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Leonardo Ridolfi
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The real wages of the workers of the Dome of Florence (1326-1861)

Leonardo Ridolfi, University of Siena
Michelangelo Vasta, University of Siena & CEPR

Abstract: This paper presents the first long-run homogeneous series of real wages, working days, and skill premiums for building workers in Florence from 1326 to the Italian Unification in 1861. In doing so, we build upon new archival data drawn from the archives of the Opera del Duomo in Florence and the Badia Fiesolana in Fiesole, which span more than 20,000 wage observations. By combining daily wages with annual working days, we provide a more precise estimate of labor input and living standards, while assessing the impact of the common assumption of 250 working days on real wage calculations. We also reconstruct the long-term evolution of the skill premium, shedding new light on the structure of labour markets in pre-industrial Southern Europe. Our findings allow us to revisit the interaction between wages, demographic cycles, and living standards, placing Florence more firmly in both the Italian and international contexts of the Little Divergence debate.

Keywords: real wages, labour markets, living standards, Little Divergence.
JEL Classifications: N13, N33, N94

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1. Introduction

Since the groundbreaking work of Allen (2001), real wages have become a crucial element for assessing workers' living standards in a global comparative perspective. This approach has sparked significant quantitative research on urban real wages of casual building workers across Europe including various Italian cities such as Milan since 1600 (Allen 2001, Malanima 2002), Rome from 1540 to 1810 (Rota and Weisdorf 2020), Venice from 1390 to 1790 (Buscemi and Ridolfi 2024), and Palermo from 1540 to 1850 (Buscemi 2025). Florence serves as a crucial reference point in this debate, as Allen incorporates its real wages in his comparative studies (Allen 2011). With its cultural and economic leadership, Florence was one of the most dynamic, wealthy, and sophisticated cities in Europe during the late Middle Ages and early modern period (Goldthwaite 1982, van Zanden and Felice 2022). Renaissance Florence experienced a building boom that likely had no parallel in Europe (Goldthwaite 1972). Construction was a widespread phenomenon that touched all areas of public, private, and ecclesiastical life. Notably, this period saw the completion of the cathedral of Santa Maria del Fiore, one of the largest churches in Christendom, with the iconic cupola erected under the direction of Filippo Brunelleschi from 1420 to 1436 (Haines 2011). Unsurprisingly, this flourishing activity has attracted considerable scholarly attention, with numerous studies seeking to understand the functioning of Florentine labor markets and to assess workers' remuneration. The most well-known wage and price series have been compiled by Parenti (1939), Goldthwaite (1982) and La Roncière (1982). These form the statistical backbone of some of the most prominent series on Florentine real wages (Allen 2001; Malanima 2013) and GDP per capita (Malanima 2011), which have been central to much of the scholarly debate on the decline of the Italian economy.

Notwithstanding these important contributions, two major gaps remain in the literature. First, the existing series for Florence covers only the period from 1286 to 1605. This limitation is particularly significant, as it excludes a critical phase of transformation for both Florence and the Italian peninsula. Indeed, this was the period when the city entered a phase of decline following the peak of the Renaissance (Parenti 1939, Malanima 2011, Federico et al. 2024). Second, the Florentine wage and price series can be considered "first-generation" estimates that, as explicitly acknowledged by their authors, may be affected by some of the biases recently highlighted in studies on real wages in cities like London, Milan, and Strasbourg (Mocarelli 2004, Geloso 2018, Stephenson 2018). These might include compositional biases due to seasonal and occupational wage differences (Goldthwaite 1982, p. 435), as well as the combination of heterogeneous information from various construction sites, including large building projects such as the Ospedale

degli Innocenti and the Strozzi Palace, as well as much smaller ones reflecting only a few weeks of work for maintenance and repair operations.

This paper aims to fill these gaps presenting the first homogeneous series of real wages and skill premium of building workers for Florence, spanning from 1326 up to the Unification of the country in 1861. In so doing, we build upon new archival data drawn from the archives of the Opera del Duomo in Florence and the Badia Fiesolana in Fiesole, a small town nestled in the hills just outside Florence. These data span several centuries and enable us to estimate homogeneous price and wage series over time. In this regard, our work relates to a recent strand of literature that has examined large construction projects at major cathedrals, such as Saint Paul in London (Parker, Stephenson, and Wallis 2023), San Pietro in Rome (Rota and Weisdorf 2020), and the royal palaces of Madrid (García-Zúñiga and López Losa 2021) and Toledo (Drelichman and Agudo 2020).

Additionally, our paper contributes to a recent strand of the literature which has sought to investigate changes in working time in the pre-industrial period using direct observations from individual workers in Denmark (Jensen, Radu, and Sharp 2019), England (Ridolfi 2017, Stephenson 2020), France (Ridolfi 2019, 2021), Japan (Kumon 2022), Sicily (Buscemi 2024), Spain (García-Zúñiga 2020), and Sweden (Gary 2025). We add to this literature by providing the first century-long homogeneous series of working days per year for Florence, based on the wage lists preserved at the *Opera del Duomo*, covering, albeit with some minor gaps, the period from 1446 to 1861.

Overall, this information allows us to: *i*) close the post-1600 gap in the Florentine series and test whether the grim picture painted by Allen (2001) for central-northern Italy, focusing on Milan, holds true for Florence; *ii*) examine if and to what extent the assumption of 250 working days per year affects the estimates of real wages; *iii*) place Florence more firmly in the national *iv*) and international contexts contributing to the debate on the Little Divergence.

2. Background

The study of construction wages in Florence draws on the work of Goldthwaite (1982), La Roncière (1982), and Parenti (1939). These studies rely on a range of sources that provide a comprehensive and varied view of Florence's pre-industrial labor market, likely unmatched in the Italian context. Parenti's (1939, p. 15) work is based on the account books of the S. Maria Regina Coeli monastery (also known as the Monastery of the Chiarito). La Roncière (1982), on the other hand, uses the account books of Santa Maria Nuova and cross-checks 14th century data with information from three additional sources: the account books of two farms in Legnaia and Settimo belonging to the Hospice San Paolo de Convalescenti during the 1320s; work on the repair of mills along the Arno River near Varlungo in 1369; and the building campaign of the Opera del Duomo

around 1375-78. Finally, Goldthwaite (1982, pp. 440-442) compiles the most extensive dataset, drawing on a variety of archival and secondary sources. These include public and private building projects, routine maintenance, major construction efforts, and some rural building activities. Notable archival sources include the income and expenditure journals of Santa Maria Nuova, which offer scattered details on maintenance work for the hospital's extensive properties and buildings from 1337 to 1469. Other key sources are the building accounts of the Strozzi family, which document work on the Strozzi Palace and the building accounts of Ss. Annunziata in the 15th and 16th centuries.[1] Among the secondary literature, Goldthwaite (1982) also draws on data from Pinto (1974) for 1395-1406 and Parenti's own research for 1520-99. We contribute to this literature by exploring the account books of two major additional Florentine institutions: the Opera del Duomo (see Figure 1) and the Badia Fiesolana.

Figure 1. Map of Florence

Source: Goldthwaite (1982, p.3)

The Opera del Duomo di Firenze (formally known as the Opera di Santa Maria del Fiore) is our primary source. The origins date back to 1294, when the Florentine government convened to discuss the fate of the Basilica of Santa Reparata, the city's main cathedral and religious center

[1] For the Strozzi Palace, we have evidence for the following periods: 1489–1506, as well as various projects from 1413, 1416–1419, 1464–1469, 1474–1477, 1483, 1533–1534, and 1547–1548. For the church of Ss. Annunziata, records are available for the years 1384, 1453–1456, 1460–1463, 1516–1520, 1551–1561, and 1577–1580.

during the early Middle Ages. Likely built in the 5th or 6th century, the Basilica was by then deemed inadequate for the needs of a rapidly growing city. A heated debate ensued over how to restore the church. Proposals ranged from simple restoration to more ambitious plans to rebuild the cathedral entirely (Guasti 1887). The latter approach prevailed, and in 1294, the Florentine government decided not merely to restore the Basilica of Santa Reparata, but to construct a new cathedral altogether (from which the motto *reffici debet* derives).[2] Thus, the Opera del Duomo was established in 1296 with the purpose of overseeing the construction of the Cathedral of Santa Maria del Fiore. It was managed as a semi-independent institution created by the Florentine Republic. Over time, it evolved into a powerful and highly organized body with lasting influence. A key moment came in 1331, when the Florentine government (*Comune*) delegated responsibility for the construction and maintenance of the new cathedral to the influential Wool Guild (*Arte della Lana*), which had the financial resources, organizational structure, and political clout to manage such a monumental project (Guasti 1887, Haines 2002a). This shift is crucial for our analysis, as it transform the Opera in a permanent body with a clear organizational structure and stable financial resources (Fabbri 2002).

The governing board of the Opera consisted of six officials (*Operai*) and a treasurer (*Camarlingo*). Beneath them were four key figures elected by the wardens and consuls of the Wool Guild: the *Provveditore*, the master mason, the notary, and the scribe (Terenzi 2015). The *Provveditore* was a supervisory official, often acting on behalf of the Florentine government or the Wool Guild. He had broad oversight powers, managing finances, supplying materials, and ensuring that the Operai and master builders executed the work correctly and efficiently. As in other construction projects, the master mason served as the technical head, responsible for design, engineering, site supervision, and the hiring and coordination of workers and artisans. He also defined the roles of the workers, drafting deeds for the Operai, while the scribe kept records of the days worked. Beneath this complex governing structure were the workers themselves. Depending on the period, these workers were either directly hired by the Opera or employed through subcontracting arrangements. The Opera could rely on significant financial resources derived from the management of taxes imposed by the municipality, from rents, and finally from its substantial properties (Fabbri 2002). In the 14th and 15th centuries, the Opera del Duomo also acquired timber rights in Casentino, a mountainous and forested region east of Florence (Becattini 2015). These forests were abundant in tall, straight fir and chestnut trees-vital for large-scale construction projects. The timber from Casentino was particularly crucial for platforms, cranes, and the support structures used in Brunelleschi's construction of the Cupola.

[2] See Guasti (1887, p. XXXIV). See also the same author on the interpretation of the term *refacere*.

The second institution we are focusing on is the Badia Fiesolana, a very important abbey located in the hills of Fiesole, just outside Florence. Founded in the 11th century as a Benedictine monastery, it quickly became a prominent religious center as part of the Camaldolese order in the 15th century and was later renovated under Cosimo de' Medici (Borsi 1976). Throughout the centuries, the Badia alternated phases of prosperity and decline. With the suppression of religious orders in 1778 by Leopold II of Habsburg-Lorraine, the archival records cease to be available.

3. Sources and methodology

3.1 Wages

The account books preserved at the Opera del Duomo are the primary sources for this study. Their structure varies significantly over time, making it important to consider these variations. Figure 2 tracks these changes across the years under examination. We can identify five distinct periods.

For the first period (1294–c. 1360), unfortunately, no data have been preserved in the archives to the best of our knowledge. From around 1360 to 1440, we see the first systematic records of wages, identified through the analysis of the *ruoli*—seasonal authorizations for the payment of workers sent to the Opera's treasurer. We start our analysis with the roll of 1380.

For the years 1417–1436, the data are drawn from the project led by Margareth Haines (2002b), *Gli Anni della Cupola*, a digital edition of all the Opera del Duomo documents. For earlier years, the data were collected directly from the Archive. Each roll contains a list of names along with the wages paid to workers during the two semesters that made up the accounting year (summer and winter). As shown in Figure 2, the rolls categorize workers by their occupational status: masters (*magistri*), laborers (*manovali*), and boys/apprentices (*pueri*). It is important to note that these workers' lists reflect projected workforce needs, rather than the actual workforce (Terenzi 2015). The lists—prepared by the *Provveditore*, the master mason, and the scribe, and approved by the wardens (*Operai*)—do not provide information on actual workdays. Being included in the list simply meant that an individual was authorized to work at the Opera, but it did not guarantee their presence on-site during the semester. However, for the few years where the rolls can be cross-referenced with other accounting sources, the results show a high degree of reliability (Terenzi 2015). After the 1440s, the structure of the sources changes, along with the richness, type, and variety of information. Our primary sources in this phase are the Opera's cashbooks (*Quaderni di cassa*), which record payments made to workers on an entry-by-entry basis. As shown in Figure 2, the organization of the cashbooks differs significantly from that of the fabric rolls. While the rolls aimed to quantify the expected workforce on-site for the semester, the cashbooks focused on

detailing the debts and credits of each worker in relation to the Opera. Consequently, all actual transactions between a worker and the Opera were carefully recorded, providing a complete account of the monthly wages paid to workers in each semester.

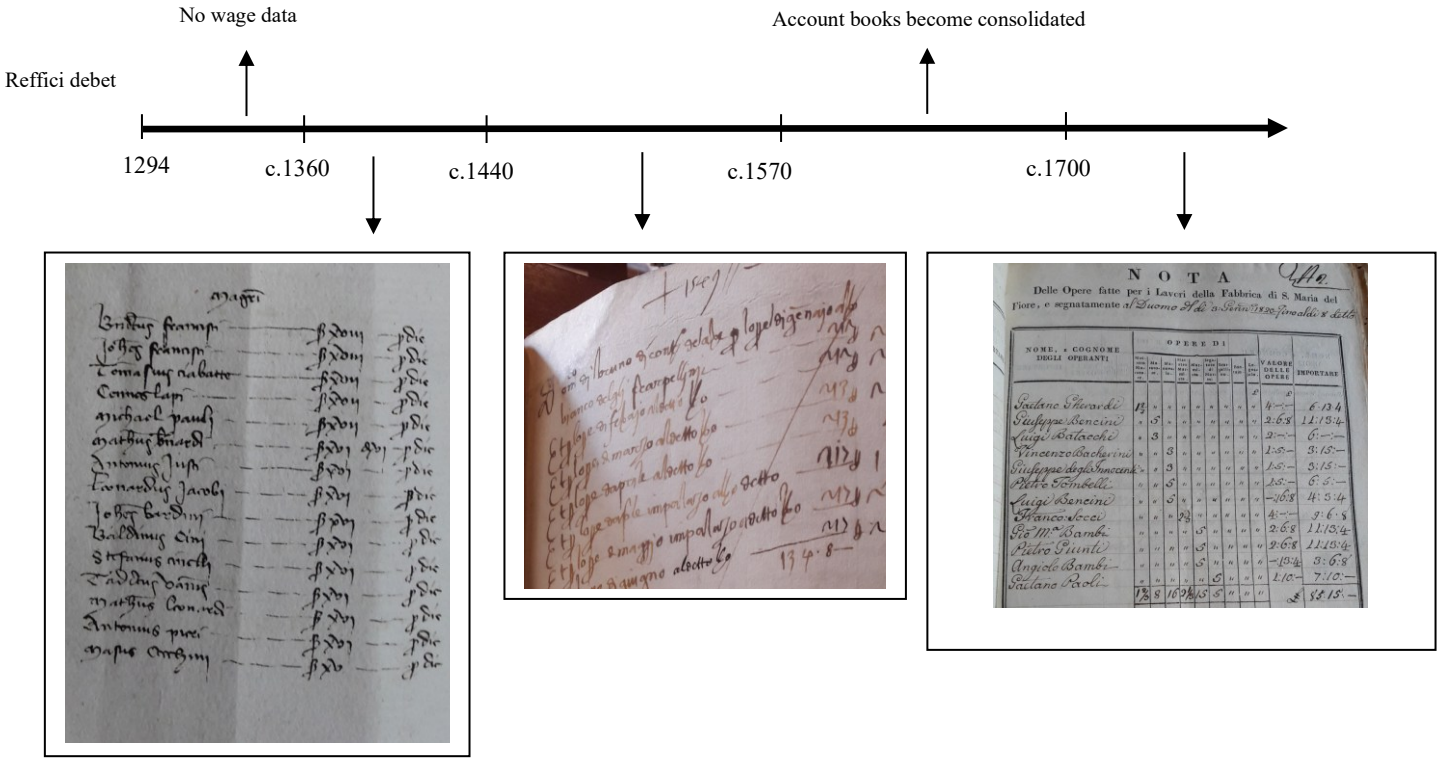
Between c. 1580 and the second half of the 18th century, the accounting structure changes once again, likely to reflect a shift in the workforce hiring practices. The accounts are no longer organized by individual entries; instead, they are consolidated. Only the total costs for masonry work were recorded, without any detailed breakdown of individual payments. With a few exceptions related to small maintenance or restoration projects, this results in a lack of systematic data on workers' wages during this period.

After 1750, the account books become detailed once again. The primary sources in this phase are the so-called *note delle opere*, or notes of the works of the fabric. Information is typically presented in printed tabular form, as shown in Figure 2. This displays a weekly payment note from the Opera for the week of January 3-8, 1820. The first column lists the names of the workers, followed by days worked, daily wages, and weekly totals. The workers' occupations are also listed, classified into nine categories, including master mason, mason, building laborer, and carpenter.

The archival records of the Opera del Duomo provide the foundation for constructing the first long-run wage dataset for Florence, covering the period from the late 14th century to the Italian unification in 1861. However, two main limitations affect this sample. First, as noted earlier, there is a gap between 1580 and 1750. Second, there is the question of the sample's representativeness. The Opera's workers may constitute a distinct—possibly privileged—segment of the Florentine labor force (Haines 1985). To address these issues, we turn to the Badia Fiesolana, for which extensive accounting records are available. Preserved in the Archives of the Ospedale degli Innocenti in Florence, these sources allow us to reconstruct the wages of building workers from the first half of the 15th century until 1776. The data are drawn from the Badia's yearly account books (*Giornali*), which detail the daily expenses of the abbey, including wages paid to construction workers for renovation and building projects. Given the proximity of the Badia to Florence and the fact that many workers were also employed in urban construction sites, it is reasonable to assume a certain integration of the labor market between this institution and the others considered in this study and in the literature.[3]

[3] It is also worth noting that La Roncière (1982, pp. 271-72) addressed this topic, and that Goldthwaite (1982) used the data from the Badia to complement the Florentine series.

Figure 2. Wage data sources



Sources: AOSM, II.1.31; VIII.I.197; XI.3.2.

Lastly, we complement our own data with figures drawn by Parenti (1939), Goldthwaite (1982) and La Roncière (1982), thereby extending the time coverage of our sample back to the 1320s. While there are potential limitations to these series, it seems unwise to dismiss the richness of this material a priori. At the same time, to account for unobserved factors not considered in the computation of the average wages—such as seasonality and source heterogeneity—we closely examine the detailed descriptions of these secondary works. In particular, we take into account that La Roncière's series mostly refers to summer wages and, importantly, we incorporate, as much as possible, the site-specific heterogeneity included in Goldthwaite's data.[4] For example, we account for the fact that wage data from 1489 to 1506 come, in large part, from the building project of the Strozzi palace. This was probably the largest private building project of the time and could have offered the best employment opportunities, but also lower than average remunerations given the fact that Filippo Strozzi retained considerable control over the workforce (Goldthwaite 1982). Incorporating this information into the estimation of the series should lead to more accurate estimates, as opposed to merely aggregating this sparse material.

[4] Goldthwaite (1982, pp. 441–2) provides a detailed description of his materials and the institutions from which the data is drawn, allowing us to reconstruct the provenance of the data for each year quite accurately. However, since we do not have access to Goldthwaite's raw data, we cannot determine exactly how much of the information for a given year comes from one source rather than another when multiple sources are used.

The final dataset comprises 20,382 wage observations of casual workers paid by the day (opera) from 1326 to 1861. The majority of the data comes from the Opera del Duomo (90 percent of the sample), followed by the Badia Fiesolana (around 7 percent), with the remainder drawn from secondary literature. As shown in Table 1, the data are nearly evenly distributed across different periods of the year, with a slight predominance of summer wages (27 percent). For approximately 8 percent of the data (mainly from secondary sources), seasonality is unrecorded.

Table 1. Wage sample by season

Season	Freq.	Percent
NA	1,615	7.9
Autumn	4,377	21.5
Spring	4,115	20.2
Summer	5,521	27.1
Winter	4,754	23.3
Total	20,382	100

Source: see text and Appendix A.

In terms of wage structure, monetary wages dominate, with less than 1 percent of the data referring to mixed wages (workers paid in both cash and kind). This reflects the fact that, in the urban context of Florence, food provisions were uncommon and generally limited to special occasions such as holidays and patron saint festivals (Goldthwaite 1982, Ridolfi 2023). As shown in Table 2, the most frequent unskilled occupation is that of a building laborer, whereas among skilled workers, masons and stonemasons are the most common. All together these three occupations account for nearly 69percent of the total. Other occupations, such as marble workers, bridge builders, and blacksmiths, appear less frequently. A few roles, including carter digger, and gilder, each represent less than 0.1percent of the dataset.

We estimate new series of nominal day wages for casual male building workers using a regression framework à la Clark (2007). Specifically, we fit the following pooled OLS regression model for both skilled and unskilled labourers:

$$ln(w_{it}) = \alpha + \beta_t Year_t + \gamma_k Occupation_k + \sum_k \delta_k \, (Occupation_k \, \mathrm{X} \, Post_{1500}) + \mathbf{X'}_{it}\pi + \theta_i + \varepsilon_{it} \qquad (1)$$

where w_{it} is the nominal wage in location *i* and time *t* expressed in grams of silver per day, $Year_t$ is a year dummy for each year with wage data, while $Occupation_k$ are occupational indicators for the kth occupations illustrated in Table 2. We also introduce an interaction term $(Occupation_k \, \mathrm{X} \, Post_{1500})$, where $Post_{1500}$ is a post-1500 dummy. This term helps account for changes in the occupational structure at the Opera del Duomo over time. Specifically, in the early modern period, there is a distinction between master masons, masons, and building laborers,

whereas during the late Middle Ages, the classification is typically dual (masters versus laborers) (La Roncière 1982, p. 269). As a result, in the Middle Ages, both master builders and masons were classified as "maestri." Finally, **X** is a set of controls for food (one if nourished and zero otherwise) and season (autumn, spring, summer, winter and NA), and θ_i are location fixed effects for six localities: building activity in Florence, specific building sites in the same city (Strozzi Palace and Cupola of the Dome) and building activity in nearby locations (Agna in the province of Pistoia, Fiesole, and Trassinaia). We set as base case the autumn wage of a mason/building labourer paid in cash working in Florence.

Table 2. Wage sample by occupation and skill

Occupation	Skill	Observations	Percentage
Building laborer	0	5,822	28.6
Mason	1	4,838	23.7
Stonemason	1	3,373	16.6
Marble worker	1	1,606	7.9
Master	1	1,381	6.8
Sawyer	1	813	4.0
Woodworker	1	625	3.1
Master marble craftsman	1	480	2.4
Master mason	1	463	2.3
Bridge builder	1	335	1.6
Blacksmith	1	269	1.3
Muleteer	0	112	0.6
Master bridge builder	1	106	0.5
Stone cleaner	0	51	0.3
Master foreman	1	50	0.2
Carter	0	12	0.1
Digger	0	9	0.0
Gilder	1	8	0.0
Others	0/1	29	0.1
Total		20,382	100

Source: see text and Appendix A. *Notes*: the category 'Others' include all occupations with less than 8 observations.

3.2 Working days

As mentioned in the previous section, our sources also provide information on the number of days worked per period. This allows us to construct the first series of actual days worked per year, spanning four centuries, from 1446 to 1861, with some gaps. The data, sourced from the Opera del Duomo, comes from three different types of records. From 1446 to 1506, we rely on wage lists that include details such as the worker's name, daily wage, days worked per month, and monthly totals. In total, we have gathered 4,100 entries, corresponding to 70,870 paid workdays for around 200 workers. In some instances, the wage lists do not cover the entire year. To estimate the total number of workdays per year, we calculate the average number of working days per month and multiply it

by 12 months to obtain the annual totals.[5] We supplement this information with data from the *Quaderni di Cassa*, which report semestral data on the total amount paid (on a monthly basis) and, at times, the days worked per month. This sample covers the years 1451 to 1575, with a total of 520 entries corresponding to 27,743 paid workdays for 510 workers. For each semester, we calculate the total days worked and multiply that number by two to estimate the total days worked per year. Finally, from 1645 onwards, we rely on the *Note delle Opere* (notes from the works of the fabric). This sample spans the years 1645 to 1861, with 10,957 entries corresponding to 59,293 paid workdays for approximately 400 workers. Overall, we have a sample of more than 1,000 workers.

One issue that might affect our estimates concerns turnover (Ridolfi 2019, 2021). Our goal is to estimate the average working year for regular workers—those who are consistently on site. We define regular workers based on three thresholds: at least 100, at least 150, and at least 200 working days per year. It is important to highlight that the records of the Opera provide a relatively accurate account of working days, free from the complications of mixed employment, which often makes difficult the reconstruction of working days for those employed across various construction sites. The Opera del Duomo not only required but also ensured a certain level of commitment and continuity from its workers (Haines 1985). For example, the Opera workers were prohibited from taking on work outside the Opera unless they had first obtained permission from the Operai. A regulation from February 1418 (AOSMF II 1 72, c. 19v.), concerning the stonecutters, further reveals that the Opera imposed a salary suspension on any worker engaged in tasks outside the Opera or on its own construction sites for projects commissioned by third parties, for the duration of their work on that particular task. Similar measures were also applied to the masters, as indicated by this provision dated March 1418 (AOSMF II 1 70, c. 10v) where it is stated that no masters could work outside the Opera without permission (*sine expressa licentia et deliberatione dictorum operariorum*) and that 'anyone who, without first obtaining permission and following the deliberation as stated above, goes, stays, or works as previously mentioned, shall not be allowed to return to work in the said Opera. If they return, no days shall be recorded for them, nor shall any salary be given unless it has first been deliberated by the said Operai.'[6] A regulation of February 1418 instead stipulates a fine of 10 lire for those who worked outside without permission (AOSMF II 1 72, c. 19v). The duration and number of permits granted by the Opera were also regulated, as outlined in an ordinance from March 1430 (AOSMF II 2 1, c.124). This ordinance specifies that permissions for the masters of the Opera to work outside could be granted for a maximum of two

[5] We also test with 10 months, but results are similar. Since building activity was continuous over time, we retain 12 months in our baseline specification.

[6] AOSMF II 1 70, c. 10v '*…et quod quicumque non habita primo licentia et facta deliberatione ut supra dicitur ibit, stabit vel laborabit ut supra dictum est non possit reverti ad laborandum in dicto Opere et, si revertetur, non scribatur sibi dies et non detur sibi aliquod salarium nisi primo fuerit deliberatum per dictos operarios.'*

days at a time and for up to four masters per instance, with no exceptions, despite any contrary deliberations.[7]

3.3 Prices

Our price data come from a variety of sources: the archives of the Opera del Duomo and the Ospedale degli Innocenti in Florence as well as the annual account books of the Badia Fiesolana for the period 1440-1776. These data are complemented by existing series from secondary literature. A detailed review of all these sources can be found in Appendix A. Our dataset covers prices for nine items that were fundamental to pre-industrial diets (see Table 3). To construct consistent price series over time and across different regions, we combine the raw data by fitting the following regression model for each item in our basket (except for bread):

$$ln(p_{it}) = \alpha + \beta_t Year_t + \gamma_k Quality_k + \theta_i + \varepsilon_{it} \quad (2)$$

where p_{it} is the price of the generic item *i* at time *t*, *Year* and θ_i are year and location fixes effects, respectively while $Quality_k$ denotes an indicator that captures variations in quality. These quality differences—particularly relevant for goods such as wine, meat, and textiles—often translated into substantial price differences. We predict bread prices using Federico et al. (2024) bread equation.[8] The price series are used to estimate a Laspeyres consumer price index. Following the standard in the literature, we use a basket that provides approximately 1,940 calories per person per day (Allen 2001). While white bread makes up the largest portion of total consumption, the basket also includes some meat, as well as expenditures on lighting and lodging (see Table 3). Total bread consumption of 225 kg highlights the central role of bread in the dietary habits of Florence. Despite the city's chronic shortage of grain from its surrounding countryside—and the consequent need to source agricultural goods from other areas—the Florentines preferred wheat bread. According to Cherubini (1998, p. 78), the average daily bread ration in 15th century Florence was approximately 0.6 to 0.7 kilograms per person, with similar quantities common in the 13th century as well (La Roncière, 1982, p. 388). In contrast to other regions (particularly rural areas) where mixed bread and the consumption of minor cereals such as barley and rye were common, wheat

[7] The years of the deliberations are converted from the Florentine calendar to the current one.

[8] Federico et al. (2024) estimate bread prices from wheat prices using a panel of 1,083 matched pairs of wheat and bread prices for the same location and year drawn from 7 Italian regions (Lazio, Liguria, Lombardia, Piemonte, Puglia, Sicilia and Veneto) over the years 1526-1861. Federico et al.'s (2024) bread equation is as follows: $Bread_{it} = 0.657 + 0.964 \cdot Wheat_{it} + FE_i$ where FE_i varies with the region and in the case of Tuscany is -0.171. In the international comparisons, to ensure consistency, we rely on Allen's (2001) bread equation to predict bread prices: $Bread_{it} = 0.063 + 1.226 \cdot Wheat_{it} + (0.017 + 0.014) \cdot Wage_{it} - 0.092$. Note that this equation is estimated on a sample of European Italian cities but just two are Italian (Milan and Florence). London serves as the base category.

became firmly established in medieval Florence. It constituted the basic foodstuff in both urban and rural settings, even during famines (La Roncière, 1982, pp. 384-385). The expenditure share for wheat ranged from 40 to 50 percent (Pinto, 1981, pp. 171-172; Tognetti, 1995, p. 298).

While there is broad agreement between the bread consumption assumed in Allen's basket and the scattered evidence from medieval budgets, more discrepancies emerge when considering meat and wine. For instance, data from slaughtered animals suggest a higher average per capita meat consumption, exceeding 30 kg per year (Fiumi, 1953, p. 220; La Roncière, 1982, p. 387). At the same time, institutional rations administered in the 14th century by hospitals and religious institutions—likely upwardly biased—indicate very high wine consumption, ranging between 226 and 300 liters per person per year (La Roncière, 1982, p. 389). Interestingly, the share of expenditure on rent was between 4 and 7 percent of total expenditure between 1289 and 1377, according to La Roncière (1982, p. 394). This value aligns with the 5 percent expenditure share assumed by Allen (2001). Unsurprisingly, these differences reflect variations in methodology and the composition of the basket. For instance, medieval household baskets consistently show higher-than-average meat consumption. Patchy evidence drawn from various sources and regions of Europe suggests that meat consumption peaked in the post-Black Death period, when real wages were at their highest, but declined progressively, especially following the great inflation of the 16th century (Bennassar and Goy 1975, Revel 1975, Ridolfi 2019). Since our basket is intended to reflect an average subsistence consumption across centuries—not just medieval dietary regimes—we consider Allen's basket a useful standard reference point.

Table 3. Consumption basket

Consumer Price Index	Unit	Calories per unit	Baseline
Bread	Kg	2,450	225.2
Legumes	Lt	1,225	20
Meat	Kg	2,500	5
Olive oil	Lt	9,000	5
Wine	Lt	850	90
Textile	M		5
Candles	Kg		2.6
Lamp oil	Lt		2.6
Firewood	MBTU		2
Rent	% of total cost		5
Total calories	Per person/day	1,946	

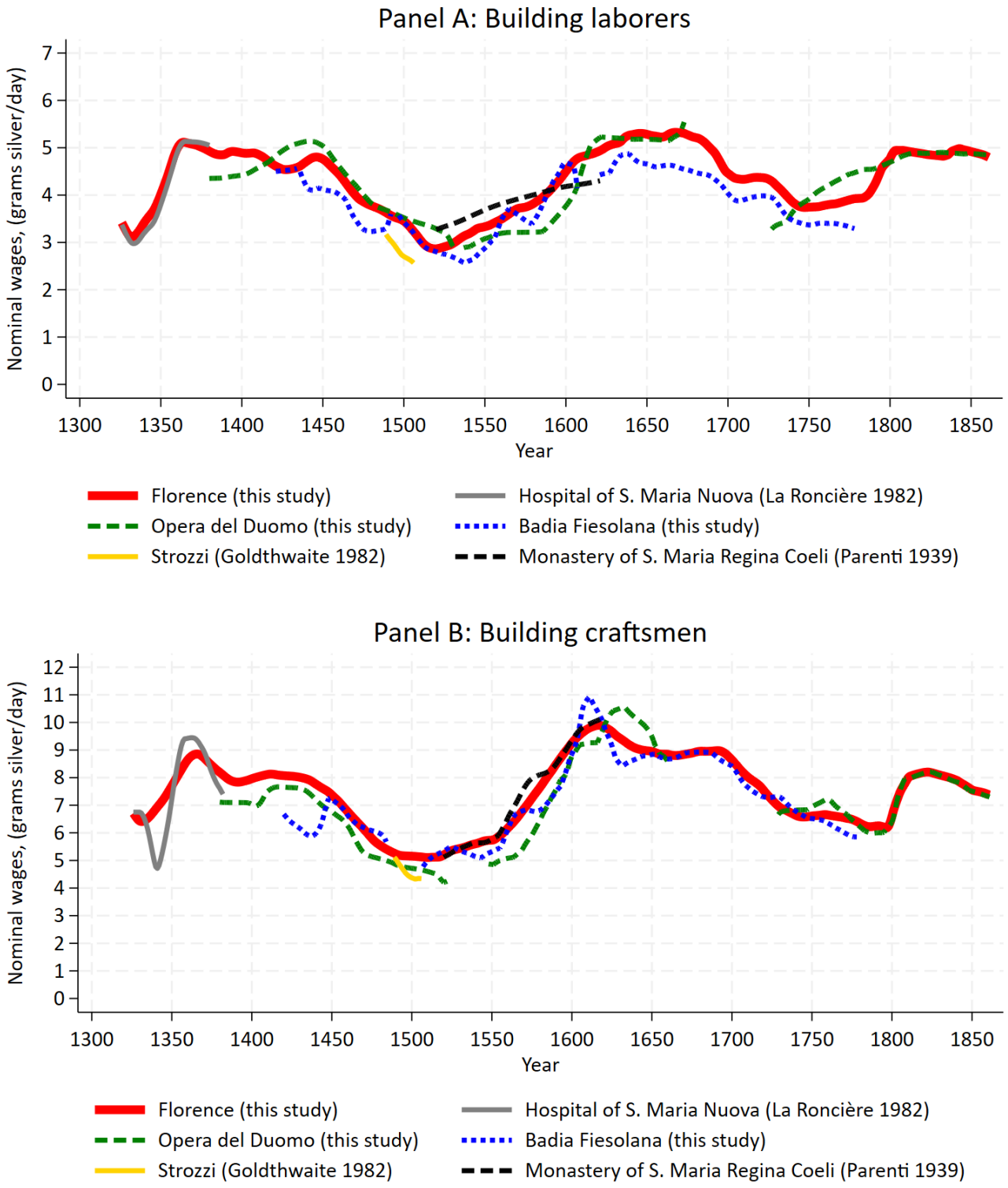
4. Results

4.1 Nominal wages and skill premium

We begin by comparing our nominal wage series, expressed in grams of silver per day, with existing estimates in the literature. Figure 3 displays our overall nominal wage series for Florence,

alongside the individual series from the main institutions used to compile it. Panel A presents the series for building laborers, while Panel B shows the corresponding series for building craftsmen.

Figure 3. Nominal daily wages in Florence



Sources: see text. *Notes*: it is worth noting that the series labelled 'Strozzi' (Goldthwaite 1982), which covers the years 1489–1506, also includes records from building works on a house belonging to the Hospital of the Incurables (1490–1497) as well as from the construction of the palace of Alemanno Salviati (1499–1500) and Santa Felicita (1502).

Overall, our baseline series (in red) shows three peaks: after the Black Death in 1348, around the mid-17th century, and in the early 19th century, while three troughs occur in the 1330s before the shock caused by the Black Death, in 1520s, and in the 1740s (unskilled worker) and in 1790s (skilled workers). While a rigorous analysis of labor market integration in Florence is beyond the scope of this paper, overall, the evidence suggests that wages of different institutions followed broadly similar long-term patterns. However, using a diverse range of sources provides a clearer picture of average urban wages than relying on just one or a few selected sites. For instance, the nominal wages of building laborers at the Opera tend to growth faster than elsewhere during the Cupola years (1420-1436) and in the last decades of the 18th century. Furthermore, their levels are not systematically higher than those recorded at the Badia, with an overall difference of approximately 9 percent in favour of the Opera del Duomo (Figure 3, Panel A).[9] Similar patterns also emerge for skilled workers (Figure 3, Panel B): the ratio between the Opera del Duomo and the Badia Fiesolana's series is equal to 1, although the Opera del Duomo series peaks during the period of the construction of the Cupola. Interestingly, the wages at S. Maria over the years 1520-1619 are about 18 percent higher than those at the Opera. This difference may reflect the fact that the Opera tended to guarantee more stability of employment (Terenzi 2015).

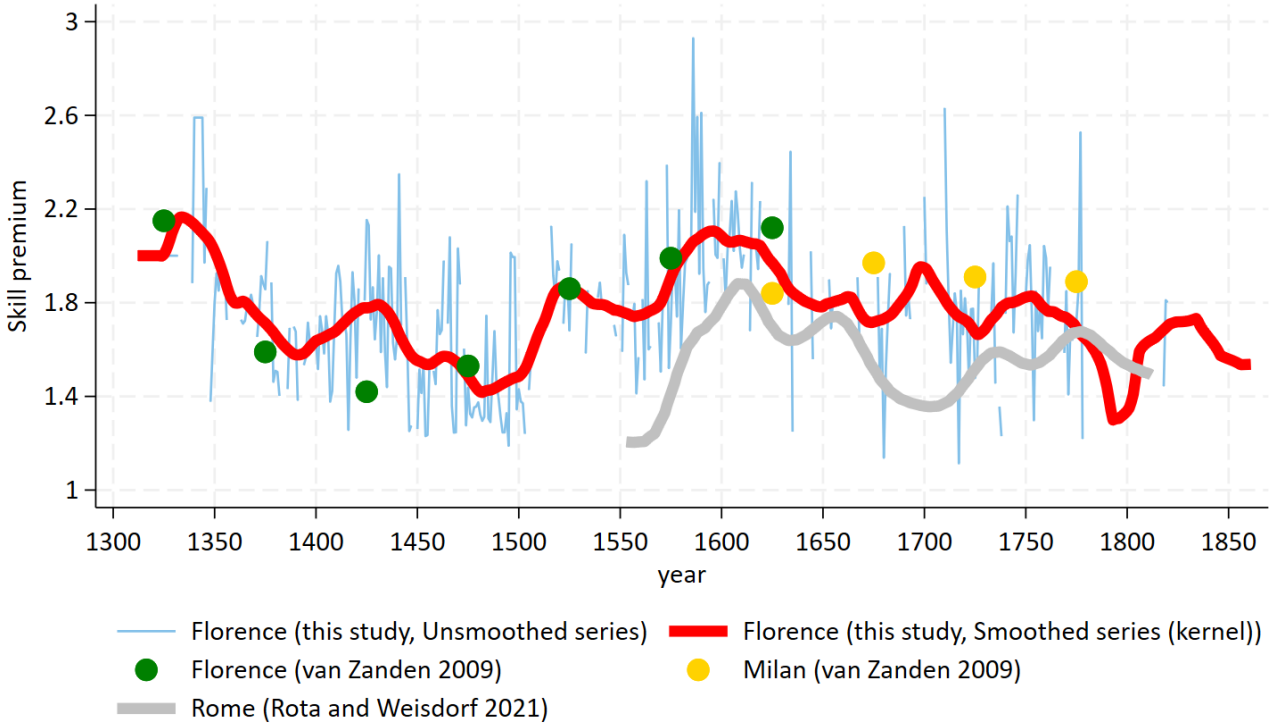
In Figure 4, we also present a detailed overview of the evolution of the skill premium in Florence from 1300 to 1861. This is calculated as the ratio between the average nominal daily wage of a mason and of a building laborer. On average, the skill premium in the building industry fluctuates between 1.3 and 2.2 and has a mean value of 1.75.[10] Peak values are observed in the first decades of the 14th century when it was not uncommon for masons to earn twice as much as their unskilled counterparts. After around 1348, the skill premium declined sharply, reaching a minimum in the last decade of 1400, when it stood at around 1.4—implying a 40 percent premium over the wages of building laborers. This decline aligns with evidence from other European cities (van Zanden 2009). From around 1500 onwards, the skill premium rose again, peaking around the last decade of the 16th century. After this, a gradual decline occurred, with fluctuations continuing into the second half of the 1800s, when the average skill premium was approximately 1.5, reaching 1.54 in 1861. Remarkably, this level of the skill premium at the Unification is fully consistent with Federico et al. (2021) who report a value of 1.61 for Italy in 1861, using an entirely different set of sources.

This result provides an interesting perspective on the evolution of skill premia in Italy and Southern Europe more broadly. The literature has long emphasized the differences between the

[9] Furthermore, the regression coefficients consistently show that unskilled workers' wages at the Strozzi Palace and the rural areas were lower than average (Appendix B, Table B1).
[10] These statistics refer to the series in kernel.

North Sea area, where the skill premium remained relatively low and stable (around 1.5), and Southern Europe, where the skill premium tended to rise, particularly from 1500 onwards, reaching values of 1.8 or higher by the end of the 18th century (van Zanden 2009). Our new series from Florence does not fully align with this pattern, showing that the Southern European pattern of an increasing level of the skill premium was not shared in by all major Southern European urban centers. This trend appears broadly in line with estimates for Rome, although the levels in the latter case are generally lower.

Figure 4. Skill premium in Florence, 1310-1861



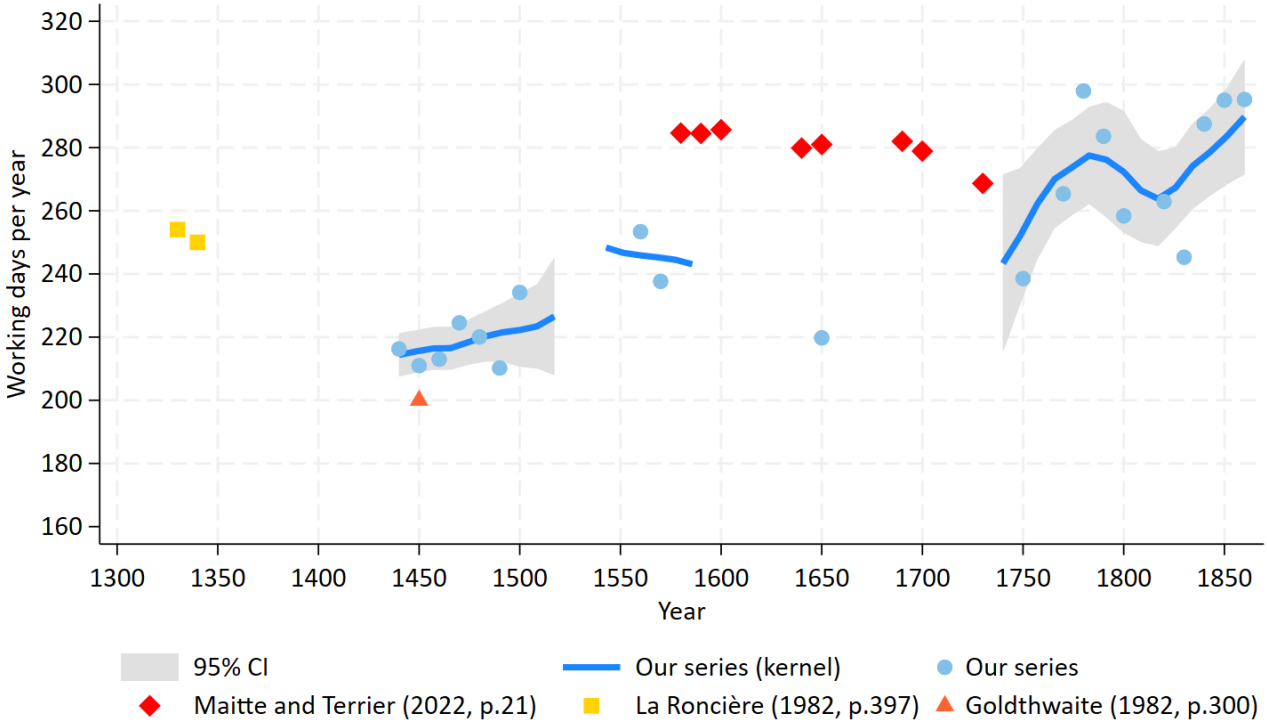
4.2 Working time

Figure 5 shows the evolution of working time in construction in Florence, using the sources and methodology explained in section 3.2. We present both the annual estimates and the smoothed series using polynomial fitting. Our series is also compared with other indirect estimates found in the literature: the evaluation by La Roncière (1982, p.397) for the early 14th century, which places the average working year around 250 days; an evaluation by Goldthwaite (1982, p.300), which sets the working year lower—around 200 days—during the 15th century; and more recently, the estimates by Maitte and Terrier (2022) regarding the days worked in the workshops and construction sites of the Grand Duke of Tuscany between 1585 and 1736. It is important to

highlight that this latter series does not refer to the actual working year, but the maximum workable days in the firm (Maitte and Terrier 2022, p. 22).

From Figure 5 two main conclusions emerge. First, while our data show an average of 249 working days—perfectly in line with the standard assumption of 250—there is considerable fluctuation over time, suggesting that a fixed benchmark may oversimplify historical trends. Indeed, the actual average working time increased from around 216 days in the second half of the 15th century to roughly 274 days in the 19th century—representing a 27 percent rise along the period. Second, comparing these results with other estimates shows a high degree of alignment with Goldthwaite's figures, while also highlighting how the actual working year during the 15th and 16th centuries was well below the theoretical maximum. Although the data for this period are more fragmented, the estimates point to 210-253 actual working days, as opposed to the approximately 280 maximum working days suggested by Maitte and Terrier.

Figure 5. Working year in Florence

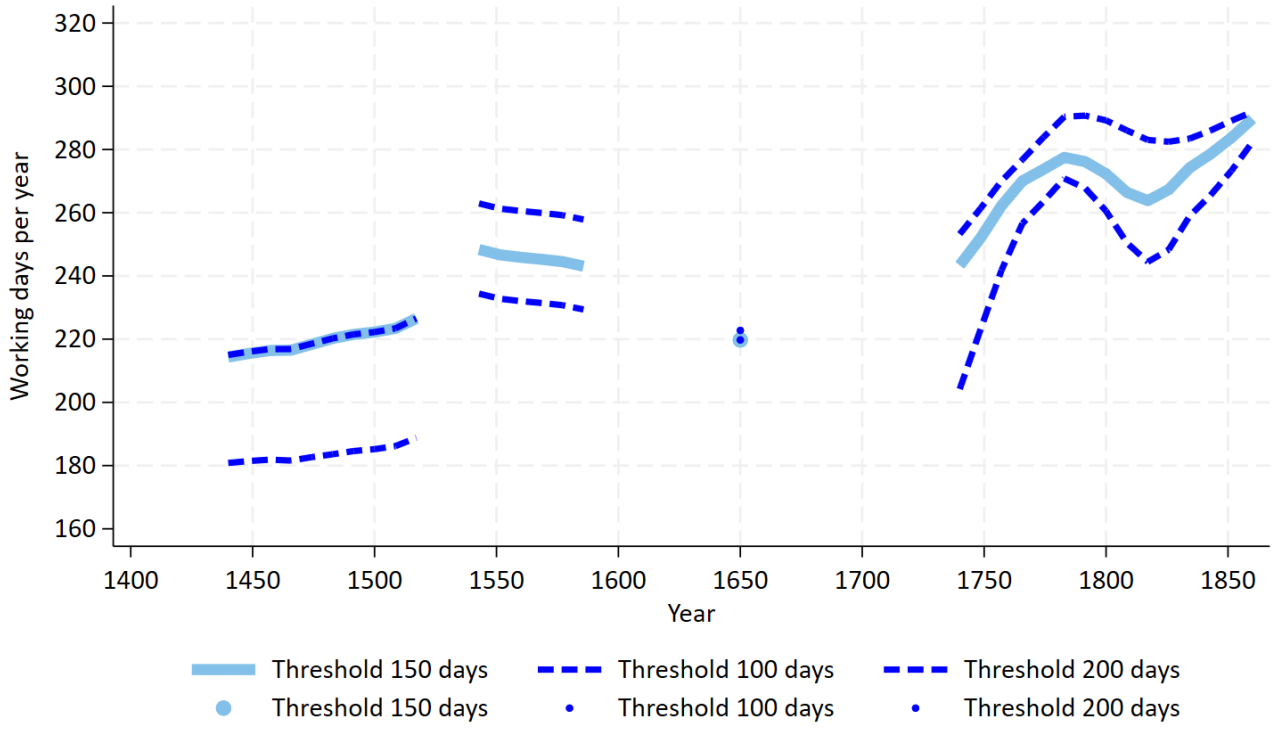


Sources: see text. *Notes*: Goldthwaite (1982, p. 300) estimates the working year in the 15th century at approximately 200 days as a maximum. In our analysis, we represent this value using the year 1450 as a reference point.

The series presented in Figure 5 is based on a definition of a regular worker set at 150 days. However, how would the long-term trajectory of working days in Florence change if different thresholds were used? To answer this, we compare our baseline series with two alternative estimates based on a 100-day threshold (lower limit) and a 200-day threshold (upper limit). The results of this comparison are shown in Figure 6. Between 1446 and 1500, the average working year

fluctuates between 181 and 216 days, with no noticeable differences between using the different thresholds. In the second half of the 16th century, the number of working days ranges from about 220 to 244, and between 1750 and 1861, it fluctuates between 259 and 284 days. As for the trend, the series based on the 150-day and 200-day thresholds show similar rates of increase (ranging from 26 and 31 percent respectively, between 1446 and 1861). However, applying the lower 100-day threshold results in greater growth, with working time increasing from 180 to 280 days, corresponding to a 43 percent rise between 1446 and 1861. These data suggest an increase in working time in the range of 26-43 percent between the mid-15th century and the mid-19th century.

Figure 6. Working time in Florence: sensitivity analysis

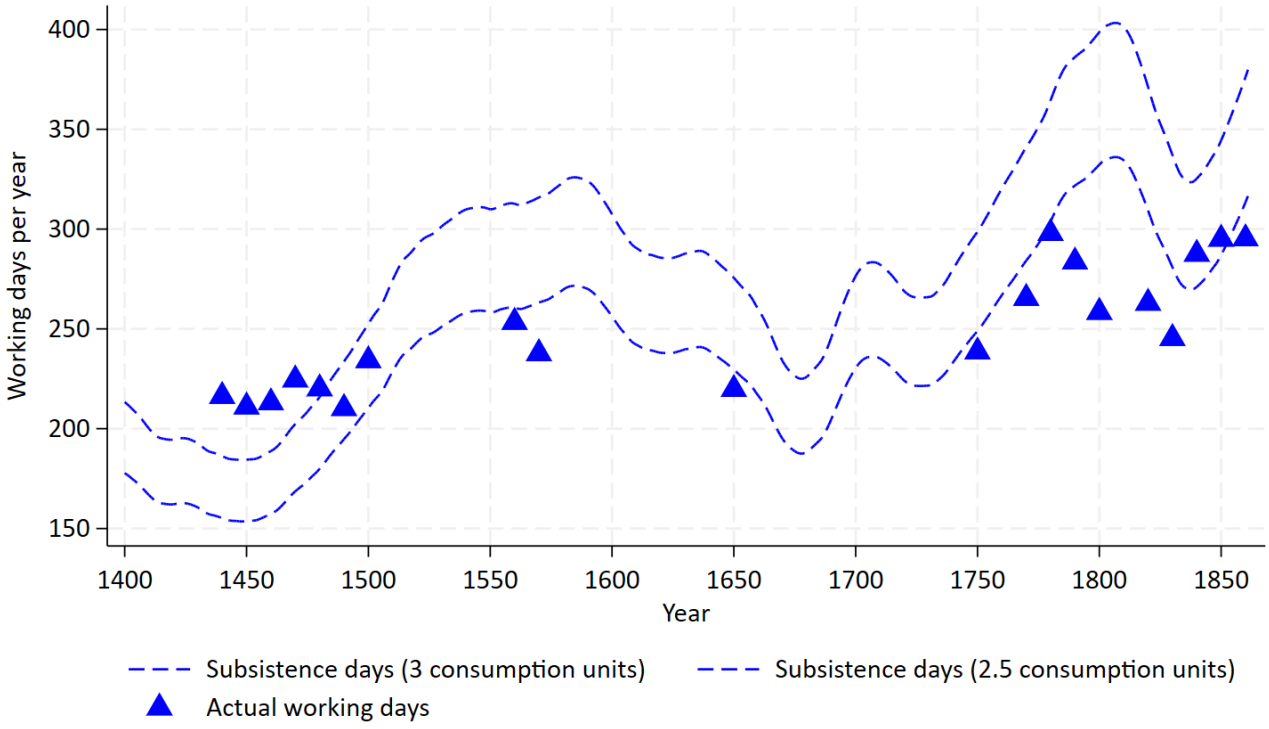


Working time offers a valuable lens through which to explore key dimensions of historical labor markets, including labor supply responses and standards of living. In Figure 7, we plot our baseline series of historical working days with the subsistence working year defined as the minimum number of days necessary for a male breadwinner to provide for his family (Allen and Weisdorf 2011). We consider two distinct hypotheses about household size. The first scenario assumes that the household was composed of two adults and two children, with children consuming half as much as adults, equivalent to 3 adults. The second hypothesis assumes a household size equivalent to 2.5 adults.[11] The subsistence working year estimated with 2.5 adults coincides

[11] In their exercise, Allen and Weisdorf assume an equivalent of 3.25 adults.

reasonably well with the series of annual labour input. This suggests that fluctuations in working time were not driven by an Industrious Revolution or shifts in consumption patterns, but more by growing prices, as households attempted to offset the loss of purchasing power to maintain a stable standard of living. If we consider a household of 3 adults, we see that the breadwinner is not anymore able to support the family at subsistence level except for the 15th century when the earnings of the breadwinner were enough to support the family and the work of women and children was less necessary than in the later centuries (Malanima 2022). This evidence also aligns with the long-term evolution highlighted by Allen and Weisdorf (2011) for rural England and by Ridolfi (2019, 2021) for France. It is also consistent with the view of an Industrious Revolution confined primarily to Dutch and English workers, but not observed in France, Portugal and Spain, as suggested by recent estimate of the labour share (Federico, Nuvolari and Vasta 2023).[12]

Figure 7. Subsistence and actual working time in Florence



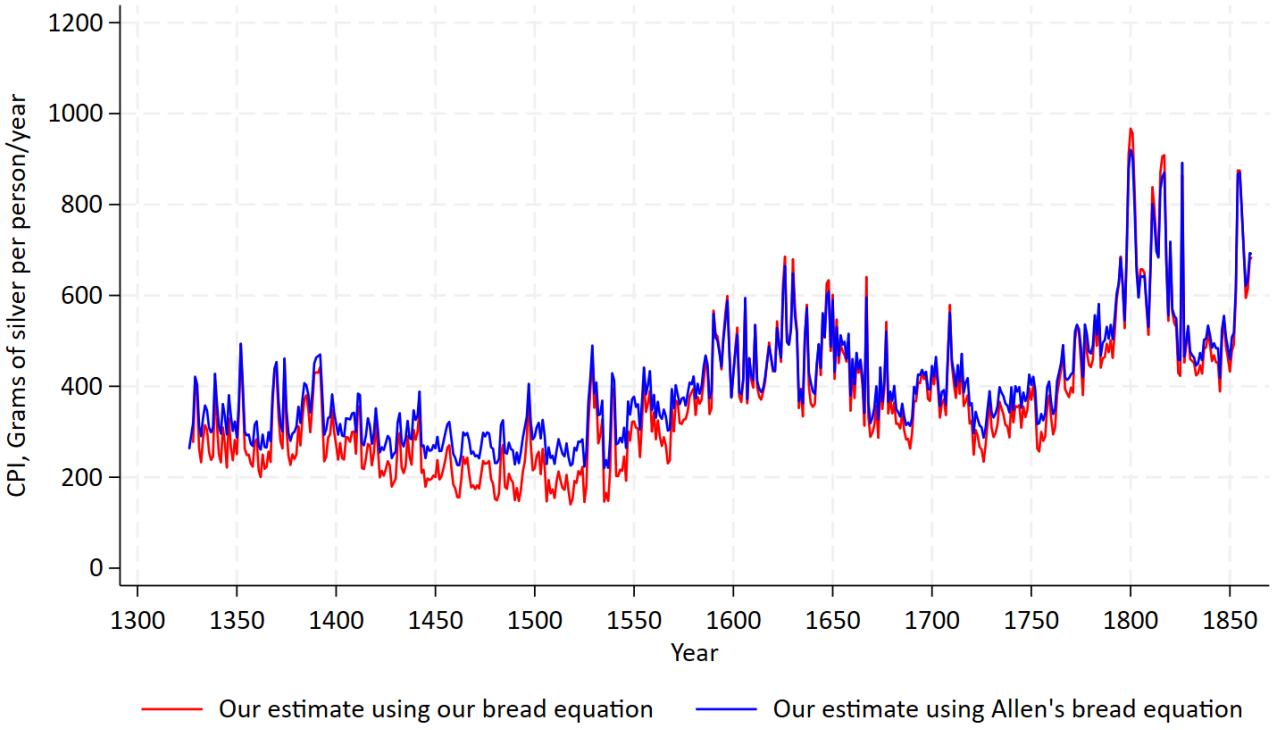
4.3 Consumer price index

In this section, we compare the evolution of the cost of living in Florence from 1326 to 1861 using the sources and methodologies presented in Section 3.3. Figure 8 shows two series of the cost of living. The red line represents our benchmark series. This uses the Italian bread equation by Federico et al. (2024) to estimate the price of bread (which is known to be the most important

[12] The pairwise correlation between the working time and CPI is 0.59 and statistically significant at 1 percent level.

element of the basket). The figure also shows the evolution of the cost of living in Florence with bread prices estimated using classic Allen's bread equation (blue line). Both series are expressed in grams of silver per person per year and are comparable in terms of the structure of the basket (Laspeyres basket with 1,940 calories).

Figure 8. The evolution of the CPI in Florence



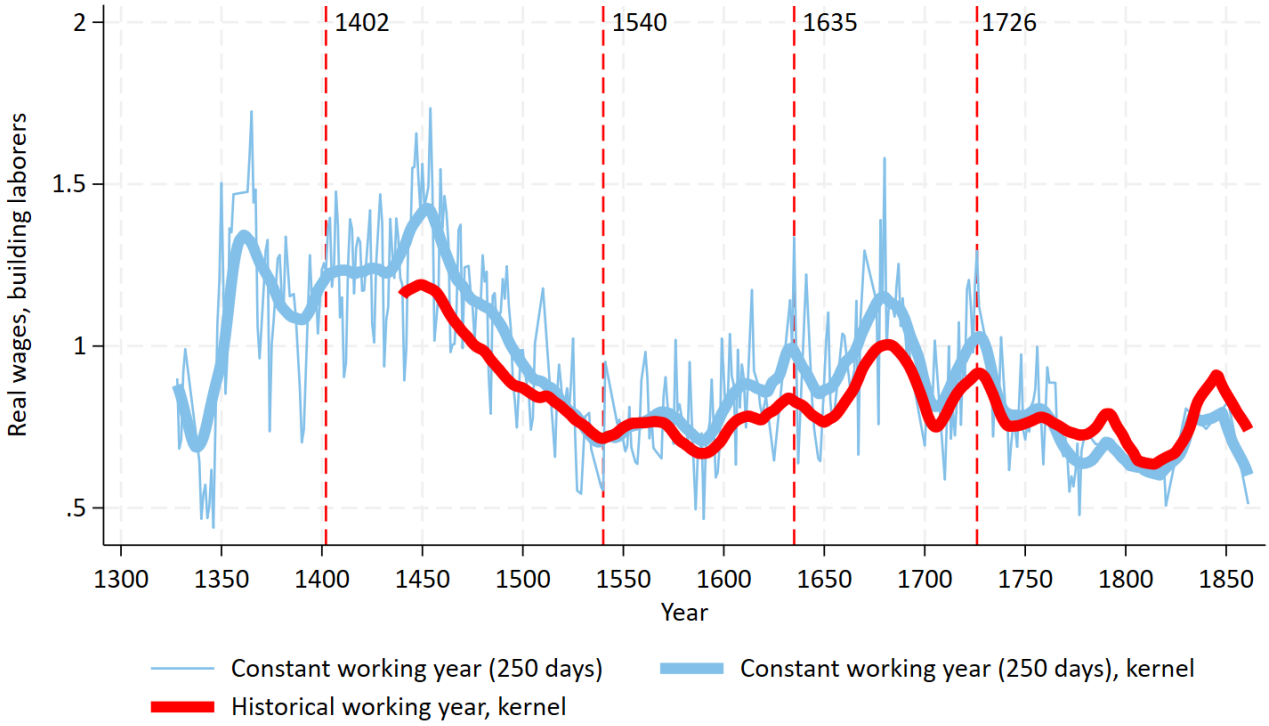
The evolution of the cost of living follows long-term cycles like those highlighted in the literature for other contexts. Specifically, there is a period immediately before and after the 1348 plague, marked by high consumer prices, followed by a long deflationary phase lasting until the mid-15th century. This is followed by a period of price stabilization until the early 1500s and a significant inflationary wave in the 16th and up to mid-17th centuries. In the subsequent period, prices decline again, before rising once more between c. 1750 and 1800, coinciding with the strong demographic growth that saw Florence's population increase from around 75,000 in 1750 to c. 110,000 inhabitants in 1850 (MAIC 1862). Another key insight from Figure 8 concerns the differences in trend and level between our benchmark series and the other one. Specifically, Allen's bread equation yields a lower estimated price of bread, which results in a lower overall cost of living compared to our baseline. Consequently, our price estimates are approximately 9 percent higher over the entire period, and up to 19 percent higher before 1500 (see section 3.3 and footnote 9 for details).

4.4 Real wages

In this section, we first present our newly constructed series of real wages in Florence. We then compare it with those from other major Italian cities. Finally, we extend this comparison to include selected international reference cities, placing Florence within the broader context of the Little Divergence debate.

Figure 9 shows the evolution of real wages for construction workers in Florence from 1326 to 1861. The red curve, or baseline estimate, incorporates our reconstructed series of working days, while the blue one assumes a constant 250 working days per year. We consider the baseline series to be the most accurate, although it begins in 1446 due to the lack of earlier data on working days. In the comparative analysis, however, we rely on the constant working days series, as comparable estimates of working time are not available for the other Italian and European cities considered. Nevertheless, no major differences emerge between the two series. The average value of real wages over the period is 0.91 when using a fixed 250 working days, and 0.85 when using our series with variable working days.[13] However, some differences become apparent in two sub periods: the second leg of the so-called "Golden Age of Labor" (1450-1550) and the pre-unification decades (1820-1861).

Figure 9. Real wages in Florence



Notes: The breakpoints for the 'Historical Working Year' series differ slightly from those of the 'Constant Working Year' series. These latter occur in 1558, 1625, and 1733.

[13] We estimate real wages with variable days using the annual series of working days with the threshold of 150 days, interpolating the gaps linearly.

We formally test the behaviour of the series using a simple econometric approach. Specifically, we apply the Bai-Perron (2003) test to identify structural breaks in the series of 250 working days. Results reveal four breakpoints, dividing the series in five distinct subperiods as shown in Figure 9.[14]

The dynamics of the first two subperiods (1326-1402 and 1403-1540) can be interpreted as a Malthusian cycle triggered by the Black Death. Indeed, recent estimates show that the population in Florence fell sharply- from 92,000 to 37,000 inhabitants- as a result of the plague (Benedictow 2021, p. 723). In the first leg of the Malthusian cycle (1326-1402), real wages rose sharply by 34.4 percent, moving from a welfare ratio of 0.90 to 1.21. In contrast, the second leg (1403-1540), saw a dramatic decline with real wages falling by 41 percent and bringing the welfare ratio down to 0.71.

In the following two periods the real wages grew. In the period 1540-1635, characterized by the consolidation of the Medici power and the creation of the Grand duchy of Tuscany in 1569, the welfare ratio increased by 39 percent, rising from 0.71 to 0.99. Indeed, the Medici consolidated their power by seeking the support of the people against the old oligarchy. Enhancing workers' protection and limiting the influence of the *popolo grasso* (wealthy elite), they fostered broader social consensus but also improved the legitimacy and stability of the Principate (Parenti 1939).

In the following period (1635-1726), still characterized by the Medici rule, real wage growth was very limited (only 4 percent). Such stagnation may be seen as foreshadowing the eventual decline of the Medici dynasty. Finally, in the last phase, beginning with the advent of the Lorena dynasty in 1737 and ending with the unification of Italy, the welfare ratio declined sharply. During this period, rising consumer prices (see Figure 8) significantly eroded household purchasing power, leading to a 42 percent drop in real wages and a fall in the welfare ratio to 0.60, the lowest level in the entire series. Reassuringly, this value is perfectly in line with the estimate for the center of Italy in 1862 by Federico, Nuvolari and Vasta (2019).[15]

It is interesting to relate these estimates of real wages to the demographic development of Florence. In a pre-industrial world, often interpreted through a Malthusian lens, examining the long-term relationship between real wages and population offers a valuable framework for assessing the extent to which Malthusian forces shaped economic and social development over time. While a rigorous analysis of the Malthusian model goes beyond the scope of this paper, it is important to

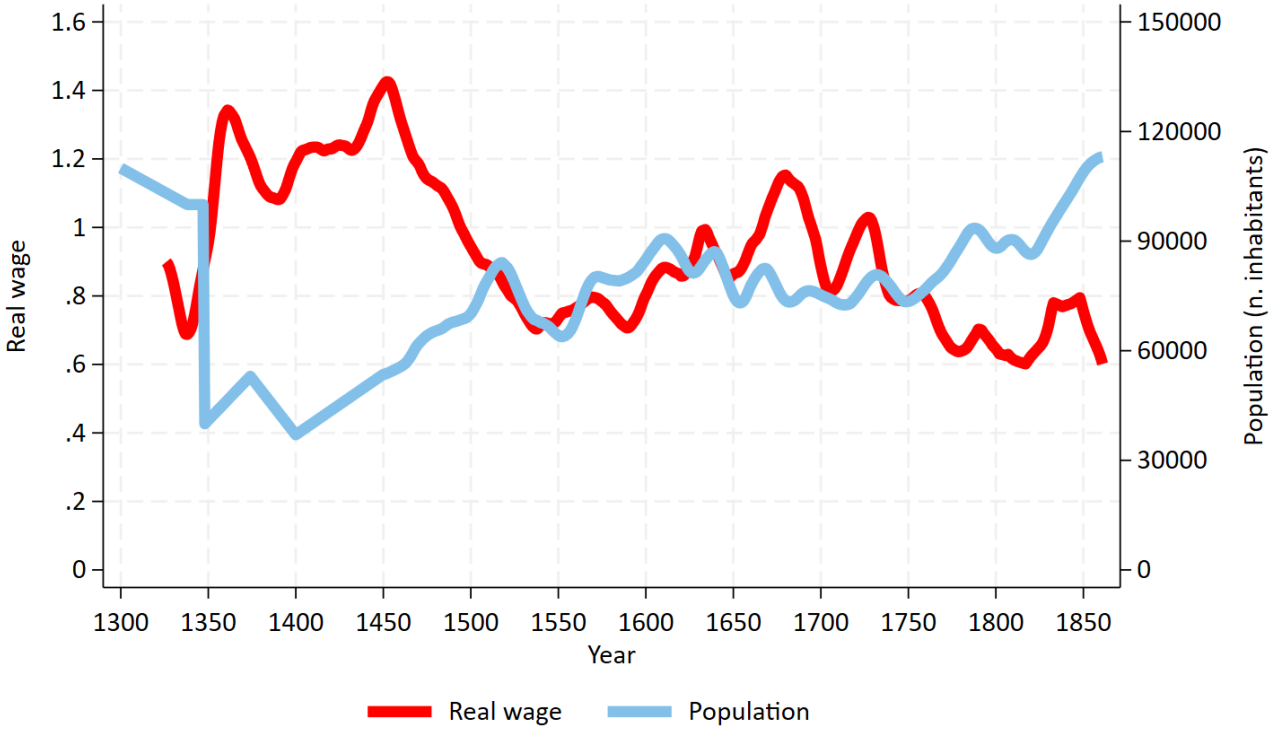
[14] We use the Stata XTBREAK command (Ditzen, Karavias and Westerlund 2021) which adopts a sequential approach. It tests progressively from the null of one break vs zero breaks until the test cannot reject the null for the n-th break, under the constraint that the length of segments between the breaks does not to exceed a pre-determined proportion of the length of the series (or "trimming"). We have settled the standard 0.15 threshold.

[15] The value for Florence in 1862 for a *terraiolo*, a low skilled worker employed in construction, was 0.56 (personal communication with the authors).

acknowledge that demographic dynamics are not the sole determinant of wages. Other factors, such as labor demand and the cyclical nature of construction activity, likely played significant roles.

Figure 10 illustrates the relationship between real wages and population in Florence from 1300 to 1861. Over the long term, a negative relationship between population and real wages can be observed. The correlation coefficient between the two series is -0.42, significant at the 1 percent level. Specifically, the period between 1300 and mid-16th century appears, as already mentioned, to fit a classic Malthusian dynamic. The dynamics for the period 1540-1726, previously identified with the Bai-Perron text, are less certain, as both population and real wages fluctuate without any clear trend. From 1726 onwards, the decline in real wages aligns with a phase of demographic expansion.

Figure 10. Real wages and Population in Florence



Sources: real wages, see text. Population from MAIC (1862).

We further explore the relation between population and real wages by adopting a simple Augmented Malthusian model, following Moller and Sharp (2014).[16] Specifically, we test this relationship with the following regression model (for a detailed presentation of the regression results, refer to Appendix C):

[16] For a recent application of this model to the relationship between population and GDP per capita in the Italian context, see Federico et al. (2024)

$$Ln\ Real\ wage_{it} = \beta_0 + \beta_1 ln\ Population_{it} + \sum_k \gamma_k D_k + \sum_k \delta_k\ (ln\ Population_{it} \times D_k) + \varepsilon_{it} \quad (3)$$

where $Ln\ Real\ wage_{it}$ represents the log of real wages of building labourers in Florence, $lnPopulation_{it}$ is the log of Florentine population, D_k are period dummies for each of *k-th* periods identified by the Bai-Perron test. Error terms are clustered by decade.[17]

Figure 11 illustrates how the elasticity between real wages and population in Florence changes from 1300 to 1861. This is obtained as the sum of the coefficient β_1 measuring the average relationship between population and real wages in Florence from 1326 to 1861 and the coefficient δ_k measuring the subperiod relationship.[18] Reassuringly, results align with the visual patterns observed in Figure 10. Indeed, the elasticity of real wages with respect to the population is negative and statistically significant during the first two periods (-1.4 and -0.9 respectively). The relationship becomes positive and statistically significant at 1 percent level in the period 1540-1635, while it loses significance in the following period. From 1726 onwards, the Malthusian forces seem to reemerge slightly, with an elasticity of -0.46 significant at 5 percent level.

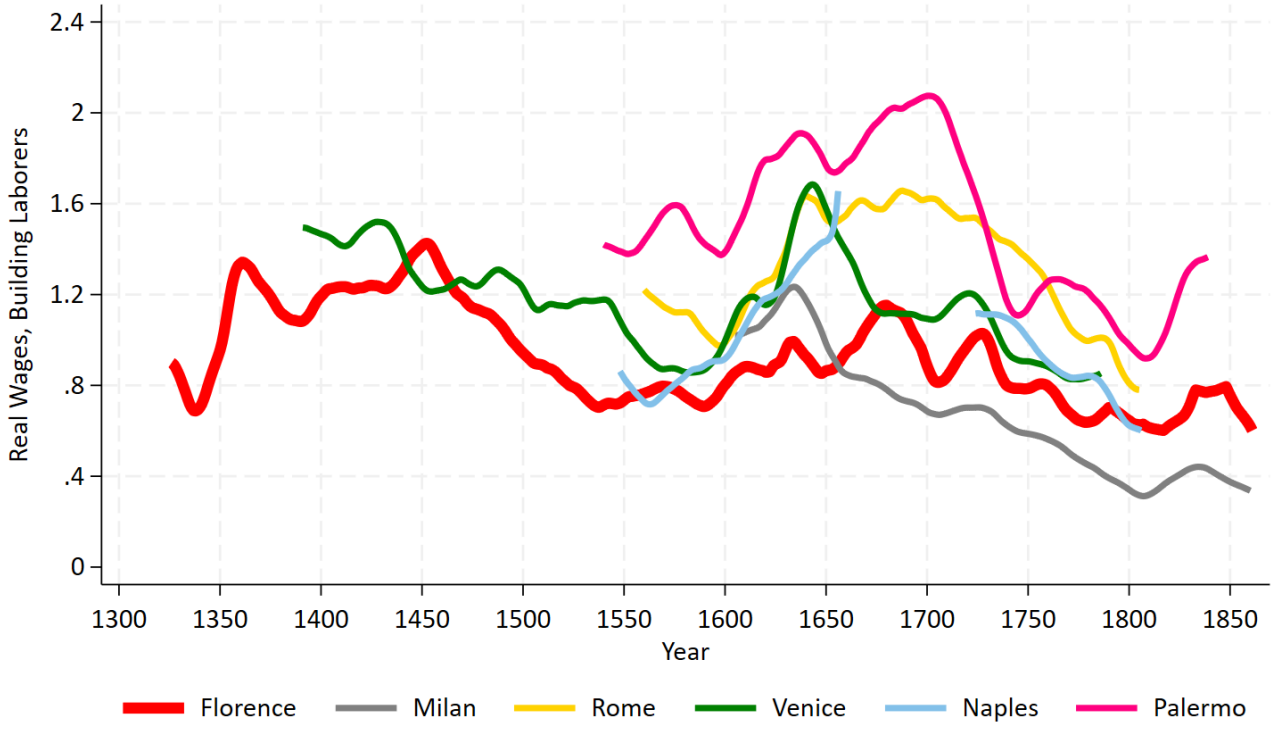
Figure 11. Real wages and population in Florence

Notes: 1402 stands for the period 1326-1402; 1540 stands for the period 1403-1540, 1635 for the period 1541-1635, 1726 for the period 1636-1726 and 1861 for the period 1727-1861.

[17] We also test alternative clustering procedures (20 and 30 years) but results are very similar.
[18] The elasticities between population and real wages are estimated using Stata 18's *margins* command. Standard errors are calculated using the Delta method.

Figure 12 compares the evolution of real wages for construction workers in Florence with similar series for a selected sample of Italian towns: Milan, Venice, Rome, Naples, and Palermo. This comparison places Florence within the broader context of major pre-unification state capitals. The panel spans a period of six centuries, though it is unbalanced. Only for Florence and, to some extent, Venice is it possible to provide a comprehensive overview of the entire period. For the other cities, the wage series begin only from the 1500s. To ensure a consistent comparison, all real wage series were constructed using Allen's methodology, which assumes 250 working days per year and a basic basket providing 1,940 calories. Regional consumption differences—such as the use of olive oil in the South of the peninsula and butter in the North, or variations in wood consumption reflecting different climatic conditions—have been considered (Federico, Nuvolari and Vasta 2019). Bread prices, however, are derived from the bread equation proposed by Federico et al. (2024), which seems to be more appropriate for the Italian context as it is based on a dataset of bread prices in the Italian peninsula.

Figure 12. Florence in the Italian context. Building laborers' real wages



Sources: Florence, this study; Milan and Naples, Allen (2001); Palermo, Buscemi (2025); Rome, Rota and Weisdorf (2020); Venice, Buscemi and Ridolfi (2025). *Notes*: all series have been obtained using Federico et al. (2024) bread equation.

In the 14th century and the first half of the 15th century, real wages of building laborers in Florence were lower than in Venice, the only leading city in the Italian peninsula for which data go back to the Middle Ages. In this period, the gap was around 20 percent in favor of Venice. Between

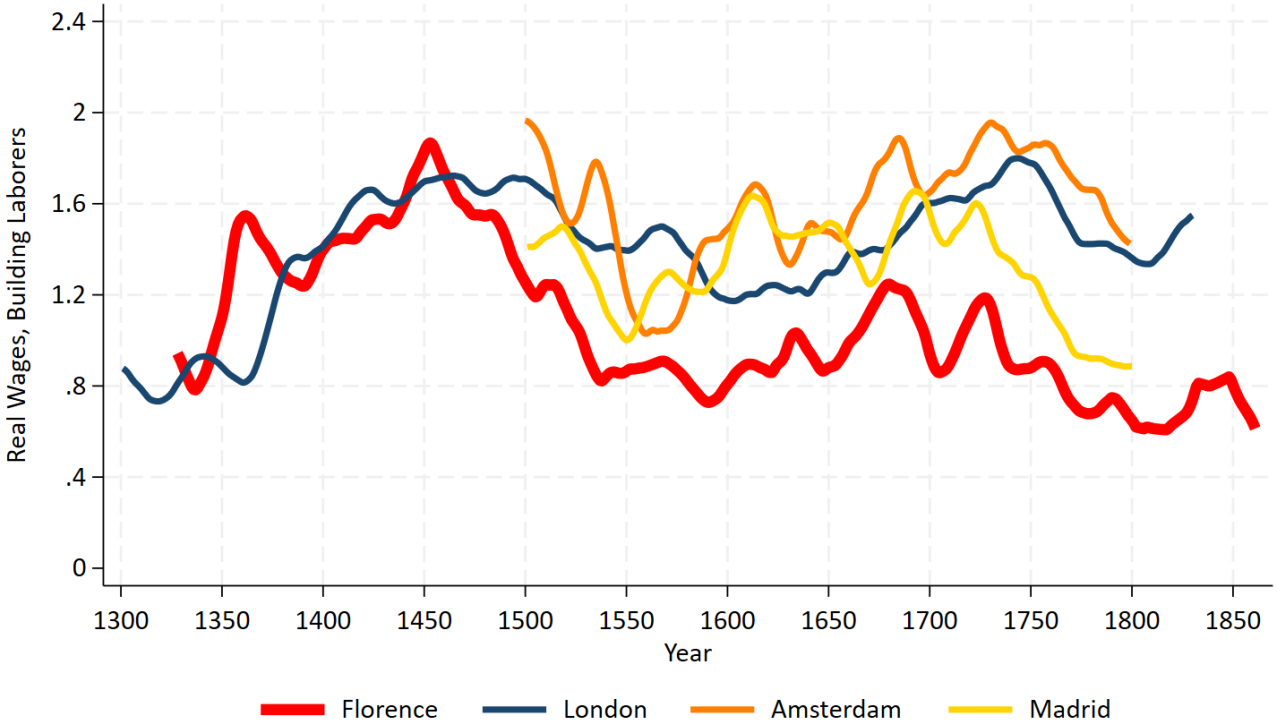
the mid-15th century and the late-16th both cities underwent a period of sharp decline. Real wages fell by about 43 percent in Florence and by about 24 percent in Venice even if the decline lasted longer and was more gradual in the latter city. From the late 16th century up to the early 18th century, the dynamics of real wages in various Italian cities diverged, making it difficult to pinpoint a single, unified economic cycle, even within the same macro-areas. For instance, in Central-Northern Italy, Venice witnessed substantive real wage growth between the late 1500s and the decades after the devastating plague of 1629-31 (Alfani 2013, Buscemi and Ridolfi 2024). However, after this period, real wages declined almost continuously until the end of the Venetian Republic in 1797. Even in Milan, the peak was attained in the years immediately after the great plague of 1629-30 yet its consequences on the urban fabric were more dramatic than elsewhere in the area, leading to a prolonged decline that shaped many pessimistic accounts of Italy's economic trajectory (Sella 1979, Alfani and Percoco 2019). Milan's experience—marked by its tight link with textile industry and Spanish domination —does not reflect the broader Italian cycle. Between the 1600s and 1780s, real wages fell by 58 percent in Milan and by only about 22 percent in Florence and Venice. Unlike Venice and Milan, where real wage growth stops in the years immediately following the 1629-31 plague, in Palermo and Rome the cycle of real wage growth continues until the late 1600s (38 and 55 percent respectively) driven by the construction booms of Baroque in the Sicilian cities (Buscemi 2025) and the urban renewal projects under Bernini and Borromini in Rome (Piola Caselli 1999, Rota and Weisdorf 2020). For Florence, the period of real wage growth occurs between 1600 and 1680, during which real wages increase by about 33 percent. In the same years, real wages in Milan declined by 26 percent and remained broadly stagnant in Venice. The contrasting trend between real wages in Florence and those in Milan and Venice during the turbulent 17th century further highlights the distinct nature of wage dynamics in Central-Northern Italy. In contrast, the pattern of change of real wages in Florence, resembles more closely that in Rome and to a lesser extent Southern Italy. In Naples, the real wage cycle peaked around the 1650s-1660s (Allen 2001). Overall, these findings highlight that understanding the dynamics of real wages in pre-unification Italy requires a detailed regional analysis, as the economic trajectories of cities varied significantly depending on local factors.

Lastly, Figure 13 compares the Florentine real wages with those of Amsterdam, London and Madrid. To ensure consistency, all the series are constructed using Allen's methodology, along with his bread equation for estimating bread prices. The data clearly show that Florentine real wages were comparable to, or even higher than, those in London up until the first half of the 15th century. However, from that point onward, London shows greater resilience to demographic growth. A significant divergence in real wages, in line with Allen's findings, begins around 1450 and lasts

until the end of the 16th century. Yet, the real wage gap between London and Florence narrows considerably during the first half of the 1600s, only to widen sharply again starting in the late 1600s. By around 1850, real wages in Florence were roughly half those in London and Amsterdam. The real wages of construction laborers in Florence are also lower than those in Madrid. However, the gap between the two series fluctuates without showing significant changes over time.

Overall, this evidence provides a more nuanced view of the real wage divergence between Northern and Southern Europe, supporting a later timeline for this process—likely occurring between the mid-17th and mid-18th centuries—consistent with recent findings in the literature across various European countries (López Losa and Piquero Zarauz 2021, Malanima 2013, 2022, Pfister 2017, Ridolfi 2019).

Figure 13. Florence in the international context. Building laborers



Sources: Firenze, this study; London and Amsterdam, Allen (2001); Madrid, López Losa and Piquero Zarauz (2021). *Notes*: Amsterdam, rye bread; Madrid brown bread; London and Florence wheat bread. *Note*: all series have been obtained using Allen's bread equation.

5. Conclusions

We present the first homogeneous series of real wages in Florence for skilled and unskilled construction workers from 1326 to 1861. These estimates are primarily based on the extensive accounting records of the Opera del Duomo, cross-checked with a wide range of complementary sources. In addition, we construct the first series of annual working days for Florence using direct

archival evidence from the Opera, allowing us to assess their implications for long-run real wage growth, and a new long-term series of the skill premium.

Our findings reveal several important patterns. First, the real wage cycle in Florence was tightly connected to demographic fluctuations up to the mid-16th century, in line with the Malthusian framework typical of pre-industrial societies. During this phase, population shocks, such as those triggered by the Black Death and subsequent epidemics, significantly influenced labor supply and wage dynamics. Second, in the post-Malthusian phase, Florence exhibited a more stable trajectory of wages compared to other North-Central Italian cities. In particular, the sharp decline experienced by Milan in the late 17th and early 18th centuries appears to be a local exception rather than a generalized phenomenon for urban Italy. Third, the relative advantage of skilled workers in the construction sector remained broadly stable over the long run but showed a tendency to decline, particularly from the 17th century onward. This gradual erosion suggests a modest compression of wage differentials, further limiting incentives for large-scale human capital accumulation.

Taken together, all these findings nuance the prevailing view of early and generalized wage divergence within Southern Europe. They indicate that the significant divergence in urban real wages with respect to North-Western Europe occurred later than often assumed, becoming evident only in the late 17th century rather than in the early modern period. More broadly, our evidence contributes to the debate on the *Little Divergence*, suggesting a more complex and regionally differentiated trajectory for Italian urban living standards and their relationship with demographic cycles and labor market institutions.

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Appendix A. Wage and price sources

Nominal wages

Archivio Opera del Duomo di Firenze

Bastardelli contenenti le prime note delle Deliberazioni degli Operai prese dai notari Cancellieri (93, 1354-1459).

II.1.11.
II.1.12.
II.1.20.
II.1.30.
II.1.31.
II.1.35.
II.1.36.
II.1.44.
II.1.45.
II.1.68.
II.1.69.

c.1417-1436: Anni della Cupola (available at: https://duomo.mpiwg-berlin.mpg.de/).

Lettere e negozi del provveditore

IV.2.117.
IV.2.118.
IV.2.149.
IV.2.151.
IV.2.156.

Conti

V.4.1.
V.4.3.
V.4.4.
V.4.V8.
V.4.10.

Quaderno di Cassa e Riscontro di cassa

VIII.1.1.
VIII.1.2.
VIII.1.8.
VIII.1.257.

Entrata e uscita. Quaderno tenuto dal Camarlingo

VIII.3.1-6.
VIII.3.7-12.
VIII.3.13-18.
VIII.3.19-24.
VIII.3.25-30.
VIII.3.31-36.
VIII.3.37-41.
VIII.3.47-52.
VIII.3.53-58.
VIII.3.59-64.
VIII.3.65-70.
VIII.3.71-74.

Giustificazioni di computisteria,

XI.3.2.
XI.3.3.
XI.3.4.
XI.3.5.
XI.3.6.
XI.3.7.
XI.3.8.
XI.3.9.
XI.3.10.
XI.3.11.
XI.3.12.
XI.3.13.
XI.3.14.
XI.3.15.
XI.3.16.
XI.3.17.
XI.3.18.
XI.3.19.
XI.3.22.
XI.3.23.
XI.3.26.
XI.3.27.
XI.3.29.

Badia Fiesolana, *Giornali della Badia Fiesolana*
A.O.I.F. 11527: 1440-1446
A.O.I.F. 11528: 1447-1466
A.O.I.F. 11529: 1469-1472
A.O.I.F. 11531: 1477-1495
A.O.I.F. 11534: 1496-1498
A.O.I.F. 11535: 1499-1501
A.O.I.F. 11536: 1503-1509
A.O.I.F. 11537: 1510-1519
A.O.I.F. 11538: 1519-1523
A.O.I.F. 11539: 1524-1536
A.O.I.F. 11547: 1539-1540
A.O.I.F. 11548: 1540-1544
A.O.I.F. 11549: 1545-1551
A.O.I.F. 11551: 1549-1552
A.O.I.F. 11552: 1553-1554
A.O.I.F. 11555: 1557-1559
A.O.I.F. 11562: 1569-1570
A.O.I.F. 11565: 1575-1580
A.O.I.F. 11567: 1584-1586
A.O.I.F. 11569: 1588-1590
A.O.I.F. 11571: 1591-1594
A.O.I.F. 11573: 1591-1597
A.O.I.F. 11574: 1598-1601
A.O.I.F. 11575: 1601- 1603
A.O.I.F. 11576: 1603-1606
A.O.I.F. 11577: 1607-1610
A.O.I.F. 11578: 1611-15
A.O.I.F. 11579: 1616-1621
A.O.I.F. 11580: 1621-1624
A.O.I.F. 11581: 1624-1627
A.O.I.F. 11582: NA
A.O.I.F. 11583: 1630-1633
A.O.I.F. 11584: 1633-1636
A.O.I.F. 11585: NA
A.O.I.F. 11586: 1637-1639
A.O.I.F. 11587: 1639-1642
A.O.I.F. 11588: 1642-1646
A.O.I.F. 11589: 1646-1649
A.O.I.F. 11590: 1649-1652
A.O.I.F. 11591: 1653-1656
A.O.I.F. 11592: 1657-1661
A.O.I.F. 11594: 1661-1664
A.O.I.F. 11595: 1664-1668
A.O.I.F. 11596: 1668-69 e 1670
A.O.I.F. 11597: 1672-1676
A.O.I.F. 11598: 1676-1680
A.O.I.F. 11599: 1680-1687
A.O.I.F. 11600: 1687-1694
A.O.I.F. 11601: 1700-1703
A.O.I.F. 11602: 1704-1710
A.O.I.F. 11603: 1710-1715
A.O.I.F. 11604: 1716-1721
A.O.I.F. 11605: 1721-1727
A.O.I.F. 11606: 1733-1738
A.O.I.F. 11607: 1738-1740
A.O.I.F. 11608: 1740-1747
A.O.I.F. 11609: 1748-1755
A.O.I.F. 11610: 1755-1760
A.O.I.F. 11611: 1761-1764
A.O.I.F. 11612: 1765-1770
A.O.I.F. 11613: 1770-1776
Ospedale degli Innocenti
A.O.I.F. 9693, 9694.

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Bread

NA.

Candles

Giornali della Badia Fiesolana, see nominal wage section.

Firewood

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Giornale agrario toscano, Vol. II, (1828). Pezzati.

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Legumes

A.O.I.F., *11332, 11335 Monastero della Nunziatina di Firenze, Spese diverse e di vitto.*

A.O.I.F., *Spese Minute del Dispensiere, 4576, 4577, 4579, 4580, 4582, 4584, 4585, 4586.*

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Meat

A.O.I.F., 11332, 11335 Monastero della Nunziatina di Firenze, Spese diverse e di vitto.

A.O.I.F., Spese Minute del Dispensiere, 4570, 4572, 4573, 4576, 4577, 4579, 4580, 4582, 4583, 4584, 4585, 4586; Registro delle spese fatte dal dispensiere 10523.

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Tognetti, S. (1995). Prezzi e salari nella Firenze tardomedievale: un profilo. *Archivio Storico Italiano*, 153(2 (564), 263-333.

Oil

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Textiles

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A.O.I.F. *Quaderno del vestiario A, 4446.*

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Wheat

A.O.I.F. *Giornali della Badia Fiesolana, see nominal wage section.*

Bandettini, P. (1957). *I prezzi sul mercato di Firenze dal 1800 al 1890.* Torino, ILTE.

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Wine

A.O.I.F., 11332, 11335 Monastero della Nunziatina di Firenze, Spese diverse e di vitto.

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Appendix B. Estimation of wage series

Table B1. Coefficients of the wage regressions

Variable	Building laborers	Building craftsmen
NA	-0.021	-0.032
	(0.018)	(0.029)
Spring	-0.024***	0.006
	(0.007)	(0.010)
Summer	-0.001	0.030***
	(0.006)	(0.009)
Winter	-0.016**	-0.007
	(0.007)	(0.009)
Nourished	-0.336***	-0.501***
	(0.032)	(0.061)
Agna	-0.160***	-0.107
	(0.034)	(0.084)
Cupola	0.012	-0.062**
	(0.020)	(0.026)
Fiesole	-0.089***	-0.110**
	(0.025)	(0.046)
Strozzi	-0.108*	0.047
	(0.058)	(0.132)
Trassinaia	0.000	-0.109***
	(0.144)	(0.033)
Constant	0.231	0.462
	(0.165)	(0.340)
Year FE	YES	YES
Occupation FE	YES	YES
Occupation FE X Post	YES	YES
N	6,011	14,371
R^2	0.770	0.831

Notes: standard errors in parentheses. † p<0.15, * p<0.10, ** p<0.05, *** p<0.010

Appendix C. Real wages and population

Table C1. Coefficients of the regression between real wages of building laborers and population

	Real wage
Population (log form)	-1.408***
	(0.041)
Period 1403-1540	-5.009**
	(2.071)
Period 1541-1635	-19.750***
	(1.460)
Period 1636-1726	-13.238**
	(5.281)
Period 1727-1861	-10.067***
	(2.613)
Period 1403-1540 X Population	0.509***
	(0.185)
Period 1541-1635 X Population	1.807***
	(0.131)
Period 1636-1726 X Population	1.246**
	(0.467)
Period 1727-1861 X Population	0.944***
	(0.233)
Constant	15.005***
	(0.442)
N	252
R^2	0.382

Notes: standard errors in parentheses are clustered by decade. † p<0.15, * p<0.10, ** p<0.05, *** p<0.010