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## Research Paper

## The premium for skilled labor in the Roman world

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## ABSTRACT

Romans rewarded skill in material terms, and wage data reflects this. This study develops a method for understanding the return on skill in the Roman period, starting from internal pay scales observed in Egyptian documents. These data reveal a modal premium of 100 and mean of 74. Roman-period returns on training compare favorably with evidence from outside Egypt, especially detailed pay scales in Diocletian's Price Edict, thus suggesting a broader Empire-wide premium. This Roman skill premium is then compared with a selection of data from other pre-modern periods, which show that the relative price of skill in ancient Rome was not historically atypical, despite the particularly high levels of enslavement and urbanization characteristic of the Roman economy. The return on investments in training during the Empire can be seen to reflect both numeracy practices and developing market conditions for skill.

The last two decades have seen energetic study of incomes in premodern economies. When and where they can be reconstructed, prices and wages offer considerable insight into a range of topics, from the timing and scale of economic development to its impact on living standards. As an outgrowth of these efforts, an expanding literature explores the relative price of skilled labor and the value added to work by training (Clark, 2005; van Zanden, 2009; Federico et al., 2021). The skill premium as a measure of the return on investments in human capital depends on the interaction of the supply and demand for skill. The ratio of skilled to unskilled wages plays a key role in debates over the causes and effects of economic growth (Mokyr, 2009; de Pleijt and Weisdorf, 2017). Economic historians' interest in these topics occurs concurrently with an outpouring of recent research on labor in the ancient Mediterranean (Monteix and Tran, 2011; Verboven and Laes, 2016; Hawkins, 2016a; Marcone, 2016; Lytle, 2018; Freu, 2018; Stewart et al., 2020). Within this ambit, there have been several reconstructions of unskilled incomes and discussions of earnings and living standards (Allen, 2009; Rathbone, 2009; Scheidel and Friesen, 2009; Harper, 2016).

To date, what has yet to receive much attention is the topic of Roman skill premia. The price of skill in the Roman world should not only interest historians of premodern incomes, but it also speaks to some of Imperial economy's core distinguishing features, such as slavery and urbanization. Slave labor's dominant place in Roman production leads some to argue that a cheap supply of skilled slaves marginalized free skilled labor (Finley, 1999; cf. Temin, 2004). Meanwhile, under Imperial rule, the Roman Mediterranean's "world of cities" (Finley, 1977, p. 305) featured urbanization rates not approached again in the West until the early-modern period (Wilson, 2011; Hanson, 2016). Roman cities were crucial to the creation of the "material complexity" (Kay, 2014) characteristic of the Roman period, and high urbanization rates supported a concomitant expansion of demand for skilled goods and services to levels that remain noteworthy for a premodern economy.

This paper contributes to a finer understanding of how these and other features shaped the price of skilled labor in the Roman world, and what that meant for the earning power of workers and households. I develop and apply a method for understanding the premium added to Roman labor by training. Within the existing literature on Roman incomes, there is some agreement that skilled wages in ancient Rome were relatively high as a consequence of a thin labor market and disincentives towards training. This position remains largely untested, however, and is based on a very limited sampling of data. As we shall see, this view does not hold up to closer

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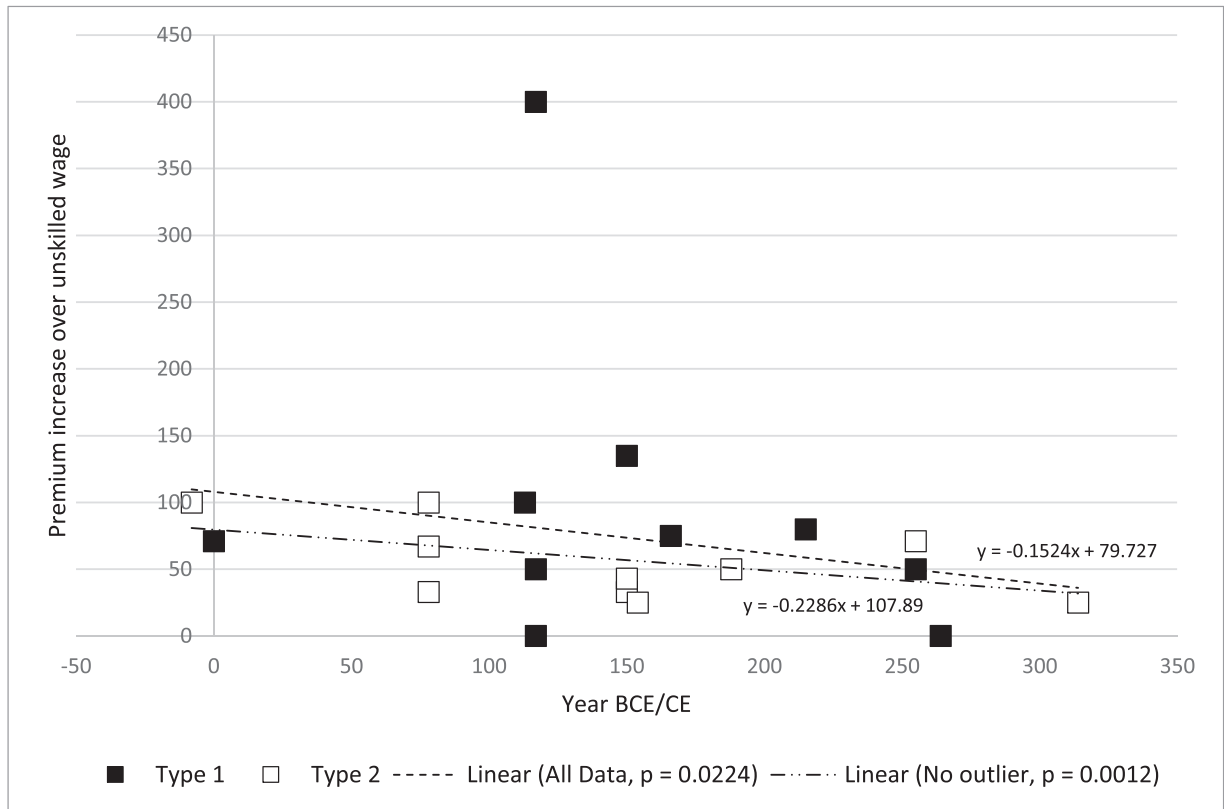


Fig. 1. Roman skill premia in Egyptian documents, 50 BCE – CE 350 ( $N = 20$ ).<sup>7</sup>

scrutiny. I provide a corrective by assembling the most comprehensive database to date of the relative price of Roman skilled labor. I focus on pay scales observed in Egyptian papyri dating from the establishment of Augustus' principate to the reign of Constantine (29 BCE – 337 CE). Analysis of the database reveals a modal skill premium of 100 (2:1), with a mean somewhat lower, around 74 (Fig. 1).<sup>1</sup> The premium appears lower in agricultural than urban settings and also declines starting in the mid-second century CE, although in both cases small sample size warns against overinterpretation. The most important finding is the overall range of premia in documents from Roman Egypt, as we encounter a matching 2:1 modal cash premium in the Empire-wide Price Edict of Diocletian (301 CE). A 2:1 ratio also features more widely in Roman adjustments to incomes, indicating cultural numeracy preferences. The collected evidence thus broadly supports an ideal Roman skill premium of double the price of unskilled labor, while in reality returns were often slightly lower. Comparison with data from other periods suggests this range was general continuous with relative labor prices in Late Antiquity and the Middle Ages. On this reading, the Roman skill premium does not appear historically high. I propose explanation for the level of return on skilling that is rooted in the characteristic mechanisms of the Roman economy, especially urbanization and related phenomena. I emphasize how urban demand for skill was eventually met by deskilling technological change and expanding credit markets. These aspects are recognized as impactful on markets for skill by economic historians, but are not so far considered in the literature on Roman skilled wages.

## 1. Historical background

Current consensus holds that the Mediterranean economy under Roman rule experienced “modest, though significant” levels of *per capita* development (Hopkins, 1995-96). There remains less agreement about this development's causes or impact on living standards (Temin, 2013; Jongman, 2014; Erdkamp, 2016; Harper, 2016; Terpstra, 2020). Human capital receives some attention in this debate (Saller, 2012) but deserves greater interest. Historians understand Roman economic growth as mostly Smithian, arising from divisions of labor, specialization, and efficiency (Bernard, 2018; Terpstra, 2019). Legal and other institutional changes lowered transaction costs across the Empire, incentivizing production and trade. However, institutions on their own cannot fully explain how workers were capable of producing more. Meanwhile, Roman technological change, while important in some sectors, was comparatively low overall (Mokyr, 1990; Wilson, 2002; Terpstra, 2020). If we want to understand how Roman workers increased marginal output, we need to look at how readily they gained knowledge and training.

<sup>1</sup> Throughout, skill premium is expressed as percent increase over unskilled wages or prices.

To approach this topic, we rely on the evidence for Roman wages. Not all labor in Roman antiquity was compensated by wages, and this paper's procedure should not be taken to imply that Rome resembled a modern capitalist economy. One major exception was slavery. The outsized presence of cheap slave labor in ancient Rome was once thought to have trivialized wage labor while at the same time discouraging technological progress (Finely, 1999). More recent literature recognizes slave- and wage labor as two sides of the same coin. The selling of slaves encouraged wider labor markets, while Rome saw historically high manumission rates, implying substantial amounts of freed wage labor (Lo Cascio, 2021). At the same time, slave- and free labor in the Roman world were not perfectly substitutable (Harper, 2010, p. 216). We see Roman employers expressing preference for slave- or wage-labor for different occupations or according to the complexities of local labor supplies. This cautions against straightforward comparisons between skilled wages and skilled slave prices. Certainly, slave prices represented rational decisions about the utility of labor. However, they may be seen as a sort of sunk cost, different from a wage. The one-time payment made for a slave also reflected a variety of factors in addition to occupational skill, including the slave's health, age, physical appearance, gender, and so forth.

Following this, I consider skilled slave labor and slave prices when relevant, but my main focus is on wages paid to free labor. This choice also simply reflects the nature of the evidence. We happen to possess far more attestations of Roman wages than slave prices (cf. Scheidel, 2005; Harper, 2010). This evidence reflects Romans' common use of price to describe remuneration for work (Rathbone, 2009; Harper, 2016). Romans were by no means the earliest Mediterranean society to speak about labor in terms of prices. However, for most parts of the Mediterranean, wage evidence is fuller for the Empire than for preceding periods. Romans' ability to conceive of work in terms of price also extended to skill. Artisanal skill, called *ars* or *technê*, was rewarded in social but also material terms (Tran, 2013; Nicolas, 2016; Groen Vallinga and Tacoma, 2016).

Roman incomes have been collected and analyzed many times (Duncan-Jones, 1982; Drexhage, 1991; Rathbone, 2009; Scheidel, 2002, 2010, 2014a; Domingo, 2013; Harper, 2016; Freu, 2022). Two aspects of this data merit emphasis for those less familiar with the Roman economy. First, sample sizes for measuring Roman economic trends are often much smaller than for later economies. This sometimes limits what can be said about the precise timing or nature of trends. However, what evidence does survive leaves no doubt that prices formed an important part of Rome's labor economy, and this encourages us to work, albeit cautiously, with what we have. Second, the geographical distribution of surviving data is uneven. For reasons of preservation, papyrological evidence from Egypt represents by far the fullest source of Roman economic information. Egypt is often the only region where we may reconstruct time series of prices and earnings. Every province possessed its own distinct ecology, factor endowments, labor markets, and so forth. However, longstanding interest in assessing the generalizability of Egyptian data holds that Egypt's Imperial economy was not especially peculiar (Bagnall, 1993; Harper, 2017). To the limited extent we observe wages elsewhere, they resemble what appears in the papyri (Rathbone, 2007a, 2009). This holds true also in this paper, where Egyptian data shows similarities with evidence from outside the province. Thus, while wages of craftsmen, peasants, and other laborers from Egypt form the bedrock of my dataset, the analysis seeks broader understanding of the price of skilling across the Imperial economy.

## 2. Sources and methods

Attestations for Roman wages appear in a wide range of genres, and not all of them hold the same informative value. It is one thing to treat a wage on a paystub written on a piece of papyrus. While context may be largely irrecoverable, the price itself seems reliable in the sense that it forms record of an actual transaction. This evidence differs from wages in literary texts authored by propertied elites. No ancient author has left us a work on wages *per se*, making information anecdotal, while combining scattered references into pay scales is often difficult. For example, Cato's mid-second century BCE treatise *On Agriculture* records 72 sesterces paid to six men for six days' work hauling a millstone, while another passage records 8 sesterces paid to a skilled laborer for assembling the mill. We do not know whether this second payment was a daily wage or how long the job took. Thus, attempts to combine figures into a skill premium produce inconsistent results (cf. Rathbone, 2009, p. 314; Kay, 2014, p. 286). A second issue is that writers tended to cite wages and prices for rhetorical effect. A cook in Plautus' play the *Pseudolus*, performed around 200 BCE, earned a *nummus*, equivalent to four drachms, while others received a single drachm. However, the cook himself reports these figures as a way to brag about his talent. Context leads us to suspect the 4:1 premium is exaggerated.

Problems of rhetorical manipulation are pervasive in wages attested in literary texts. Consider two cases regularly held up as evidence of a high Roman skill premium. Scheidel (2005, p. 7) and Hawkins (2016b, pp. 45–46) base opinions of a generally high Roman skill premium in large part on the agricultural writer Columella's price of 6000–8000 sesterces for a slave vinedresser compared to a price of 2000–4000 sesterces for an unskilled adult slave at that time. However, the fuller citation shows that skilled vinedressers were in fact available for lower prices, but Columella advised investment in especially expensive and skilled slaves for this particular task.<sup>2</sup> The higher price supports Columella's point but explicitly does not describe a normal premium. Rhetorical manipulation also characterizes a famously enormous skill premium found in Cicero's juridical speech on behalf of the celebrity actor Quintus Roscius (Cic. *Pro Rosc. Comoedo* 28–29). Roscius and a slaveowner entered a partnership to train a slave, but fell out with each other, and Roscius sought to recover his share. Cicero argued that training with the celebrity Roscius had raised the slave's value exorbitantly, from a purchase price of 6000 to a value of 600,000 sesterces. Cicero's whole case hinged on emphasizing the value relative to the purchase cost, and exaggeration may be expected. These rhetorically high premia confirm basic expectations that training increased the price of labor but shed little light on normative levels.

<sup>2</sup> Columella, *Rust.* 3.3.8: "Seven iugera require the labour of more than one vinedresser, upon whom people in general set a low value, thinking that even some criminal may be bought off the auction-block; but I, disagreeing with the opinion of the majority, consider a high-priced vinedresser of first importance. And supposing his purchase price to be 6000 or, better, 8000 sesterces."

Documentary sources are more reliable but present their own challenges. Most studies of Roman incomes reconstruct real prices by working across documents. Almost never do we find single documents containing both wages and commodity prices. Studies must juxtapose data for incomes and expenditures from often highly disparate sources. Further issues are introduced by converting different currencies or extrapolating from daily wages to annual incomes.<sup>3</sup> In these circumstances, potential for error becomes considerable. Related to this is a second concern. As [Freu \(2015\)](#) emphasizes, extant Roman price data typically leaves us unable to recognize external pressures shaping prices. Most commonly, we find prices themselves, but cannot speak to contractual concerns, supply pressures, seasonality, and other factors affecting that price. By moving from one document to another, we assume these aspects are similar enough for comparison, but we have little means of testing this assumption.

In this paper, I control for these issues by looking at pay scales within individual pieces of evidence. In other words, I develop a method that restricts inquiry to documents containing both unskilled and skilled incomes. This approach avoids error-laden extrapolation across already fragile evidence. In Egyptian documents, pay scales appear within single documents in two ways. One type of document records pairs or groups of workers employed in the same occupation earning different incomes. These workers are interpretable as masters and apprentices, as this relationship is sometimes explicit. A second type of document records payments to large numbers of workers across multiple occupations but receiving scaled levels of pay. In some cases, these broader pay scales are helpfully revealed to relate to skill level across occupations. In both intra- and cross-occupational comparisons, internal pay scales relate to the earnings of more and less skilled workers. We might expect relative incomes in these two forms of information to resemble each other, but some differentiation emerges and is discussed below.

Some final remarks concern what I understand as skilled and unskilled work. I am specifically interested in the value added to labor by investments in training. Following recent literature on wage inequality, the context of skilling is envisioned as one of “learning by doing.” For the Roman Empire and much of the premodern world, this effectively means apprenticeship.<sup>4</sup> [Stewart et al. \(2020\)](#) argue that modern concepts of professionalism are relevant to antiquity, as exceptionally high status for select occupations accompanied exceptionally high incomes. However, this apex of pay scales reflected social and prestige factors not acquirable through normal training ([Bernard, 2021](#)). I frequently refer to a “basic skill premium” as what a skilled artisan or master earned above their apprentices. The key is that skill was acquired by time spent on the job.

Most occupational groups examined in the Roman evidence fall into low-skilled classifications in schemes like HISCO or HISSCLASS ([van Leeuwen et al., 2002](#); [van Leeuwen and Maas, 2011](#)). However, Roman papyrus documents present lexical issues that make fuller application of these cross-cultural occupational schemes difficult. We sometimes find apprentices and masters called by the same occupational title. Another issue is the common use of generic terms like the Greek *ergatês*, which can refer to either skilled or unskilled labor ([Fikhman, 1994](#)). The ambiguous term *pais* could refer to free or slave workers, but in all cases indicates younger and probably lower or unskilled workers ([Mirkovic, 2005](#)). For these reasons, price observations need to be made on a case-by-case basis.

My narrow focus on returns on investments in training excludes some information otherwise frequently discussed in the literature on Roman incomes. One notable absence from my discussion is military pay. The Roman army employed some 350,000 men, and information for incomes is comparatively full. Following Augustus’ reforms, army service became in some ways a profession ([Lee, 2020](#)). Pay stratification was based on service members’ rank at recruitment, and salary increases formed rewards in recognition of performance. Every unit contained select soldiers called after their receipt of one and a half (*sesquiplarii*) or double pay (*duplicarii*) ([Rathbone, 2007b, 2009](#)). However, these raises do not reflect training so much as prestige or a sort of “survival premium” from surviving multiple campaigns.

### 2.1. Data: skill premia in Egyptian documents

This section lays out evidence for premia in documentary sources. As noted above, documents with internal pay scales record either intra- or cross-occupational pay scales. Observations of pairs or groups of workers in the same occupation are identified as type 1. These documents by and large record wages for craftspeople. Type 2 documents record pay scales observed in single sources of evidence but across multiple occupations. These documents are represented mostly by accounting archives from large estates recording lists of payments to agricultural labor, often arranged calendrically. Type 2 documents can be considerably lengthy texts containing over 100 attested incomes. In order not to overweight longer documents, and because such texts more frequently describe broad wage hierarchies than paired wages, I report skill premia across single documents of this type, or only at select points where a relative skill is clearly observed. This procedure also controls for how little we know about variations in market conditions from document to document (cf. [Freu, 2015](#)). In longer type 2 texts, real incomes in estate ledgers show seasonal and other fluctuations, so that where possible I observe scaled incomes reported around the same time of year or close to each other in the text, presumably showing a relation to similar hiring circumstances.

While documentary papyri are limited to one province, the data do reflect multiple contexts. Documents come from different regions within Egypt with variable economic and ecological characteristics. Locations range from the urbanized Fayyum Oasis in Middle Egypt to the cities of Upper Egypt further south up the Nile Valley, to the sparsely populated Eastern Desert inland from the Red Sea.<sup>5</sup> Documents come from rural and urban contexts and describe a range of productive activities. Many list payments for

<sup>3</sup> For similar difficulties in later periods, see [Humphries and Wiesdorf \(2019\)](#).

<sup>4</sup> [De Munck et al. \(2007\)](#); [Minns and Wallis \(2013\)](#); [Mokyr \(2019, pp. 23-24\)](#); for the Roman world, see [Freu \(2011\)](#); [Russell and Wooten \(2017\)](#); [Russell \(2020, pp. 250-51\)](#).

<sup>5</sup> This section presents a curated collection of wage information with a focus on skill premia. For fuller accounts of wages in Roman papyri, see [Rathbone \(2009\)](#), [Harper \(2017\)](#).

**Table 1**  
Roman skill premia in Egyptian documents, 50 BCE – CE 350 ( $N = 20$ ).

Document	Occupation	Source	Date	Skill Premium
1	agricultural workers	P.Lond. 3.1171 <i>recto</i> (Arsinoe)	8 BCE	100 (Type 2)
2	weavers	P.Oxy. 2.737 (Oxyrhynchus)	0	71 (Type 1)
3	agricultural workers	SB 8.9699 = P.Lond 1.131 (Hermopolites)	78–79 CE	100 (Type 2)
4	agricultural workers	SB 8.9699 = P.Lond 1.131 (Hermopolites)	78–79 CE	33 (Type 2)
5	agricultural workers	SB 8.9699 = P.Lond 1.131 (Hermopolites)	78–79 CE	67 (Type 2)
6	builders	P.Lond. 3.1177 <i>verso</i> (Arsinoe)	113–14 CE	100 (Type 1?)
7	builders	SB 14.11958 (Oxyrhynchus)	117 CE	0 (Type 1)
8	builders	SB 14.11958 (Oxyrhynchus)	117 CE	400 (Type 1)
9	builders	SB 14.11958 (Oxyrhynchus)	117 CE	50 (Type 1)
10	agricultural workers	P.Lips 1.91 (Memnoneia or Hermonthis)	150 CE	43 (Type 2)
11	agricultural workers	P.Lips 1.91 (Memnoneia or Hermonthis)	150 CE	33 (Type 2)
12	quarrymen and smiths	Cuvigny (1996), (Mons Claudianus, Egypt)	ca. CE 150	135 (Type 1)
13	irrigation workers	P.Mil.Vogl 4.214 (Tebtynis)	154 CE	25 (Type 1)
14	builders	P.Migl.Vogl. 7.304 (Tebtynis)	166 CE	75 (Type 1)
15	agricultural labor	P.Oxy. 7.1049 (Oxyrhynchus)	175–200 CE	50 (Type 2)
16	builders	BGU 2.362 (Arsinoites)	215 CE	80 (Type 1)
17	building work on an agricultural estate	SB 6.9409.1 (Theadelphia)	255 CE	71 (Type 1)
18	irrigation workers	BGU 1.14 (Memphites)	255 CE	50 (Type 2)
19	builders	SB 10.10299 (Hermopolis)	264 CE	0 (Type 1)
20	builders	CPR 8.22 (Hermopolites)	314 CE	25 (Type 2)

craft activities, mainly construction work (documents 6–9, 12, 14, 16–17, 19–20) but also textile production (document 2). In these documents, apprenticeship is sometimes explicitly described. Other documents refer to workers on Egypt's well-known irrigation systems (documents 13, 18) or to general agricultural labor (documents 1, 3–5, 10–11, 15). In these documents, pay scales often correspond to occupational titles in ways similar to craft settings, e.g. we find workers called *ergatai* paid more than *paidés*. Therefore, I interpret agricultural pay scales as reflective of experience on the job.

Table 1 presents evidence in chronological order. Each document requires close reading, and I offer some interpretive notes. Document 1 records monthly payments on an estate, including to a group of herdsmen (*boukolos*, *boêlatês*) with a leader (*prostatês*) earning 24 drachms a *pais* 12 drachms. Document 2 describes different occupational titles relating to weaving. Masters (*magistri*) earn 6 asses, hired work (*conductores*) 4, and weavers (*textores*) 3.5. A *magister* paired with *textores* at several points suggests oversight or apprenticeship. The labor market for weavers was thick in this area of Egypt, inferring a low skill premium (Freu, 2022, p. 288). Documents 3–5 come from a long list from a single estate. Wages rise and fall seasonally in relation to the Nile inundation (Swiderek, 1960, pp. 100–4). Relative incomes appear in entries recording groups of workers differentiated by title and level of pay. On the 16th of Pharmouthi, an *ergatês* earns 4 obols working beside two *paidés* earning 2 obols. On the 25th of the same month, 2 *ergatai* earn 4 obols beside two *paidés* earning 3 obols. On the 27th and 28th the same combination earns 5 and 3 obols respectively. The same document refers to pay for more skilled occupations but unhelpfully without term of employment: an engineer (*mêchanarios*) earns 12 drachms, a scribe (*kômogrammatês*) 12 drachms, a vinedresser (*ampelourgos*) 4 drachms. If daily wages, these form considerable premia, but they may alternatively suggest long-term contracts, as landowners sought to retain highly skilled labor.

Document 6 relates to irrigation work (Habermann, 2000). Incomes for builders or carpenters (*tektones*) fall consistently into basic and enhanced levels, with the lowest paid earning 12 drachms and the highest 24 drachms (per month?). Documents 7–9 describe payments to groups of construction workers. In one instance, carpenters (*tektones*) and generic laborers (*ergatai*) earn the same wage. In another group, a “temple-builder” (*hierotektôn*) earns 7.5 drachms alongside a helper earning 1.5 drachms. In a third group, a builder earns 1.5 drachms alongside helpers earning 1 drachm. Documents 10–11 are from *ostraca* recording salaries from a large estate. These describe a pay scale based on age and thus presumably training in which older (*andres*) workers earn a bronze drachm equal to seven obols plus three obols performing agricultural tasks, while younger (*paidés*) workers earn a bronze drachm (Nachtergaele, 2007, p. 285). Other *ostraca* from the same archive suggest a somewhat lower premium of eight to six obols between the same groups (Johnson, 1936, p. 308).

Document 12 refers to salaries on *ostraca* for quarrymen in the imperially controlled granodiorite quarries at Mons Claudianus in the Eastern Desert. These workers produced architectural blocks prized by the Emperor for monumental construction. The *ostraca* sometimes refer to sons or brothers at the lower or middle paygrade associated with relatives earning higher wages. Workers at the lowest wage level are sometimes called *pais*, suggesting younger, less skilled individuals. All levels of pay are high, and these are good salaries (Freu, 2022, p. 287). Incomes may reflect intervention by the Imperial state (Hirt, 2010), and archaeology also suggests good access to Mediterranean foods, perhaps imported to the desert area by state initiative (van der Veen, 1998). High wages may therefore be seen as hazard pay to recruit and retain skilled workers to a fairly inhospitable area.

Occupational titles in document 13 cluster at different pay rates, suggesting a scale. Groups of irrigation workers (*ergatai potizôn*) most frequently earn 5 obols, although one case of 7 obols is listed, while *paidés* earn 4. Document 14 relates expenses for the construction of a wine press with salaries dividing between 14 obols for a builder (*oikodomos*) and 8 obols for laborers (*ergatês*) performing low- or unskilled tasks like mixing mortar (Freu, 2011, p. 38 n. 83). Document 15 from an agricultural estate lists payments to workers (*ergatai*) binding hay and to mule drivers (*onêlatai*), who receive consistent wages of 12 obols, whereas one individual

**Table 2**

The occupational pay scale of Diocletian's Price Edict (301 CE).

Daily maximum wage	Occupation	Number (29)
12 denarii plus maintenance	Female weaver (1 type)	1
16	Female weaver (1 type)	1
20	Shepherd, Linen weaver	2
25	Farm laborer, Driver of camels, asses, and hinnies, Mule driver, Water carrier, Sewer cleaner, Silk worker (2 types)	7
40	Silk worker (1 type), Linen weaver	1
50	Shipwright on river ships, Baker, Blacksmith, Wagonwright, Worker in marble pavements, Lime burner, Cabinet maker, Carpenter, Stonemason	9
55	Maker of plaster figurines	1
60	Marble mason, Worker in wall mosaics, Shipwright on seagoing ships	4
75	Wall painter, Maker of terracotta figurines	2
150	Portrait painter	1

is paid 18 obols (Johnson, 1936, p. 308). Document 16 is a temple account with a builder (*tektôn*) working alongside his assistant (*pais*). The text also refers to higher paid professions, a scribe paid 1.67 drachms a day and a rhetor arguing a court case earning 60 drachms a month. Document 17 comes from the archive of the Heroninus estate. Payments here are not always easy to understand on the basis of skill, but in one case a builder (*oikodomos*) earns four drachms a day working beside two assistants (*hypourgoutes ergatai*) paid two drachms and two obols (Rathbone, 1991; Freu, 2011, p. 38 n. 83). Other evidence from the estate suggests cash wages were often supplemented with food, suggesting real income levels were higher. Document 18 describes irrigation-system workers (*ergatai*) digging or higher paid, and presumably higher skilled workers, “making the dike” (*potameitai*). Document 19 records construction salaries including a builder (*tektôn*) and his assistant (*hypourgous*) earning the same wage. Document 20 records builders earning 500 drachms and those performing menial tasks earning 400 drachms.

## 2.2. Skill premia outside Egypt

Beneficially, pay scales in a few documents outside Egypt resemble the data collected above. Cuvigny (1996) first observed that the pay scale of miners described on wax tablets from the gold mines of Alburnus Maior in the province of Dacia, in modern Albania, conform to that found at Mons Claudianus (document 12). Because the Dacian and Egyptian documents describe labor in imperially controlled contexts, gold and granodiorite extraction respectively, the overlap makes sense. Imperial monopsony on products from these sites probably affected wages.

Several legal texts furnish information about Roman incomes. The most informative single document of this sort is the Edict of Maximum Prices (Price Edict) issued by Diocletian in 301 CE. This fundamental text should be understood to belong to a larger corpus of civic documents interested in legislating prices (e.g. Crawford 1996, no. 25; CIL II 6278), although little headway can be made with other examples. The Price Edict is normally held to represent the emperor Diocletian's attempt to codify maximum costs for goods and services to address rapid inflation (Corcoran, 1996, pp. 205–33; cf. Bransbourg, 2020). The text's stated intention was to regulate prices across the Empire. The sprawling list contains over a thousand figures for everything from shipping rates to shoes. Other evidence shows the attempt to curb inflation failed, making real costs found in the document problematic (Duncan-Jones, 1982, p. 367). However, internal ratios of prices seem to be reliable (Groen-Vallinga and Tacoma, 2016). There are 29 daily wage maxima.<sup>6</sup> All daily wage entries include reference to additional food allowance (*pasto*) of unspecified value or contents. Skill underlies the pay scale with higher skilled jobs earning more pay. There is clear preference for a basic unskilled income of 25 denarii and skilled income of 50 (Table 2). This 2:1 skilled to unskilled pay ratio appears frequently enough to suggest a benchmark premium of 100 for wage labor. Accounting for the unspecified food allowance lowers the premium. Using price information in the Edict, Allen (2009, p. 330) reconstructs daily food costs of 11.1 denarii, deflating the benchmark premium from 100 to 69.

Notably, the 2:1 premium appears in relation to slave prices in the Edict as well. “For a slave trained in skill, according to their sex and age, and the quality of their skills, it shall be proper to agree the price between buyer and seller as long as double the price established for a single should not in the least be exceeded” (Salway, 2010, p. 20).

## 3. Analysis

From Egypt, I have collected 20 relative price observations across 15 documents, with some estate books allowing for observation of multiple premia (cf. Fig. 1). A simple mean across this dataset reports a skill premium of 74 with a mode of 100 (Table 3). The sample size is small, but we may note the return on skill in Egypt declines from around 100 in the Early Empire to around 50 by the third and fourth centuries CE. The statistical significance of the trend, at least within the data collected, is suggested by *p*-values below 0.05. The last reported premium at or above the modal figure of 100 is the top salary for quarrymen at Mons Claudianus around 150 CE followed by a lower premium in 154 CE. This may suggest the shift took place around the middle of the second century

<sup>6</sup> The total of 31 reported by Groen-Vallinga and Tacoma (2016) depends on taking the entry for the driver of camels, asses, and hinnies as three different occupations.

**Table 3**  
Summary of roman skill premia in Egyptian documents, 50 BCE – CE 350.

Class	Mean	Mode
Overall ( $N = 20$ )	74	100 (3)
Type 1 ( $N = 10$ )	96	0 (2)
Type 2 ( $N = 10$ )	55	100 (2), 33 (2)

CE. There is also an impression of sector-based differentiation. Looking at occupational comparison, the mean type 1 premium of 96 reflecting hierarchies within occupations ( $N = 10$ ) is higher than the mean type 2 premium of 55 reflecting hierarchies across occupations ( $N = 10$ ), mostly on large agricultural estates. Again, the volume of data warns urges cautious interpretation, but it is possible craftspeople working primarily in urban settings earned better returns on skilling than agricultural workers. The main takeaway is that we see frequent wage premia of 100 in our evidence, with a slightly lower figure on average.

Comparison with the Price Edict proves instructive, as its nominal benchmark premium of 100 matches the modal premium in the papyri, even as the mean is lower. We might infer there was an ideal premium of 100 for skilled labor, which was in actuality typically somewhat lower, especially in rural settings. There are multiple ways to explain this difference. The shortfall may reveal the character of a labor market affected by the Imperial state's legal attempts at integration, but nevertheless highly contingent and dislocated. An alternative explanation may lie in what we observe explicitly in the Price Edict: the netting from cash wages of food supplements. The Edict's inclusion of food alongside all daily wages had a deflationary effect on the skill premium, equalizing wages across pay scales. As noted, the cost of included food supplement lowers the Price Edict's benchmark premium to 69, closer to the average premium found across the papyri. At least some cash wages listed in papyri were accompanied by food supplements. However, the practice is not noted consistently, making it difficult to track its prevalence over time or by occupation. The language used to describe supplements sometimes refers to grain but is more often too vague to permit us to know what foodstuffs they contained.

### 3.1. Doubling and currency

The 2:1 premium that appears in both Egypt and the Price Edict reappears in other contexts of hiring in the ancient Roman world. This supports the idea that doubling was a widely used method for calculating the relative value of labor in the Roman world. While the Roman skill premium below as responsive to the market for skill, the prevalence of doubling raises issues of sociocultural preference and their impact upon the ancient economy. The role of cultural numeracy merits emphasis as something less impactful on modern economies, but more extensively seen in early societies. Compare counting habits in other early societies where we find digit preference or “heaping” of ages in multiples of five (Scheidel, 1996). Riggsby (2019, pp. 96–7) finds that halving was far and away the most common form of fractionation in Roman systems of measurement. In the evidence for Roman labor, “double pay” was a common reward for Roman soldiers, as noted above. Market pressures otherwise often resulted in manipulations of incomes by doubling. In the Babylonian Talmud (*Yoma* 38a), construction workers striking for better pay received twice their originally agreed upon wages. As Shaw (2015, p. 83) notes, casual labor during the harvest in the Roman world often received double pay. It is conceivable that cultural preferences created price stickiness by inclining Romans to think first in terms of doubling.

There is also the related issue of currency. So far, I have considered skill premia as abstract figures able to respond incrementally to labor market pressures, but nominal wages were bound to the denominational structure of coinage in circulation (Lucassen, 2007). Again, this matters less in modern economies where decimalization allows for movements well below meaningful shifts in real income. In Imperial Egypt where daily cash wages were typically expressed down to the obol, normally one sixth or seventh of a drachm, and unskilled wages were often only a few obols, there was limited ability to respond to market pressures without dramatically altering real incomes. On top of this were cultural preferences. Bailey (2013, p. 156) observes Roman preference for whole numbers and against amounts expressed in different metals. This made them likely to adjust the price of a silver denarius by adding or subtracting a silver half denarius than by using bronze fractions.

### 3.2. Skilled wages and slave prices

For reasons discussed above, we have a hard time gaining equivalently full understanding of the value of skilled slave labor, but it is noteworthy that the ratio of 2:1 appears in some contexts of skilled slave labor. I noted how the chapter of the Price Edict on slave prices refers to a maximum return of 2:1 on a trained slave, identical in structure to the same document's benchmark 100 skill premium for free wages. This 2:1 ratio appears in other legal texts. In a passage of the Justinianic *Digest* transmitting the jurist Paul, writing around 200 CE, a slave owner doubles the value of an unskilled slave through training: “A worker on the order of a friend bought a slave at ten (*aurei*) and taught him his trade, and then sold him at twenty” (Dig. 17.1.26.8). On the basis of this and other legal evidence, some argue that a 2:1 ratio of skilled to unskilled slave prices was customary (Hermann-Otto, 1994, p. 327; Gamauf, 2012, p. 243). Legal texts may suggest the premium on skilled slave prices trended downward in Late Antiquity. The maximum slave prices in the Codex of Justinian (530 CE) list untrained adult males costing 20 solidi and skilled craftsmen 30, or a basic skill premium of 50 (CJ 7.7.1).

Some institutional advantages may have encouraged investments in skilling slaves. The value of a slave's skill (*artificia*) was specifically protected by Roman property law (e.g. Dig. 50.15.4.5). Elites such as Cato and Crassus profited from retailing slaves they

**Table 4**

Sampling of skill premia from the Mediterranean and adjacent regions, 400 BCE – CE 1250.

Place	Date	Premium	Source
Athens	409–7 BCE	0	Loomis (1998), pp. 105–08
Attica	329–8 BCE	67	Loomis (1998), pp. 111–13
Egypt	211–182 BCE	100	BGU VI 1290
Gaul and Western Empire	500 CE	66–100	Burgundian Code
Egypt	ca. CE 500	20	Freu (2022), p. 287
Byzantine Empire	530 CE	50–200	Codex of Justinian
Egypt	ca. CE 600	233–300	Morelli (1996), pp. 133–162
Egypt	ca. CE 600	100	Freu (2022), pp. 288
Lombardy	643 CE	56–100	Edict of Rothari
Egypt	709 CE	60	Morrisson and Cheynet (2002), p. 865
Judea	710 CE	88	Morelli (1996), p. 163
Baghdad	762–6 CE	67–150	Ashtor (1969), p. 64
Egypt	ca. CE 850	50–300	Ashtor (1969), pp. 90–91; Ashtor (1976): 94
Egypt	900–950 CE	100	Ashtor (1969), p. 92
Egypt	ca. CE 1100	33–133, norm 50	Ashtor (1969), p. 224; Goitein (1967), pp. 95–99
Egypt	1216 CE	50	Ashtor (1969), p. 225

trained or took direct interest in training (Plut. *Cat. Mai.* 21.7; Plut. *Crass.* 2.6). In the Empire, large “slave schools” (*paedagogia*) trained servile youths on estates of wealthy elites and in some urban contexts (Laes, 2011, pp. 156–57). A dedication of 198 CE found on Rome’s Caelian Hill names 24 instructors, all ex-slaves, from a substantial Imperial slave school (CIL 6.1052; Mohler, 1940). This material reflects economies of scale available to those with resources to make initial investments in skilling slaves.

This comparison of work based on legal status (free and slave) shows some of the same mental habits surrounding approaches to the added value of skill across the Roman labor supply. This is instructive, because we should expect slavery to have had some impact on the market for free skilled labor; however, so far as we can tell, the multipliers for skill were the same regardless of status. If wealthy Roman slave owners sought returns from investments in training, we may suspect that free workers also were interested in similarly proportional returns. We need to be cautious in taking this comparison further, however. As noted above, the markets for slaves and freed labor overlapped but do not appear to have been perfectly substitutable. There are also basic issues of evidence: slave prices were not wages, while we possess little data on relative slave prices. Paired slave prices similar to the wages analyzed above are absent in papyrological documents. This makes it simply impossible to check relative prices in legal documents against documentary sources. Flower (2022) notes that literary sources give costs of skilled slaves only in exceptional cases. Examples of this were seen above with Columella’s vinedresser and Cicero’s account of Roscius.

### 3.3. The comparative perspective

As a status-based comparison only takes us so far, we can extend discussion instead to other societies. How did the Roman premium for free skilled labor compare to wage inequality in other pre-industrial economies? Since the Imperial Mediterranean economy is typically seen as more urbanized and more reliant on slavery than other periods, we might expect differentiation. However, while a full account of skill premia before the modern period is beyond this paper’s scope, a sampling of available data suggests skill premia in the Roman world were well within the order of magnitude seen in the same region in other periods. Table 4 collects data from the literature on prices and wages from the Mediterranean and adjacent areas before and after Roman rule. Special attention has been given to Pre- and Post-Roman Egypt, the same region as the bulk of our Roman information. This sampling should be considered provisional, since we are dealing with numerous regions and labor regimes. However, it serves the purpose of refuting claims for unusually high Roman returns on skill.

Nothing suggests the Roman skill premium was exceptionally high. Prices from before the Roman period are sparse and variable, but an important datum is an early second century BCE papyrus from Ptolemaic Egypt recording a premium of 100, fully in line with premia from the Early Empire. With the exception of a low premium recording wages to construction workers at Marea around CE 500, relative incomes after the Empire were in fact higher in Late Antique and Medieval Egypt. Master masons in Egypt in the ninth century CE received double or triple the pay of unskilled laborers. The premium does not change appreciably over the next two centuries even as economic crisis deflated real incomes in the region (Ashtor, 1969, pp. 92–93). Shatzmiller (2018, p. 468–70) reports very high skilled incomes from Iraq and Egypt with premia reaching as high as 1800 in the eighth to tenth centuries CE, although these salaries were for highly skilled professionals.

Beyond Egypt, good argument for general continuity of relative wage levels through the Late Antique period comes from maximum wages specified in several law codes. Premia in the Burgundian Code (500 CE) fall between 66 and 100. The premium listed for a blacksmith over an unskilled agricultural worker is identical to that found in the Price Edict two centuries earlier (Harper, 2010, p. 226; Beaudet, 2019, pp. 45–46). The Edict of King Rothari (643 CE) lists premia between 56 and 100 (Beaudet, 2019, pp. 46–47). These figures are closely continuous to levels observed in the Roman period.

Forward in time, van Zanden (2009) demonstrates that the skill premium in much of Western Eurasia moved significantly downward between about 1350–1450 CE from a range of 100–150 to a lower range of 50–100, where it remained stable until the industrial



revolution. His analysis instructively directs our attention to the relationship between mortality shocks and the skill premium, as he interprets the decrease as response to lowered interest rates and a new equilibrium on the labor market following the Black Death.

#### 4. Discussion: the Roman market for skill

As in other periods, the relative price of skilled labor during the Empire should reflect the interaction of the supply and demand for skill. This section considers features of the Roman market for skilled labor. While the Roman situation is obviously different, van Zanden's observation of the Black Death's effects on skilled labor raises the interesting initial question of the impact of exogenous shocks like plagues on the Imperial skill premium. Recent literature emphasizes the effects of a series of pandemics on the Imperial market for unskilled labor, starting with the so-called Antonine Plague that broke out in the later 160 s, and then after two pandemics of Late Antiquity in the third and sixth centuries CE (Scheidel, 2002, 2010, p. 457; Pamuk and Shatzmiller, 2014; Harper 2017). As with our analysis here, these observations are built largely upon data found in the Egyptian papyri. Did pandemics of the Roman period and Late Antiquity also reconfigure the market for skilled labor? Available data suggest not. There is no discernible movement in premia around the time of the Antonine Plague, despite several data points before and after its outbreak. The Plague's onset postdates the slight decline apparent in the Egyptian data (cf. already documents 10–11, 13) and seems unrelatable to that trend. Freu (2015, p. 170) connects a high unskilled wage attested in BGU 1.14 (document 18 above) with labor shortages in the 250 s following the outbreak of Cyprian's plague. The same document contains a premium of 50, but this figure is not out of line with other data from that time. Finally, the sampling of comparative evidence here reveals no deflation of skill premia following the outbreak of the so-called Justinianic plague in Europe and the Mediterranean, again despite noticeably elevated unskilled wages (Scheidel, 2010, p. 448; Pamuk and Shatzmiller, 2014). We must conclude either that, while real unskilled incomes fluctuated, the relative price of skill moved in tandem, or that we simply cannot see the effects of these mortality shocks on the market for skill in our evidence.

##### 4.1. Demand: urbanization and technological change

Considering this, we might focus more closely on endogenous characteristics of supply and demand for skill as they developed during the Empire. In this section, I look more closely at how the developing structures of the Roman economy affected the price of skill. I paint the timing of various economic mechanisms with a broad brush, as the data are not always sufficient to provide more granularity. It is, for example, very hard to track the end of Roman slavery, with some now arguing that slaveholding persisted as a significant component of post-Roman economies (Harper, 2011). However, we can still make headway in providing a general picture of urbanization's impact on demand in the Late Republic and Early Empire, eventually offset by supply-side effects.

Progressively rising demand for skill starting in the Early Empire, particularly for skilled craft labor, is inferable from increased occupational specialization in epigraphic and papyrological evidence. Ruffing (2008, p. 45) demonstrates a peak in the number of different job titles found in documentary evidence in the second and third centuries, building on a rise in the first century CE. Increasing craft specialization responded to the purchasing power of Roman elites who increasingly came to depend on markets. Recent work traces a shift starting in the first century BCE from the acquisition of artwork as spoils of war to a more "normal" art market with elites employing skilled artisans, or purchasing skilled slaves, to make architecture, statues, gemstones, wall-paintings, mosaics, and other luxury goods (Harris, 2015; Flohr, 2017). Over the first two centuries of the Empire, rising sub-elite consumption levels progressively supported an increase in this source of demand, as Scheidel and Friesen (2009, pp. 84–5) point to the emergence of a "middling" stratum comprising 6–12% of the Roman population by the mid-second century CE whose aggregate disposable income was considerable.

As noted, this rising demand for skilled goods went hand in hand with urbanization. Roman cities were important centers for the consumption of skilled goods and services; they concentrated wealth and purchasing power and allowed for finer divisions of labor. Even the physical creation of cities called for large volumes of skilled labor for public and private construction. The link between urban centers and elite demand for skilled goods and services may help explain the possibility discussed above that premia for urban craft labor in the papyri appear somewhat higher than for agricultural labor. Urbanization rates differed from region to region, but generally peaked across the Roman Empire from about 50 BCE to CE 200 (Wilson, 2011). Specific to the source of Roman wage data, Egypt's urban population expanded from the Augustan period up to about CE 150 before stabilizing, while there is some evidence for urban population decline in the third and fourth centuries CE (Bagnall, 2011).

Roman technological change formed part of the response to rising urban demand. In thinking about impacts upon demand for skill, it is important to distinguish Roman technological change from the modern world in which mechanization or skill-biased change has been seen to raise skill premia (Acemoglu, 2003; Acemoglu and Autor, 2011). Instead, there was little mechanization, and many important innovations of the Roman period were deskilling. This makes Roman technological change's impacts upon the market for skill closer in nature to the understanding of classical political economists (Brugger and Gehrke, 2018). Deskilling applies to the diffusion of concrete masonry starting in the first century BCE and the increased modularity of cut-stone or bricks used for Imperial architecture. By the first and second centuries CE, marble columns and capitals were serially produced and shipped from quarries to construction sites. Deskilling also appears in the serial production of slipped table-ware and other moveable goods (Wilson, 2008). This form of technological change may have made skill in some Roman crafts more attainable, helping to explain the historically normal or even low duration of some Roman apprenticeships, discussed in the next section. Wilson (2006) argues that many serial technologies particular to the Roman world disappeared with the fragmentation of the Empire starting in the third century.

#### 4.2. Supply: opportunity costs and excess urban mortality?

From a supply-side perspective, a point of emphasis in the literature on Roman skilling is the lack of formal educational systems, leaving training to families and households. However, the study of apprenticeship patterns in other periods confirms that family- and group strategies shaped investments in skill, making the Roman situation not unusual for the pre-industrial period (De Munck and Soly, 2007, p. 20). Still, household opportunity costs have played a central role in arguments for a putatively high Roman skill premium (cf. Bernard, 2016, p. 83). Hawkins (2016a, pp. 174–80, 2016b, pp. 45–6) holds that high opportunity costs of training put apprenticeship out of reach for many Roman households, making the market for skilled labor tight. Saller (2007, p. 110, 2012, pp. 75–7) develops a version of this thesis in which high Roman urbanization rates led to excess mortality through the urban graveyard effect whereby deaths outnumbered births in large urban centers prior to the demographic transition (Scheidel, 2003, 2014b; Jongman et al., 2018). The urban graveyard effect's applicability remains debated for the Roman Empire (Hin, 2013; Lo Cascio, 2016; Redfern, 2017), although in Saller's view, its effects pushed Roman families away from the long-term rewards of training, although.

Did some combination of high opportunity costs and excess urban mortality discourage Roman households from investments in skill? Both Hawkins and Saller suggest largely on the basis of Columella's vinedresser that the price of skill in ancient Rome was historically high. However, I have cast doubt on this reading of Columella, while a fuller view of the data suggests to the contrary that Roman skill premia were not unusually high for premodern societies. We may also question the assumption that Roman apprenticeship presented historically high opportunity costs. Several dozen apprenticeship contracts from Roman Egypt confirm that apprenticing was common (Bergamasco, 1995; Freu, 2011, p. 29). The arrangements preserved in this evidence display considerable variety, but contractual relationships between masters and students reveal similarities with later periods (Smits and Stromback, 2001, pp. 1–2). Hawkins points to an apprenticeship contract from Oxyrhynchus from 183 CE in which the party placing a minor into a master's care remained responsible for living expenses and received compensation starting only in the third of five years. However, such obligations were not the rule, and surviving documents are more varied in terms of the party responsible for living costs. It is also the case that, on the whole, the term of apprenticeship in Roman papyri seems equal to or even shorter than customary for early modern Europe (Huebner, 2013, p. 77; cf. Prak and Wallis, 2019). Bergamasco (1995, pp. 151–52) notes that Egyptian contracts reveal apprenticeship of five months to six years, although in longer arrangements of four or more years apprentices often remained in the master's workshop after completing training. Practice seems variable in our evidence. However, if anything, the length of ancient apprenticeships should be expected to have reduced the skill premium by comparison to other periods.

Some corroboration that families saw apprenticeship as a quick way to increase income appears in the mid-second century CE autobiographical work *Somnium* by Lucian of Samosata. Lucian's family removed him from rhetorical school and sent him to apprentice in stonemasonry with his uncle. Lucian explicitly states the move was guided by desire for short-term return, so that he could quickly earn a skilled income (*Som.* 1–4). Lucian was in his early teens, and Roman apprentices started training at a young age. Free apprentices tended to be around 12. Slaves may have started younger, as Roman law recognized their ability to work from the age of five (Laes, 2011, p. 165).

#### 4.3. Institutions: professional organizations and the credit market

The quality of training institutions surrounding human capital formation can lower the skilled-unskilled income ratio (Chor, 2005; van Zanden, 2009). A strong institutional framework encourages an increase in the relative supply of skilled workers, leading to lower wage inequality. In the Roman world, we have seen that apprenticeship was formalized by contract. The Roman state recognized apprenticeship and collected taxes from both apprentices and masters. The role of professional organizations, *collegia* and *koinônia*, is also worth considering. Against older views, recent literature allows for these associations' more active role in the economic life of their memberships (Van Minnen, 1987; Liu, 2009; Jinyu, 2016; Freu, 2012; Verboven, 2016). Professional organizations may at times have had a hand in tax collection, and organization leaders sometimes took interest in training apprentices. A few papyri refer to examinations of apprentices by *collegia* (Freu, 2011, pp. 34–35). None of these practices was applied with the systematic manner encountered with later guilds, however. *Collegia* may thus have positively affected the supply of skilled labor to an extent, but the existence of similar or even more robust professional organizations in later periods mean we should not overemphasize their role.

Possible institutional explanation for the downward trend observed in the data collected for Roman skill premia may lie in the credit market. Credit institutions hold recognized importance to investments in human capital (van Zanden, 2009; Minns and Wallis, 2013). The more easily and safely Roman households assumed debt, the more willingly they will have sought longer term returns. Imperial regulation reduced legal interest rates, leading to the development of financial markets. In Egypt, the interest rate was reduced from the Ptolemaic norm of 24% per annum to 12% under Augustus. Starting in the Early Empire or even Late Republic, there also was an expansion in the use of credit instruments (Lo Cascio, 2003; Harris, 2006). By the later first and into the second centuries CE, these shifts supported a boom in lending (Lerouxel, 2016; Rathbone, 2020). The Roman evidence does not allow detailed time series of credit markets and wage movements, as reconstructed for later periods (cf. van Zanden, 2009). Thus, our picture remains impressionistic, but its timing is consonant in very broad terms with the development of the skill premium observed in Egyptian documents. That is, following a rise in demand for skilled labor from the Late Republic and Early Empire prompted by urbanization, a reduction in the price of credit and its progressively wider availability will have supported rising investments in training by the mid-second century CE that lowered the relative cost of skilled labor. This discussion becomes speculative beyond a point, but we at least see a possible economic mechanism for the downward trend in our skill premium data. Further study of the application of credit to situations of human capital in the Roman world would be welcome.

#### 4.4. Skill premia and living standards

If the skill premium in Roman Egypt and the wider Empire was not unusual in the long run of premodern history, did the acquisition of skill offer Romans meaningful material advantage? Those who could afford to do so, as we have seen, sought to take advantage of economies of scale in training large numbers of slaves where several attestations of doubling suggest returns on skilling may have been proportionally similar to wage premia. What about the waged labor on which our inquiry has focused? Like Lucian of Samosata, many Roman households may have seen investments in training as a pathway to economic success. Especially in light of the deskilling implied by some Roman technologies, the investment in acquiring a basic skilled income may have seemed attractive. To add detail, I briefly turn to recent reconstructions of Roman living standards. Real incomes for Roman unskilled labor remain low throughout the period. According to Allen (2009, p. 338), unskilled wages made up 56% of a respectability basket for a Roman family but 110% of a bare-bones basket. Scheidel (2010, pp. 430, 434, 2014a) takes the more pessimistic view that unskilled wages offered 30% and 80% of these respective baskets. The premium for skill reconstructed here helped Roman workers approach or achieve the cost of a respectability basket, even if it did not create much disposable income. In other words, the basic return on training for free labor in the Roman world may not have offered wage-earners significant economic mobility. However, skill may have afforded a level of economic security unavailable to their unskilled peers.

#### 5. Conclusions

This article has examined the premium for skill during the Roman Empire. Documents from Roman Egypt show a mean premium of 74 for skilled wages and a mode of 100 or double an unskilled wage. While the small sample size urges cautious interpretation, observed premia are higher in urban than rural settings and decline somewhat over time starting in the mid-second century CE. Meanwhile, doubling appears widely in Roman responses to market effects on labor, while a skill premium of 100 for cash wages also features in Diocletian's Price Edict. Once maintenance costs explicitly mentioned in the Edict's wage data are accounted for, the resulting premium of 69 resembles the mean of 74 reported by the papyri. In terms of an overall Roman skill premium, these convergences help address the limitations of ancient price information and point to a widely similar range of returns for skill. Comparison of Roman wage inequality with data from other societies gives the impression of general continuity into later periods. This is true despite the particularities of the Imperial economy, including its profound reliance on slave labor and especially its high levels of urbanization. From the Late Republic to the Early Empire, Roman urbanization rates began to rise to levels not repeated in the Western world until the early modern period; this supported an initial expansion of demand for skilled goods and services that was then offset by other mechanism. The detailed study of the market for skill in ancient Rome highlights aspects familiar from later economies (credit markets, institutions), and others perhaps less so (numeracy, deskilling). In this way, I hope to have promoted the Roman period's place in ongoing historical discussions of incomes, despite limitations of the Roman data in terms of sample size or geographical spread. Even in this case where the Roman skill premium resembled that of later economies, the particular structure of the Roman labor economy repays close investigation.

#### Data Availability

No data was used for the research described in the article.

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#### References

- Acemoglu, D., 2003. Patterns of skill premia. *Rev. Econ. Stud.* 70, 199–230.
- Acemoglu, D. and Autor D., Skills, tasks and technologies: implications for employment and earnings, in D Card and O Ashenfelter, eds. *Handbook of Labor Economics* Vol. 4, Part B, 2011: 1043–1171.
- Allen, R.C., 2009. How prosperous were the Romans? Evidence from Diocletian's Price Edict. In: Bowman, A.K., Wilson, A.I. (Eds.), *Quantifying the Roman Economy*. Oxford University Press, Oxford, pp. 327–345.
- Ashtor, E., 1969. *Histoire Des Prix Et Des Salaires Dans L'orient Medieval*. Sevpen, Paris.
- Ashtor, E., 1976. *A Social and Economic History of the Near East in the Middle Ages*. Collins, New York.
- Bagnall, R.S., 1993. *Egypt in Late Antiquity*. Princeton University Press, Princeton, NJ.
- Bagnall, R.S., 2011. Ptolemaic and Roman Egypt: population and settlement. In: *Urbanisation, and Population*. Oxford University Press, Oxford, pp. 317–351.
- Beudet, A. *La specialization des métiers de la production en Gaule de 450 à Gaule*. MA thesis, Université Laval, 2019.
- Bailey, M., 2013. Roman Money and Numerical Practice. *Rev. Belg. Philol. d'histoire* 91 (1), 153–186.
- Bergamasco, M.L., 1995. *Didaskalikai nella ricerca attuale*. *Aegyptus* 75, 95–167.
- Bernard, S., 2016. Workers in the Roman imperial building industry. In: Verboven, K, Laes, C (Eds.), *Work, Labour, and Professions in the Roman World*. Brill, Leiden, pp. 62–86..
- Bernard, S., 2018. The economy of work. In: T.E.Lytle (ed.), *A Cultural History of Work in Antiquity*. Bloomsbury, London, pp. 19–32.
- Bernard, S., 2021. Were there ancient professions? *Rev. of Stewart, Harris, and Lewis, eds. 2020. J. Rom. Archaeol.* 34 (2), 853–861.
- Bransbourg, G., 2020. Inflation and monetary reforms in the fourth century: Diocletian's twin Edicts of AD 301. In: Butcher, K. (Ed.), *Debasement: Manipulation of Coin Standards in Pre-Modern Monetary Systems*. Oxbow, Oxford, pp. 165–194.
- Brugger, F., Gherke, C., 2018. Skilling and deskilling: technological change in classical economic theory and its empirical evidence. *Theory Soc.* 47, 663–689.

- Chor, D., 2005. Institutions, wages, and inequality: the case of Europe and its periphery (1500-1899). *Explor. Econ. Hist.* 42, 547–566.
- Clark, G., 2005. The condition of the working class in England, 1209-2004. *J. Political Econ.* 113 (6), 1307–1340.
- Corcoran, S., 1996. *The Empire of the Tetrarchs: Imperial Pronouncements and Government A.D. 284–324*. Oxford University Press, Oxford.
- Crawford, M.H., 1996. *Roman Statutes*. Institute of Classical Studies, London 2 vols.
- Cuvigny, H., 1996. The amount paid to the quarry-workers at Mons Claudianus. *J. Rom. Stud.* 86, 139–145.
- De Munck, B., Soly, H., 2007. 'Learning on the Shop Floor' in historical perspective. In: De Munck, B., Kaplan, S.L., Soly, H. (Eds.), *Learning on the Shop Floor: Historical Perspectives on Apprenticeship*. Bergahn, New York, pp. 3–32.
- De Munck, B., Kaplan, S.L., Soly, H., 2007. *Learning on the Shop Floor: Historical Perspectives on Apprenticeship*. Bergahn, New York.
- De Pleijt, A.M., Weisdorf, J.L., 2017. Human capital formation from occupatinos: the 'deskilling hypothesis' revisited. *Cliometrica* 11, 1–30.
- Domingo, J.A., 2013. The differences in Roman construction costs: the workers' salary. *Boreas* 36, 119–144.
- Drexhage, H.J., 1991. Preise, Mieten/Pachten, Kosten und Löhne im Römischen Ägypten bis Zum Regierungsantritt Diokletians. *Scripta Mercaturae Verlag, St Katharinen*.
- Duncan-Jones, R.P., 1982. *The Economy of the Roman Empire: Quantitative Studies*, 2nd ed. Cambridge University Press, Cambridge.
- Erdkamp, P., 2016. Economic growth in the Roman Mediterranean world: an early good-bye to Malthus? *Explor. Econ. Hist.* 60, 1–20.
- Federico, G., Nuvolari, A., Ridolfi, L., Vasta, M., 2021. The race between the snail and the tortoise: skill premium and early industrialization in Italy (1861-1913). *Cliometrica* 15, 1–42.
- Fikhtman, I.F., 1994. Sur quelques aspects socio-économiques de l'activité des: corporations professionnelles de l'Égypte byzantine. *Z. Papyrol. Epigr.* 103, 19–40.
- Finley, M.I., 1977. The ancient city: from Fustat de Coulanges to Max Weber and beyond. *Comp. Stud. Soc. Hist.* 19 (3), 305–327.
- Finley, M.I., 1999. *The Ancient Economy*. Updated Edition. University of California Press, Berkeley.
- Flohr, M., 2017. Artisans and markets: the economics of Roman domestic decoration. *Am. J. Archaeol.* 123 (1), 101–125.
- Flower, H., 2022. The most expensive slave in Rome: Quintus Lutatius Daphnis. *Class. Philol.* 117 (1), 99–119.
- Freu, C., 2011. Apprendre et exercer un métier dans l'Égypte romaine (Ier - VIe siècles ap. J.-C.). In: Monteix, N., Tran, N. (Eds.), *Les savoirs professionnels des gens de métier: études sur le monde du travail dans les sociétés urbaines de L'empire Romain*. Centre Jean Bérard, Naples, pp. 27–40.
- Freu, C., 2012. L'identité sociale des membres des collèges professionnels égyptiens (Ier - VIe s.p.C.). In: Dondin-Payre, M. (Ed.), *Collegia: Le Phénomène Associatif Dans L'occident Romain*. Ausonius, Pessac, pp. 229–246.
- Freu, C., 2015. Labour status and economic stratification in the Roman world: the hierarchy of the wages in Egypt. *J. Rom. Archeol.* 28 (1), 161–177.
- Freu, C., 2018. Écrire l'histoire du travail aujourd'hui. Le cas de l'Empire romain (note critique). *Ann. Hist. Sci. Soc.* 73 (1), 163–184.
- Freu, C., 2022. Les Salariés De L'égypte romano-byzantine. Essai d'histoire économique. Institut de papyrologie, Paris.
- Gamauf, R., 2012. Kindersklaven in klassischen römischen Rechtsquellen. In: Heinen, H., Deifler, J. (Eds.), *Kindersklaven – Sklavenkinder. Schicksale zwischen Zuneigung und Ausbeutung in Der Antike und Im Interkulturellen Vergleich. Beiträge zur Tagung des Akademievorhabens Forschungen Zur Antiken Sklaverei (Mainz, 14. Oktober 2008)*. Franz Steiner, Stuttgart, pp. 231–260.
- Goitein, S.D., 1967. *A Mediterranean Society: the Jewish Communities of the Arab World As Portrayed in the Documents of the Cairo Geniza*. Volume I: Economic Foundations. University of California Press, Berkeley.
- Groen Vallinga, M., Tacoma, L.E., 2016. The Value of Labour: Diocletian's Price Edict. In: Verboven, K., Laes, C. (Eds.), *Work, Labour, and Professions in the Roman World*. Brill, Leiden, pp. 104–132.
- Habermann, W., 2000. *Zur wasserversorgung einer metropole im kaiserzeitlichen ägypten. neuedition von P. Lond. III 1177. Text, Übersetzung, Kommentar*, Munich: C.H. Beck.
- Hanson, J.W., 2016. *An Urban Geography of the Roman World, 100 BC to AD 200*. Oxbow Books, Oxford.
- Harper, K., 2010. Slave Prices in Late Antiquity (and in the Very Long Term). *Historia* 59 (2), 206–238.
- Harper, K., *Slavery in the Late Roman World, AD 275-425*. Cambridge University Press.
- Harper, K., 2016. People, plagues, and prices in the Roman World: the evidence from Egypt. *J. Econ. Hist.* 76 (3), 83–89.
- Harper, K., 2017. *The Fall of Rome: Climate, Disease and the End of an Empire*. Princeton University Press, Princeton.
- Harris, W.V., 2015. Prolegomena to a study of the economics of Roman Art. *Am. J. Archaeol.* 119 (3), 395–417.
- Harris, W.V., 2006. A Revisionist View of Roman Money. *J. Rom. Stud.* 96, 1–24.
- Hawkins, C., 2016a. Roman Artisans and the Urban Economy. Cambridge University Press, Cambridge.
- Hawkins, C., 2016b. Contracts, coercion, and the boundaries of the Roman Artisanal Firm. In: *Work, Labour, and Professions in the Roman World*. Brill, Leiden, pp. 36–61 edited by K Verboven and C Laes.
- Herrmann-Otto, E., 1994. *Ex Ancilla natus: Untersuchungen zu Den Hausgeborenen Sklaven und Sklavinnen im Westen des Römischen Kaiserreiches*. Franz Steiner Verlag, Stuttgart.
- Heubner, S.R., 2013. *The Family in Roman Egypt: A Comparative Approach to Intergenerational Solidarity and Conflict*. Cambridge University Press, Cambridge.
- Hin, S., 2013. *The Demography of Roman Italy: Population Dynamics in an Ancient Conquest Society (201 BCE –14 CE)*. Oxford University Press, Oxford and New York.
- Hirt, A.M., 2010. *Imperial Mines and Quarries in the Roman World: Organizational Aspects 27 BC-AD 235*. Oxford University Press, Oxford and New York.
- Hopkins, K., 1995-96. Rome, taxes, rents, and trade. *Kodai* 6, 41–75.
- Humphries, J., Weisdorf, J., 2019. Unreal Wages? Real income and economic growth in England, 1260-1850. *Econ. J.* 129, 2867–2887.
- Johnston, A.C., 1936. *Roman Egypt to the Reign of Diocletian*. Economic Survey of Ancient Rome. Johns Hopkins Press, Baltimore vol. 2.
- Jongman, W.M., 2014. The new economic history of the Roman empire. In: F. de Callatay (ed.), *Quantifying the Greco-Roman Economy and Beyond*. Edipuglia, Bari, pp. 153–168.
- Jongman, W.M., Jacobs, J.P.A.M., Goldewijk, G.K., 2018. Health and wealth in the Roman Empire. *Econ. Hum. Biol.* 34, 138–150.
- Kay, P., 2014. *Rome's Economic Revolution*. Oxford University Press, Oxford.
- Laes, C., 2011. *Children in the Roman Empire. Outsiders Within*. Cambridge University Press, Cambridge.
- Lee, D., 2020. A professional Roman army? In: E., Stewart, E., Harris, D., Lewis (Eds.) *Skilled Labour and Professionalism in Ancient Greece and Rome*. Cambridge University Press, Cambridge, pp. 362–382.
- Lerouxel, F., 2016. *Le Marché Du Credit Dans Le Monde Romain (Égypte et Campanie)*. Bibliothèque des Écoles françaises D'Athènes Et De Rome. Rome: École française de Rome 374.
- Liu, J., 2009. *Collegia centonariorum: the Guilds of Textile Dealers in the Roman West*. Brill, Leiden.
- Liu, J., 2016. Group membership, trust networks, and social capital: a critical analysis. In: Verboven, K., Laes, C. (Eds.), *Professions in the Roman World*. Brill, Leiden, pp. 203–226.
- Lo Cascio, E., 2003. *Credito e moneta nel mondo romano*. Edipuglia, Bari.
- Lo Cascio, E., 2021. Labor. In: Noreña, C.F. (Ed.), *A Cultural History of Western Empires in Antiquity*. Bloomsbury, London, pp. 109–130.
- Lo Cascio, E., 2016. The impact of migration on the demographic profile of the city of Rome: a reassessment. In: Tacoma, L.E., de Ligt, L. (Eds.), *Migration and Mobility in the Early Roman Empire*. Brill, Leiden, pp. 23–32.
- Loomis, W.T., 1998. *Wages, Welfare Costs, and Inflation in Classical Athens*. University of Michigan Press, Ann Arbor.
- Lucassen, J., 2007. *Wages and Currency: Global Comparisons from Antiquity to the Twentieth Century*. Peter Lang, Bern.
- Lytle, T.E., 2018. *A Cultural History of Work in Antiquity*. Bloomsbury, London.
- Marcone, A., 2016. *Storia Del Lavoro in Italia. L'età Romana: liberi, Semiliberi e Schiavi in Una Società Premoderna*. Castelvécchi, Rome.
- Minns, C., Wallis, P., 2013. The price of human capital in a pre-industrial economy: premiums and apprenticeship contracts in 18th century England. *Explor. Econ. Hist.* 50 (3), 335–350.
- Mirkovic, M., 2005. Child labour and taxes in the agriculture of Roman Egypt. Παις και αρηλιξ. *Scr. Class. Isr.* 24, 139–149.

- Mohler, S.L., 1940. Slave education in the Roman Empire. *Trans. Amer. Philolog. Associ.* 71, 262–280.
- Mokyr, J., 1990. *The Lever of Riches: Technological Creativity and Economic Progress*. Oxford University Press, New York.
- Mokyr, J., 2009. *The Enlightened Economy: an Economic History of Britain 1700–1850*. Yale University Press, New Haven.
- Mokyr, J., 2019. The economics of apprenticeship. In: Prak, M., Wallis, M. (Eds.), *Early Modern Europe*. Cambridge University Press, Cambridge, pp. 20–43.
- Monteix, N., Tran, N., 2011. Les savoirs professionnels des gens de métier: études sur le monde du travail dans les sociétés urbaines de l'empire Romain. Centre Jean Bérard, Naples.
- Morelli, F., 1996. *Olio e retribuzioni nell'egitto tardo (V-VIII d.C.)*. Istituto papirologico G. Vitelli, Florence.
- Morrison, C., Cheynet, J.C., 2002. Prices and wages in the Byzantine World. In: *The Economic History of Byzantium: From the Seventh through the Fifteenth Century*. Dunbarton Oaks, Washington, DC, pp. 807–870 edited by A Laiou.
- Nachtergaeel, G. De quelques comptes d'un grand domaine de haute-Egypte au IIe siècle p.C., *Chronique d'Égypte* 82 (2007); 281–92.
- Pamuk, S., Shatzmiller, M., 2014. Plagues, wages, and economic change in the Islamic Middle East, 700–1500. *J. Econ. Hist.* 74 (1), 196–229.
- Prak, M., Wallis, P., 2019. *Apprenticeship in Early Modern Europe*. Cambridge University Press, Cambridge.
- Rathbone, D., 1991. *Economic Rationalism and Rural Society in Third-Century A.D. Egypt. The Heroninos Archive and the Appianus Estate*. Cambridge University Press, Cambridge.
- Rathbone, D., 2007a. Roman Egypt. In: *The Cambridge Economic History of the Greco-Roman World*. Cambridge University Press, Cambridge, pp. 698–719 edited by W Scheidel, I Morris, and R Saller.
- Rathbone, D., 2007b. Military finance and supply. In: *The Cambridge History of Greek and Roman Warfare, vol. II: Rome from the Late Republic to the Late Empire*. Cambridge University Press, Cambridge, pp. 158–176 edited by P Sabin, H van Wees, and M Whitby.
- Rathbone, D., 2009. Earnings and costs: living standards and the Roman economy (First to Third Centuries AD). In: Bowman, A.K., Wilson, A.I. (Eds.), *Quantifying the Roman Economy*. Oxford University Press, Oxford, pp. 299–326.
- Rathbone, D., 2020. The credit market in Roman Egypt and Campania, review of François Lerouxel. *Le marché du crédit dans le monde Romain (Égypte et Campanie)*. *Bibliothèque des Écoles françaises d'Athènes et de Rome* 374. Rome: École française de Rome, 2016. *J. Rom. Archaeol.* 33 (2), 913–916.
- Redfern, R., 2017. Urbanization, economic change, and dental health in Roman and medieval Britain. *Eur. J. Archaeol.* 20 (2), 346–367.
- Riggsby, A., 2019. *Mosaics of Knowledge: Representing Information in the Roman World*. Oxford University Press, Oxford and New York.
- Ruffing, K., 2008. *Die berufliche Spezialisierung in handel und handwerk: untersuchungen zu ihrer entwicklung und zu ihren bedingungen in der Römischen Kaiserzeit im östlichen Mittelmeerraum auf der Grundlage Griechischer inschriften und papyri*. Rahden: Leidorf.
- Russell, B., 2020. Roman sculptors at work; professional practitioners? In: E., Stewart, E., Harris, D., Lewis (Eds.) *Skilled Labour and Professionalism in Ancient Greece and Rome*. Cambridge University Press, Cambridge, pp. 243–265.
- Russell, B., Wooten, W., 2017. Makers and making: classical art in action. In: A., Lichtenberger, R., Raja (Eds.), *The Diversity of Classical Archaeology*. Brepols, Turnhout, pp. 253–270.
- Saller, R.P., 2007. Household and Gender. In: Saller (Ed.), *The Cambridge Economic History of the Greco-Roman World*. Cambridge University Press, Cambridge, pp. 87–112.
- Saller, R.P., 2012. Human capital and economic growth. In: Scheidel (Ed.), *The Cambridge Companion to the Roman Economy*. Cambridge University Press, Cambridge, pp. 71–86.
- Salway, B., 2010. *Mancipium rusticum sive urbanum*. The slave chapter of Diocletian's Edict on Maximum Prices. *Bull. Inst. Class. Stud.* 109, 1–20.
- Scheidel, W., 1996. What's in an Age? A comparative view of bias in the census returns of Roman Egypt. *Bull. Am. Soc. Papyrol.* 33, 25–59.
- Scheidel, W., 2002. A model of demographic and economic change in Roman Egypt after the antonine plague. *J. Rom. Archaeol.* 15, 97–114.
- Scheidel, W., 2003. Germs for Rome. In: Edwards, C., Woolf, G. (Eds.), *Rome the Cosmopolis*. Cambridge University Press, Cambridge, pp. 158–176.
- Scheidel, W., 2005. Real slave prices and the relative cost of slave labor in the Greco-Roman world. *Anc. Soc.* 35, 1–17.
- Scheidel, W., 2010. Real wages in early economies: evidence for living standards from 1800 BCE to 1300 CE. *J. Econ. Soc. Hist. Orient* 53, 425–462.
- Scheidel, W., 2014a. Roman real wages in context. In: *Quantifying the Graeco-Roman economy and Beyond*. Edipuglia, Bari, pp. 209–218 edited by F de Callatay.
- Scheidel, W. Germs for Rome? Ten years after. In *Les Affaires De Monsieur Andreau, économie et Société Du Monde Romain*, edited by C Apicella, M-L Haack, F Lerouxel, and J Andreau, 311–15. Bordeaux: Ausonius, 2014.
- Scheidel, W., Friesen, S.J., 2009. The size of the economy and the distribution of income in the Roman Empire. *J. Rom. Stud.* 99, 61–91.
- Shatzmiller, M., 2018. The adoption of paper in the middle east, 700–1300 AD. *J. Econ. Soc. Hist. Orient* 61 (3), 461–490.
- Shaw, B.D., 2015. *Bringing in the Sheaves. Economy and Metaphor in the Roman World*. Toronto University Press, Toronto.
- Smits, W., Stromback, T., 2001. *The Economics of the Apprenticeship System*. Edward Elgar, Cheltenham.
- Stewart, E., Harris, E., Lewis, D., 2020. *Skilled Labour and Professionalism in Ancient Greece and Rome*. Cambridge University Press, Cambridge.
- Swiderek, A., 1960. *La propriété foncière privée dans l'Égypte de vespasien et sa technique agricole D'après P. Lond. Recto*, 131. Wrocław: Polska Akademia Nauk.
- Temin, P., 2004. The labor market of the early Roman Empire. *J. Interdiscip. Hist.* 34 (4), 513–538.
- Temin, P., 2013. *The Roman Market Economy*. Princeton University Press, Princeton.
- Terpstra, T., 2019. *Trade in the Ancient Mediterranean: Private Order and Public Institutions*. Princeton University Press, Princeton.
- Terpstra, T., 2020. Roman technological progress in comparative context: the Roman Empire, Medieval Europe and Imperial China. *Explor. Econ. Hist.* 75.
- Tran, N. 2013. *Dominus tabernae: le statut de travail des artisans et des commerçants de l'occident Romain (Ier Siècle av. J.-C. - IIIe siècle ap. J.-C.)*. Rome: Ecole Française de Rome.
- Tran, N., 2016. *Ars and doctrina: the socioeconomic identity of Roman skilled workers (First Century BC – Third Century AD)*. In: Verboven, K., Laes, C. (Eds.), *Work, Labour, and Professions in the Roman World*. Brill, Leiden, pp. 246–261.
- Van der Veen, M., 1998. A life of luxury in the desert? The food and fodder supply to Mons Claudianus. *J. Rom. Archaeol.* 11, 101–116.
- van Leeuwen, M.H.D., Maas, I., Miles, A., 2002. *HISCO: Historical International Standard Classification Occupations*. Leuven University Press, Leuven.
- van Leeuwen, M.H.D., Maas, I., 2011. *HISCLASS: A Historical International Social Class Scheme*. Leuven University Press, Leuven.
- Van Minnen, P., 1987. Urban craftsmen in Roman Egypt, *Münstersche Beiträge zur Antiken Handelsgeschichte*, 131, pp. 49–72.
- Van Zanden, J.L., 2009. The skill premium and the 'Great divergence'. *Eur. Rev. Econ. Hist.* 13, 121–153.
- Verboven, K., 2016. Guilds and the organisation of urban populations during the principate. In: Verboven, K, Laes, C (Eds.), *Work, Labour, and Professions in the Roman World*. Brill, Leiden, pp. 173–202.
- Verboven, K., Laes, C., 2016. *Work, Labour, and Professions in the Roman World*. Brill, Leiden.
- Wilson, A.I., 2002. Machines, power, and the ancient economy. *J. Rom. Stud.* 92, 1–32.
- Wilson, A.I., 2006. The economic impact of technological advances in the Roman construction industry. In: Lo Cascio, E. (Ed.), *Tecnica e Progresso Economico Nel Mondo Romano*. Edipuglia, Bari, pp. 224–236.
- Wilson, A.I., 2008. Large-scale manufacturing, standardization, and trade. In: Oleson, J. (Ed.), *Oxford Handbook of Engineering and Technology in the Classical World*. Oxford University Press, Oxford, pp. 393–417.
- Wilson, A.I., 2011. City sizes and urbanisation in the Roman Empire. In: Bowman, A.K., Wilson, A.I. (Eds.), *Settlement, Urbanisation, and Population*. Oxford University Press, Oxford, pp. 161–195.