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Importing sobriety: Understanding the tea trade during the Industrial Revolution

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## **Abstract**

Economic historian Robert Allen observed that during the Industrial Revolution, the British working class experienced a period of stagnant real wages. This has led many historians to investigate changes in the diet of the working class during that time. While there has been a focus on the entire food basket, this paper concentrates on the consumption of tea, which was entirely imported. I seek to explore why demand for tea increased during the Industrial Revolution by examining the effect of working hours on tea imports between 1760 and 1834. I aim to identify the determinants of tea demand and while underlining the crucial role that increasing working hours played in surplus extraction. The Industrial Revolution was characterized by long working hours, and the declining consumption per capita of so-called luxury items, such as tea, was actually due to their use as stimulants. To examine the relationship between working hours and tea imports, I employ a Dynamic OLS (DOLS) methodology, which demonstrates that tea imports responded positively to increasing working hours. This finding is corroborated by another method, the Fully Modified OLS (FM-OLS). I also propose new methods for calculating hours worked and tea imports in the process.

**JEL Classification** - N33, J22, I15, N73, F14

**Keywords** - Tea, Working hours, Time Series, Trade History, Industrial Revolution

## Introduction

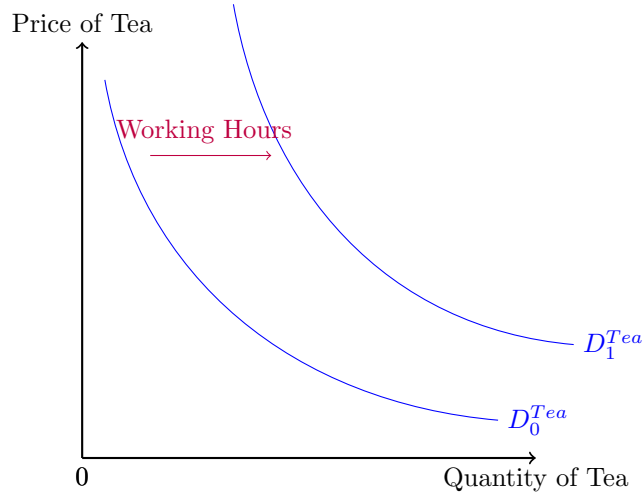
Tea remains the world's most popular commercial drink today and the second most consumed liquid in the world. It is a commodity like many others that have had its fair share of wars and tribulations because of it. Sidney Mintz (Mintz, 1985) was a pioneer in the studies that traced the evolution of a commodity. His unit of analysis was the classic good of sugar. The focus was not so much on presenting sugar and its history matter of factly, rather its dialectical relationship with society at large. Dialectical in the sense that it reflected the change in tastes and preferences of the population and yet it served the purpose of capital accumulation. Both forces acted upon each other to make tea a staple in the British household in the Industrial revolution. A commodity that is seen as a luxury today often becomes an essential tomorrow. This evolution from a luxury to an essential deserves a lot of attention. A commodity undergoes certain changes in its *social* characteristics as it makes this transition. We can ask here if it is the usefulness of the commodity that determines its relation to society or is it the society's evolution itself that determines the relation with this commodity. A luxurious good's consumption has a very different context to that of an essential good. What makes the consumption of a good essential occupies a centrality in this essay. We argue that tea's place in society is not merely a case of it being a useful product but at the same time it is the juncture that English society found itself in that made tea popular.

Tea as a drink acts as a stimulant that awakens people. Caffeine is one of the stimulating drugs in tea and it could range from 14mg to 61mg per serving ideally (Chin et al, 2008). Caffeine, as the reader might be aware, has properties that energizes or stimulates people. This fact was much widely publicized in 18th century Britain by various groups. This not only helped cultivate a tea culture in Britain but at the same time it helped extracting longer working hours from the workers. Medical science has well documented the effects of caffeine on the human body (Hindmarch et al, 2000; Einöther & Martens, 2013). This, though, has been lacking in the field of economics, which is rather a strange omission especially considering how central working hours is to the functioning of an economy. We can go about asking to what extent can we attribute the rise in the hours to tea consumption? This paper attempts to answer this question by placing it in a historical context. As we understand today, the standards of living have improved by leaps and bounds. This improvement

is reflected in the increase in the consumption of most food items. As we will see the standards of living were not necessarily improving in the 18th century. However during the Industrial revolution, circumstances necessitated a move from a local diet to an imported diet mainly consisting of tea and sugar. More so when taking into account what Voth(2000) claims, labor input per member of the labor force increased by 20 to 23 per cent between 1760 and 1831. Tea as a stimulant played an important part in it.

The link between mental alertness and tea consumption in today's time has not gone under the radar of the scientific journals. For such research, we need sophisticated data on biological indicators of attention. Since we lack such data from those times, I attempt to find a reasonable proxy in the form of working hours. Working hours represents the physical capabilities of the workers and higher the working hours the more deterministic it is of the basket of consumption goods. One such *luxurious* good was tea that found its place in the basket of goods in 18th century Britain. Though several historians (Macfarlane & Macfarlane, 2009; Rappaport, 2017) have also alluded to a higher consumption of tea helping workers work longer hours, to the best of this author's knowledge, this is the first quantitative study to study the relationship between working hours and tea consumption. Why did tea have such a low elasticity of demand, even with it being an imported good let alone a luxurious one?

I put forth a time series analysis to understand the relation between hours worked and tea imports. The methodology I use is a dynamic ordinary least squares regression (DOLS) to find the link between the two. This methodology enables me to see the elasticity of demand with respect to not just price but that of working hours as well. For it to be accurate, we must also check if the variables that explain tea consumption are cointegrated or not. Taking note of the fact that consumption of agricultural output & net imports declined or stagnated (Clark et al, 1995), I try to hypothesize that tea imports enabled the workers to work for longer hours. thereby shifting the demand curve for tea. Clearly, tea imports can not merely be explained by an increase in working hours so I also add other controls that increased the demand for tea.



In light of new research from Antman (2022), who finds that the mortality during the Industrial revolution reduced due to an increasing demand for tea, demand for tea deserves attention. She calls it an 'unintentional' consequence of tea drinking. This demand was because of reasons I quantify in this paper. Another important distinction that sets this paper apart is that it concerns a change in diets and custom that occurred due to no concerted policy efforts as such but rather as an unintended consequence of capitalism's desire for higher working hours. The paper is organized as follows. Section II provides some historical background as to how tea became a staple in a British household. Section III digs deeper into the length of the working day and the history of it in Britain. As I lack proper data on working hours from the 18th century, I propose a method to predict working hours for that time period under examination. Additionally, tea smuggling was rampant and I correct for it in Section IV. I present my main Time series model in Section V. Section VI discusses the results and Section VI concludes.

## Historical Background

### *History of Tea Consumption in Britain*

In 1660 few Britons had heard of tea, it was a unique commodity as the Qing dynasty prevented the transfer of its seeds, plants, and knowledge to the West (Sigley, 2015). In the 1650s it started arriving in the British Isles and in 1685 trade policies were liberalized by China's emperor to attract

silver to the empire and that gave tea importation a push. However, it was not until after the Glorious Revolution of 1688-89 that tea culture began to take shape in the Isles (Ovington, 1699).

There were certain social forces behind this move besides some politico-economic forces. Social pressures come in the form of a society coming to grips to civilize its people. Here, the role of the temperance movement needs to be highlighted. Locally produced beer was the preferred drink but tea was promoted for its health benefits. Tea came to be seen as a civilizing commodity and its benefits were widely advertised. It was inspired by many Chinese intellectuals like Lu Wen, who claimed that tea *does not cause men to get drunk, but subtly awakes to pure thoughts* (Benn, 2008). Political economists of the time - David Ricardo & Thomas Malthus - were very influential as the industrialists advocated the use of tea to not just create a sober workforce but wanted to sustain a healthier market as they believed that *immorality* creeps in when wages increase (Hirschman, 2013). So abstinence from alcohol became a major plank for the liberal minded temperance advocates. The idea that it was a cure for alcoholism was pushed forward and it converted many to its fold in the early 18th century (Woolmer, 1811). Mass consumption of tea also enabled liberal businessmen to conduct exchange of goods with China and India. They believed that the growth of working-class tea consumption was an important cog in the globalized trade engine.

The more important argument for the popularity of tea and one I intend to explore in more detail is the use of tea as a stimulant. To the reader this must not come as a surprise that caffeine does provide relief from fatigue but early 18th century English society was still starting to understand its stimulating properties. One of the first accounts would be John Chamberlayne's *The Natural History of Coffee, tea.....berries* (Chamberlayne, 1682) who mentioned how stimulating a drink of tea could be. There was a consensus regarding the benefits of tea and it seemed to be widely accepted (Moxham, 2003). The approval of the protestant church in the form of the temperance movement mentioned above was another evidence of tea being a drink that was seen as an acceptable stimulant. It did not cause inebriation and rowdiness, like alcohol did. The psychoactive effects of tea were conspicuous and it was perceived as a civilising agent by the society at large (Mathee, 1995). As James F. W. Johnston explained in the *Chemistry of Common Life* (1855), *it exhilarates without sensibly intoxicating* (Johnston, 1855). Since its stimulating effects were well known, 18th century Britain established a taste for it. There are evidences that by midcentury 1750s tea had

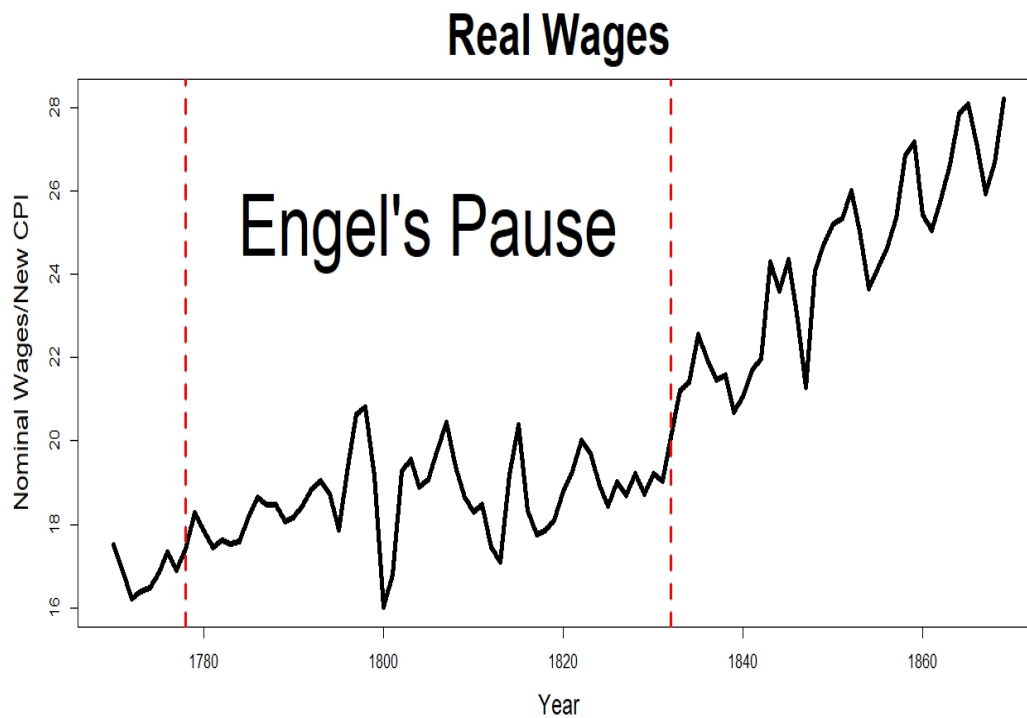


Figure 1: Source - Allen, R. C., 'Pessimism preserved: real wages in the British Industrial revolution', Oxford University Dept. of Economics working paper no. 314 (2007)

become a household drink (Styles, 2007). It could be afforded by most plebian consumers. Tea by midcentury was no longer a luxury but became a normal good as the price trend shows in Figure 16 (in appendix).

For this essay my period of focus is 1760 to 1834. The reason I choose this period is because it coincides with the first Industrial Revolution. This period was characterized by wide changes in British society. It saw an increasing marketization of labor as a commodity and it, by and large, represented the transition from a feudal society to a capitalist society (Polanyi, 2001). This period is also important as it saw the increase in the plight of the workers as they crowded urban centers to work. The other reason why 1834 is the year I choose to end my analysis is because that was the year that the monopoly privileges for tea accorded to the EIC ended in 1834 (Morse, 1926).

We can see in Figure 1 that the real wages until around 1830s was rather stagnant, it was only after that the standards of living improved significantly (Clark, 2007; Feinstein, 1998). What was the

defining force behind such a movement from locally produced goods to a different diet including tea and sugar under these conditions. So consumption per se may not have increased if we are to go by the real wages indices. Though with stagnant real wages one can still see better nutritional status amongst workers. On the contrary, there was a decline in the nutritional status of the workers during the Industrial Revolution. Hobsbawm(1957) painted a bleak picture of consumption gains during this period using agricultural output. Consumption per capita regained its 1760 levels only in the 1840s (Crafts, 1985). Since then, methods to estimate nutritional benefits have improved, mostly using physical statures of people (usually height). Komlos & Küchenhoff (2012) find a deteriorating nutritional status as decreasing heights accompanied the onset of the Industrial revolution. High food prices meant that not only did people look for cheaper alternatives (which came in the form of tea and sugar) but it also reduced their nutritional status (Baten et al, 2014). Perhaps high food prices is what explains the stagnating real wages we see above. Cinnerella (2008) adds to this discussion by using parish level data to find that the heights did decrease during this time and that this may be due to rising food costs. Though tea as such does not have a calorific content of its own but it was consumed mainly with sugar. Sugar, as we know, does have calorific values. It is one of the only imported commodities to have risen in the calorific value content in an Englishman's diet from 1700 to 1850 (Harris et al, 2010). When we see this in light of tea consumption we shall understand sugar consumption better. The EIC entered the tea business as a complement to sugar. It was suffering from an excess in the late 17th century, just when tea drinking was becoming a culture in Britain (Lawson, 1997). Tea came to sugar's rescue as sugared tea became the norm in many towns and villages around Britain. Sugared tea and white bread became the nutritional mainstays, it supplanted the traditional produces of milk, cheese, ale, meat & oats (Ellis et al, 2015). Harris et al (2010) lists all the categories where the calorific content may have gone up and wheat was the only non-stimulant food to have gone in value during this period. They use domestic crop yields which may not be particularly indicative but the import content of the other foods was negligible until the early 1800s as per Wrigley (2015). This also gives approval to the method used.

Presented above is also a summary of the British food puzzle from 1770 to 1850. Clark et al (1995) use three different methods to find that the supply of foodstuffs by domestic farm production and by net imports stagnated or even declined. Voth(2000) lends credence to the argument put



forth by Clark et al(1995), he invalidates the famous finding of Fogel (1993) that food was so scarce that workers could not toil for longer hours. Food was scarcer, evidenced by a 0.13 per cent growth in domestic agricultural output while population growth rate was 0.58 per cent per annum between 1760 and 1780, while between 1780 and 1801, the population growth rate was 1.05 per cent and output growth in agriculture at 0.75 per cent (Wrigley & Schofield, 1981; Crafts, 1986) & we see a similar trend between 1800 and 1831. Imports were unimportant for the period up to and including the early 1800s. How were people working for long hours when food availability was down? The answer lies in the availability of tea & sugar. Voth(2013) calls it luxurious spending but the truth is that an increasing share of a working class family’s budget was spent on tea and sugar. Voth (2013) claims that people were not on the verge of starvation and backs up with the amounts being spent on ‘luxuries’ such as tea and sugar as can be seen in Table 1. It was not necessarily money spent on luxuries but rather as Hersch (2022) show that the benefits of these luxuries did not just accrue to the few upper-class families.

Year	Sugar	Tea
1780	3.63%	6.36%
1790	4.89%	4.93%
1800	7.33%	4.80%
1810	4.32%	3.58%
1820	4.63%	3.57%
1830	3.90%	3.55%
1840	4.30%	2.42%

Table 1: Budget shares of tea and sugar, Source - *Hersh, J. and Voth, H.J., 2022. Sweet diversity: Colonial goods and the welfare gains from global trade after 1492. Explorations in Economic History, p.101468.*

Coming back to tea and the role it played in the Industrial revolution, we can, going by some of the evidence provided above, say that workers were using sugared tea as a cheap alternative for energy. This can be seen in the context of the increasing food prices and how the Industrial revolution increased the workload of the workers. Tea and its stimulant properties were well known and such properties were taken advantage of by the industrialists, who along with the Protestant church were

the biggest proponents of the usage of tea. Tea breaks that are so popular today is a relic of the Industrial revolution, the poster in Figure 2 is from around 1935 but it can be seen how tea was seen on the factory floor. A report of the Factory Enquiries Commission in 1834 showed that many mill owners were allowing workers tea breaks of 15 and 30 minutes in Derbyshire and Lancashire. This break was given to them between lunch and closure (Factory Enquiries Commission, 1834). It is no surprise given the facts we have presented that tea consumption shoots up in the 18th century.



Figure 2: Source - *Poster by John Gilroy, ITMEB, c. 1935. (Courtesy of Gilroy Family Estate)*

On a concluding note, I would like to draw the reader's attention towards coffee. Coffee, like tea, is another stimulant brew and both of them are not indigenous to Europe. Coffee, as one can imagine, is a viable substitute for tea. Coffee consumption at 0.1 lbs per capita was around 10 times that of tea in 1700 but the fortunes did turnaround for tea in the second half of the 18th century as we can see in the graph below. But there are certain factors that pushed tea consumption above that of coffee. Primary among them is the lack of supply of European coffee as it was grown in the foothills of Yemen and as per some estimates only 1/8th of the output was shipped to Europe, so Europe as

a market did not have much say in its pricing (Smith, 1996). Secondly, Britain was slow to follow its imperial rivals the Dutch and the French in planting coffee in its area of mercantile interest. We can see in Figure 3 it was not until the 19th century that coffee picked up its demand. Thirdly, as De Vries (2008) explains in his book, the West Indian sugar lobby and the East India Company (EIC hereinafter) lobbied against the use of coffee to create a cheap market for sugared tea. The EIC had entered the tea business in the 1660s and in the 18th century it had a monopoly over the trade.

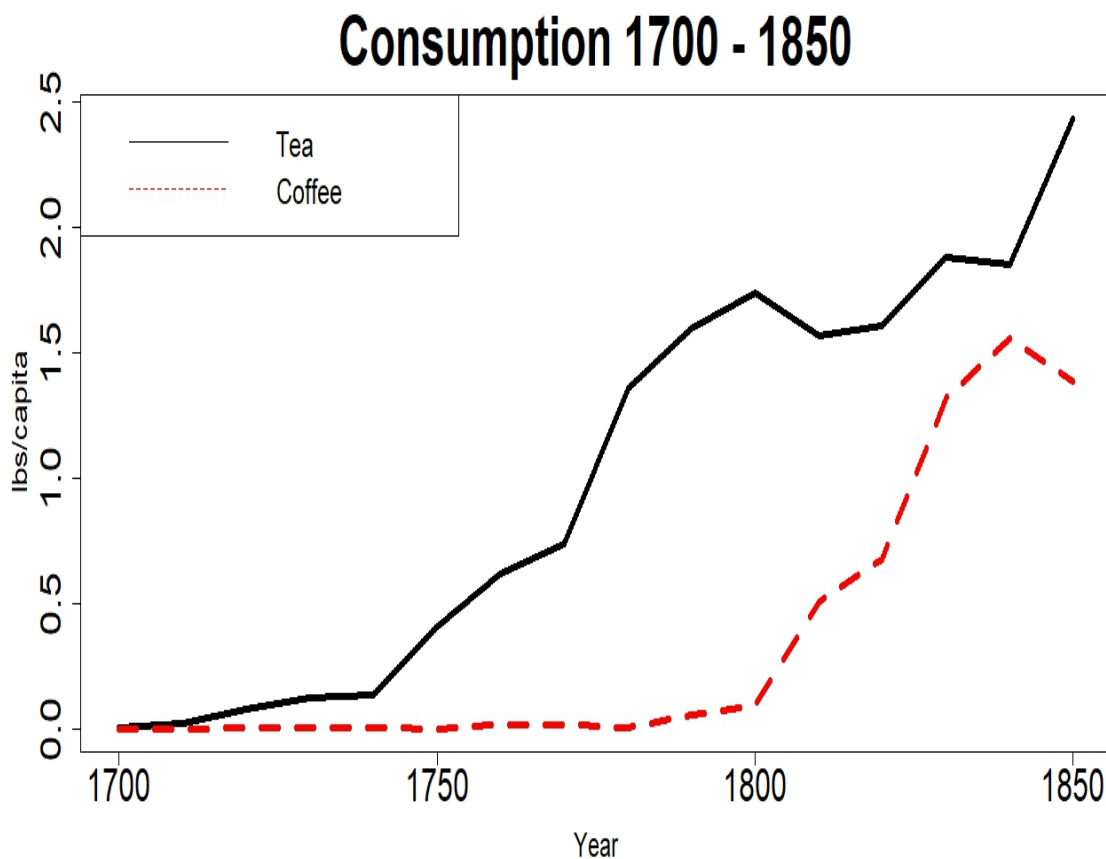


Figure 3: Consumption of tea and coffee, Source - Mokyr, Joel. "Is there still life in the pessimist case? consumption during the industrial revolution, 1790—1850." *The Journal of Economic History* 48, no. 1 (1988): 69-92.

## *The Working Day*

Marx saw the length of the working day as an indicator of the degree of capitalist exploitation (Marx, 1867) and working time is essential to know the labor input into production. The Industrial Revolution for all its machinal developments, had a significant labor input as well. Becker's seminal article (Becker, 1965) puts time as one of those inputs that are necessary, albeit an intermediate one. When one considers the notion of time mathematically, it is the total purchasing power of a person. Abstracting away from the concept of money, time is all that a person can spend to produce output. How that time translates into measurable quantities is a whole another debate, but time is the underlying factor behind such debates. The discussion surrounding working time during Industrial revolution has been slow in economics compared to other social sciences. Most historians (Reid, 1976; Briggs, 1965; Pollard, 1978) have a consensus about an increasing hours of work during the Industrial revolution. Though most of the estimates provided by them are not too accurate. The most influential proponent of the view that working hours increased was from Thompson (1967). He claimed that the holiday after the weekend (Saint Monday) began to disappear once the factory system began. (Tranter, 1700) believes that annual hours may have gone up from 2500 hours to 3000 hours, while (Freudenberger,1974) argues that it is instead an increase from 3000 hours to 4000 hours. There is a lot of variability in the estimates provided by them. For the purpose of my essay, it is important to have a good estimate of working hours for that time period. Voth(2001) & Clark(2005) remain the only ones, to the best of this author's knowledge, to provide credible estimates of working hours for the time period in concern.

Voth(2000) holds that the uptick in hours from 1760 to 1800 is the same as the drop in working hours that took place after the First World War. Voth's method also is a lot more sophisticated than the others that have attempted to impute working hours. He uses court records of more than 2800 individuals to gauge the daily patterns of life. Although, he could produce estimates for three years - 1760, 1800 & 1830. It is still a good benchmark to follow as the benchmark enables us to test for the veracity of my estimates. Though for my model to be used properly, we need to make use of an acceptable measure of working hours unlike an interpolation of the three years available. Clark (2009) calculates the implied working hours per working day by dividing the day wage by the hourly wage. Between 1720 and 1869, wages were sometimes quoted both by the day and by

the hour, for other years hourly wages exist. This makes the calculation of working hours especially difficult as there are not a lot of observations one could rely on. He still manages to estimate decadal working hours from 1720 to 1850. His estimates show that the average length of day does not have the same increasing trend that Voth(2001) has, instead it has daily working hours of almost 12 hours in 1760 to 10.5 hours in 1800 before it stagnates until 1820. The caveat would be that this method suffers from a lack of observations. I am mainly concerned with the working day and not necessarily the number of days in a week or year. It still needs emphasis that it is not just the working day itself that increased in length but the total number of days people worked during the Industrial revolution. (Allen & Weisdorf, 2011). They hold consumption constant and check the wages accumulated through the year. So the focus is on the working year instead of the working year. Number of days is not what interests us but it is still worthy of mention as it is characteristic of this period where overall working length showed an increase.

The question of whether the increase in labor is due to favorable demand conditions or supply conditions is not deeply looked into yet. Though Voth(2000) uses the time paths of hours and wages to suggest that the main determinant of increased labor input could have been a change in labor supply. The period was characterized by declining wages as shown by Feinstein (1998). Declining wages may have been one of the factors in having a higher labor supply as people needed to work more to maintain their living standards. As English agriculturist Arthur Young put it - *'Everyone but an idiot knows that the lower classes must be kept poor or they will never be industrious.'* (Ashton, 1948). The low wages conundrum has indeed baffled many economists but that is not the purpose of my essay (Clark et al, 1995; Feinstein, 1998; Crafts 1997). The takeaway from these studies though is that the Industrial revolution was known for the reallocation of resources on a massive scale. It could occur because of reallocation of the productive resources of households. It led to migration of people from the rural countryside to the urban centers to work in the textile mills (De Vries, 1994). Charles Dickens' Coketown is a fictional account of those times but it describes the urban landscape during this time. It paints an urban Britain that has self-serving factory managers and he often derided the teetotal movement that wanted to promote tea to serve their needs.

Since I am investigating the connection between tea and hours, I would invoke the arguments put forth by Fogel (1993) once again. In his piece, he claims that a 1 per cent increase in average calories

leads to a 38 per cent increase in the number of hours of light work that was undertaken by the lower classes. This has been refuted by Voth(2013). Interestingly for us, the relation between food and hours was established by Fogel (1993). With precedent being set already, I find it paradoxical that with low food availability and higher working hours that people were relying on less nutrition. My study is important in that regard as it shows that a British habit of tea drinking may have been due to higher industriousness, especially when one sees the importance of tea in keeping the workforce alert and energetic.

## Methodology & Results

### *Hours and Tea Imports*

Before I can run my SVAR, I need to correct my tea series and create an hours series. As Voth(2001) shows that the data on hours is staggeringly deficient. Most of my inputs on the hours comes from surveys and anecdotal evidence. Since the deficiency of the data needs to be taken into account, I propose a new method to be able to predict hours during this time. Using a Cobb Douglas production function I can traverse this hurdle that a lack of data presents.

$$y_{hour} = A(k_{hour})^\alpha$$

The equation above is the standard Cobb Douglas using per capita notations.  $Y$  is the total output and output per capita is denoted by  $y$ . Total capital stock is  $K$  while  $k$  is capital per labor. Here hourly rate of output is  $y_{hour}$  & capital stock per hour of labor is  $k_{hour}$ .  $\alpha$  is the capital share of income and  $A$  is the Total Factor Productivity (TFP hereafter). This can be rewritten as

$$y = A\left(\frac{k}{h}\right)^\alpha$$

Now we have  $y = y_{hour}h$  and this can be expressed as

$$A\left(\frac{k}{h}\right)^\alpha h$$

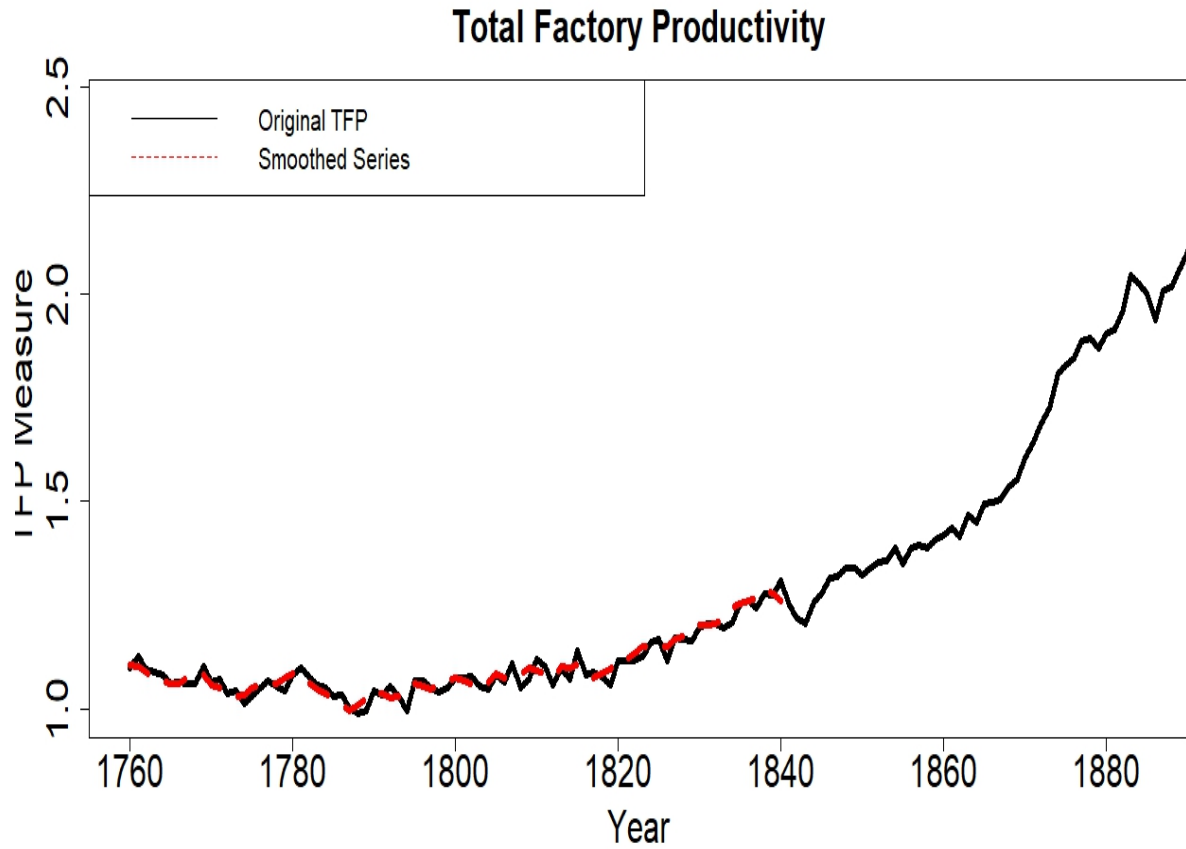


Figure 4: Total Factor Productivity, the smoothed 3 year average TFP shown as the dotted line

Using the following equation we can find hours from the data available

$$h = \left[ \frac{y}{Ak^\alpha} \right]^{\frac{1}{1-\alpha}} \quad (1)$$

These short run variations are unusual for a TFP series as TFP should reflect underlying technological level that typically does not change abruptly in the short run. In this paper, I use 3-year moving averages to smooth the TFP series. The smoothed series would capture long-term and intermediate-term variations in technological levels but avoid unrealistic short-term abrupt changes. The smoothed TFP series in Figure 4 can be used to compute the hours from 1760 to 1834 using (1).

### Annual Hours worked 1760 to 1834

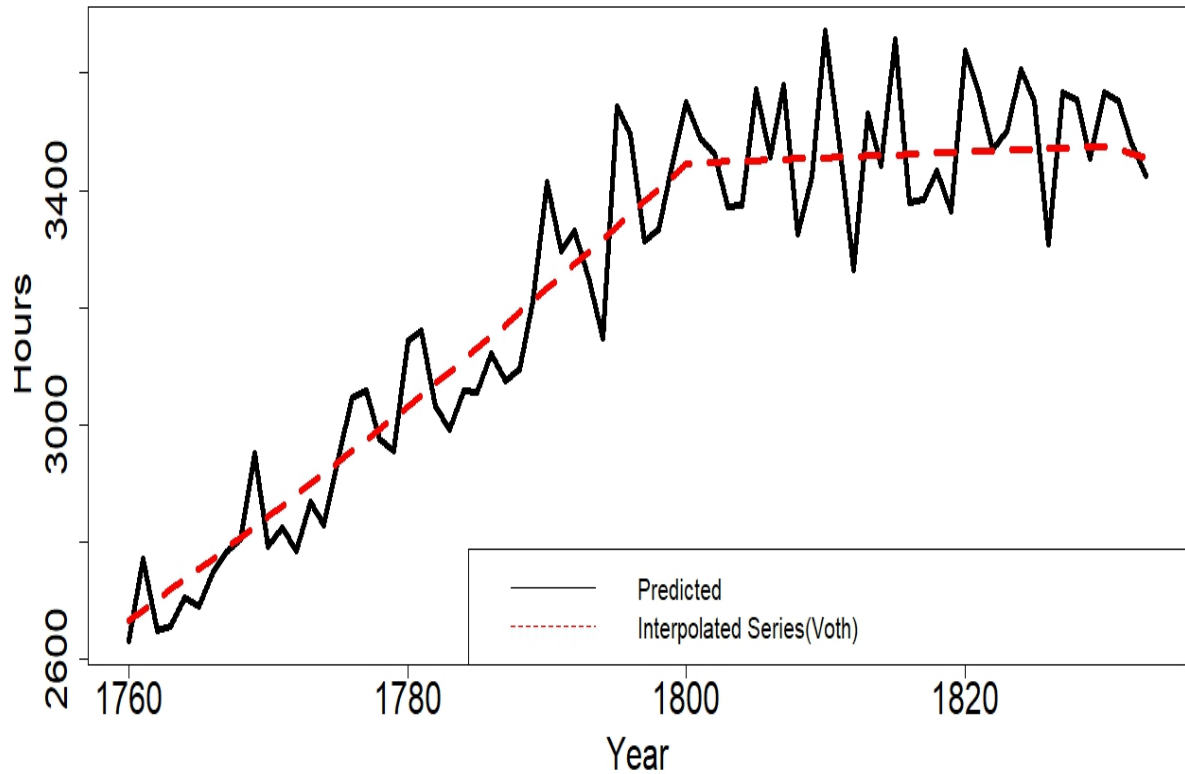


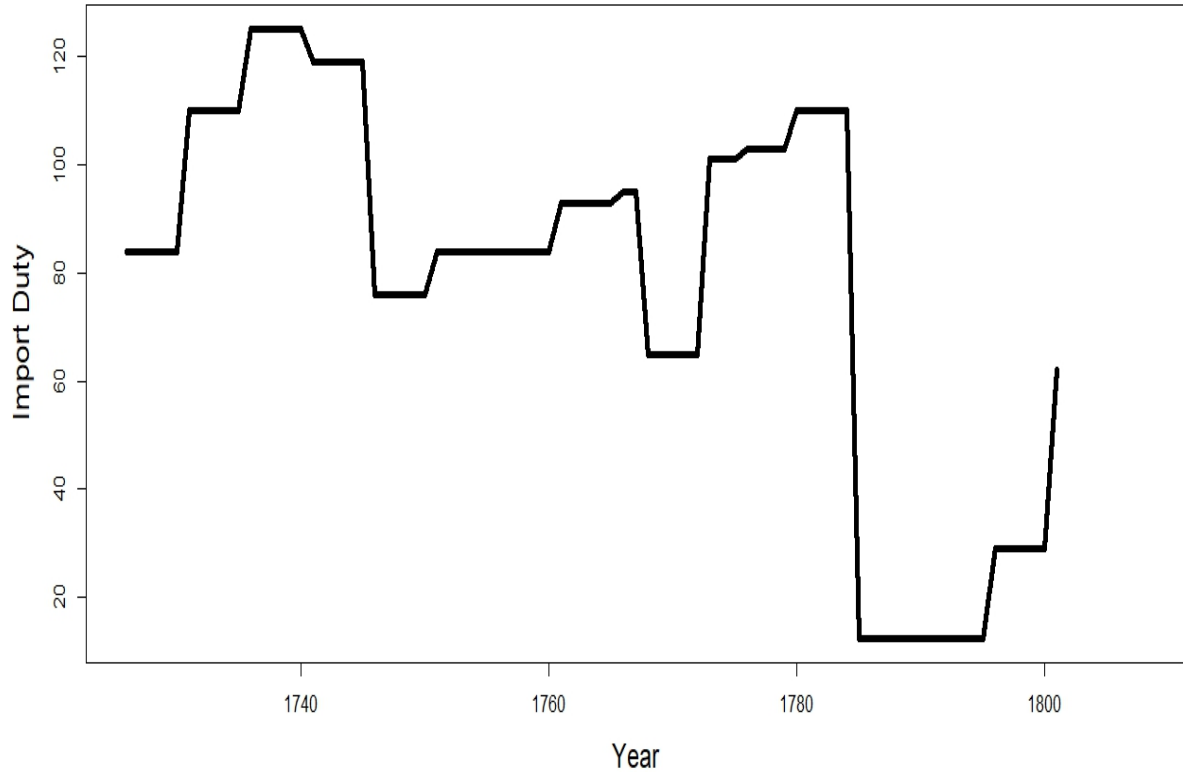
Figure 5: Author's calculation

When plotted against the interpolated series provided by Voth(2000), the hours series reconstructed by this paper does rather well in following the trend implied by Voth's series. Compared to Voth's series, the reconstructed hours series incorporates more realistic short-term variations. If anything, these hours predicted are similar to some of the observations Clark(2005) collected. I can also see in his observations that from 1760 to 1800 there is an increase in the hours worked until it drops a little and stagnates as is shown by my series as well. Figure 5 juxtaposes my calculation of hours with that of Voth's.

Tea was one of the most smuggled goods in British history (Cheung Mui, 1968). To account for the accurate amount of quantity brought in I must correct for smuggling before I proceed to make any interpretations of my time series analysis. After the seven years' war methods of importation



## Import Duties imposed on Tea



and distribution were vastly improved and by the 1770s, a new form of smuggling had taken grip of the trade (Mui & Mui, 1984). It was not until 1784 when the Commutation Act was passed that smuggling was brought to a virtual end (Cheung Mui, 1968). To correct it, I run an OLS regression on real prices of tea and imports per capita collected by Voth & Hersch (2022). The data is from 1740 to 1801. The real prices of tea for the others are not available and hence a regression of these years is carried out.

$$\text{Imports per capita}_t = \beta_0 + \beta_1 * \text{Price}_t + \beta_2 * \text{Import Duty}_t + \epsilon_t$$

I would also like to point out that there are discrepancies in the data on tea imports provided by several authors that have written about tea. One advantage I have over the others is the data of tea

<i>Dependent variable:</i>	
Tea per capita	
Real Prices	-0.005*** (0.001)
Import Duty	-0.013*** (0.002)
Constant	2.946*** (0.150)
Observations	61
R <sup>2</sup>	0.758
Adjusted R <sup>2</sup>	0.749
Residual Std. Error	0.420 (df = 58)
F Statistic	90.595*** (df = 2; 58)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

imports I use. Tea imports data was produced by the EIC in a reply to a question in the Parliament on their trade dealings with China in 1845. My data comes from the official sources, whereas Antman(2022) uses tea import data from Bowen(2007) which has a lot of variation in the tea import trends. Around 1784 the import figures shot up and that was in response to the Commutation Act passed in 1784. But prior to those years, as aforementioned, smuggling was quite high. I run the regression above to find how import duties and real price of tea explain tea imports.

Smuggling was rampant only when the import duties on tea were exorbitant. From 1772 to 1784 the import duties on tea were more than 100% of the net cost. I adjust for smuggling by making use of the estimates from this regression and hold the import duty from 1772 to 1784 to be 65%, it was the net tax rate on imports before 1772. In doing so, I can eliminate the incentive to smuggle. We see that around those years, tea imports was still not as high as post 1784, which is as expected. It is well established by historians that post 1784 the tea imports did pick up quite significantly (Cole, 1958; Heung Mui, 1968).

## Adjusting for smuggling

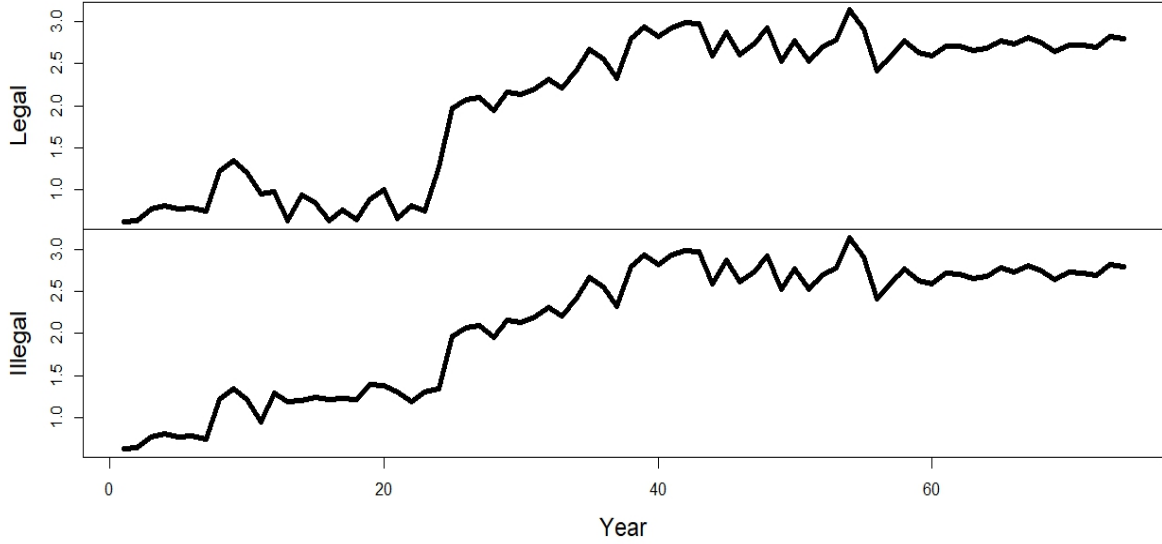


Figure 6: Author's computation

### *Regression analysis & Discussion*

Prior to analyzing the import demand functions for pulses, the data used in the analysis underwent unit root tests to ascertain its time-series characteristics. Below is a summary of the characteristics of all our variables. I perform the augmented dickey fuller (ADF) test as well as the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The tests show that all our variables are indeed non-stationary. If we are to regress these variables then our test statistics will be overblown resulting in inaccurate standard errors, which is very symptomatic of a spurious regression. To conclude that

Unit Root Tests			
Variable	ADF	KPSS	Order
Tea	1.009	0.64**	1
Coffee	-0.6854	0.55**	1
Sugar	0.0566	0.68**	1
Real Wages	0.2385	0.87***	1
Hours	0.9701	-7.57***	1
Urbanization	NA	NA	1

they exhibit a long run equilibrium relationship then a cointegration must be carried out. This paper adopts the testing procedure laid down in Johansen & Juselius (1990). It is a sequential test which test for the number of non-zero eigenvalues, thereby also determining the rank  $r$  of the matrix  $\Pi$ .

$$\Delta X_t = \delta + \sum_{i=1}^{k=1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \epsilon_t$$

Using the maxi-eigenvalue test, which is based on the comparison of a null hypothesis of  $(r - 1)$  against the alternative hypothesis of  $r$  the table below reports the test statistic. It is a likelihood ratio test, so invoking Wilks' theorem we can compare our test statistic with a  $\chi_2$  distribution. The results below illustrate the presence of a long run relationship between the variables. We can reject the null hypothesis of there being zero cointegrating vector in favor of the alternative hypothesis, which says that there will be atleast one cointegrating vector. The subsequent tests though fail to reject the null hypothesis at the 5% level of significance. We can use the OLS estimates though the limiting non-standard distribution of error terms will make the inference invalid, even though the estimates will be super consistent due to a faster convergence rate to the true value ( $T^{-1}$  as opposed to  $T^{-1/2}$ ) Instead, I estimate the cointegrating vector using the dynamic OLS (DOLS) and

No of CE(s)	Eigenvalue	Max-eigen statistic	5% critical value
r = 1	0.662	31.482	27.584
r = 2	0.428	16.189	21.131
r = 3	0.369	13.331	14.264
r = 4	0.054	1.599	3.841
r = 5	0.3952	0.1931	2.05

a semi-parametric method in Fully modified OLS(FM-OLS). This estimation method is robust to small samples and allows for simultaneity bias(Masih & Masih, 2000). The specification for DOLS is given as follows

$$\text{Log(Imports of Tea PC)}_t = \alpha_0 + \alpha_i X_t + \sum_{j=-p}^p \delta_j \Delta X_{t-j} + \epsilon_t$$

where {Price of Coffee, Price of Sugar, Working Hours, Urbanization, Real Wages}  $\in \mathbf{X}$ . All variables have been logged. Meanwhile the FM-OLS uses the long-run covariance matrices of the residuals of the equation above, i.e.  $(\epsilon_t, \Delta \epsilon_t)'$ . The results are presented below in Table 2. It indicates that

imports of tea per capita did respond to an increase in working hours. Another point to note would be that tea can not be conclusively be said to be a normal good as Hersch & Voth(2022) claim as increase in real wages does not have a statistically significant effect on imports of tea per capita. Ceteris paribus, an increase of working hourse by 1% increases the tea imports per capita by 1.32%. As a matter of fact, the elasticity for working hours is the highest amongst all the other explanatory factors. The other coefficients have expected signs, as an increase in the price of a substitute(coffee) should increase the consumption of the good, while at the same time an increase in the price of a complementary good(sugar) should decrease the consumption of the good. Industrial revolution was characterized by increasing urbanization and due to such urbanization, the workers did not have access the tradition diets it was used to. Sugared tea became one of the core components of the working class diet.

	<i>Dependent variable: Imports of Tea Per Capita</i>	
	Fully Modified OLS	Dynamic OLS
Trend	-0.014*** (0.0003)	-0.0001*** (0.0003)
Real Tea Price <sub>t</sub>	-0.348*** (0.067)	-0.323*** (0.093)
Real Sugar Price <sub>t</sub>	-0.507*** (0.014)	-0.543*** (0.144)
Real Coffee Price <sub>t</sub>	0.505*** (0.017)	0.445*** (0.141)
Real Wages <sub>t</sub>	-0.605 (0.44)	-0.417 (0.298)
Hours Worked <sub>t</sub>	1.3221** (0.043)	1.471* (0.713)
Urbanization <sub>t</sub>	TBA ( )	TBA ( )
Level	-11.575** (5.204)	-13.443*** (0.380)
Sample	1760-1834	1760-1834
R <sup>2</sup>	0.986	0.978

*Note:*

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 2: Regression results

## Conclusion

In this essay I have attempted to show the importance of the tea trade in the capitalist history of Britain. More so, when it has the transition from a feudal society to a capitalist society we see the usage of labor power in the so called Industrial Revolution. The dominant proprietary classes of Britain alongwith the temperance movement played a very important role in promoting tea. As I was researching this essay, there would not be a single article that did not underline the role played by these two factions. I have established a quantitative relationship between hours worked and the tea consumed and there are errors with historical data of all kinds. This is no different but my analysis is also backed by several anecdotal evidences. These anecdotal evidences are important for us as it only lends credence to the quantitative data and it is not a substitute.

What we can say with certainty though is that tea trade was important for it enabled workers to work longer hours. Our methodology does leave further questions to be answered including how does tea compare to the contribution of other superfoods, particularly sugar. Sugar was popular long before tea was in Britain but historians have used sugar to explain long working hours. As far as other foods are concerned, their consumption on average declined during this period. It really sets this time period apart in modern history as this may have been the only period where overall consumption may have gone down but the hours extracted from workers was on the rise. A doubling of tea imports saw an increase in working hours as other goods were on the decline. Sugar, on the other hand, did not quite plateau like tea did just when hours began to stagnate in the beginning of the 18th century. So a quantitative analysis of sugar to separate the effects of consumption for leisure consumption and need consumption could be very difficult. Additionally, sugar was consumed in other forms also, whereas tea was only used as a drink. All in all, to find the effect of superfoods on hours worked, tea provides us with the best opportunity.

Capital accumulation during this phase definitely has a lot of factors but as researchers point out the slow labor productivity growth during this time I think it is imperative to point out how else capital accumulation could have taken place. Labor was pushed to its limits and it has its precedents in history that panned out much later (Broadberry et al, 2015). Tea may not be the only device used but it is an important stimulant as I have shown. Tea's case is also well documented in Britain much

later. British colonialism went on to take extreme forms of dispossession to cultivate tea in different parts of the world. Though it was in a different context as we know that due to the Factory Acts from the 1830s the hours worked in the factories were reduced. But when the floodgates for tea trade were opened, tea no longer remained under the purview of the EIC. Until then, tea was an important commodity in capital accumulation. At some later juncture in British society tea probably came to be seen in a different light. But before then, was tea a taste that Britisher developed or was it forced by capital?

## Data Appendix

1. Tea Imports - The raw data below is sourced from a return made by the East India Company to Parliament in 1845, entitled 'Statement of the Number of Pounds Weight of the different Varieties of Tea sold by the East India Company in each Year from 1740 down to the Termination of the Company's Sales, together with the Average Prices at which such Teas were sold. It can be found in a spreadsheet here - <https://qmhistoryoftea.wordpress.com/resources/tea-sales/>
2. GDP - This series comes from Broadberry et al (2010). They have computed the annual contribution to British GDP by sectors from 1270 to 1870.
3. Labor Productivity from 1860 to 1914 - This series has been computed by Bank of England and can be found on their website
4. Hours from 1760 to 1834 - This has been computed as an interpolation from data collected by Voth(2001). He has provided three estimates of hours worked at 1760, 1800 & 1830
5. Tea & Sugar prices - These come from Hersch & Voth(2022) in their paper on increasing welfare of the people in Britain.
6. Real Prices of tea - These prices have been computed by Clark(2005)
7. Import Duty & Wholesale Tea Prices - This has been collected and shown the paper on smuggling by Cole(1958)
8. Budgetary expenses on Tea & Sugar - These are provided by Feinstein(1998)



9. Capital share or Labor Share - This can found in a macroeconomic aggregates compiled in Clark (2009)
10. Capital stock - Feinstein & Pollard (1988) provide the estimates for capital stock. It is the non-dwelling net capital.
11. Real Wages - Using the Bank of England dataset mentioned above, I use Sheet A48, column B for it.
12. Tea re-exports - Data from 1740 to 1794 is available in Cheung & Mui(1968). The rest of the re-exports can be found in Schumpeter (1961)

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