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Italy in the great divergence: what can we learn from Engel's law?

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Abstract. We estimate and internationally compare the evolution of GDP pc in central-northern and, for the first time, southern Italy in 1400-1861. To address concerns on the representativeness of daily wages, we rely on an unconventional demand approach, using a general equilibrium model and occupational data. Our estimates are consistent with an "industrious revolution" in the "long 18th century" (1650-1800). Central-northern Italy stagnated. Southern Italy, though poorer, was growing slowly. Our comparison suggests that the "great divergence" between Europe and Asia in the 18th century was rooted in contingent institutional developments, rather than persistent differences.

1. Introduction

Italy, as one of the richest countries of the pre-modern world, has played a central role in debates on the "great divergence" (Pomeranz 2000) in living standards between Europe and Asia (see e.g. Allen *et al.* 2011; Broadberry 2021; Goldstone 2021). However, current assessments suffer from one clear and one potential limitations. The clear limitation is that lack of quantitative data on southern Italy's pre-modern development has meant that, to date, the literature has almost entirely ignored the southern half of the peninsula.[3] For example, in two seminal articles, Malanima (2011, 2013) has reconstructed Italian GDP pc and real wages over the very long-run, but only considered the centre-north. This is no negligible neglect: southern Italy accounted for 44% of the area and, at the time of unification in 1861, 36% of the population.[4] The potential limitation is that the literature has either looked directly at daily wages or at GDP pc estimates constructed with a demand-side approach, which heavily relies on daily wages. The extent to which daily wages can be considered as representative of annual incomes is increasingly questioned (Broadberry *et al.* 2015; Hatcher 2018; Stephenson 2018; Humphries and Weisdorf 2019; Rota and Weisdorf 2021). In a related critique, scholars (Bolt and van Zanden 2021; van Zanden and Felice 2022) have argued that indirect demand side approaches, such as that used by Malanima (2011) to reconstruct the GDP pc of central-northern Italy, are inherently biased against finding economic growth. This article offers new estimates of the long-term trends in GDP pc in pre-modern Italy, including a first estimate for southern Italy, independent of real wages, and places them in an international context.

To cast a new light on Italy's position in the great divergence, we exploit Engel's law: as GDP pc rises, its share spent on food and therefore the agricultural employment share declines. GDP pc can thus be inferred from the occupational structure. We rely on Chilosi and

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[3] Allen (2001), who also looks at real wages in Naples, is one notable exception.
[4] We use republican borders. Like Chilosi and Ciccarelli (2022), we define southern Italy as the territory of the Kingdom of Naples together with the Sardinian and Sicilian isles. All the other provinces belong to the centre-north. These boundaries differ slightly from those used by Malanima (2011), who consider Latium as lying outside the centre-north. In the spirit of Pomeranz's (2000) and Malanima's (2011) stress on the need to compare economically homogenous units, we keep the distinction throughout the paper, but also provide figures aggregated for the whole of Italy in Table A1 in Appendix A.

Ciccarelli's (2022) new series of agricultural employment shares and Groth and Persson's (2016) general equilibrium model to estimate consistent GDP pc series in central-northern and southern Italy since 1400. Crucially, unlike conventional demand-side estimates, our series are not dependent on potentially unrepresentative daily wages. Notably, the occupational structure, by definition, encompasses the whole economy and Chilosi and Ciccarelli (2022) base their estimates on observations from 83 different provinces, while real wages refer to specific occupations and a few selected locations. While our model neglects to consider other potentially informative variables, such as relative prices, and is bound to miss out the effect of yearly price variations,[5] the evidence is that it effectively captures long-term trends. As shown by Wallis *et al.* (2018: 890), for Britain in 1530-1800 Groth and Persson's (2016) model's predictions are very close to Broadberry *et al.* 's (2015) trend, which is based on output figures and is arguably the "gold standard" of pre-modern national accounting: the correlation coefficient between the two series is as high as 91%. Our estimates can therefore provide useful robustness checks to those using conventional demand approaches, also exploiting information on regional real wages, such as those being currently developed by Federico *et al.* (2022).

Our analysis contributes to on-going debates on the great divergence, both methodologically and empirically. To begin with our methodological contributions, we qualify and refine the critique that data-parsimonious approaches are inherently biased towards finding stagnation rather than economic growth (Bolt and van Zanden 2021; van Zanden and Felice 2022). We qualify this critique because by using an even more data-parsimonious demand approach than the conventional one, we revise previous estimates of rates of economic growth upwards for central-northern Italy and find positive rates of economic growth in southern Italy. Indeed, our sensitivity analysis shows that, by neglecting changes in export specialisation and in the functional distribution of income, our baseline estimates might understate the actual rates of economic growth. We refine the critique by highlighting that Malanima's (2011) conventional demand-side GDP pc series is at odds with occupational trends and the timing of the "industrious revolution" in the "long 18th century" (de Vries 2008), as well as van Zanden and Felice's (2022) 1427 benchmark. Such inconsistencies are avoided with the general equilibrium model that we use. Hence, improvement of existing series does not necessarily lie with collecting sufficient data to enable the construction of reliable output estimates, an approach that in Italy, as well several other pre-modern economies, is unlikely to become feasible in the foreseeable future. An alternative, targeted, approach would aim at improving upon existing demand-side estimates with improved measures of macroeconomic variables.[6]

Turning to our empirical contributions on the timing and causes of the great divergence, our new series for central-northern Italy confirms the dating of the "little divergence" within Europe and the "great divergence" between Europe and Asia previously produced by the growth accounting literature (Malanima 2011; Broadberry *et al.* 2015, 2018; Broadberry and Guan 2022). Central-northern Italy fell behind north-western Europe between the 17th and 18th centuries and had forged ahead of China already in the Middle Ages but decisively overtook its most developed region, the Yangzi Delta, only during the 18th century. This dating agrees also with Pomeranz's (2011) revision of the beginning of the great divergence from the 19th to the 18th century. We add southern Italy to the picture, highlighting that its experience was different from that of its richer northern neighbours: it fell behind north-western Europe about

[5] While our model allows also changes in relative productivity to contribute to structural change, we do not expect the neglect of relative prices to have a major impact on long-term trends: in central-northern Italy the ratio between prices of agricultural and non-agricultural goods remained stable until 1800 (Malanima 2011: figure 2).
[6] A related but better-known point (cf. e.g. Bolt and van Zanden 2020; Ward and Deveraux 2021; van Zanden and Felice 2022) is that level differences emerge as rather sensitive to the choice of deflator and thus reaching a consensus on this issue is another *desiderata* for historical growth accounting research.

a century earlier and forged ahead of the Yangzi Delta about half a century later. According to our new series, in both southern and central-northern Italy, there was no evidence of a systematic inverse relationship between population size and GDP pc, indicating that gains from Smithian specialisation (Smith 1776) and industriousness (de Vries 2008) countered any Malthusian tendency to decreasing returns (Malthus 1826). In the Italian macro-areas, just like in north-western Europe, as well as China, we find no economic shrinking in the wake of the resumption of population growth during the 15th century. We thus call into question the current orthodoxy that the great divergence originated in 1348, as in the aftermath of the Black Death Malthusian checks disappeared only in north-western Europe (Pamuk 2007; Broadberry 2021; de la Escosura and Rodríguez-Caballero 2022; see also Voigtländer and Voth 2013a, 2013b). This finding complements Henriques and Palma's (2022) recent assessment that institutions in southern Europe were no worse than in England before the 17th century (see also Edwards and Ogilvie 2022). The Italian macro-areas, unlike China, were spared of Malthusian crises also in the 18th century even if they, too, had little access to new world's goods (cf. Pomeranz 2000; see also Palma 2016). At the time China experienced a crisis of state capacity and market development with no parallel in Western Europe. Hence, our comparison suggests that contingent institutional developments were responsible for the onset of China's great divergence with Europe.

2. Estimation strategy

To estimate GDP pc's *levels*, we rely on the latest estimate of Italy's centre-north over south GDP pc's ratio by Felice (2019: Table 1): 1.18. While this ratio refers to 1871, rather than 1861, major differences between the two years are hardly plausible.[7] We combine this ratio with Malanima's (2011) GDP pc in the centre-north,[8] converted in 2011 international $ by the Maddison project (2020 edition), to compute the GDP pc in southern Italy in 1861. In Section 5, one of our robustness checks examines the extent to which our key results are sensitive to a plausible alternative GDP pc's ratio in 1861.[9]

To estimate *trends* in GDP pc in southern and central-northern Italy, we use Groth and Persson's (2016) method, which exploit Engel's law to reconstruct GDP pc trends consistent with agricultural employment shares, relying on a general equilibrium model (see also Wallis *et al.* 2018 and Ridolfi 2023 for a comparison with other GDP's reconstruction methods). Here we provide a summary of the model (production, consumption and equilibrium), while the reader is referred to Groth and Persson's (2016) paper for details on derivations of the formulae. Beginning with *production*, there are two sectors, agricultural (or primary) and urban (industry and services), four inputs (labour, capital, land and intermediates from the other sector, e.g. raw wool is employed by the urban sector, while bricks are employed by the primary sector, assumed to have the same prices as final goods in their sector) and standard Cobb-Douglas production functions with constant returns to scale. Land only enters in the production function

[7] Felice's (2019) approach to allocate Italian value added to southern and central-northern regions is inspired by the Geary-Stark's method (Geary and Stark 2002). However, Felice (2019) relies on output-based regional value added estimates, rather than regional wages combined with employment structure shares, for the whole of the agricultural and most of the industrial sectors. Therefore, Felice's estimate of the GDP pc's ratio – differently from his sectoral labour productivity estimates discussed in Appendix C and below - is robust to biases in his employment shares in these two sectors (cf. Chilosi and Ciccarelli 2022).

[8] There is essentially no difference between the 1871 GDP pc of the centre-north as defined by Felice (2019) (with Latium in) and that of the centre-north as defined by Malanima (2011) (with Latium out): 28 cents of 2011 € equivalent to 0.01% of the GDP pc of Felice's (2019) centre-north. It is therefore safe to ignore such differences for our purposes.

[9] Another issue is that using Ward and Deveraux's (2021) "current price" deflator, Italy's GDP pc in 1872 becomes lower than in the Maddison database. However, other European GDP pc are also decreased (while they do not produce new estimates for China). Hence, the effect on our results is not expected to be significant.

of primary goods and capital is specific to the sector (e.g. cattle for the primary sector or spinning wheels for the urban sector). Formally, the outputs (net of raw material produced within the sector) in the primary and the urban sectors, respectively, are:

$$Q_{1t} = A_{1t} X_{2t}^{\alpha} L_{1t}^{\beta} K_{1t}^{\gamma} Z^{1-\alpha-\beta-\gamma} \qquad \text{(Equation 1a)}$$

$$Q_{2t} = A_{2t} X_{1t}^{\theta} L_{2t}^{\varepsilon} K_{2t}^{1-\theta-\varepsilon} \qquad \text{(Equation 1b)}$$

where for each sector i and year t, A_{it} refers to TFP, X_{it} is the intermediate input produced by that sector, L_{it} and K_{it} refer to labour and capital. Z is amount of land, which is fixed, implying diminishing returns to the variable factors (intermediate urban goods and agricultural labour and capital). The remaining parameters are positive elasticities with a sum lower than one and are defined also in Table 1 below. Intermediates imply interdependencies between sectors. While the Cobb-Douglas function ensures tractability, it embodies a relative ease of substitution of intermediate inputs from the other sector with the remaining inputs. This assumption is likely to be violated, particularly for urban output. Nevertheless, as seen in the sensitivity analysis (Figure 4), our results are hardly affected by a significant downward adjustment of θ.

Turning to *consumption*, by design, households need to consume a minimum amount of primary goods to subsist, while they divide up their remaining income between fixed proportions of primary and urban goods and saving. Formally, the consumption functions of primary and urban goods, respectively, are (omitting, for simplicity, the time subscript):

$$c_1 = \begin{cases} y & if\ y < b \\ b + m(1-\sigma)(y-b) & if\ y \geq b \end{cases} \qquad \text{(Equation 2a)}$$

$$c_2 = \begin{cases} 0 & if\ y < b \\ (1-m)(1-\sigma)(y-b)/p & if\ y \geq b \end{cases} \qquad \text{(Equation 2b)}$$

where y is the household's annual income, b defines a subsistence minimum, m and σ are marginal propensities to consume agricultural goods and to save, respectively, out of the income over subsistence, and p is the price of urban goods relative to that of agricultural goods. These simple consumption functions imply that, at any level of income above subsistence, the income elasticity of consumption is lower than one for agricultural goods and higher than one for urban goods. In other words, the share of income spent on agricultural goods declines with income per capita, as postulated by Engel's law. Moreover, a rising income per capita implies a rising saving income ratio: as expected, the marginal propensity to consume declines with income per capita.[10]

Let us now look at *equilibrium*. Entrepreneurs choose quantities of inputs and outputs to maximise profit as price-takers under perfect competition, yielding the familiar condition that each input's marginal product time the output's price is equal to the inputs' price. Under the (rather undemanding) assumption that households can afford to survive Equations 2a and 2b can be aggregated over all households. Markets clear when aggregate demand equals aggregate supply for each input and output. A series of substitutions yield the two key equations. Labour income pc in the primary sector in year t relative to the baseline in year 0 is:

$$\frac{w_{1t}L_t/N_t}{w_{10}L_0/N_0} = \frac{1-M+\sigma l_t}{1-M+\sigma l_0} \cdot \frac{1-(1-\alpha)M-[1-(1-\alpha)M+\beta\varepsilon^{-1}Jw_2/w_1]l_0}{1-(1-\alpha)M-[1-(1-\alpha)M+\beta\varepsilon^{-1}Jw_2/w_1]l_t} \qquad \text{(Equation 3a)}$$

[10] Saving is equal to income less total consumption.

with $M = \sigma + m(1-\sigma)$ and $J = \theta + (1-\theta)m(1-\sigma)$. Total income pc is:

$$\frac{Y_t}{N_t} = \left[\frac{1-\alpha}{\beta} + \left(\frac{1-\theta}{\varepsilon}\frac{w_2}{w_1} - \frac{1-\alpha}{\beta}\right) l_t\right] \frac{w_{1t}L_t}{N_t} \qquad \text{(Equation 3b)}$$

Equation 3a makes it possible to reconstruct trends in agricultural labour income pc relative to a baseline year. Equation 3b tells by how much levels in each period need to be adjusted to factor in also urban wages, as well as income from land and capital. Hence, by combining the two equations, one can reconstruct trends in GDP pc. The key variable is the employment share of the urban sector l_t, which by Engel's law is positively related to changes in GDP pc over time. Our source for this variable is Chilosi and Ciccarelli's (2022) recent estimates. Labour income pc in the primary sector can be decomposed in changes in wages, determined by productivity, and labour participation rates, determined by how much and how many individuals work. In Section 3 we look at how labour participation rates would have to evolve to be consistent with trends in Allen's (2001) and Malanima's (2013) series of real daily wages. Table 1 defines the time-invariant parameters and presents the baseline values allocated to them by Groth and Persson (2016) and by this article. The first four elasticities relate to the production functions (Equations 1a and 1b) and the following two parameters to the demand function (Equations 2a and 2b). The last term is the urban wage premium, which is co-determined by relative prices and total factor productivities (Groth and Persson 2016: Equation 2.4).

Table 1: Baseline parameters of Groth and Persson's (2016) model in theirs and this article

Parameters	Description	Groth and Persson (2016)	This article
α	Elasticity of agrarian output with respect to intermediaries from industry and services	0.09	0.09
β	Elasticity of agrarian output with respect to labour	0.51	0.68
θ	Elasticity of output in industry and services with respect to agrarian intermediaries	0.2	0.2
ε	Elasticity of output in industry and services with respect to labour	0.53	0.48
m	Marginal propensity to consume agricultural goods out of the consumption basket	0.05	0.05
σ	Marginal propensity to save	0.1	0.1
w_2/w_1	Urban-agrarian wage ratio	1.25	1.7

Sources: see the text and Groth and Persson (2016: Table 2).

Groth and Persson's (2016: Table 2) parameters are calibrated to England in 1688, using Dodgson's (2013) input-output table, constructed with Gregory King's economic data. In the absence of input-output tables for pre-modern Italy, we mostly use the same baseline values as them, providing a battery of robustness tests to check the sensitivity of the results to plausible variations in the size of the parameters in Section 6. The income per capita in England in 1688 is expected to be not too different from those of our Italian macro-areas in pre-modern times. Hence, it is reasonable to expect the parameters to have similar values. However, we add two tweaks to better reflect Italy's particular economic conditions. First, we set the urban wage premium at 70% instead of 25%. As discussed in detail in Appendix C, consistency between existing GDP pc estimates and employment structures demands that in pre-modern Italy the urban premium was higher than in England, where agricultural labour productivity was particularly high. The basic skill premium (eg. mason 2nd class relative to labourer) was 50% in early modern Europe (van Zanden 2009) and that value matches Italian data, too (Bandettini 1960; Malanima 2006). However, the premium was much higher for other urban occupations, e.g. in the early and mid-19th century it was about 150% for a foreman (Bandettini 1960: 8; Daniele and Malanima 2017: table 3). Hence, differences in average urban and agricultural labour incomes cannot be established from wage rates alone. They also depended on the distribution of skill amongst the work-force. If most urban workers were unskilled then the premium would be lower than 50%, as Groth and Persson (2016) argue. However, if enough urban workers were sufficiently skilled, the premium could be higher. Available occupational data does indeed suggest that most pre-modern workers were skilled (De Pleijt and Weisdorf 2017). The overall difference between the average labour income in urban and agricultural occupations can be gleaned from national accounting figures. Van Zanden and Felice (2022: table 3) detect a particularly high urban premium in 1427's Tuscany. Their figures imply labour and total income urban premia of 137% and 243%, respectively.[11] This difference between the wage and total income premia reflects a higher labour income, as opposed to capital/land income, share in agriculture than in the richer urban sectors. In Italy in 1861 the urban total income premium was 135% (Appendix C). That this figure is lower than the corresponding one in 1427 Tuscany confirms van Zanden and Felice's (2022) contention that there the distribution of incomes across sectors was particularly unequal. Nevertheless, the 1861 figure is also consistent with a comparatively high urban wage premium. Assuming that the ratio between total income and labour income premia were the same as in 1427 Tuscany yields an urban wage premium of 62%, but the figure would be higher if the distribution of capital/land across sectors were not as skewed. We therefore settle for 70%.

We decided against using a different urban premium for central-northern and southern Italy. According to Felice's (2019: Table B.4 in the Appendix) the two macro-areas, just after unification, were very different in this respect. Rather surprisingly, in 1871, in southern Italy, there was no urban premium: the value added per worker was the same in the agricultural and urban sectors. By contrast, in central-northern Italy, there was a conspicuously high urban premium, 115%, since workers in urban sectors in central-northern Italy earned 60% more than their southern counterparts. However, a stark urban labour productivity difference between the centre-north and the south is difficult to square with the stylised fact that most industrial enterprises in the south survived competition from those in the centre-north after protective duties were abolished following unification in 1861 (Federico 2023). Felice's (2019) labour productivity estimates are based on post-unification censuses, which suffer from a negative bias in the agricultural employment share in the south greater than that he considers (Chilosi and Ciccarelli 2022). If one uses our employment shares of 1861 (Table A1 in Appendix A),[12] the picture dramatically changes: the urban income premium in southern Italy become 128%, a figure which is very close to the one we find for the whole nation (again: 135%), and urban

[11] Figures obtained by dividing the wage and total income over sectoral share in urban occupations by those in agriculture.
[12] It is safe to use 1861 data to estimate the occupational structure in 1871: there is no evidence of significant structural transformation in these years (Daniele and Malanima 2009: Table 5).

workers in the south and centre-north earned the same.[13] Indeed, a similar urban premium is as expected, if the Italian labour market of skilled workers were integrated, as recent findings by de la Croix *et al.* (2022) as well as the lives of many illustrious Italians, like Leonardo and Caravaggio, would suggest was the case already since the Middle Ages. Close earnings for southern and central-northern workers with the same occupation also matches available real wage series until unification (Allen 2001; Malanima 2006; Daniele and Malanima 2017; Federico *et al.* 2019).[14]

The second change that we implement to the values of the baseline parameters is that we allow the labour income share to be higher in agriculture than in the urban sectors. As is well-known, the elasticity parameters of the Cobb-Douglas production function correspond to labour and capital income shares.[15] Groth and Persson (2016: 21) assume that the labour income share was 66% in the urban sectors. Consistency with other parameters and value added figures in 1688 England imply that their agricultural labour income share was 56%. Van Zanden and Felice's (2022: table 2) data from the 1427 Florentine *catasto* show that, on the contrary, the urban labour income share (55%) was significantly lower than the agricultural labour income share (80%).[16] This hierarchy is as expected: labour income shares are bound to be lower for poorer sectors of the work-force.[17] At the same time, as mentioned before, probably inequality between sectors in 1427 Tuscany was relatively high also by Italian standards and therefore we settle for slightly different figures: 60% in the urban sectors and 75% in agriculture. One of the sensitivity tests allows the income labour shares in both sectors to decline over time to reflect rising inequality.

Groth and Persson's (2016) model assumes that trade in primary products was balanced, so that changes in the agricultural employment share match changes in the share of income spent on primary products. This assumption is standard for central-northern Italy, where trade is reckoned to have been a small share of agricultural production (Allen 2000; Federico and Malanima 2004: 447-448). It is even less demanding in the south, where mid-19th century statistics show that the value of trade per capita was much lower than in the central-northern states (Federico and Tena Junguito 2014: table 3). We nevertheless relax the assumption of balanced trade in one of the sensitivity tests presented in Section 5. Having presented the method, we are now ready to present the results. To begin with, we look at GDP pc in southern and central-northern Italy.

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[13] Using 1881 instead of 1871 regional value-added figures has a relatively modest effect on the results. Southern Italy's urban premium becomes 88%. The decline is mainly determined by the fact that – somewhat surprisingly – Felice's (Table B.4 in the Appendix) figures, regardless of whether his or our employment shares are used, detect a fall in the productivity of workers in the urban sectors between 1871 and 1881. Thus, the decline is not driven by potentially positively biased values of southern agricultural value added in 1871 (cf. Federico 2011) which, of course, would, on the contrary, imply an actual urban premium in southern Italy in 1871 even higher than 128%.

[14] See Appendix C for further details on real wages in southern and central-northern Italy around 1861.

[15] Specifically, in our settings, the elasticity of output in agrarian output with respect to labour (β) is equal to one minus the elasticity of agrarian output with respect to intermediaries from industry and services (α) times the income labour share in agriculture. The elasticity of output in industry and services with respect to labour (ε) is equal to one minus the elasticity of output in industry and services with respect to agrarian intermediaries (θ) times the income labour share in industry and services (cf. Groth and Persson 2016: 21).

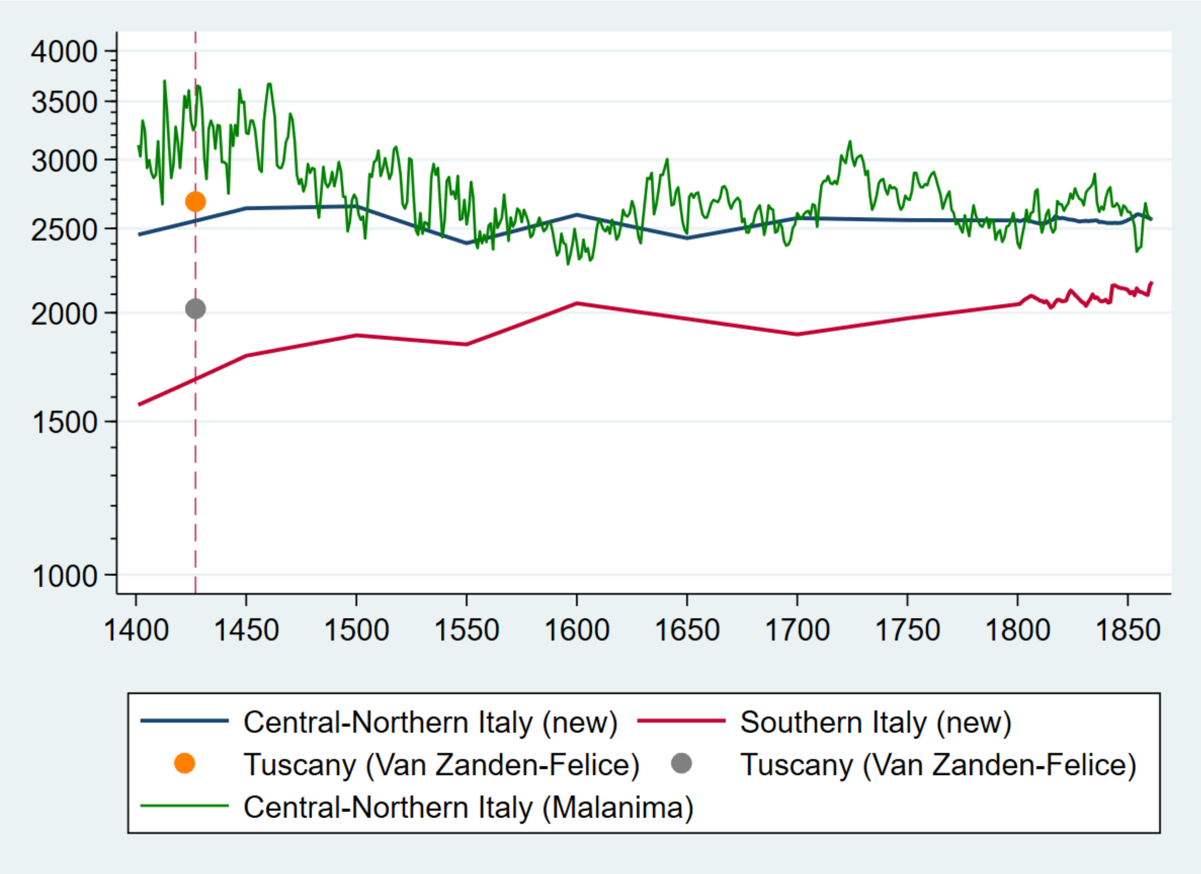
[16] The overall labour income share, 63%, was very much in line with those observed in other pre-modern (and indeed modern) contexts.

[17] Although reliance on animals meant that agriculture was a relatively capital-intensive sector, even in early modern England where pastoralism was more developed than in Italy, the evidence from the probate record is that agricultural workers owned less capital/wealth than those in the urban sectors (Wallis *et al.* 2018: Table 3).

3. GDP in southern and central-northern Italy

Figure 1 shows our GDP pc estimates, obtained with equations 3a and 3b and Chilosi and Ciccarelli's (2022) occupational data in southern and central-northern Italy. Our estimates are compared with other available GDP pc figures from pre-modern Italy.

Figure 1: GDP pc in southern and central-northern Italy (2011 international $, log scale), 1401-1861



Sources: see Appendix B.

Beginning with *levels*, in terms of absolute poverty lines (694$ at 2011 prices, Bolt and van Zanden 2020: 19), southern Italy's GDP pc ranged from a minimum of 2.26 in 1401 to a maximum of 3.13 in 1861, as compared to 3.5 (in 1550) to 3.8 (in 1500) in central-northern Italy.[18] On the one hand, these levels are reassuring: levels below subsistence for long periods of time would have been implausible. On the other hand, these levels are at odds with welfare ratios – number of small families that can subsist with one wage - below barebone subsistence found by other studies (eg. Allen *et al.*'s 2011: Figure 5; Federico *et al.* 2019: Figure 2). While we cannot rule out measurement errors in at least some these wages,[19] it is worth asking what the figures imply for consistency between wage and GDP pc levels. On grounds of data abundance and reliability, we look at 1861, when our levels are consistent with Baffigi's (2015)

[18] Using Malanima's (2011) series the north-south difference would starker still: in our years the range would be between 3.28 and (in 1596) 5.32 (in 1413).

[19] Mocarelli (2018) argues that Allen's (2001) and Malanima's (2013) 18th-century welfare ratios in Milan are too low because they neglect to consider food subsidies. Similarly, Malanima (2013: Figure 8), using a different price deflator, reaches the conclusion that Allen's (2001) central-northern Italian real wages are too low, but his results in terms of welfare ratios are not too different: by 1800 a skilled worker could only support – albeit at a higher standard than suggested by Allen's (2001) figures - three individuals.

output-based estimates and Federico *et al.* (2019: Figure 2) find that, across the peninsula, unskilled wages were below barebone subsistence, being sufficient to feed c. 0.8 small families. As discussed shortly, the canonical assumption of 250 working days appears to be violated in the 18th and early 19th centuries, which were characterised by an "industrious revolution" (de Vries 2008), leading to a lengthening of the working year. However, even assuming 353 days worked – an estimate at a high end of those found in the literature (reviewed below) – would imply that an unskilled worker in Italy in 1861 earned between 34% (in southern Italy) and 54% (in central-northern Italy) less than an average individual.[20] Under the canonical assumptions of a labour participation rate of 40% and a labour income share of two thirds, these figures would imply that in 1861's Italy the wage of an average worker was 2.20 and 2.60 times that of an unskilled worker in the two-macro-areas, respectively. Surely too low lower bounds, with 60% labour participation rate and 45% income labour share, yield corresponding ratios of 1.18 and 1. In other words, only under extreme assumptions on length of the working year, labour participation rates and income labour share would unskilled wages approximate average wages. While there is evidence that Italian labour was under particular duress so that such estimates might actually be not far off the mark (Gabbuti 2020: Figure 2; Chilosi and Ciccarelli 2022: Table 2), the figures would nevertheless imply a large wedge between labour and total income. Under less extreme assumptions, Italian pre-modern workers earned significantly more than unskilled wages, even in a prevalently agricultural economy, like southern Italy. Our results chime with the observations that low and medium skilled occupations were common also in pre-modern agriculture (de Pleijt and Weisdorf 2017: Table 6) and that the earnings of tenant and land-holding farmers often differed significantly from those of agricultural labourers (Pomeranz 2017; Hatcher 2018).

Turning to *trends*, in the south we detect slow economic growth, with an average yearly rate of change 0.05% and a cumulated change of 38%. We can distinguish three periods. During the Renaissance (1400-1600) economic growth was relatively rapid, with an average yearly rate of 0.10%, leading to a cumulated change of 31%, nearly as much as in the whole period. The economy contracted during the "17th century crisis", with an average yearly rate of -0.08% and a cumulated change of -10%, but gradually recovered during a "long Risorgimento" (1700-1861), when the average yearly rate of growth was 0.07%. By 1861 the GDP pc was above its 1700 level by 6%. Our long-term trend in central-northern Italy is mostly not so different from that of Malanima (2011).[21] In particular, we agree in detecting that GDP pc in 1500 was essentially at the same level as in 1861. There are nevertheless at least two obvious discrepancies. Firstly, in the early 15th century Malanima's series (2011) detects a GDP pc about a fifth higher than us, for incomes to sharply drop after 1450. Secondly, in the decades around 1750, again Malanima (2011) finds that the GDP pc was initially significantly higher than for us, but then rapidly fell. In both instances, when Malanima (2011) detects crisis, we find stagnation.

Whence these differences? They do not stem from different agricultural employment shares. Our shares in the 15th century (Figure A3 in Appendix C) are slightly higher than those of Malanima (2011: table 3), despite slightly different borders and computational approach.[22] Therefore, by Engel's law, it is our GDP pc series that should be lower than his in 1400 and

[20] This computation considers that the poverty line implies a standard of living higher than the barebone basket: its cost in 2011$ is 1.90 rather than 1.25 (Federico et al. 2021: 10).
[21] Yearly fluctuations are obviously much more marked for Malanima (2011) than they are for us. This difference holds also in the 19th century when we can rely on yearly data. The occupational structure is stickier than prices and thus is bound to miss out on short-term changes.
[22] The difference between our and Malanima's (2011) agricultural employment shares are as follows: 2.91 percentage points in 1400, 4.91 percentage points in 1450 and 0.52 percentage points in 1500.

especially 1450 and not the other way round. The drop in GDP pc that Malanima (2011) detects in the second half of the 15th century is at odds with his trend in the agricultural employment share, which went down by as much as 4 and half percentage points at the same time, even more markedly than with our series (cf. Figure A1 in the Appendix). Since, like our source (Chilosi and Ciccarelli 2022), Malanima (2011) extrapolates the agricultural employment share with urbanisation rates, the structural transformation that Malanima (2011) detects between 1450 and 1500 would be spurious if there were a concomitant decrease in rural industry. While direct evidence is scant, a decline in rural industry in the second half of the 15th century is hardly likely. In 1427 Tuscany the non-agricultural rural employment share was 6% (Herlihy and Klapisch-Zuber 1978: ch. 10), an all-time low by the standards of pre-modern Europe (Chilosi and Ciccarelli 2022: Table A4 in on-line Appendix D). It is exactly in the second half of the fifteenth century that historians detect evidence of a first wave of proto-industrial development in Italy (Epstein 2000: chapter 6; Franceschi 2004).[23] Analogous remarks apply to the 18th century, when Malanima (2011: table 3) detects a fall by over two percentage points in the agricultural employment share, while according to our estimates it fell by just over one percentage point. Moreover, once again, if anything we expect to underestimate structural transformation, with historians highlighting the vitality of rural industry in the 18th century, particularly in northern Italy (Vigo 1987; Panciera 2006). In other words, it is difficult to square rapid falls in living standards in the second half of the fifteenth century and the decades around 1750 in central-northern Italy with what we know about trends in the occupational structure at the time, regardless of whether we use our or Malanima's (2011: table 3) estimates of the agricultural employment share.[24]

In both the 15th and 18th centuries, differences between our and Malanima's (2011) GDP pc's series are caused by fluctuations in daily real wages, which are one of his key inputs, but are not used with our approach. Real wages shot up in the aftermath of the Black Death (1348) and rapidly fell with the resumption of population growth in the second half of the 15th century (Malanima 2011: Figure 5). If, as argued by Hatcher (2018), wages after the Black Death went up less and are less representative of incomes than usually thought, the boom and bust in the century and half after 1348 detected by Malanima (2011) needs to be reconsidered. This contention is also consistent with van Zanden and Felice's (2022) recent estimate of the GDP pc of the Republic of Florence in 1427, whose territory included the large part of present-day Tuscany. They argue that Malanima's (2011) estimates for the early 15th century suffer from a positive bias stemming from the unwarranted assumption that Florence's wages were representative of national incomes. On the one hand, the leading role played by Florence in Renaissance banking and commerce (Goldthwaite 2009) would lead one to think that, if anything, the Tuscan GDP pc should be greater than that of the centre-north as a whole. Thus,

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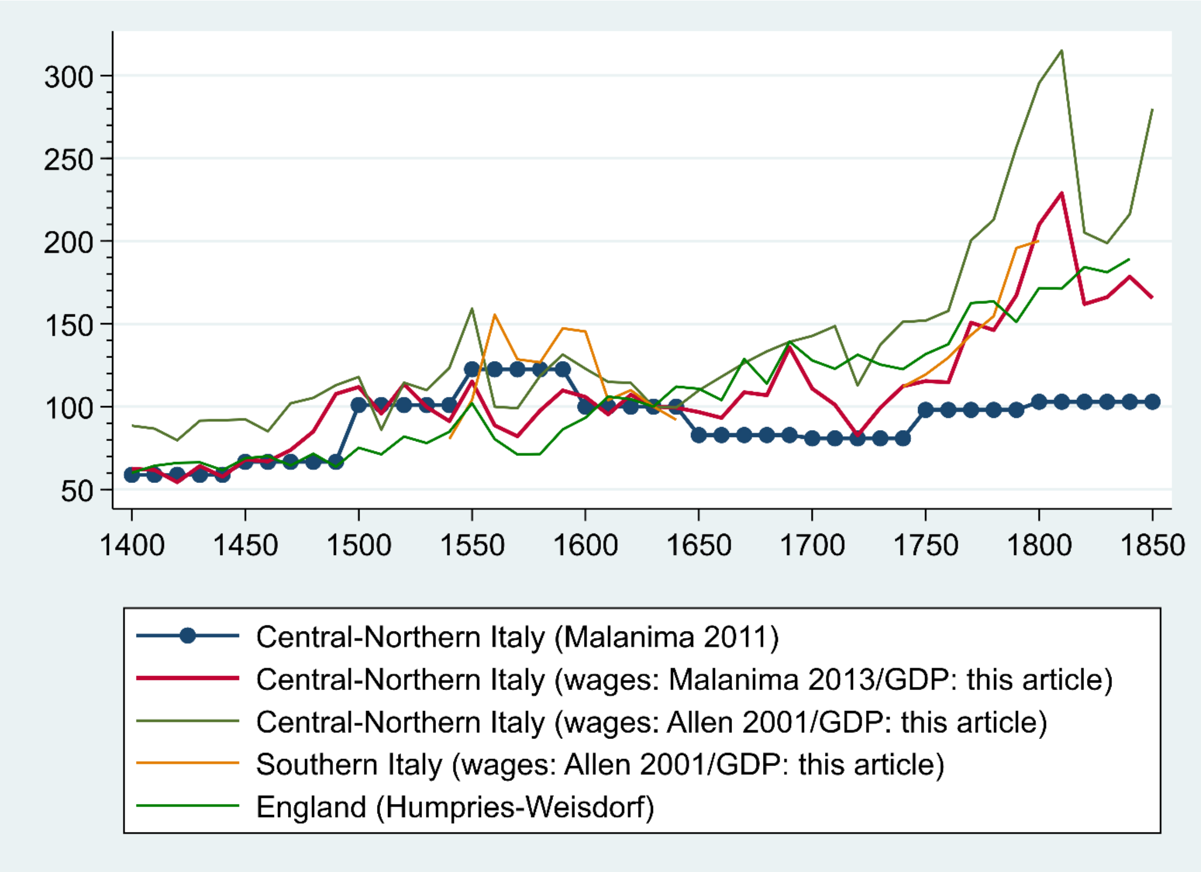
[23] As stressed by van Zanden and Felice (2022), the fall in the second half of the 15th century is also at odds with the experience of contemporary observers, such as the Renaissance historian Francesco Guicciardini, who perceived the late 15th century as a period of unprecedented prosperity.

[24] Although an aspect of the "industrious revolution" was a tendency to spend a larger share of income on non-food items (de Vries 2000: 190), the English evidence, with a robust inverse relationship between agricultural employment share and income per capita in c. 1650-1800 (Figures 3 and A3 in Appendix C), indicates that this force was hardly sufficient to significantly counter the effect of Engel's Law. The point can only apply more strongly in the Italian cases, where earnings were closer to subsistence and thus there was less scope for preferences to trump the nutritional needs of the body. Moreover, our baseline estimates use a propensity to consume food with the budget above subsistence at the low end of plausible values, with the consequence that the economic growth revealed by a decrease in the agricultural employment shares is conservative. Using an even lower value would have a modest effect on the results anyway (Figure 4).

the agricultural employment share that van Zanden and Felice (2022: Table 2) detect there, 59%, is a few points lower than our figure for central-northern Italy in the same year, 64%. On the other hand, it cannot be ruled out that van Zanden and Felice's (2022) reliance on a fiscal source may introduce a negative bias in their estimates: the Florentine well-to-do were well-versed in the art of tax evasion (Caferro 2008: 180). While such effects are difficult to quantify, there is no doubt that 1427 estimate is rather sensitive to the deflator used. With van Zanden and Felice's (2022: table 4) preferred deflator, the Tuscan GDP pc was as low as 2,020 (2011 international) $; with Allen's (2001) deflator, it shoots up to 2,684 $, a figure one fourth higher. It is nevertheless reassuring that our estimate for the centre-north in the same year, 2,551 $, falls within these two bounds.

The 18th century's crisis found by Malanima (2011) was also a Malthusian crisis, driven by rapidly falling real wages, in the wake of population growth (Malanima 2011: Figures 3 and 5). Even more markedly than in the centre-north, our slowly rising GDP pc during the 18th century in the south is at odds with trends in daily real wages, which according to Allen (2001) also saw a sharp contraction (detected by Malanima 2006, too). However, again, if one suspends belief in the representativeness of daily wages, doubts can be expressed about the extent to which these downward trends can be considered as representative of annual incomes. As seen in Britain, discrepancies between trends in daily wages and GDP pc can be reconciled if one considers changes in the length of the working year (Broadberry *et al.* 2015: chapter 6; Humphries and Weisdorf 2019). In Figure 2, we look at how trends in labour participation would have to look like for trends of daily real wages detected by Allen (2001) and Malanima (2013) to be consistent with those of our labour income. In other words, we plug in Equation (3b), Allen's (2001) and Malanima's (2013) trends in wage rates (w_{it} in the Equation) and solve for the labour participation rate ($\frac{L_t}{N_t}$), in both central-northern and southern Italy. We assign Allen's (2001) series for Florence to central-northern Italy and that for Naples to southern Italy. For the sake of comparison, we also include the implicit working time from Malanima's (2011: Table A1.3) GDP pc's estimate and annual number of days worked in England, as estimated by Humphries and Weisdorf (2019: Figure 4).

Figure 2: Labour participation index (1630s=100), 1400s to 1850s



Sources: Table A2 in Appendix A.

There is a fairly close, but less than exact, match between our labour participation indices using Allen's (2001) and Malanima's (2013) real wages, with those based on the former being significantly more volatile than those based on the latter. This difference can be traced to the use of a different price index to deflate real wages: while Allen (2001) relies on Laspeyers price index with constant quantities, Malanima (2013) relies on a Fisher price index, which allows consumers to change quantities in response to changes in relative prices, implying smoother changes in real wages and therefore in our index. Nevertheless, both series agree in detecting a massive increase in labour participation in the "long 18th century": both in central-northern and southern Italy: by the 1840s, labour participation had increased nearly two-fold or more, relative to the 1630s baseline. This increase matches closely de Vries' (2008) dating of the "industrious revolution", for whom the long 18th century saw a massive expansion in labour supply, as working time went up and increasingly households relied on all family members to complement the efforts of the main earner. Our trends also agree with Humphries and Weisdorf's (2019: Figure 4) estimate of the length of the working year in England, which increased nearly two-fold between the 1630s and the 1840s, from 187 to 353 days. Moreover, our central-northern Italian trends, using Malanima (2013) daily wages (but only to a lesser extent Allens' 2001), agree with Humphries and Weisdorf's (2019: Figure 4) result on a "proto-industrious revolution", starting in the 15th century.[25] The overall correlation coefficient

[25] With Malanima's (2013) wages, we find a nearly two-fold increase in labour participation between the first decade of the 15th and the first decade of the 16th centuries, while Humphries and Weisdorf (2019: Figure 4) find a similarly large but more protracted increase, from 112 days in 1400-1409 to, as said, 187 days in the 1630s, with much of the change occurring, however, in the 16th century. In consequence, for Humphries and Weisdorf (2019:

between the two series is as high as 85%. There is, however, a clear discrepancy with the working time implied by Malanima's (2011: Table A1.3) GDP pc series for Italy's central-north, which reaches a maximum in the second half of the 16th century, and has hardly any long-term increase at all between the 1630s and the 1840s, going from 204 to 210 days.

To be sure, the increase in the length of the working year was not quite as marked according to Federico *et al.* (2022: Figure A.3): for them, between 1400 and the 1840s the number of days worked went up from 180 to 310, corresponding to an increase by just 72%, as compared to 215% for Humphries and Weisdorf's (2019: Figure 4) and 186% combining Malanima's (2013) daily wages with our GDP pc's estimates for Italy's centre-north. Indeed, recent work based on direct evidence has cast doubts on the idea that 18th century London building workers could easily find employment for more than about 180 days in a year (Stephenson 2020), though, at the same time, the working year might have been significantly longer in southern Europe (Ridolfi 2023). This is not the place to solve these disputes. It is nevertheless worth pointing out that labour participation rates can change extensively, depending on how many individuals participate in the labour market, as well as intensively, depending on how hard each individual work. In consequence, working days are expected to increase less than our labor participation rate. There are also two possible factors that can lead us to overstate somewhat the increase in labour participation. The first factor is that our estimate of labour participation – like that of Humphries and Weisdorf's (2019: Figure 4) – neglects to consider that, as they stress, daily wages included a premium to compensate workers for irregular unemployment (see also Rota and Weisdorf 2020, 2021). Hence, annual wages were lower than daily wages times days worked, with the difference increasing in years when it was hard to find regular employment. A corollary of this point is that fluctuations in daily wages of building workers might merely reflect fluctuations in labour demand, with the implication that e.g. falling wage rates in times of population growth might reflect a rising demand for housing, rather than Malthusian pressure. This perspective would explain, for instance, why agricultural wages, did not decline in 18th century Tuscany (cf. Rota and Weisdorf 2021), although they are more directly exposed to Malthusian pressure than masons' wages. The second factor potentially introducing a positive bias in our labour participation trends is that any form of skilled-biased technical change is bound to increase the distance between unskilled and average wages. Thus if, as expected in a Smithian economy, the division of labour increased with population size it is possible that masons' wages became increasingly unrepresentative of trends in labour incomes in the 15th/16th and 18th centuries: labour productivity gains from specialization further up in the wage distribution might have offset losses from any decreasing returns at its low end.[26] While it is difficult to quantify the two effects with any precision, they would have to be very large to alter the direction of our labour participation trend.

Figure 4) working days returned to the pre-Black Death level. It is noteworthy in this respect that Malanima's (2011: Table A1.3) working days are is sharp disagreement with those of Humphries and Wesidorf (2019: Figure 4) in detecting a longer working year in the half-century immediately after the Black Death (1350-1400) than in the subsequent one (1400-1450). This trend is rather counter-intuitive and it, too, raises doubts on the reliability of the boom (1350-1450) and bust (1450-1500) that Malanima (2011) detects in central-northern Italy in the 150 years following the Black Death.

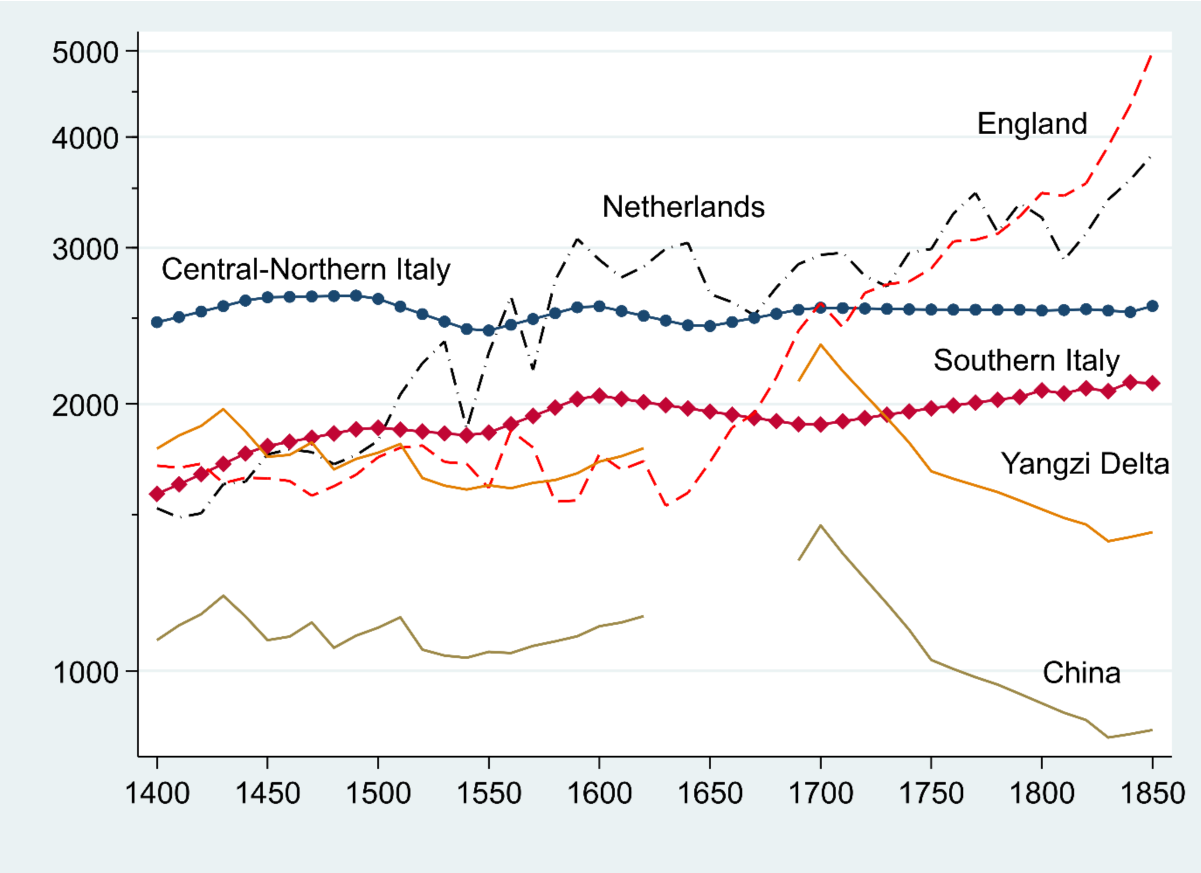
[26] Although, as mentioned before (Section 2), the evidence on the Italian skill premium, in line with European trends, point to a stable 50% premium (van Zanden 2009: Figure 2), it is based on a crude division between skilled and unskilled work and is based exclusively on the building industry. It is thus hardly ideal to capture the Smithian dynamics considered here: for instance, in early modern London, numbers of occupations strongly suggest a massive increase in the division of labour (Persson 2015: Table 2.1), in spite of the sable premium.

In summary, labour participation trends consistent with our GDP pc series are much more in agreement with conventional wisdom about the timing of the industrious revolution than those consistent with Malanima's (2011) GDP pc's series for central-northern Italy. Moreover, as seen before, our trend for the centre-north, differently from that detected by Malanima (2011), is consistent with van Zanden and Felice's (2019) recent estimates of Tuscan GDP pc in the early 15th century, based on a direct approach relying on a fiscal source. The differences stem from trends in daily wages pushing Malanima's (2011) estimates towards trends inconsistent with the occupational data. Taken together, this evidence indicates that our demand-side approach, based on Growth and Persson's (2016) general equilibrium model, can deal with inconsistencies between occupational and daily wages' trends more satisfactorily than the conventional demand-side approach taken by Malanima (2011). Our new series suggest that in the long-run the centre-north stagnated, rather than declined. Southern Italy, though poorer, was slowly growing. The next section considers the implication of our new GDP pc's series for debates on Italy's place in the great divergence.

4. International comparison

In this Section, we compare our Italian macro-areas with the two places that have been at the centre of the debate on the great divergence: England and the Yangzi Delta. In addition, firstly, to facilitate comparison with previous work, which in the absence of solid evidence on the Yangzi Delta had focused on China, we also include the series for the whole Asian country. Secondly, we include the Netherlands, too, whose series is directly relevant for comparisons between European and Asian frontiers, as well as debates on the "little divergence". GDP pc estimates from China (and therefore the Yangzi Delta), England and the Netherlands are all based on an output approach, not dependent on real wages. The GDP pc series are shown in Figure 3.

Figure 3: GDP per capita in Italy (2011 international $, log scale): an international perspective, 1400s-1850s



Sources: see Appendix B.

The timings of the great divergence between Europe and Asia and the little divergence within Europe are unaffected by using our series for the centre-north, instead of Malanima's (2011). Central-northern Italy's income per capita was in the order of twice as big as that of China already at the beginning of the 15th century, was caught up by Britain by 1700 and had fallen behind it by the mid-18th century. During the 18th century central-northern Italy also fell decisively behind the Netherlands, which had caught up with it during the Dutch Revolt (1568-1648). Southern Italy was different. In 1400, it was broadly on par with England, the Netherlands and China, though it temporarily became quite a lot richer than China in the 16th century. It markedly fell behind the Netherlands already in the 16th century and England with the latter's take-off of the mid-17th century. Southern Italy decidedly forged ahead China with the latter's decline in the 18th century, though the gap was sizeable already in 1400. By the mid-19th century, the GDP pc in southern Italy was about twice as large as that of China, but half or less than those of the Netherlands and England.

The series in Figure 3 only imperfectly match Broadberry *et al.*'s (2018: Figure 8) argument that the Yangzi Delta fell significantly behind Europe's frontier only from 1700. Central-northern Italy emerges as being richer than the Yangzi Delta throughout our period, even it lost its status of European leader to the Netherlands during the 16th century. To be sure, since 1700 the gap between the European leader and the Yangzi Delta greatly widened. However, in the three preceding centuries it was already significant: it remained roughly stable, with the European leader being about 50% richer than the Yangzi Delta. Indeed, between 1500 and 1620 there was hardly any difference between the GDP pc of the Yangzi Delta and those of southern Italy and England, places which are thought to be significantly behind the European frontier at the time. In other words, Figure 3 would suggest that the great divergence was inherited from the high Middle Ages, when the "commercial revolution" enriched central-northern Italy, while China failed to hold on to the gains the "Song's Renaissance". Nevertheless, once again, relative levels are very sensitive to the choice of deflator: using 1990$ rather than 2011$ implies that the picture significantly changes to match very closely Broadberry *et al.*'s (2018: Figure 8) dating of the great divergence in 1700, with no difference in the GDP pc of the European leader and the Yangzi Delta in the preceding three centuries (Figure A2: Appendix A).

A striking feature of Figure 3 is how little trends across places differed in the fifteenth century. The average yearly rates of change are as follows: 0.08% in central-northern Italy, 0.19% in southern Italy, -0.05% in England, 0.20% in the Netherlands, -0.04% in China and -0.08% in the Yangzi Delta.[27] The Spanish territories of southern Italy and the Netherlands were somewhat more dynamic than the others, but this grouping cuts across the southern vs. north-western Europe or Europe vs. Asia divides. These trends are incompatible with the current orthodoxy that the Black Death (1348) marked a watershed in the history of the great divergence because only north-western Europe managed to hold on to the gains made in its aftermath. In contrast, in southern Europe, the argument goes, a Malthusian cycle of expansion was followed by an equally abrupt contraction when population growth resumed in the second half of the 15th century (Pamuk 2007; Broadberry 2021; de la Escosura and Rodríguez-Caballero 2022). Malanima's (2011) series shown in Figure 1 offers a paradigmatic illustration of the Malthusian contraction. However, as argued before (Section 3), estimates of the occupational structure exhibit no evidence that this contraction took place in central-northern Italy. Conversely, Broadberry *et al.* (2015) fail to detect a bust in the second half of the 15th century in England because they rely on an output-based estimate: as shown by Nuvolari and Ricci (2011: Figure 6) a conventional demand-side approach like that used by Malanima (2011), with daily real wages playing a key role, would produce a contraction in the English economy even greater than in central-northern Italy. In contrast, our evidence indicates that none of the places in our sample saw significant shrinking during the 15th century.

Significant differences across places can be observed during the 18th-century phase of population growth. But in that century, too, the trends, require substantial revisions of the conventional wisdom that only north-western Europe had broken free of Malthusian constraints pushing down living standards whenever population expanded. As discussed before (Section 3), we fail to detect generalised Malthusian crises in the 18th century in either of our Italian macro-areas. That the downward trajectory that characterised China and the Yangzi Delta was avoided not only in north-western Europe but in Italy, too, implies a re-assessment of Pomeranz's (2000) thesis that access to the new world natural resources was one of the crucial conditions that allowed Europe to avoid ecological disaster. This thesis was initially conceived for the 19th century, but Pomeranz (2011) later accepted that the great divergence began earlier than he originally thought, in the 18th century. The argument on the centrality of the new world does not cause obvious difficulties for 18th-century China: while it saw large increases in imports from the Americas, these consisted of coined silver rather than primary goods (Irigoin 2018). The same remark applies to 18th-century Britain, whose trade with the rest of the world

[27] Computations based on yearly data (decadal data for China and the Yangzi Delta) using the (natural) log of the GDP pc as dependent variable and year (decade) as the only explanatory variable. All European coefficients are significant at the 1% level. China's coefficient is insignificant and that of the Yangzi Delta is significant at the 10% level.

became at least as important as that with the rest of Europe and saw a massive increase in openness, with export per capita going from less than 30 cents of 1913 $ in 1700 to over 3 $ in 1800 and over 4 $ in 1820. It is rather more difficult, however, to apply the same reasoning to explain the resilience of the economies of central-northern Italy, which in the 1820s only exported less than half as much as Britain, and especially southern Italy, which at the same time exported slightly less than Britain did nearly a century earlier, in 1750. What is more, the available evidence (from the 1850s) suggests that while Britain did import almost exclusively primary products (93%), southern Italy imported mostly manufactures (88%) (with central-northern Italy lying in the middle).[28] Hence, while global trade and empire remain very much plausible candidates to account for why Britain pushed the boundaries of Smithian specialisation beyond the old frontier, their absence falls short of being sufficient to explain China's fall from grace.

Domestic factors appear more credible candidates. To begin with, the demographic shock appears to have been much larger in China, where population grew by 147%, than in either Italy, which saw an increase by 44%, or Britain, where the same figure was 76%.[29] To be sure, as shown by Solar (2021: Table 2 and Figure 4), using sources different from Broadberry *et al.* (2018), would reduce China's population growth by perhaps two-thirds, but the revisions would not be sufficiently large to alter the conclusions that China's demographic expansion was particularly rapid and that it was associated with a significant decline in living standards. Either way, population growth in 18th century-China was particularly rapid also by its own historical standards, rather than reflecting an average age of marriage or mortality rates persistently lower than those found in pre-modern Europe (cf. Voigtländer and Voth 2013a, 2013b): thus, the previous phase of population expansion in southern Italy was just as rapid as in China in the second half of the 15th century (32% vs. 33%) and significantly more rapid in the 16th century (57% vs. 37%) (see also Pomeranz 2000: 40-41; Rosenthal and Wong 2011: chapter 2; Edwards and Ogilvie 2022).

18th-century China was characterised by processes of hollowing out of the state and market disintegration with no parallel in Western Europe. Taxation nearly halved from 7.2 grams per capita in the first half of the 18th century to 4.2 grams in the second half (Ma and Rubin 2019: Table 2).[30] Such figures compare with 27/28 grams in southern Italy, 46/44 grams in central-northern Italy and 92/109 in Britain, in the first and sixth decades of the 18th century, respectively (Chilosi and Ciccarelli 2022: Table A5 in the on-line Appendix). A regime of low fiscal pressure in China was characteristic of the Ming-Qing period (1368-1912), following the

[28] Although by importing manufactured cotton from Britain, the Italians were also relying on the new world natural resources' windfall, cotton imports into Britain only picked up in the 19th century (Chilosi and Federico 2021: Table 1b). The precise figures of exports per capita in 1913$ are as follows. Britain: 0.28 in 1700, 0.78 in 1750, 3.03 in 1800 and 4.02 in the 1820s; southern and central-northern Italy, respectively: 0.72 and 1.58 in the 1820s. From 1800 onwards, the figures are from the Federico and Tena-Junguito World Trade database (https://www.uc3m.es/ss/Satellite/UC3MInstitucional/es/TextoMixta/1371246237481/?d=Touch) except for the share of primary products in the imports of the Italian south (continental part), which is from Federico and Tena-Junguito (2014: Table 3). The pre-1800 British figures are from Allen (2003) and have been first adjusted to consider exports into Europe, using the export shares in 1790 from Daudin et al. (2008: Table 4.1), and then converted from 1700 £ into 1913 $ per capita, taking the conversion rate from 1800, when estimates from both sources are available.

[29] The increase was very similar in southern (47%) and central-northern Italy (42%). Britain's and China's populations are from Broadberry *et al.* (2015: on-line database, 2018: Appendix Table); Italy's population is from Chilosi and Ciccarelli (2022). In all cases the computations are based on decadal means to facilitate comparison with China's figures, which are at decadal frequency in the source. The same sources and method are used to compute the population growth rates shown later in this paragraph.

[30] According to Liu (2021), these estimates suffer from a negative bias possibly as high as a factor of three. Nevertheless, even considering this bias, our qualitative conclusions would stand.

neo-Confucian idea of the benevolent state, and specialist scholars see it as an enabler of Smithian growth (von Glahn 2020; Deng 2021). Indeed, medieval Britain, too, which was similarly relatively insulated from external military pressures, combined particularly low taxation with high market integration (Federico *et al.* 2021: Figure 3; Chilosi and Ciccarelli 2022: Table A5 in the on-line Appendix). However, during the 18th century, due to the combination of population growth and the 1712's imperial creed of 'permanent freezing the total tax revenue', China's fiscal pressure reached new, unsustainable, lows. At the same time grain markets progressively disintegrated, with the state-funded granaries and water-control system becoming increasingly unfit for purpose (Pomeranz 2000: 245-248; Gu and Kung 2021; Bernhofen *et al.* 2022). Such trends sharply contrasted with increasingly integrated grain markets in early modern Italy, as well as north-western Europe (Chilosi *et al.* 2013: Table 3). In short, a credible hypothesis behind the 18th century's fork is that China saw a Malthusian crisis in the wake of declining state capacity and market disintegration, while our European places were spared from these ills. In consequence, the great divergence began.

5. Sensitivity analysis

The previous analysis has produced three main empirical results. Firstly, we found secular stagnation in central-northern Italy and slow growth in southern Italy. Secondly, southern Italy's dating of the little and great divergence differed from those of central-northern Italy, as it fell behind the north-western European economies earlier and forged decisively ahead of China later than its richer northern counterpart. Thirdly, we detect no evidence of a Malthusian contraction in either southern or central-northern Italy in the 15th century.[31] However, to obtain these results we had to make several assumptions. The objective of this section is to investigate the extent to which our results are sensitive to plausible relaxations of these assumptions.

To begin with, we examine the sensitivity of trends, offering three batteries of tests. Firstly, we follow in the footsteps of Groth and Persson (2016: Table 5) and allow the values of the parameters of the model used to obtain GDP pc estimates from the agricultural employment shares (Table 1) to take different values than in the baseline estimation. We implement the same changes as they do in their own sensitivity analysis, with the only exceptions of the three parameters for which we chose different values in our baseline estimation (β, ε and w_1/w_2). In these cases, we use their baseline values instead.

Secondly, we factor in that wealth inequality tended to increase monotonically throughout our period, across Italy's regions (cf. e.g. Alfani and de Tullio 2019), by allowing the income labour share to decrease over time, as it is expected to be inversely related to income inequality and therefore to wealth inequality (cf. Bengtsson and Waldenström 2018; Kuhn *et al.* 2020). Federico *et al.* (2021) suggest that 20 percentage points is a plausible variation in income labour shares for pre-modern Europe and our baseline income labour shares are calibrated on the early 15th century. Accordingly, in our sensitivity test, we allow the income labour shares, both in agriculture and in the urban sectors, to be 20 percentage points higher in 1400, when the values are the same as in the baseline, than in 1861. We linearly interpolate the associated parameters β (elasticity of agrarian output with respect to labour) and ε (elasticity

[31] Analogous remarks apply to the 18th century, but in the interest of space here we only consider the 14th century, when the difference with conventional estimates is particularly large. In any case, our result that the 18th century did not see contractions in our Italian areas is also robust to the set of sensitivity tests presented here. The results of a further sensitivity tests not reproduced here but available upon request considers that cross-sectional variations in the shares of agricultural workers in cities and country-side gives rise to upper and lower bounds in our occupational series (Chilosi and Ciccarelli 2022: Figure 6). Using these bounds instead of our baseline series has hardly any effect on our results.

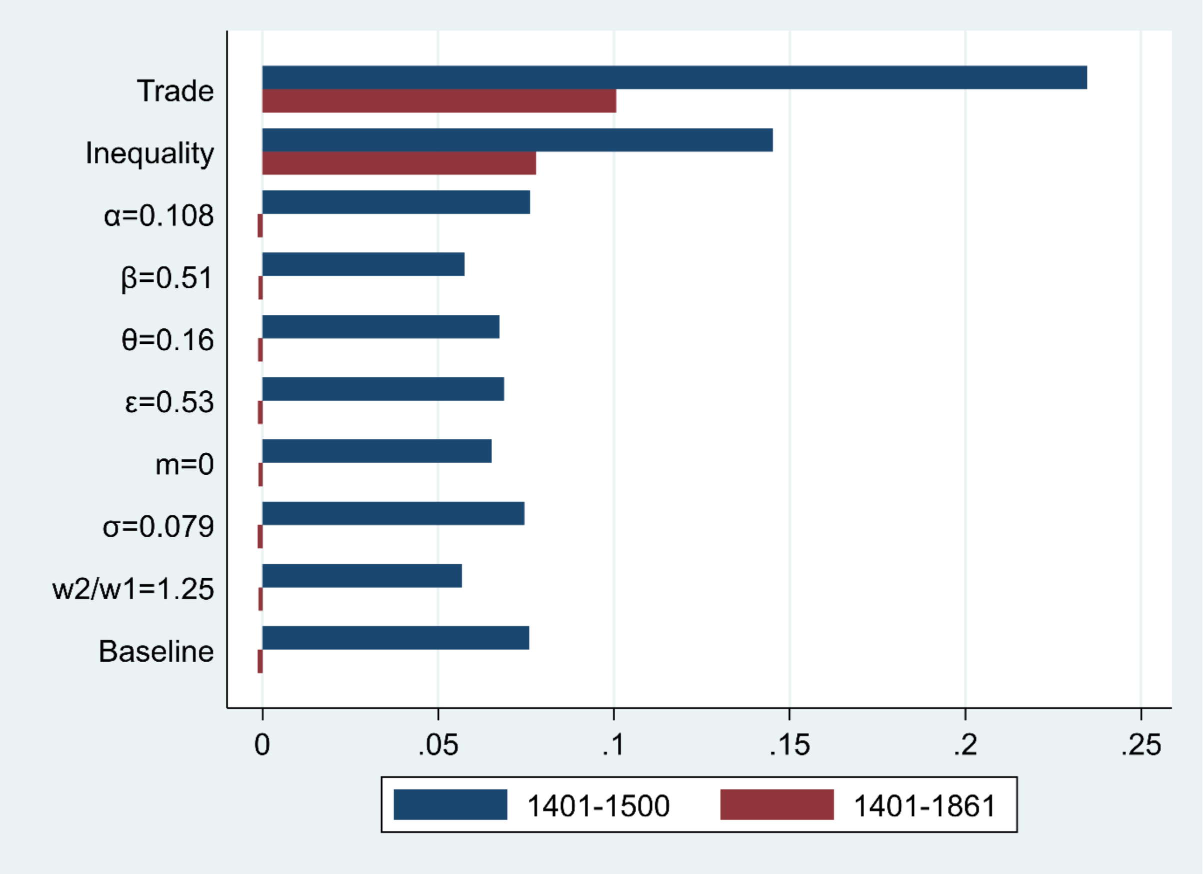
of output in industry and services with respect to labour) in between these dates.[32] The result is that our income labour shares go from 71% to 48% in the south and from 67% to 46% in the centre-north. The shares in 1861 are nearly identical to the first available national estimate: 48% in 1895 (Gabbuti 2021: Figure 2).

Thirdly, in our baseline, we follow the standard assumption that trade in primary products was balanced, so that there was an identity between agricultural production and consumption. The ratio between the two in the early 19th century can be estimated as up to 1.06 in southern Italy and 1.05 in central-northern Italy (Appendix C). Southern Italy was specialized in agriculture at least since the high Middle Ages and we do not expect major changes in the preceding period (Epstein 1995; Abulafia 2005). We therefore divide the agricultural employment share there by 1.06 throughout to reflect that not all agricultural supply was consumed domestically (following Allen 2000: Equation 1). By contrast, export specialization in central-northern Italy was dynamic: in the Middle Ages it was specialized in manufacturing and trade (Epstein 1995; Abulafia 2005) but lost a comparative advantage in textiles with the 17th century crisis, according to conventional wisdom (Cipolla 2005: 190-192). Allen (2000: 14) reckons that the ratio between agricultural production and consumption in pre-modern Europe could be as low as 0.9. We thus adjust the agricultural employment share in the centre-north assuming that the ratio was 0.9 in 1400, 1 just before 1600 and 1.05 in 1861 (linearly interpolating the ratio in between these years). Figure 4 compares average yearly rates of growth under these various sensitivity tests with the baseline rates, both over the whole period and in the 15th century only.

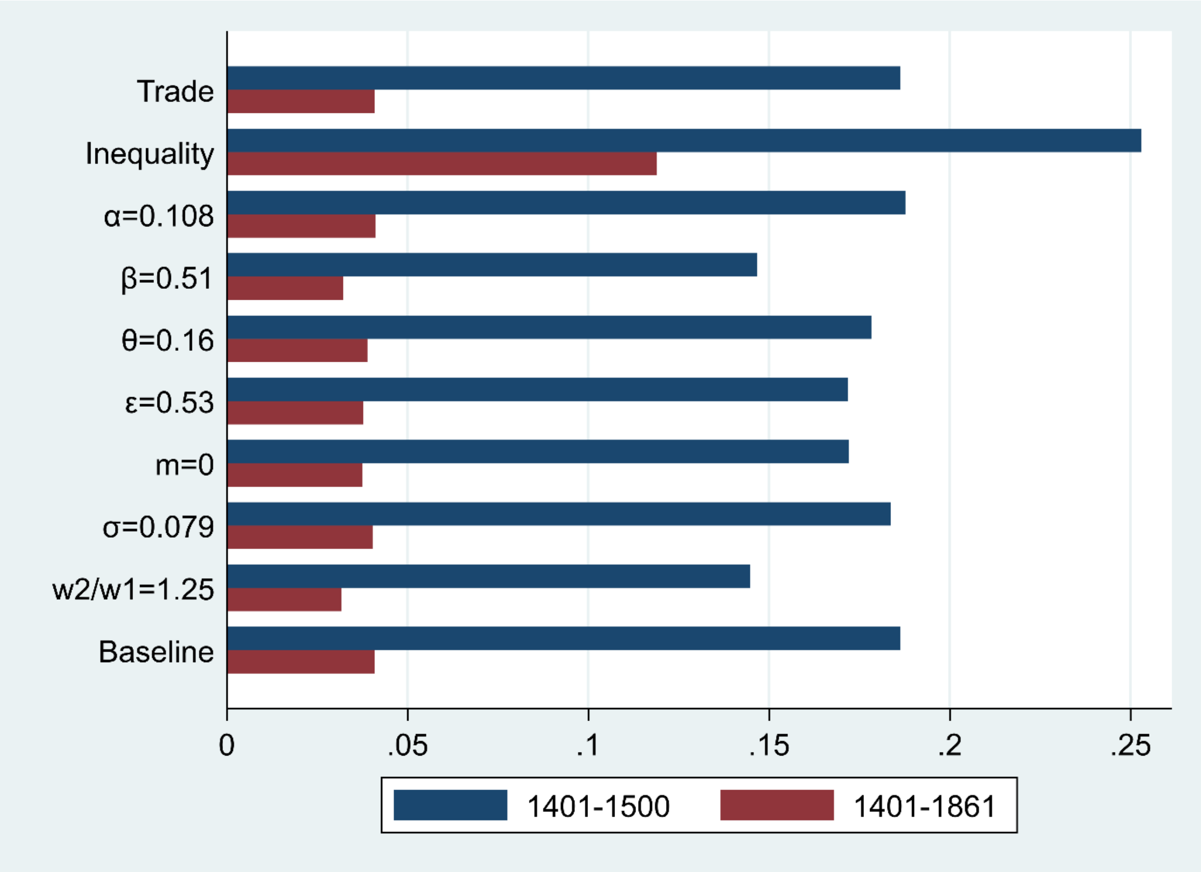
[32] We remind the reader the elasticity of output in agrarian output with respect to labour (β) is equal to one minus the elasticity of agrarian output with respect to intermediaries from industry and services (α) times the income labour share in agriculture. The elasticity of output in industry and services with respect to labour (ε) is equal to one minus the elasticity of output in industry and services with respect to agrarian intermediaries (θ) times the income labour share in industry and services (cf. Groth and Persson 2016: 21).

Figure 4: Sensitivity analysis of average yearly rates of growth of GDP pc (*100)

a) Central-northern Italy



b) Southern Italy



Notes: sensitivity analyses from "m=0" to "θ=0.16" allow one parameter at the time from Equations 2a and 2b to take a different value than in the baseline. The y-axis' labels show the new values. "Inequality" allows the labour income shares in both the agricultural and the urban sector to decline by 20 percentage points relative to the baseline between 1400 and 1861. "Trade" considers that southern Italy was specialized in the export of primary products, while central-northern Italy changed export specialization from urban to primary products. See the text for details. In all cases we obtain the average yearly rates of growth by regressing the natural logarithm of the estimated GDP pc series against year.
Sources: Table A3 in Appendix A.

None of the sensitivity tests challenge our key results on the trends: under all settings, we continue to reject long-term stagnation in the south as well as contraction in the 15th century, when, on the contrary, we find robust evidence of relatively rapid economic growth in both macro-areas. The baseline rates of growth are quantitatively very close and qualitatively identical across the first battery of tests. However, when we allow the labour income shares to decline or export specialization to change economic growth become significantly more rapid.

Let us look closer at the cases of more rapid economic growth, beginning with inequality. When we factor in rising inequality, the rates of economic growth increase significantly in both macro-areas: in central-northern Italy, one would have to modify the picture of long-term stagnation with one of slow growth, with an average rate of 0.07%; in southern Italy the average rate of growth becomes 0.12%, a value which is still lower but not too far off from the average rates of growth of the Netherlands (0.19%) and England (0.22%) at the same time. Indeed, those average rates of growth would have been nearly matched by central-northern Italy and exceeded by southern Italy in the 15th century when we detect rates of 0.15% and 0.25%, respectively. Central-northern Italy's GDP pc in 1427 would have been 1,800 2011$, a value which is only somewhat lower than van Zanden and Felice's (2021: Table

4) preferred estimate for Tuscany in the same year, 2,021$. While the GDP pc in southern Italy in 1401 would have been significantly lower than under the baseline (1,088 vs. 1,567 2011 $) the value is hardly implausibly low, as it still lies well-above the poverty line of 694$ (Bolt and van Zanden 2020: 19).

Why should a fall in the income labour share increase our estimates of economic growth so significantly? On the one hand, decreased agricultural wages and labour income shares are associated to decreased agricultural labour productivity and thus consumption of primary products. By Engel's law such a change reveals an increased income per capita. By the same logic, on the other hand, a decreased labour income share in the urban sectors is associated with increased consumption of urban goods and thus reveals a decreased income. Moreover, by definition, increased labour income shares (both primary and urban) match into falls in the capital and land income shares. Hence, the sign of the net effect of a decreased labour income share on the estimated GDP pc is undetermined a priori, but likely positive in agricultural societies.

Adjusting the agricultural employment shares for export specialization has no effect on trends in southern Italy – where we assume that specialization did not change over time – but has an even bigger effect on economic growth in central-northern Italy than adjusting for rising inequality. The long-run rate of growth in central-northern Italy becomes as high as 0.10%, as considering imports of agricultural products in the 15th and 16th centuries implies much reduced revealed incomes: in 1401 the GDP pc becomes as low as 1,518 2011 $, essentially the same as in the south (1,567 $). Under these settings, a fork between the two macro-areas only really opens in the wake of the uneven impact of the 17th century crisis, which (under all settings) hit the south much harder than the centre-north. This differential effect of the 17th century crisis is plausible: it matches the uneven impact of the plague, which in the continental south was about as deadly as the Black Death (Alfani 2020: 202-204). However, it is worth stressing data availability constraints imply this sensitivity test, as well as that on the effect of rising inequality, is based on rather crude assumptions on the evolution of the variables under scrutiny. Their results should therefore be taken as informative on the possible direction and sources of significant biases in our baseline analysis but cannot be expected to provide precise measures of their size.

Next, we look at the sensitivity of how our results on the timings of the little and great divergence. To do so, we look at the decade when the place that ended up being richer at the end of our period (England or the Netherlands vs. the Italian macro-areas and the Italian macro-areas vs. China or the Yangzi Delta) acquired a significant, at least 20%, and persistent (equal or higher until the end) GDP pc advantage. We do not consider variations in the values of parameters of the model, since, as just seen in Figure 4 these have at most a very modest effect on the trends and therefore are not expected to have any significant effect on the timings of divergence. We do, however, look at the effects of considering rising inequality and export specialization, which, as just seen, have significant effects on the trends. In addition, we consider two variations that affect GDP pc's levels. Firstly, we convert all GDP pc in 1990 instead of 2011 $, given, as seen in Sections 3 and 4, level differences between places are rather sensitive to the choice of deflator. Secondly, we allow the GDP pc ratio between central-northern and southern Italy at the time of unification to be larger than in our baseline. This sensitivity test reflects concerns that we assume no change in the ratio between 1861 and 1871 and that any positive bias in the southern agricultural value added in 1871 (cf. Federico 2011) is bound to cause a negative bias in our baseline ratio. As an alternative, we use a ratio which is consistent with the results of the fixed effects panel regression reported in Table A4

(Appendix C): 1.46,[33] rather than 1.18 as in the baseline. Table 3 show the results of these sensitivity tests.

Table 3: Sensitivity analysis of the timing of little and great divergence

		Decade of divergence			
Place	Sample	England	Netherlands	China	Yangzi Delta
Central-northern Italy	Baseline	1780s	1760s	Before 1400	1720s
Central-northern Italy	1990$	1720s	1830s	Before 1400	1790s
Central-northern Italy	1861	1780s	1760s	Before 1400	1720s
Central-northern Italy	Inequality	1750s	1680s	Before 1400	1740s
Central-northern Italy	Trade	1760s	1690s	Before 1400	1730s
Southern Italy	Baseline	1690s	1580s	Before 1400	1760s
Southern Italy	1990$	1660s	1580s	1750s	after 1850s
Southern Italy	1861	1660s	1580s	Before 1400	1760s
Southern Italy	Inequality	1680s	Before 1400	1710s	1790s
Southern Italy	Trade	1690s	1580s	Before 1400	1760s

Notes: decade of divergence: decade when the place that ended up being richer at the end of our period acquired a significant, at least 20%, and persistent (always equal or higher) GDP pc advantage. The second sample (“1990$”) deflates GDP pc with 1990$ instead of 2011$; the third sample (“1861”) assumes that the GDP pc ratio between central-northern and southern Italy in 1861 was 1.47 instead of 1.18; the third sample (“Inequality”) allows the labour income shares in both the agricultural and the urban sector to increase by 20 percentage points relative to the baseline between 1400 and 1861 when computing the GDP pc in southern and central-northern Italy; the fourth sample (“Trade”) considers that southern Italy was specialized in the export of primary products, while central-northern Italy changed export specialization from urban to primary products when computing their GDP pc.
Sources: see the text.

None of these sensitivity tests challenge the result that southern Italy fell behind north-western Europe before and forged ahead the Yangzi Delta later than central-northern Italy. Indeed, the different experience of the great divergence vis-à-vis China emerges more starkly than under the baseline if we use 1990$ as deflator and when we factor in rising inequality in our Italian GDP pc’s computations, with central-northern Italy forging ahead of China in the Middle Ages and southern Italy only in the 18th century. The use of 1990$ implies significantly later dating of the great divergence of the two Italian macro-areas vis-a-vis the Yangzi Delta. Nevertheless, nearly all tests agree in dating the great divergence between the Italian macro-areas and the Yangzi Delta to the 18th century. The dating of the little divergence as an early modern affair emerges as robust, too, with only one exception: adjusting for rising inequality in southern Italy anticipates its take-over by the Netherlands by at least nearly two centuries, to before the beginning of the 15th century. It is also noteworthy that the use of 1990$ implies that central-northern Italy fell behind England earlier but behind the Netherlands later than in the baseline. In contrast, Netherlands’ take over of central-northern Italy is anticipated by 70-80 years if we factor in inequality or changing trade specialization in the latter’s GDP pc’s

[33] We assume that the fixed effect is the same in southern and central-northern Italy, an assumption which is reasonable in the light of the fact that the agricultural labour productivity level and sectorial export specialization in around 1861 were very similar in the two macro-areas (Appendix C). The GDP pc in the south in 1861 is thus obtained by dividing its agricultural employment share in 1861 (75.12) minus the constant (81.51) and the fixed effect (12.11) by the slope of the regression line (-0.011).

estimate. All in all, the overall picture on the dating of the little and great divergence is only little affected by alternative assumptions in the construction of the Italian GDP pc's series.

6. Conclusion

This article has applied Groth and Persson's (2016) general equilibrium model, exploiting Engel's law and using Chilosi and Ciccarelli's (2022) just-published occupational series, to reconstruct a first GDP pc series for southern Italy, as well as a new one for central-northern Italy between 1400 and 1861. Our analysis contributes to on-going debates on the great divergence. Methodologically, we highlighted that Malanima's (2011) conventional demand estimate is difficult to square with trends in the occupational structure, as well as being at odds with conventional dating of the "industrious revolution". These inconsistencies are avoided with our approach. The broad issue is the extent to which daily wages are representative of GDP pc can vary significantly over time, because of changes in labour participation, skill composition of the workforce or functional distribution of income. Thus, reliance on daily wages to drive long-term GDP pc trends risks introducing spurious movements, unless factors affecting their relationship are systematically controlled for. Crucially, since the occupational structure encompasses the whole economy, our approach is more robust than the conventional demand approach to changes in the macroeconomic environment. Our approach is not as data-demanding as an output-based approach and can be potentially applied also in other contexts, even when wage data are not available. At the same time, there is scope to improve the reliability of our estimates with more and better macroeconomic data. Thus, a neglect of changes in functional distribution of income and export specialization implies that our baseline estimates of long-term economic growth might still suffer from a negative bias. Another limitation of our approach that should be addressed by further research is that it neglects to exploit available prices of goods and factors of production to reconstruct also short-term fluctuations.

Empirically, we found stagnation rather than decline in central-northern Italy and slow growth in southern Italy. Our results imply a more positive assessment of the performance of the pre-modern Italian economies than previous studies, forcing us to ask new questions, why they were resilient, rather than why they declined. Our estimates confirmed that GDP pc in Italy fell behind north-western Europe and forged ahead the Yangzi Delta in the early modern era. However, the timing of these divergences in southern Italy was significantly different from central-northern Italy, as it was poorer. Both southern and central-northern Italy – in common with China and the Yangzi Delta - saw no GDP pc contractions when population growth resumed in the 15th century, calling into question the current orthodoxy that the Black Death was a watershed in the history of the great divergence because in its aftermath Malthusian checks disappeared only in north-western Europe. The Italian economies, differently from China, were spared of a general Malthusian crisis during the population expansion of the 18th century, too. Looked at in the Italian mirror, uneven access to new world natural resources appears insufficient to account for the beginning of the great divergence in the 18th century. A more likely explanation is that a Chinese Malthusian crisis was precipitated by a decline of state capacity and market development, that had no parallels in Western Europe. Hence, in our interpretation, like Pomeranz's (2000), the great divergence was rooted in contingent developments rather than persistent differences, but we changed the emphasis from geography to institutions.

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Appendix A: Statistical Appendix

Table A1: GDP pc in Italy, 1400-1861

	Population ('000s)			Urbanisation (%), 10,000 threshold			Urbanisation (%), 5,000 threshold			Agricultural employment share (%)			GDP pc (2011$)		
Year	S Italy	CN Italy	Italy	S Italy	CN Italy	Italy	S Italy	CN Italy	Italy	S Italy	CN Italy	Italy	S Italy	CN Italy	Italy
1400	2,571	5,753	8,324	3.10	10.70	8.35	9.30	15.21	13.38	83.99	64.39	70.44			
1401	2,563	5,754	8,317	3.26	10.78	8.46	9.55	15.30	13.53	83.91	64.36	70.39	1567	2459	2184
1450	2,200	5,300	7,500	10.90	14.80	13.66	21.80	19.98	20.51	80.10	62.99	68.01	1785	2637	2387
1500	2,885	6,115	9,000	13.90	15.70	15.12	25.00	20.33	21.83	78.57	62.88	67.91	1884	2651	2405
1550	4,000	7,500	11,500	11.50	12.80	12.35	12.10	13.73	13.16	79.25	64.82	69.84	1839	2404	2208
1600	4,719	8,554	13,273	19.60	14.80	16.51	31.50	18.86	23.35	76.26	63.32	67.92	2051	2592	2399
1650	4,325	7,175	11,500	17.50	13.80	15.19	19.10	14.67	16.34	77.37	64.55	69.37	1968	2437	2261
1700	4,758	8,723	13,481	14.90	14.30	14.51	28.80	18.28	21.99	78.51	63.49	68.79	1889	2569	2329
1750	5,592	9,908	15,500	18.50	14.20	15.75	31.00	17.92	22.64	77.33	63.60	68.55	1971	2556	2345
1800	6,920	12,611	19,532	22.99	12.82	16.43	50.72	17.87	29.51	76.33	63.61	68.12	2045	2554	2373
1801	6,962	12,508	19,469	22.93	12.77	16.41	50.45	17.74	29.43	76.30	63.65	68.17	2048	2549	2369
1802	7,003	12,414	19,416	23.16	12.82	16.55	50.54	17.86	29.64	76.16	63.61	68.14	2059	2553	2375
1803	7,044	12,283	19,327	23.41	12.89	16.73	50.55	18.02	29.88	76.01	63.57	68.10	2070	2559	2381
1804	7,085	12,333	19,418	23.51	12.78	16.69	50.65	17.96	29.89	75.92	63.58	68.09	2077	2557	2382
1805	7,127	12,410	19,536	23.62	12.64	16.65	50.67	17.82	29.80	75.82	63.62	68.07	2084	2552	2381
1806	7,168	12,515	19,683	23.83	12.48	16.61	50.71	17.72	29.73	75.73	63.66	68.05	2092	2548	2382
1807	7,209	12,601	19,810	23.81	12.37	16.53	50.52	17.59	29.57	75.77	63.69	68.09	2088	2543	2377
1808	7,250	12,656	19,906	23.65	12.35	16.46	50.40	17.48	29.47	75.88	63.73	68.15	2080	2539	2372
1809	7,292	12,743	20,035	23.65	12.28	16.42	50.15	17.41	29.32	75.94	63.75	68.18	2075	2536	2368
1810	7,333	12,814	20,146	23.67	12.25	16.41	49.99	17.30	29.20	76.08	63.78	68.25	2065	2532	2362
1811	7,374	12,843	20,216	23.83	12.38	16.56	49.89	17.33	29.20	76.08	63.77	68.26	2064	2533	2362
1812	7,415	12,777	20,192	23.74	12.44	16.59	49.94	17.44	29.38	76.21	63.74	68.32	2055	2537	2360
1813	7,456	12,830	20,286	23.70	12.35	16.52	49.75	17.40	29.29	76.09	63.75	68.29	2063	2536	2362
1814	7,498	12,697	20,194	23.34	12.58	16.57	50.03	17.75	29.73	76.29	63.65	68.34	2049	2549	2363
1815	7,539	12,792	20,331	23.59	12.72	16.75	49.83	17.84	29.71	76.56	63.62	68.42	2027	2553	2358

1816	7,580	12,767	20,348	23.71	12.92	16.94	49.82	18.00	29.85	76.46	63.57	68.37	2036	2559	2364
1817	7,621	12,415	20,036	24.00	13.44	17.46	49.57	18.61	30.39	76.21	63.39	68.27	2055	2582	2382
1818	7,663	12,633	20,296	24.36	13.44	17.56	49.63	18.40	30.19	76.00	63.45	68.19	2070	2574	2384
1819	7,704	12,835	20,539	24.63	13.30	17.55	49.67	18.21	30.01	76.01	63.51	68.20	2070	2567	2380
1820	7,745	12,861	20,606	24.62	13.43	17.64	49.88	18.32	30.18	76.12	63.48	68.23	2061	2571	2379
1821	7,786	13,014	20,800	24.69	13.47	17.67	49.90	18.25	30.10	76.10	63.50	68.22	2063	2568	2379
1822	7,827	13,164	20,992	24.74	13.40	17.63	50.04	18.15	30.04	76.07	63.53	68.21	2065	2564	2378
1823	7,869	13,337	21,206	24.92	13.39	17.67	50.03	18.07	29.93	75.66	63.55	68.04	2098	2561	2389
1824	7,910	13,542	21,452	25.02	13.60	17.81	49.84	18.01	29.74	75.35	63.57	67.92	2122	2559	2398
1825	7,951	13,680	21,631	24.94	13.57	17.75	49.93	17.98	29.72	75.48	63.58	67.95	2112	2558	2394
1826	7,992	13,843	21,836	24.81	13.52	17.66	50.00	17.90	29.65	75.67	63.60	68.02	2096	2555	2387
1827	8,034	14,055	22,088	24.79	13.51	17.61	49.99	17.77	29.48	75.81	63.64	68.07	2085	2550	2381
1828	8,075	14,253	22,328	24.70	13.45	17.52	49.86	17.67	29.31	75.98	63.67	68.12	2072	2546	2374
1829	8,116	14,262	22,378	24.59	13.50	17.52	49.88	17.73	29.39	76.15	63.65	68.19	2059	2548	2371
1830	8,157	14,315	22,472	24.70	13.59	17.62	49.80	17.75	29.38	76.23	63.65	68.21	2053	2549	2369
1831	8,199	14,408	22,607	24.48	13.67	17.59	49.69	17.81	29.37	76.45	63.63	68.28	2036	2551	2365
1832	8,240	14,538	22,778	24.35	13.64	17.51	49.56	17.72	29.24	76.16	63.65	68.18	2058	2548	2371
1833	8,281	14,569	22,850	24.22	13.76	17.55	49.47	17.82	29.29	75.96	63.63	68.09	2074	2552	2378
1834	8,322	14,686	23,008	24.41	13.77	17.62	49.20	17.81	29.16	75.64	63.63	67.97	2099	2551	2388
1835	8,363	14,723	23,086	24.16	13.83	17.57	49.01	17.87	29.15	75.89	63.61	68.06	2079	2554	2382
1836	8,405	14,803	23,208	24.16	13.83	17.57	48.79	17.87	29.06	75.83	63.61	68.04	2084	2553	2383
1837	8,446	15,102	23,548	24.02	13.66	17.38	48.35	17.56	28.60	76.02	63.70	68.12	2069	2542	2372
1838	8,487	15,142	23,629	23.69	13.77	17.33	48.08	17.61	28.55	76.14	63.69	68.16	2060	2544	2370
1839	8,502	15,322	23,824	24.05	13.74	17.42	48.15	17.54	28.46	76.09	63.71	68.13	2063	2541	2371
1840	8,555	15,458	24,013	24.27	13.68	17.46	48.00	17.47	28.35	76.00	63.73	68.10	2070	2538	2372
1841	8,623	15,610	24,233	24.46	13.64	17.49	47.72	17.40	28.19	76.21	63.75	68.18	2054	2536	2365
1842	8,690	15,663	24,352	24.20	13.80	17.51	47.54	17.43	28.17	76.17	63.74	68.18	2057	2537	2366
1843	8,839	15,792	24,630	24.49	13.84	17.66	47.40	17.39	28.16	75.02	63.75	67.80	2149	2535	2397
1844	8,852	15,852	24,703	24.92	13.92	17.86	47.64	17.46	28.27	75.00	63.73	67.77	2151	2538	2399
1845	8,907	15,960	24,867	24.89	13.92	17.85	47.56	17.39	28.20	75.08	63.75	67.81	2144	2535	2395

1846	8,986	16,035	25,021	24.83	13.96	17.86	47.33	17.42	28.16	75.16	63.74	67.84	2137	2536	2393
1847	9,041	16,112	25,153	24.79	13.99	17.87	47.08	17.44	28.09	75.19	63.74	67.85	2135	2537	2393
1848	9,100	16,103	25,203	24.91	14.10	18.00	46.94	17.59	28.19	75.22	63.69	67.85	2133	2543	2395
1849	9,174	16,163	25,337	25.06	14.09	18.06	46.70	17.58	28.12	75.25	63.65	67.85	2130	2549	2397
1850	9,253	16,247	25,500	25.20	14.13	18.14	46.65	17.67	28.19	75.33	63.59	67.85	2124	2556	2399
1851	9,349	16,362	25,711	24.85	14.15	18.04	46.15	17.64	28.01	75.57	63.54	67.91	2105	2563	2397
1852	9,437	16,476	25,913	24.75	14.21	18.05	45.75	17.71	27.92	75.44	63.47	67.83	2114	2571	2405
1853	9,486	16,587	26,073	24.66	14.32	18.08	45.52	17.71	27.83	75.70	63.40	67.87	2094	2581	2404
1854	9,565	16,518	26,082	26.25	14.88	19.05	45.41	18.05	28.08	75.21	63.30	67.67	2133	2594	2425
1855	9,499	16,282	25,781	25.71	14.71	18.77	45.55	18.07	28.19	75.43	63.29	67.77	2115	2595	2418
1856	9,574	16,277	25,852	25.67	14.63	18.72	45.38	17.91	28.09	75.46	63.34	67.83	2113	2589	2413
1857	9,650	16,303	25,953	25.72	14.52	18.68	45.20	17.81	28.00	75.53	63.37	67.89	2107	2585	2407
1858	9,725	16,366	26,090	25.49	14.39	18.53	45.12	17.68	27.91	75.62	63.41	67.96	2101	2580	2401
1859	9,828	16,563	26,392	25.53	14.25	18.45	44.71	17.50	27.63	75.68	63.46	68.01	2096	2573	2395
1860	9,717	16,759	26,475	26.31	14.11	18.59	45.11	17.32	27.52	75.01	63.52	67.73	2150	2566	2413
1861	9,605	16,923	26,528	26.50	14.10	18.59	45.44	17.10	27.36	74.75	63.58	67.62	2172	2558	2418

Notes: S Italy=southern Italy, CN Italy=central-northern Italy. We use republican borders. Like Chilosi and Ciccarelli (2022), we define southern Italy as the territory of the Kingdom of Naples together with the Sardinian and Sicilian isles. The urbanisation rate is equal to the population of centres with at least 5,000 or 10,000 inhabitants divided by total population.

Sources: see Appendix B.

Table A2: Labour participation index (1630s=100), 1400s to 1850s

Decade	Central-northern Italy (Malanima 2011)	Central-northern Italy (wages: Malanima 2013/GDP: this article)	Central-northern Italy (wages: Allen 2001/GDP: this article)	Southern Italy (wages: Allen 2001/GDP: this article)	England (Humphries-Weisdorf)
1400	59	62	88		60
1410	59	62	87		64
1420	59	54	80		66
1430	59	64	92		66
1440	59	58	92		62
1450	67	68	92		69
1460	67	67	85		70
1470	67	74	102		64
1480	67	85	105		72
1490	67	108	113		64
1500	101	112	118		75
1510	101	96	86		71
1520	101	114	114		82
1530	101	100	110		78
1540	101	91	123	80	85
1550	123	115	159	104	102
1560	123	89	100	156	80
1570	123	82	99	129	71
1580	123	98	119	127	71
1590	123	110	132	147	86
1600	100	106	123	145	93
1610	100	95	115	104	106
1620	100	107	114	110	105
1630	100	100	100	100	100
1640	100	99	99	92	112
1650	83	97	110		111
1660	83	93	118		104
1670	83	109	126		129
1680	83	107	133		114
1690	83	136	139		139
1700	81	111	143		128
1710	81	101	149		123
1720	81	83	113		131
1730	81	99	137		125
1740	81	112	151	112	123
1750	98	115	152	119	132
1760	98	115	158	130	138
1770	98	151	200	143	163
1780	98	146	213	155	164
1790	98	167	257	196	151

1800	103	210	295	200	172
1810	103	229	315		171
1820	103	162	205		184
1830	103	166	199		181
1840	103	179	216		189
1850	103	166	280		

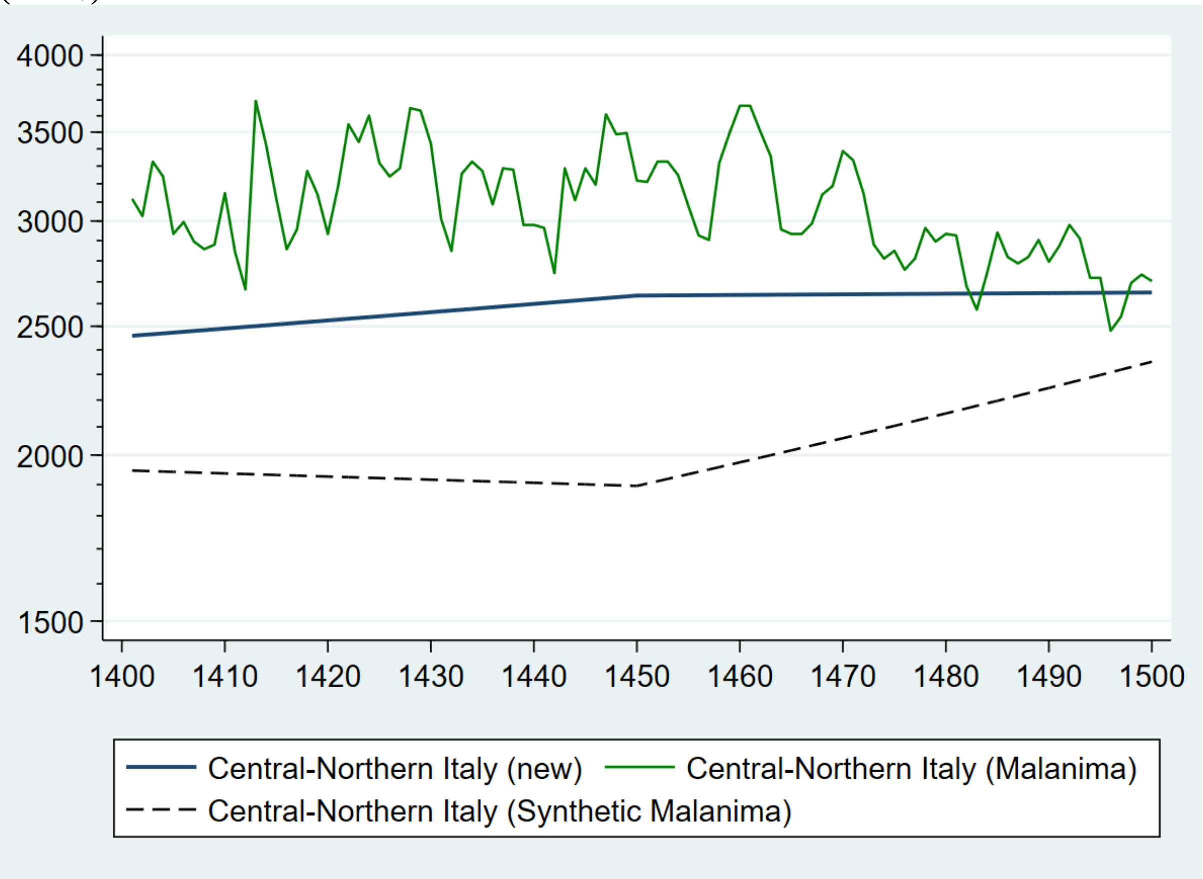
Sources: see Appendix B.

Table A3: Sensitivity analysis of average yearly rates of growth (*100)

		Rate*100	
Place	Sample	1401-1861	1401-1500
Central-northern Italy	Baseline	-0.001*	0.076***
Central-northern Italy	m=0	-0.001*	0.065***
Central-northern Italy	w_2/w_1=1.25	-0.001*	0.057***
Central-northern Italy	σ=0.079	-0.001*	0.075***
Central-northern Italy	α=0.108	-0.001*	0.076***
Central-northern Italy	β=0.51	-0.001*	0.058***
Central-northern Italy	ε=0.53	-0.001*	0.069***
Central-northern Italy	θ=0.16	-0.001*	0.067***
Central-northern Italy	Inequality	0.078***	0.145***
Central-northern Italy	Trade	0.101***	0.235***
		1401-1861	1401-1500
Southern Italy	Baseline	0.041***	0.186***
Southern Italy	m=0	0.038***	0.172***
Southern Italy	w_2/w_1=1.25	0.032***	0.145***
Southern Italy	σ=0.079	0.040***	0.184***
Southern Italy	α=0.108	0.041***	0.188***
Southern Italy	β=0.51	0.032***	0.147***
Southern Italy	ε=0.53	0.038***	0.172***
Southern Italy	θ=0.16	0.039***	0.178***
Southern Italy	Inequality	0.119***	0.253***
Southern Italy	Trade	0.041***	0.186***

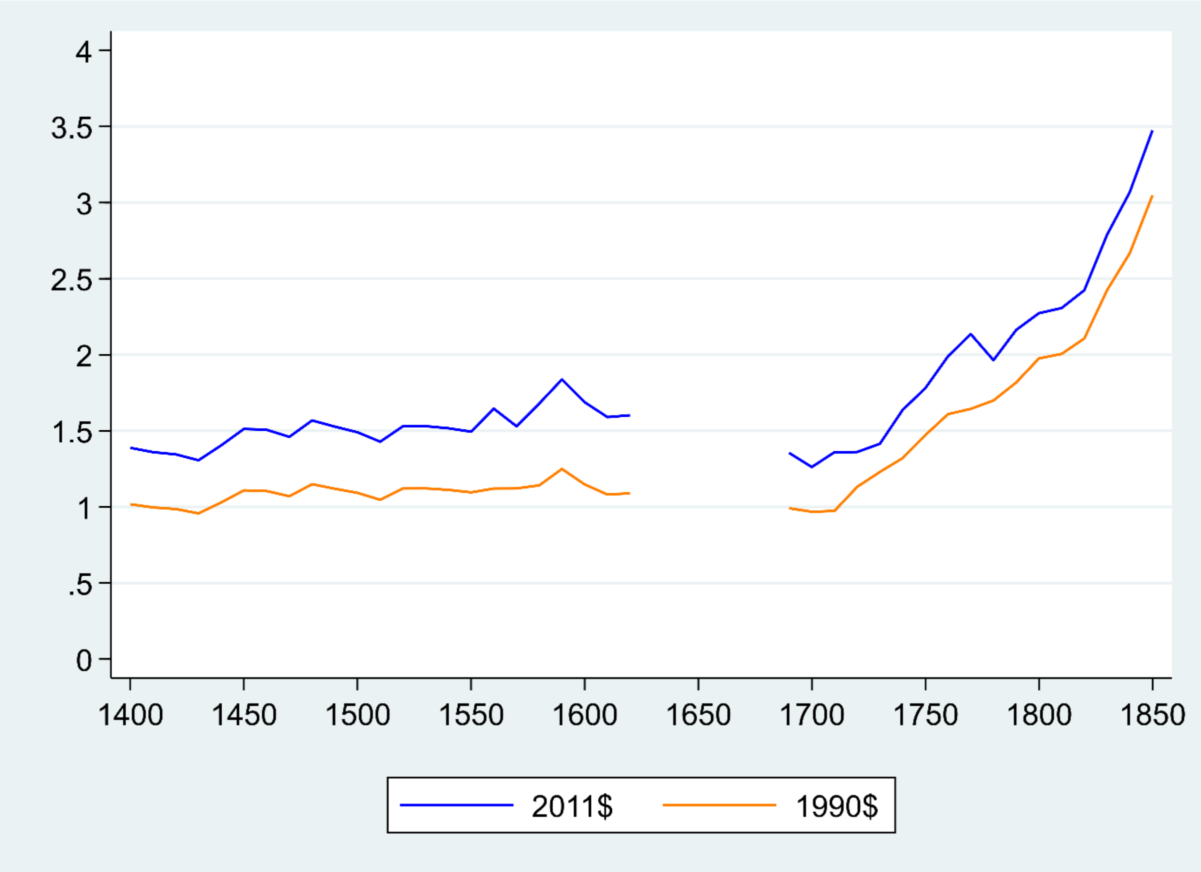
Notes: ***=significant at 1% level, **=significant at 5% level, *=significant at 10% level. Sensitivity analyses from "m=0" to "θ=0.16" allow one parameter at a time from Equations 3a and 3b to take a different value than in the baseline. The y-axis' labels show the new values. "Inequality" allows the labour income shares in both the agricultural and the urban sectors to decline by 20 percentage points relative to the baseline between 1400 and 1861. "Trade" considers that southern Italy was specialized in the export of primary products, while central-northern Italy changed export specialization from urban to primary products. See the text for details. In all cases we obtain the average yearly rates of growth by regressing the natural logarithm of the estimated GDP pc series against year.
Sources: see Section 5 in the text.

Figure A1: Comparison of GDP pc estimates in central-northern Italy in the 15th century (2011$)



Notes: central-northern Italy (new) is obtained by applying the Groth and Persson's (2016) method to our estimates of the agricultural employment share (Table A1); central-northern Italy (Malanima) is obtained by Malanima (2011) with a conventional demand-side approach and converted in 2011$ by the Maddison Project (2020); central-northern Italy (synthetic Malanima) is obtained by applying the Groth and Persson's (2016) method to Malanima's (2011: Table 3) estimates of the agricultural employment share.
Sources: Figure 1, Section 3 and Maddison Project (2020).

Figure A2: Comparison of ratio between GDP pc in the European leader and the Yangzi Delta with different deflators



Sources: Figure 4; to convert GDP pc series into 1990$ we use country-specific ratios obtained by dividing decadal figures from the Maddison 2020 database (in 2011$) with the same figures from Broadberry *et al*. (2018: Table 8) (in 1990$).

Appendix B: Sources

Table A1: the sources for population and urbanisation rates are the same as in Chilosi and Ciccarelli (2022). However, here we also make use of Italy's annual population figures from Federico and Tena-Junguito (2023). For the centre-north, these are transformed from 1871 to republican borders with the average ratio in 1848-1853, 1.11, when Chilosi and Ciccarelli (2022) have data for all Italian provinces. Like Chilosi and Ciccarelli (2022), when agricultural employment shares are available for all provinces (1848-1853 for the centre-north and 1838-1861 for the south) we aggregate the provincial data. Otherwise, we extrapolate agricultural employment shares using urbanisation rates (5,000 threshold for the centre-north and 10,000 for the south) and Equation A2a in Chilosi and Ciccarelli (2022: on-line Appendix A), with the following values: α=2.036 in the south and 0.835 in the centre-north and β=-2.714 in the south and -1.288 in the centre-north. In addition, while Chilosi and Ciccarelli (2022) compute the agricultural employment shares separately for the city of Naples and the rest of the south over the whole period, before aggregating them, here we exploit available data on the occupational structure of the province of Naples after 1800. This refinement, together with the use of annual population data from Federico and Tena-Junguito (2023) explains why there are slight differences between the agricultural employment shares used here and those presented in Chilosi and Ciccarelli (2022: Figure 6). Italian GDP pc's trends are computed separately for south and centre-north with Groth and Persson's (2016) general equilibrium model, using the agricultural employment shares shown in the previous columns and the parameters from Table 1 (in the text). Their 1861 levels are from Malanima (2011) for the centre-north (converted in 2011 international $ by the Maddison project 2020 edition) and based Felice's (2019) GDP pc ratio in 1871 for the south (see Section 2 in the text for details).

Table A2. The labour participation indices computed with our GDP pc's series rely on Equation 3b and real wages from Allen (2001) (assigning Florence to central-northern Italy and Naples to southern Italy) and Malanima (2013). The labour participation indices from the other two sources (Malanima 2011: Table A1.3; Humphries and Weisdorf 2019: Figure 4 and Table A2) are computed with their estimated length of the working year (in days).

Table A4. For our dependent variable (agricultural employment share) see Table A1. Our main source of GDP pc in 2011$ (column 1) is the 2020 edition of the Maddison database available at https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020?lang=en, which includes data from central-northern Italy, England (Britain since 1700) and China. The GDP pc for central-northern Italy, unlike the series shown in Table A1, uses urbanisation rates computed over an area which does not include Latium. Yet there are only small differences between the two urbanisation rates series and thus we do not expect this issue to significantly affect the results. To convert British GDP pc data into England only data, from 1700 onwards we multiply the British figures by 1.13, thus assuming that the English economy followed the same trend as the British economy. To convert the Chinese GDP pc series into a series for the Yangzi Delta, we rely on Broadberry and Guan (2022: Table 8), who have produced estimates of the GDP pc ratio between the two areas in four benchmark years (1400, 1580, 1770 and 1850). We consider daily wages (column 4) of building craftsmen from Allen (2001) (in grams of silver at constant Strasbourg prices in 1745–1754), assigning Florence to central-northern Italy, Naples to southern Italy and London to England, as well as the subsequent revisions for central-northern Italy and England by Malanima (2013) (in grams of silver at constant England/Italy prices in 1420-40) (column 5). Chinese real wages from Allen *et al.* (2011) only include a handful of observation from the Yangzi Delta and thus have not been included. Finally, we use annual rural real wages from Tuscany in Central-Northern Italy and England (column 6) from Humphries and Weisdorf (2019) and Rota and Weisdorf (2021) (in 'respectable' welfare ratios).

Figure 1. For southern and central-northern Italy see the text; central-northern Italy (Malanima 2011) as converted by the Maddison project (2020); Tuscany (both upper and lower bound): van Zanden and Felice (Table 4), using England's series from the Maddison project (2020) to convert their ratios into 2011 international $. The lower bound uses van Zanden's and Felice's (2022) preferred deflator; the upper bound uses Allen's (2001) deflator.

Figure 3. Central-northern and southern Italy: Table A1. To convert British GDP pc data (from the 2020 Maddison project database) into England only data, from 1700 onwards we multiply the British figures by 1.13, thus assuming that the two economies followed the same trend. To convert Holland's GDP pc series (from the 2020 Maddison project database) before 1807 into one for Netherlands, we divide it by 1.31, thus assuming that the two economies followed the same trend. To convert the Chinese GDP pc series (from Broadberry et al. 2021: Appendix Table 1 and converted into 2011$ using the 1840 benchmark from the 2020 Maddison project database) into a series for the Yangzi Delta, we rely on Broadberry and Guan (2022: Table 8), who have produced estimates of the GDP pc ratio between the two areas in four benchmark years (1400, 1580, 1770 and 1850) and linear interpolation of the ratio between these years.

Figure A3. Central-northern and southern Italy: Table A1. England: following Keibek (2016: Table 22), the 1380s figures accept Smith's upward revision of Broadberry *et al.*'s (2015: Table 9.02) male agricultural employment share from the 1381's poll tax return. The male agricultural share between 1520s and 1750s is from Wallis *et al.* (2018: Figure 3a, balanced sample). The female agricultural share in the 1380s, 1520s, 1680s and 1750s are from Broadberry *et al.* (2015: Tables 9.02, 9.03 and 9.04). Like them, we assume that females accounted for 30% of the labour force. We linearly interpolate the female agricultural share in missing decades. For the 1810s and the 1850s, we rely on England's male figures from Shaw-Taylor *et al.* (2010: Table 3) and England and Wales figures for males and both sexes from Shaw-Taylor *et al.* (2019: Tables 12 and 15), assuming that the ratio between the male shares apply also to the total shares. We gratefully acknowledge permission by Shaw-Taylor *et al.* (2010, 2019) to cite their estimates, which are preliminary and may be modified in the future. Wales: Wallis *et al.* (2018: Figure 3a, balanced sample). Yangzi Delta: Yang (2022: Table 2, TLA prefectures).

Appendix C: Consistency of agricultural employment shares with development

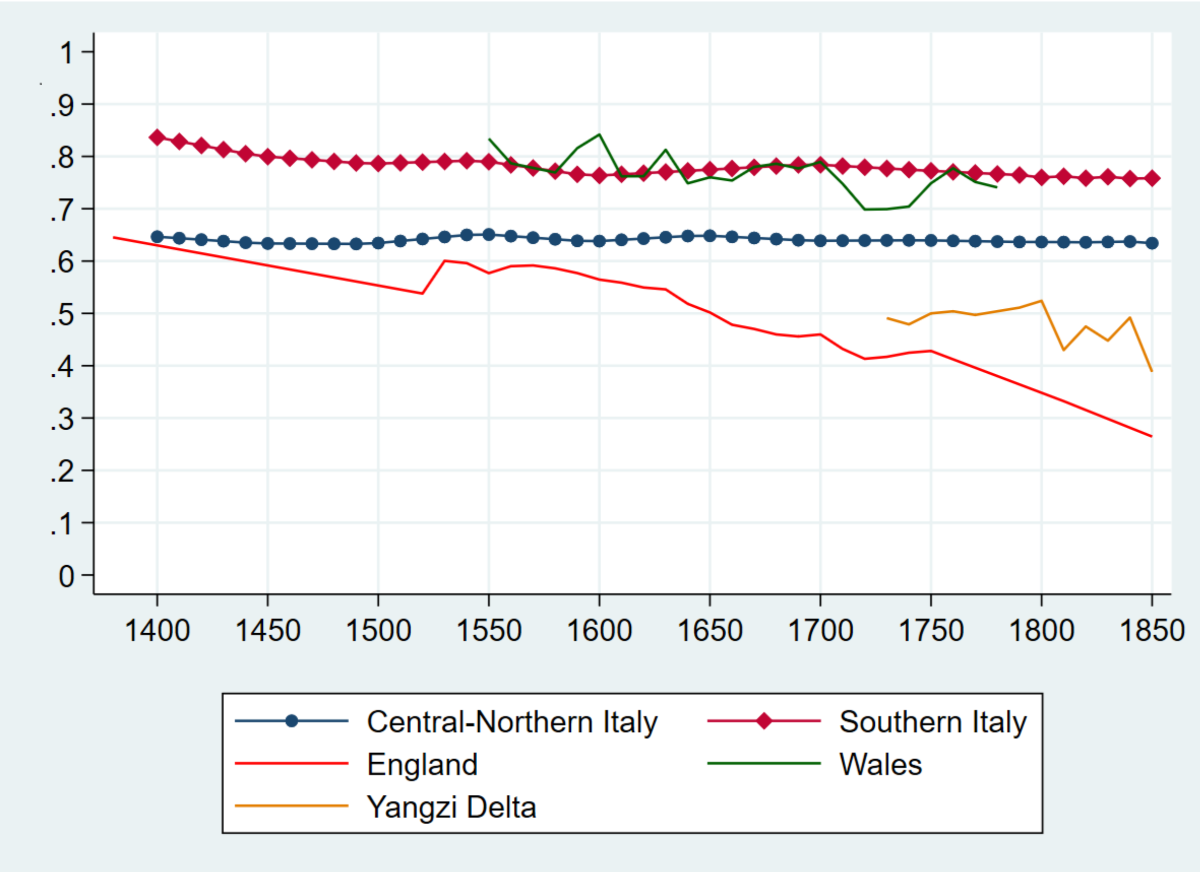
Chilosi and Ciccarelli (2022) have reconstructed for the first time estimates of the agricultural employment share in southern Italy since 1400, as well as a new series for central-northern Italy. They have relied on two types of data: occupational data from early 19th century censuses and urbanisation rates, available at 50-year benchmarks before 1800.[1] The approach of extrapolating trends in the occupational structure with urbanisation rates was first pioneered by Tony Wrigley (1985: Table 4) and has subsequently become standard in the growth accounting literature (Malanima 2011: Table 3; Álvarez-Nogal and De La Escosura 2013: Table 2; Palma and Reis 2019: Table 2; Ridolfi and Nuvolari 2021: Table 4; Pfister 2022: Figure 3; see also Allen 2000: table 2). The early 19th century censuses provide several snapshots of the occupational structure by province. Combining these figures with provincial urbanisation rates has allowed Chilosi and Ciccarelli (2022) to estimate average shares of agricultural workers in and outside cities. Armed with these estimates, they have been able to extrapolate estimates of the occupational structure using urbanisation rates. The approach has been path-breaking: the phenomenon of agro-towns – large agglomeration of peasant farmers – which were common in southern Italy, coupled with biased occupational data for southern Italy in post-unification censuses, had previously prevented scholars from using urbanisation rates to reconstruct southern Italy's pre-modern occupational structure. At the same time, the usual disclaimers apply. The assumption that shares of agricultural workers in town and country remain constant for over four centuries is standard but nevertheless strong. Estimates are bound to become progressively less reliable as one ventures further back in the past. In southern Italy, this is not so much because of the growth of rural industry: the 19th century censuses consistently indicate that, even more markedly than in the centre-north, its importance was marginal. Potentially more problematic is the phenomenon of agro-towns, which is known to have hardened in the early modern era. And yet the available evidence suggests that changes mainly involved centres smaller than the 10,000 inhabitants threshold. Hence, while we cannot rule out that direct estimates might alter the picture somewhat, it is unlikely that they would lead to an overhaul of it.

Figure A3 presents Chilosi and Ciccarelli's (2022) agricultural employment shares, placing the Italian figures in an international perspective. In the comparison, we include specifically England, Wales and the Yangzi Delta because, firstly, England and the Yangzi

[1] Oddo and Zanini's (2022) recent critique to the use of urbanisation as a proxy for economic development in pre-industrial Italy surprisingly neglects to consider its relationship to the occupational structure and therefore to Engel's law. Their heavy reliance on trends in real wages as a proxy for trends in economic development is also open to criticism.

Delta have been at the centre of the debate on the great divergence; secondly, as in all three places the estimates are based on relatively frequent direct observations of occupational data, they are of comparatively high quality. Third, since in England and the Yangzi Delta GDP pc estimates have been constructed independently from these occupational shares, when we move on to examine the relationship between structural transformation and economic growth in Section 3, we do not run the risk of simply capturing a mechanical association implied by the construction of the variables.[2]

Figure A3: Agricultural employment shares in Italy: an international perspective, 1380s-1850s



Notes: we linearly interpolate between observations. We omit an obvious outlier at the beginning of the Welsh series. The Yangzi Delta figures include only males, in the absence of precise estimates on females.
Sources: see Appendix B.

Chilosi and Ciccarelli's (2022) agricultural employment shares for central-northern Italy are very close to those from Malanima (2011: Table 3) and the overall picture is the same: secular stagnation. Southern Italy, in contrast to the centre-north, saw slow structural transformation, with most of the fall taking place in the 15th and 16th centuries. Nevertheless, the difference in levels between the two Italian macro-areas remained large throughout the

[2] Palma and Reis (2019: Table 2) report occupational shares in Portugal based on direct observations since 1700, but only at 50-year benchmarks. Ridolfi and Nuvolari (2021: Table 4) only start relying on direct estimates from 1800. Moreover both these articles use the occupational data as an input in their GDP pc's estimation. There are only two snapshots for Holland three centuries apart (in 1508 and 1807) in our period (van Zanden and van Leeuwen: 2012: Table 3). Direct estimates are also available for China since 1640 from Guo *et al.* (2019), but they were admittedly exploratory and have been superseded by Yang's recent estimates (2022: Section II). The latter are particularly detailed for the Yangze Delta – whose size is comparable to those of the other places considered, as well as being at the centre of debates on the great divergence. We therefore decided to focus on this area, rather than looking at China as a whole.

period, always in excess of 10 percentage points. This gap resembles that between England and Wales: the level in southern Italy was very close to that seen in early modern Wales, while between the 1400s and the 1580s England was roughly on par with central-northern Italy. However, in the intervening period England saw rapid structural transformation – particularly in the decades around 1650 – with the result that a large gap opened up with central-northern Italy, as well as Wales. The difference between England and central-northern Italy went up from just over 5 percentage points – a figure which is probably within the margin of error - in the 1580s to nearly 20 percentage points by the early 18th century.

In the Yangzi Delta, on the one hand, since the source is based on records of homicides and that the number of witnesses is bound to increase with population density, one cannot rule out an urban survival bias and therefore a negative bias in the agricultural employment share (Yang 2022: 1276-1277). On the other hand, unfortunately, we are only able to consistently observe male data. Neglecting female workers, surely, implies a bias in the opposite direction. By the middle of the Qing era (1644-1911), in the Yangzi Delta farming had become an almost exclusively male activity (Pomeranz 2003: 134). With the growth of cotton cultivation between the 14th and the 18th centuries, rural women in the Yangzi Delta increasingly specialized in cotton spinning and weaving, alongside silk reeling (Huang 2023). The scattered available figures confirm that a larger share of early modern Chinese women than men were weaving or spinning (Yang 2022: 10). In the 18th century, the male agricultural employment share estimated in the Yangzi Delta was nearly identical that found in England at the same time by Wallis *et al.* (2018: Figure 3a). However, figures from Shaw-Taylor *et al.* (2010: Table 3) show that, certainly by the early 19th century, the English male agricultural employment share had become lower than in the Yangzi Delta. Both in the 18th and the early 19th centuries, estimates of the male agricultural employment share in the Yangzi Delta were significantly lower than the estimated total shares in central-northern and especially southern Italy, with differences in the order of over 10 and 20 percentage points, respectively. During the 18th century, the Yangzi Delta's trend is one of slow de-industrialisation, but there is a reversal in the early 19th century. Since the population of the Yangzi Delta – which specialised in textile manufacturing - grew significantly less than in the rest of China between 1580 and 1770 (Broadberry and Guan 2022: Table 3A), it seems likely that de-industrialisation in 18th-century China as a whole was more rapid than implied by Figure A8.

Are the agricultural employment shares in central-northern Italy, southern Italy, England and the Yangzi Delta shown in Figure A3 consistent with other available measures of economic development? To answer this question, we run the following regression:

$$ag_{it} = \alpha + \gamma_i + \beta y_{it} + u_{it} \quad \text{(Equation A1)}$$

Where ag_{it} is the agricultural employment share and y_{it} is the GDP per capita or real wage place i in decade t, γ_i is a geographical dummy and β is the main coefficient of interest. We consider GDP pc and real wages because they are the two main variables used in the literature to map the great divergence. Engel's law predicts that β is negative: since the share of national income spent on food decreases with income, so does the share of the labour force employed in the primary sector. Table A4 shows the results of our regressions in columns 1 and 4 to 6. For the sake of comparison, we also include in columns 2 and 3 the results of the same income regression (Equation 1), using GDP pc for the 19th century and for 20th centuries' developing countries from Clark (2016: 2) and Clark *et al.* (2012: 366-367).

Table A4: Agricultural employment share (%) and income (GDP pc or wage) regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP pc			real wage		
				daily	daily	annual
	1380s-1850s	19th century	20th century	1380s-1850s	1380s-1850s	1380s-1850s
	this paper	Clark (2016)	Clark *et al.* (2012)	this paper	this paper	this paper
GDP pc	-0.011***	-0.011[a]	-0.010***			
Wage Allen				-0.105		
Wage Malanima					-0.838**	
Wage annual						-12.459***
Central-Northern Italy	12.110***			3.703	6.916***	2.183***
Southern Italy				16.646***		
England	-7.162***			-9.791***	-6.627***	-1.625***
Yangzi Delta	-16.407***					
Constant	81.513***	86.8[a]	84.9[a]	61.080***	63.087***	79.651***
R-squared	0.769	0.479[b]	0.865	0.001	0.054	0.739
N	107	81	182	112	94	82

Notes: ***=significant at 1% level, **=significant at 5% level, *=significant at 10% level; [a]=statistical significance not reported in the original source, [b]=from the slightly different specification reported in Crafts (1984: table 3). All regression coefficients are estimated with equation 1. In columns 1 and 4 to 6, to facilitate comparison, the geographical dummies are presented for all places in each sample as a constant plus a set of geographical coefficients whose observations-weighted sum is 0, as default in the stata output for fixed-effects panel regressions. Columns 2 and 3 show the results of the same income regression for the 19th century and for 20th centuries' developing countries from Clark (2016: 2) and Clark *et al.* (2012: 366-367). They use 2005$, while column 1 uses 2011$, but this difference is bound to have a small effect on the results (eg. in the US the total inflation rate between 2005 and 2011 was only 15%).
Sources: see Appendix B.

Under all specifications, the sign of the coefficient of the income variable is negative, as expected. Nevertheless, the values of the R-squared highlight a major dividing line between daily wages (columns 4 and 5), on the one hand, and GDP pc and annual wages (columns 1 and 6), on the other. Since the results are obtained with fixed-effect panel regressions with only one time-varying explanatory variable, the R-squared reported refer to the 'within' fit and can be interpreted as a measure of the strength of the correlation between trends in agricultural employment share and income variables. The fit is much poorer with daily wages – whose trends emerge as being essentially uncorrelated with those in the agricultural employment shares, with R-squared of 5% at most – than with the other two income variables, which on the contrary, emerge as being strongly correlated with trends in the dependent variable, with R-squared of about 75%. The fit is particularly poor with Allen's (2001) series of daily real wages which produce an R-squared of 0.1% and a statistically insignificant coefficient. Turning to the sizes of the β coefficients, it is reassuring that there is a very close match between the regressions using GDP pc as the explanatory variable with our sample (column 1) and those with later data by Clark (2016) and Clark *et al.* (2012). For example, one hundred extra $ are expected to decrease the agricultural occupational share by 1.08% in our sample as compared to 1.13% with the 19th-century sample. There is substantial agreement with the coefficient estimated with the annual wages by Humphries and Weisdorf (2019) and Rota and Weisdorf

(2020), too (column 6). Since real wages use a different unit of measurement from GDP pc, to compare results of column (1) and those of columns (4)-(6), for wages we look at welfare ratios – the number of families which can subsist with a wage[3] – while for GDP pc we consider the poverty line (in 2011$). An increase by one 'respectable' welfare ratio in the annual real wage is expected to be associated with a decrease by 12.46 percentage points in the share of agricultural workers. Since the cost of a 'respectable' basket is 2.6-2.7 times that of a 'bare-bone' basket (Allen *et al.* 2011: Table 5), the marginal effect of a 'bare-bone' welfare ratio on the agricultural employment share is minus 4.56-4.75 percentage points. Converting the corresponding coefficient from the GDP pc regression (column 1) with the absolute poverty line of 694$ (at 2011 prices) (Bolt and van Zanden 2020: 19) yields a decrease by 7.47 percentage points. This figure, as expected, given that the cost of one absolute poverty basket is one and half times that of a barebone basket (cf. Federico *et al.* 2021: 10), falls in between those associated with the two welfare ratios (4.56 to 12.46 percentage points, as just seen). By contrast, once again, the picture emerging from the daily wages (columns 4 and 5) is rather messy. For the Allen's (2001) series, an increase in the real wage by one welfare ratio is associated with a decrease by only 2 percentage points in the agricultural employment share. For Malanima's (2013) series, the same effect is as large as minus 18 percentage points.

Next, let us consider the geographical dummies (the γ_i coefficients in Equation A1). A positive (negative) value indicates that the agricultural employment share is higher (lower) than expected based on the values of the income variable. In turn, two factors mainly determine this relationship: agricultural labour productivity and trade in primary products. A high (low) agricultural labour productivity implies a high (low) consumption of primary products for any given agricultural employment share, and, by Engel's law, reveals a low (high) income. Hence, we expect a negative relationship between agricultural labour productivity and the size of the dummy. Similarly, if the place is a net importer (exporter) of agricultural products its consumption of primary products increases (decreases) and thus a lower (higher) agricultural employment share corresponds to any given income level. In other words, the size of the dummy is expected to decrease with the size of net imports of primary products.

Our estimates of the geographical dummies in the first specification (column 1) show that, based on their GDP pc figures, the agricultural employment share was lower than expected in England and the Yangzi Delta and higher than expected in central-northern Italy. The difference between the English and central-northern Italian dummy is -19 percentage points. This figure is rather close to the difference between England and an average country estimated by Wallis *et al.* (2018: 889) with a slightly different approach and a different sample (19th-century data), -16 percentage points, lending credence to the estimate. The negative sign in England had to be mainly driven by labour productivity, rather than trade. On the one hand, a comparatively low agricultural employment share is consistent with an early lead in English agricultural labour productivity, which was already visible in as early as 1300 (Allen 2000: Table 7; see also Wallis *et al.* 2018: 888-889). On the other hand, scholars have assumed that prior to 1800 English trade in primary products was roughly balanced (Allen 2000; Groth and

[3] Allen's (2001) real wages are in grams of silver at constant Strasbourg prices in 1745– 1754. To convert them into welfare ratios we assume, as Allen (2001) does, 250 working days in a year, 3 adults equivalent per wage-earner (i.e. a family with two children, each consuming half as much as an adult), and 5% rent allowance per adult equivalent. Hence the nominal daily wage needs to be multiplied by 250 and divided by the nominal cost of a subsistence basket times 3.15. Implementing these adjustments is equivalent to dividing Allen's (2001) daily real wage figures by 5.23. Under the same assumptions, to convert Malanima's (2013) real wages, which are in grams of silver at constant England/Italy prices in 1420-40, into 'respectable' welfare ratios they need to be divided by c. 4.6. The subsistence baskets are defined slightly differently by Allen (2001) and Malanima (2013).

Persson 2016).[4] The absolute value of the geographical dummy is significantly higher in the Yangzi Delta, where both productivity and trade pushed the agricultural employment share down, than in England. Agricultural labour productivity in the Yangzi Delta (in 1620-1820) was nearly as high as in England (Allen 2009).[5] However, more clearly than early modern England, the Yangzi Delta was a net importer of primary products, vis-à-vis the rest of China: it specialized in cloth production, importing food and raw materials, like rice and timber (Pomeranz 2000).

A positive sign for the geographical dummy in central-northern Italy had to be mainly driven by lower agricultural labour productivity than in England and the Yangzi Delta. Similarly to England, scholars usually assume that trade in primary products in central-northern Italy before unification (1861) was balanced (Allen 2000; Federico and Malanima 2004; Malanima 2011). Precise figures become available only in the 1850s and indicate that by then central-northern Italy had become a net exporter of primary products (Federico and Tena-Junguito 2014: Table 3).[6] However, the figures also show that its level of openness was low by European standards (Federico and Tena-Junguito 2014: Table 1), suggesting that trade was not the main driver of the relatively high levels of agricultural employment shares that we observe in central-northern Italy.[7] Agricultural labour productivity is a more likely candidate: Allen (2000: Table 7, 2009; see also Federico and Malanima 2004) finds that its levels were in line with other places in continental Europe and significantly lower than in north-western Europe or the Yangzi Delta. While Allen's (2000) assessment also depends on urbanisation rates and the assumption of balanced trade, there is independent corroborating evidence on the relatively low agricultural labour productivity of central-northern Italy. Van Zanden and Felice (2022: Table 2), basing themselves on a fiscal source – the Tuscan *catasto* of 1427 – detect a particularly wide urban-rural income gap, by the European standards of the time: the urban sectors' (industry or services) labour income premium over agricultural labour incomes was 138%, as compared to output per workers urban sectors' premia of 60%-90% in England (in 1381 and 1522, respectively) and 44% in Holland (in 1514) (authors' computation using data from van Zanden 2002: Table 3; Broadberry et al. 2015: Table 9.01; van Zanden and Felice 2022: Table 6). A comparatively high urban income premium in Italy is also confirmed by the output per worker urban sectors premium in 1861. Combing value added figures from Baffigi (2015: Table 3) with our employment sectors' shares (Table A1) yields a figure of 135%. The same figure for Britain in 1800 and 1851 were 2% and 44% respectively (authors' computation using data Broadberry et al. 2015: Table 9.01). In other words, a positive dummy in central-northern Italy agrees with the available evidence, which consistently indicates that throughout

[4] Raw wool was England's staple export in the high Middle Ages, but, already by the 14th century, increasingly processed wool was replacing it (Broadberry *et al.* 2015: xxxv). While Britain was a net importer of food already in 1695, it is only since 1800 that the figures detect a large gap between local supply and consumption of food (Clark *et al.* 1995: Table 2). Moreover, Allen (2000: 14) stresses that between the mid-17th and mid-18th centuries England exported large quantities of grain and he therefore assumes that it was a net exporter of primary products during this period.

[5] Huang (2023), too, stresses that agricultural labour productivity, though not the labour productivity of rural manufacturing, was comparatively high in early modern China, looking at direct input and output evidence.

[6] Figures are available for all main polities of the centre-north (the Kingdom of Sardinia, the Lombardo-Veneto, Tuscany and the Papal States). Their combined figures show that the value of exports of primary products exceeded the value of imports of the same products by nearly 4 millions of 1913$, equivalent to 3% of their total trade. Since less than a fifth of trade was between Italian polities, these figures can be considered as representative of trade between central-northern Italy and the rest of the world (Federico and Tena-Junguito 2014: Table 3 and Table 5). The traditional interpretation has it that central-northern Italy lost a comparative advantage in textile production after 1600 (Cipolla 2005: 190-192). For a critique of the traditional view see Sella (2014).

[7] To be specific, as seen below, agricultural trade would lead one to expect central-northern Italy's agricultural employment share at the time of unification to be about 1.06 times higher than it would have been under balanced trade.

our period central-northern Italy was characterised by low agricultural labour productivity, relative to both north-western Europe and the Yangzi Delta.

The signs of the geographical dummies in the regressions with real wage as the income variable (columns 4 to 6) confirm that, for any given level of income pc, the agricultural employment share was higher in central-northern Italy than in England, though the difference is not quite as marked as with GDP pc (column 1). Moreover, the differences across real wage series are consistent with the just-mentioned differences in comparative labour productivity across sectors. Allen's (2001) and Malanima's (2013) series refer of daily wages to building craftsmen, an urban occupation. Humphries and Weisdorf's (2019) and Rota and Weisdorf's (2021) series of annual wages refer to agricultural workers. The difference between the central-northern Italian and English dummies is significantly larger when using urban wages than when using agricultural wages. This result is consistent with a higher agricultural labour productivity in England than in central-northern Italy, as it implies that a lower agricultural employment share in the former than in the latter is not as surprising when measures of living standards are drawn from the agricultural sector alone. All in all, England's and central-northern Italy's dummies estimated with real wages are consistent with those estimated with GDP pc.

Nevertheless, a much larger dummy (nearly 13 percentage points) for southern than central-northern Italy (column 4) is difficult to square with what we know about trade in primary products and agricultural labour productivity in these two areas. In the mid-19th century, the Kingdom of Naples, similarly to Italy's centre-north, was a net exporter of primary products. However, it was significantly less open: net exports of primary products pc were worth only 0.44 1913\$, as compared to 1.27 1913\$ in the polities of the centre-north.[8] To be sure, processed food such as wine was classified by the statistics as manufactures, rather than primary products. However, even under the extreme assumption that all exports from the Kingdom of Naples were classified as primary products, the net exports of primary products pc would only go up to 0.97 1913\$ and would thus remain lower than in the centre-north. We lack data on trade composition from the rest of southern Italy (the Sicilian and Sardinian isles), but we know that Sicily was surely more open than the Kingdom of Naples. An upper bound estimate of the net exports of primary products in southern Italy as a whole can be computed under the extreme assumptions that the isles only exported primary products and only imported manufactures and that the Sardinian isle was as open as the Kingdom of Sardinia as a whole. With these additional adjustments, the value of net exports pc of primary products of Southern Italy would surpass that in central-northern polities, but not by very much, becoming 1.85 1913\$.[9] These figures imply that around 1860 the ratio of agricultural production to agricultural consumption – a figure that tells by how much agricultural employment shares should be adjusted to take into account trade (Allen 2000: Equation 1) - can be estimated as 1.05 in the centre-north and no more than 1.06 in the south.[10] Clearly, trade alone cannot explain why the agricultural employment share in 19th century Italy was so much higher in the south than in the centre-north.

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[8] This and the subsequent figures are authors' computations based on Federico and Tena-Junguito (2014: Table 3).

[9] This computation also draws on Sardinian population from Chilosi and Ciccarelli (2022).

[10] Production of primary products is based on value added figures and consumption is equal to production minus net exports. Italy's GDP pc in 1861 at current borders in 1913\$ is from Federico and Tena Junguito World Trade database available on line at http://www.uc3m.es/tradehist_db (dividing value of exports by openness, both at constant prices); share of agricultural value added over GDP in 1861 is from Baffigi (2015: Table 3); shares of agricultural value added in southern and central-northern Italy in 1871 are from Felice (2019: Table B.4 in the Appendix). Using the arguably more reliable 1881 agricultural value-added data instead of the 1871 data has hardly any effect on the size of the ratios, which remains identical at the two decimals level.

Analogous remarks apply to agricultural labour productivity. Previous literature (Federico 2007; Felice 2019) has found that, somewhat surprisingly, just after unification (1861) agricultural labour productivity was higher in southern Italy than in central-northern Italy. For instance, Felice (2019: Table B.4 in the Appendix) finds that in 1871 each agricultural worker produced annually 6,512 2011€ in the south as compared to 4,792 in the centre-north. If agricultural labour productivity in southern Italy were higher than in central-northern Italy one would expect its dummy to be lower rather than higher, as we find. However, these labour productivity estimates were based on post-unification censuses, which suffer from a negative bias in the agricultural employment share in the south greater than that considered by Felice (2019) (Chilosi and Ciccarelli 2022). Combing figures on value added per worker by Felice (2019: Table B.4) in 1871 with our estimates for 1861 implies a significant downward revision of the southern figure,[11] which becomes 4,926 2011€, essentially the same level as in the centre-north.[12]

In other words, both trade and agricultural labour productivity indicate that, by the mid-19th century, at any rate, one would expect a significantly higher agricultural employment share in southern than in central-northern Italy to signal a significantly lower GDP pc. Allen's (2001) wage series, by contrast, detect at most modest differences in standards of living between the two macro-areas in the centuries before unification, with real wages that were on average 7% higher in the centre-north over the whole period (1548-1641 and 1747-1806) covered and were actually 15% lower in latter part (1747-1806). This contrast explains why the geographical dummy estimated with Allen's (2001) wage series for southern Italy is so much greater than that for central-northern Italy, even if evidence on agricultural trade and labour productivity would lead one to expect little or no difference between the two dummies. The inconsistency between Italy's north-south gap implied by wage and occupational data chimes with Hatcher's (2018) critique that real wages are not necessarily representative of income levels in an economy and therefore they can potentially be misleading as an indicator of comparative living standards (see also Rota and Weisdorf 2020). As mentioned in Section 4, it is possible that Allen's (2011) data for central northern Italy in the 18th century are too low because they suffer from measurement error: his wages from Milan, for instance, neglect to consider the impact of food subsidies on the cost of living (Mocarelli 2018). Malanima (2006) and Daniele and Malanima (2017) find that real wages between 1700 and 1861 were very similar in the two macro-areas, while for Federico *et al.* (2019) in 1861 real wages were actually slightly higher in the centre-north than in the south. There is a broader issue, though: as argued in Section 3, labour income depends crucially not only on wage rates but also on the distribution of skills in the workforce, given that the wage skill premium significantly varied between occupations.

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[11] It is safe to use 1861 data to estimate the occupational structure in 1871: there is no evidence of significant structural transformation in these years (Daniele and Malanima 2009: Table 5).

[12] Again, using 1881 value-added data instead of the 1871 data has an only marginal quantitative effect on the result: agricultural labour productivity in southern Italy becomes 5,027 2011€.

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