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Expensive Labour and the Industrial Revolution: Evidence from Stable Employment in Rural Areas

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Expensive Labour and the Industrial Revolution: Evidence from Stable Employment in Rural Areas[1]

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Abstract

In explaining the Industrial Revolution, the so-called *high-wage* hypothesis argues that mechanisation served to replace expensive labour. Supporting evidence comes from daily wages of urban construction workers and shows that these were higher in northwest Europe than in the south. We argue that casual urban wages overestimate the cost of early-industrial labour. Early factories were rural and thus did not pay an urban wage premium. Moreover, early factories employed stable rather than casual workers and thus did not pay a premium for job insecurity. We present novel premia-free wages paid to stable workers in rural Italy, which we compare to wages paid to similar workers in England. We find that English workers earned only 20 per cent more than their Italian counterparts in 1650, but a staggering 150 per cent more in 1800. Although our empirical evidence shows that the precondition for the *high-wage* hypothesis is still in place, it is no longer clear – because growing English wages and early industrialisation coincide – whether it was high wages that drove mechanisation or the other way around.

JEL: J3, J4, J8, I3, N33

Keywords: Stable Employment, Economic Growth, Industrial Revolution, Great Divergence; Living Standards, Prices, Wages.

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1. Introduction

Why was the first Industrial Revolution English? One of the leading explanation is that expensive factory labour prompted early industrialists to substitute labour with machines (Allen 2009). Supporting evidence comes from daily wages paid to urban building labour and shows that workers in eighteenth-century London were considerably more expensive than workers in other leading European cities (Allen 2001). This so-called *high-wage* explanation for why England industrialised first implicitly assumes that daily urban wages serve as a plausible reservation wage for early factory labour. But factory workers were usually drawn from the countryside rather than from urban areas and were moreover hired on a stable basis rather than on casual terms (Mokyr 2001). This highlights two potential problems with the empirical foundation for the *high-wage* hypothesis. We present new wage data to show that the condition for the *high-wage* hypothesis is still in place after avoiding these problems, but that it is no longer clear whether it was high wages that spurred mechanisation or the other way around.

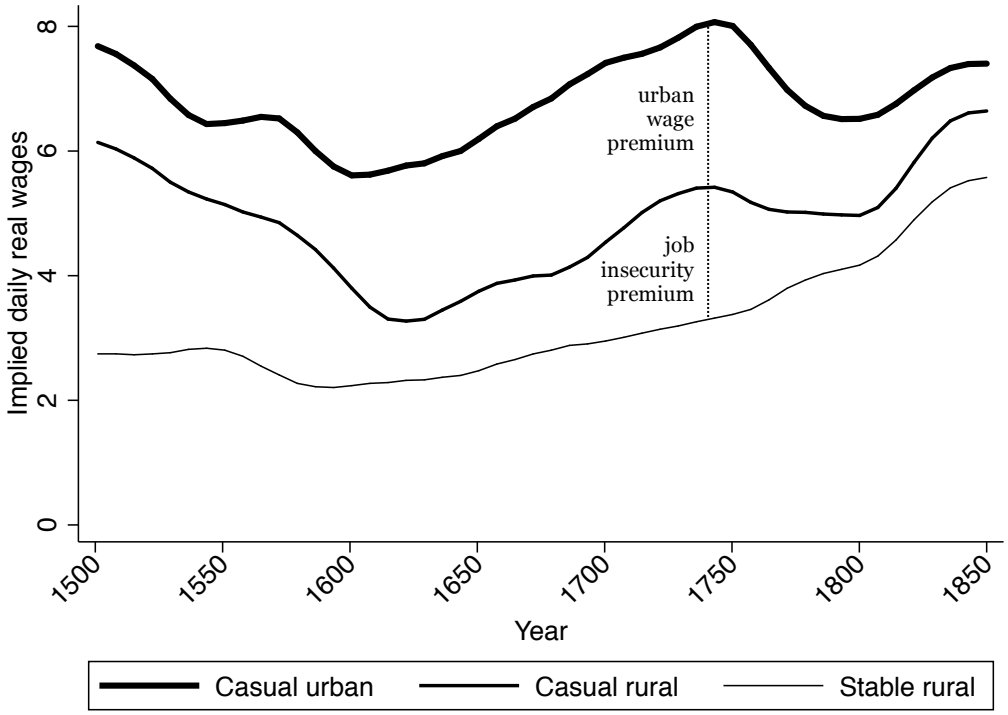
The first of the two problems with casual urban wages is that urban workers received a wage premium to cover their urban living expenses – a premium that rural workers, and hence early industrial labour, did not obtain. The second problem is that casual workers usually received a wage premium for job insecurity that stable workers, and thus early factory employees, also did not achieve. The size of these two compensating wage premia can be quantified by comparing the daily wages of casual workers in urban locations with those of stable workers in rural areas. Figure 1 below indicates how the two premia evolved for unskilled English workers between 1500 and 1850. The thick and medium-thick lines show the day wages of urban and rural casual workers, respectively, and the vertical distance between them suggests the size of the urban wage premium. The thin line beneath them shows the implied day wages of stable rural workers – the wages that we argue proxy best

for the cost of early factory labour. The compensating wage premium for job insecurity is thus indicated by the gap between casual and stable rural workers' wages. Combined, the two wage premia indicate the size of the potential measurement error of using casual urban wages rather than stable rural wages to determine the cost of early factory labour. The magnitude of the measurement error implied by Figure 1 proposes that early industrial workers in England might have been substantially *less* costly than casual urban wages suggests. This warrants a further investigation.

This study offers new and improved empirical evidence for considering the *high-wage* hypothesis. We present newly-collected and hitherto unexplored annual wage rates paid to unskilled stable workers in rural Italy (Tuscany), which we then compare to the annual wage rates of similar workers in rural England, recently reported in Humphries and Weisdorf (2019). The advantage of this comparative exercise is that stable rural workers did not receive the two compensating wage premia described above – one for urban living and one for unstable employment. This means we can reconsider the *high-wage* hypothesis while avoiding some of the main drawbacks of earlier wage evidence, as discussed in detail in Stephenson (2018a) and Hatcher and Stephenson (2019).

Our annual wage rates are collected from historical account books of rural estates in Italy and cover the early-modern period up until after the classical years of the Industrial Revolution, 1500-1850. Our study focuses on Tuscany, a region of Italy that – like England – largely escaped the plague outbreaks of the seventeenth century and hence did not suffer the setbacks in development that other Italian regions experienced at the time (Alfani 2013; Alfani and Percoco 2019). This makes Tuscany the best area of Italy for a fruitful comparison with England during the early-modern period.

Figure 1: Real wage rates of unskilled casual and stable labourers in England, 1500-1850



Note: Nominal wages are turned into real wages by deflating them with Allen's daily cost of a 'respectable' living. The daily wage rate of stable farm workers is calculated on Allen's assumption that the working year was 250 days long. All three lines are smoothed using the *lpoly* function in Stata/IC15. *Sources*: Urban and rural casual labours: Allen (2001). Rural, stable labour: Humphries and Weisdorf (2019). Cost-of-living index: Allen (2015).

Our comparison of historical real wages shows that the precondition for the *high-wage* hypothesis is still in place. That is, 18th-century English workers were still more expensive than their Italian counterparts even after correcting the cost of labour for the compensating wage premia described above. Although our new empirical evidence confirms a 'great divergence' between the northwest and the south of Europe, it brings two key insights into the debate about what drove industrialisation. The first concerns *timing*. The original evidence, based on casual urban wages, showed that England and Italy grew apart during the late middle ages (Allen 2001). Conversely, we observe that stable rural workers in England were only mildly more expensive than in Italy until c. 1650, when an unskilled

English worker cost as little as 20 per cent more than an Italian worker. However, by 1800, a stable rural worker in England cost an astonishing 150 per cent more than his Italian equivalent. The divergence thus began several centuries later than in Allen's original study and – important for considering what drove early mechanisation – *coincided* with the classical years of the Industrial Revolution.

The second insight from our new and more appropriate wage evidence concerns the *shape* of the 'great divergence'. Allen's original comparison showed that Italian workers became increasingly cheaper in the run-up to the Industrial Revolution, while English workers continued to cost more or less the same as in earlier periods (Allen 2001, Figure 8). In our version, however, English labour became increasingly more expensive whereas the cost of Italian labour remained roughly constant. Stable rural wages thus provide a much more intuitive explanation than earlier evidence for why English but not Italian workers would have been replaced by machines. However, because the new wage evidence shows that growing wages in England *overlapped* with early industrialisation, it is no longer clear whether it was high wages that induced mechanical innovations or the other way around.

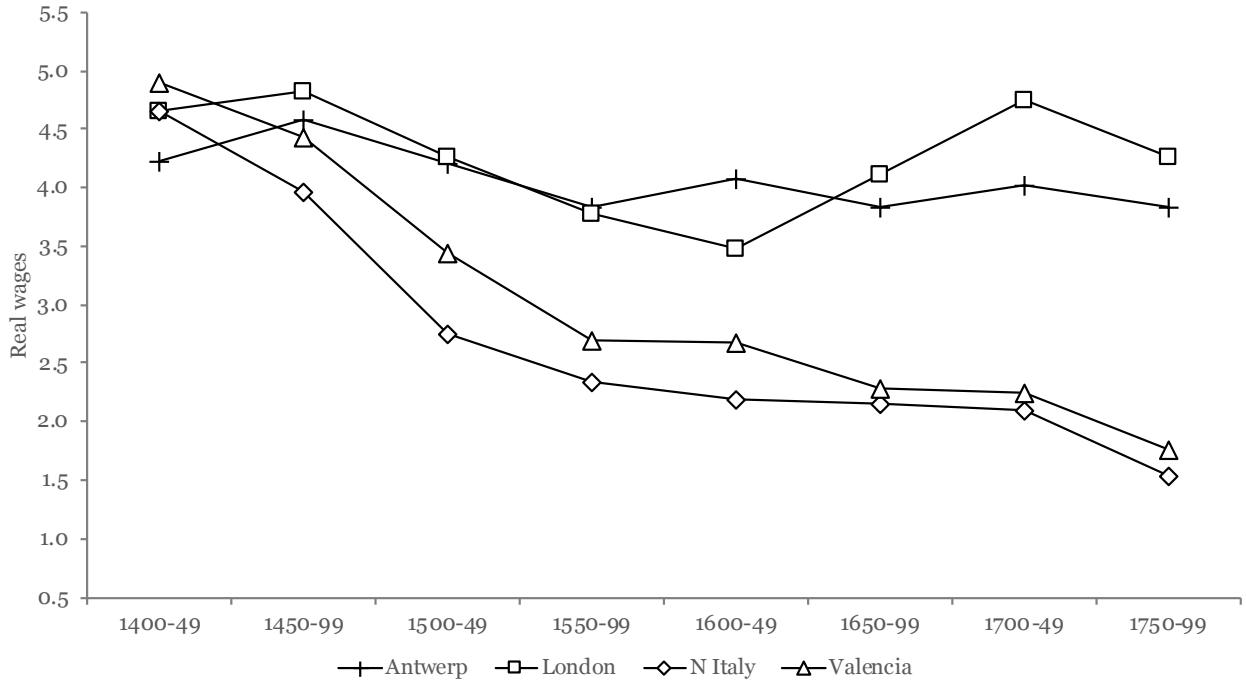
We proceed as follows. Section 2 summarises the key arguments for and against the *high-wage* hypothesis and the problems with using casual urban wages to test them. Section 3 describes our newly-collected annual wage rates for Italy and explains how they are transformed into real wages. Section 4 compares our stable rural wage rates for Italy with those already existing for England. Finally, Section 5 draws conclusions.

2. Background

Allen's seminal comparison of casual urban construction wages (Allen 2001) showed that building workers in some of Europe's richest cities – London, Florence, Madrid, Naples, and Valencia – received roughly the same level of real wages during the fifteenth century. However, while other European cities saw falling real wages in the centuries leading up to the Industrial Revolution, daily wage rates in London remained consistently high. Hence, by the late seventeenth and early eighteenth century, building workers in London were paid more than twice as much as their European peers. These contrasting developments in casual urban construction wages, which Allen referred to as the 'great divergence within Europe' (Allen 2001, title), are replicated in Figure 2 below. Inspired by John Habakkuk's thesis that labour scarcity led to high wages, which resulted in the search for labour-saving innovations (Habakkuk 1962), Allen used this 'great divergence' to explain England's position as a frontrunner in the Industrial Revolution, arguing that expensive English workers motivated English industrialists to replace factory labour with machines (Allen 2001, 2009, 2015, 2019). Allen's *high-wage* argument is widely accepted as one of the leading explanation for why England industrialised first.

The *high-wage* hypothesis has, however, not escaped scepticism. Follow-up works divides into three main categories: (i) those that question Allen's nominal wage evidence (e.g. Malanima 2013; Malinowski 2016; Pfister 2016; Garcia-Zuniga and Lopez-Losa 2018a; Geloso 2018; Stephenson 2018b); (ii) those that question the consumption basket used by Allen to transform nominal wages into real wages (e.g. Humphries 2013; García-Zúñiga and López-Losa 2018b); and (iii) those that question the idea that historical workers could always find 250 days of work each year at the wage rates reported in Allen's study (e.g. Stephenson 2018a; Hatcher and Stephenson 2019; Humphries and Weisdorf 2019).

Figure 2: Allen's cross-European daily construction wage comparison, 1400-1800



Note: The real wages express the number of consumption baskets that an unskilled building labourer is able to afford on the assumption of 250 days of work per year. *Source*: Allen (2001).

The issues raised in the first two categories have so far not presented any serious challenge to the *high-wage* argument. Subsequent revisions of the nominal wages paid to daily construction workers still confirm that these were considerably higher in London in 1800 than in any of Allen's other sampled cities (Allen 2019). Also, raising the number of calories included in his original consumption basket did not create any threats to Allen's previous conclusions (Allen 2014). However, the issue raised in the last category – how much work casual workers were actually able to find each year – is still a subject of debate. The rest of this section highlights the scholarly concerns linked to the assumption that finding 250 days of work per year was always possible for casual workers. In turn, these concerns emphasise the problems associated with the use of casual wages as an empirical foundation for the *high-wage* hypothesis.

Historical labour inputs and their discontents

The length of the historical working year is vital for assessing both workers' annual earnings and employers' cost of labour. Historical workers are normally divided into two types: casual and stable workers. Stable workers were secured continuing employment across the year. Casual workers on the other hand, especially those employed in seasonal trades such as construction work, usually – as we discuss further below – received a compensating wage premium in order to cover the risk of underemployment, a wage premium that stable workers did not receive. This means that daily wage rates were not just reflecting casual workers' labour productivity. They also depended on how much work casual labourers were able to find – something that varied from year to year and place to place – and in turn influenced the size of the compensating wage premium.

Since very little knowledge exists about casual workers' annual employment possibilities, previous studies – Allen (2001) included – had to make conjectures. The common assumption is that casual workers always found 250 days of work each year. This amount of working days is not far from the numbers observed in more recent historical times. For example, late nineteenth-century Italian workers, according to Federico *et al* (2019), are estimated to have worked for 253 days per year on average. Huberman's comparable estimate is 290 days for Italy and 309 days for England (Huberman 2004). While these numbers would suggest that workers were always able to find at least 250 days of work each year, this was not the case in the pre-modern period.

Sporadic evidence suggests that annual labour inputs varied greatly during pre-modern times (Allen and Weisdorf 2011). In particular, the English working year appears to have been relatively short during the Middle Ages, when as little as 150 days of work a year were observed (Blanchard 1978). Inspections of the patterns of employment on early-modern construction sites – from which Allen's London wages were drawn – showed that

the figure of 250 days of work per year was unattainable for most building workers. On the major construction projects in London, such as St Paul's Cathedral, an average labourer could not expect to find more than 100 days of employment per year (Stephenson 2018a).

Construction work elsewhere in Europe followed similar patterns. In Malmö, Sweden, and even during some of the busiest construction years, workers had less than 85 working days per year on average (Gary 2019). Construction workers in Florence and Milan were more fortunate and seem to have found some 180-200 days each year (Mocarelli 2019). Since these numbers were normally not enough to sustain an average family, construction workers either had to supplement their income from other sources, or work as part of a building team that moved from site to site in order to make an adequate income (Lucassen 1987). For example, by tracking construction workers across time and space in historical France, Ridolfi (2016) concluded that around 250 days was roughly correct, although French workers had to seek employment on several building sites and take unskilled jobs – even in agriculture – in order to achieve that number of days each year.

A compensating wage premium for unemployment

These employment patterns problematise the use of casual construction wages as empirical support for the *high-wage* hypothesis. The main issues are that construction workers might not have found 250 days of work each year or – if they did – they might not have found 250 days at the superior wage rates reported by Allen (Allen 2001, 2009, 2019). This presents a problem to the extent that casual workers received a compensating wage premium for underemployment (e.g. Hatton and Williamson 1991).

Scholarly awareness of such a risk premium has deep roots. Adam Smith, in *The Wealth of Nations*, alluded to the issue more than two centuries ago, pointing out that: 'Employment is much more constant in some trades than in others. In the greater part of

manufactures, a journeyman may be pretty sure of employment almost every day in the year that he is able to work. A mason or bricklayer, on the contrary, can work neither in hard frost nor in foul weather, and his employment at all other times depends on the occasional calls of his customers. He is liable, in consequence, to be frequently without any. What he earns, therefore, while he is employed must not only maintain him while he is idle, but make him some compensation for those anxious and desponding moments which the thought of so precarious a situation must sometimes occasion [...]. The high wages of those workmen, therefore, are not so much the recompense of their skill as the compensation for the inconstancy of their employment' (Smith 1776, pp. 115-116).

Evidence in support of Smith's reflections is forthcoming in Peter Swenson's study of early 20th-century European labour-market relations (Swenson 1991). Swenson observed that casual construction workers in Scandinavia earned systematically higher wages than comparable workers in manufacturing sectors *not* influenced by employment inconstancy. In tandem with Smith, Swenson argued that the difference could be explained by a compensating wage premium paid to Nordic construction workers in order to cover them during winter periods, when building work ceased due to freezing temperatures. Swenson showed that the hourly wage rates paid to masons in Sweden were twice as high as the hourly wages paid to workers of equal skills – turners and filers – who were employed in non-seasonal industries. Swenson also noted that in places where winter temperatures were higher and the construction season therefore longer, such as in the south of Europe, the hourly wages of masons were roughly on a par with those paid to turners and filers (*ibid.*, Table 1). Based on his observations, Swenson concluded that casual workers were generally able to negotiate a wage premium linked to job uncertainty, the size of which depended on their off-season options.

Systematic analysis of the size of the wage premium is still to be carried out for more knowledge about how labour markets valued the risk of job insecurity in historical Europe. Meanwhile, Price Fishback, in a survey article of American studies, found the wage premium to be universal across the 19th-century US job market, with up to 80 per cent additional pay made to casual as oppose to stable workers (Fishback 1998). If the wage premium for job insecurity was widespread also in historical Europe, and if Swenson is correct that the size of the premium depended on factors such as weather conditions, then the eighteenth-century construction wage-gap observed between the northwest and the south of Europe (see Figure 2 above) could potentially be explained by differences in the length of the construction seasons. Specifically, if the construction season was shorter in the northwest and the compensating wage premium therefore higher than in the south, a simple multiplication of Allen's daily London wages by 250 days might therefore overestimate the historical cost of hiring stable workers in England, but not in Italy.

The fact that early factories hired labour on a stable basis is clearly evident in the literature. The forerunner of early factory work was the *putting-out* system. This system allowed workers to participate in manufacturing on a casual basis. But with the emergence of the early factory system, part-time employees were rare and full-time work was 'an all-or-nothing choice' (Mokyr 2001, p. 8). Early factories were also seldom located in the urban areas that Allen's wages come from. They emerged in the countryside, near smaller towns or villages (*ibid*.). The alternative to early factory work, therefore, was not urban construction work, but agricultural work or domestic service. Hence, the reservation wage that early factory managers faced was the labour cost of stable farm workers or domestic servants. The purpose of this study is thus to compare the wages paid to stable rural workers in England and Italy. The aim is to uncover whether or not the payments made to stable rural workers supports the *high-wage* hypothesis. This is the subject of the remaining sections.

3. Data

Our annual wage rates of stable Italian workers were collected from historical account books of manorial estates in the hinterlands of Florence and Pistoia in Tuscany for the period 1500 to 1850. Florence and Pistoia both belonged to the Grand Duchy of Tuscany before the Unification of Italy, in 1861, and to the Province of Florence thereafter. Today's road distance between the centres of the cities is some 35 km, equivalent to a (long) day's walk. As one would expect, the wages observed in the two areas were therefore very similar, both in levels and trends, as we show later on.

We compare out Italian wages to the wages of similar workers in England (Humphries and Weisdorf 2019). There are two main reasons why we focus on Tuscany rather than other Italian regions. The first and most obvious reason is that Allen's original study also used Tuscan wages (Allen 2001). The second reason, however, links to the occurrence of seventeenth-century plagues. According to Guido Alfani, epidemic outbreaks afflicted most of Italy between 1629 and 1631 and again in the 1650s (Alfani 2013). Mortality rates of 250-500 deaths per thousand were observed in Naples and Milan – two additional cities included in Allen's original study (*ibid*., p. 417). Meanwhile, the city of Florence was hit only lightly by the plagues, with mortality rates around 140 deaths per thousand, close to the death rates observed in plague-spared England at the time. According to Alfani and Percoco (2019), the plagues reversed the process of urbanisation in the affected Italian regions and displaced the touched cities to lower growth paths. However, since Tuscany was not severely impacted by the seventeenth-century plagues and indeed witnessed growing urbanization rates during the seventeenth century (*ibid*., Table 5), this region offers the most appropriate Italian setting for comparison with historical England.

The sampled wage rates used in our comparison below are those paid to stable farm workers and domestic servants. When it comes to farm work, historical Tuscany had three

types of employment arrangements: casual contracts, stable contracts, and share-cropping contracts. Under the share-cropping agreement, the landowner provided the *mezzadro* (the share-cropper) with a plot of land as well as a house (Alfani and Ammannati 2017). In return, the share-cropper agreed to cultivate the land and share the final product of the land with the owner. The extensive work responsibilities and skill requirements meant that share-croppers were usually paid significantly more for their services than their unskilled stable counterparts, as we show below. Since they were not unskilled workers, share-croppers were thus excluded from our sample.

Share-cropping was the most common form of farm employment, comprising some 60 per cent of the agricultural workforce (Population Census of 1881). Casual farm workers made up 20 per cent, while stable farm workers – one of our two focus groups – made up another 20 per cent. The Census of 1881 does not break labour down by contract in domestic service, so we are unable to say how many servants – our second focus group – were employed on a stable versus casual basis. But we suspect – due to the nature of domestic service work – that casual contracts were rather unusual. Unskilled annual workers in England, our country of comparison, made up some 20-50 per cent of the total male workforce depending on the period in question (Humphries and Weisdorf 2019, p. 22). There is no information about the Italian shares prior to 1881.

Sample restrictions

Our main goal is to build an index of annual wages paid to unskilled workers. The focus on unskilled work allows us to compare with the wages of similar workers in England (Humphries and Weisdorf 2019). Separating skilled from unskilled work among non-share-cropping workers was not always straightforward. Even though the occupational titles recorded in manorial account books suggested that the work was unskilled, there were many

examples that some workers, especially servants, were paid considerably better than their occupational peers, even on the same estate. For example, Pietro Gargani, a servant at a manor near Florence (Conti Ginori 155), received a total of 456 *lire* per year in 1823. His colleague Giuseppe Lattari, another servant employed during the same year, was paid less than half that amount – 204 *lire*. Such large differences in payments for the same occupation are not unique to our Italian sources – many English cases were similar in this regard (Humphries and Weisdorf 2019, pp. 8-9). As in the case of England, we assumed that Gargani – because of his superior pay rate – tacitly held a position with non-trivial work responsibilities and skill requirements that justified his higher earnings. In order to keep the sampled wages unskilled, we therefore proceeded to remove Gargani from the sample while keeping Lattari. All workers were evaluated this way, leaving us with the lower end of the wage distribution for unskilled occupations, as was also done for the comparable English workers (*ibid*.). The qualitative nature of our conclusions below is robust to including workers identified as receiving a skill-premium (Figure A3 in Appendix 3).

Our restricted sample counts a total of 340 annual wage rates paid to unskilled Tuscan farm workers and domestic servants hired on stable contracts. Although this may not sound like a great deal of observations, it must be remembered that these payments are up to 500 years old and hence very difficult to trace in the source material. Moreover, the average number of observations per decade compare to previous studies of historical workers (e.g. Allen 2009). Since workers were not always mentioned by name, we can also not be certain how often re-entry of the same worker has occurred.

Table 1: Occupations and Regions

Job title	*Freq.*	*Per cent*	*Cum.*
Farm labourers	200	59	59
Domestic servants	100	29	88
Men and helpers	40	12	100
Total	340	100	100
Region			
Florence	215	63	63
Pistoia	125	36	100
Total	340	100	100
Share-croppers			
Florence	38	29	29
Pistoia	92	71	100
Total	130	100	100

For our sampled wage rates, 63 per cent concerns employees in the region near Florence. The rest were found in the vicinity of Pistoia (see Table 1). Of the sampled workers, 59 per cent were recorded as farm labourers and 29 per cent as domestic servants. The remaining 12 per cent – a group we refer to as 'men and helpers' – consists of coachmen, gatekeepers, grooms, shepherds, woodcutters, as well as regular labourers and work men, all of which are considered to be unskilled professions (Maas and van der Leeuwen 2011). Since share-croppers were assumed to be rather common during our period of interest (see above) and in order to make sure that we distinguish them from our other stable workers, we also collected 130 annual payments made to share-croppers between 1717 and 1846. As mentioned above, the share-croppers were paid significantly more on average than our sampled unskilled farm workers and domestic servants, as we show further below.

Payments in kind

There are always uncertainties linked with building a historical wage index. A central problem is that both stable and casual workers often received some or all of their payments *in kind* – something that resulted from the pre-modern shortage of coins (Palma 2016). Casual workers normally received food and drink as part of their daily pay, whereas stable workers usually received board and lodging privileges as part of their payment. As is tradition, such payments need to be monetised and added to the workers' cash payments in order to determine their overall remuneration.

Although board and lodging privileges were not usually mentioned explicitly in the account books, it was clear from the size of the cash payments that these alone were generally insufficient for the workers to survive on. In order to monetise these board and lodging privileges, we followed previous studies and imputed the relevant workers with the value of a standardised consumption basket as we explain below. For example, the annual cash payment made to Antonio Giorgetti, a farm labourer in the region of Florence in 1724 (MSL 66), was 40 *lire*, 3 *crazie*, and 4 *soldi*. The estimated cost of living of an adult worker that year was 60 *lire* (see below). So Giorgetti was one-third short of sustaining himself on the cash payment recorded in the account book. As with our comparable English workers, we thus assumed that board and lodging were an implicit part of Giorgetti's contract and proceeded to impute him with the monetary value of a typical consumption basket.

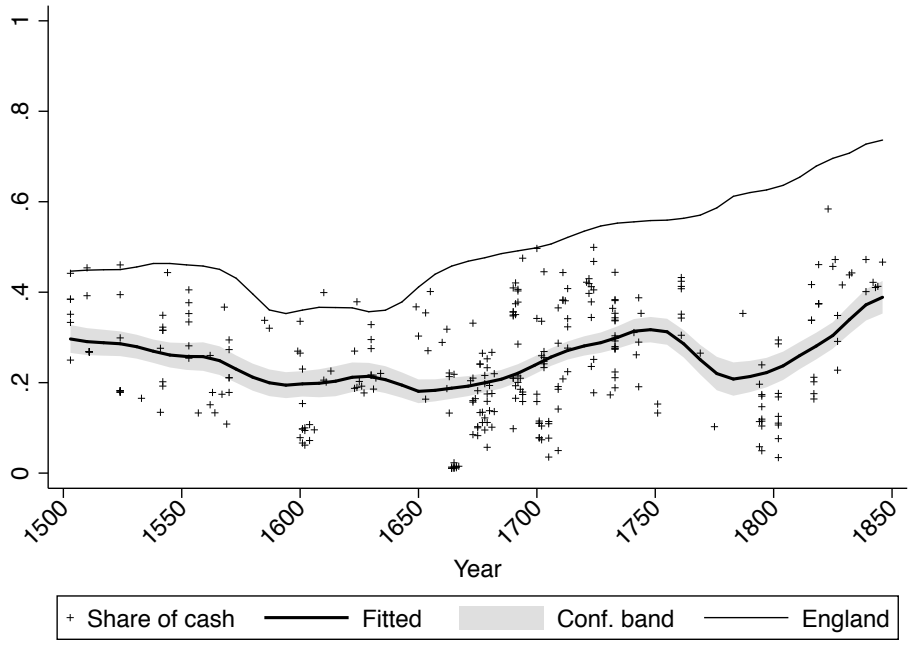
To this end, we used the amended version of Allen's so-called *respectability* consumption basket presented in Malanima (2013). Malanima's consumption basket has the advantage over Allen's in that it complies with Jane Humphries' criticism that Allen's original consumption basket was too meagre in terms of calories for workers to subsist on (Humphries 2013). Allen's original basket offered a male worker 1,941 calories per day, which Humphries felt was too few calories for a worker to survive on given that he had to be

physically active. Malanima's version of Allen's basket includes 2,500 calories per day, which is not only a 'respectable' level of nourishment for an adult male, but also sufficient to deal with Humphries' concern (Allen 2014). In addition to food and drink, the consumption basket also contains linen for clothes, candles and lamp oil for light, fuel for heat, and a rent allowance making up five per cent of the total cost of the basket commodities. Table A2 in Appendix 2 lists the commodities included in the baskets for Italy and England, alongside their volumes. Butter in the Italian basket has been replaced by oil and beer by wine. English workers are also assumed to consume somewhat more energy for heating than Italians. Otherwise, the English and Italian baskets are identical and similar to those presented in Malanima (2013).

Coming back to Giorgetti's case above, his total (cash and kind) payment was then made up of his payment recorded in the account book – some 40 *lire* – plus the monetary value of the payments in kind that we imputed – that is, the value of the consumption basket, which in 1724 was worth 60 *lire*. The monetary value of the consumption basket was achieved by multiplying the items included in the Italian basket with the prices reported in Malanima (2003). Giorgetti's total annual remuneration thus came to some 100 *lire*. We also checked that the imputed payment was in line with payments made to workers whose cash payments were more than enough to subsist on. For example, Giovanni Manganelli, another farm labourer in the region of Florence in 1724, received an annual cash payment of 91 *lire*. This was twice the amount of cash paid to Giorgetti (the 40 *lire*), yet it was in same range as Giorgetti's implied total remuneration (the 100 *lire*). Hence, Manganelli was not imputed with the value of a consumption basket.

Fortunately, non-pecuniary payments were sometimes detailed directly in the account books. These enabled to us to check that our imputing procedure was in line with the value of workers' actual payments in kind. Non-pecuniary payments – when specified – included agricultural commodities, such as various grains (mostly wheat, sorghum, rye, and millet), beans, wine, and olive oil. These commodities and their volumes allowed us – in combination with the historical prices reported in Malanima (2003) – to compute the value of the workers' payments in kind. Indeed, on some occasions the account books even specified the employer's pecuniary assessment of the non-pecuniary benefits given, making them easy for us to add to any cash remuneration. For example, Simone Panicci, a farm labourer in the region of Florence in 1674 (Guidi 247), received an annual payment of 7.5 *stadere* of wheat (one *stadere* is 25 litres), which according to his employer were worth 26 *lire*. In order to check that the monetary value recorded by the employer was not completely out of touch with reality, we multiplied the historical price of wheat reported in Malanima (2003) – that is, 3.485 *lire* per *stadere* in 1674 – by the 7.5 *stadere* that Panicci received, obtaining exactly 26 *lire*. None of cases where we were able to calculate the monetary value of the workers' payments in kind raised any suspicion about the fairness of the employer's pecuniary assessment. Figure A4 in Appendix 4 shows that the cases where we were able to observe and monetise the payments in kind (red marks in the graph) align well with the cases where payments in kind were imputed (blue marks). Moreover, Figure A5 in Appendix 5 shows that imputed workers' income falls markedly below the poverty (dotted) line when payments in kind are *not* accounted for.

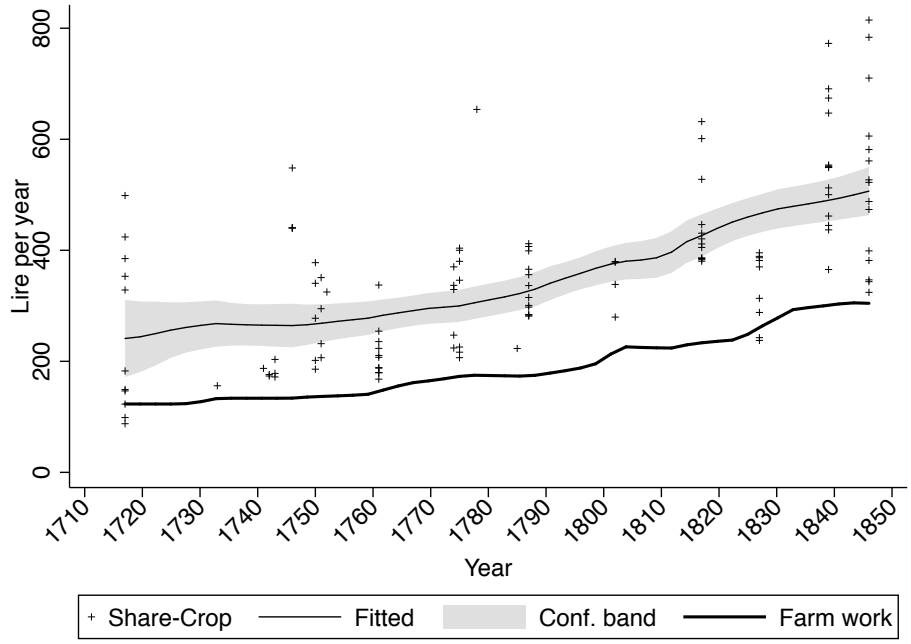
Figure 3: The share of cash to total annual payments in Italy and England, 1500-1850



Notes: The symbol '+' represents individual shares of cash to total payments. The polynomial fitted line is made using *lpoly* in Stata/IC15. *Source*: Data for Italy: see Appendix 1. Data for England: Humphries and Weisdorf (2019).

One of the key features of the early-modern English labour market was that the cash component grew as a share of workers' total payments (Humphries and Weisdorf 2019, p. 13). The comparable shares of payments in cash and kind among our Italian workers are illustrated in Figure 3. The Italian share of cash to total payments ranged from between 20 and 40 per cent and with no apparent trend. This share is somewhat less compared to the share of cash paid to the English equivalents. Cash in England made up some 40 to 50 per cent of annual workers' full payment during the sixteenth and seventeenth centuries, after which the share rose steadily during the eighteenth and nineteenth centuries to reach some 80 per cent in 1850 (Figure 3).

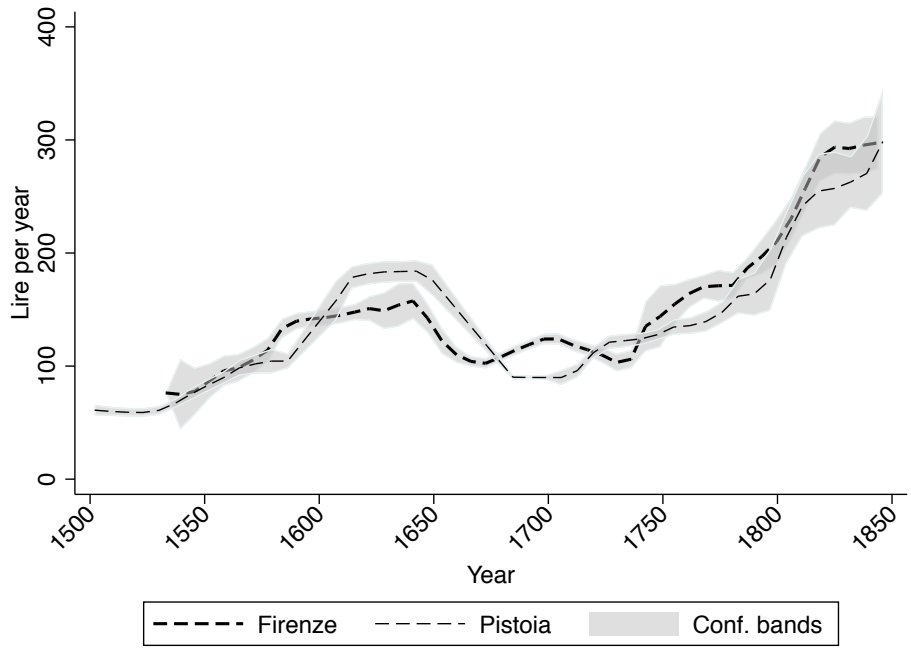
Figure 4: Nominal annual payments made to share-croppers, 1710-1850



Notes: The symbol '+' represents individual payments made to share-croppers. The polynomial fitted lines are made using *lpoly* in Stata/IC15. Farm work includes both farm workers and servants. *Source*: see Appendix 1.

A few more things are pertinent to consider before we turn to the real-wage comparison between England and Italy in the next section. First, returning to the share-croppers and whether or not their pay differed to that of the stable unskilled workers, Figure 4 shows that a typical share-cropper was paid considerably more, as expected, than an ordinary worker. Indeed, the large variation in share-croppers' nominal payments reflect differences in the size of land that they cultivated (Alfani and Ammannati 2017). It is nevertheless reassuring that the average payments made to share-croppers moved in tandem with those of ordinary unskilled stable workers.

Figure 5: Nominal annual payments in the areas of Florence and Pistoia, 1500-1850



Notes: Polynomial fitted lines are made using *lpoly* in Stata/IC15. *Source*: see Appendix 1.

Another potentially important point concerns any regional or occupational differences in the observed payments. Figure 5 shows that nominal annual payments in the surrounding areas of Florence and Pistoia, respectively, were roughly identical in terms of levels and trends. Periodic deviations – such as the mildly better payments made in the region near Pistoia during the greater part of the seventeenth century – could potentially be explained by compositional effects due to shifts in the type of workers included in the wage index, e.g. farm work versus domestic servants.

To find out whether or not compositional effects plague the wage series presented below, we compared a model that fits a line to the raw data against a model that fits a line to the wages predicted by a regression model that accounts for the spatial differences illustrated by Figure 5 and the occupational heterogeneities reported in Table 1. The check was done by running a piecewise OLS model of the following form:

$$\ln(Wage_{it}) = \alpha_i + \Sigma_j \gamma_j Job_j + \Sigma \eta_k Region_k + \Sigma \phi_l Decade_l + e_{it},$$

where $Wage_{it}$ is a wage payment made to individual *i* at year *t*; Job_j is a dummy for each of our three categories of workers (men and helpers, farm labourers, and domestic servants) reported in Table 1 above; $Region_k$ is a dummy for each of the two regional areas (Florence and Pistoia); $Decade_l$ is a dummy capturing the decade when the payment was observed; and e_{it} is the error term.

The model was run piecewise – once for each of the four periods: 1500-1599, 1600-1699, 1700-74 and 1775-1850. The regression estimates underlying the predicted wages are reported in Table A6 in Appendix 6. Figure A6 in Appendix 6 shows that the wages predicted by the model roughly align with the model fitted to the raw data. Since the wage series fitted to the raw data is not plagued by large compositional effects, and because we wish to conduct our comparative analysis using the individual wage observations rather than predicted averages, we proceeded to use the raw data in our comparison below. The qualitative nature of our findings described in the next sections are robust to using the predicted averages instead. Table A7 in Appendix 7 reports the estimated total average annual payments between 1500 and 1850, by decade.

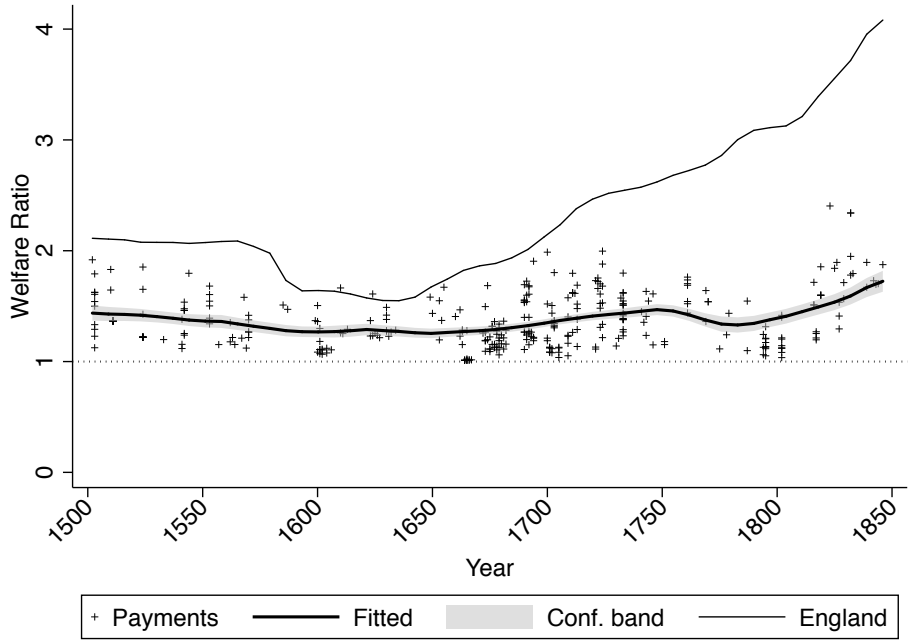
4. Results

We can now present our novel series of annual wages paid to rural stable Italian workers employed between 1500 and 1850 and compare these to the annual wages of similar workers in England reported in Humphries and Weisdorf (2019, Table A2). The overarching goal is to re-examine Allen's *high-wage* hypothesis, but this time using the wages of stable rural workers rather than the potentially misleading daily wages of casual urban workers. To recap, the *high-wage* argument holds that England was the first country to industrialise, because workers there were more expensive than elsewhere, making it profitable for early industrialists in England to replace them with machines (Allen 2001, 2009, 2015, 2019). For this premise to still have relevance we would need to see that the sampled English workers cost significantly more, in real terms, than their Italian counterparts during the period when England began to industrialise, that is, during the long eighteenth century.

Comparison: England versus Italy

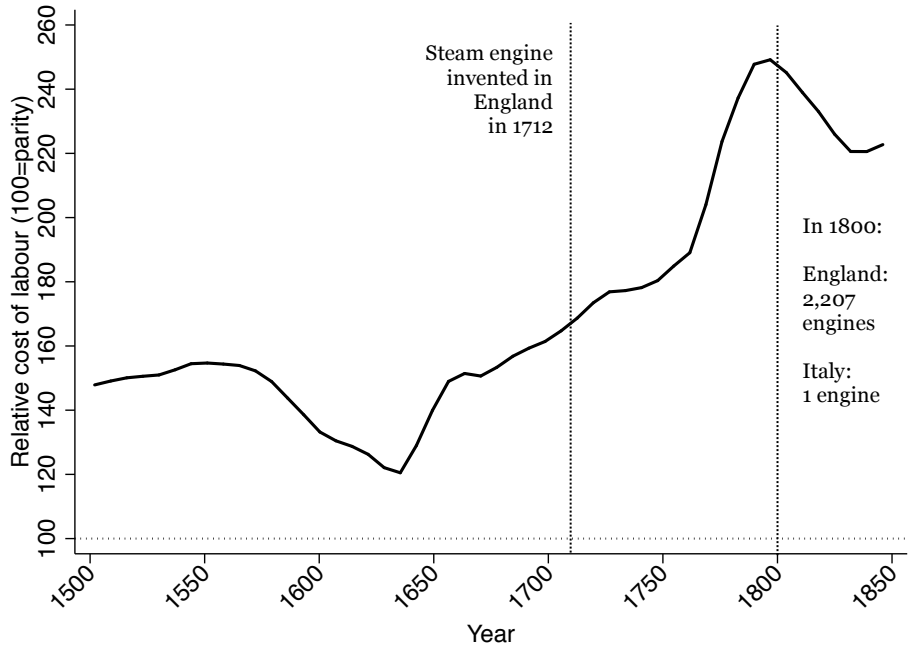
Figure 6 shows the real annual wage rates of our Italian workers against the annual wage rates of comparable English workers. Real wages were obtained by dividing the annual nominal wage rates by the annual costs of Malanima's consumption basket reported in Table A2 in the Appendix. Figure 7 shows the size of the pay gap between the two countries. Table A7 in Appendix 7 reports the average real annual wage rates for Italy and England, by decade. Together, Figures 6 and 7 contain a set of messages that speak directly to ongoing debates about the timing of the 'great divergence' between the north-western and southern parts of Europe and, by implication, to the relevance of the *high-wage* hypothesis about why the first Industrial Revolution happened in England and not in Italy.

Figure 6: Real annual income in Italy and England, 1500-1850



Notes: Real wages (welfare ratios) are computed by dividing the annual nominal wage rates by the annual costs of Malanima's *respectability* basket. The symbol '+' represents individual payments. The polynomial fitted lines are made using *lpoly* in Stata/IC15. *Sources*: Italian wage rates: see Appendix 1. English wage rates: Humphries and Weisdorf (2019). Annual costs of Malanima's *respectability* basket for Italy: Malanima (2013, Statistical Appendix).

Figure 7: The cost of labour in England relative to Italy, 1500-1850



Note: The polynomial fitted line is made using *lpoly* in Stata/IC15. *Source*: Italian wage rates: see Appendix 1. English wage rates: Humphries and Weisdorf (2019). Steam engines: Nuvolari *et al* (2011).

The first observation is that stable rural English workers were only moderately more expensive than their Italian counterparts during the sixteenth and seventeenth centuries, with English workers being paid between 20-50 per cent more than their Italian peers (Figure 7). In terms of workers' so-called *welfare ratios* – informing how many times a worker's annual income could buy the consumption basket described above – an average Italian worker earned the equivalent of one and a half baskets in 1500 (Figure 6). That level of income remained fairly constant until the mid-nineteenth century. It never surpassed two consumption baskets, showing how relatively poor unskilled Italian (Tuscan) workers were in early-modern times, barely able to support a wife and certainly not any children without the additional contribution of those other family members. The so-called *male breadwinner model* would not hold up for the lower working-classes in Tuscany before 1850.

By contrast, an average English worker earned slightly more than the equivalence of two consumption baskets during most of the sixteenth century (Figure 6), which was also not enough to keep a typical English family fed at the time (Humphries *et al* 2019). Real annual earnings in England then dropped somewhat below two baskets during the first half of the seventeenth century. But then, from less than two baskets in 1650, an English worker's average annual earnings rose considerably during the long eighteenth-century, reaching well over four consumption baskets in 1850. It is clear from this that even the lowest segments of the English society at the time were significantly better off in terms of real income than their Italian peers. Not only was an average English unskilled worker able to support a wife and a few children, which meant that the *male breadwinner model* was actually relevant for England in the early nineteenth century, but even a modest contribution from the wife would allow a typical lower-class family to take part in a 'consumer revolution' along the lines of what Jan de Vries describes in his book about the 'industrious revolution' (de Vries 2008).

Coming back to the *high-wage* argument, it is also visually clear from Figure 7 that a 'great divergence' in the cost of a hiring stable rural labour materialised between England and Italy during the long eighteenth century. From the mid-seventeenth-century on, when an unskilled stable rural English worker cost as little as 20 per cent more than a comparable Italian worker, the surge in English real annual wages meant that an English worker was an astonishing 150 per cent more expensive at the turn of the nineteenth-century than his Italian counterpart. The development in the cost of eighteenth-century English labour thus showed a stark contrast to Italy where little or no change occurred across more than three centuries, with an unskilled stable rural Italian worker in 1850 barely more expensive than his counterpart in 1500 (Figure 6).

Strikingly different from the 'great divergence' depicted in Allen's original study of urban construction wages (Figure 2 above), the rising price of stable rural labour in England coincides with Britain's early mechanisation (Figures 6 and 7). For example, the first steam engine – a cornerstone of the Industrial Revolution – was installed in England in 1712. Although steam engines were initially used in the mining sector, they quickly spread after the 1740s and during the second half of the 18th century to the most innovative branches of the economy, including the cotton industries, along with the rising cost of labour (Nuvolari *et al* 2011). By 1800 – when the pay-gap between England and Italy was close to a peak – some 2,207 steam engines had been erected and put to use in England. Italy in 1800 had only one steam engine in operation (Tann and Breckin 1978). Our new and improved empirical evidence – stable wages paid to rural workers rather than casual wages paid to urban workers – are certainly consistent with the idea that mechanisation and rising wages went hand in hand. However, the direction of causality is now an open question and the also main topic of our concluding remarks.

5. Conclusion

This article has argued that the daily wage rates paid to casual urban construction workers are not a suitable empirical basis for considering the relevance of the *high-wage* hypothesis. We reasoned that casual urban construction wages might have included two compensating wage premia – one for shouldering job insecurity and one for compensating the higher costs of urban living. We argued that these premia were irrelevant for early factory managers who relied on rural workers and hired them for stable basis. Therefore, we proposed instead that factory managers considered the costs of hiring stably-employed farm workers and domestic servants. Those positions were more plausible alternatives to early factory work and hence their pay rates better able to capture the reservation wage that factory managers paid attention to when calculating the factory's wage bill and making decisions about whether or not to replace labour with machines.

To this end, we built and presented a novel wage index for based in payments made to stable rural workers in Italy (Tuscany), which we then compared to payments made to similar workers in England for a more plausible empirical setting in which to consider the *high-wage* argument. Our wage comparison showed that English workers were only mildly costlier during the sixteenth and seventeenth centuries than their Italian counterparts, but that the wage gap grew markedly wider during the eighteenth century, when the cost of English labour rose to unprecedented heights. By 1800, an unskilled stable worker in rural England was more than twice as expensive as his Italian counterpart. The rising pay and pay gap coincided with the early mechanisation of Britain, including the invention and spread of steam engines, something that Allen argued would happen once early industrialists found it profitable to replace the pricy English workers with machines.

However, although our empirical evidence shows that the precondition for the *high-wage* hypothesis is still in place — English workers *were* indeed more expensive than their Italian peers at the time of industrialisation, also after correcting for the misguiding wage premia described above – the mechanism is no longer evident. Allen's original wage data showed that English labour became relatively more expensive than Italian labour in the period *leading up* to the Industrial Revolution. This allowed him to argue that high wages was a motivating factor behind mechanisation. Our new and improved wage data show that the rising cost of English workers and industrialisation *coincided*. This means it is no longer clear whether it was high wages that incited innovations or the other way around – a subject of further research.

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Appendix 1: Data Sources

The State Archives of Florence:

Canigiani: 204, 206, 212, 223

Conti Ginori: 141, 143, 153, 154, 155, 156, 157, 159, 162, 164

Guidi: 202, 247

MSL: 35, 36, 38, 41, 61, 64, 66, 81, 82 84, 85, 89, 90

The State and Commune Archives of Pistoia:

Amati Cellesi: 294, 297, 318, 405

CG Rinuccini: 126, 249, 258

Ganucci Cancellieri: 191, 212, 223, 238, 242, 254, 256

Gherardi Badioli: 70

OC SR: XXIV 5

OC: 67, 356, 365, 377, 392, 393, 435, 388, 398

Appendix 2: The Consumption Basket

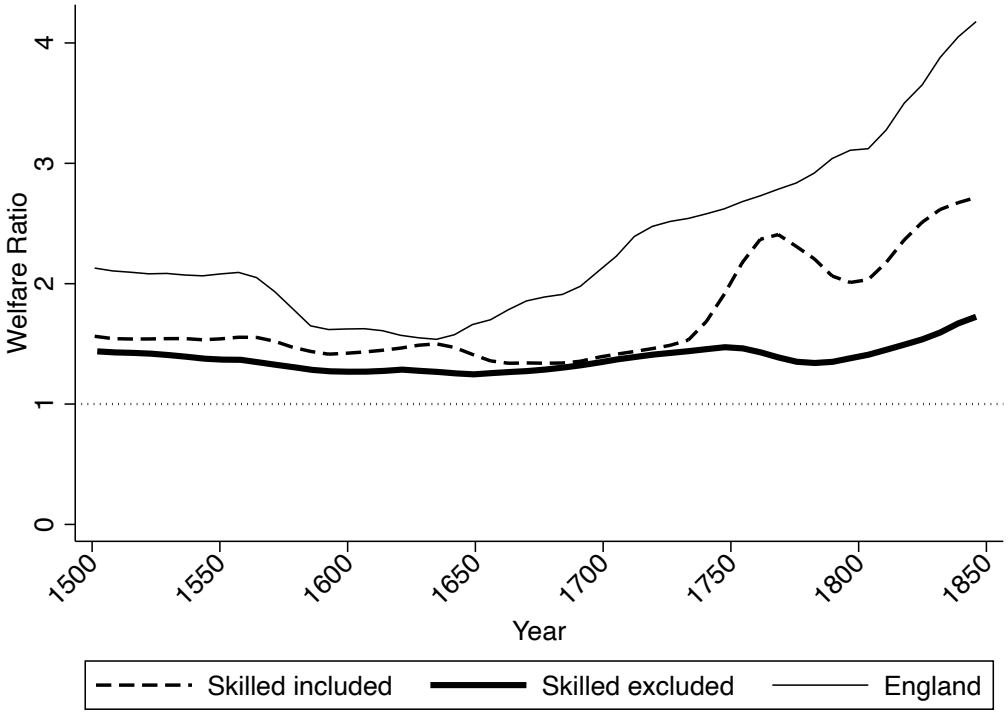
Table A2: The *respectability* basket for England and Italy

	England			Italy		
Food:	*Amount*	*Unit*	*Calories/day*	*Amount*	*Unit*	*Calories/day*
Bread	*200*	*kg*	*1,315*	*200*	*kg*	*1,315*
Rye	130	litres	784	26	kg	784
Maize				(120)	(litres)	(789)
Meat	15	kg	82	15	Kg	82
Eggs	40	units	7	40	Units	7
Butter	6	kg	123			
Oil				5	Kg	123
Wine				150	litres	288
Beer	210	litres	230			
Total calories			2,541			2,599
Non-food:	*Amount*	*Unit*	*Mill. BTU/year*	*Amount*	*Unit*	*Mill. BTU/year*
Linen	5	meters		5	meters	
Firewood						3,000
Charcoal			6,000			

Note: Maize, according to Malanima (2013), replaces rye in the Italian basket from 1700 onwards. MBTU is million British thermal units. *Source*: Malanima (2013, Table 2).

Appendix 3: Skilled Italian Workers

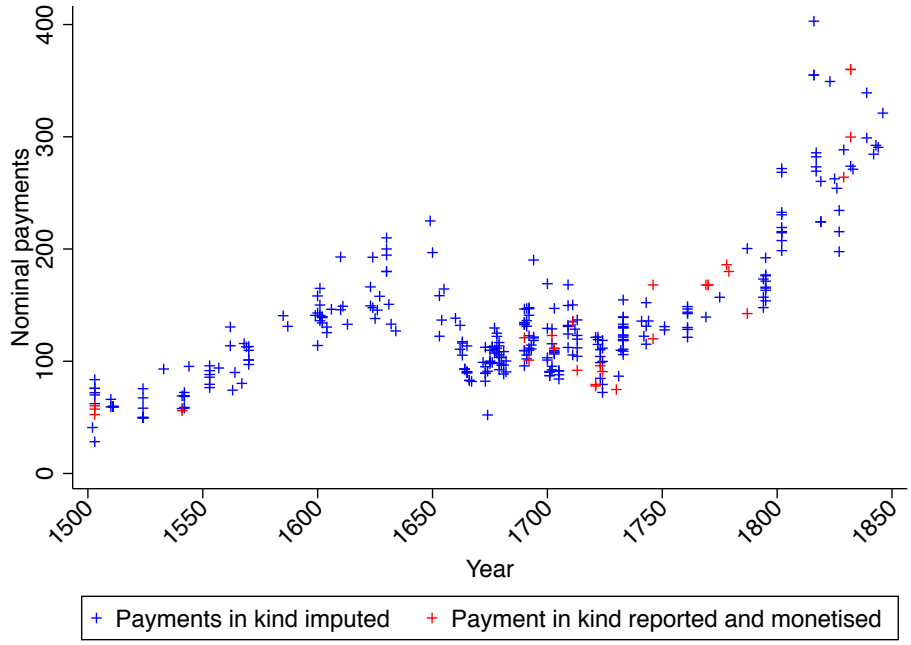
Figure A3: Real annual income with and without potentially-skilled workers in Italy, 1500-1850



Notes: Real wages (welfare ratios) are computed by dividing the annual nominal wage rates by the annual costs of Malanima's *respectability* basket. The dashed line combines unskilled and potentially-skilled Italian workers, whereas the thick and thin solid lines includes only workers deemed unskilled. Polynomial fitted lines are made using *lpoly* in Stata/IC15. *Sources*: Italian wage rates: see Appendix 1. Unskilled English wage rates: Humphries and Weisdorf (2019). Annual costs of Malanima's *respectability* basket for Italy: Malanima (2013, Statistical Appendix).

Appendix 4: Monetisation of Payments in Kind

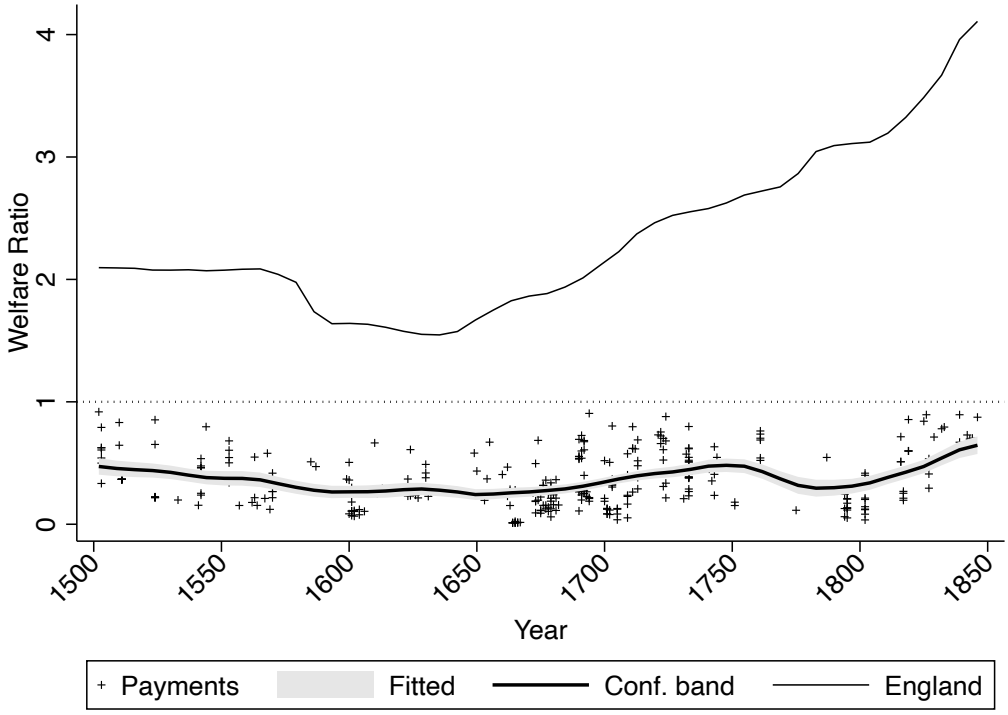
Figure A4: Nominal payments with in-kinds either imputed or observed and monetised



Notes: The symbol '+' represents individual nominal payments. Red marks concern remunerations in the cases where the account books specified the payments in kind, which meant they could be monetized either by us using historical prices or they were monetised by the employer in the source. *Sources*: see the text and Appendix 1. Historical prices: Allen (2001) and Malanima (2003).

Appendix 5: Removing Imputed Payments in Kind

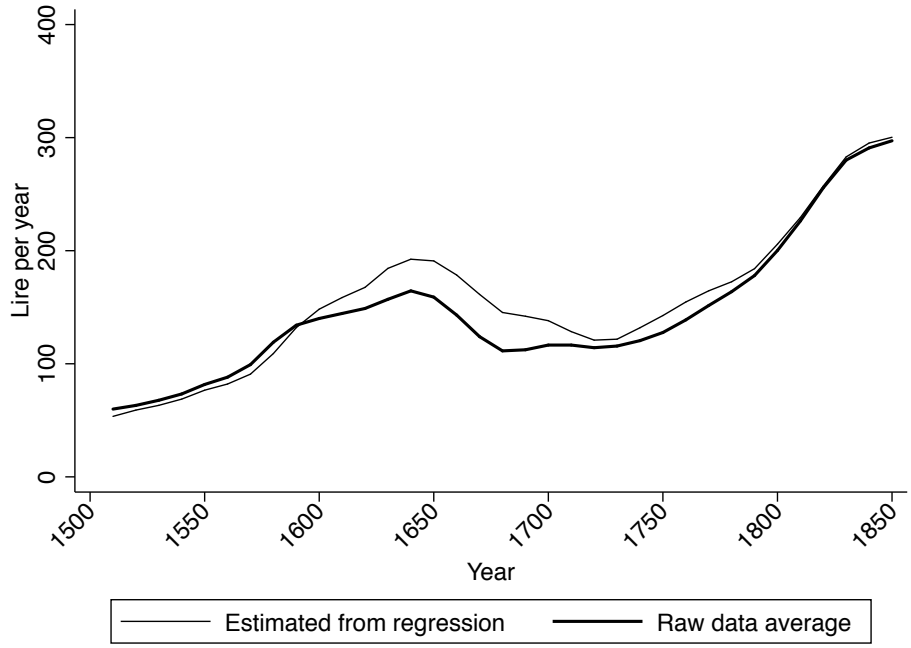
Figure A5: Real annual Italian income *without* imputed payments in kind, 1500-1850



Notes: The graph shows the income of those Italian workers whose cash salaries were below the poverty line and hence were imputed with the value of the basket. Polynomial fitted lines are made using *lpoly* in Stata/IC15. *Sources*: Italian wage rates: see Appendix 1. Unskilled English wage rates: Humphries and Weisdorf (2019). Annual costs of Malanima's *respectability* basket for Italy: Malanima (2013, Statistical Appendix).

Appendix 6: Incomes Estimated by Regression

Figure A6: Estimated nominal annual payments using regression, 1500-1850



Notes: Polynomial fitted lines made using *lpoly* in Stata/IC15. *Sources*: see Appendix 1.

Table A6: Regression coefficients

	(1) 1500-1599	(2) 1600-99	(3) 1700-69	(4) 1770-1850
Florence area	-0.02	-0.29***	0.15***	0.08
	(0.10)	(0.09)	(0.05)	(0.06)
Pistoia area	REF	REF	REF	REF
Man or helper	-0.07	0.28***	0.00	-0.01
	(0.11)	(0.06)	(0.00)	(0.08)
Farm labourer	0.00	0.15***	0.00	0.02
	(0.11)	(0.05)	(0.00)	(0.09)
Domestic servant	REF	REF	REF	REF
1500-10	-0.86***			
	(0.11)			
1510-20	-0.87***			
	(0.11)			
1520-30	-0.95***			
	(0.12)			
1530-40	-0.33**			
	(0.09)			
1540-50	-0.75***			
	(0.12)			
1550-60	-0.49***			
	(0.11)			
1560-70	-0.27**			
	(0.11)			
1570-80	-			
	(-)			
1580-90	0.06			
	(0.12)			
1590-1600	REF			
1600-10		0.12***		
		(0.04)		
1610-20		-0.01		
		(0.08)		
1620-30		0.09		
		(0.09)		
1630-40		-0.04		
		(0.08)		
1640-50		0.52***		
		(0.06)		
1650-60		-0.02		
		(0.09)		
1660-70		-0.20**		
		(0.06)		
1670-80		-0.20***		
		(0.05)		
1680-90		-0.10		
		(0.06)		
1690-1700		REF		

Table A6: Regression coefficients, *continued*

	(1) 1500-1599	(2) 1600-99	(3) 1700-69	(4) 1770-1850
1700-10			-0.39***	
			(0.06)	
1710-20			-0.27***	
			(0.06)	
1720-30			-0.49***	
			(0.06)	
1730-40			-0.12***	
			(0.04)	
1740-50			-0.06	
			(0.05)	
1750-60			-0.06**	
			(0.03)	
1760-70			REF	
1770-80				-0.55***
				(0.10)
1780-90				-0.44***
				(0.13)
1790-1800				-0.57***
				(0.08)
1800-10				-0.30***
				(0.10)
1810-20				-0.04
				(0.08)
1820-30				-0.14**
				(0.07)
1830-40				0.04
				(0.07)
1840-50				REF
Constant	4.97***	4.97***	4.93***	5.63***
	(0.11)	(0.12)	(0.03)	(0.07)
Observations	68	118	98	56
R^2	0.76	0.68	0.44	0.76
R^2-adjusted	0.71	0.64	0.40	0.71

Robust standard errors in parentheses:
*** p<0.01, ** p<0.05, * p<0.1

Appendix 7: Income by Decade

Table A7: Nominal and real income, by decade, 1500-1850

	Nominal income			*Real income*		
Decade	*Total*	*Cash*	*Kind*	*Italy*	*England*	*Freq*
1500-10	82	37	45	1.82	2.20	13
1510-20	60	16	44	1.37	1.96	9
1520-30	56	15	41	1.36	2.14	9
1530-40	93	15	78	1.20	2.07	1
1540-50	74	25	49	1.52	2.02	10
1550-60	94	34	61	1.55	2.14	7
1560-70	120	39	81	1.48	2.07	14
1570-80	128	42	86	1.49	1.67	0
1580-90	136	45	91	1.49	1.61	2
1590-1600	139	35	105	1.33	1.57	4
1600-10	145	21	124	1.17	1.67	13
1610-20	141	30	111	1.27	1.61	2
1620-30	172	43	129	1.33	1.56	12
1630-40	137	28	109	1.26	1.48	3
1640-50	211	71	140	1.51	1.49	2
1650-60	144	44	100	1.44	1.73	5
1660-70	99	10	89	1.12	1.72	16
1670-80	105	19	86	1.22	1.95	30
1680-90	121	37	84	1.44	1.87	14
1690-1700	130	41	89	1.46	1.87	22
1700-10	116	29	88	1.33	2.33	27
1710-20	137	55	82	1.67	2.50	12
1720-30	117	53	65	1.81	2.48	18
1730-40	122	38	84	1.45	2.57	19
1740-50	161	66	95	1.70	2.59	8
1750-60	129	19	111	1.17	2.81	2
1760-70	175	83	92	1.90	2.71	11
1770-80	269	130	139	1.94	2.93	3
1780-90	236	107	130	1.82	3.25	2
1790-1800	168	23	144	1.16	3.02	11
1800-10	229	37	192	1.19	3.21	9
1810-20	287	90	197	1.46	3.13	11
1820-30	279	127	152	1.84	3.70	8
1830-40	381	220	161	2.37	3.98	7
1840-50	297	127	170	1.75	4.32	4

Note: Numbers for the decade 1570-80 are interpolated using the adjacent decades. *Sources*: Italian nominal data: see Appendix 1. Annual costs of the *respectability* basket for Italy: Malanima (2013, Statistical Appendix). English real annual payments: Humphries and Weisdorf (2019, Table A1).