a share of economic surplus and net national income after being lower for several prior centuries (1400s to 1600s).

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<sup>2</sup> Which some have claimed were also caused indirectly by a mini-ice age (e.g, Fagan 2000, Blom 2019 among others).

<sup>3</sup> Stanfield (1974) emphasized one of Baran's (1957) concepts of the economic surplus as potential output less essential consumption of a society to yield potential surplus. Without knowing or being able to estimate slack in the British economy from the 13<sup>th</sup> to 19<sup>th</sup> Centuries., this paper focuses on Baran's concept of the actual surplus, which is actual output minus essential consumption.

If data sources for this paper are correct (Clark 2009, Broadberry, et al 2015), capital income and economic surplus levels might have been higher in the 13<sup>th</sup> and 14<sup>th</sup> Centuries than in the next several centuries and did not reach higher levels again until the 1700s in Britain. See Figures 1 to 3. Surplus for investment was available in the late medieval period, but because of few incentives for productive investment, it was mostly wasted on what some consider unproductive pursuits, and therefore it had little if much impact on economic growth. The lack of a well-developed monetary system and regional and fragmented markets could be another reason. It is granted that the building of cathedrals and palaces employed many people, yet constructing these edifices probably did not in turn raise the current or future productivity of a nation's workforce that much. In the transition period of the 15<sup>th</sup> to 16<sup>th</sup> Centuries, investment levels would still be predicted to be low since capitalism was still not the predominant economic system as mercantilism and trading still reigned. High labor costs (Clark 2009, Humphries and Weisdorf 2019) for several centuries might have prevented the formation of a large enough economic surplus to justify investment too. In the 17<sup>th</sup> Century, the economic surplus began to grow again thanks to a growth in capital income and a lowering of wages, and these events led to the beginning of a more consistent and greater level of capital investment in mostly productive endeavors.<sup>4,5</sup>

(Insert Figures 1 to 3 around here)

This paper proceeds as follows. The next section, Analysis, describes the data sources used in the research for this paper, the definitions of key variables, and the displays of data. Finally, a Discussion

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<sup>4</sup> Rimmer, Higgins, and Pollard (1971) assess the year-to-year rates of investment in the 18<sup>th</sup> and 19<sup>th</sup> Centuries in the UK and estimate it to be slower than other estimates and believe a lot of capital investment undertaken was due to the rapid deterioration of many forms of plant and equipment. They cite the frequency with which horseshoes and many farm tools had to be replaced. Nonetheless, such replacement was necessary to propel agricultural output to higher levels, and therefore the investment expenditures could be considered productive still.

<sup>5</sup> The debate over productive versus non-productive pursuits and occupations can be traced at least as far back as Adam Smith (2000(1776)). In general, those commercial and governmental activities and occupations which do not add to or help to create value in the production or distribution of products or services are considered unproductive whereas those that do add value are productive. In an enterprise, workers who design and create a product would be considered productive whereas cleaning and bookkeeping personnel, although important, would not really be considered productive. In classical political economy this was an important distinction, and it is still considered important to many heterodox economists. It has mostly been discarded, however, by mainstream and neoclassical economists. It is not a primary focus of this paper, however.

and Conclusion section discusses the implications of the findings for historical and modern economic performance and prospects.

### **Analysis**

Lambert (2021) uses Clark (2009) data to estimate levels of aggregate capital stock, investment, and government surpluses and deficits on a decadal basis from 1200 to 1860, and this is a time span longer than what has been previously estimated by other researchers who mostly start their estimates in the 17<sup>th</sup> or 18<sup>th</sup> Centuries.<sup>6</sup> Using Lambert's conjectures, Figure 4 illustrates the growth of the estimated real capital stock over several centuries, and it is shown that growth in the real capital stock does not really begin to climb somewhat until the 17<sup>th</sup> and 18<sup>th</sup> centuries with accelerating growth in the 19<sup>th</sup> century. Lambert's estimated real annual net investment expenditures or change in the capital stock from one decade to the next show a similar pattern as displayed in Figure 5. It appears that investment and capital stock amounts do not really begin to be substantive until the 1600s or 1700s, which according to many authors is about the time that capitalism becomes the dominant form of economic organization in England or the UK.<sup>7</sup> It is around 1770 to 1780 and beyond when investment begins to climb dramatically (Figure 5), a time period which corresponds to the rise of important textile innovations and their implementation in Britain (Caitling 1986).

In some of the decades real net investment is estimated to be negative perhaps because the depreciation of capital stock is greater than total investment or perhaps due to natural disasters, crop failures, economic recession/depression, or war.<sup>8</sup> If some scholars are correct, then the amounts for net

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<sup>6</sup> An exception is a paper by Broadberry and Pleijt (2021) which estimates capital stock and investment levels of different types (working capital, fixed, domestic and overseas assets, etc.) usually going back to the 1350s on a every half century basis. They do not estimate government deficit/surpluses, however. Lambert (2021) finds a high correlation between his estimates and theirs for the years for which there is overlap.

<sup>7</sup> The United Kingdom formally came into existence in 1707 thanks to the Treaty of Union between England and Scotland although the two states had been unified through a common monarch when James I (James VI of Scotland) became King of England around 100 years earlier (Macinnes 2011). Although Great Britain or Britain is not quite the same as the United Kingdom, this paper uses these terms interchangeably for ease of exposition.

<sup>8</sup> Broadberry and Pleijt (2021) show zero for some of their every 50 year estimates but no negative values.

investment in productive pursuits should be small from the 13<sup>th</sup> to the 16<sup>th</sup> centuries but should grow from the 17<sup>th</sup> to the 19<sup>th</sup> centuries. In the earlier period, during feudalism, and in the subsequent transition period from feudalism to capitalism, economic incentives were either mostly nonexistent or weak whereas in the later period they were much stronger. Much of the large economic surplus of the 13<sup>th</sup> and 14<sup>th</sup> Centuries could have been saved or spent on military escapades, lavish churches, and/or palaces by the aristocracy.<sup>9</sup> As Figure 1 illustrates, the economic surplus as a share of net national income does not come close to the levels of the 13<sup>th</sup> and 14<sup>th</sup> Centuries until the 17<sup>th</sup> and 18<sup>th</sup> Centuries.

Figure 6 displays estimates by Lambert (2021) of English and UK government surpluses and deficits over the 1200 to 1860 period in which government spending is normally in surplus until the late 18<sup>th</sup> Century and beyond. Much of this could be for military expenditures (Britain was in many wars and armed conflicts in the 18<sup>th</sup> and 19<sup>th</sup> Centuries), and data from Mitchell (1988, pages 578-580) shows a disproportionate amount of British net public expenditures from 1688 to 1801 to be for the army, navy, or ordnance with a low of 20% to a maximum of 96% and an average of 45%. Barro (1987) writes that most of Britain's deficits during the period of 1701 to 1918 comes from spending on wars with the exception of a budget deficit incurred to buy the freedom of slaves from slave owners in 1835-1836 and in a dispute over income taxes during 1909-1910.<sup>10</sup> Barro's Figure 8 in his paper which plots public debt as a percentage of GDP looks very similar to Figure 6 in this paper because he mostly relies on the Mitchell

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<sup>9</sup> This paper takes a Post-Keynesian/Kaleckian point of view that almost all wages or labor income is spent on consumption and that investment almost entirely comes from upper class income which mostly goes to savings or economic surplus (Lavoie 2009). The high labor costs of the 15<sup>th</sup> and 16<sup>th</sup> Centuries are factors that constrained the economic surplus amounts as a portion of NNI shown in Figure 1.

<sup>10</sup> One could argue that the government's buy out of slaves could be considered as the retirement of one form of human capital, slaves, for another, labor, although the first was considered property (investment), and the second one is labor.

data.<sup>11</sup> Finally Figure 7, using Mitchell's data, shows UK net public debt as a percentage of GDP from 1692 to 1860 accelerating during the 18<sup>th</sup> and 19<sup>th</sup> Centuries.<sup>12</sup>

Using investment levels or changes in capital stock that Lambert derives from estimates from the Clark (2009) data, one can calculate a Baran Ratio (Xu 2019, Lambert 2020) which shows the amount of net, domestic real investment on a yearly basis that comes out of a society's economic surplus, which in this case is the sum of Clark's net domestic capital and land income estimates plus domestic taxes collected by the state. Clark's estimates of capital income are net of depreciation and include returns to tools and equipment, farm animals, commercial ships, commercial buildings as well as returns to public investments such as canals, ports, bridges, turnpikes, and roads. To invest domestically more than 100% of the domestic economic surplus implies either larger and larger amounts of government borrowing (i.e., not all debts are used for war or the military but for ports, canals, etc.); and/or capital account surpluses due to foreign investment; and/or trading in slaves and/or conquest<sup>13</sup>; and/or if accumulated surplus from the past that has not been invested is used for current investment, then the Baran Ratio can be greater than one. Using national income accounting where Consumption (C) + Investment (I) + Government (G) +

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<sup>11</sup> Interestingly one thing that Barro finds is that as long as currency could be converted to gold, money supply growth and inflation are not problems resulting from the budget deficits or the temporary rises in government spending mostly due to military spending. He claims that such deficits are associated with increases in long term interest rates, however, except for the deficits associated with the slave buy out and the income tax dispute. In those two cases, long term rates do not rise. Clark (2001) in estimating deficits from the 1720s to the 1830s finds no "crowding out" effects of British deficits. Figure A1 in the appendix also plots Clark's estimates of real interest rates from 1200 to 1860. **Admittedly, greater government debt implies greater taxation later, which in turn cuts into consumption and profits, and any decline in these would limit the economic surplus. However, it can be argued that the British economy grows fast enough during this time to offset any negative consequences of increasing debt levels.**

<sup>12</sup> Esteban (2001) writes that the French wars would have been very difficult for Britain to finance had it not been for trade credits from India.

<sup>13</sup> Richardson (1987) and Etlis and Richardson (2008), among other scholars, estimate that the British slave trade of the 17<sup>th</sup> to 19<sup>th</sup> Centuries had a big impact on British economic growth. Graeber (2006), among others, claims that earnings from the slave trade is a key factor in propelling capitalism to greater heights in Europe, yet also notes that wage labor is a necessary replacement to slavery since mass consumption is necessary to complement the mass production that starts with the industrial revolution. **Etlis (1987) writes that the slave trade is not in decline in the late 18<sup>th</sup> Century as some have described it, although abolitionists begin to slowly work against it, which transforms the British economy. It is also about the time of key advances in manufacturing. According to the findings of this paper, the year 1780 and the late 18<sup>th</sup> Century are associated with the beginning of large gains in UK domestic investment. The Broadberry, et al and Clark estimates do not give any data on the value or number of slaves in England and/or the UK for the centuries for which they provide conjectures.**

Exports-Imports (X-M) expenditures equal Gross Domestic Product (GDP), if Savings (S) are less than I, then the difference can be made up by capital account surpluses, government spending for public investment, or perhaps from previously accumulated surplus not being used.<sup>14</sup> Clark (2009) and Davis (1962 and 1979) show exports usually being of greater value than imports in the late 17<sup>th</sup> Century and part of the 18<sup>th</sup> Century until around the 1780s when imports overtake import values, and over the centuries trade volume grows from around 7% to 22% of national income by the 1850s. It is also about this time that the government begins to run huge deficits on annual basis. Brezis (1995, page 51) first shows net capital inflows in 18<sup>th</sup> Century and then net capital outflows, not inflows, in the 19<sup>th</sup> Century, and Mitchell (1988, pages 448-453) mostly estimates negative and growing balances of trade (exports – imports) during the 18<sup>th</sup> and 19<sup>th</sup> Centuries, although re-exports make up a significant greater share of trade in the 18<sup>th</sup> than in the 19<sup>th</sup> Century. These estimates imply capital account surpluses with investment flowing inward. Feinstein and Pollard (1988) give data that show domestic investment in Britain far outpacing overseas investment (see Table A1 in the appendix). Given Mitchell's debt data, greater absolute and per capita debt is accumulated during this time period, which although it mostly helped to finance the military, some of it could have been used for domestic public investment. Any one or all of these factors could have made up the extra domestic investment amounts.<sup>15</sup>

Xu (2019) labels investment coming from the economic surplus the Baran Ratio since the economist Paul Baran (1953 and 1957) believes that capital formation mostly comes out of the economic surplus. Put on a yearly basis, the ratio can be expressed as

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<sup>14</sup> Banking and investment exchanges were not that developed in medieval England or in later centuries due to fragmented markets, church teachings, and a lack of lending institutions. The emphasis on investment during medieval times was on land, and probably wealthier land owners often loaned funds to others for land purchases (Postan 1972, pages 150-153). Some held their surplus earnings and income in the form of gold or silver.

<sup>15</sup> Clark (2009) calculates domestic estimates for the UK from 1200 to 1860 yet refers to "net national income" rather than using net domestic income. Also, since Broadberry et al (2015) are very careful to count only income and output from within England and the UK, one must accept that income and output from colonies and territories are not included in their estimates. The emphasis of both studies in constructing data from the 13<sup>th</sup> to the 19<sup>th</sup> Centuries is on a closed economy, probably because it is not until the 1800s that trade becomes a large part of the English economy according to Feinstein and Pollard (1988).



$$\text{Baran Ratio} = \text{Investment} / \text{Economic Surplus} .$$

Xu (2019) believes that Baran's concept of the economic surplus is important in understanding investment in a capitalist economy because investment spending can only come from the surplus generated from labor. That is, profits, gains, and rents earned by owners or landlords and the taxes collected by a government come mostly if not entirely from the labor employed in capitalist enterprises or farms. It is not until the Baran Ratio reaches consistently positive levels and achieves a critical and sustained level of more than 1 and usually of around 2 or more that economic growth and higher levels of development can be attained. Figure 8 displays the decadal pattern of the Baran Ratio, which as can be seen in the diagram does not begin to increase until late in the 16<sup>th</sup> Century, and it is not until after 1770 that the Baran Ratio shows consistent and substantive increases in magnitude, a period long after the proliferation of greater property rights brought about by various key events including the English Civil War / Revolution and the Glorious Revolution. Figure 5 shows a similar pattern when it comes to real investment amounts.<sup>16</sup>

(Insert Figures 4 to 8 and Tables 1 and 2 around here)

Table 1 shows a Pearson correlation coefficient matrix among the variables real economic surplus per head, real investment per head, real government surpluses/deficits per head, the Baran Ratio, Clark's estimates of real income-based GDP per head, Broadberry et al's estimates of real output-based GDP per head and net public debt as a percentage of GDP (Mitchell 1988 and Chantrill n.d.) for the decades 1200 to 1860 with the exception of Broadberry et al's numbers which range from 1270 to 1860. Per capita estimates are made using either Clark's (2009) or Broadberry et al's population estimates. All coefficients are statistically significant at an alpha of 5% and show moderate to strong correlations. More importantly, the amount of real economic surplus per capita, real investment per capita, and the Baran Ratio are positively and moderately correlated with Clark's income based real GDP per capita

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<sup>16</sup> A table of all the data used in this paper is displayed in the appendix.

measurement and are strongly and positively associated with the Broadberry, et al output based real GDP per capita estimates.<sup>17</sup> Real government surpluses per capita are negatively and moderately correlated with Clark GDP per capita estimates and strongly and negatively correlated with real investment per capita, the Baran Ratio and the Broadberry, et al real GDP per capita values. The greater the real government surplus (net total local and national tax revenues less spending), the lower real investment, the Baran Ratio and the lower the real GDP per capita on average. Conversely, the greater the deficit, the higher values of these variables on average.<sup>18</sup> In some ways, this supports Keynesian notions of the government needing to help boost real GDP. Finally, net public debt as a percentage of GDP is strongly correlated with the economic surplus and moderately and positively correlated with the two measurements of GDP per capita, real investment, and the Baran ratio. It is inversely and moderately correlated with government surpluses/deficits in that larger deficits (negative numbers) correspond to larger debt percentage numbers which are all greater than zero.

Since serial correlation exists in the relationships among the variables, using the Augmented Dickey-Fuller (Cheung and Lai 1995) test finds rejection of the null hypothesis that the Baran Ratio, Investment per Head, Surplus per Head, and Surpluses/Deficits per Capita are non-stationary (have a unit root) at 0, 1, or 2 lags whereas there is failure to reject the null hypothesis for Clark Real Income per Head, Broadberry GDP per Capita, and Debt as a percentage of GDP at 0, 1, or 2 lags.<sup>19</sup> Johansen (1995) tests for cointegration for the variables in Table 1 are displayed in Table 2 and show that with a lag of 1 there are at least 3 or fewer cointegrating equations among the variables.<sup>20</sup>

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<sup>17</sup> There is of course a simultaneous relationship among many of these variables with investment not only leading to higher real output/income per capita, but the latter also leads to higher investment, consumption, etc., in turn. That is, a feedback loop exists among investment and output.

<sup>18</sup> The high negative correlation between investment per capita and government surpluses/deficits per capita is not surprising, of course, since surpluses/deficits were derived by taking the economic surplus minus investment estimates.

<sup>19</sup> These results can be provided upon request by the author.

<sup>20</sup> Conceptually the relationships among some of the variables should not be spurious since they are related by definition. Investment is defined as coming from savings (surplus), and investment is part of the equation  $GDP = Consumption + Investment + Government Expenditures + (Exports - Imports)$ .

Figure 9 plots the Baran Ratio as an independent variable against Clark's real income based GDP per capita estimates from 1200 to 1860, and Figure 10 plots the Baran Ratio against Broadberry et al's real GDP per capita values as a dependent variable from 1200 to 1860. Vector autoregression diagnostic techniques indicate that a lag of one provides cointegration for the Baran Ratio and the Broadberry et al real GDP per capita measurement and suggest a lag of 1 or 3 for the Baran Ratio and the Clark real income per capita. However, with the latter pair, a lag of 1 allows the Baran Ratio coefficient to achieve statistical significance at 5% whereas this is not the case with a lag of 3.<sup>21</sup> Table 3 displays vector autoregression models using the Baran Ratio as an exogenous variable with a lag of one and the two income/GDP per capita measurements as endogenous variables. A 1 unit increase in the Baran Ratio is correlated with an approximate 2 to 4 unit increase in real income or real GDP per capita on average, and each model explains at least 86% of the variation in their respective dependent variables.

(Insert Table 3 and Figures 9 and 10 around here)

A Chow (1960) test indicates that the year 1780 is a valid break point in the data, and in looking at Figures 9 and 10, the Baran Ratio beginning in 1780 predicts higher levels of real GDP per head once it achieves a consistent level of approximately 1 or more, and then standards of living go up even further as the Baran Ratio achieves and then exceeds 2.

#### *A Post-Keynesian Application of the Baran Ratio*

Keynes discussed an investment multiplier and how it affected consumption and employment (248-249) and noted the consequences of savings being greater than planned investment in the macroeconomy resulting in less than full employment and stagnation. Or, a case where aggregate demand is less than aggregate supply. In the minds of Sweezy (1942) and Baran and Sweezy (1966), and similar to Keynes (1964 (1936)), not enough of the economic surplus generated by an economy was absorbed by investment opportunities, and so the economy often tended toward recession or stagnation as

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<sup>21</sup> Please see these tables in the Appendix.

$$\delta I / \delta t > \delta C / \delta t$$

where the rate of consumption (C) over time (t) began to fall behind the rate of investment (I) over time (Sweezy 1942, 186-189).

Many heterodox economists contend that Keynes argued that the disequilibrium between savings and investment as well as the gap between actual and full employment and between actual and potential real GDP could not only last in the short run but also into the long run and could be the usual state of affairs in a capitalist economy (Lavoie 2009, Marglin 2018) . If so, although we have no real records of unemployment or underemployment and potential real GDP in England and the UK during the time period covered in the research for this paper, and although feudalism and mercantilism are different economic systems than capitalism, this paper tries to show that the greater the level of investment expenditures and the greater the Baran Ratio, the greater the real GDP per capita and the greater the economic growth. The slow growth or no-net-growth or static Malthusian economic systems of feudalism and mercantilism perhaps could be argued to be an economy where there is a long run equilibrium of stagnation and underemployment that is finally transformed by the right type and right levels of investment under appropriate institutional settings.

Using an “old post-Keynesian” or Cambridge growth equation (Pasinetti 1974, Lavoie 2009, 108-109)

$$r = g / s$$

where “r” is the profit rate or rate of return to capital, “g” is the economic growth rate, and “s” is the propensity to save out of profits, and it is assumed that workers either do not save or save very little out of total savings, then rearranging we have

$$g = s*r .$$

If it is assumed that savings = investment, or that they are roughly equal, and that savings can also come from capital account surpluses and tax revenues, then “s” can be considered to be similar to the Baran Ratio in this paper, and “r” is the return to capital estimated by Clark (2009). Calculating the growth rates over the centuries on a decadal basis and using the last formula, Figure 11 shows that growth rates do not really become that large and consistently positive in value until the late 16<sup>th</sup> and most of the 17<sup>th</sup> Centuries, the centuries during which capitalism supposedly becomes more prevalent. Prior to this time, growth rates appear to vary widely under feudalism and then tend to vary less so during the mercantilism era. Up until 1600, this paper estimates that the average growth rate is around 0%, and then thereafter, it is around 5.6% over the decades, which somewhat supports the econometric work of Crafts and Mills (2017). More so, the growth rate over the decades from 1780 to 1860 is around 10.8%. Finally, the association between the Baran Ratio and investment per capita is pretty strong as shown in Figure 12.

(Insert Figures 11 and 12 around here)

### **Discussion and Conclusion**

A limitation of this exploratory paper is that the estimates are based upon other conjectures. Also, the data are examined through heterodox economic theories and points of view, perspectives with which others may not agree or consider appropriate. Another limitation of the results found in this paper is that during the periods examined not nearly as many complete economic records existed then as they do today. Clark and his data perhaps are influenced by a Malthusian point of view of medieval times (Clark 2007a) whereas Broadberry, et al (2015) see this time period as one with greater growth. However, general trend estimates from these two comprehensive sources of British economic history over seven centuries are the best options available in order to some general analyses of long term British economic growth. Other historical accounts encountered in doing research for this paper have data that only go back to the 17<sup>th</sup> Century.

Yet if the conjectures are fairly reasonable, and since this paper is mostly interested in estimating general trends for the purposes of reinforcing and making certain points, the results lend some additional support to some of the arguments regarding the transition from feudalism to mercantilism to capitalism. Economic surplus, investment, investment rates, government spending and debt appear to be largely ineffective or too small before the 17<sup>th</sup> or 18<sup>th</sup> centuries to impact standards of living. Crafts and Mills (2017) argue that trend growth in England and the UK up until the industrial revolution basically roughly averages zero, and Clark (2007b) claims that the general economic efficiency and productivity of the British economy is mostly stationary until the 1800s.<sup>22</sup> Government deficits have no “crowding out” effects on the economy of the 1700s and 1800s (Clark 2001). The findings of this paper point to deficits possibly having a “crowding in” effect on British economic growth.

In Baran’s view, a lot of the economic surplus would have been wasted in the 13<sup>th</sup> and 14<sup>th</sup> Centuries when feudalism is still the dominant economic system (King 1988). The economic surplus as a portion of net national income according to the 2009 Clark data is higher in these centuries than later ones, yet investment levels are lower. Even with feudalism in decline in subsequent centuries, some of the economic surplus could have been “wasted” by the aristocracy rather than spent on productive capital. Sweezy (1976(1950)) notes that traders and merchants during the mercantilist era improved transportation technology but do not contribute much to changes in productive technology. Brenner (1985) writes that medieval and mercantile era guilds, through their monopoly power, frustrated investment in innovative techniques, and it is not until petty producers come along that this changes. Investment in larger land holdings and more advanced farming techniques yield greater economies of scale than the typical smaller, medieval farms that featured mostly subsistence style farming (Brenner 1985, Heller 2011, Cockshot 2019). These events coincide with the enclosure movement as those who are forced to leave common farm areas become the manufacturing workers of the industrial revolution (McCloskey 1972, Marx and

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<sup>22</sup> Graphs of real GDP per capita using the Clark and Broadberry et al data showed pretty much a flat line trend pretty much during both feudalistic and mercantilistic (or transition period) epochs.

Engels 2004 (1848)). Rights to property, investment, and global trade are established well before the late 18<sup>th</sup> Century, but perhaps dramatic gains are not seen in real GDP per capita until 1780 and beyond as this paper shows. Perhaps property rights are a necessary but not a sufficient condition for strong economic development and robust growth. Other major conditions are the levels of public and private sector investments that need to reach a certain level before real and sustained economic growth occurs. The types of and levels of investment appear to matter.

For those readers familiar with the Dobby-Sweezy debate (Dobb 1947, Sweezy 1976 (1950) among many other publications) as well as the Brenner debate (Brenner 1976, Brenner 1985, Heller 1985, Heller 2011 among many others), the statistical findings of this paper are probably not surprising since many of these authors note the stagnation of most of the medieval period and economic decline in the late medieval period in Europe. They also note the slow and gradual transition from feudalism to mercantilism and then to capitalism and the takeoff of economic growth with the agricultural and industrial revolutions. This paper's findings also somewhat support the writings of those who emphasize the importance of property rights for investment and economic advancement in that such rights are not strong enough for advancement until around the 16<sup>th</sup> and 17<sup>th</sup> centuries (North and Thomas 1971 and 1973, McCloskey 1972).

As classical economists like Smith and Marx and later the neo-Marxists Baran (1953 and 1957) and Baran and Sweezy (1966) noted, some forms of business could be claimed to be "productive" and others as "unproductive" or wasteful. Baran and Baran and Sweezy claimed that much of finance, retailing, wholesaling, advertising, military expenditures, R&D efforts on packaging and design, etc. in a capitalist economy were all wasteful and really did not contribute that much to a society's economic net welfare. On the other hand, "productive" industries included those in manufacturing, mining, agriculture, education, etc. in which the populace gains something tangible and useful from the consumption of their products or services. Therefore, not only did innovation and investment matter, but also the type of

investment in innovation (productive versus unproductive) could matter in addition to the property rights and strong national government presence needed to secure the rights of ownership and to profits.

While some can assert that demand for certain goods and services creates the investment that is needed to supply the goods and services, there are some lessons from history that show that this can be a very slow process, and sometimes the potential investment is still not made. As an illustration of how investment opportunities and levels of investment matter in England and the UK over the transition from feudalism to capitalism, Figure 13 shows estimates for the number in millions of oxen and horses used in England and Britain from 1221 to 1496 and then from 1550 to 1870 (Broadberry, et al 2015).<sup>23</sup> Although the choice of and employment of horses or oxen by farmers has something to do with terrain considerations (Langdon 1982 and 1986, Broadberry, et al 2015), a principal consideration is the cost of maintaining and keeping each type of animal (Langdon 1982 and 1986). Despite the versatility of the horse, oxen are cheaper to feed and when no longer useful or when the price of beef is high, can be sold or used for food. Horses are considered a luxury during early medieval times, and so oxen with their low costs are preferred for tilling or plowing soil. It is not until farms become larger during the enclosure movement and when agricultural markets become larger and wider geographically during the 16<sup>th</sup> and 17<sup>th</sup> centuries that the horse becomes more useful despite its higher operating costs in not only farming but also in hauling and transporting agricultural output (Langdon 1982 and 1986). Langdon (1982 and 1986) argues that as the average farmer comes to possess greater and greater amounts of land and greater affluence, he can afford to make the investment in the more costly yet more productive and multifaceted horse. The horse is always available for further investment, and the demand for food always strong, but the ability to invest has to reach a critical level first. As another example, Clark (1989), in a follow up to the “Postan thesis” claims that compost is readily available during most of medieval times but is ignored

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<sup>23</sup> The authors omitted the period of 1497 to 1549 because of a lack of historical records and difficulties in coming up with accurate estimates.



by medieval farmers because the opportunity cost of investment is too high for long term investment in better agricultural techniques despite strong demand for food and frequent food shortages.<sup>24</sup>

(Insert Figure 13 around here)

Schumpeter in *Capitalism, Socialism, and Democracy* (2003 (1943)) noted how that the economies that preceded capitalism were like a circular flow system of trading and exchange that remained static and never really expanded. It was only with innovation and investment under capitalism that the circular flow expanded and grew thanks to waves and cycles of innovation. For Schumpeter, early in capitalism entrepreneurs sought investment for their ideas in order to make a profit. In the *General Theory* (1964(1936)), Keynes indicated that job creation during an economic downturn could be done through unproductive activities such as burying treasury notes in bottles and having workers dig them back up again (129) although he conceded that it would be better to have people employed in more productive activities through greater levels of some type of investment even if it meant the “socialization” of some investment. British governmental deficits and net public debt grew substantially probably due to military and warfare expenditures, which are unproductive uses of resources in some minds (Baran and Sweezy 1966, Mohun 1994, Lambert and Kwon 2015), yet some funds were spent on ports, bridges, canals, roads, and other forms of infrastructure.<sup>25</sup>

Perhaps many topics and themes discussed in this paper do not cover that much new ground. Yet it is argued that the Baran Ratio concept succinctly summarizes how a large enough level of investment is necessary for a society to make large advancements in standards of living. To re-invest all of the

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<sup>24</sup> In modern times, Baran and Sweezy (1966) claim that most research and development is for minor changes in products regarding their design and packaging. Substantive R&D is mostly done by the government, and much of it is only used in the private sector after some time has passed and when it appears that investment in the new technology is safe and profitable regardless of societal needs or possible demand. In a letter to Sweezy, Baran writes that capitalist investment only follows innovation depending upon the investment climate at the time (Baran and Sweezy 2017, pages 145-146). Lambert (2020b) finds some empirical support for the Baran and Sweezy assertions, and it appears that a lot of R&D and innovation results in greater monopolization of markets.

<sup>25</sup> Although Baran and Sweezy emphasized that it was World War II that eventually lifted the US out of the Great Depression and restored full capacity utilization and full employment.

economic surplus or its equivalent and to dramatically increase government spending are large amounts of stimuli for a national economy.<sup>26</sup> A modern day example could be China perhaps. At the same time, many of the other advanced nations of the world are being criticized for not reinvesting enough in their infrastructure, schools, and health care systems. If there also exists too much unemployment and underemployment in various world economies, then greater use of corporate profits for reinvestment in productive activities such as manufacturing and construction or greater spending by governments on infrastructure and education at even higher levels than exist now in order to start on a path of greater economic growth may be a viable alternative as illustrated by the Baran Ratio.

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<sup>26</sup> It is granted that Britain engaged in a slave trade and engaged in overseas conquest in order to expand its export business, and these also are factors in its debt and deficit levels. Yet it also engaged in investment in many productive activities such as infrastructure, scientific innovation, manufacturing plants, etc.

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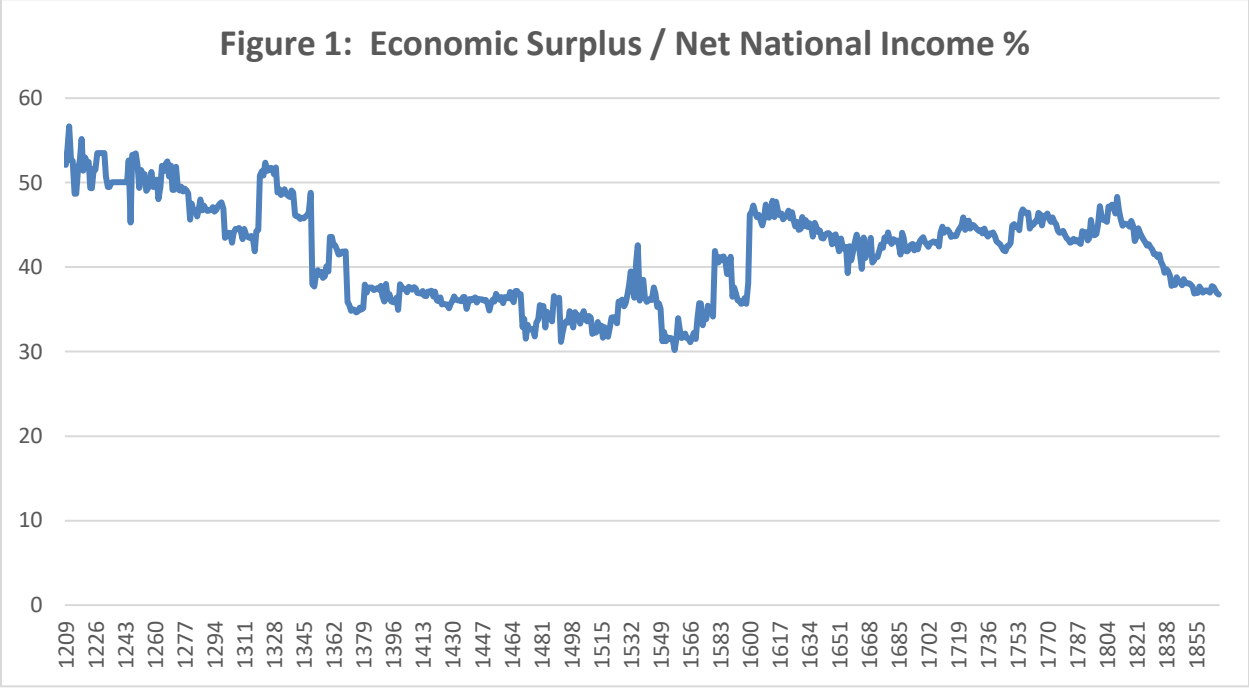
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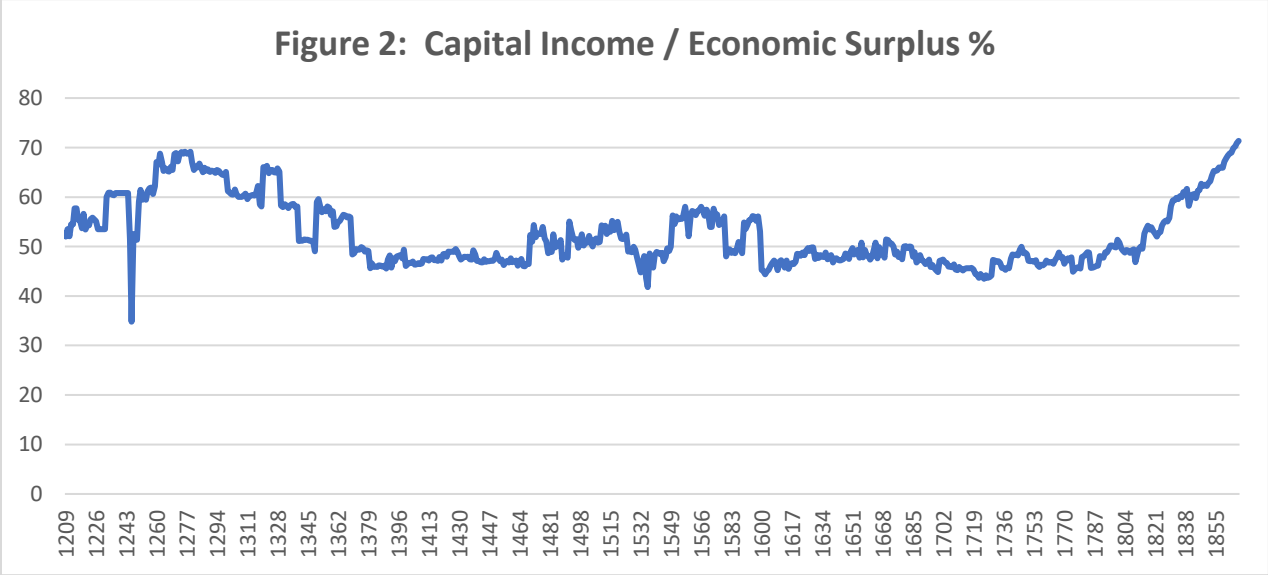
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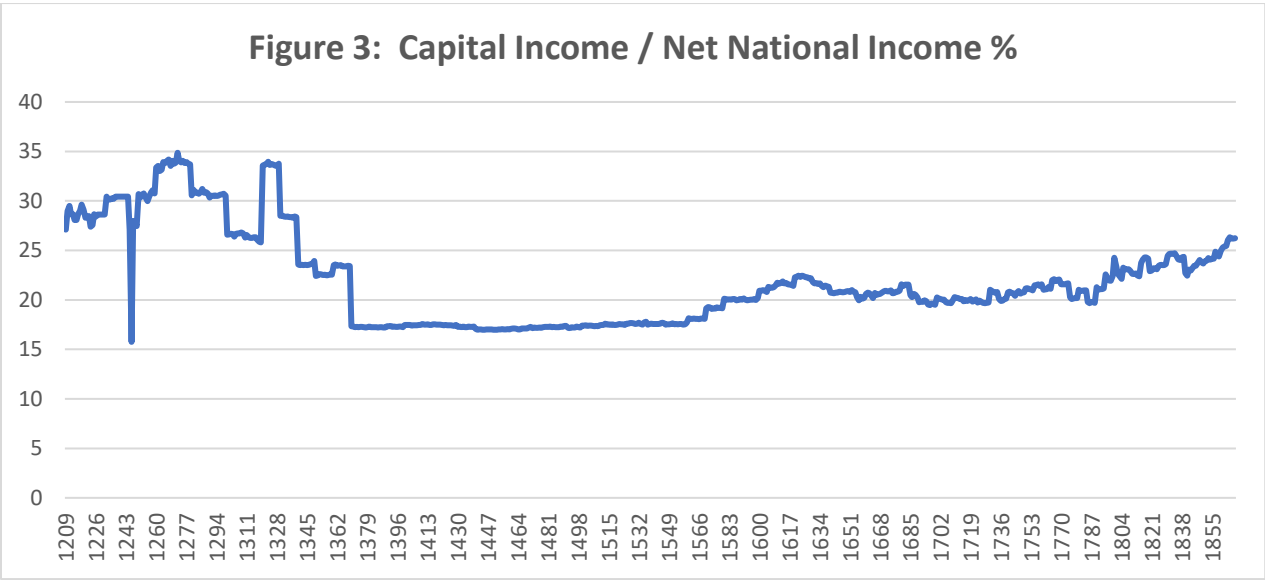


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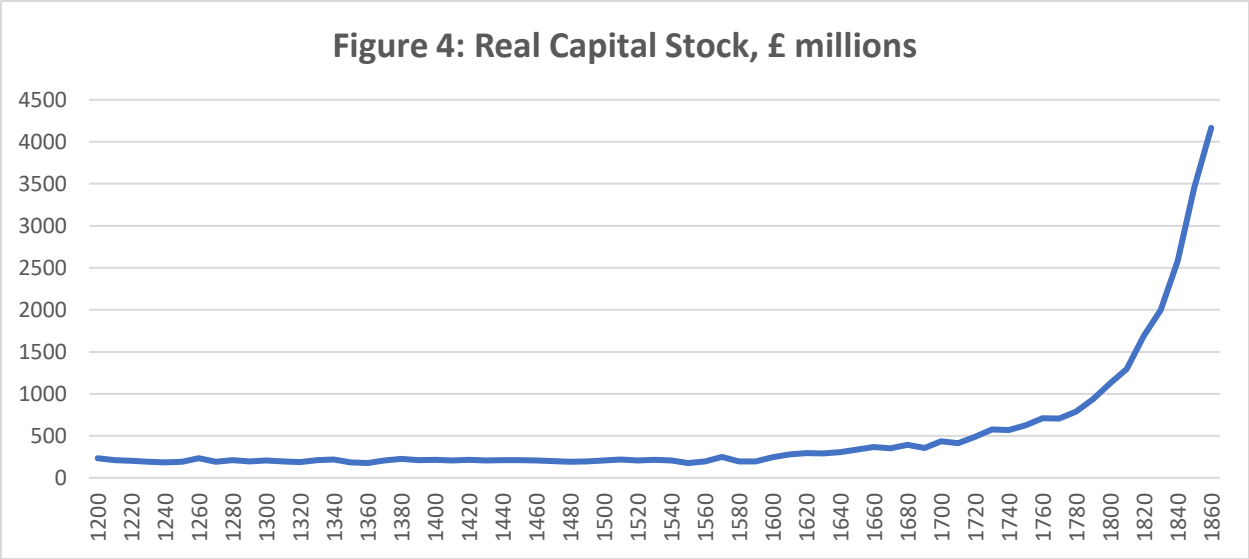


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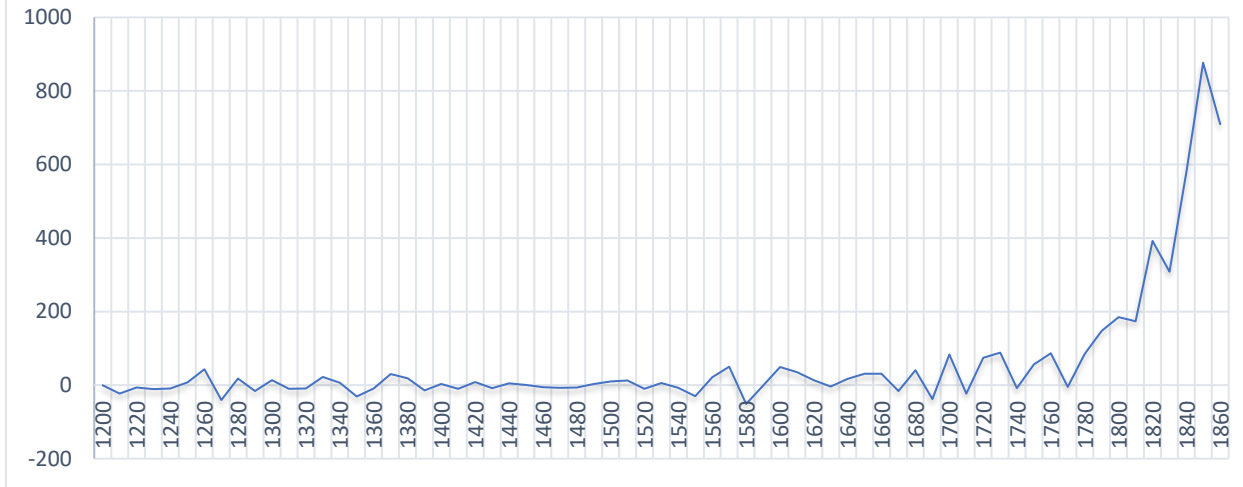


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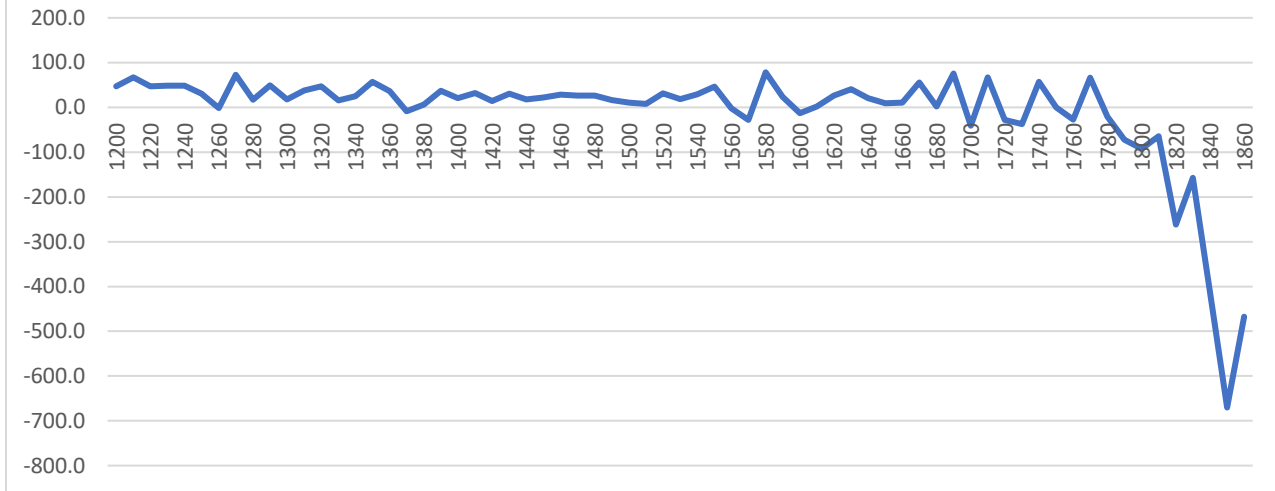
Source: Lambert (2021) estimates based on Gregory Clark, “National Income, Prices, Wages, Land Rents, Population, England, 1209-1869”, from his website, <http://faculty.econ.ucdavis.edu/faculty/gclark/data.html> .

**Figure 5: Real Investment, £ millions**

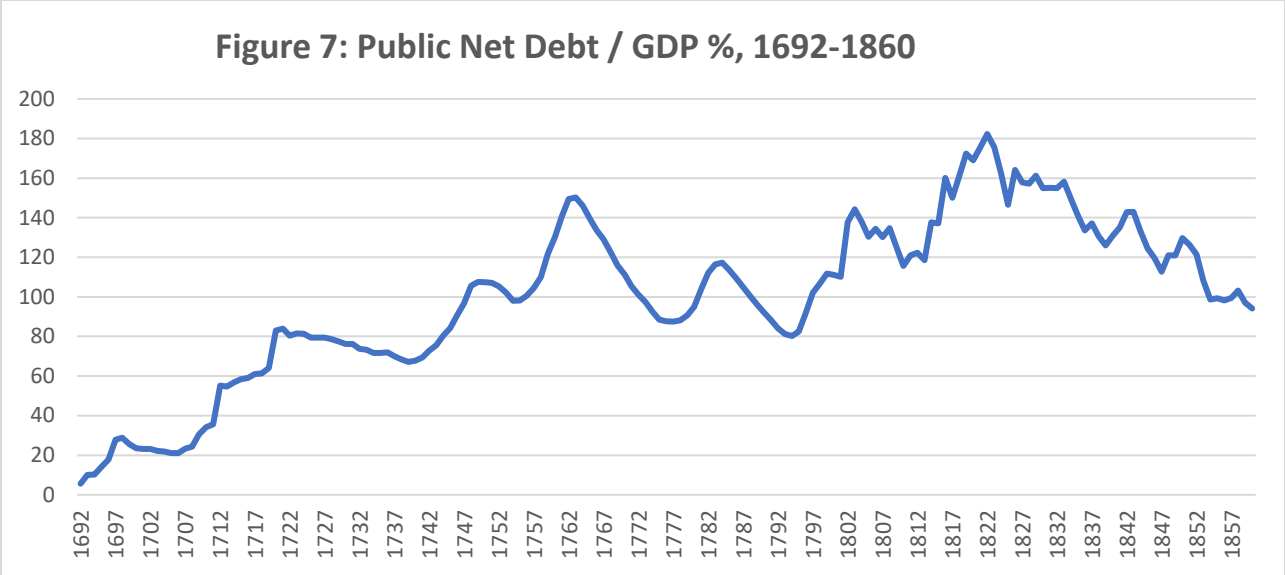


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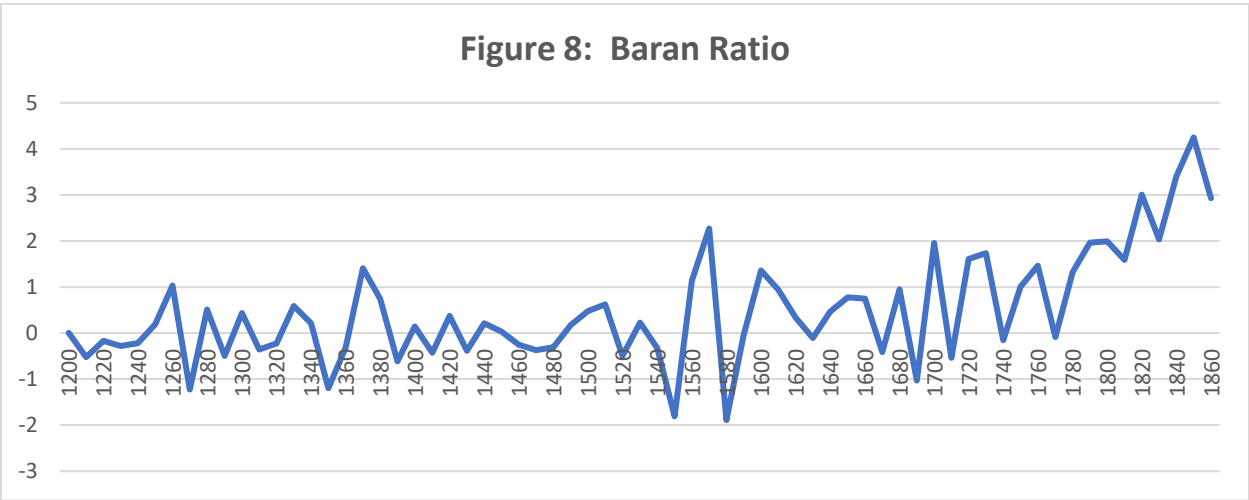
**Figure 6: Real Govt Deficit/Surplus, £ millions**



Source: Lambert (2021) estimates based on Gregory Clark, “National Income, Prices, Wages, Land Rents, Population, England, 1209-1869”, from his website, <http://faculty.econ.ucdavis.edu/faculty/gclark/data.html> .



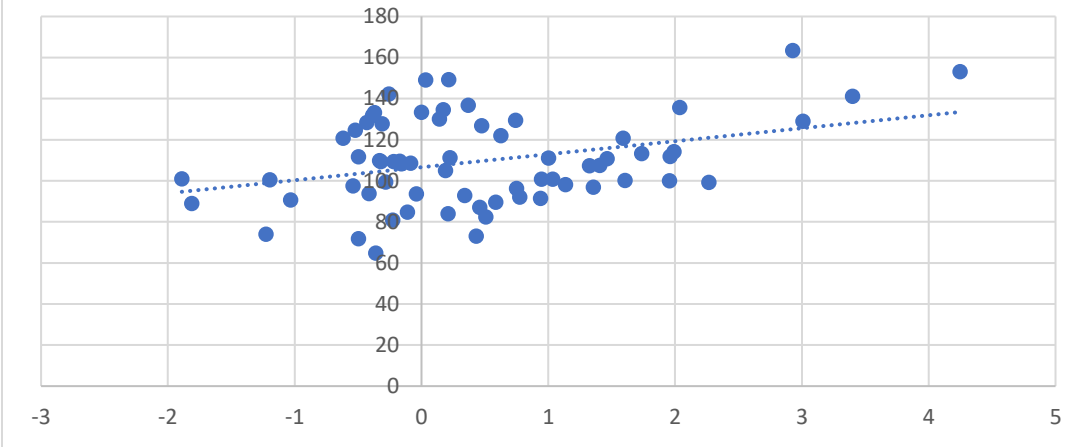
Source: From B.R. Mitchell, *British Historical Statistics* (1988) and Christopher Chantrell (no date) *UK Public Spending*, <https://www.ukpublicspending.co.uk/>



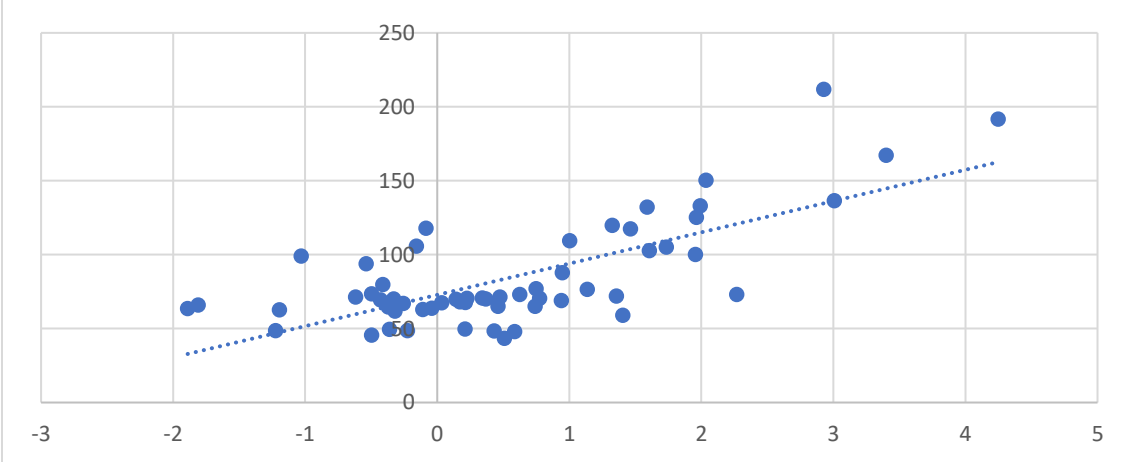
Source: Estimates based on Gregory Clark, "National Income, Prices, Wages, Land Rents, Population, England, 1209-1869", from his website, <http://faculty.econ.ucdavis.edu/faculty/gclark/data.html>.



**Figure 9: Clark Income based GDP per Head (y) by Baran Ratio (x)**



**Figure 10: Broadberry, et al Real GDP per Capita (y) by Baran Ratio (x)**



**Table 3—Vector Autoregression Results**

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1) Dependent Variable is Clark Real Income Based GDP per Capita

|                    | <u>b</u> | <u>S.E.</u> |
|--------------------|----------|-------------|
| Constant           | 8.59     | 5.2         |
| Baran Ratio, 1 lag | 3.93*    | 0.82        |

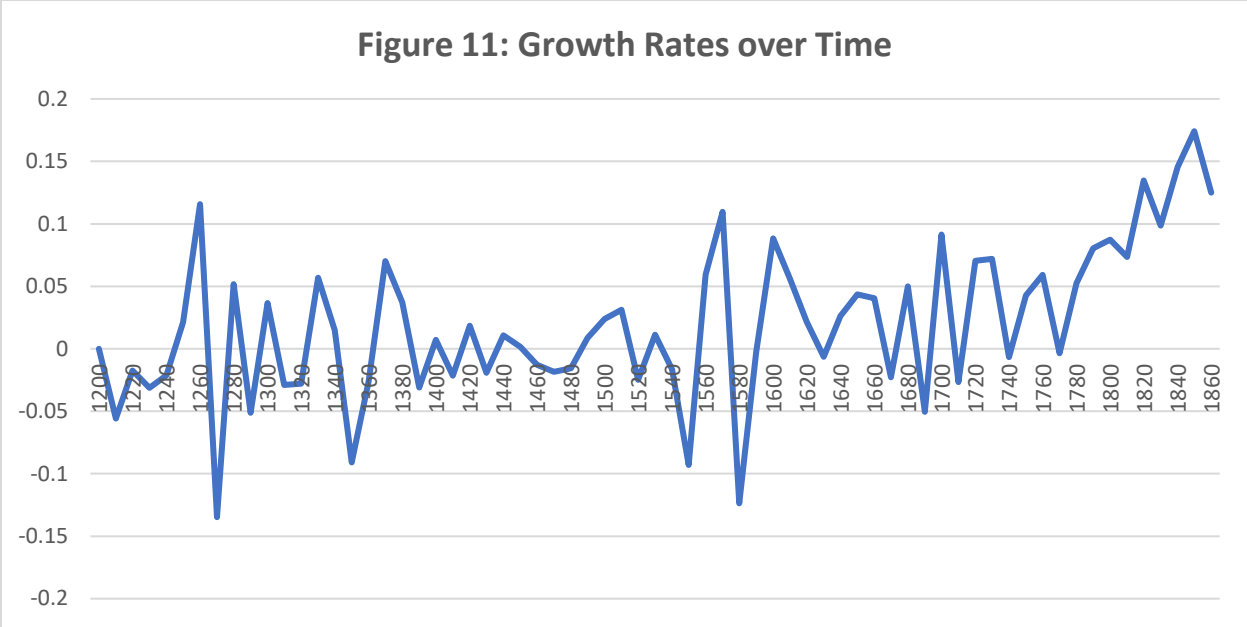
n=66  
Adj.  $r^2 = 0.87$

2) Dependent Variable is Broadberry Real GDP per Capita

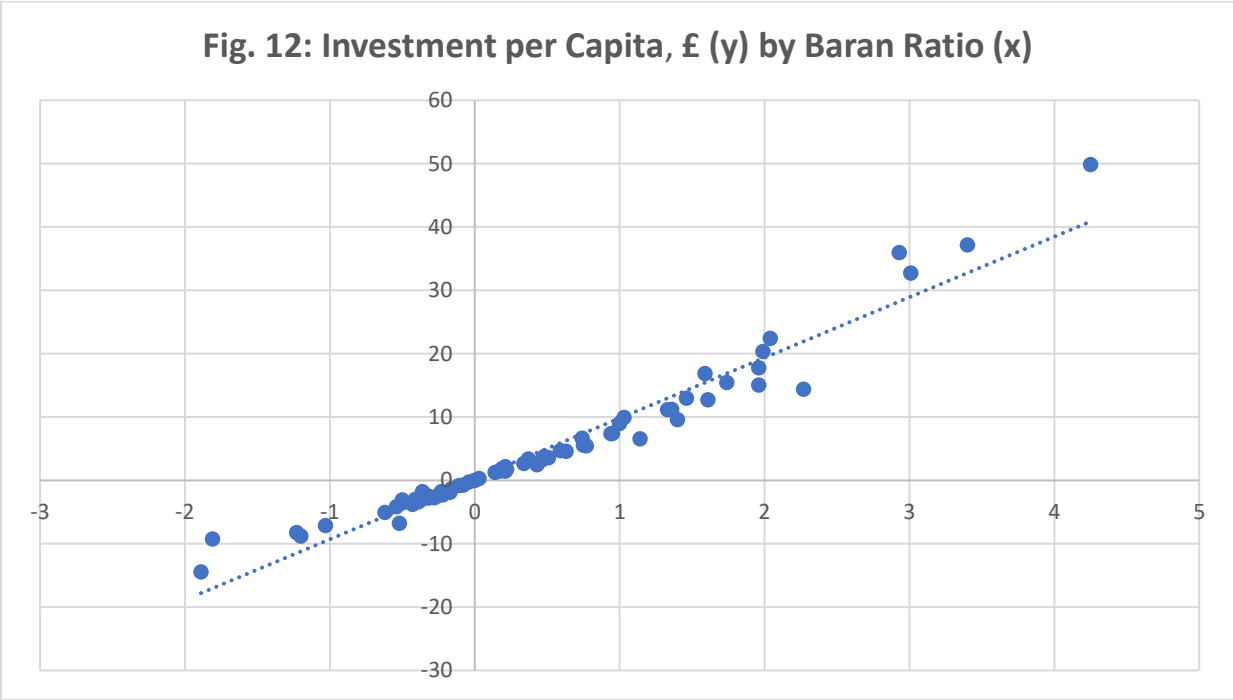
|                    | <u>b</u> | <u>S.E.</u> |
|--------------------|----------|-------------|
| Constant           | -3.17    | 2.17        |
| Baran Ratio, 1 lag | 2.06*    | 0.74        |

n=59  
Adj.  $r^2 = 0.98$

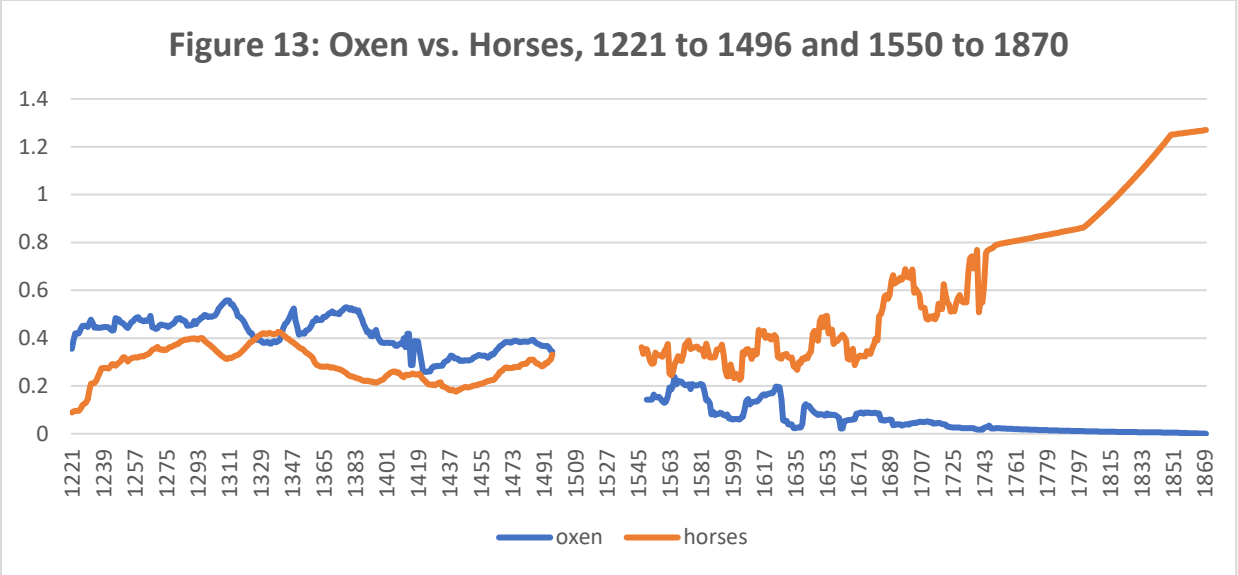
p<0.05



Source: Based on Clark data (2009)



Source: Based on Clark data (2009)



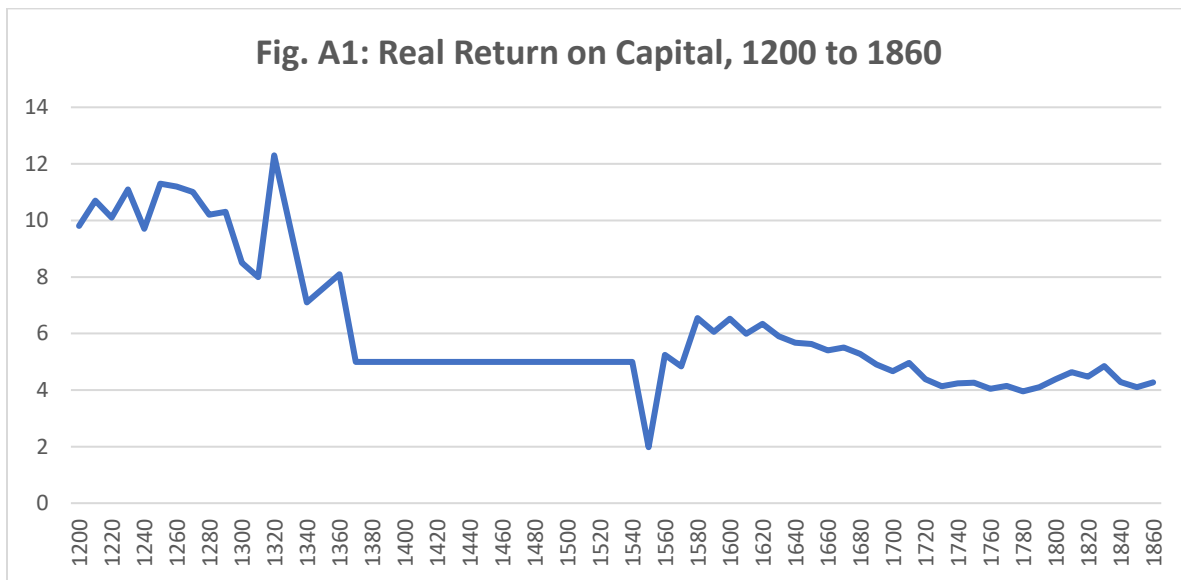
Source: Adapted from Broadberry, et al (2015), Figure 2.01, page 54 and from the data from the website <https://www.cambridge.org/gb/academic/subjects/history/economic-history/british-economic-growth-12701870?format=PB> .



## Appendix

### Table A1

| Decade    | Total net domestic investment<br>(£ million per annum at constant prices) | Total net investment abroad |
|-----------|---|-----------------------------|
| 1761-1770 | 8.5   | 0.7                         |
| 1771-1780 | 11.3  | 0.7                         |
| 1781-1790 | 13.2  | 1.3                         |
| 1791-1800 | 16.7  | 1.3                         |
| 1801-1810 | 17.4  | -2                          |
| 1811-1820 | 22.3  | 5.6                         |
| 1821-1830 | 30.8  | 7.8                         |
| 1831-1840 | 36.7  | 4.4                         |
| 1841-1850 | 51.7  | 7.3                         |
| 1851-1860 | 60.4  | 18.9                        |



Source: Clark (2009).

**Data**  
(money values in £s)

| <b>Decade</b> | <b>Econ Surplus per Capita</b> | <b>Baran Ratio</b> | <b>Clark Income Based GDP per Head</b> | <b>Broadberry GDP Per Head</b> |
|---------------|--------------------------------|--------------------|--|--------------------------------|
| 1200          | 13.83                          | 0.00               | 133.33                                 |                                |
| 1210          | 13.99                          | -0.52              | 124.67                                 |                                |
| 1220          | 11.09                          | -0.17              | 109.48                                 |                                |
| 1230          | 9.16                           | -0.28              | 99.35                                  |                                |
| 1240          | 9.31                           | -0.22              | 109.31                                 |                                |
| 1250          | 9.92                           | 0.19               | 104.90                                 |                                |
| 1260          | 10.11                          | 1.03               | 100.82                                 |                                |
| 1270          | 7.64                           | -1.23              | 74.02                                  | 48.54                          |
| 1280          | 6.76                           | 0.51               | 82.35                                  | 43.43                          |
| 1290          | 7.14                           | -0.50              | 71.73                                  | 45.49                          |
| 1300          | 5.50                           | 0.43               | 73.04                                  | 48.32                          |
| 1310          | 4.75                           | -0.36              | 64.71                                  | 49.43                          |
| 1320          | 8.26                           | -0.23              | 80.88                                  | 48.56                          |
| 1330          | 7.29                           | 0.59               | 89.54                                  | 47.89                          |
| 1340          | 6.75                           | 0.21               | 83.99                                  | 49.69                          |
| 1350          | 8.44                           | -1.20              | 100.49                                 | 62.72                          |
| 1360          | 8.80                           | -0.32              | 109.31                                 | 61.67                          |
| 1370          | 4.96                           | 1.40               | 107.52                                 | 59.02                          |
| 1380          | 8.33                           | 0.74               | 129.41                                 | 65.09                          |
| 1390          | 7.75                           | -0.62              | 120.75                                 | 71.39                          |
| 1400          | 9.07                           | 0.14               | 130.07                                 | 69.73                          |
| 1410          | 7.74                           | -0.43              | 128.27                                 | 69.34                          |
| 1420          | 9.02                           | 0.37               | 136.77                                 | 70.08                          |
| 1430          | 8.35                           | -0.39              | 131.70                                 | 66.65                          |
| 1440          | 8.64                           | 0.21               | 149.18                                 | 67.57                          |
| 1450          | 10.16                          | 0.03               | 149.02                                 | 67.46                          |
| 1460          | 9.65                           | -0.26              | 142.16                                 | 66.99                          |
| 1470          | 7.76                           | -0.37              | 133.17                                 | 64.49                          |
| 1480          | 8.59                           | -0.31              | 127.78                                 | 66.10                          |
| 1490          | 7.76                           | 0.17               | 134.64                                 | 68.09                          |
| 1500          | 8.52                           | 0.48               | 126.80                                 | 71.28                          |
| 1510          | 8.55                           | 0.63               | 121.90                                 | 73.05                          |
| 1520          | 7.34                           | -0.50              | 111.60                                 | 73.46                          |
| 1530          | 8.07                           | 0.22               | 111.28                                 | 70.39                          |
| 1540          | 8.48                           | -0.33              | 109.80                                 | 70.07                          |
| 1550          | 5.33                           | -1.81              | 88.89                                  | 65.81                          |
| 1560          | 5.91                           | 1.14               | 98.04                                  | 76.40                          |
| 1570          | 7.22                           | 2.27               | 99.18                                  | 73.09                          |
| 1580          | 8.55                           | -1.89              | 100.98                                 | 63.51                          |

|      |       |       |        |        |
|------|-------|-------|--------|--------|
| 1590 | 6.91  | -0.04 | 93.63  | 63.71  |
| 1600 | 8.38  | 1.36  | 96.90  | 71.83  |
| 1610 | 8.56  | 0.94  | 91.34  | 68.99  |
| 1620 | 8.55  | 0.34  | 92.81  | 70.55  |
| 1630 | 6.98  | -0.11 | 84.64  | 62.82  |
| 1640 | 7.86  | 0.46  | 87.09  | 64.98  |
| 1650 | 6.18  | 0.77  | 91.99  | 70.39  |
| 1660 | 7.05  | 0.75  | 96.24  | 76.95  |
| 1670 | 7.09  | -0.41 | 93.79  | 79.82  |
| 1680 | 7.65  | 0.95  | 100.82 | 87.67  |
| 1690 | 7.96  | -1.03 | 90.69  | 98.98  |
| 1700 | 7.06  | 1.96  | 100.00 | 100.00 |
| 1710 | 6.51  | -0.54 | 97.55  | 93.85  |
| 1720 | 8.09  | 1.61  | 100.16 | 102.65 |
| 1730 | 8.65  | 1.74  | 113.24 | 104.96 |
| 1740 | 7.44  | -0.16 | 108.17 | 105.74 |
| 1750 | 9.03  | 1.00  | 111.11 | 109.39 |
| 1760 | 9.12  | 1.46  | 110.78 | 117.35 |
| 1770 | 9.38  | -0.08 | 108.50 | 117.79 |
| 1780 | 8.98  | 1.33  | 107.35 | 119.67 |
| 1790 | 9.03  | 1.96  | 111.77 | 125.20 |
| 1800 | 8.78  | 1.99  | 114.22 | 133.04 |
| 1810 | 11.19 | 1.59  | 120.75 | 132.07 |
| 1820 | 10.42 | 3.01  | 128.92 | 136.40 |
| 1830 | 11.19 | 2.04  | 135.62 | 150.25 |
| 1840 | 10.12 | 3.40  | 141.18 | 167.14 |
| 1850 | 11.70 | 4.25  | 153.11 | 191.67 |
| 1860 | 11.67 | 2.93  | 163.40 | 211.76 |

## Data

| Decade | Investment per Capita | Govt Deficit/Surplus per Capita | Mitchell Debt Pct GDP |
|--------|-----------------------|---------------------------------|-----------------------|
| 1200   | 0.00                  | 13.84                           |                       |
| 1210   | -6.77                 | 19.70                           |                       |
| 1220   | -1.84                 | 12.52                           |                       |
| 1230   | -2.72                 | 12.37                           |                       |
| 1240   | -2.25                 | 12.47                           |                       |
| 1250   | 1.87                  | 8.03                            |                       |
| 1260   | 9.96                  | -0.32                           |                       |
| 1270   | -8.25                 | 14.98                           |                       |
| 1280   | 3.61                  | 3.49                            |                       |
| 1290   | -3.08                 | 9.27                            |                       |
| 1300   | 2.49                  | 3.29                            |                       |
| 1310   | -1.78                 | 6.70                            |                       |
| 1320   | -1.76                 | 9.52                            |                       |
| 1330   | 4.70                  | 3.33                            |                       |
| 1340   | 1.49                  | 5.62                            |                       |
| 1350   | -8.80                 | 16.16                           |                       |
| 1360   | -2.79                 | 11.52                           |                       |
| 1370   | 9.62                  | -2.78                           |                       |
| 1380   | 6.70                  | 2.35                            |                       |
| 1390   | -5.02                 | 13.13                           |                       |
| 1400   | 1.29                  | 7.76                            |                       |
| 1410   | -3.79                 | 12.61                           |                       |
| 1420   | 3.37                  | 5.79                            |                       |
| 1430   | -3.39                 | 12.19                           |                       |
| 1440   | 2.16                  | 7.92                            |                       |
| 1450   | 0.33                  | 9.69                            |                       |
| 1460   | -2.49                 | 12.19                           |                       |
| 1470   | -3.02                 | 11.18                           |                       |
| 1480   | -2.57                 | 10.86                           |                       |
| 1490   | 1.45                  | 6.96                            |                       |
| 1500   | 3.82                  | 4.22                            |                       |
| 1510   | 4.58                  | 2.74                            |                       |
| 1520   | -3.54                 | 10.68                           |                       |
| 1530   | 1.76                  | 6.09                            |                       |
| 1540   | -2.39                 | 9.66                            |                       |
| 1550   | -9.26                 | 14.38                           |                       |
| 1560   | 6.55                  | -0.78                           |                       |
| 1570   | 14.38                 | -8.03                           |                       |
| 1580   | -14.42                | 22.03                           |                       |

|      |       |        |        |
|------|-------|--------|--------|
| 1590 | -0.26 | 6.50   |        |
| 1600 | 11.24 | -2.95  |        |
| 1610 | 7.40  | 0.46   |        |
| 1620 | 2.67  | 5.18   |        |
| 1630 | -0.78 | 7.79   |        |
| 1640 | 3.18  | 3.74   |        |
| 1650 | 5.46  | 1.59   |        |
| 1660 | 5.58  | 1.86   |        |
| 1670 | -2.98 | 10.19  |        |
| 1680 | 7.44  | 0.43   |        |
| 1690 | -7.10 | 13.98  |        |
| 1700 | 15.08 | -7.37  | 23.43  |
| 1710 | -4.12 | 11.75  | 34.08  |
| 1720 | 12.74 | -4.79  | 82.95  |
| 1730 | 15.48 | -6.57  | 76.15  |
| 1740 | -1.29 | 9.45   | 67.71  |
| 1750 | 9.01  | -0.02  | 107.44 |
| 1760 | 13.00 | -4.12  | 130.22 |
| 1770 | -0.74 | 9.50   | 111.34 |
| 1780 | 11.16 | -2.74  | 94.89  |
| 1790 | 17.81 | -8.73  | 92.18  |
| 1800 | 20.37 | -10.14 | 111.03 |
| 1810 | 16.88 | -6.26  | 115.70 |
| 1820 | 32.72 | -21.84 | 169.03 |
| 1830 | 22.42 | -11.41 | 154.99 |
| 1840 | 37.17 | -26.24 | 130.80 |
| 1850 | 49.85 | -38.11 | 129.66 |
| 1860 | 35.98 | -23.69 | 94.05  |

## Vector Autoregression Diagnostics

Selection-order criteria

Sample: 5 - 67

Number of obs = 63

| lag | LL       | LR      | df | p     | FPE     | AIC     | HQIC     | SBIC    |
|-----|----------|---------|----|-------|---------|---------|----------|---------|
| 0   | -277.777 |         |    |       | 421.553 | 8.8818  | 8.90856  | 8.94984 |
| 1   | -217.483 | 120.59* | 1  | 0.000 | 64.1768 | 6.99945 | 7.03959* | 7.1015* |
| 2   | -216.337 | 2.2916  | 1  | 0.130 | 63.8868 | 6.99482 | 7.04834  | 7.13089 |
| 3   | -214.93  | 2.814   | 1  | 0.093 | 63.077* | 6.9819* | 7.0488   | 7.15199 |
| 4   | -214.348 | 1.1629  | 1  | 0.281 | 63.9364 | 6.99519 | 7.07546  | 7.19929 |

+-----+

Endogenous: Clark Income based GDP per head

Exogenous: Baran Ratio

Selection-order criteria

Sample: 12 - 67

Number of obs = 56

| lag | LL       | LR      | df | p     | FPE      | AIC      | HQIC     | SBIC     |
|-----|----------|---------|----|-------|----------|----------|----------|----------|
| 0   | -256.426 |         |    |       | 596.851  | 9.22951  | 9.25756  | 9.30185  |
| 1   | -168.926 | 175*    | 1  | 0.000 | 27.1788* | 6.14021* | 6.18228* | 6.24871* |
| 2   | -168.39  | 1.072   | 1  | 0.300 | 27.6368  | 6.15678  | 6.21287  | 6.30145  |
| 3   | -167.907 | 0.96617 | 1  | 0.326 | 28.1583  | 6.17524  | 6.24535  | 6.35608  |
| 4   | -167.594 | 0.62495 | 1  | 0.429 | 28.8683  | 6.1998   | 6.28393  | 6.4168   |

+-----+

Endogenous: Broadberry GDP Per Head

Exogenous: Baran Ratio