# Wages and Labour Relations in the Middle Ages: It's not (all) about the money

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# Wages and labour relations in the Middle Ages: It's not (all) about the money

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## Abstract

For long periods of history, a significant proportion of the labour force has received all or part of their wages in non-monetary in-kind payments. Despite its historical ubiquity, this form of labour remuneration remains poorly understood. This paper presents a framework which allows for the valuation and interpretation of in-kind wages. We apply our method to a new dataset of agricultural wages for labourers in medieval England (1270-1440), most of whom received a composite wage for which in-kind payment was the largest share. Assessing the market value of the wages these workers received, we find an increase in the relative importance of cash payments in the latter decades of the 14th century. We show that this was connected to a fundamental shift in labour relations, providing new empirical insights into the so-called 'golden age of labour' that followed the Black Death.

**JEL classification codes:** J33, J42, N33, N53

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# 1 Introduction

While historians and economists have long appreciated that information on wages and standards of living are among the best evidence to explore the dynamics of pre-industrial economies, recent scholarship has pushed wages to the very centre of key debates. Indeed, several grand theories, like the Little and Great Divergences and the 'Malthusian' nature of pre-modern economies, use wage data as a core building block. Yet, there remains a degree of arbitrariness surrounding both the data and the assumptions that underpin many wage series. A reality of many pre-industrial labour markets is that wages were paid both in cash and in non-monetary 'in-kind' remuneration. These in-kind payments were typically grain but also sometimes accommodation, food, clothing or even tools. To date, however, most scholarship has focused on cash wages and relegates in-kind payments to the periphery, even though this form of payment comprised a significant proportion of labour remuneration in the pre-industrial world. This is due to the practical difficulties of converting the wide range of goods and services provided by employers as in-kind payments into cash equivalents. However, largely ignoring in-kind payments leaves a crucial dimension of pre-industrial labour markets obscured over many centuries.

This paper proposes a new empirical framework which facilitates the exploration of the economics of in-kind wages in late medieval England. We not only observe in-kind wages in very high resolution but also their role in a watershed moment in labour history. The Black Death of 1348-50 was the single greatest negative labour supply shock in European history which, in the case of medieval England, killed roughly about 45 to 65 percent of the population (Benedictow, 2021, 874-875, DeWitte & Kowaleski, 2017). While researchers have long asked how such cataclysmic mortality affected *levels* of labour remuneration, we argue that changes in the *composition* of wage payments are a hitherto understudied dimension of the labour dynamics of that era and that wage composition is particularly useful in illuminating the driving forces behind fundamental changes in the medieval labour market. In addition, as economic theory contends that in-kind payments should only exist in the presence of labour market frictions, our empirical approach can also shed new light on previously hypothetical market imperfections.

That the spectacular mortality of the Black Death created a subsequent 'golden age' for labourers is an argument which has loomed large in both historical and economics literature. Historians have emphasized that the new scarcity of workers after the Black Death offered not only the prospect of higher wages for those that survived the plague but also the possibility to acquire further bargaining power in the labour market.[1] Alternatively, some economists have hypothesized that rises in wages after the Black Death were a function of the sudden change in the land:labour ratio which, in turn, had a direct impact on the productivity characteristics of the medieval economy and thus the wages earned by labourers.[2] We can test these hypotheses with a robust sample of composite wage observations drawn from medieval English manorial accounts from between 1270 and 1440.[3] Specifically, we gather the wages paid, accurately costed with their cash and in-kind components, to manorial *famuli*, the core group of agricultural labourers employed on medieval English demesnes (the personal farms of lords as opposed to the lands of their peasant tenants). *Famuli* were hired for long terms of often up to a year on a single demesne, in contrast to casual day and piece-rate workers.

We find that, for these *famuli* labourers, the 13th and 14th centuries, including the decades immediately following the plague, were characterized by wage rigidity. Their wages increased after the Black Death, but the rise in labour remuneration did not occur until several decades after the first outbreak of plague in 1348. We argue that in-kind payments played an important role in this change, and moreover, provide a crucial window for understanding the monumental shift in labour relations in late medieval England. Our findings generally support the notion of a 'golden age' of labour, in the sense that the Black Death was followed by a period of moderate - albeit substantially delayed - wage growth. Crucially, we find that the delay in wage growth was a function of labour market power dynamics at the time, specifically, a

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[1]From perspectives from history and economics alike, see Hilton, 1969; Penn & Dyer, 1990; Bailey, 2014; Acemoglu & Wolitzky, 2011

[2]For instance, Voigtländer and Voth (2013, 787) model that population dynamics affect wages directly through the land:labour ratio. Such an assumption is also (implicitly) present in some economic history appraisals (for example, see Pamuk, 2007, 294). These Malthusian interpretations of the Black Death are rooted in the work of North and Thomas (1971) and Postan and Hatcher (1978), among others.

[3]The terminal decades of our sample are determined by surviving manorial account evidence. While we do have observations from before 1270 and after 1440, the samples are generally too small and/or the accounting too idiosyncratic for robust statistical analysis.

interaction between three factors: the outside options available to *famuli* labourers; the ability of lords to influence the labour market; and the utility of in-kind wages for labourers. These factors worked to sustain wage rigidity for most of the late Middle Ages, including the decades immediately after the Black Death. However, in the latter decades of the 14th century, these dynamics began to shift and labourers were increasingly able to command higher wages. We find that the rise in labour remuneration coincided with an increase in the cash component of composite wages and the frequency with which individual *famuli* are named in the accounts which record their wages.

We argue that the payment of composite wages, where grain was the largest component, was a strategy used by landlords to control the labour market, but one that could have benefits for labourers. From the 1270s to the 1370s, cash was a relatively small component of the total value of the total wages paid to *famuli*. The cash components of wages were consistently sticky and, for many roles, barely changed over more than a century. However, the cost of living for labourers varied dramatically and unpredictably year-on-year due to the volatility of grain prices. Therefore, an in-kind grain payment was a vital form of insurance for many medieval workers as it insulated individuals from regular, and often severe, market price fluctuations. However, wages with a large in-kind component also served to make labourers dependent on the lords who employed them. Ultimately, before the Black Death, in-kind payment was convenient for lords, as it ensured that their core labour force would be well fed. The arrangement was simultaneously helpful for labourers in years when grain prices were high, and vital in very bad years when corn was scarce. However, after the Black Death, when the demand for labour increased following a collapse of the working population, in-kind remuneration ceased to be desirable for *famuli* labourers as such an arrangement reduced their mobility in an era where outside options, both for other employment, or for acquiring land, were more abundant. At the same time, a fall in both the levels and volatility of grain prices after the 1360s ensured that workers were increasingly able to meet their subsistence requirements more cheaply and reliably, therefore reducing the desirability of the insurance provided by in-kind payment. This improvement in their bargaining position led workers to demand not only higher wages, but crucially, that these increases be paid in cash. While many

scholars have highlighted the importance of changing labour relations in late medieval England, the key role of in-kind payments, especially with respect to the labour market power wielded by lords, has not previously been appreciated.

This paper contributes to several interconnected strands of literature. First, our focus on in-kind wages allows us to shed new light on the economic effects of the Black Death. Historians and economists alike have seen the demographic collapse it created as a watershed moment in the development of Western Eurasia (for appraisals from both perspectives, see Bailey, 2021 and Jedwab, Johnson, & Koyama, 2022 respectively). Indeed, narratives concerning both the 'Great Divergence' between Europe and the rest of the world (see North & Thomas, 1973, Voigtländer & Voth, 2013) and the 'Little Divergence' between European regions (see R. C. Allen, 2001; Pamuk, 2007, among others) have all pointed to the Black Death as a key catalyst in setting economies on different economic trajectories. A key area in which this demographic collapse has been identified as a transformative event is labour relations (Acemoglu & Wolitzky, 2011). Serfdom has often been seen as the main channel of labour coercion in the Middle Ages and traditional perspectives have seen the Black Death and its impact on land:labour ratios as key to driving its disappearance (North & Thomas, 1971).[4] Much of the historical literature has mirrored this argument challenging perspectives which saw the role of social conflict as central to this process (Postan & Hatcher, 1978, Bailey, 2014, 65-68).[5] This literature has also highlighted that after the Black Death, rather than attempting to reimpose serfdom, lords instead sought to maintain their coercive powers through the labour market, relying on new legislation aimed at capping wages and restricting the mobility of labourers created by the royal government (Whittle, 2023). On the ground, the enforcement of this legislation was made possible through collusion between lords and the wealthier peasants who also employed labourers themselves (Penn & Dyer, 1990).[6] However, the effective enforcement of this legislation was very short lived. By the 1360s many employers were

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[4] The welfare consequences of labour coercion and coercive institutions such as serfdom have been hotly debated in the literature. Evidence from the abolition of serfdom in the Russian Empire finds causal evidence of the negative productive effects of labour coercion and, relevant to our paper, suggests a negative impact on the diets and health of serfs (Markevich & Zhuravskaya, 2018).

[5] For prominent examples of literature which placed social conflict at the heart of changes in serfdom, see Hilton (1969) and Brenner (1976).

[6] Delabastita and Rubens (2023) discuss the potential consequences as well as the historical and current-day importance of employer collusion.

regularly breaking the rules set for hiring and paying workers, signaling a rapid end to effective employer collusion in the face of high demand for labour. We believe that our data and method provides crucial insights into how market power evolved in these crucial decades following the Black Death, and illuminates how labour coercion and power relationships operated in practice.

Second, it is worth highlighting that there are still unresolved questions concerning the dynamic wage growth effects of the Black Death. At the macro level, pro-growth interpretations fit poorly within a Malthusian framework, in which positive income effects are temporary, and the "Iron Law of Wages" has a depressing effect on the rewards to labour once population levels begin to recover from an exogenous shock (Galor & Weil, 1999; Clark, 2007a; Ashraf & Galor, 2011).[7] The lack of historical consensus regarding both the causes and the scale of wage growth after the Black Death, only adds fuel to this fire. While a range of studies have suggested that both the real wages of male workers (Clark, 2007b; Dyer, 2015) and the earnings of women relative to men increased after the Black Death (de Pleijt & Van Zanden, 2021), other studies have argued that these phenomena were more muted (Bardsley, 1999; Humphries & Weisdorf, 2015, 2019). Perhaps the most strident criticism has come from Hatcher (2011), who has persuasively argued that much of the evidence which underpins rises in wages ascribed to the 15th century is not credible. He highlights the literature's exclusive reliance on unrepresentative samples of wages paid to day labourers collected and published more than fifty years ago.[8] We argue that there is a further consideration, hitherto largely ignored in the literature. This is the composition of the payments workers received. This is particularly important for the medieval period, and especially for workers on annual contracts, who typically received payments

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[7]Voigtländer and Voth (2013) show how the Malthusian framework can be extended to allow for a higher-income steady state after a major demographic shock.

[8]While the 'golden age of labour' hypothesis has been embraced in many grand narratives concerning the effects of the Black Death, the economics literature has recently also debated the scale of this phenomenon. In their literature review, Jedwab et al. (2022, 152) acknowledge that "existing wage series have serious limitations and the extent of this observed rise in the data might be overstated in some of the discussions of a late medieval "golden age" for workers". Bosshart and Dittmar (2021, 33) remark that "existing data on incomes do not permit the temporal and spatial comparisons at the heart of the key economic debates".

both in cash and in-kind.[9]

We also contribute to the broader literature on the reconstruction of living standards throughout history, which has long been a core mission of economists and economic historians. However, wages have moved to the forefront in the last two decades, as they have become pivotal to several crucial debates surrounding comparative economic development. Pioneering was Bob Allen's work which provided a set of price and wage series drawn from across Europe to facilitate the comparison of different European economies (R. C. Allen, 2001). Wages have also been central to more general measures of economic output, triggering a significant debate around the relative merits of income-based estimates as made by Clark (2007b), which rely heavily on the evidence of day wages earned by agricultural workers, and output-side estimates made by Broadberry, Campbell, Klein, Overton, and Van Leeuwen (2015). The centrality of wage evidence in these narratives has triggered fierce methodological debates. These chiefly centre around how to transform wage evidence drawn from the available sources into accurate estimates of yearly earnings representative for the wider population. Controversies include disagreement over the economic sectors from which wages should be analyzed; whether the focus should be on annual or day labourers (Humphries & Weisdorf, 2019); the accurate interpretation of source material (Stephenson, 2018); and the merits (or lack thereof) of a narrow focus on certain types of work and workers in pre-industrial societies (Hatcher, 2011). We provide a new series of earnings for annually-employed male workers in agriculture that measures both the levels and composition of composite wages with in-kind components at the individual level.

The remainder of this paper is structured as follows. The next section explores how the prevalence of in-kind wages can illuminate various market frictions. The third section explains our empirical approach and contextualizes this methodology within the vast literature on historical wage trends. Section 4 then documents the historical sources and the data structure of our sample. In Section 5, we discuss the results.

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[9]There have been other noteworthy attempts to account for in-kind benefits, but these typically rely on *ad hoc* case studies and valuation methods. A significant share of this work has focused on perquisites in the early modern period, including, for instance, studies on agriculture (Muldrew, 2018), domestic service (Hill, 1996, ch.4), the wool industry (Randall, 1990) and the overall prevalence of this payment system (Schwarz, 1992, ch.6). Particularly relevant to our work are the studies by Rush (2001) and Liu (2012, 273-278), which value grain payments made to *famuli* in 14th-century Glastonbury Abbey and the two 15th-century manors of Lullington and Pittington, respectively. Other work on grain payments has focused exclusively on quantities of grain remuneration (Claridge & Langdon, 2015).

Section 6 contextualizes our findings with respect to earlier research on agricultural day wages. Finally, Section 7 concludes.

# 2    The economics of in-kind wages

Why were wages paid in kind? Economic theory would contend that, in the absence of frictions on input or output markets, we should expect remuneration to happen through cash as the means of exchange.[10] Despite this, in-kind wages have been a feature of many historical labour markets, especially in the pre-industrial era. As such, we must look at the range of frictions and information asymmetries which may have had a role in determining forms of labour remuneration. Our theoretical framework distinguishes between two types of market failure that could potentially explain the historical persistence of in-kind wages:

1. **Product market imperfections**

   The most straightforward explanation for the historical presence of in-kind payments is a product of market failure that inhibited workers' ability to independently acquire staple goods. Such a situation could have arisen if wage labourers were simply not able to acquire the goods they required for their subsistence. In this scenario, a possible solution would have been to have such goods provided by employers, who *could* acquire them, as labour remuneration. Similarly, but somewhat less severely, we might hypothesize that employers were able to provide grain for their employees at a cheaper rate than employees could purchase it themselves.

2. **Labour market imperfections**

   A second consideration is labour market frictions, which may also have had a role in the historical persistence of in-kind wages. We outline three potential labour market failure scenarios.

   2.1. Information asymmetries between employers and employees, in that the former had far less 'on the ground' knowledge than the latter, might have raised the need for efficiency wages, where workers are remunerated with a share of their production. In this paradigm, employers would have provided a portion of the

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[10] A similar starting point can be found in the larger strand of literature on why governments choose to provide transfers in-kind (Currie & Gahvari, 2008).

total production an in-kind payment, thereby incentivizing labourers to be more productive, as they would share in the benefits of efficiency gains.

2.2. A second theoretical option is that in-kind wages were used to foster the dependency of employees on employers, as in-kind payments could have made it more difficult for workers to move away from their employers. This could bind both logistically, as wage payments paid in bulky goods like grain are difficult to move, and financially, as in-kind payment could make capital accumulation more difficult relative to cash wages.[11]

2.3. Third, nominal wage rigidities in labour markets might have hampered the income security of labourers in the face of varying food prices. As such, in-kind payments could be favoured by workers for their utility as an insurance mechanism.[12] From an employer's perspective, this can also be connected to the use of efficiency wages to guarantee worker productivity through the provision of a nutritional lower bound.

Both product market and labour market frictions could be relevant in the case of medieval England. Product markets developed significantly in England over the course of the Middle Ages. Similarly, labour relations also changed dramatically, especially in terms of how wages were bargained and determined. Food security was also a persistent problem in pre-industrial economies. While efficiency wages were common in other historical contexts,[13] the concept is not relevant for medieval England because the wages of agricultural labourers were not mechanically linked to the quantities of grain produced on the manor. In our context, the quantities of grain paid to *famuli* as in-kind payments were typically fixed at discrete levels depending on occupation and seniority (Claridge & Langdon, 2015).

The theoretical connection between market imperfections and in-kind wages underlines how the latter can illuminate labour relations in medieval England. Historically, wages were not determined simply by the marginal product of labour, $MP^L$,

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[11]The latter could, for instance, be a constraint to migrating towards other employers (Friebel & Guriev, 2005).

[12]Ito and Kurosaki (2009) provide contemporary evidence for such considerations by agricultural labour in developing economies. Kurosaki (2011) formalizes this and provides a broader, 20th-century perspective.

[13]As an example, we refer to the case of 19th-century US agriculture, as suggested by Alston and Ferrie (1993, 858).

as in the neoclassical framework without frictions, but also by labour market power, typically denoted by a markdown $\mu$ that employers can charge on $MP^L$. Formally, we thus have, for any wage series of interest, $\tilde{Y}$ that: $\tilde{Y} = \mu MP^L$. The idea that labour market frictions play an important role in the determination of medieval wages is, of course, not new.[14] Nevertheless, empirical evidence on the evolution of $\mu$ has not been forthcoming.[15] We utilize evidence of in-kind payments, as outlined in the previous subsections, to shed further light on the drivers of post-Black Death changes in the medieval English labour market. To do so, we need an empirical framework to quantify in-kind remuneration.

# 3 Empirical framework

## 3.1 Working with medieval wages

To date, most studies of pre-industrial labour remuneration have avoided tackling in-kind wages directly, largely because doing so is a very complicated and time intensive endeavour. Historians have long noted the complexity which in-kind payments present for the calculation of incomes (Farmer, 1988, 760). A common solution to the complexity of disaggregating and valuing such an assortment of in-kind payments has simply been to ignore them. Many studies have instead focused on a subset of workers for which cash wages were predominant, be it day labourers in agriculture (as in Burnette, 2004; Clark, 2007b; Munro, 2012), construction workers (as in R. C. Allen, 2001; Clark, 2005; Malanima, 2013; Rota & Weisdorf, 2020), or a combination thereof across multiple industries (as in Munro, 2003; Ridolfi, 2019; Losa López & Piquero Zarauz, 2021). More formally, the variable of interest, a nominal measure of the earnings of a representative labourer $\ell$ in the year $t$, $\tilde{Y}_{\ell,t}$, is thus captured by $Y_{\ell,t}^d$, the average wage of a day labourer in agriculture (or another industry). To turn these into a rep-

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[14]For instance, Munro (2003, 204) posits that "wages would, however, clearly not be determined in the short-term by the Classical equation: i.e. that $W_L = MRP_L$ - not then and just as certainly not now". We also refer to Paker, Stephenson, and Wallis (2023) for an early modern perspective.

[15]See Jedwab et al. (2022, 162-164). The lack of quantitative evidence remains despite the fact that there are several indications that the late Middle Ages were marked by a transformation of labour relations (Hilton, 1969; Bailey, 2014). It is worth noting that in much of the economics literature on the (decline of) feudalism and serfdom, scholars speak of *labour coercion* rather than *market power* (notably, see Acemoglu & Wolitzky, 2011). In our bare-bones model, these terms are mutually interchangeable.

resentative measure of annual income, it is then necessary to impose an assumption about the number of days that labourers were employed: $L_{\ell,t}$:

$$\tilde{Y}_{\ell,t} = Y_{\ell,t}^d . L_{\ell,t} \tag{1a}$$

For instance, several studies assume that workers worked a constant 250 days per year (R. C. Allen, 2001, 2009; R. C. Allen & Weisdorf, 2011). However, there is very little historical evidence to inform us about the precise number of days worked by any individual labourer, a problem which is especially acute for the medieval period. Methodological obstacles include identifying which religious holidays might have been observed at any given place and time and gaining insights into labour supply decisions on the intensive margin (essentially an understanding of how many days an individual was actually willing to work).[16] Indeed, many scholars have challenged the assumption that male labourers were fully employed for 250 days a year.[17]

To sidestep this problem, Humphries and Weisdorf (2019) focused only on workers who were contracted annually, obviating the need to make any assumptions about the length of the working year.[18] Their results show that the 250-day method might overestimate earnings in the medieval period and underestimate those of the industrial era. Specifically, they posit that $\tilde{Y}_{\ell,t}$ should be captured using the cash income of annual workers, $Y_{\ell,t}^{\text{cash}}$, as follows:

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[16]Another concern with the exclusive focus on day wages $Y_{\ell,t}^d$ is to what extent these are representative for the general worker population. We return to the discussion of sample selection issues in Section 4.

[17]Such criticisms often rest on the suggestion that, for the many labourers who worked casually, rather than on annual contracts, 250 days of work would have been difficult to string together. Other critics point to the so-called 'backward-bending' labour supply curve to suggest that labourers may not even have desired to take on 250 days of work, even if they could find it. Some workers may have prioritized the utility of leisure over increasing incomes in periods of higher wages. The scantly available quantitative evidence suggests indeed that annual working days varied widely (for instance, see R. C. Allen & Weisdorf, 2011). There is anecdotal evidence that some workers indeed opted to work less in the wake of the Black Death, much to the chagrin of employers (Hatcher, 1998). Finally, the fragmentary and seasonal nature of medieval labour markets make it very unlikely that medieval labourers were fully employed at all times (Hatcher, 2011).

[18]A core assumption in this approach follows Clark and Van Der Werf (1998) in positing that day and annual labourers were perfectly homogeneous and that there were no frictions between both labour markets. Therefore, information on annual wages informs us not just on annual workers, but also on the annual income to be earned by day labourers based on actual days worked. We present an alternative interpretation in Section 6.

$$\tilde{Y}_{\ell,t} = \underbrace{Y_{\ell,t}^{\text{cash}}}_{\text{cash}} + \underbrace{CPI_t}_{\text{in-kind}} \tag{2}$$

However, the consequence of a focus on annual contracts is that in-kind payments play a much more important role, as annually-employed workers are most often found in agriculture, and these labourers typically received payments both in cash and in-kind, particularly in the Middle Ages. Therefore, such an approach requires the inclusion of in-kind payments in some form. When workers were paid with a range of goods (or even services) some kind of common denominator is needed to value these in-kind payments. Humphries and Weisdorf use a Consumer Price Index basket, $CPI_t$, to value the in-kind payments labourers received. Specifically, they utilize Allen's 'respectability basket' (R. C. Allen, 2009), which they argue "provides a tool for capturing and valuing the goods commonly consumed by an average person during the pre-modern era" (Humphries & Weisdorf, 2019, 2871).[19] In other words, this approach assumes that all workers in receipt of any in-kind payment received *at all times* a (respectable) subsistence wage for their labour efforts.[20] While this approach works reasonably well for observing long-run trends over the entire pre-industrial period, at the national level, such an approach cannot accurately capture the value of in-kind wages at any higher resolution, which is problematic because these payments varied significantly across space and time. This is because workers were paid in a dizzying array of grains, with considerable differences in both market value and calorie content, and the fact that, as with cash payments, in-kind payments also varied significantly by the age, gender and role of the worker. Finally, some studies have explored in-kind payments structurally, but somewhat myopically, without full consideration of the cash portion of wages that labourers also often received (Claridge & Langdon, 2015).

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[19]For another application, see Kumon (2022) in the context of Japan.

[20]Related to our study, Humphries (2023) also quantifies the values of various in-kind remuneration throughout history. This work presumes that these wages capture a contemporary understanding of a 'standards of living'. Just like in Humphries and Weisdorf (2019), however, this approach presumes that wages were always determined by an efficient market mechanism.

## 3.2 Towards a complete appraisal of medieval wages

We take an approach that completely appraises both the cash *and* in-kind wages of workers in the Middle Ages:

$$\tilde{Y}_{\ell,t} = \underbrace{Y_{\ell,t}^{\text{cash}}}_{\text{cash}} + \underbrace{\sum_{g \in G} P_{g,t}.Q_{\ell,g,t}}_{\text{in-kind}} \qquad (3)$$

For the *cash component*, we simply use the amounts of cash paid to annual *famuli* workers in the form of $Y_{\ell,t}^{\text{cash}}$. For the *in-kind component* we quantify the total grain payment (called "liveries" in the sources) paid to workers, $Q_{\ell,g,t}$, as well as the market value of grain ($g$) in the year ($t$) it was paid, $P_{g,t}$. We do so over the universe of different grains paid to workers $G$. In the following section, we discuss in further detail the data and historical sources needed to implement this methodology.

Our approach encompasses *a complete appraisal of the market values of both the cash and in-kind components of labour remuneration*. While many workers (and their families) may have simply consumed in-kind grain payments, the cash conversion is indicative of the market value of a grain payment in any given year, as it reflects how much a worker would have received if they had sold their liveries on the market, or alternatively, the amount of cash they would have had to spend if they purchased that grain on the market. The conversion of in-kind payments into cash would have been necessary for many in order to provide labourers and their families with other necessities like clothing, shoes and fuel (Claridge & Langdon, 2015). We calculate Equation (3) at the level of labourer $\ell$, allowing us to quantify the value of in-kind payments at the individual level. We believe our method brings two key contributions: first, it facilitates a more accurate empirical analysis of labour remuneration in the Middle Ages, and, second, it allows us to capture critical changes in labour market dynamics and relations through the observation of the composition of wages. In what follows, we discuss the data requirements needed to implement this method.

# 4 Data

## 4.1 The medieval sources

Agricultural work was by far the most common type of employment available in medieval England. It is estimated that almost 60 per cent of the entire labour force worked in this sector (Broadberry et al., 2015). The *famuli* labourers we draw upon were employed on medieval English demesnes: the working farms of medieval lords as opposed to the lands of their tenants. The wages of these labourers are recorded in manorial accounts created by demesne mangers which survive in the thousands for late medieval England. *Famuli* can be distinguished from the two other sources of labour available to medieval lords, namely waged day-labour and the 'customary' labour provided by a subset of tenants as part of their rent. While these were also undoubtedly important sources of labour, especially at times of peak requirements such as harvest, the *famuli* formed the core of demesne workforce and it is estimated that they accounted for at least a third and up to a half of the total labour deployed (Claridge & Langdon, 2015). They were typically hired for longer periods of time, most commonly for the whole agricultural year. As the most permanent staff on demesne farms, the *famuli* were responsible for a range of core tasks across both the arable and pastoral operations of demesnes, such as ploughing and animal herding (Campbell, 2009).[21]

The *famuli* were a unique group of workers whose main source of income came from the wages paid to them by landlords. Their jobs were very secure relative to other labourers, leading Bruce Campbell (2009, 85) to describe them as the "aristocracy of labour". Much of the waged labour force, in comparison, consisted of smallholding tenants who used temporary waged employment to supplement the incomes generated from their own land. However, the *famuli* were not a small group, with a total estimated population of around 105,000 in c.1300, representing perhaps two percent of the total English population, and a much larger proportion of wage-earners.[22] The legal status of the *famuli* is somewhat murky, but the two authoritative general accounts of this group suggest they were generally personally unfree and remained so up to the

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[21]John Hatcher, in his critique of the use of day wages to impute annual incomes commented that the wages of the *famuli* "provide a further opportunity to place the reputed wages of day labourers in a broader context..." (Hatcher, 2011, 14)

[22]This is our estimate based on a population of 4.75 million in 1290 (Broadberry et al., 2015, 20)

end of the 14th century (Postan, 1954; Farmer, 1996). Being unfree potentially limited their bargaining power vis-à-vis their lords.[23]

The wages paid to *famuli* provide an excellent data set for our purposes for several reasons. The records precisely specify both the cash and in-kind payments made to each individual worker. Typically, the sources classify these workers by occupation, allowing us to explore and control for changes in wages according to responsibilities and skill. The records also detail precisely how many weeks in a given year each *famulus* worked, meaning we do not have to make any assumptions about the length of the working year.

We do not always capture the full remuneration received by *famuli* and our wage estimates are probably best understood as a lower bound. The total wage of any individual *famulus* could have been slightly higher once all the other elements we are unable to quantify have been considered. One potential issue arises from the instances where wages were paid with the remission of rent. It has been argued that *famuli* had their origins as slaves in Anglo-Saxon England, who subsequently mutated into a specific type of serf who, in exchange for their labour, paid no cash rent on their holdings (Farmer, 1996). These so-called 'service' *famuli* continued to be present in the late Middle Ages but were already falling in number by 1300, by which point they accounted for only 10 per cent of total *famuli*, a shift explained by the fact that rent remissions were generally worth significantly less than wages (Claridge & Langdon, 2015). Moreover, 'service' *famuli* can be relatively easily distinguished from the 'stipendiary' *famuli* and the former are excluded from our analysis. Thus, while some of the workers we examine may have held a smallholding or been allotted lodgings in manorial buildings, this sort of benefit did not extend to large tracts of rent-free agricultural land from which *famuli* could have gained a substantial additional income.[24]

More problematic is the payment of routine perquisites to *famuli* throughout the year. These differed significantly between manors according to local custom, but it was typical for *famuli* to be given some food in addition to their wage. This was

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[23]However, whether this dramatically changed their legal position for the worse against their employers in comparison to the free is questionable. Recent interpretations have challenged the notion that lords could effectively use serfdom as a tool to control the medieval peasantry (Bailey, 2014, 337).

[24]Farmer (1996) identifies several *famuli* who were paid a wage by the lord(s) who employed them, but also paid cash rents to the same lord. This provides evidence that rent-free grants of land were not a typical part of *famuli* remuneration.

often in the form of pottage (sometimes translated as beer, but typically a kind of porridge) provided to workers during the day as breakfast or lunch, and dinner at the lord's table. Either of these perquisites could be restricted a specified number of weeks in the year, and dinner *ad mensam domini* was usually a perk provided to *famuli* during the busiest time of year at harvest. Additionally, *famuli* also sometimes received small cash 'tips' called *oblatio* at religious feasts. The value of such benefits cannot be consistently quantified or even attributed to individual workers. The wages we reconstruct are thus likely underestimates in some cases, but they still capture the overwhelming majority of *famuli* remuneration, and, more significantly, changes in their level are a good guide to changes in the total remuneration of these workers.

## 4.2 The data sample

As outlined in Section 3, three key ingredients are necessary to provide a complete valuation of remuneration in the Middle Ages: 1) cash wages; 2) the quantities of grain paid and, 3) the value of that grain. Fortunately, manorial accounts, which survive very well for medieval England, provide us with exactly this information. To address potential concerns of changing sample compositions, we collected data from manors and estates for which accounts survive in long runs. In Appendix B, we provide a detailed exposition of the data collection process. In essence, the manorial accounts allow us to identify cash wages at the level of individual labourers. This data is typically found in the section which enumerates a demesne's cash expenditures, usually with a dedicated heading for cash stipends. The grain payments, in terms of the quantities paid, are recorded elsewhere in the same account. Fortunately, in most cases, it is straightforward to match workers between the two sections of the account, giving us a comprehensive overview of all workers' payments, both in terms of cash and quantities of grain. Furthermore, we can trace various other characteristics, like occupation and length of employment, for individual workers.

A third key ingredient necessary for our empirical strategy is the price information needed to quantify the market value of the *famuli*'s in-kind earnings. Here, we can rely on the seminal work of David Farmer (1988, 1991), who constructed annual price series for five key grains (wheat, rye, barley, oats and peas) from the 12th to 15th centuries. For grains not included in the Farmer series, we were able to create a new database of

grain prices recorded from the same manorial accounts from which we draw our wage data, as most manors recorded price information in the context of both the sale and purchase of grains. With this extended database of grain prices, alongside significant work on medieval English grain markets in the secondary literature, we were able to assign a market value to most grain livery payments. In some instances we had to make some minor assumptions, which are also outlined in Appendix B.

## 4.3 The representativeness of our sample

In Figure 1, we present the geographical distribution of our sample. This map shows sampled manors across the entirety of medieval England, with four out of five - what we consider to be based on their unique agricultural, demographic and economic structures - 'macro-regions' represented.[25] A notable omission is any wage data from Midlands manors. Our sampling strategy is influenced by the survival of records, which may not be exogenous to the phenomena we are aiming to investigate. Hence, we follow other historical research on wage trends (notably, see Margo, 2000; Humphries & Weisdorf, 2019) by adopting a 'hedonic-like' regression design to account for the potential sampling biases. More specifically, we estimate the following Ordinary Least Squares (OLS) regression model:

$$y_{\ell,t}^i = \alpha_\ell + \sum_{o \in O} \beta_o \, \text{Occupation}_o + \sum_{r \in R} \gamma_r \, \text{Region}_r + \sum_{d \in D} \zeta_d \, \text{Decade}_d + \varepsilon_{\ell,t} \qquad (4)$$

$$\forall i \in \{\text{Cash}, \text{In-kind}\}$$

For every annually-employed (more than 300 days) male labourer $\ell$ in our sample, we regress the logarithm of the value of their in-kind earnings $\sum_{g \in G} P_{g,t}.Q_{\ell,g,t}$ and cash earnings $y_{\ell,t}^{\text{cash}}$ on dummies capturing their occupational group, region and decade of observation.[26] Collection $O$ contains the following major occupational groups: ploughmen, pastoral workers, carters, child workers, managers and two miscellaneous categories (one for miscellaneous agricultural workers and one for miscellaneous non-

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[25]See Appendix A for a full list of the manors sampled. Figure A5 in Appendix C provides an overview of the sample composition by estate.

[26]We leave the analysis of female *famuli* and those employed more casually for further research. We express logarithms with lower-case letters, vectors are indicated with bold font.

agricultural workers). Individual labourers who did not fit into any of the occupational groups were placed in the appropriate miscellaneous category. Managers (typically reeves and bailiffs) are a relatively small group in our dataset. In the interest of examining the most homogeneous group of agricultural labourers, these managers were dropped from the analysis. Collection $R$ captures the aforementioned four macro-regions: East Anglia, the North, the South and South-West and the Thames Basin. For an overview of the distribution of our sample over these categorical variables, we refer to Table A1 in Appendix C. The output of the OLS regressions in Equation (4) can be found in Table A2 in Appendix E.

Finally, we can now use the resulting estimates $\hat{\boldsymbol{\beta}}$, $\hat{\boldsymbol{\gamma}}$ and $\hat{\boldsymbol{\zeta}}$ and exogenous weights derived from the closest approximations of nationally-representative data to calculate the 'hedonic average'. First, we multiply $\hat{\boldsymbol{\beta}}$ with a vector containing the employment shares of the *famuli*, following the cross-sectional sample of Claridge and Langdon (2015). Second, we use $\hat{\boldsymbol{\zeta}}$ and the 1290 population shares from Broadberry et al. (2015) to account for England's population distribution.[27] Adding these elements to our estimates $\hat{\alpha}_\ell$ and $\hat{\zeta}_d$ for every respective decade $d$, we create the hedonic decadal averages for annual cash and in-kind labour remuneration which will be the core of our analysis for the remainder of this paper.

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[27]In other words, we use time-invariant weights for both the occupational and demographic dimensions of this reweighting exercise. We argue that this is innocuous. From an occupational perspective, Figure A11 in Appendix E showcase that our sample is representative at the national level regardless, as well as that there were no significant structural changes in the occupational composition of the *famuli* over the course of the period we study. From a population perspective, we can also assess the 1377 estimates of Broadberry et al. (2015). These confirm the widely-held belief that "population decline was fairly evenly spread across the country, affecting both core and periphery alike" (Broadberry et al., 2015, 15), mitigating concerns over the use of time-invariant population weights.

Figure 1: **Geographic distribution of sampled manors**
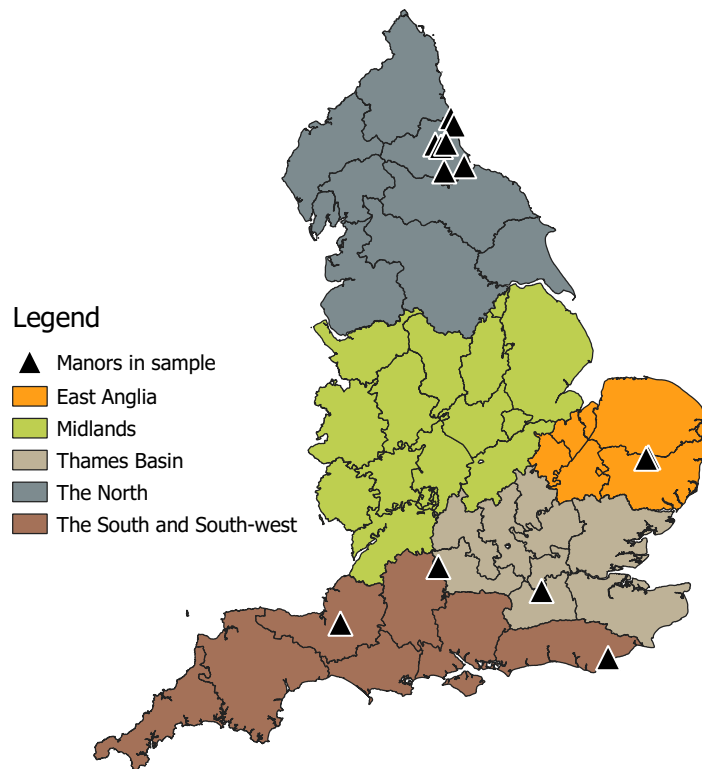


**Source:** Authors' database. This map uses historical county borders by The Cambridge Group for the History of Population & Social Structure, or CAMPOP (Satchell et al., 2018).

# 5 Results

## 5.1 Main trends

What does our new wage data reveal? Figure 2 provides our series of decadal hedonic averages of the total composite wages comprised of their in-kind and cash components, expressed in both nominal and real terms between 1270 and 1440.[28] These demonstrate that, between the 1270s and 1370s, average nominal wage levels for annually-employed *famuli* labourers remained broadly fixed between 19 s. and 29 s. which would purchase the equivalent of 1.1 to 1.5 Allen baskets, thus ensuring a 'respectable' standard of living for the average *famuli* labourer. This would have allowed an average *famuli* worker to sustain themselves at a relatively comfortable level across this entire period, but would have left little surplus to either support non-working dependents or to save in order to smooth consumption across the life cycle. However, from the 1380s onward

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[28]For the raw data, we refer to Figure A9 in Appendix E.

remuneration climbed dramatically, reaching an average of 41 s. by the 1420s (and even 56 s. by the 1430s), which provided a real wage of more than two 'respectability' baskets. Such a change would have alleviated pressures on the household budgets of workers, potentially allowing for greater saving and consumption, or perhaps a reduction in the number days other members of the household needed to work. Put simply, after over a century of stagnation, the average real wage of annually-employed, male *famuli* workers basically doubled in the space of sixty years, and this certainly would have translated into a significantly improved standard of living.

These general trends are broadly consistent with recent studies of annually employed agricultural labourers, such as in Humphries and Weisdorf (2019). An advantage of our empirical approach, however, is that we are able to capture the uncertainty that many medieval workers, such as *famuli* labourers, would have faced when a major part of their income's value was subject to the dramatic fluctuations that characterized grain prices in medieval England.[29] This observation is not only important to fully appreciate the economic reality of the Middle Ages, but also to better understand the general developments of labour markets in that era. As we will see, income uncertainty in itself was a driver of wage trends.
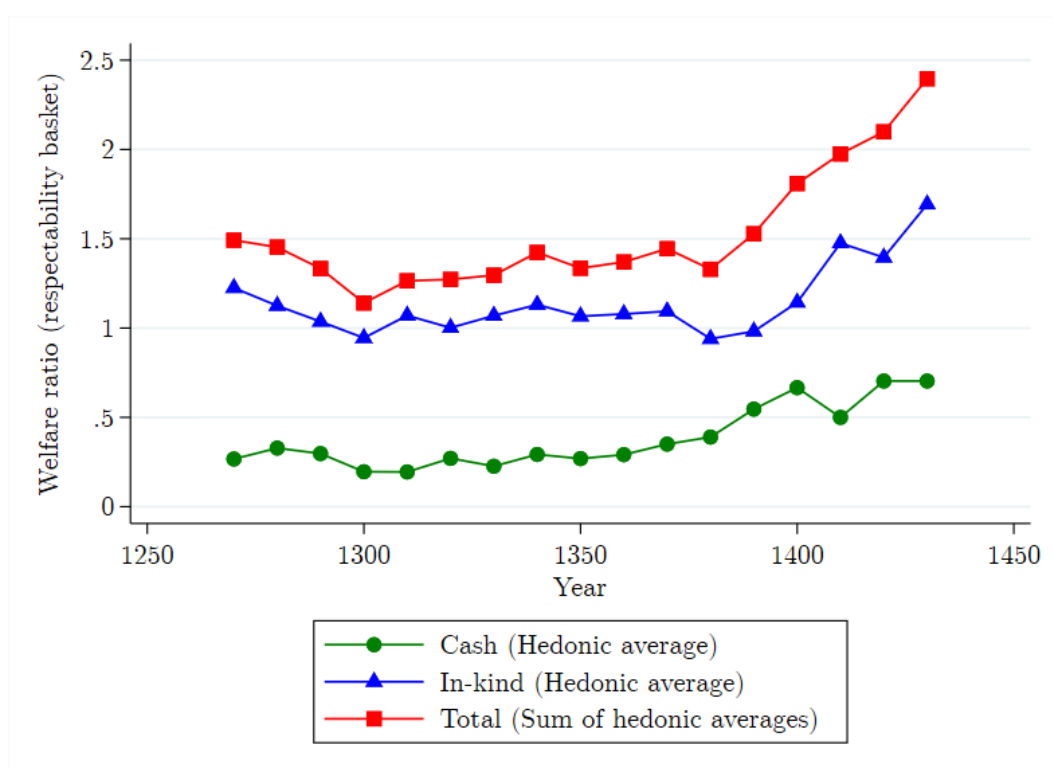
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[29]This becomes especially apparent when one directly compares our estimates of in-kind income to the value of CPI baskets. We refer to Figure A10 in Appendix E for this exercise.

Figure 2: **Annual cash and in-kind wages in England, 1270-1430**
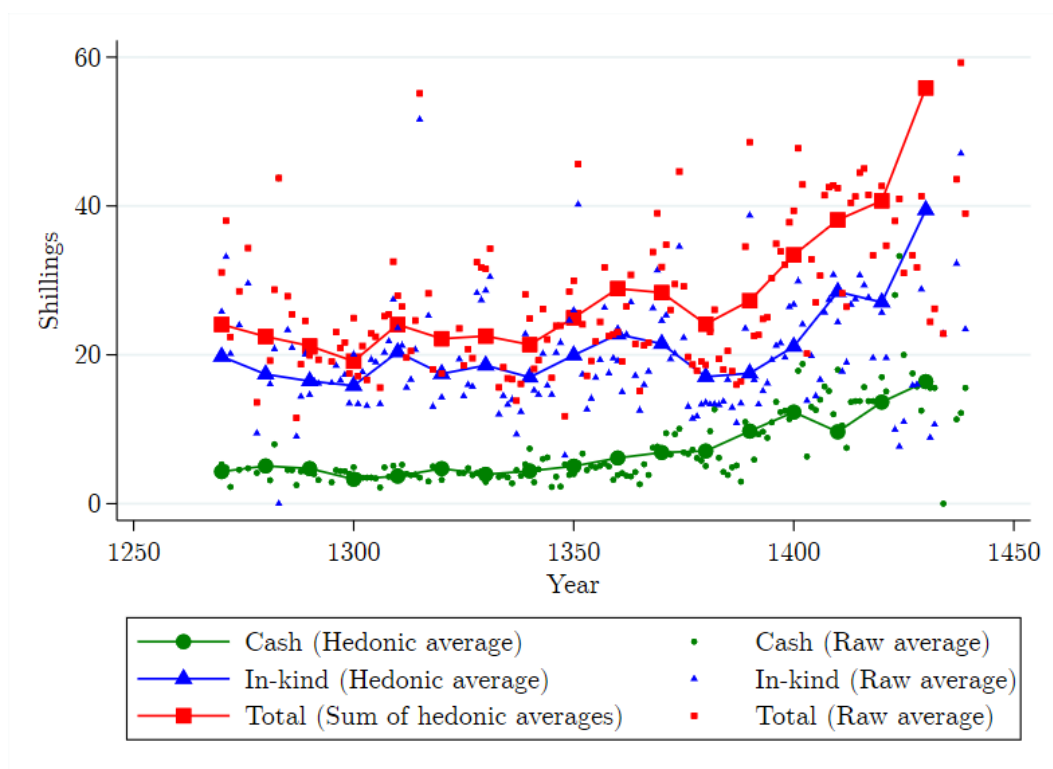


(a) **Nominal wages (Shillings)**



(b) **Real wages (Welfare ratios)**

So what might explain the wage growth as described in Figure 2? As outlined in Section 2, a first and obvious candidate is the massive changes in factor ratios that took place in the wake of the Black Death. England moved from a situation where labour was abundant and land was scarce to one where land was abundant, but labour was scarce. In this scenario, high mortality caused the supply of labour to contract, and Malthusian mechanisms allowed the rewards of labour to soar (Voigtländer & Voth, 2013; Postan & Hatcher, 1978). While this popular interpretation is certainly credible, it likely does not present the complete picture. For *famuli* workers, wages, in nominal and real terms, only crept upwards in the last quarter of the 14th century. This meant that an entire generation of workers who survived the Black Death did not experience any significant wage increases or, indeed, improvements in their standards of living. This wage rigidity suggests that market frictions must have been significant in this period. Our empirical framework allows us to investigate this by assessing the relative importance of in-kind payments.

Our analysis reveals that not only did *famuli* wages increase in the latter decades of the 14th century, but their composition also changed. *Famuli* increasingly received a greater proportion of their wages in cash. Figure 3 shows that, after the 1380s, the cash component of wages increased dramatically. While the quantities of grain paid to labourers remained largely static, the cash component of wages increased from about 20% to 35% as a proportion of total remuneration. The increasing importance of cash payments in the determination of total labour remuneration becomes even more apparent when decomposing the total year-on-year wage variance into its cash and in-kind components.[30] Before the Black Death, about 83% of total wage variance between years was explained by movements in the economic value of the grain liveries. After 1370, this share decreased to only about 55%, with the importance of cash wage variance increasing to 38%.

How do we explain this increase in the proportion of wages paid in cash? Following the theoretical framework from Section 2, we identify the potential for frictions in either product markets or factor markets to have driven the changes we observe in the latter parts of the 14th century. We assess these respectively in Sections 5.2 and 5.3.

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[30]We note that $Var(\tilde{Y}_{\ell,t}) = Var(Y_{\ell,t}^{\text{cash}}) + Var(Y_{\ell,t}^{\text{in-kind}}) + 2Cov(Y_{\ell,t}^{\text{cash}}, Y_{\ell,t}^{\text{in-kind}})$. These figures are based on raw averages rather than the the figures produced by our regression models.

Figure 3: **Proportion paid in cash of wages in England, 1270-1430**
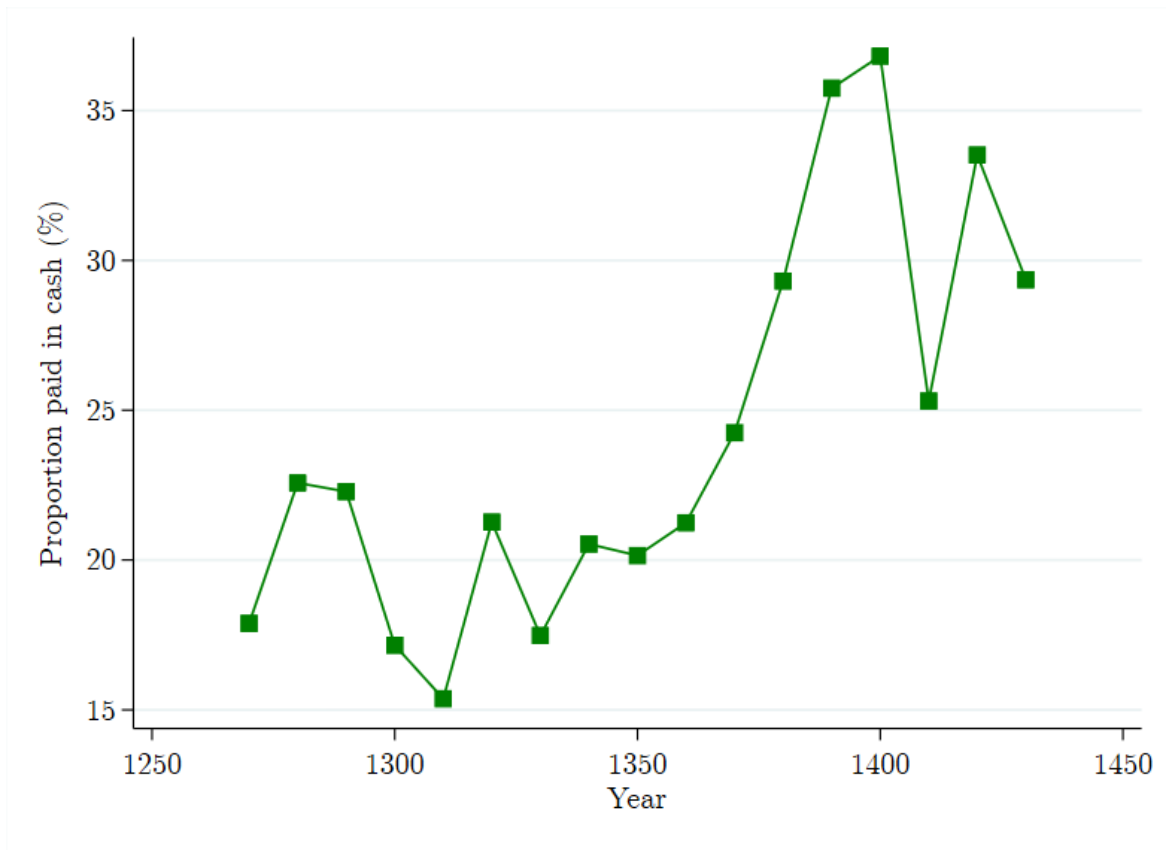
## 5.2 Looking for explanations: product market frictions

### The cost of holding and using cash

One potential explanation for a rise in the proportion of cash paid to *famuli* could be that there were was an expansion in the money supply that allowed employers, who previously had no alternative but to pay wages in-kind because of scarce currency, to now remunerate workers in coin. This argument might be most famously articulated by Herlihy (1967, 125) who argued that, in the Black Death, "men were dying but coins were not", a phenomenon which led to a significant increase in the money supply on a *per capita* basis. However, a monetary explanation does not fit well with the timing of our results. If, after the Black Death, a sudden increase in the availability of coinage per capita allowed lords to pay a greater proportion of wages in cash due to the easing of money supply constraints, we should expect to see a sharp increase in the cash component of wages soon after 1348-1349 rather than the delayed response that

we observe only decades after the plague first visited England. Moreover, estimates of the *total* money supply in medieval England all point to a tightening over the late 14th and 15th centuries at precisely the point in time when our data show an increase in the proportion of remuneration paid in coin. Palma (2018) estimates that the supply of coinage increased significantly in England between the late 13th century and the first quarter of the 14th century. However, this marked expansion in the money supply was not reflected in the proportion of cash in the composite wages paid to *famuli* in these decades. Moreover, he demonstrates that the money supply actually contracted significantly throughout the 15th century, exactly at the moment when workers were receiving a larger proportion of their wages in cash.[31] Similarly, Farmer (1991) argues that, after the 1370s, the money supply was shrinking both absolutely and per capita. Mounting constraints in the overall money supply were compounded by the "problem of small change" during this period. After gold coins were first introduced in England in 1344, an increasing proportion of mint output was struck in these high-value gold coins rather than the silver pennies which were more suitable for smaller-scale transactions (M. Allen, 2011, Sargent & Velde, 2002, 131-135). A shortage of lower-value coins could have made paying the relatively small sums to *famuli* more difficult. The English crown's failure to debase its coinage to the same extent as its European neighbours was also a missed opportunity to expand the money supply (Mayhew & Ball, 2022). These patterns are reflected in the archaeological evidence which reveals that most coin finds date from the 13th and early 14th century, with significantly fewer examples for the post-Black Death era (Dyer, 2022, 261-262). Therefore, while monetary explanations are compelling in theory, changes in the money supply in late medieval England were at best a neutral factor, or perhaps even worked against the payment of cash wages.

**The development of grain markets**

A theoretical explanation for the persistence of in-kind payments could be frictions in the markets for the products which employers used for in-kind payments. In medieval England, such a scenario would be that lords, as employers, were able to provide grains for employees as a form of labour remuneration more efficiently than workers

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[31]We refer to Figure A8 in Appendix D for Palma's series of nominal coin supply per capita. It is apparent that swings in the per-capita coin supply do not coincide with the observed structural changes in cash payments of labour remuneration.

could acquire grains themselves. In terms of the increasing cash component we see in *famuli* wages, one might suppose that grain markets became sufficiently integrated after the Black Death so as to render in-kind payments unnecessary. However, our understanding of medieval English grain markets does not support this supposition. Historians have reconstructed the precocious development of markets in England as part of a wider commercialization literature.[32] While the extent of market integration and commercialization more generally are still being debated (for instance, see Schneider, 2014), recent studies have pointed to both markets (Clark, 2015; Federico, Schulze, & Volckart, 2021) and ownership structures (Delabastita & Maes, 2023) as factors which made the medieval English economy relatively more integrated that its European neighbours. By the late 13th century, England was characterized by a highly commercialized economy in which a significant proportion of the population engaged with product markets to secure their basic necessities (Britnell, 1993, 228-231, Campbell, 2009). In most places markets were easily accessible and all strata of society used them regularly (Britnell, 1981; Masschaele, 1994; Britnell, 2012). Grain was typically (with the notable exception of famine years) widely available to purchase on the market. For example, between 1288 and 1315, 38 percent of all grain produced by demesnes in the London region was sold (Campbell, Galloway, Keene, & Murphy, 1993, 153-156). What is crucial to our argument is not so much the *level* of commercial development, which might be up for debate, but rather that the pace of *change* did not vary substantially at the structural break we observe in Figure 3. Instead, the traditional literature paints a picture of stagnation, if not decline, in the decades following the Black Death (Britnell, 1993, 156).

While markets had proliferated in late medieval England, the prices of grains were still volatile and often unpredictable.[33] Thus, wages paid in-kind provided a crucial form of insurance to *famuli* labourers in the period before the Black Death. The difficulty in predicting prices is evidenced by the fact that agricultural managers showed limited price responsiveness in decisions about which crops to plant (Schneider, 2014). The potential danger this price volatility posed to wage earners is revealed by the significant hardship England experienced before the Black Death, including the infamous

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[32]For overviews of this literature, see Hatcher and Bailey (2001, 121-173) and Schofield (2016, 117-148).

[33]We quantify grain volatility in medieval England in Figure A7 in Appendix D.

Great Famine of 1315-1317, which is generally seen as the worst subsistence crisis in European history. While such crises were undoubtedly caused by exogenous climatic events (Campbell & Gráda, 2011), Slavin (2014) demonstrates that a combination of market segmentation, the decline of government price supervision, and hoarding by elites seriously exacerbated the impact of harvest shortfalls. This remarkable price volatility caused considerable food and income insecurities especially in the face of the nominal wage rigidity we observe before the Black Death (see Figure 2). This brings us to the role of the labour market frictions underlying these rigidities, and the explanations these offer for the initial persistence and subsequent decline of in-kind payments.

## 5.3   Looking for explanations: labour market frictions

In this section, we argue that the patterns of wage rigidity which defined *famuli* remuneration up to about 1380, and both the subsequent increase in wages *and* the proportion of these paid in cash, are all best explained by changing labour market dynamics. The bargaining power of labourers was shaped by the interaction of three separate factors, namely the attractiveness of outside options for workers, the effectiveness of collusion among employers, and the value of in-kind payments as a form of insurance. These factors changed significantly across the late medieval period and in combination led to the changes in wages we observe. However, all three only worked in concert from the 1370s onwards, helping to explain why dramatic improvements in *famuli* remuneration were delayed to the last quarter of the 14th century.

**Outside options**

What other economic opportunities were available to *famuli* labourers beyond annually-contracted work for lords, and how did these change over time? In simplistic terms, *famuli* in late medieval England could have pursued two alternative ways to earn a living. The first was to earn as a tenant-cultivator, by farming free or customary land held from a lord in return for rent. The second option was to work as a labourer for day wages on the lands of either lords or other tenants who might hold more land than they could work with their own household labour. In many cases, these two activities were likely combined by many peasants. To leave a *famuli* role to pursue tenant farm-

ing would have, of course, meant the acquisition of land. For opportunities as a day labourer the availability of work would have been an important consideration.

The availability and attractiveness of these outside options both changed significantly over the course of the late Middle Ages. When grain prices were buoyant before the Black Death, it was possible for those who had managed to acquire sufficient quantities of land to maintain a reasonable standard of living. However, land had become increasingly scarce by the latter parts of the 13th century. That this period was characterized by significant land hunger is illustrated by the extent of sub-divided holdings and subletting at rack rents (Campbell, 2005). Many peasants held smallholdings of five acres or less (Dyer, 1989, 119), which, even when farmed intensively, were insufficient to either provide a subsistence income or fully occupy all available household labour. This led many to supplement their incomes with waged day labour alongside the landless population for whom waged labour was the sole source of income. However, the low land:labour ratio created heavy competition for already-limited employment opportunities and day wage levels were consistently modest. Between 1264 and 1348, a day labourer would have had to find an average of 169 days of work just to earn the equivalent of a typical *famulus'* in-kind grain livery (Bailey, 1998; Clark, 2007b).[34] The most widely available opportunities for day labour were the tasks of harvesting and threshing (separating the inner kernel of grain from its stalk and fibrous shell). As harvesting was typically completed in six or eight weeks in the late Summer and early Autumn, work as a day labourer would have been harder to find outside of this busy period.

However, the 1350s and 1360s, led to a rapid improvement in the quantity and quality of outside options available to *famuli* workers. The sudden reduction in population led to a glut of available tenancies, and the relatively low prices fetched for the land that changed hands over this period demonstrates its supply relative to reduced demand (Bailey, 2014, 326, Bailey, 2021, 150-53). At manors throughout England, the proportion of tenancies transferred outside of families increased significantly to over 50 per cent (Mullan & Britnell, 2010, 87-90, Dyer, 2022, 68-70). Moreover, in their desperation to find new tenants to take up the land vacated through either plague

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[34]This and subsequent estimates of day-labourer-working-days required to earn the equivalent of an average *famulus'* livery are based on dividing our series of annual in-kind grain livery values by Clark's (2007b) series of day wages.

mortality or post-plague migration, most lords quickly dropped the servile elements attached to customary landholdings, making these even more attractive to potential new tenants (Bailey, 2014, 315-326). Alongside improvements in land availability, day labour also became an increasingly viable option for workers. Day wages increased dramatically and quickly in the wake of the Black Death; between 1349 and 1379 a day labourer would only have had to find 98 days of work to earn the equivalent of an average *famuli* labourer's grain livery .

These trends largely continued into the late 14th and 15th centuries. From the mid-1370s the value of both customary and leased land fell even further, signifying a depressed land market where supply outstripped demand (Poos, 1991, 49-51, Bailey, 2021, 246-247). Simultaneously, day wages kept rising, meaning that from 1380 to 1439, a day labourer required only an average of 82 days' work to match the value of an average *famulus'* livery. This leads to an obvious question: why did *famuli* wages, and the proportion of these that were paid in cash, take two decades to adjust after the Black Death? While, before the plague, a secure job as a *famuli* labourer was likely very attractive, these roles became less appealing in a post-Black Death world flush with new opportunities. Therefore, the impact of the Black Death led to an immediate and persistent improvement in the outside options available to *famuli* workers in 14th century England, undoubtedly leading to a dramatic strengthening of their bargaining power with their employers. While an improvement in the outside options available to *famuli* labourers goes some way to explaining the higher wages that they were eventually able to command, this alone does not explain why these changes took three decades to appear.

**Institutional frictions and collusion among employers**

We have explored the possibilities that opened to *famuli* after the Black Death. Now, we consider how lords, as employers, responded to these new realities and how they attempted to use their political power to constrain wage growth. Before the Black Death, England was characterized by a developed and remarkably free labour market. There is very little evidence for any regulation of rural labour markets even at the local level (Bailey, in press) and while serfdom was undoubtedly at its height, recent scholarship has shown that lords rarely exercised their powers to prevent labour mobility

before the Black Death (Bailey, 2014, 330).

The Black Death tipped the demographic balance in favour of labour. In response to this, medieval English elites introduced new legal institutions designed to maintain employers' labour market power. This was effective in the short term. Lords, many of whom were also Members of Parliament, worked to introduce legislation which allowed the burgeoning English state to intervene in the labour market (Whittle, 2023; Bailey, in press). The resulting Ordinance of Labourers (1349) and Statute of Labourers (1351), sought to cap wages, both cash and in-kind, compel labourers to accept work as and when it was offered, and to push workers towards enforceable annual contracts rather than more casual terms (Horrox, 1994, 287-90, 312-7). This legislation was enforced to some effect in the 1350s, an achievement made possible through the effective collusion between seigniorial lords and wealthier peasants who also employed labourers. This 'partnership' ensured that statutes drafted in Westminster would be enforced on the ground throughout the realm (Poos, 1983, Hettinger, 1986, 127, 204).

However, these new collusive mechanisms proved to be ineffective in the medium-term, at least as a means to cap the wages of skilled, male agricultural workers. This is clearly demonstrated in the rise of day wages in the immediate aftermath of the Black Death. As early as the 1360s, some employers (including lords), likely those who appreciated flexibility in terms of employment, began increasingly to collaborate with workers to circumvent the new labour legislation, acquiescing to worker demands (Hatcher, 1994). This can be glimpsed in instances when individuals were persecuted for transgressions of the statute of labourers; where we find many cases of workers leaving contracted employment in order to take higher salaries offered elsewhere.[35] Courts punished workers for breaking the statute of labourers far more frequently than they sanctioned employers for offering terms prohibited by the legislation and while the original ordinance of 1349 explicitly legislated for these, penalties for employers were not mentioned in the subsequent 1351 statute (Given-Wilson, 2000). This ultimately limited the effectiveness of enforcement (Poos, 1983, Hettinger, 1986, 108-121). The English crown lacked the level of state capacity necessary to control the labour market, which had long been characterized by a substantial number of highly mobile workers.

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[35]For example, Walter and John Sire of Barrowby brought a case against Robert Tasker of London-thorpe because he 'left his employment in return for the offer of a higher salary, contrary to statute' (Horrox, 1994, 321)

The lack of prosecutions for violations of the labour laws in manorial courts may also suggest resistance to the legislation in local communities (Bailey, in press). These problems were recognized by contemporary elites, who complained vociferously both in parliamentary petitions and contemporary poems and chronicles (Hatcher, 1994; Bailey, 2019). From the 1370s onward, successive iterations of the legislation increasingly focused on the problem of vagrancy, with its key targets becoming young, mobile, unmarried, propertyless and female (Bailey, 2021, 266-270, Whittle, 2023). The failure of the post-plague labour legislation to suppress wage rates was broadly acknowledged by the Statute of Cambridge of 1388, which established new levels for maximum wage rates which were well above pre-Black Death levels (Horrox, 1994, 323-326).

In order for *famuli* wages to rise, workers had to leave these positions or at least threaten their lordly employers with the credible possibility of doing so. In the decade immediately following the Black Death, *famuli* workers may have felt reluctant to leave their secure positions, even for day wages which had become significantly more lucrative. Such reticence could have been due to fears of prosecution under the new labour legislation which was heavily trained on those who earned by the day. Workers may have been equally reluctant to leverage improved outside options as a bargaining tool to command higher wages in their *famuli* roles in case any rise they recieved resulted in a transgression of the statutory limits. However effective the labour legislation was in the 1350s, in the subsequent decades, cracks had begun to show, and widened quickly. By the 1360s it would have been obvious to many labourers that the legislation was largely ineffective. This begs the question of why it still took a further two decades for wages to rise, bringing us to the third of our three factors which explain our reconstructed wage series.

**Wage rigidity and the need for an insurance mechanism**

To fully understand why the remuneration of *famuli* labourers only improved from the 1380s we need to understand the benefit workers received from in-kind payment. For the majority of our period, most of the workers we observe received a largely fixed quantity of grain which remained sticky in its amount even if its value changed dramatically due to price fluctuations. Why was this helpful for *famuli* labourers? The era before the Black Death was characterized both by high grain prices, and,

more significantly, high price volatility. These trends in grain prices continued into the first two decades following the Black Death. Specifically, while the late 13th century saw reasonably consistent prices, the first three quarters of the 14th century saw a peak in volatility, in part due to dramatic price rises caused by the harvest failures of the Great Famine of 1315-17, the dislocation of the Black Death of 1349 and 'a combination of dearth and plague' in 1369 (Campbell, 2000, 7). This meant that the price of grain in any given year was very hard to predict. Therefore, in-kind payment in grain insulated *famuli* labourers from the vagaries of medieval agriculture. However, paying grain simultaneously served employers' purposes by limiting the mobility of core *famuli* labourers. Ultimately, the widespread practice of paying *famuli* labourers with grain worked as a form of paternalistic control, providing workers with at least a subsistence-level standard of living, irrespective of the success of the harvest or the prevailing price of grain in any given year, but the provision of this assurance was tied to the service of a single employer.

However, from the 1370s onward, while acknowledging that *famuli* workers continued to receive the same insurance benefits from in-kind payment as they had previously, the value of this insurance, and thus its utility as a carrot to keep workers tied to particular employers, decreased significantly because grain became cheaper and its prices less volatile. This meant that workers were far more likely to trust that they would be able to buy the grain necessary for their subsistence with cash on the market, even in years of poor harvests. By the the 15th century, price volatility was definitely not entirely a ghost of the past, particularly due to an exceptionally bad harvest in 1437, but generally prices remained low compared to the periods immediately before and after the Black Death. Therefore, the insurance value of in-kind payment was significantly diminished in the late 14th century.

Before the 1370s, workers may well have been willing to accept the inflexibility of having a large proportion of their wage paid in grain in exchange for the security such payments offered. This was especially true in the wider context of the 1350s and 1360s, which were characterized by recurrent plague outbreaks, climatic instability and animal murrains (Bailey, 2021, 168-170). With an uncertain economic outlook, rolling the dice and taking up newly-available land as a tenant cultivator or seeking high-paying but irregular opportunities as a day labourer could have seemed unattractive

in comparison to a secure annual contract which guaranteed enough food irrespective of the wider economic trends.[36] However, a fall in both the levels and volatility of grain prices in the 1370s, coupled with the later stabilization of the economy from the 1390s, served to make in-kind payments less attractive (Bailey, 2021, 268-270). Workers were increasingly willing to abandon the safety net of in-kind payment and voted with their feet, or at least threatened to do so, in order to secure greater wages with a larger cash component from their employers.

**Individually contracting: the nominal evidence**

That workers had acquired considerably more agency in wage bargaining, and were regularly leveraging it, is demonstrated by a further set of evidence available in the source material. This is the propensity of workers to be named in manorial accounts. Individually naming workers in accounts was virtually unheard of before the Black Death. However, in the late 14th century, demesne managers began to regularly name individual labourers. Figure 4 demonstrates this trend and illustrates how the practice of naming individuals began in earnest after the Black Death and increased quickly so that the majority of workers were named personally in the accounts before the end of the 14th century. Before the late 1360s, at maximum, fewer than 20 percent of workers were named. In many years, none were identified at all. Those who were named in this period were most often specifically skilled and richly remunerated workers, such as 'Alexander', who helped manage the Bishop of Winchester's vineyard at Esher.[37] In such cases, in this period before the Black Death, the naming of an individual was rare, and likely only done when exceptional wages were likely to be scrutinized. However, from the 1370s onwards, the number of workers named in accounts grew substantially, to between 30 and 60 per cent at the end of the 14th century, and then from 60 to 100 percent in the 15th century. Moreover, naming was no longer restricted to noteworthy workers but rather were attached to a wide variety of rather unremarkable labourers, including ploughmen and shepherds. By the 1390s, *famuli* working on the estates of

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[36]Munro (2012, 312-313) further argues that price inflation rose faster than the prevailing nominal wages offered for piece-work between 1351 and 1375, leading to a fall in real wages for this type of work in the two decades following the Black Death. This would provide a further reason why *famuli* labourers were reluctant to leave annually contracted employment to seek opportunities on the casual labour market

[37]Hampshire Record Office, 11 M59/B1/55-8

Battle Abbey and Durham Cathedral Priory began to be identified primarily by their name rather than their occupation.[38]

From the 1380s, profound shifts in the labour market allowed *famuli* workers to capture a larger share of their marginal contribution to production through an increase in their wages, thus realizing a gain created by the dramatic disappearance of a vast share of the labour force following the Black Death, but only nearly three decades later. This was accompanied by a change in the composition of their wages. A greater proportion of total *famuli* remuneration began to be paid in cash rather than the in-kind payments which had defined their remuneration for most of the Middle Ages. Broadly, these changes were created by a significant shift in the bargaining power of annually-contracted workers. This was caused by an increase in the outside options available to *famuli* labourers which made leaving employment as a *famulus* a credible threat to the lords who depended upon their labour. The collusive legal institutions instigated by employers to prevent labour mobility and cap wages failed to remain effective beyond the first decade after the Black Death, increasing the scope of action for disgruntled employees. Finally, a fall in the value of the insurance afforded by in-kind payments made cash payment more attractive and also made workers more certain that they would be able to enjoy an improved standard of living even if they left employment relationships.

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[38]This is not simply a sample composition effect. We refer to Figure A12 in Appendix E, where we demonstrate this exercise for individual estates.

Figure 4: **Share of workers named individually in manorial accounts**
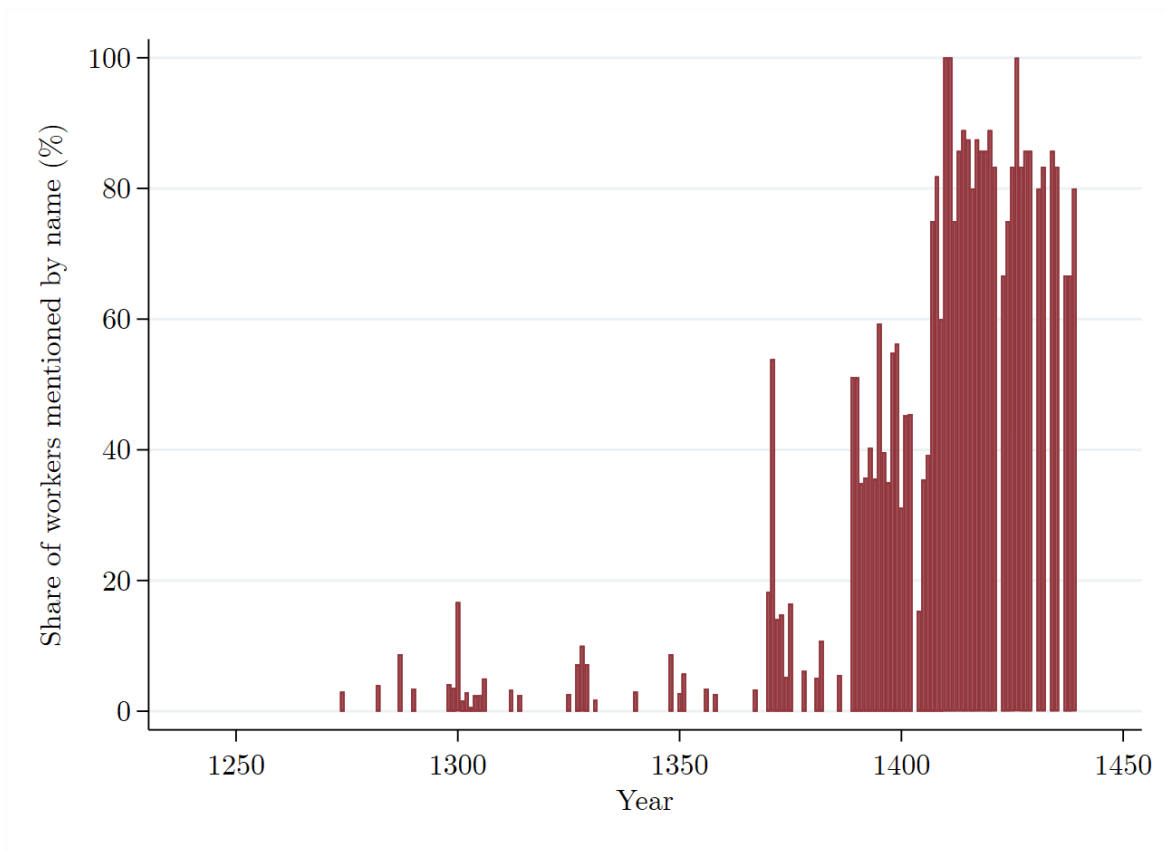
# 6    A tale of two labour markets?

Finally, how do our results and the arguments we have used to explain them fit with the story of the wages of day labourers which look quite different? Figure 5 compares the *trends* in nominal wage levels received by the *famuli* labourers we observe against day labourers as measured by Clark (2007b). This is not a comparison of *earnings*, as we make no attempt here to equate wages earned by the day with the incomes *famuli* earned by the year.

Figure 5: **Comparison of daily and annual agricultural wages in England, 1270-1430**
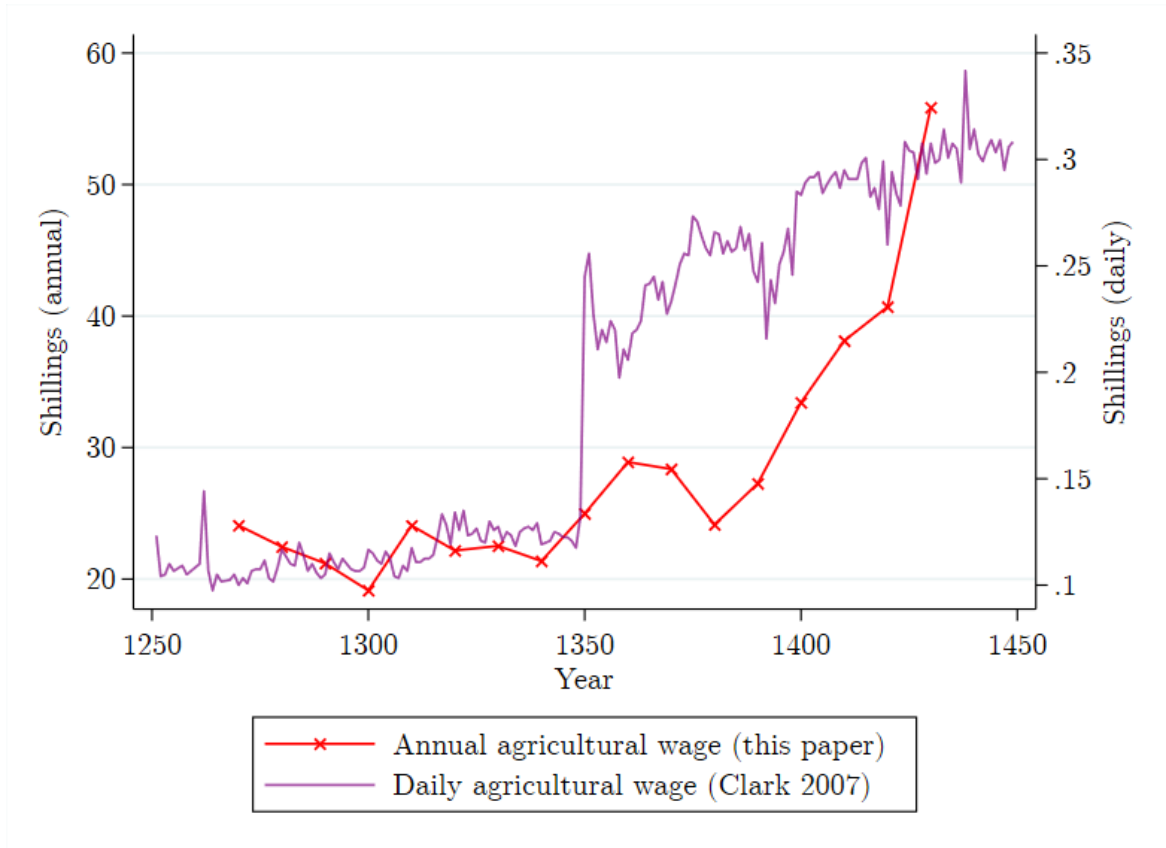
We can appreciate that the trends in levels of remuneration were similar for *famuli* and day labourers before the Black Death. However, we see a significant divergence after 1348, when the wages of day labourers climbed quickly and significantly. In 1349, the average wage of a day labourer was 0.13 s.; by 1350 it had climbed to 0.25 s., basically doubling in a single year. *Famuli* wages, as we have discussed above, remained largely stagnant until 1380, when they began to increase. In fact, *famuli* wages took 80 years to achieve the same nominal growth that day wages experienced in a year, doubling from 25 s. to 50 s. per year, on average, by the 1430s.

Our theoretical framework can explain this divergence. There were some fundamental differences between the circumstances of day labour and annually-employed *famuli*. One of the key characteristics of day labour in this period was its mobility. Most day labourers would have been free to take on whatever work was offered, easily transitioning from one employer to another in the process. This allowed their wages to respond very quickly to changes in the labour supply, taking advantage of employer

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competition, particularly at peak periods, like during the harvest season.

The nature of *famuli* jobs, on the other hand, were fundamentally less mobile and carried higher search costs. *Famuli* were further encumbered by the in-kind payments through which they were typically remunerated. While, of course, any individual *famulus* could choose to leave their roles to take on day labour there were a host of incentives, as discussed above, that might have dissuaded many facing such a decision before the 1380s. As a consequence, the day labour market was characterized by significantly less wage rigidity after the Black Death than we observe for workers employed annually.[39]

# 7   Final thoughts

In this paper, we have demonstrated that in-kind wages can reveal new insights into the factors which underpinned significant moments in the wages of pre-industrial labourers.

With a methodology which allows us to precisely value in-kind grain wages drawn from medieval English manorial accounts, we provide a wage series which accurately captures not only total earnings, but also the changing proportions of the cash and in-kind components paid to annually-employed *famuli* workers between 1270 and 1440. We find that, after a century of stagnation, the wages of these labourers did rise substantially from the 1370s onwards, and that this growth was driven by an increasing proportion of cash remuneration. We argue that the timing and nature of this change cannot be explained solely by a shift in factor ratios after the Black Death, or product market frictions such as changes in money supply or the integration of grain markets. Instead, the growth of cash wages in the late 14th century is best explained by labour market frictions, and specifically the increased bargaining power of workers. *Famuli* labourers benefited from improved outside options and the failure of employer collusion. This allowed them to demand higher wages with the credible threat of leaving a lord's employment.

Our findings have important ramifications for broader debates in late medieval his-

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[39]It could be that these differences in wage rigidity had an impact on labour supply decisions on both the extensive and intensive margin. It remains an open question as to whether day labourers could have found (or even wanted to find) sufficient work to turn wages that were lucrative by the day into annual incomes that would have eclipsed the earnings of *famuli* labourers (Hatcher, 2011).

tory and economic history more broadly. In understanding changes in living standards after the Black Death, our findings support interpretations which have highlighted the roles of both labourer agency and political institutions, rather than a myopic focus on changes in the land:labour ratio. Our findings support the idea of a 'golden age of labour' insofar as living standards clearly rose for annually-employed *famuli* labourers, but reveal that a rise in wages was delayed by a failure of the bargaining power of labourers to sufficiently increase until three decades after the Plague. Moreover, this paper helps to explain the demise of the 'direct farming' era in England, when lords managed their demesne lands directly and acted as institutional grain producers for the late medieval economy. In the face of demands for higher wages, combined with a fall in grain prices, many lords chose to lease out their demesne lands for fixed rents rather than manage these directly. This opened up new potentials for peasant entrepreneurship, potentially paving the way for the wider increases in agricultural productivity of later centuries.

More generally, we hope to inspire more research into in-kind wages. Non-monetary wages were a significant, and in many cases dominant, form of labour remuneration in many economies in the pre-industrial world; and even remain so today in developing economies. Through the combination of careful theorizing about why in-kind wages might be paid in any given context and empirical work to accurately value these wages, we will be able to better understand the dynamics of labour markets in economies of various stages of development.

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# Appendices

## A  Data sources

**Note:** Separate date ranges are given when the gap between any two accounts is greater than five years.

**Durham Cathedral Priory**

- <u>Manors:</u> Bearpark, Belasis, Bewley, Billingham, Dalton, Ferryhill, Fulwell, Houghall, Ketton, Muggleswick, Pittington, Rainton, Wardley, Westoe
- <u>Dates:</u> 1285-1310, 1326-45, 1370-79, 1389-1410
- <u>Sources:</u> Britnell (2014); University of Durham, Palace Green Library, Special Collections, Durham Cathedral Muniments.

**Glastonbury Abbey**

- <u>Manors:</u> Ashbury, Ashcott, Damerham, Glastonbury
- <u>Dates:</u> 1274-5, 1281-82, 1301-6, 1312-16, 1331-36, 1342-61, 1368-78, 1393-95
- <u>Sources:</u> Longleat, Glastonbury Abbey collection, mss 5251-87, 7353, 9670, 9933, 10632-785, 11185-281.

**Bishopric of Winchester**

- <u>Manors:</u> Esher
- <u>Dates:</u> 1270-1365
- <u>Sources:</u> Stone (2017); Winchester, Hampshire Record Office, 11M59/B1/35-117.

**Battle Abbey**

- <u>Manors:</u> Barnhorn
- <u>Dates:</u> 1325-26, 1333-34, 1352-59, 1368-88, 1396-1440
- <u>Sources:</u> San Marino, Huntingdon Library, Battle Abbey collection, BA335-397.

**Abbey of Bury St Edmunds**

- <u>Manors:</u> Hinderclay, Redgrave
- <u>Dates:</u> 1277-1439
- <u>Sources:</u> University of Chicago, Hanna Holborn Gray Special Collections Research Center, Sir Nicholas Bacon Collection of English Court and Manorial Documents, mss 325-393, 412-510.

# B    Construction of the authors' database

In this appendix, we provide a detailed explanation of how data from manorial accounts was used to quantify *famuli* labour remuneration in the Middle Ages, both cash and in-kind. Figure A1 represents a schematic overview of the structure of our database. Manorial accounts typically provide data at both the level of the manor, and of the individual worker. Furthermore, we leverage the foundational data collection and compilation work from other scholars to convert information from these manorial accounts into national indices, primarily the renowned price series of David Farmer (1988, 1991).

Figure A1: **Structure of the *famuli* remuneration database**
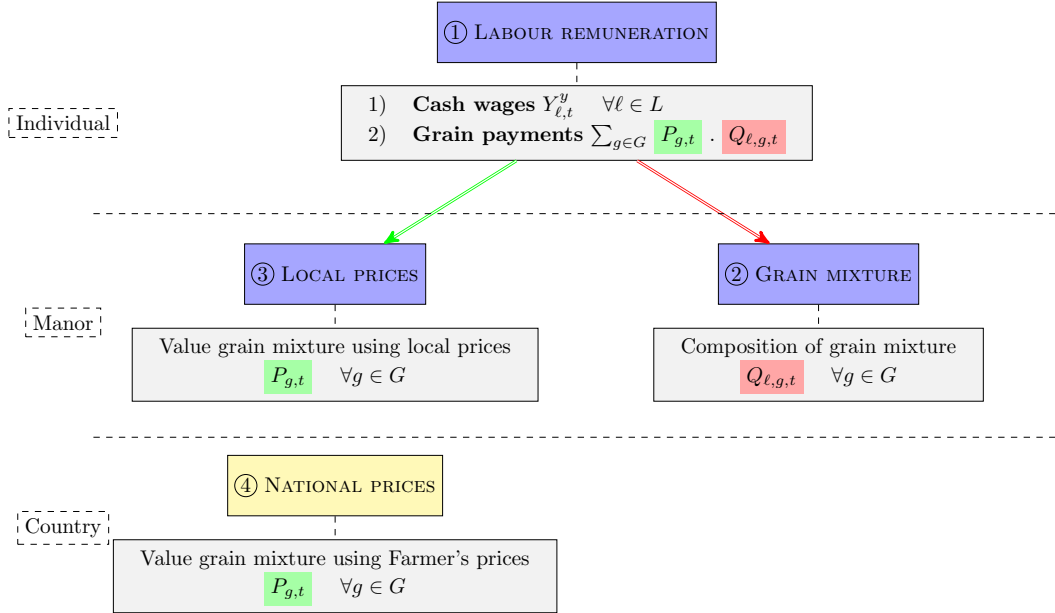


**Notes:** Datasets in blue are collected by the authors from the manorial accounts. Datasets in yellow are based on published sources.
**Source:** Authors' illustration.

**Remuneration data**

A first data set ① contains information on the remuneration of all *famuli* labours on the sampled manors ($L$). Naturally, this includes cash wages ($Y_{\ell,t}$) as well as the quantities and types of grain ($g$) paid to individual workers ($\sum_{g \in G} Q_{\ell,g,t}$). This information is typically drawn from two different sections of manorial accounts. Cash expenditure is typically recorded on the front of the account roll, and a subsection, often with the

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heading or marginal gloss of 'stipends of the famuli' (*stipendium famulorum*) contains information on cash payments made to *famuli*. Grain payments or 'liveries' are typically recorded in the grange account on the back of the roll. These grain payments are sometimes contained in a single 'liveries of the famuli' *liberationem famulorum* section or at other times they are mixed in with the entries for individual grains in the grange account.[I] The grange account records the different grains sown and harvested on the demesne as well as the grain 'liveries' given to *famuli*.

These liveries were most often paid as a specific quantity of a collective grain mixture, of which we know the composition. We recorded the grain composition of the in-kind payments in a second dataset ②. Most straightforward is when the in-kind payment was paid in a single grain type, but this was relatively rare. At most manors, in most years, workers were paid with a mixture of multiple grains, and the quantities and ratios were recorded in the account. In these cases, we have to assume that all workers were paid with mixtures of the same composition.[II] Furthermore, in some cases *famuli* received a 'bespoke' grain livery, unique to that individual. In these cases the accounts also recorded the quantities and ratios of different grains paid out. We recorded those cases in a separate database (not shown in Figure A1).

We are also able to derive a number of individual characteristics of these workers. Both the 'stipend' and 'livery' sections usually detail the occupation of the worker (for example, 'ploughman', 'harrower', 'dairy maid',...) and occasionally the more specific tasks they performed. The length of employment was also regularly recorded. Most *famuli* were employed on annual contracts, but many were also hired for only part of the year, and this was especially true for more junior people and those who worked in very seasonal jobs, like dairying or harvest work. Further complicating the matter is

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[I]Manorial accounts usually start with a heading that includes the name of the manor, the account's dates, and the name of the responsible official, such as the bailiff or reeve. Accounts typically followed the harvest year and spanned from Michaelmas (September 29th, the traditional end of harvest) to Michaelmas of the following year. The front side of the manuscript typically details the income of the manor, while the back side, or dorse, outlines expenditure. Near the end of most accounts is a grange and stock section, which records the yield of the harvest that year, as well as the receipts and losses of grain and livestock and of secondary livestock products such as cheese, eggs and hides.

[II]Formally, we thus have that the in-kind payment is equal to $\omega_\ell \times \sum_{g \in G} P_{g,t}.Q_{g,t}$, with us observing $\omega_\ell$. We cannot discount the possibility that some (likely more senior) individuals could have been paid with a higher proportion of, or even exclusively in, the more desirable and more expensive grains. However, we think this scenario is unlikely given the great pains that manorial officials took to differentiate between the wage rates of individual labourers. This is also consistent with evidence from Glastonbury Abbey (Rush, 2001, 130).

that many *famuli* were given a grain livery for one part of the year and a cash stipend for another. These two 'tenures' could be consecutive or concurrent.[III]

The rates of in-kind payment are most often expressed in the accounts as the number of weeks an individual had to work to earn a quarter of grain (291 liters by volume or approximately 192 kilograms by weight). Occasionally, rather than specifying the earnings of each worker individually, the account will specify that 'x' number of workers were paid a collective cash payment or livery. In these cases we have assumed that each worker earned the same wage. This seems a safe assumption, given that accounts almost universally specify when different workers earned at different rates. Similarly, accounts sometimes record separate payments for the same worker for different parts of the year. These cases are typically payments made at different rates for work by season, a reflection of the cyclical nature of the tasks required at various points in the agricultural year and work intensities caused by changes in daylight hours.

To calculate the total remuneration of any individual worker, we match the set of cash wages with the set of grain liveries given in the two parts of the account in order to add them together. It is typically straightforward to match the two types of payment as the same set of workers are usually enumerated, often in exactly the same order, in the two parts of the account. We have excluded from our database those occasional entries where it proved impossible to match a specific cash wage to a unique grain livery.

**Price data: valuing the grain payments**

Having identified individual labourers' total remuneration and their length(s) of employment, the next step is to value the in-kind payment they received in a year $(t)$ using the prevailing market prices of that year $(P_{g,t})$. To do so, we primarily draw on the seminal work of David Farmer (1988, 1991) who constructed a series of annual prices for five key grains (wheat, rye, barley, oats and peas) in the form of a dataset ④.[IV]

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[III]In the case of many individuals employed on an annual basis the overlap is clear. For example, seven *famuli* at Barnhorn, in Sussex, in 1372-1373 were given a grain livery for 52 weeks and a cash stipend for 26 weeks. It is clear that the cash was intended to augment workers' incomes during the busiest time of the year. However, some *famuli* received a grain livery for one part of the year and a cash stipend for a different period of time, an arrangement that was particularly common in the wages of dairymaids.

[IV]See Figure A6 in Appendix D for a plot of the price series.

Second, for other grains which are not included in the Farmer series (for example, *bere[m]corn* (a type of Barley), *drasca* (malt dregs), or beans, vetches and other legumes), we supplemented with prices recorded in the same manorial accounts as workers' wages. More specifically, we collected 5130 further observations of grain prices recorded in the manorial accounts of our sample. These were most commonly recorded in sales transactions, but sometimes also in purchases.[V] When both purchase and sale prices were available at the same manor in the same year, we used the sale price. The results of this archival research are bundled in local price database ③.

In a third step, we leveraged this new database with historical literature to make a couple of assumptions regarding the grains we were not able to price. Two grains commonly used as in-kind payments are not priced in the Farmer series: beans and *curralum*. First, we assume that beans, peas and other legumes follow an identical price pattern. This aligns with secondary literature.[VI] Also, some accounts contain prices for both beans and peas in a single year, and these seem to show an almost one-to-one relationship (see Figure A2(a)). As such, we priced all legumes using the Farmer price index for peas.

Second, we know that *currallum* was a catch-all term for various forms of inferior quality grain, but most typically referred to wheat. In some accounts, it seems to specifically refer to wheat chaff which was the fibrous byproduct of threshing and not digestible by humans. It was therefore less desirable and less valuable than wheat itself and was typically used as a fodder crop. Elsewhere, *currallum* was used in a more general sense to indicate poor quality threshed or unthreshed wheat which could still be eaten by humans (Rush, 2001, 131). This latter use of the term seems to be far more likely in the references we find in recorded grain liveries, given that these were largely compromised of edible food grains to be consumed by workers and that the prices recorded for *currallum* were often higher than other (clearly edible) grains like rye and barley. Because *currallum* was not bought and sold frequently, we do not have local prices for this grain for every year. The price data that we do have reveals that it was consistently priced at $\frac{2}{3}$ of wheat, as we would expect for a poorer quality variant of the same grain (see Figure A2(b)). Therefore, we priced all *currallum* accordingly

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[V]Implicitly, we assume that manors, just as the *famuli*, were price-takers on grain markets.

[VI]For example, Farmer's authoritative series (1988, 733) "concentrates on (...) peas of all types (...) as representative of the legumes".

using the nominal wheat price in the Farmer dataset.

Third, on one occasion, at the manor of Rainton in 1343-4, workers were paid in flour (*farina*). To value this in-kind payment, we used the Farmer price index for wheat this year, with a 7.69 percent premium added to account for the fact that the cost of milling this wheat had already been paid.[VII] This premium is based on the modal 'multure' rate (the in-kind payment of a proportion of flour paid to millers by mill users in return for grinding their corn) of one 13th found in the north of England (Langdon, 2004, 330-331).

Fourth, *famuli* were sometimes paid with the so-called 'mixture of the mill', basically a mixture of grains provided by the local mill. In some cases the proportions of this mixture can be found in the relevant 'mill' section of the account, but in some cases the composition of the mill mix is unknown. In these cases, we assume that the mill regularly ground the crops grown on the demesne and given to *famuli* as in-kind payment and, therefore, the mill mixture would have a value equivalent to the weighted price of all the other grains in the livery. The handful of cases for which we do observe prices of the mill mix seem to indicate that this is a reasonable assumption.[VIII] Formally, we thus assume that the mill mix $m$ can be priced as following:

$$P_{m,t} = \frac{\sum\limits_{g \in G \setminus \{m\}} P_{g,t}.Q_{g,t}}{\sum\limits_{g \in G \setminus \{m\}} Q_{g,t}}$$

In the final step, we multiply the prices $(P_{g,t})$ contained in datasets ③ and ④, together with the assumptions discussed above, by the amount of each grain received for each worker $(\sum_{g \in G} Q_{\ell,g,t})$, as documented in datasets ① and ②, to arrive at a precise value of the in-kind payments made to any specific worker in any specific year. The liveries which we could not price were dropped.[IX]

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[VII]We have assumed that the flour referred to here is milled wheat rather than another grain. This follows the common definition that the use of the word (*farina*) without the addition of any other descriptor typically refers to wheat (Ashdowne, Howlett, & Latham, 2018). We are given further confidence in this assumption by the fact that elsewhere in the Durham accounts, the flour of other types of grain is specifically identified as such.
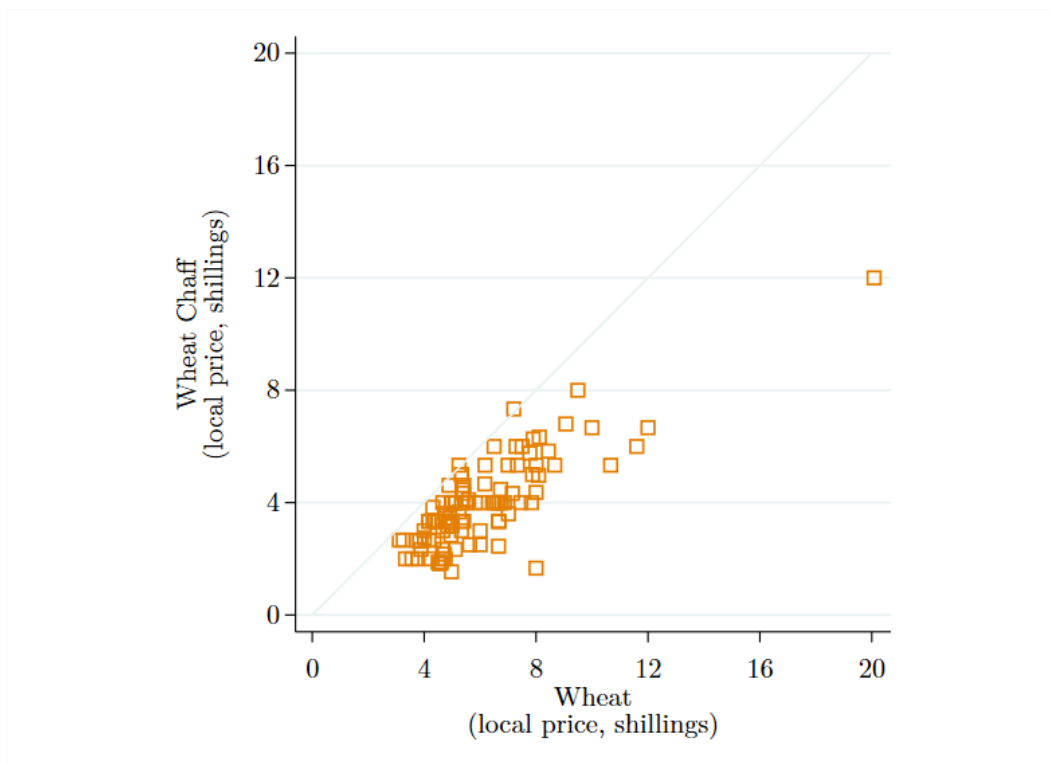
[VIII]See Figure A3 in Appendix D

[IX]We refer to Figure A4 in Appendix D for an overview of the prevalence of this issue.

Figure A2: **Empirical validation of our grain pricing assumptions**
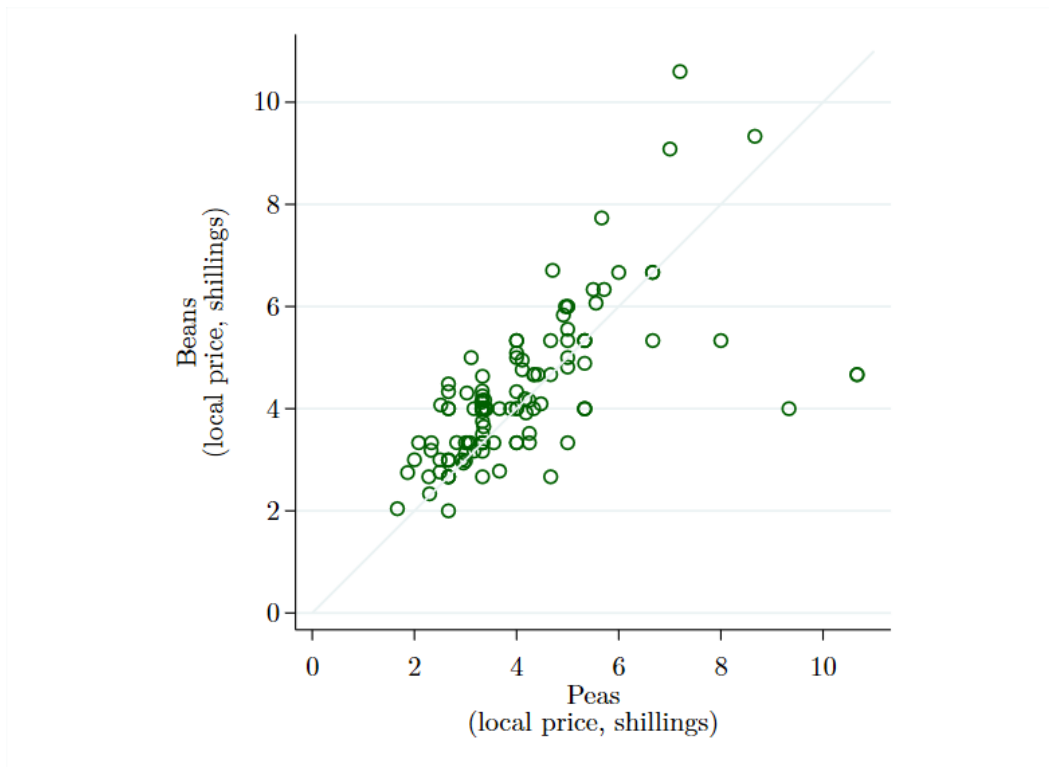


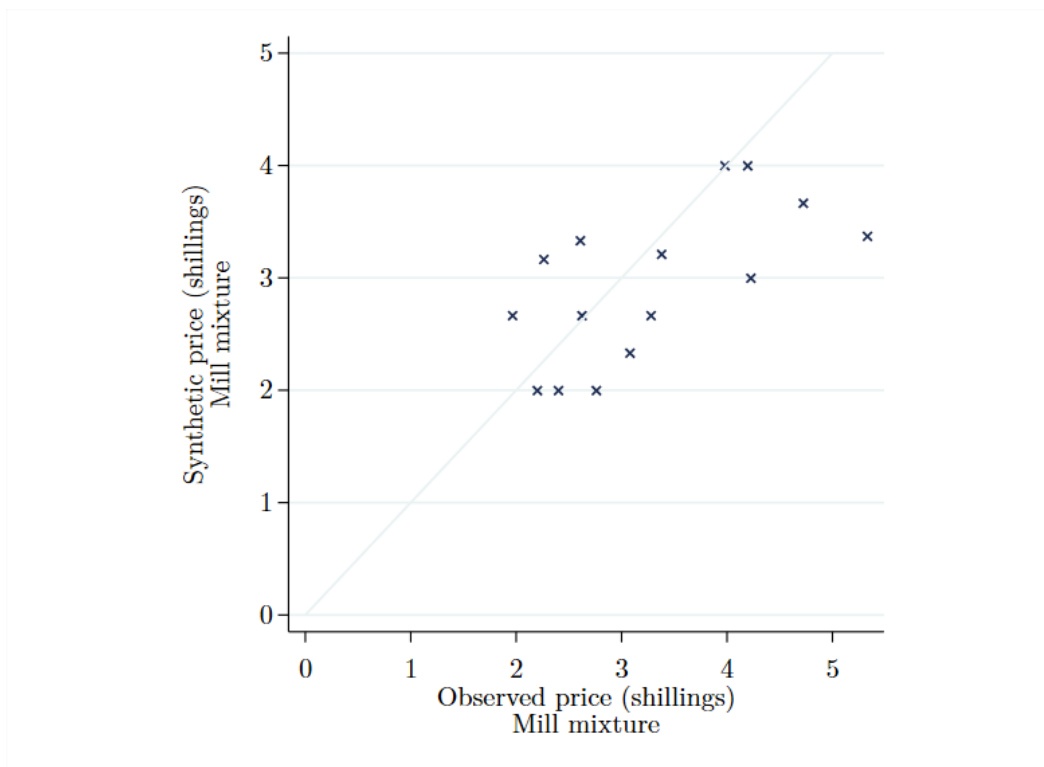(a) **Comparison between beans and peas prices**



(b) **Comparison between wheat and wheat chaff prices**

**Notes:** The diagonal grid lines represent the 45°-angle line.
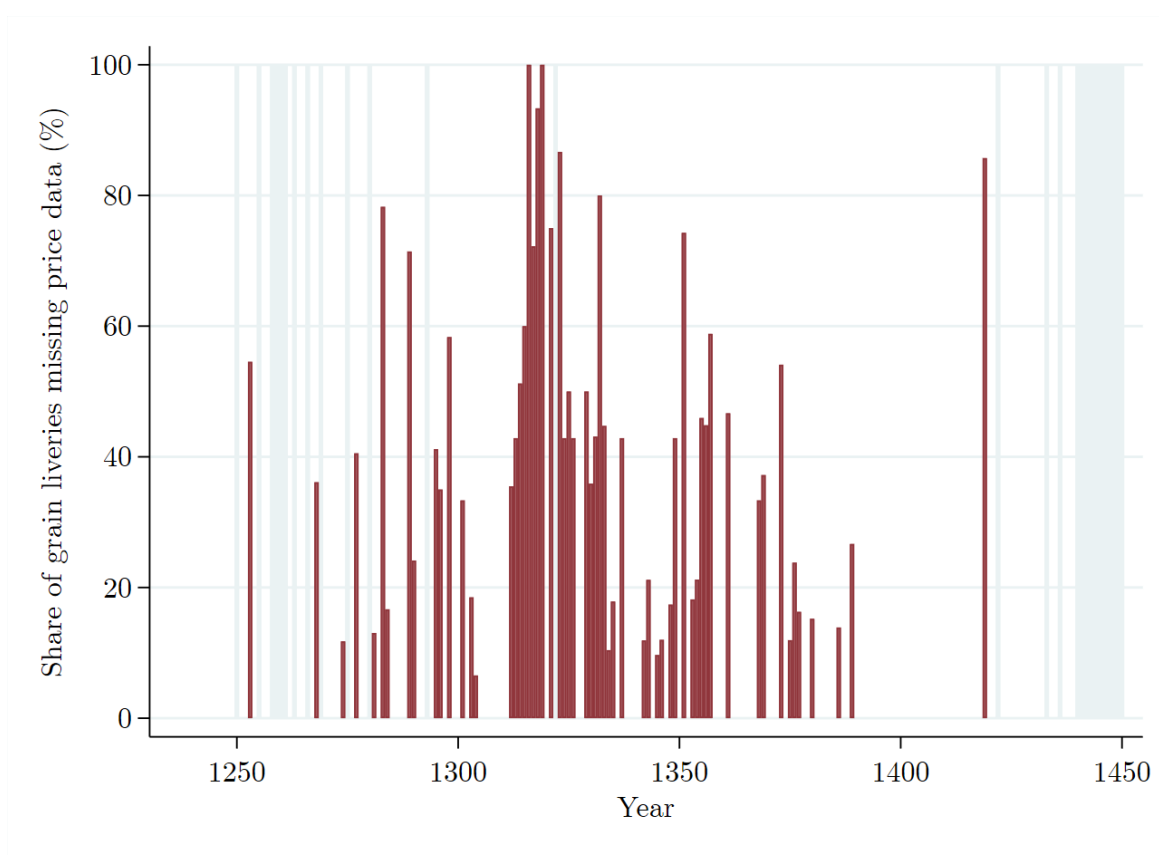
**Source:** Authors' database.

Figure A3: **Empirical validation of our mill mixture pricing assumption**



**Notes:** The diagonal grid line represents the 45°-angle line. The synthetic price is calculated as the weighted price of all the other grains in the manor's grain livery.

**Source:** Authors' database.

Figure A4: **Share of liveries with missing prices**

**Notes:** The red bars represent the share of liveries which we could not value due to no available price information. Shaded ares indicate the years for which no remuneration data is available.

**Source:** Authors' database.

# C   Sample composition and summary statistics

Figure A5: **Sample composition by estate**
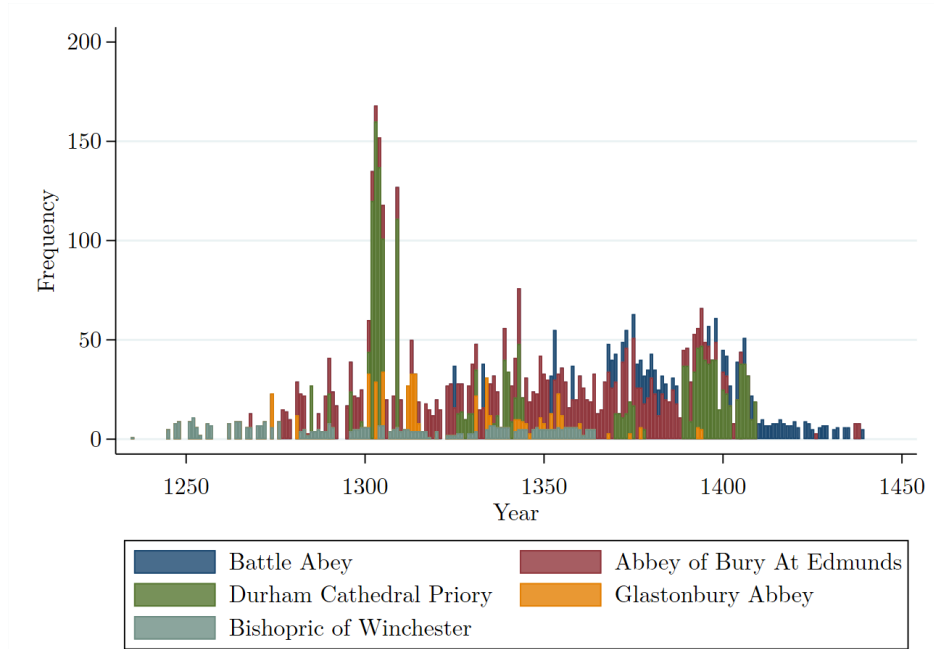


(a) **All workers**
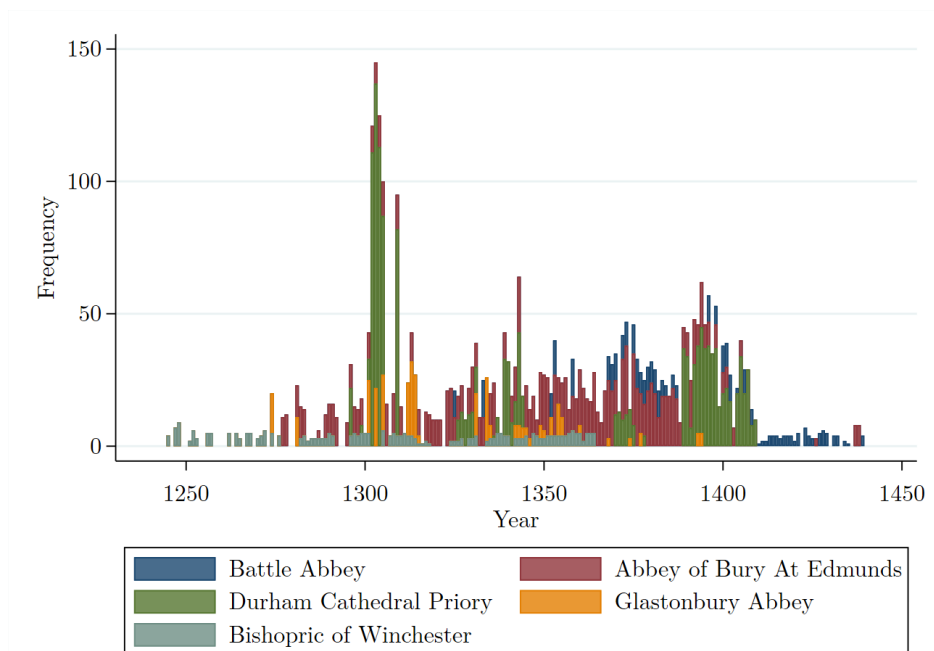


(b) **Annual workers only**

**Source:** Authors' database.

Table A1: **Distribution of sample over estate, labourer type and region**

|  | **Variable** | $d(L, I)$ | $N_L$ |
|---|---|---|---|
| Estate | Battle Abbey | 611 | 11.47 |
|  | Abbey of Bury At Edmunds | 2,056 | 38.58 |
|  | Durham Cathedral Priory | 1,730 | 32.46 |
|  | Glastonbury Abbey | 411 | 7.71 |
|  | Bishopric of Winchester | 521 | 9.78 |
| Labourer type | Agricultural Misc | 258 | 4.84 |
|  | Carter | 620 | 11.63 |
|  | Junior | 239 | 4.48 |
|  | Manager | 264 | 4.95 |
|  | Misc | 734 | 13.77 |
|  | Pastoral | 1,325 | 24.86 |
|  | Ploughman | 1,889 | 35.45 |
| Region | East Anglia | 2,056 | 38.58 |
|  | The North | 1,730 | 32.46 |
|  | The South and South-west | 925 | 17.36 |
|  | The Thames Basin | 618 | 11.60 |
| All workers |  | 5,329 |  |

# D    Background data

Figure A6: **Grain prices in Medieval England, 1250-1500**
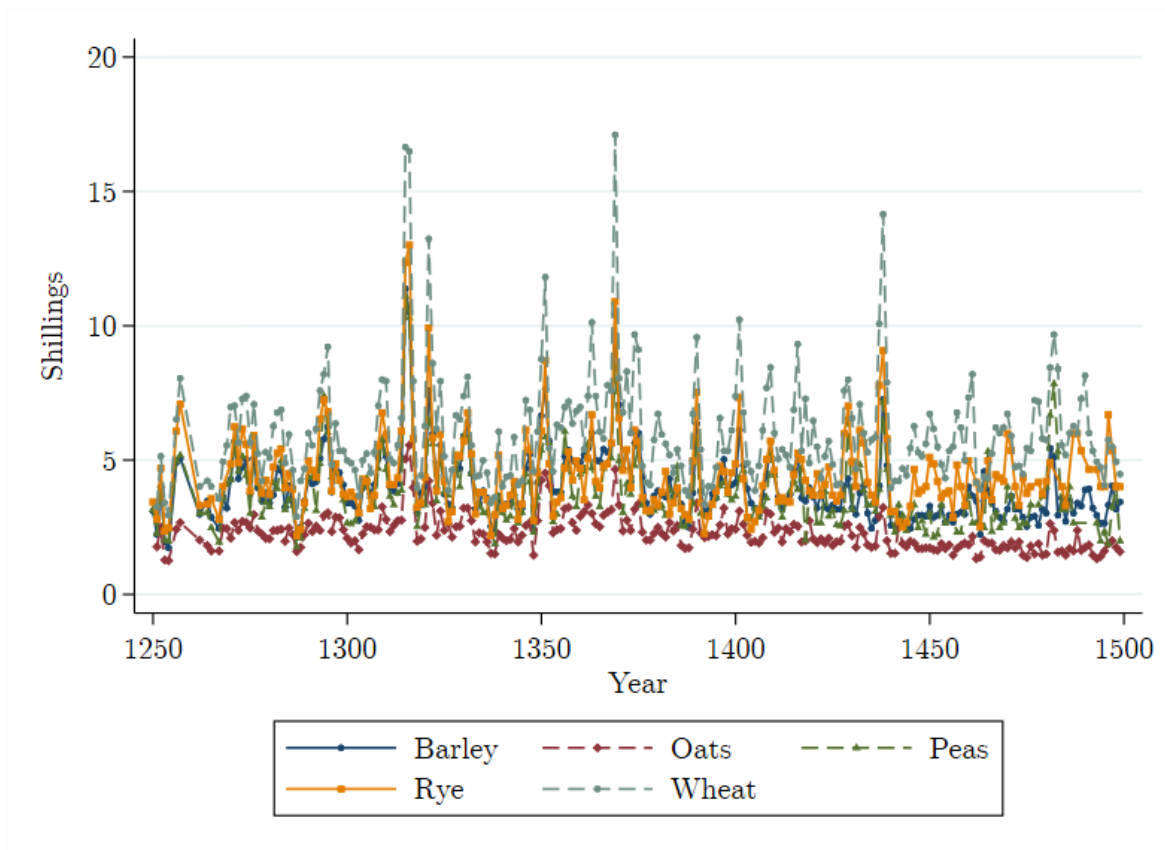


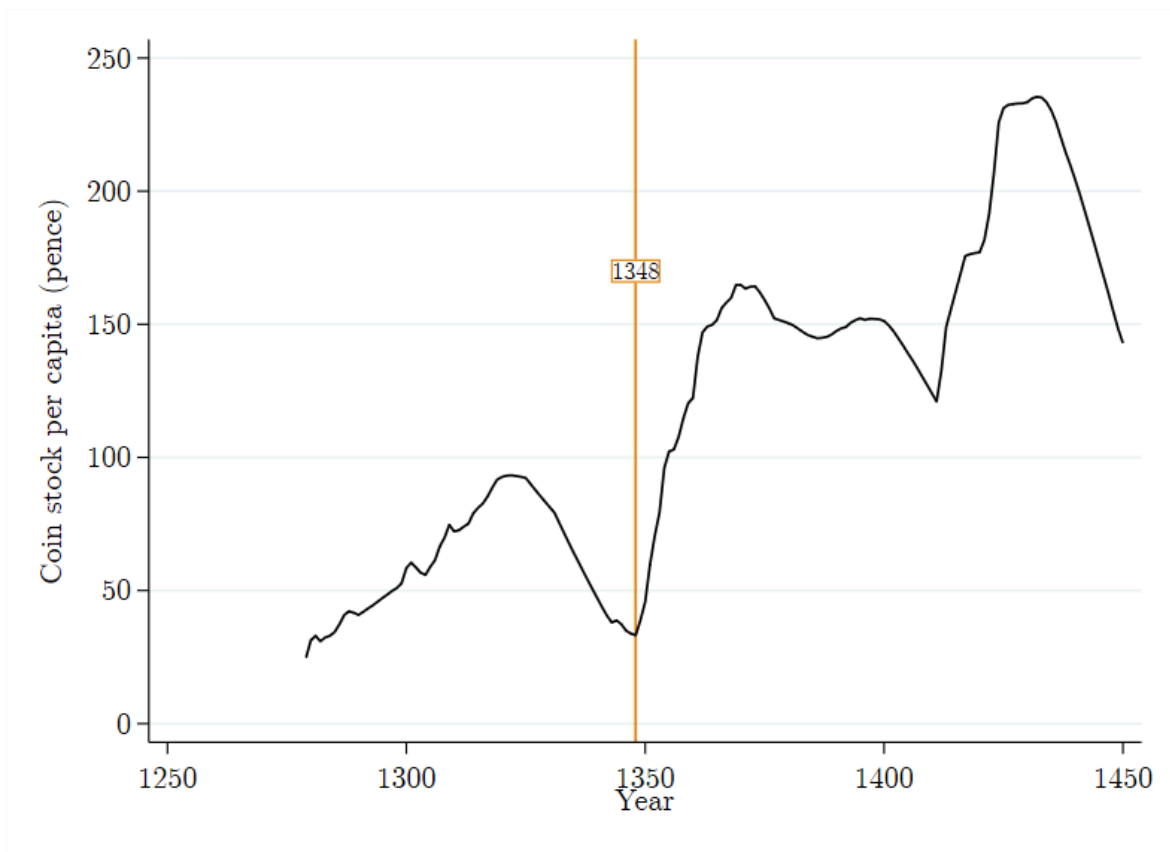**Source:** Adapted from Farmer (1988, 1991).

Figure A7: **Wheat prices and price volatility in England, 1270-1480**
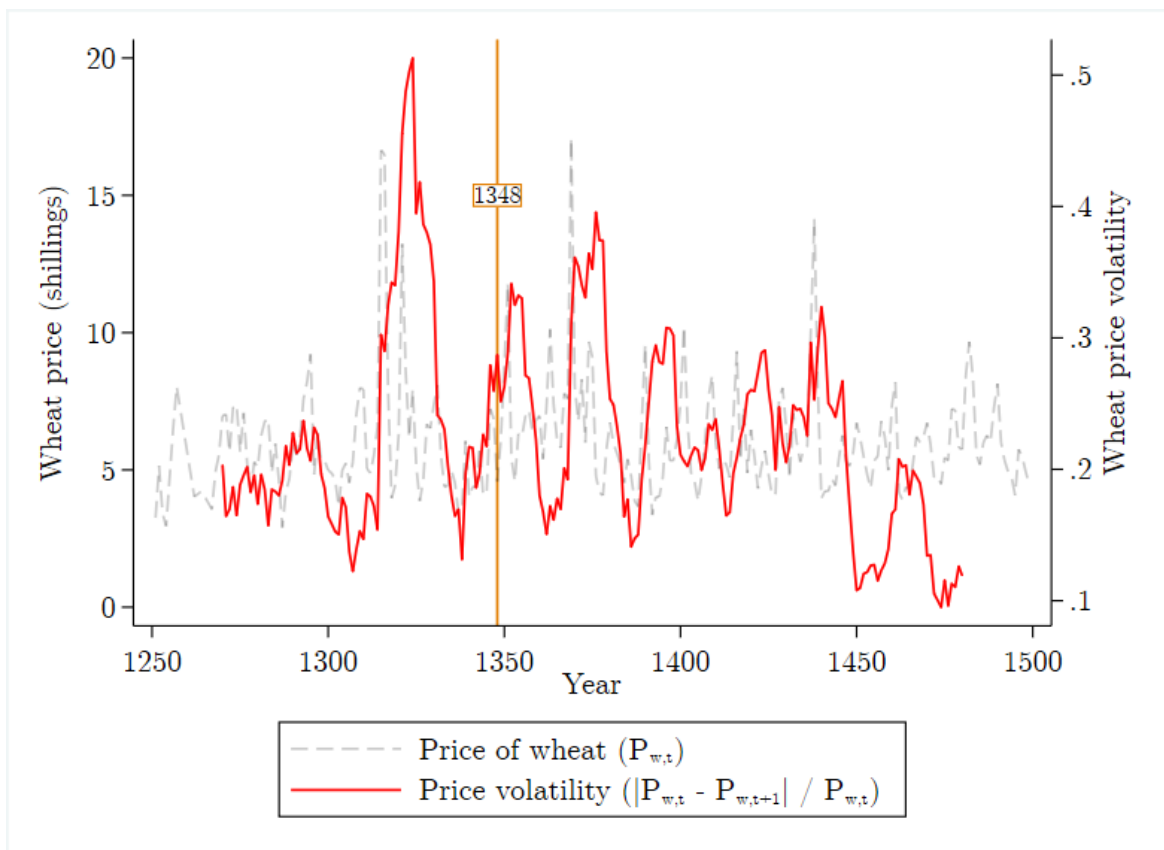


**Notes:** The grain price volatility measure is calculated as a moving average over a window of ten years. The vertical line indicates the onset of the Black Death pandemic.

**Source:** Adapted from Farmer (1988, 1991).

Figure A8: **Nominal coin supply in England, 1279-1450**



**Notes:** The vertical line indicates the onset of the Black Death pandemic.

**Source:** Adapted from Palma (2018).

# E Supplemental figures and results

**Table A2: Correlates of the log levels of cash wages ($y_{\ell,t}^{\text{cash}}$) and in-kind wages ($y_{\ell,t}^{\text{in-kind}}$) in England, 1270-1430 (OLS)**

| Variable | $y_{\ell,t}^{\text{cash}}$ | $y_{\ell,t}^{\text{in-kind}}$ |
|---|---|---|
| Occupation: Agricultural Misc. | 0.240*** | 0.0276 |
| (ref. = Ploughman) | (0.0780) | (0.0527) |
| Carter | 0.0177 | -0.0250 |
| | (0.0263) | (0.0177) |
| Junior | -0.402*** | -0.564*** |
| | (0.0846) | (0.117) |
| Misc. | 0.0978*** | -0.0361 |
| | (0.0360) | (0.0250) |
| Pastoral | 0.0875*** | -0.0808*** |
| | (0.0302) | (0.0182) |
| Region: The North | 0.863*** | 0.360*** |
| (ref. = East Anglia) | (0.0307) | (0.0201) |
| The South and South-west | 0.827*** | 0.0769*** |
| | (0.0354) | (0.0257) |
| The Thames Basin | 0.692*** | 0.317*** |
| | (0.0320) | (0.0244) |
| Decade: 1280 - 1289 | 0.163 | -0.129* |
| (ref. = 1270 - 1279) | (0.145) | (0.0740) |
| 1290 - 1299 | 0.0924 | -0.183*** |
| | (0.0936) | (0.0616) |
| 1300 - 1309 | -0.271*** | -0.221*** |
| | (0.0918) | (0.0592) |
| 1310 - 1319 | -0.152 | 0.0297 |
| | (0.0992) | (0.0634) |
| 1320 - 1329 | 0.0903 | -0.125** |
| | (0.0994) | (0.0619) |
| 1330 - 1339 | -0.0900 | -0.0620 |
| | (0.0961) | (0.0613) |
| 1340 - 1349 | 0.0186 | -0.152** |
| | (0.0980) | (0.0613) |
| 1350 - 1359 | 0.156* | 0.00869 |
| | (0.0939) | (0.0610) |
| 1360 - 1369 | 0.354*** | 0.141** |
| | (0.0948) | (0.0617) |
| 1370 - 1379 | 0.468*** | 0.0831 |
| | (0.0937) | (0.0593) |
| 1380 - 1389 | 0.496*** | -0.148** |
| | (0.0965) | (0.0630) |
| 1390 - 1399 | 0.817*** | -0.121** |
| | (0.0941) | (0.0618) |
| 1400 - 1409 | 1.050*** | 0.0657 |
| | (0.0929) | (0.0619) |
| 1410 - 1419 | 0.807*** | 0.365*** |
| | (0.113) | (0.0711) |
| 1420 - 1429 | 1.153*** | 0.314*** |
| | (0.133) | (0.0802) |
| 1430 - 1439 | 1.337*** | 0.691*** |
| | (0.167) | (0.0930) |
| Constant | 0.851*** | 2.838*** |
| | (0.0896) | (0.0582) |
| Observations | 2,453 | 2,525 |
| $R^2$ | 0.625 | 0.267 |

**Notes:** Robust standard errors are mentioned in parentheses.

$*** : p < 0.01, ** : p < 0.05, * : p < 0.1$

Figure A9: **Scatter plot of in-kind wages (in quarters of grain) and cash wages (in shillings)**
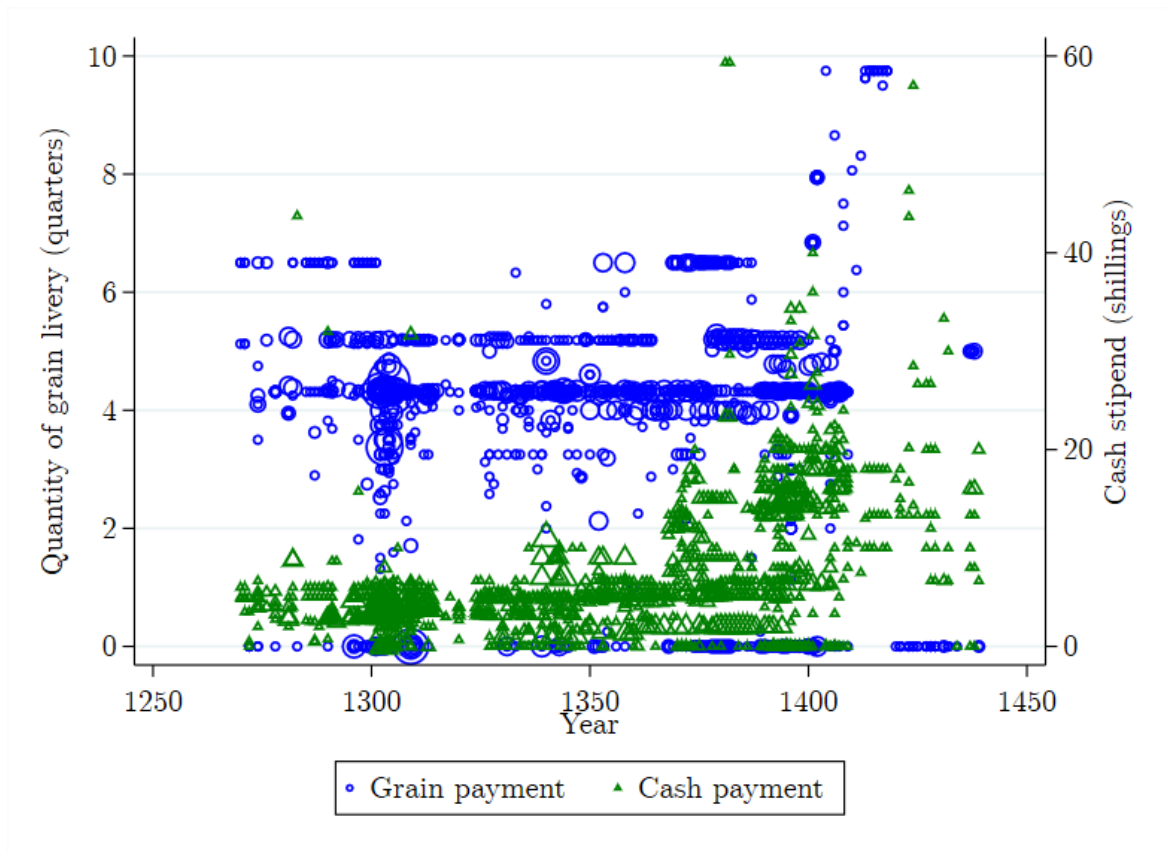


**Notes:** The sizes of the circles and triangles represent their relative frequency in the database.

**Source:** Authors' database.

Figure A10: **A comparison of valuations of in-kind remuneration using our methodology and the CPI assumption (Allen basket)**
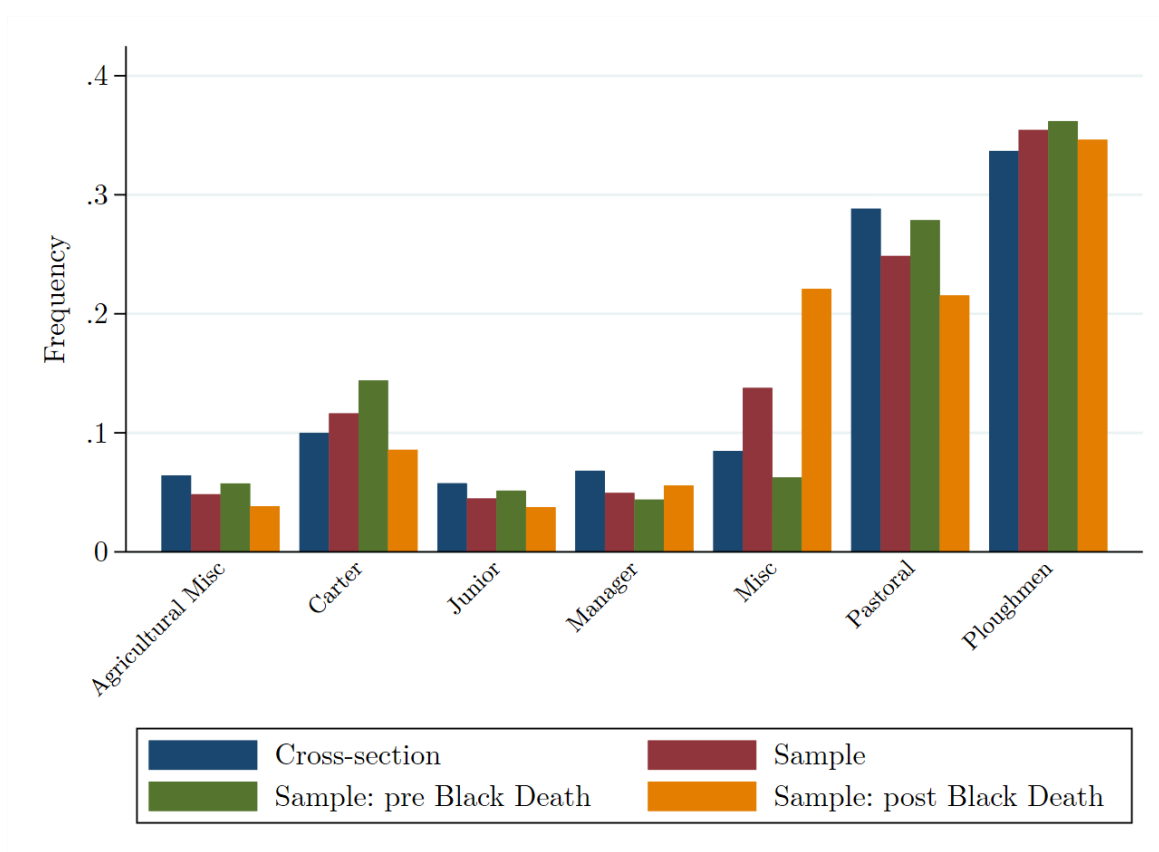


(a) **Quantity of grain as in-kind payment**

(b) **Value of grain as in-kind payment**
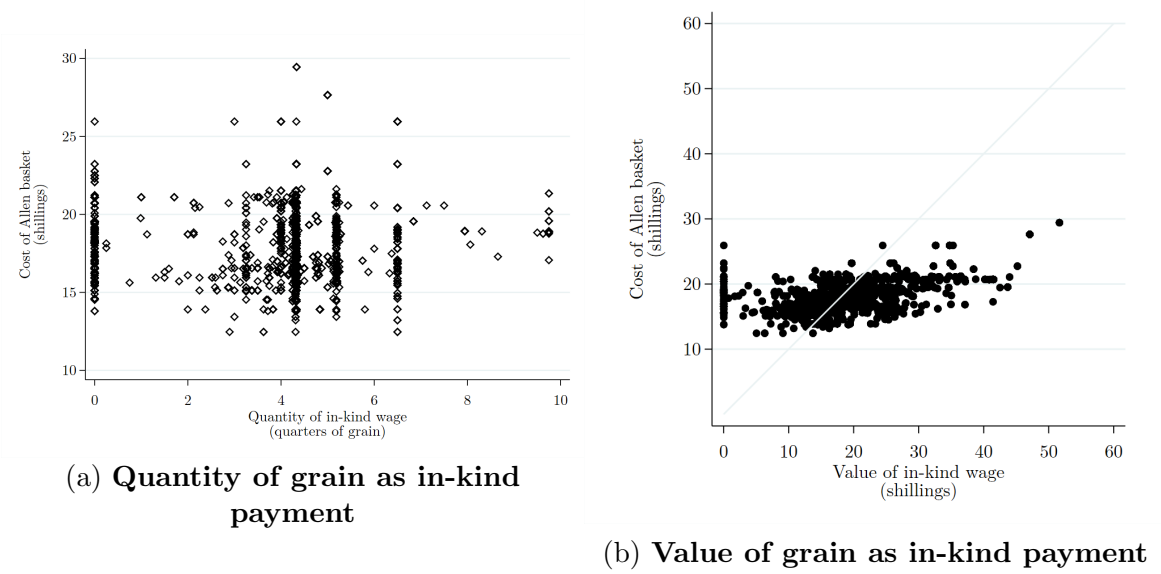
**Notes:** The diagonal grid line represents the 45°-angle line.

**Source:** Authors' database.
The year-level CPI are adapted from R. C. Allen (2009).

Figure A11: **Occupational structure of the *famuli***



**Notes:** From left to right: The blue bars represent the occupational structure according to the nationally representative sample from around 1300 in Claridge and Langdon (2015). The red bars are generated using our total sample, while the green and orange bars are constructed from our sample after distinguishing between the period before and after the Black Death respectively.

**Source:** Authors' database; Claridge and Langdon (2015).

Figure A12: **Share of workers named individually in manorial accounts, by estate**
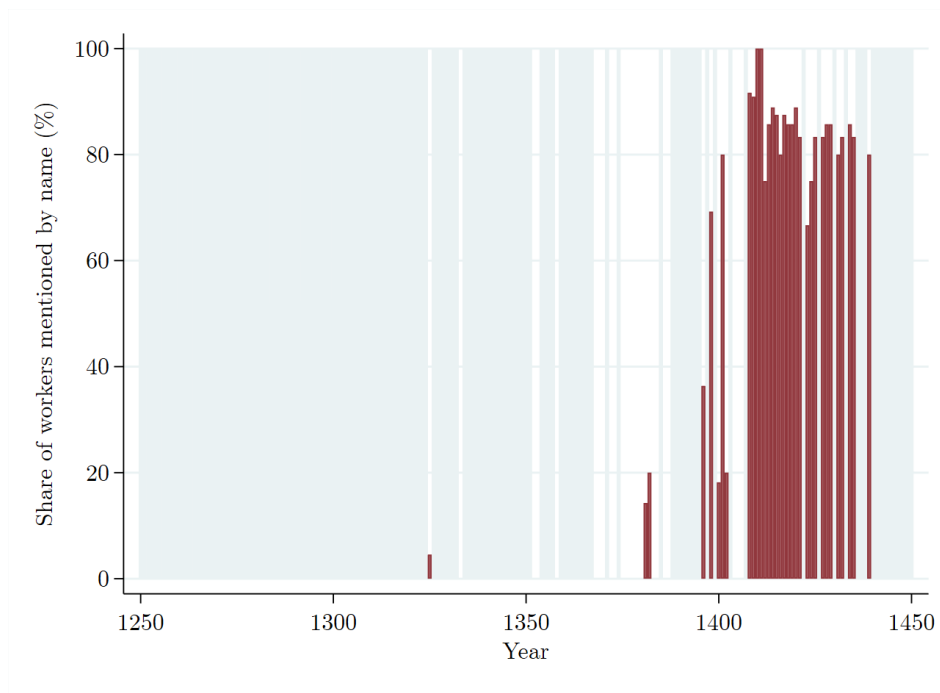


(a) **Battle Abbey (Barnhorn)**
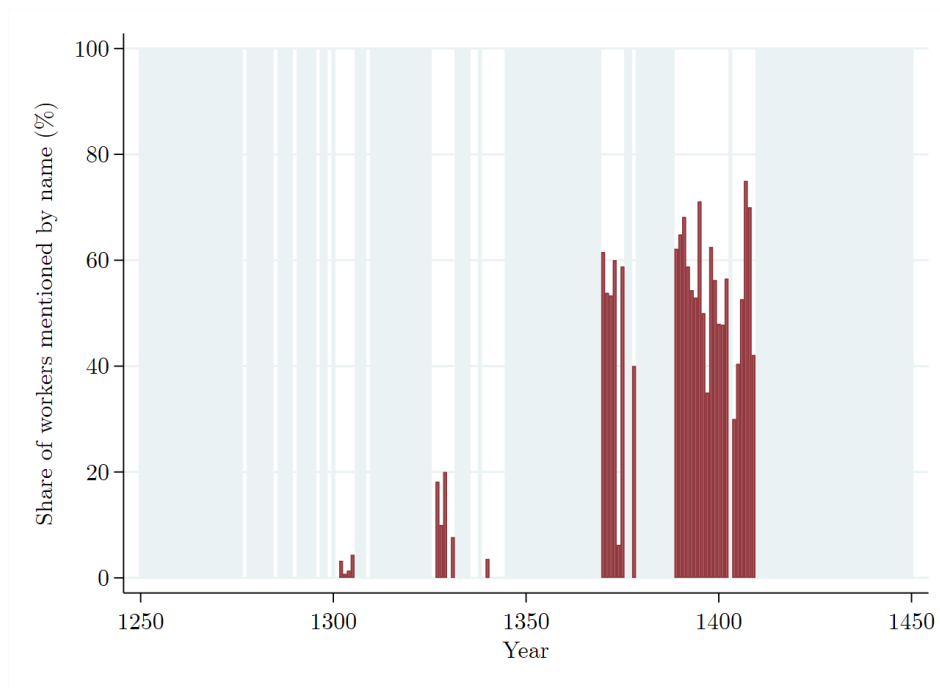


(b) **Durham Cathedral Priory**

**Notes:** The red bars represent the share of workers mentioned by name. Shaded ares indicate the years for which no remuneration data is available.

**Source:** Authors' database.