



Importing Sobrie ‘Tea’: 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 had 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 primarily concentrates on the consumption of tea, which was entirely imported. I have tried to explore why the demand for tea increased during the Industrial Revolution by examining the effect of working hours on tea imports between 1760 and 1834. I have also aimed to identify the determinants of tea demand while underlining the crucial role that increasing working hours played during the Industrial Revolution. The Industrial Revolution was characterised by long working hours, and the per capita declining consumption of the so-called luxury items, such as tea, due to their use as stimulants. To examine the relationship between working hours and tea imports, I employed a Dynamic OLS (DOLS) methodology, which demonstrated that tea imports responded positively to increasing working hours. This finding was corroborated by another method, the Fully Modified OLS (FM-OLS) methodology. I have also proposed some new methods for calculating the number of hours worked and the consequent result on tea imports in the process.

JEL Classification: N33, J22, I15, N73, F14

Keywords: Tea, Working hours, Time Series, Trade History, Industrial Revolution

INTRODUCTION

Tea, being the world’s most popular commercial drink and the second most consumed liquid globally, has endured its fair share of conflicts and challenges

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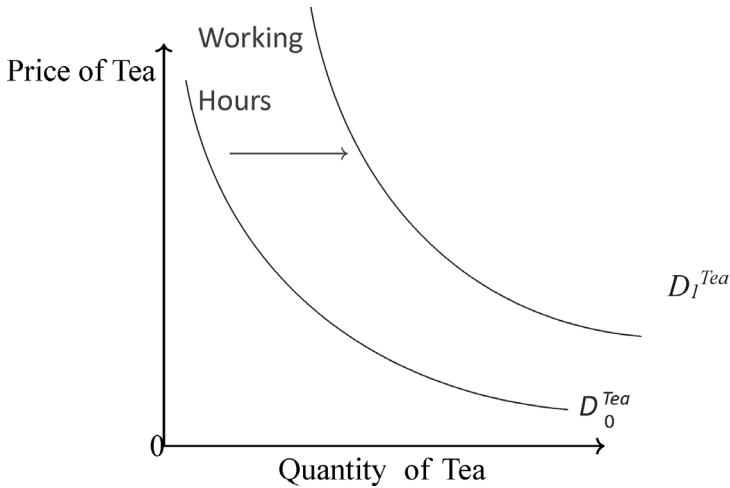
throughout history. Drawing inspiration from Sidney Mintz's (1986) groundbreaking research on commodity evolution, this article explores the transformative journey of tea, paralleling the classic case of sugar as examined by Mintz. Instead of a mere matter-of-fact historical account, the focus here lies on the dialectical relationship between tea and society at large. This dialectical framework captures the reciprocal influence between changing tastes and preferences of the population and tea's role in fostering capital accumulation. Against the backdrop of the Industrial Revolution, both societal dynamics and economic forces acted in concert to establish tea as a staple in British households. This evolution from a luxury item to an essential commodity warrants comprehensive attention. As a commodity transitions, it undergoes notable transformations in its social characteristics. This raises a fundamental question: does a commodity's usefulness solely determine its relationship with the society, or does a society's own evolution shape its connection with the commodity? The consumption of a luxury good distinctly differs from that of an essential good, making the essence of essentiality a central theme in this essay. Challenging the notion that tea's societal significance stems solely from its utility, we argue that its popularity is intricately intertwined with the specific juncture of English society during that period. By employing a multidimensional approach, combining historical analysis and socio-economic perspectives, this study endeavours to unravel the complex dynamics underlying tea's social positioning. Through a nuanced examination of tea as a commodity and its interplay with society, this research aims to contribute to a comprehensive understanding of the socio-economic implications inherent in the evolution of commodities.

Tea, known for its stimulant properties, contains caffeine, which can range from 14 mg to 61 mg per serving (Chin et al., 2008). Caffeine's energising effects have been widely recognised, especially during the 18th century in Britain, where various groups emphasised its invigorating properties. This not only fostered a tea culture but also contributed to the extraction of longer working hours from labourers. While medical science extensively documents the effects of caffeine on the human body (Hindmarch et al., 2000; Einöther & Martens, 2013), its investigation within the field of economics has been relatively scarce, despite the centrality of working hours to economic functioning. This study aims to address the extent to which the rise in working hours can be attributed to tea consumption, placing it within a historical context.

While modern times have witnessed significant improvements in living standards, marked by increased consumption of various food items, the 18th century presented different circumstances. During the Industrial Revolution, a transition from a local diet to an imported one, predominantly consisting of tea and sugar, became necessary. Furthermore, Voth (2000) highlighted a noteworthy increase of 20 to 23 per cent in labour input per member of the labour force between 1760 and 1831. By considering these historical dynamics, this paper delves into the crucial role that tea, as a stimulant, played in shaping working hours during the Industrial Revolution. By examining the relationship between tea consumption and labour practices, this research sheds light on the multifaceted connections between caffeine intake, societal circumstances, and economic factors. The findings of this study contribute to a deeper understanding of the historical interplay between tea culture, working hours, and the socio-economic changes that unfolded during this transformative era.

The connection between tea consumption and mental alertness has garnered attention in scientific journals today. However, the lack of comprehensive data on biological indicators of attention from earlier periods necessitates finding an appropriate proxy variable. In this study, working hours were used as a proxy, as they reflect the physical capabilities of workers and strongly influence the composition of consumption goods. Tea, a luxurious good, held a significant place in the 18th century British society. While some historians (Macfarlane & Macfarlane, 2009; Rappaport, 2017) hinted at the positive relationship between tea consumption and longer working hours, this study is the first quantitative investigation of this association.

To examine the link between working hours and tea consumption, a time series analysis was employed. The chosen methodology was Dynamic Ordinary Least Squares regression (DOLS), which allowed for the estimation of the elasticity of demand not only in relation to price but also to working hours. To ensure accuracy, it was necessary to determine whether the variables explaining tea consumption were co-integrated. Considering the decline or stagnation in the consumption of agricultural output and net imports (Clark et al., 1995), the hypothesis posited in this study suggested that tea imports facilitated longer working hours, consequently shifting the demand curve for tea. However, tea imports cannot be solely attributed to an increase in working hours, thus additional control variables were incorporated to account for other factors that influenced tea demand.



Recent research by Antman (2022) highlighted the importance of examining the demand for tea in the light of its unintended effects on reducing mortality during the Industrial Revolution. This study also explores the quantifiable reasons behind the increasing demand for tea, which Antman refers to as an 'unintentional' consequence of tea drinking. What sets this paper apart is its focus on the change in diets and customs, which emerged not as a result of deliberate policy efforts but as an unintended outcome of capitalism's pursuit of longer working hours. The paper is structured as follows: Section II delves into the historical background of how tea became a staple in British households. Section III explores the length of the working day and its historical context in Britain. Given the lack of comprehensive data on working hours from the 18th century, this paper proposes a method to predict working hours during that time period. Additionally, Section IV addresses the issue of rampant tea smuggling and presents corrective measures. In Section V, the main time series model is presented. Section VI discusses the obtained results, and finally, Section VII provides the concluding remarks.

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 liberalised 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 too behind this move besides some politico-economic forces. Social pressures come in the form of a society coming to grips to civilise 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 civilising 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 awaken 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* crept in when wages increased (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 globalised trade engine.

The more important argument for the popularity of tea and the one I explored 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 in this respect would be that of 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 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.

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 characterised by wide changes in British society. It saw an increasing marketisation of labour 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 the urban centers for 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 (Morse, 1926).

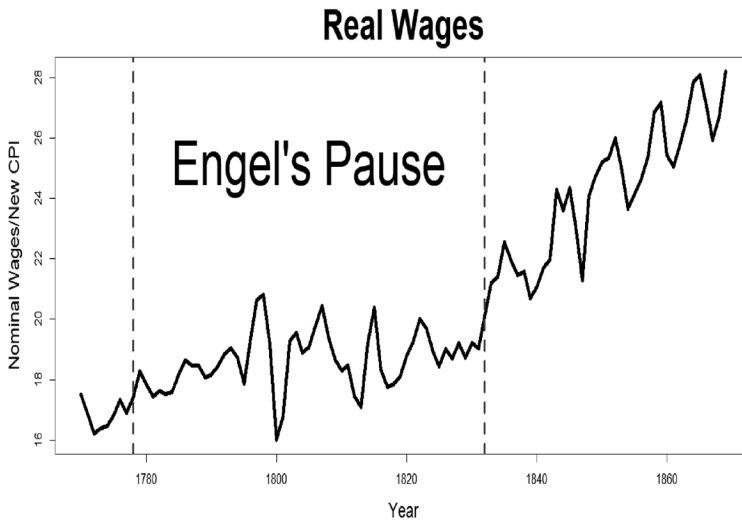


Figure 1: Normal wages during the period of study (1760-1834)

Source: Allen, R.C. (2007). *Pessimism preserved: Real wages in the British Industrial revolution*, Oxford University Dept. of Economics working paper no. 314

According to Figure 1, real wages remained stagnant until the 1830s, after which there was a significant improvement in living standards (Clark, 2007; Feinstein, 1998). This raises the question of what drove the shift from locally produced goods to a different diet that included tea and sugar during this period. Despite the stagnation in real wages, there was evidence of better nutritional status among workers. However, the Industrial Revolution was accompanied by a decline in the overall nutritional status of workers. Hobsbawm (1957)

painted a negative picture of consumption gains during this time, using agricultural output as a reference. It was only in the 1840s that consumption per capita returned to the levels of 1760 (Crafts, 1985).

Methods for estimating nutritional benefits have improved over time, primarily through the analysis of physical stature, such as height. Komlos and Ku"chenhoff (2012) found a deteriorating nutritional status indicated by decreasing heights during the onset of the Industrial Revolution. High food prices led people to seek cheaper alternatives, such as tea and sugar, but this also had a negative impact on their nutritional status (Baten et al., 2014). The stagnating real wages observed may be explained, at least in part, by the high food prices mentioned above. Cinnerella (2008) further supported this argument by using parish-level data to show a decrease in height during this period, potentially due to rising food costs. Although tea itself does not have a significant caloric content, it was primarily consumed with sugar. Sugar, known for its caloric value, was one of the few imported commodities that saw an increase in caloric content in the English diet from 1700 to 1850 (Harris et al., 2010). Understanding tea consumption in relation to sugar consumption sheds light on this trend. The East India Company (EIC) entered the tea business as a complement to sugar, which was experiencing excess production in the late 17th century, coinciding with the rise of tea culture in Britain (Lawson, 1997). Sugared tea became the norm in many towns and villages across Britain, replacing traditional staples like milk, cheese, ale, meat, and oats (Ellis et al., 2015). Harris et al. (2010) categorised various food items according to their caloric content, and wheat was the only non-stimulant food that increased in value during this period. They relied on domestic crop yields, which may not be entirely indicative, but the import content of other foods was negligible until the early 1800s, as indicated by Wrigley (2015).

Presented below is also a summary of the British food puzzle from 1770 to 1850. Clark et al. (1995) used three different methods to find that the supply of foodstuffs by domestic farm production and by net imports stagnated or even declined. Voth (2000) lend credence to the argument put forth by Clark et al. (1995); he invalidated 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 was at 0.75 per cent (Wrigley & Schofield, 1981;

Crafts, 1986) and 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) claimed that people were not on the verge of starvation and backed 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) showed that the benefits of these luxuries did not just accrue to the few upper-class families.

Table 1: Budget shares of tea and sugar

<i>Year</i>	<i>Sugar</i>	<i>Tea</i>
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%

Source: Hersch, J., & Voth, H.J. (2022). Sweet diversity: Colonial goods and the welfare gains from global trade after 1492. *Explorations in Economic History*, p.101468.

Returning to the role of tea in the Industrial Revolution, it becomes evident from the aforementioned evidence that workers turned to sugared tea as a cost-effective source of energy. This choice could be understood in the light of rising food prices and increased workloads during the Industrial Revolution. The stimulant properties of tea were well recognised, and both industrialists and the Protestant church, embraced its usage. The tea breaks we are familiar with today trace their origins back to this era. Although the poster in Figure 2 dates to around 1935, it illustrates the significance of tea in the factory settings. The Factory Enquiries Commission's 1834 report revealed that numerous mill owners in Derbyshire and Lancashire granted workers tea breaks of 15 to 30 minutes between lunch and the end of the workday (Factory Enquiries Commission, 1834). Considering the information presented, it is not surprising that tea consumption experienced a sharp increase during the 18th century.



Figure 2: Significance of tea in the factory settings

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 were certain factors that pushed tea consumption above that of coffee. Primary among them was 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 that it

was not until the 19th century that coffee picked up in demand. Thirdly, as De Vries (2008) explained in his book, the West Indian sugar lobby and the East India Company (EIC herein after) 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 until the 18th century it had a monopoly over the trade.

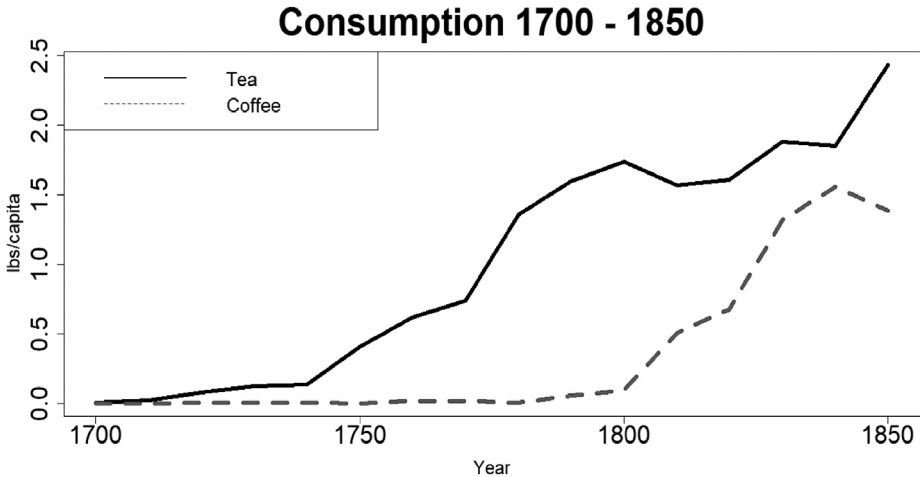


Figure 3: Consumption of tea and coffee

Source: Mokyr, J. (1988). Is there still life in the pessimist case? Consumption during the Industrial Revolution, 1790—1850. *The Journal of Economic History* 48, no. 1:69-92.

The Working Day

Marx perceived the duration of the working day as an indicator of the extent of capitalist exploitation (Marx, 1867), emphasising the significance of working time in understanding labour input in production. Alongside the mechanical advancements of the Industrial Revolution, there was a substantial labour component involved. Becker's influential article (Becker, 1965) acknowledged time as a necessary input, albeit an intermediate one. When considering time from a mathematical perspective, it represents an individual's total purchasing power. Stripping away the concept of money, time becomes the sole resource that individuals can allocate to produce output. The translation of time into measurable quantities remains a subject of ongoing debate, yet it serves as the underlying factor in such discussions. Interestingly, the analysis of working time during the Industrial Revolution had been slower to develop within economics compared to other social sciences. Nevertheless, most historians (Reid, 1976;

Briggs, 1965; Pollard, 1978) agreed on the increasing trend of working hours during that period, although the accuracy of their estimates varied. Thompson (1967) stood as the most influential advocate of the idea that working hours expanded, noting the disappearance of the holiday after the weekend (known as Saint Monday) coinciding with the rise of the factory system. Tranter (1700) suggested that annual working hours might have increased from 2500 to 3000, while Freudenberger (1974) argued for a larger increase, ranging from 3000 to 4000 hours. The substantial variability in these estimates underscored the importance of obtaining reliable figures for working hours during that specific time period. As far as my knowledge extends, Voth (2001) and Clark (2005) are the only sources that offer credible estimations of working hours within this context, which are pivotal for my essay.

Voth (2000) held 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 was also a lot more sophisticated than the others that had attempted to impute working hours. He used 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 was still a good benchmark to follow as the benchmark enabled 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) calculated 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 existed. This made the calculation of working hours especially difficult as there were not a lot of observations one could rely on. He still managed to estimate decadal working hours from 1720 to 1850. His estimates showed that the average length of day did not have the same increasing trend that Voth (2001) had, instead it had daily working hours of almost 12 hours in 1760 to 10.5 hours in 1800 before it stagnated until 1820. The caveat would be that this method suffered from a lack of observations. I am mainly concerned with the working day and not necessarily the number of days in a week or a year. It still needed to be emphasised that it was 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 held consumption constant and checked the wages accumulated through the year. So the focus was on the working year instead of the working days. Number of days was not what interested us but

it was still worthy of mention as it was a characteristic of that period where overall working length showed an increase.

The question of whether the increase in labour was due to favourable demand conditions or supply conditions was not deeply looked into yet. Though Voth (2000) used the time paths of hours and wages to suggest that the main determinant of increased labour input could have been a change in labour supply, the period was characterised by declining wages as shown by Feinstein (1998). Declining wages may have been one of the factors in having a higher labour 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 had indeed baffled many economists but this is not the purpose of my essay (Clark et al, 1995; Feinstein, 1998; Crafts, 1997). The takeaway from these studies was 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 that existed during that time. It paints an urban Britain that had self-serving factory managers and he often derided the teetotal movement that wanted to promote tea to serve their needs.

Since I was investigating the connection between tea and hours, I would invoke the arguments put forth by Fogel (1993) once again. In his piece, he claimed that a 1 per cent increase in average calories led to a 38 per cent increase in the number of hours of light work that was undertaken by the lower classes. This had 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 found it paradoxical that with low food availability and higher working hours that people were relying on less nutrition. My study is important in this regard as it shows that a British habit of tea drinking may have been due to higher industriousness, especially when one saw the importance of tea in keeping the workforce alert and energetic.

METHODOLOGY & RESULTS

Hours and Tea Imports

In order to conduct the main time series regression, several steps needed to be taken, including correcting the tea series and creating an hours series. However,

it had been established by Voth (2001) that the data on hours was severely deficient. Most of the available information regarding hours was derived from surveys and anecdotal evidence. Recognising this data limitation, I proposed a novel method to predict hours during the period by employing a Cobb Douglas production function.

The standard Cobb Douglas equation, using per capita notations, can be expressed as follows:

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

In this equation, Y represents total output, and y denotes output per capita. The total capital stock is denoted as K , while k represents capital per labour. The hourly rate of output is y_{hour} , and k_{hour} represents the capital stock per hour of labour. The parameter α represents the capital share of income, and A represents the Total Factor Productivity (TFP). By rearranging the equation, we obtain:

$$y = A \frac{k^\alpha}{h}$$

Considering that $y = y_{\text{hour}} \cdot h$, we can rewrite the equation as:

$$A \frac{k^\alpha}{h} h$$

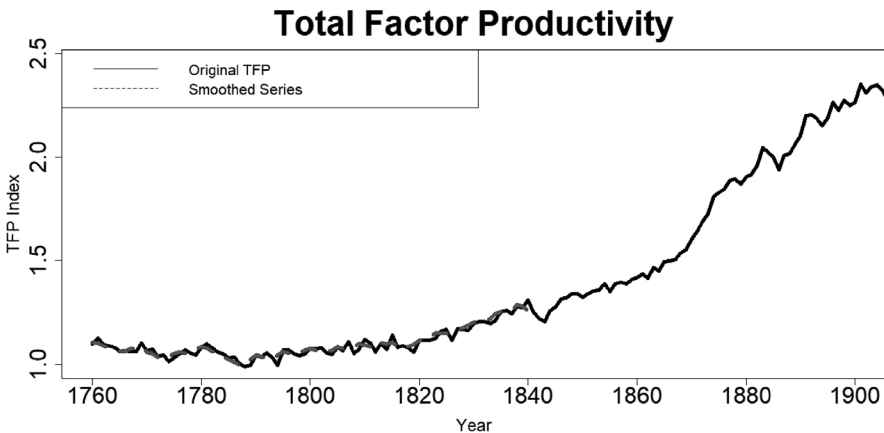


Figure 4: Total Factor Productivity, the smoothed 3 year average TFP shown as the dotted line

Using the following equation, we can estimate the hours based on the available data:

$$h = \frac{y}{A(k^\alpha)^{1-\alpha}} \quad (1)$$

It is worth noting that short-term variations in Total Factor Productivity (TFP) are unusual, as TFP generally reflects the underlying technological levels, which typically do not exhibit abrupt changes in the short run. To address this issue, a 3-year moving average was employed in this paper to smooth the TFP series. This smoothing technique enabled the capture of long-term and intermediate-term variations in technological levels while avoiding unrealistic short-term fluctuations. Figure 4 illustrates the smoothed TFP series, which could be used to calculate the hours from 1760 to 1834 using equation (1).

The reconstructed hours series in this paper demonstrates a strong alignment with the trend observed in Voth's interpolated series. Notably, the reconstructed series captures more realistic short-term variations compared to Voth's series. Moreover, the predicted hours exhibit similarities to observations collected by Clark in 2005. These observations indicate a consistent pattern of increasing hours worked from 1760 to 1800, followed by a slight decline and subsequent stagnation, which is also reflected in the reconstructed series. For a visual comparison, Figure 5 juxtaposes the calculated hours from this paper with those from Voth's series.

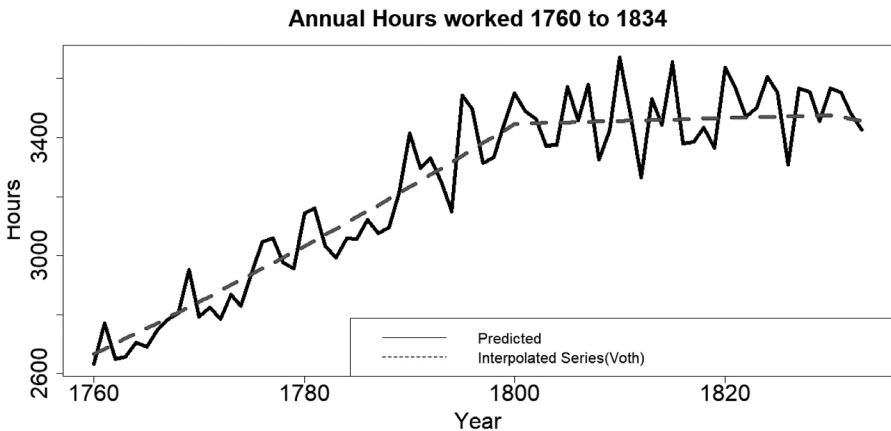
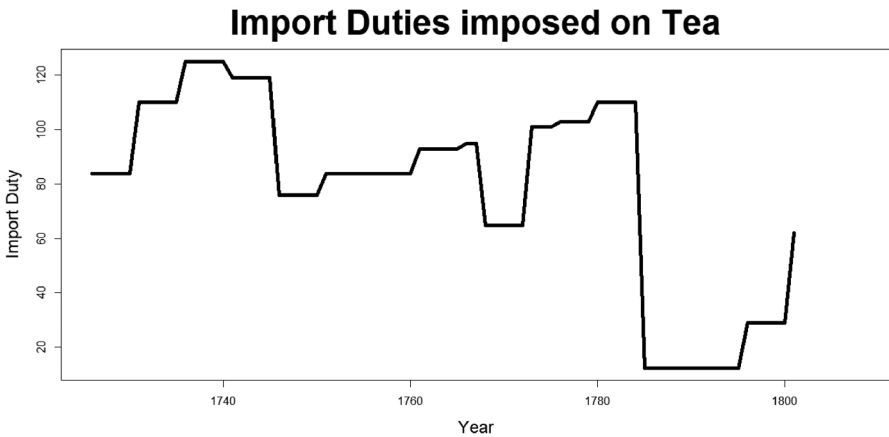


Figure 5: Author's calculation

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 make corrections for smuggling before I proceed to make any interpretations of my time series analysis. After the seven years' war methods of importation

and distribution were vastly improved, 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 ran 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 were not available and hence a regression of these years was carried out.



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

It is worth noting that discrepancies exist in the data on tea imports provided by various authors who had written about tea. One advantage of the author’s analysis is the utilisation of tea import data obtained from official sources, specifically the East India Company’s reply to a parliamentary question on their trade dealings with China in 1845. In contrast, Antman (2022) relied on tea import data from Bowen (2007), which exhibited more significant variation in tea import trends. Notably, import figures experienced a surge around 1784 in response to the Commutation Act. Prior to that period, as previously mentioned, smuggling was prevalent. The regression analysis was conducted to elucidate how import duties and real tea prices contributed to tea imports.

Dependent variable

Tea per capita Real Prices	0.005*** (0.001)
Import Duty	0.013*** (0.002)
Constant	2.946*** (0.150)
Observations	61
R ²	0.758
Adjusted R ²	0.749
Residual Std. Error	0.420 (df = 58)
F Statistic	90.595*** (df = 2; 58)

Note: *p<0.1; **p<0.05; ***p<0.01

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 made adjustments for smuggling by making use of the estimates from this regression and held the import duty from 1772 to 1784 to be 65%; it was the net tax rate on imports before 1772. In doing so, I could eliminate the incentive to smuggle. We saw that around those years, tea imports were still not as high as post 1784, which was as expected. It was well established by historians that post 1784 the tea imports did pick up quite significantly (Cole, 1958; Heung Mui, 1968).

Adjusting for smuggling

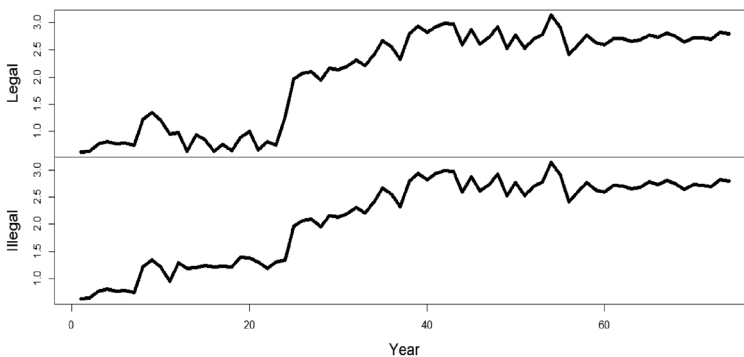


Figure 6: Author's computation

Regression Analysis & Discussion

My estimation of the demand functions followed a long tradition of estimating demand functions using the method I used (Anaman & Buffong, 2001; Masih & Masih, 2000; Mah, 2000; Agbola, 2005). Before delving into the analysis of import demand functions for tea, the data underwent unit root tests to evaluate its time-series properties. Here, we present a summary of the characteristics observed in all the variables. To assess stationarity, we conducted the augmented Dickey-Fuller (ADF) test as well as the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The results indicate that all the variables exhibit non-stationary behaviour. Consequently, regressing these variables would lead to inflated test statistics, thereby yielding inaccurate standard errors. Such a scenario is indicative of a spurious regression.

<i>Unit Root Tests</i>			
<i>Variable</i>	<i>ADF</i>	<i>KPSS</i>	<i>Order</i>
Tea	0.932	0.64**	1
Beer	0.848	0.55**	1
Sugar	-0.136	0.68**	1
Real Wages	-0.403	0.87***	1
Hours	0.753	-7.57***	1

In order to establish a long-run equilibrium relationship, it is necessary to conduct a cointegration analysis. This study adopted the testing methodology outlined by Johansen and Juselius (1990). The procedure involved a sequential test that examined the number of non-zero eigen values, thereby determining the rank, denoted as r , of the matrix Π . The equation below captures the framework of the analysis

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

The maxi-eigen value test, employed in this study, compared the null hypothesis of $(r - 1)$ against the alternative hypothesis of r . The corresponding test statistic is reported in the table below. Since this test followed a likelihood ratio distribution, we could compare our obtained statistic with the χ_2 distribution using Wilks' theorem. The results indicate the presence of a long-run relationship among the variables. We rejected the null hypothesis of zero cointegrating vectors in favour of the alternative hypothesis, which suggested

the existence of at least one cointegrating vector. However, the subsequent tests did not reject the null hypothesis at the 5% level of significance. Although OLS estimates can be utilised, it should be noted that the limiting non-standard distribution of error terms renders the inference invalid.

<i>No of CE(s)</i>	<i>Eigen value</i>	<i>Max-eigen statistic</i>	<i>5% critical value</i>
r = 1	0.548	115.28	84.45
r = 2	0.461	70.13	53.12
r = 3	0.369	36.45	34.91
r = 4	0.216	18.66	19.96
r = 5	0.131	8.36	9.24

Nevertheless, the estimates remained highly consistent due to a faster convergence rate to the true value (T^{-1} as opposed to $T^{-1/2}$). Instead, I estimated the cointegrating vector using the dynamic OLS (DOLS) and 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

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

where, {Price of Coffee, Price of Sugar, Working Hours, Urbanisation, 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. $(\epsilon_p, \Delta \epsilon_p)$.

The results are presented below in Table 2. It indicates that imports of tea per capita did respond to an increase in working hours. It is important to acknowledge that tea cannot be definitively classified as a normal good, as suggested by Hersch and Voth (2022), since an increase in real wages did not exhibit a statistically significant effect on the per capita imports of tea. However, when other factors remain constant, a 1% increase in working hours results in a 3.01% increase in the per capita imports of tea. This is particularly noteworthy because the elasticity of working hours is the highest among all other explanatory variables. The remaining coefficients indicate the anticipated signs, as an increase in the price of a substitute (such as beer) would likely lead to higher consumption of tea, while an increase in the price of a complementary good (such as sugar) would likely result in a reduction in tea consumption. Since the consumption of sugar was irregular during this period

(Clark, 2005), it is not surprising to see an insignificant effect. During the Industrial Revolution, the rise of urbanisation caused workers to change their dietary habits as they no longer had access to their traditional diets. In this period, it was remarkable that when the hourly wages of workers increased in real terms, it had an unfavourable impact on the per capita demand for tea, at least as per the FM-OLS specification. However, according to the DOLS specification, real wages did not affect the demand for tea. This is particularly intriguing because a luxury good should experience an increase in demand as incomes rises, but instead, due to stagnant wages, people were consuming different goods altogether.

Table 2: Regression results

Dependent variable: Imports of Tea Per Capita

	<i>Fully Modified OLS</i>	<i>Dynamic OLS</i>
Trend	0.005 (0.003)	-0.0001 (0.003)
Real Tea Price _t	-0.539*** (0.116)	-0.491*** (0.0121)
Real Sugar Price _t	0.360 (0.150)	2.452 (0.0252)
Real Beer Price _t	0.229 (0.281)	0.461* (0.262)
Real Wages _t	-0.828** (0.259)	-0.216 (0.352)
Hours Worked _t	1.736** (0.565)	3.01*** (0.754)
Level	-14.247** (4.279)	-24.22*** (5.67)
Sample R ²	1760-1834 0.970	1760-1834 0.989
<i>Note:</i> * p<0.1; ** p<0.05; *** p<0.01		

CONCLUSION

In this essay I have attempted to show the importance of the tea trade in the capitalist history of Britain. More so, when there was a transition from a feudal society to a capitalist society we saw the usage of labour power in the so called Industrial Revolution. The dominant proprietary classes of Britain along with the temperance movement played a very important role in promoting tea.

As I was researching for this essay, there was not 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 but there are always errors with historical data of all kinds. This research is no different but my analysis was also backed by several anecdotal evidences. These anecdotal evidences are important for us as they only lend credence to the quantitative data and are not a substitute.

What we can say with certainty though is that tea trade was important for it enabled workers to work for longer hours. Our methodology does leave further questions to be answered including how tea compared to the contribution of other super-foods, 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.

Capital accumulation during this particular phase encompasses a multitude of factors. However, researchers emphasised that given the sluggish growth in labour productivity at that time, it was crucial to explore alternative mechanisms through which capital accumulation could have occurred. Historical precedents supported the notion that labour was pushed to its limits, a phenomenon evidenced in subsequent periods (Broadberry et al., 2015). While it was acknowledged that tea may not have been the sole catalyst, its significance as a stimulant could not be understated, as demonstrated earlier. The case of tea found ample documentation in Britain, albeit at a later stage. British colonialism adopted extreme measures of dispossession to cultivate tea across various regions worldwide. It is important to note that this occurred in a different context, considering the reduction in working hours in factories due to the implementation of the Factory Acts starting from the 1830s. Nevertheless, when the floodgates for tea trade were opened, the East India Company no longer monopolised its control. Until then, tea played a pivotal role in the accumulation of capital. At a subsequent juncture in British society, tea likely underwent a shift in perception. However, prior to this transformation, it was worth examining whether tea was a taste developed by the British or if its adoption was compelled by the forces of capital.

DATA APPENDIX

1. Tea Imports- The raw data below was 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 had computed the annual contribution to British GDP by sectors from 1270 to 1870.
3. Labour 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 had provided three estimates of hours worked at 1760, 1800 & 1830.
5. Tea, Sugar & Beer prices- These came from Hersch & Voth (2022) in their paper on increasing welfare of the people in Britain. While an annual series can be had from Clark (2005).
6. Real Prices of tea- These prices have been computed by Clark (2005).
7. Import Duty & Wholesale Tea Prices- This had been collected and shown from the paper on smuggling by Cole (1958).
8. Budgetary expenses on Tea & Sugar- These were provided by Feinstein (1998).
9. Capital share or Labour Share- This could be found in a macroeconomic aggregate compiled by Clark (2009).
10. Capital stock- Feinstein & Pollard (1988) provided the estimates for capital stock. It was the non-dwelling net capital.
11. Real Wages per hour- Using the Bank of England data set mentioned above, I used Sheet A48, column B for it.

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