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British Public Investment, Government Spending, Housing, and the Industrial Revolution: A Study of Governmental and Social Surplus Absorption

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Abstract

When it comes to the British Industrial Revolution of the 18th Century, much of the mainstream economics literature has tended to focus on how property rights, limitations on the crown or government, and changes in agricultural and manufacturing techniques have caused a great transformation in the nation's economic formation. Marxian and other heterodox economics views acknowledge these developments but also emphasize the enclosure movement and the development of a class of people that becomes an exploited proletariat. Both sets of views acknowledge the role of the British government in facilitating the Industrial Revolution, but in doing a review for this paper, there is only a small amount of literature on how government investment and spending and the housing of workers may have helped to spur on or exist simultaneously with the revolution. This is especially true within heterodox schools of thought, and this paper aims to add to the heterodox economics literature by discussing how government investment and spending, and investment in housing, dramatically assist with surplus absorption during the Industrial Revolution, which in turn helps the British economy to achieve greater heights. Datasets that have been developed over the last 15 years or so can be used to illustrate this. Finally, by using the concept of the Baran Ratio, it can be shown that a significant portion of the nation's economic surplus is absorbed by government spending and investment and housing investment, and much of this in turn would have helped private business investment and spending in absorbing as much of the surplus as possible.

Keywords: Baran Ratio, government investment and spending, housing, Industrial Revolution, heterodox economics

JEL Codes: B50, B51, N13, N43

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Introduction

The Industrial Revolution of Great Britain that starts in the 18th Century has largely been credited to various factors, primarily among them the strengthening of private property rights, technological breakthroughs in agriculture, manufacturing, and transportation, and the growth of a strong central government (Smith 2000, North and Thomas 1971 and 1973). On the last point, much of the scholarly literature mentions how a stronger central government that enforces property rights and contracts permits broader and more secure markets for investors and business owners. Yet, in the course of doing research for this paper, not as much is written about how housing spending/investment and government spending and investment, deficits, and debts may have assisted British economic growth. Feinstein (1978) and Feinstein and Pollard (1988) have written about and estimated capital amounts for different industries, housing, and public investment items such as roads and bridges, canals and waterways, docks and harbors, and a category he calls “public infrastructure” for the 18th and 19th Centuries for Britain. Their definition of public infrastructure includes residential housing, churches, and public buildings such as work houses in addition to what is normally considered “infrastructure” such as roads, bridges, canals, sewers, ports, harbors, railroad lines, etc. These estimates of public infrastructure, however, are not delineated into the different categories which compose it. Broadberry et al (2015) and Broadberry and Plejit (2021) include public spending/investment on transportation in their estimates of transportation spending and on transportation productivity, yet do not separate governmental from private sector expenditures or efforts. This paper attempts to provide rough estimates of different public spending and investment levels over several centuries in addition to housing investment. Finally, in none of the writings mentioned are there conjectures on what portion of an economy’s domestic economic surplus (the aggregate of domestic business profits, rents, and interest and government taxes) is used to provide for public investment and how this compares to private investment. This paper tries to provide some conjectures on this topic by providing housing and governmental specific measurements in comparison to an overall Baran Ratio (Xu 2020, Lambert 2020, 2021a, 2021b).

The Baran Ratio basically calculates an economy's investment as a portion of its economic surplus. Doing so allows one to estimate how much of the economic surplus is being absorbed by investment as opposed to consumption. Paul A. Baran (1953, 1957) and Baran and Sweezy (1966) write that the total of a society's profits, rents, taxes, and interest can be considered an economic surplus that has been extracted from the workforce by an owner-investor class. The surplus can be consumed by this class and/or can be used for spending on investments such as new plants, equipment, roads, etc. or spent on "unproductive" business expenses such as advertising, product packaging, military expenditures and war, etc. The latter form of surplus absorption is considered "wasted" by Baran and Sweezy (1966) since no use value is created by such expenditures, society's standard of living is not substantively made better, and labor productivity is not enhanced. Yet, and in general, regardless of how the surplus is absorbed, absorption of most/all of the surplus is important because economic stagnation and underutilization and/or unemployment of the factors of production will result otherwise. That is, profits, interest, rents, and taxes that go unused and not spent or reinvested can cause a downward spiral in the "circular flow" of an economic system where Savings (S) should equal Investment (I), or

$$S = I \quad (1).$$

Too much savings that is not reinvested leads to less job creation, less new business formation, and less production, which in turn leads to declining national income. If productive investment in plant, equipment, and new technologies is not sufficient, then spending more on advertising, selling, war, or other forms of wasteful spending are practiced by modern capitalist economies. Similar to Engels (1957), Baran (1953) goes so far as to claim that during medieval times much of the economic surplus of a feudal society is absorbed by the aristocracy and the church spending large sums of money on minstrels, festivals, palaces, cathedrals, and military conquest. One implication is that this type of spending is not useful in that any employment effects are temporary, and it does not help to create productivity enhancing tools, equipment, etc., and so therefore, the surplus is mostly if not entirely wasted. It is capitalism, on the other hand, in which surplus is applied toward innovations and tools that help to boost productivity and output, which in turn help to create more surplus via greater business profits.

Sweezy (1942) writes that Marxian theory up to his time has little to say about the role of the state, or the government, in a capitalist society with the exception of the enforcement of property rights, resolving tensions between the classes, maintain the social/class order, and the regulation of labor through various laws about which Marx (Marx, Engels, Mandel, and Fowkes 1990) writes in *Capital*. Baran and Sweezy (1966) try to update Marxian thought by discussing how large corporations now dominate modern capitalism and how a modern role of the government is to help with the absorption of economic surplus through military spending, imperialism, limited wars, a minimalist welfare state, and taxes and subsidies which favor certain capitalist enterprises over others, especially bigger businesses. The increased government presence is due to the private sector being unable to absorb all of the economic surplus. Additionally, thanks to the Keynesian “revolution” in economic thinking, a modern capitalist economy often avoids or recovers from recessionary or inflationary periods through government spending and taxation. Such government activism could be considered as a way of government spending or regulation that helps to fill in any shortages in surplus absorption. These are the goals even if such spending results in higher taxes, budget deficits and more government debt.

Lambert (2020, 2021a, 2021b) has developed some conjectures on British real economic surplus and overall investment amounts from data by Clark (2009) and uses Xu’s (2019) concept of the Baran Ratio to show how large of an impact that increasing absorption of the domestic economic surplus during the 18th and 19th Centuries for investment purposes has on British economic growth. This is in contrast to varying levels of economic surplus available in previous centuries with little or negative investment amounts showing for many decades. He also tries to estimate real government deficits and surpluses on a decadal basis from the 13th to the 19th Century. The lack in investment versus savings is perhaps due to the fact that Clark (2009) does not include in his capital returns items such as churches, cathedrals, and palaces, things on which surplus spending would have been made by made the aristocracy or government and are included by Feinstein (1978) and Feinstein and Pollard (1988) as part of their estimates for “public infrastructure.” Broadberry and Pleijt (2021) estimate 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 investment, spending, or deficit/surpluses, although they do give estimates for residential housing.

To determine if a sizable share of overall capital investment occurring during the Industrial Revolution is spending on housing and public infrastructure items such as roads, bridges, ports, etc., this paper endeavors to create conjectures on these specific investment items and compares these to overall investment estimates. Government spending on such items could have been a substantive form of surplus absorption. Additionally, the estimated size of British government spending on the military is considered along with public and housing investment as forms of surplus absorption in order to more fully gauge government and residential absorption of the economic surplus. That is, non-enterprise investment is examined with respect to surplus absorption.¹ Therefore, this paper proceeds as follows. The next section is Analysis where data concerning public investment, the economic surplus, government deficits/surpluses, housing, and military spending are displayed and discussed. It is shown that government absorption of the economic surplus is substantial, and that government absorption of the surplus may have supplemented private investment and British economic growth more than what has been previously thought or acknowledged. Finally, a conclusion section summarizes all findings, notes limitations of the paper, makes recommendations on how the paper's findings can be used for economic history lessons, and makes suggestions for further research.

(Insert Figures 1 to 8 around here)

Analysis

Using Clark's data (2009), Lambert's estimates (2020, 2021a, 2021b) of an economic surplus as a portion of net national income for Britain from the 13th to 19th Centuries is created (Figure 1). After the Black Death of the mid-Fourteenth Century, wages for workers rise for about the next two centuries,

¹ Housing is counted as investment in national income accounting, and although usually built by private sector companies, it is also considered by Marxists as necessary to labor's reproduction and maintenance.

which in turn cuts into business profits, land and house rents, interest, and governmental tax revenues. It is not until around the 1600s that the economic surplus begins to increase again, and this could be due to the beginning of the English Agricultural Revolution. It is not, however, until the early 1800s that capital income as a share of the economic surplus begins to rise after averaging 45 to 50% of the surplus during the 1600s and 1700s (see Figure 2). In looking at Figure 3, capital income as a share of net national income also does not begin to exceed an average of 20% during the 17th and 18th Centuries until the 1800s, yet increases in estimates of total real investment begins to climb earlier than this (see Figure 4). The Baran Ratio (investment as a share of domestic economic surplus) also begins to accelerate in the late 1700s, which is a few decades before the increase in capital income (see Figure 5). If the conjectures in Figures 6 and 7 are correct, real government deficits begin to rise the 18th Century, especially in the latter part of the 18th Century, whereas the national debt consistently starts to hover around or above 80% starting in the 1790s. These are also periods that are a few decades before a climb in capital income in the beginning of the 1800s.

This paper tries to estimate spending on productive forms of public investment (canals, roads, bridges, lighthouses, etc. as opposed to churches, public workhouses, jails, etc.) and residential investment (social or labor reproduction) in order to illustrate how rising levels in these types of investment may have propelled subsequent private investment. Using conjectures, data, and ideas from Stenton (1936), Ginarlis (1970), Albert (1972), Hindle (1976), Pawson (1977), Morris (1979), Feinstein and Pollard (1988), Chalklin (1998), Wutherick (1999), Scott (2003), Harrison (2004), Blair and Hamerow (2007), Clark (2009), Ormrod (2010), Lindberg (2013), Bogart (2012 and 2013), Byng (2017), Alvarez-Palau and Dunn (2019), Buringh, Campbell, Rijpma, and Van Zanden (2020), Trethaway (2021), Bogart, Dunn, Alvarez-Palau, and Shaw-Taylor (2022) on the construction on churches, turnpikes, roads, lighthouses, and ports, some rough estimates of productive, public investment (after sometimes subtracting conjectures on amounts spent for churches, workhouses, etc.) can be created. The Ginarlis data is probably the most comprehensive data set for transportation investment from the middle of the 18th

Century to the middle of the 19th Century for turnpikes, parish highways, bridges, canals and rivers, and maintenance expenditures for these, and this data set with some modifications is mostly relied upon in this paper. Most of the sources examined for this paper mention that until the early 1700s that most roadways in Britain are still those emanating in Roman times, total around 3,000 miles, and that road maintenance is mostly a local initiative that is sporadic and depends upon workmen from the local town assembled by a local government (Postan 1973). After adjusting for inflation, road building and reconstruction costs are estimated to be fairly constant at 400 Pounds per mile per decade using 1860 prices from the 13th to the 17th Centuries. The 400 Pounds per square mile is an average/approximation used from various sources and leads up to the data gathered that starts in the 1700s, and these estimates for the 18th and 19th Centuries come close to those constructed by Clark (2009). This assumes that very little new investment in roadways, bridges, canals, or rivers occurs during these centuries. It is only in the early 18th Century that turnpikes and toll roads are more widely constructed and employed under the guidance of Parliament (Turnpike Acts) and investment by non-profit organizations. Therefore, Figure 8 demonstrates climbing public investment dollars (does not include churches, military spending, etc.) throughout the decades of the 18th Century. Spending on lighthouses make up a small amount of these estimates and were valued by discounting modern day values of lighthouse construction according to Clark's 1860 based output price index, although this method may yield an overestimate for each lighthouse. Stevenson (1959) writes that only one or two lighthouses are recorded in existence before 1600, and that Scotland did not have one until after 1600 (page 21). Most of the literature discusses lighthouses built after the 1700s with the implication that much intra-national coastal shipping took place during the day before then. Table A1 in the appendix shows the estimates for these types of infrastructure.

(Insert Figures 9 to 15 and Table 1 around here)

Figure 9 indicates that public investment as a share of the economic surplus begins to climb in Britain during the 18th Century. Before then, it appears that not much of the economic surplus is used for

roads, bridges, canals, ports or lighthouses. In 1770, public investment as a percentage of the domestic economic surplus peaks at around 27%, and in looking back at Figure 4, this is in contrast to the Baran Ratio (total net investment/ economic surplus) of slightly less than zero. The Baran Ratio for this year indicates a net loss in total real investment due to depreciation and/or little investment being undertaken. This offsets the government investments, yet the latter prevents the setbacks in net investment being worse. In fact, the steady increases in public investment up until that year contrast with the fluctuations in the Baran Ratio which does not show consistent increases until 1780. This is also about the time that Britain begins to consistently show government budget deficits and rising debt levels (see figures 6 and 7). In the 19th Century public investment as a portion of the surplus begins to decline as greater levels of private investment, especially in railroad transportation, begins to climb.²

Figure 10 displays estimates by Broadberry, et al (2015) for their trade and transport index going from the 13th to 19th Centuries. They show an increase in this for the 17th Century, but an even bigger increase for it during the 18th Century. In Figure 11, they show indexes of different services where government output is greater than those of other industrial sectors from around the late 17th Century to the middle of the 18th Century. This output includes public investment as well as military spending. And as Figure 12 from these authors illustrate, the growth of the horse population climbs at a faster rate during the 18th Century, which perhaps underscores the growth of transportation that is enabled by the road building projects being undertaken and completed during this time.³ According to Langdon (1982 and 1986), the horse does not overtake the ox as a useful farm animal until agricultural markets become larger which makes transporting produce longer distances necessary. Brenner (1985) notes that an increasing population and growing farm and market sizes trigger greater demands for transportation and cites Chartres (1977) as a source that indicates greater investment in private transportation capital (carts,

² One year during 1830s or 1840s private investment into railroads, allowed by parliament, equaled that year's entire GDP for England/Britain

³ There is a break in the data in Figure 12 because the authors claim that this is a period of time in which it is too difficult to come up with estimates of oxen or horses.

wagons, coaches, etc.) beginning in the late 17th Century. These in turn probably help to spur on the turnpike and canal building of the 18th Century, although in surveying the literature, it is hard to pinpoint whether the primary and/or original purpose of the turnpike system is for helping people to move or for helping goods to move since the 18th Century in Britain is a time of population increase and movement from countryside to urban areas. Yet, for the purposes of this paper, the main point to note is the intervention of the national government and local charter organizations in creating and providing toll roads and transportation modes. Without the provision of these public goods, market expansion possibly could/would have been slower than what would have been the case otherwise.

When residential housing is included with the public investment expenditures mentioned above to approximate some type of aggregate government and social spending amount, an even greater amount of the economic surplus is absorbed.⁴ Figure 13 displays real expenditures on housing plus real public investment spending as a percentage of the real economic surplus. For some of the decades shown, the portion of government and social spending contributes a modest to large amount of the Baran Ratio numbers shown in Figure 5. This is especially true when examining the decades from 1750 to 1790 where government and social investment makes up 19 to 113% of domestic economic surplus. Table 1 compares public and social investment as a share of the economic surplus to total investment as a share of the domestic economic surplus for the decades examined of the 18th and 19th Centuries, and for some decades government and social investment comprise a significant portion of the surplus and total investment. Finally, Figure 14 shows growing government spending as a percentage of GDP on the part of the British government during the 18th Century that continues until around 1816 (Mitchell 1988, Thomas and Williamson 2022). Although Mitchell (1988) shows that a disproportionate amount of this is for the military (unproductive activity), the expenditures probably still have a multiple effect across the British economy during this time period. Figure 15 illustrates how much of total national government

⁴ Residential housing investment/expenditures are approximated by taking Clark's (2009) real rental income from 1200 to 1860 and dividing these by his estimates of real interest rates.

spending goes for the military, and this is especially prominent during the 17th and 18th Centuries, and these increases in spending also correspond to rising debt levels as shown in Figure 7.

(Insert Figure 16 around here)

Conclusion

Some limits of the preceding analysis are that the conjectures developed are based upon conjectures made by other authors, and none of these estimates can be taken as completely and totally accurate estimates of economic activity which took place centuries ago. Yet, in trying to approximate as closely as possible past economic data, this paper and other writings endeavor to try to describe past economic events using the data in order to draw insights and lessons from history.

In addition to writing about national defense, taxation, and having the government enforce property rights, Smith (2002) notes how bridges and roads are necessary to help commerce and business thrive yet writes little as to whether or how much British government expenditures are important to the economic times about which he writes. Smith's and others' writings on the importance of property rights, taxation, and regulation have traditionally made up the bulk of the rational by mainstream economists and historians on why the Industrial Revolution occurred in Britain. There is recognition of the role of government regarding public works among these writings. However, the role of government spending and its possible impacts on British economic growth before and during the Industrial Revolution are often less emphasized, and this paper has only found some writings which attempt to estimate public sector spending for infrastructure that facilitates business and capitalist enterprises. Most of all, a question that this paper has attempted to address is what share of the economic surplus does government spending on public works absorb before and during the Industrial Revolution. The amounts seem to be substantive. Whether the amounts are enough to stimulate further economic growth and more surplus in a Keynesian sense is beyond the scope of this paper. Yet the conjectures on infrastructure spending imply growing public investment spending even when total investment is not growing as rapidly. The rate of increase in

public works spending in the 18th Century could have been a boost to overall investment spending in that century and in the subsequent one.

Additionally, residential housing absorbs quite a bit of the economic surplus as well. Granted, businesses profit from housing construction, but housing allows labor to “reproduce” itself and can be considered as some type of societal investment that is necessary for a capitalist society to function. Figure 17 shows real net national income per capita (Clark 2009) by this paper’s estimates of real public and housing spending from 1700 to 1860. No causality is implied by the graph, yet the two variables do show some correlation. Investment in housing and productive public spending such as roads, bridges, canals, ports, lighthouses, and waterways has traditionally been considered a potential boost to higher standards of living, and Figure 17 seems to support this.

Heller (2011) writes that a decisive factor in the ascendancy of capitalism in Britain is the role of a strong, central government which helps to create broad national and international markets for its producers, and the creation and development of international markets is often done by imperialism. The significant increase in military spending that coincides roughly with Britain’s Industrial Revolution somewhat supports this. This is also the time of tremendous growth in the British Empire despite the fact that the colonies in North America are eventually lost toward the end of the 18th Century, and imperialism allows Britain more resources and markets with which to expand its economy.

Baran and Sweezy (1966) write that as a capitalist economy grows, it must find ways to reinvest or spend the surplus it generates. If not, such an economy will stagnate and regress. According to them, in a modern capitalist economy fewer outlets for productive investment of the surplus exist, so therefore much of it must be wasted on war, advertising, and other things which have little or no use value. In the Industrial Revolution, and with the exception of military spending, the absorption of the economic surplus by government spending on public works and by families on dwellings could be considered as investments or expenditures that have use values and in turn help to create a more productive society. This is witnessed by estimates of rising GDP per capita in Britain during the 18th and 19th Centuries

(Clark 2009, Broadberry et al 2015). Without the investment in public works, further economic growth would have been difficult, and without investment in residential housing, a key outlet for accumulating surplus would have been lost.

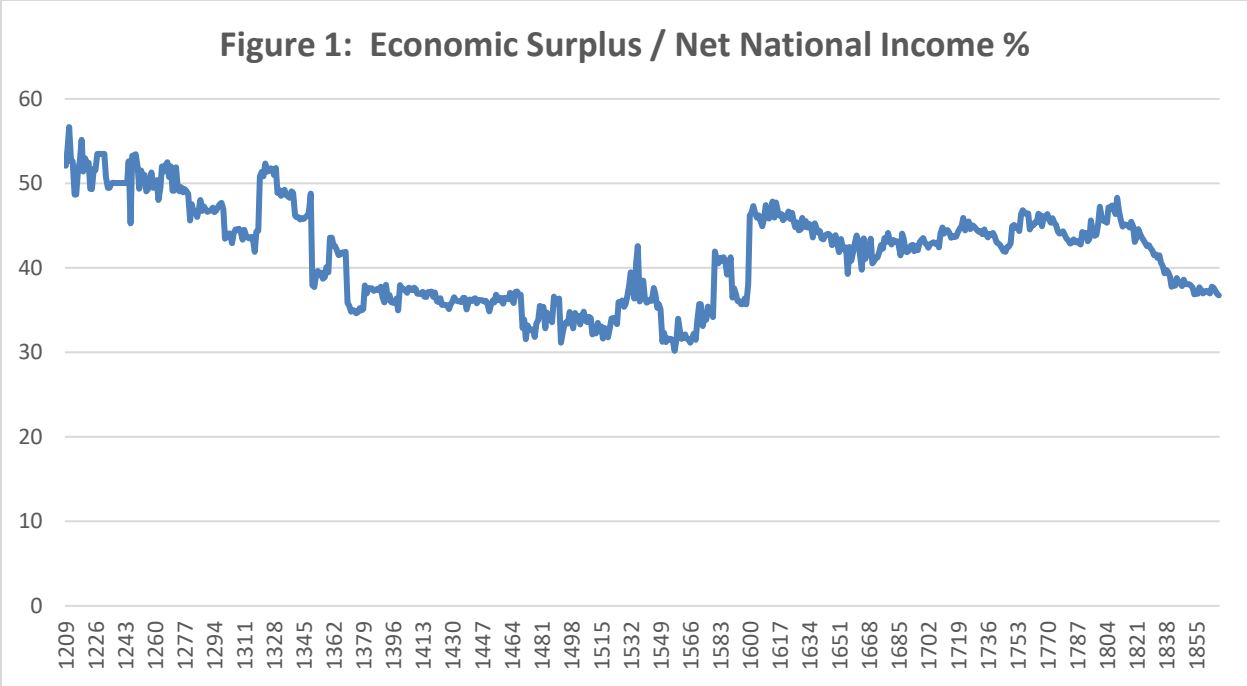
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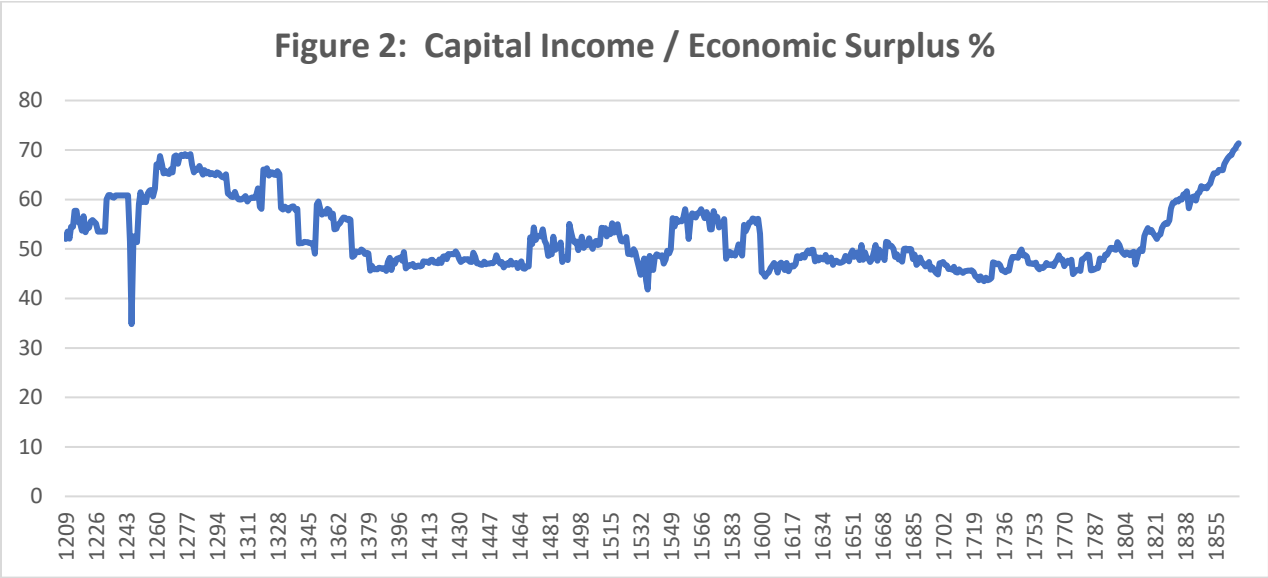
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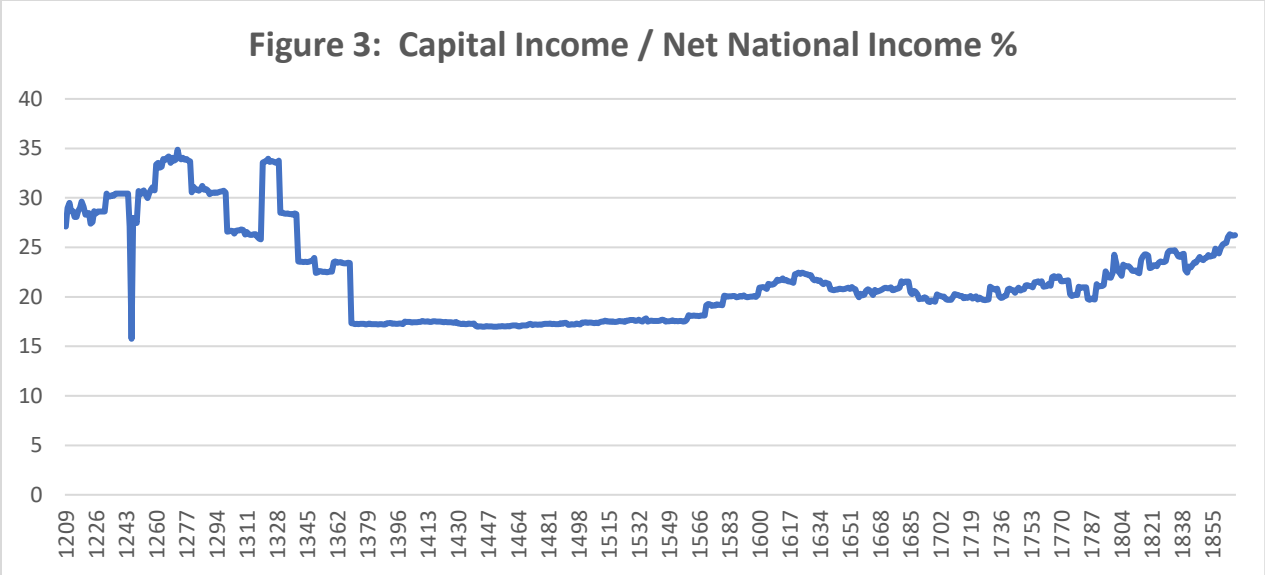
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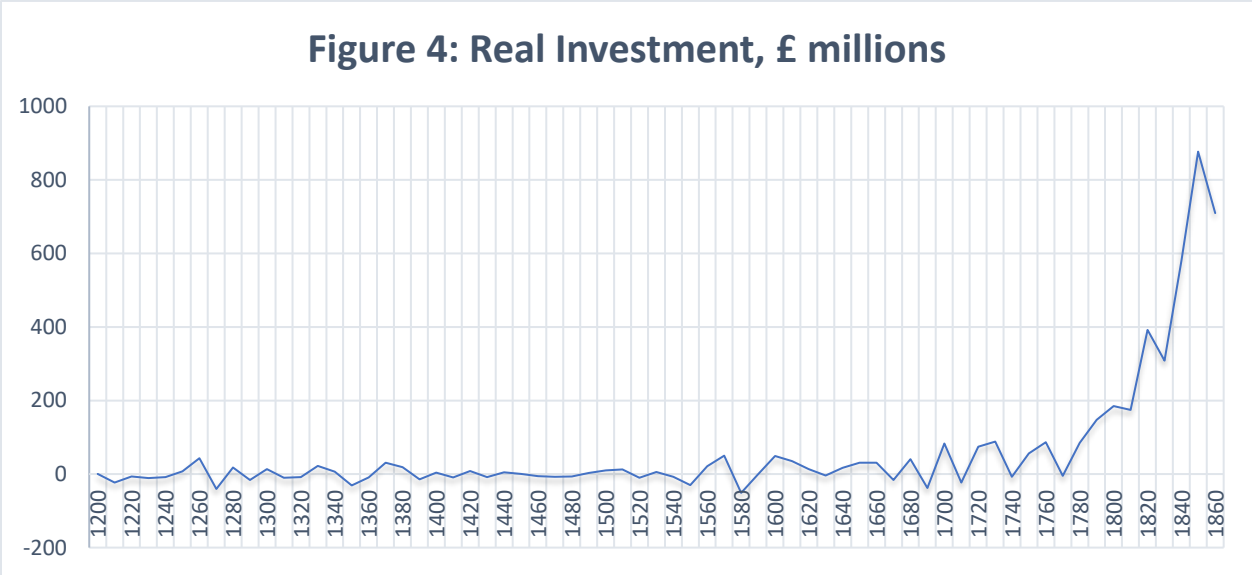
Source: Author's use of data from Gregory Clark, "National Income, Prices, Wages, Land Rents, Population, England, 1209-1869", from his website, <http://faculty.econ.ucdavis.edu/faculty/gclark/data.html> .



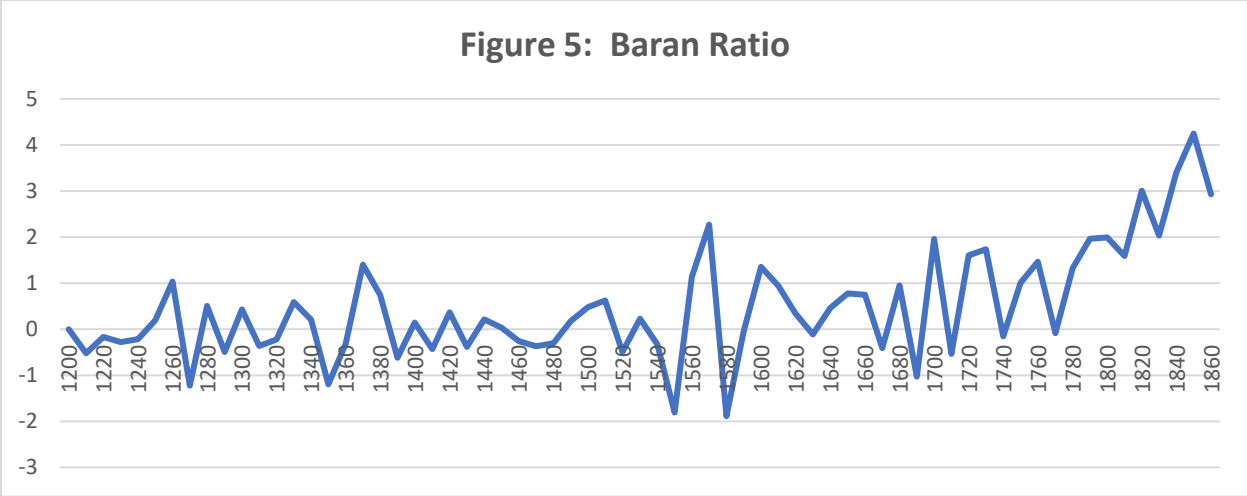
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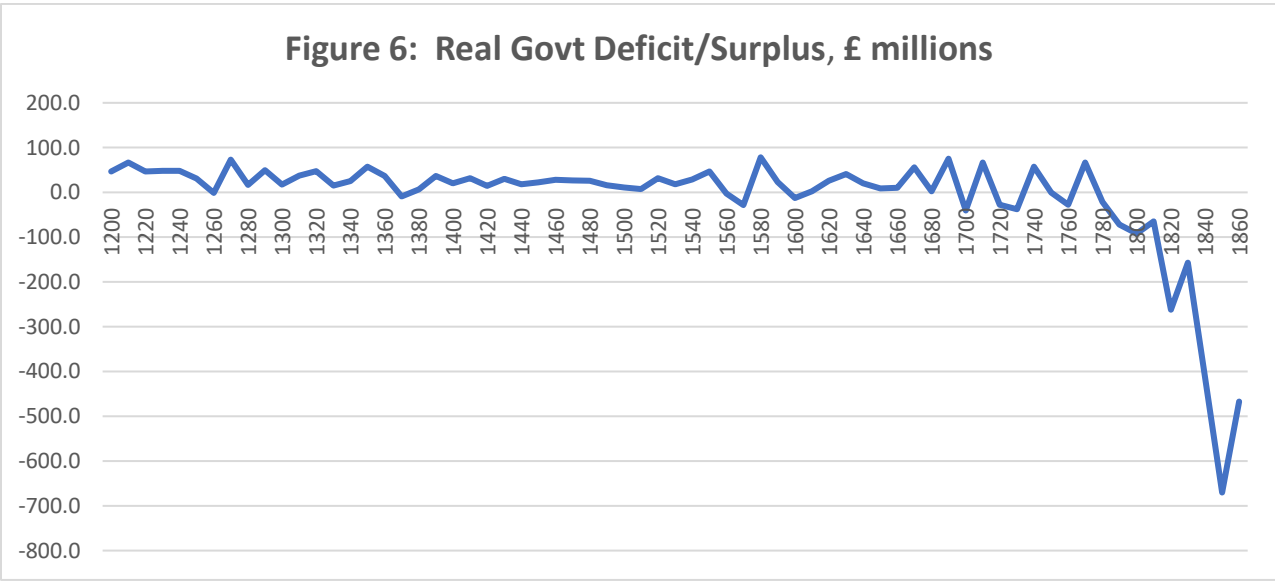
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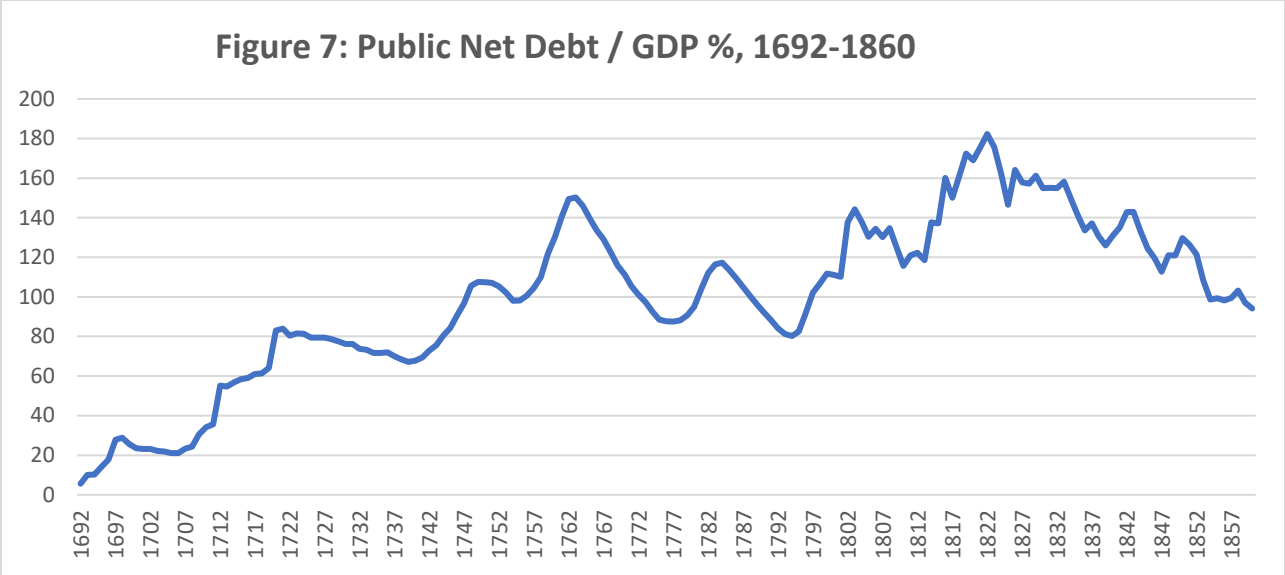
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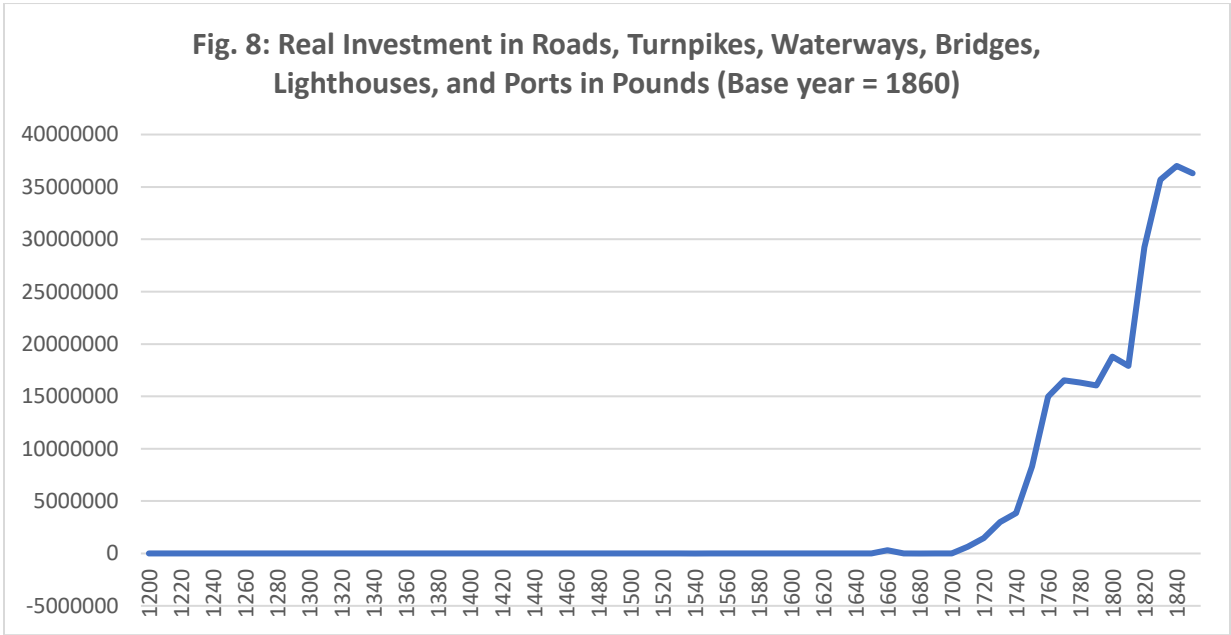
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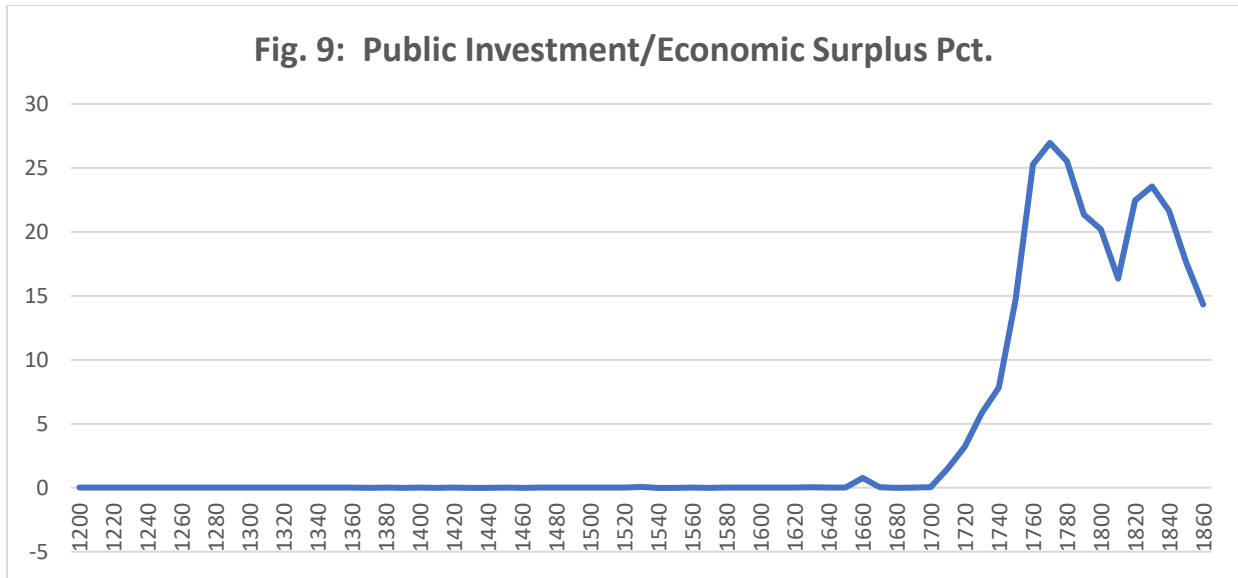
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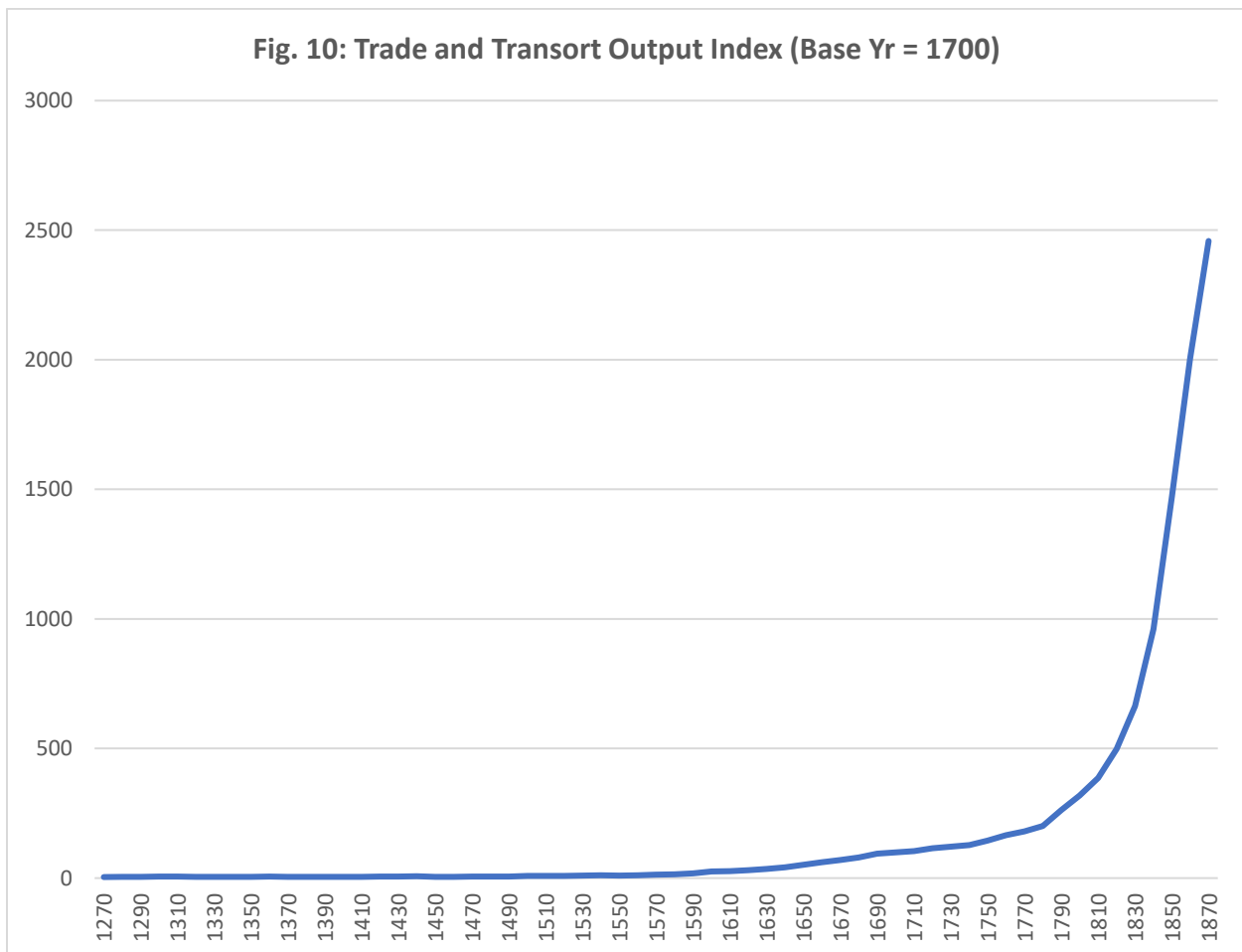
Source: From B.R. Mitchell, British Historical Statistics (1988) and Christopher Chantrell (no date) UK Public Spending, <https://www.ukpublicspending.co.uk/>



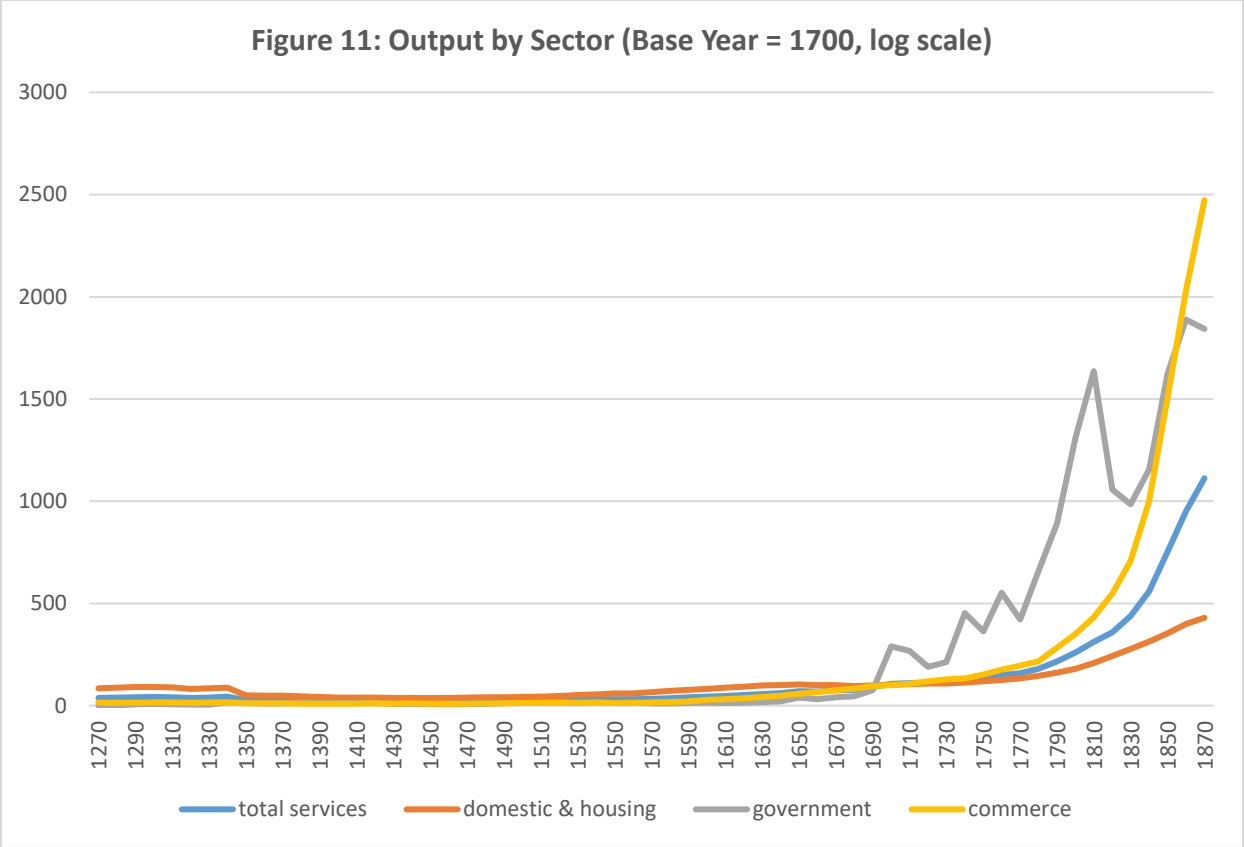
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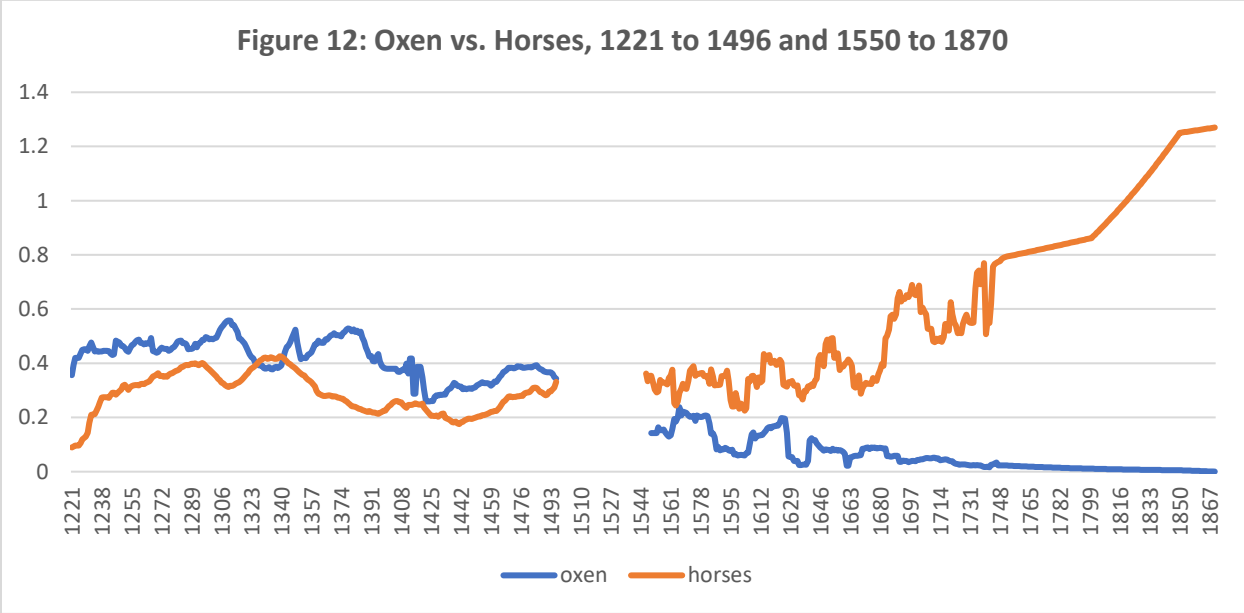
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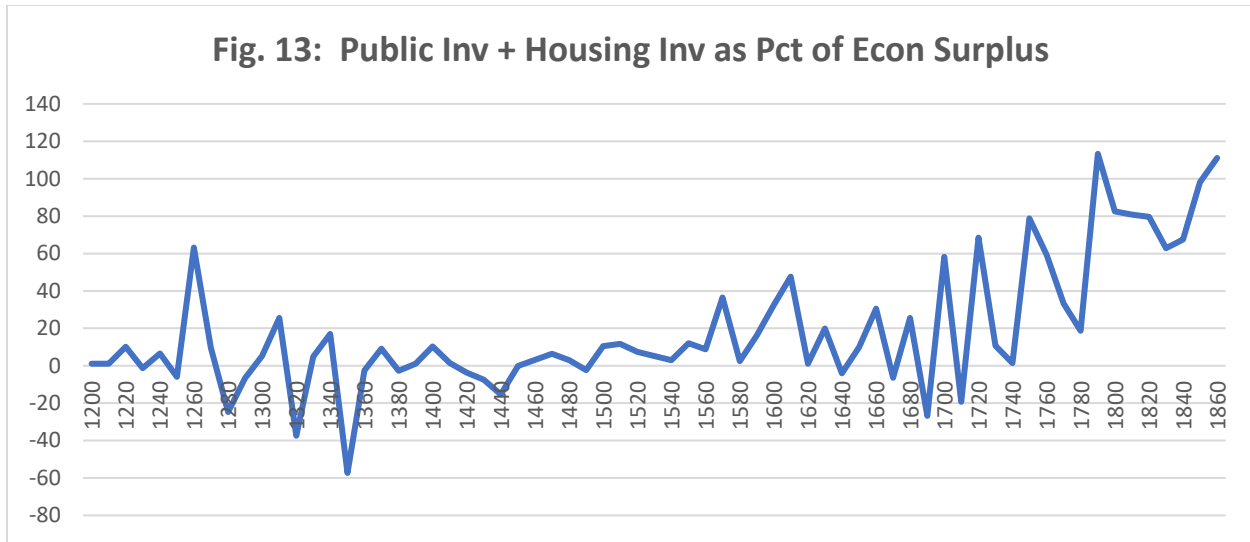
Source: Figure 4.09, Broadberry, et al (2015), page 171.



Source: Figure 4.08, Broadberry, et al (2015), page 163.



Source: Figure 2.01, Broadberry, et al (2015), page 54..

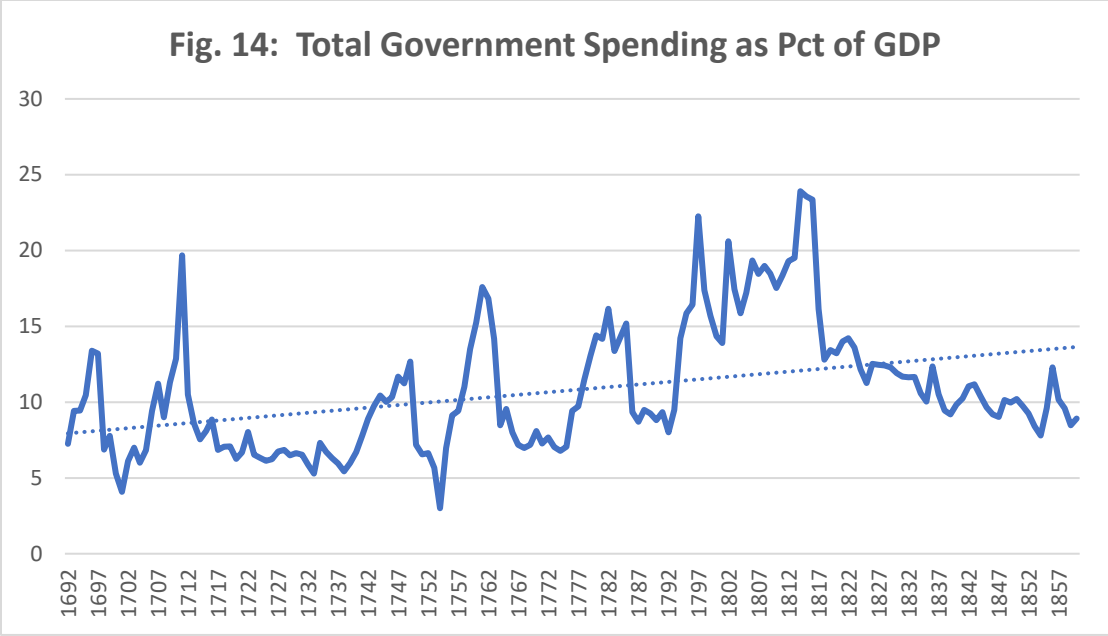


Source: Author's calculations using Clark (2009) data.

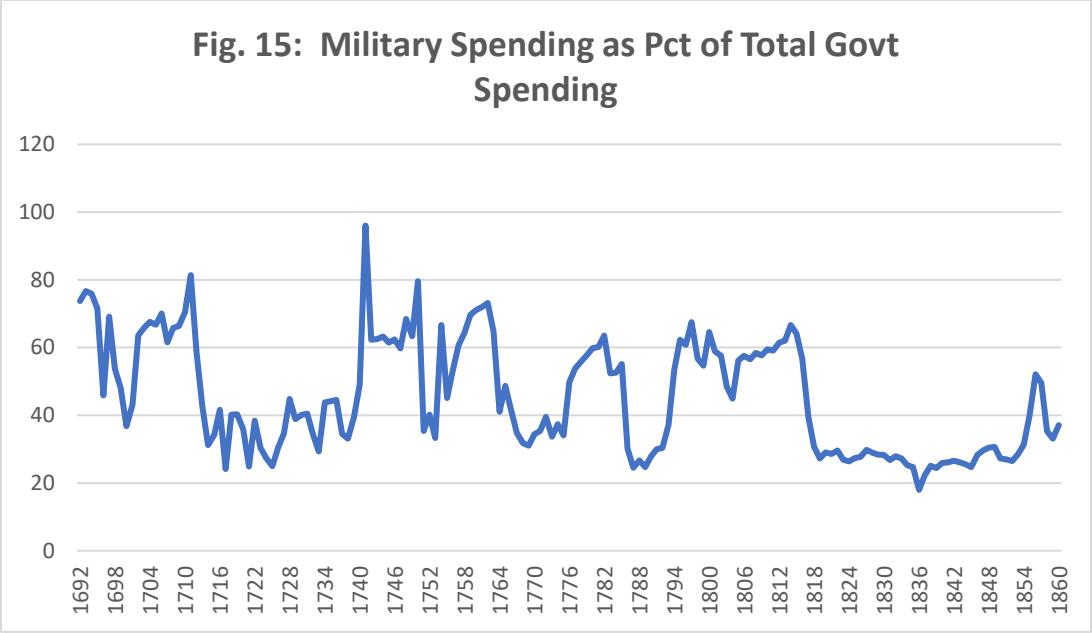
Table 1—Comparison of Investment Portions

Year	Public Inv + Housing Inv as Pct. of Econ Surplus	Total Investment / Econ Surplus Pct. (Baran Ratio X 100)
1700	58.27	195.53
1710	-19.35	-53.92
1720	68.51	160.50
1730	10.72	173.53
1740	1.38	-15.85
1750	78.77	100.23
1760	59.26	146.26
1770	33.23	-8.49
1780	18.66	132.63
1790	113.30	196.14
1800	82.50	199.19
1810	80.79	158.92
1820	79.68	300.75
1830	62.77	203.55
1840	67.43	339.97
1850	98.09	424.74
1860	111.10	292.78

Source: Author's calculations.

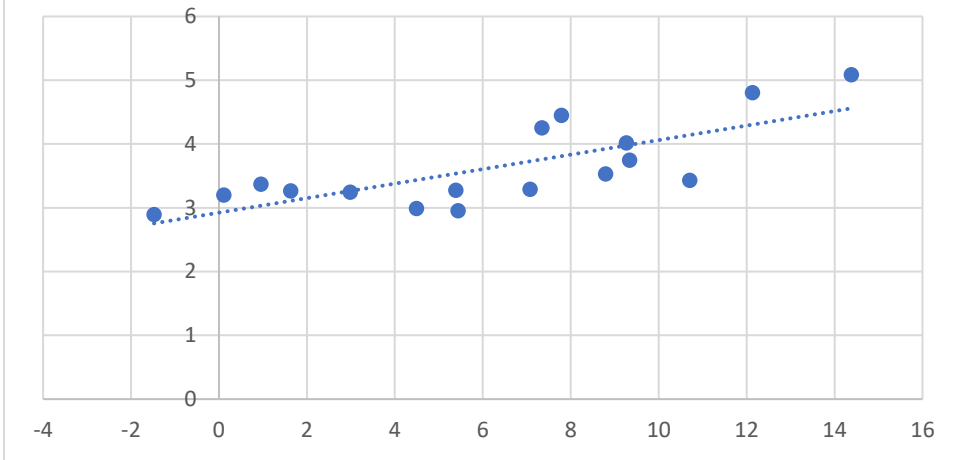


Source: From B.R. Mitchell, British Historical Statistics (1988) and Christopher Chantrill (no date) UK Public Spending, <https://www.ukpublicspending.co.uk/>



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Fig. 16: Real NNI per capita (y) by Real Public & Housing Investment (x), 1700 to 1860



Source: Author's calculations of public and housing spending and Clark's (2009) estimates of NNI per capita.

APPENDIX

**Table A1—Inflation Adjusted Investment Amounts, £
Base year = 1860**

Year	Roads, Turnpikes, Waterways, Bridges, Lighthouses, Ports (INFADJ)	Investment in Housing (INFADJ)	Public + Housing Investment (INFADJ)
1200	0	547259.5094	547259.5094
1210	0	482957.3126	482957.3126
1220	0	4030369.669	4030369.669
1230	0	-512905.8982	-512905.8982
1240	0	2575963.882	2575963.882
1250	0	-2240307.074	-2240307.074
1260	0	26196339.35	26196339.35
1270	0.325090343	3141667.313	3141667.638
1280	277.6161861	-8538904.184	-8538626.568
1290	186.9111714	-2199666.668	-2199479.757
1300	529.6704701	1611932.981	1612462.651
1310	-334.7928201	7063405.559	7063070.766
1320	-160.1280185	-14440509.14	-14440669.27
1330	152.855891	1830384.049	1830536.905
1340	776.439898	5395392.595	5396169.035
1350	412.312005	-14953556.64	-14953144.32
1360	1988.641039	-699908.9525	-697920.3115
1370	-739.3373578	1962502.019	1961762.682
1380	430.9217472	-673342.9757	-672912.0539
1390	-530.6088103	250919.9416	250389.3328
1400	60.33820835	2479420.612	2479480.95
1410	-721.5365208	324477.1834	323755.6469
1420	257.5180831	-830063.9055	-829806.3874
1430	-547.8760832	-1650880.957	-1651428.833
1440	-542.4463634	-3514321.013	-3514863.459
1450	347.0091389	-12966.41831	-12619.40917
1460	-460.0415538	706985.1297	706525.0881
1470	-45.68328288	1238481.779	1238436.096
1480	145.5590508	593426.1168	593571.6759
1490	-107.7702097	-465289.3877	-465397.1579
1500	0.103040874	2160863.197	2160863.3
1510	0	2421772.391	2421772.391
1520	0	1537217.558	1537217.558
1530	11617.67475	1233377.527	1244995.202
1540	-4410.530909	666608.2447	662197.7138
1550	-508.9708355	1985454.892	1984945.921

1560	134.5337315	1624510.842	1624645.375
1570	-886.859488	8109851.53	8108964.67
1580	3661.90544	669157.0542	672818.9596
1590	4235.484132	3584954.213	3589189.697
1600	3459.894097	11830273.03	11833732.93
1610	5072.268215	17736549.6	17741621.87
1620	1015.148286	415513.2105	416528.3587
1630	12960.53818	7277575.499	7290536.037
1640	-276.073495	-1543486.337	-1543762.41
1650	850.4007988	3955068.956	3955919.357
1660	317145.0283	12348745.96	12665890.99
1670	9889.035548	-2552787.601	-2542898.566
1680	-4412.91294	10878125.56	10873712.65
1690	6261.440588	-9941733.22	-9935471.779
1700	11024.17217	24748842.53	24759866.71
1710	659164.0158	-9064471.386	-8405307.37
1720	1485185.689	30151139.69	31636325.38
1730	2986754.442	2490575.085	5477329.527
1740	3862228.582	-3182941.985	679286.597
1750	8313566.539	36009439.89	44323006.43
1760	14963535.37	20114908.02	35078443.4
1770	16539228.81	3853376.466	20392605.28
1780	16313698.21	-4388810.885	11924887.33
1790	16040425.92	69115818.17	85156244.09
1800	18778542.37	57944204.2	76722746.57
1810	17897544.65	70544640.23	88442184.88
1820	29254334.58	74629039.85	103883374.4
1830	35702421	59502058.33	95204479.33
1840	37000181.59	78269958.98	115270140.6
1850	36305362.68	166167101.1	202472463.8
1860	34680725.43	234606397.6	269287123