

Princeton/Stanford Working Papers in Classics

Real wages in early economies:
Evidence for living standards from 1800 BCE to 1300 CE

Version 4.0

September 2009

Walter Scheidel

Stanford University

Abstract: Price and wage data from Roman Egypt in the first three centuries CE indicate levels of real income for unskilled workers that are comparable to those implied by price and wage data in Diocletian's price edict of 301 CE and to those documented in different parts of Europe and Asia in the eighteenth or early nineteenth centuries. In all these cases, consumption was largely limited to goods that were essential for survival and living standards must have been very modest. A survey of daily wages expressed in terms of wheat in different Afroeurasian societies from 1800 BCE to 1300 CE yields similar results: with a few exceptions, real incomes of unskilled laborers tended to be very low.

© Walter Scheidel. scheidel@stanford.edu

1. Introduction

Real incomes are a critical measure of human well-being. In recent years, historians have made considerable progress in the comparative study of real wages around the world. As a result, for the period from the thirteenth century CE onward, we are now in a position to compare real wages in a number of European countries as well as in Turkey, India, China, and Japan.¹ Only small and frequently deficient samples of usable evidence have survived from earlier periods, mostly in the Near East. However, despite their various shortcomings, these sources are often sufficient to support rough estimates of real wages. In this paper, I present a critical survey of pertinent data from antiquity and the early and high Middle Ages. This broadened perspective expands the chronological scope of the historical study of real incomes of unskilled workers from a few centuries to up to four millennia and at least in a few cases enables us to trace contours of change in the very long run. It must be stressed at the outset that unlike for the more recent past, the comparative study of real wages in economies prior to the Black Death has barely begun. To the best of my knowledge, this is the first attempt ever to provide a comprehensive systematic survey for a large part of the early civilized world. For this reason, the principal objective of the present contribution is to showcase different ways of approaching this topic and to assess the currently available evidence in order to lay the groundwork for future more detailed case studies that will need to relate observed variation in real incomes to variation in overall economic performance and social development.

2. Consumption baskets: Roman Egypt, first to third centuries CE

In a recent pilot study, the economist and economic historian Robert Allen has made an attempt to study the price and wage figures recorded in Diocletian's "Edict on Maximum Prices" of 301 CE from the same perspective as early modern data.² This edict sought to impose ceilings on the prices of numerous commodities and services as well as on wages in the Roman Empire. Using two different "consumption baskets" that reflect the likely consumption requirements of a "respectable" and a poor working family, Allen relates the aggregate cost of obtaining the required goods to the mandated maximum income of an unskilled laborer in order to ascertain the proportion of a particular consumption basket this worker would have been able to afford.³ Despite some difficulties in matching the configuration of goods that were used to construct

I am grateful to Robert Allen, Jan Gerrit Dercksen, Michael Jursa, Roberta Mazza, Federico Morelli, Gary Reger, and several anonymous referees for valuable comments and bibliographical support. I also benefited from feedback provided by Stanford graduate students at a workshop organized by Joseph Manning and Josiah Ober in April 2008. This paper was written during a fellowship at the Center for Advanced Study in the Behavioral Sciences (Stanford).

¹ Van Zanden 1999; Allen 2001, 2005; Özmucur and Pamuk 2002; Allen, Bassino, Ma, Moll-Murata, and van Zanden (2005). The "IISH List of Datafiles of Historical Wages and Prices" (www.iisg.nl/hpw/) gathers pertinent evidence from around the world.

² Allen (2007), also forthcoming in Bowman and Wilson (2009).

³ Allen 2007: 4-8, and see in the text below for details regarding the composition of different baskets and families. For an earlier attempt to use these data to study living standards, see Frézouls 1977/78.

consumption baskets for the last few centuries, the results for the late Roman tariff are prima facie plausible in that they are consistent with those obtained for more recent pre-modern economies. More specifically, a Roman unskilled worker's ability to purchase a given baskets of goods was similar to that of his counterparts in Florence, Vienna, Beijing, and Delhi in parts of the eighteenth or nineteenth centuries but fell far short of that of workers in early modern Amsterdam or London. At the same time, implied late Roman real wages were much lower than they came to be in both Europe and Asia during the fifteenth century.⁴ Thus, in the most general terms, the evidence of Diocletian's price edict puts late Roman 'lower class' living standards on a par with those attained by workers in much later societies that experienced growing inequality and immiseration.⁵

At the end of his paper, Allen proposes "to use actual wages and prices (rather than legal maxima) to measure real wages in the Roman period and to do this for different regions of the empire and different time periods."⁶ In practice, however, Egypt appears to be the only part of the Roman world that can be studied in this way. It is only in this region that a sufficiently large number of records of commodity prices and wage payments have survived to support an attempt to establish the aggregate cost of a specific 'consumption basket' and relate it to incomes. In this section, I focus on price and wage data from the first through third centuries CE, which have received a considerable amount of scholarly attention and are readily accessible in synthetic surveys.⁷ The distribution of prices of particularly well-documented goods – wheat, wine, and donkeys – points to the existence of two distinct periods of price stability, from the late first century CE to the 160s CE or a bit later and from the 190s to the early 270s CE. In both periods, prices for these commodities tended to fluctuate within fairly narrow bands. These two bands are separated by a sudden doubling in prices between the 160s and 190s CE. For this reason, I provide separate estimates of price and wage levels for each of these two periods (henceforth labeled "Periods 1" and "2").

In order to ensure direct comparability with existing indices, I use the two consumption baskets devised by Allen with only very minor alterations.⁸ This is not to say that the suggested configuration of consumption needs is necessarily fully applicable to conditions in Roman Egypt: these two household budgets are simply meant to serve as heuristic devices that represent different levels of living standards.

Table 1 prices the goods in Allen's so-called "respectability basket" which was "inspired by English and Dutch studies of working class budgets and suggests the spending pattern of 'respectable' workers" but adjusted to reflect the absence of New World foods such as sugar and potatoes and substitutes wine for beer to account for Mediterranean tastes.⁹ This particular configuration of goods was used to calculate real incomes according to Diocletian's price edict and in eighteenth-century Strasbourg and

⁴ See Allen 2007: 14-15 figs.2-3.

⁵ See esp. Hoffman, Jacks, Levin, and Lindert 2002, 2005; and cf. now also Milanovic, Lindert, and Williamson 2007.

⁶ Allen 2007: 9.

⁷ Drexhage 1991 (marred by errors by still the most comprehensive survey); Rathbone 1996, 1997.

⁸ The only addition is lentils, which happen to be relatively well attested in Period 1, to provide an alternative to the poor price data for beans. The *chiton*, a dress-like garment worn by men and women, has been substituted for cloth. See the note for Table 1.

⁹ Allen 2007: 4, 10-11 tables 1-2.

Naples.¹⁰ Table 1 readily shows that this exercise entails a considerable amount of uncertainty. Despite the relatively large overall number of surviving price data, different commodities are very unequally represented in the papyrological record. Thus, while a recent survey gathered no fewer than 150 price points for wine alone, the prices of many other products are only rarely or never attested in ways that would permit us to utilize them for this kind of investigation.¹¹ For example, records of the sale of (fire)wood and cloth consistently fail to specify the amount of these materials that was exchanged for a stated price. Even the price of a very basic commodity such as bread can be surprisingly difficult to ascertain: most extant records refer to unmilled grain. For all these reasons, the best we can hope for is a *range* of probable costs in each of the two periods.

Table 1 Mediterranean respectability basket

	Quantity per person per year	Price in drachms	
		Period 1	Period 2
Bread	182 kg	(?)52.8- >63.4	((?)119- >143)
Beans	52 l	(?)3.8	(?)27.5
or lentils	(52 l)	6.2	?
Meat	26 kg	51-102	(102-204)
Oil	5.2 l	18.5	39.3
Cheese	5.2 kg	?	?
Eggs	52 pieces	8.8	(17.7)
Wine	68.25 l	24.9-64	46.3-119
Soap	2.6 kg	?	?
Linen	5 m	40	90
Candles	2.6 kg	-	-
Lamp oil	2.6 l	9.3	19.7
Fuel	5.0m BTU	?	?
Gross total		209- >312	462- >661
Adjusted total		242- >362	535- >766
Household requirement		762- >1,040	1,685- >2,413
Annual wages (daily pay)		250	571
Annual wages (monthly pay)		288	708 (768)
Welfare ratio (daily pay)		<0.24 – 0.33	<0.24 – 0.34
Welfare ratio (monthly pay)		<0.28 – 0.38	<0.29 (0.36) – 0.32 (0.46)

¹⁰ Ibid. 11 table 2. See above, n.8, for my marginal alterations.

¹¹ See Rathbone 1997: 185 for the number of wine prices.

Note: Period 1 runs from the late first century CE to the 160s CE and Period 2 from the 190s to the early 270s CE. Figures prefaced by (?) are based on a single recorded price for a particular good, and figures in parentheses for Period 2 are extrapolated from reports from the preceding period. Moreover, the cost of some goods is completely unknown: hence “?” or “-.” The median price of an *artaba* of wheat (38.8 liters or 30.3kg) was 8 drachms in Period 1 and 18 drachms in Period 2: Scheidel 2002: 103, based on Rathbone 1997. Drexhage 1991: 27-33 discusses the cost of flour and bread. Milling costs of 0.43-0.57 drachms per *artaba* are reported, and one record from the second century CE prices 2 *artabas* of bread at 21 drachms. If this means that 2 *artabas* of grain produced bread worth 21 drachms, 1kg of bread would have cost 0.29-0.32 drachms: if milling resulted in a weight loss of 0-10 percent and bread was 1.2 times as heavy as the flour it was made of, 1 *artaba* of wheat would have yielded somewhere around 33 to 36kg of bread. Thus, 182kg of bread may have cost between 52.8 and 58.3 drachms. An alternative method of estimating the price of bread yields a somewhat higher total. Allen’s “bread equation” (2007: 6) assumes that the price of bread (in grams of silver per kilogram) equals $0.063 + 1.226$ times the price of wheat (in grams of silver per liter) + 0.014 times the daily wage of a skilled laborer (in grams of silver). In the case of Roman Egypt in Period 1, equating the drachma to one-quarter of an imperial *denarius* with a mean silver content of 3.076g in the mid-second century CE (cf. Duncan-Jones 1994: 227 table 15.6), this works out at approximately 0.268g of silver per kilogram of wheat – or 63.4 Egyptian drachms for 182kg of wheat – if we use the wage of an *unskilled* rural laborer. Since skilled workers would have earned more (but we cannot tell by how much), the actual amount would have been larger, i.e., >63.4 drachms. The bread prices for Period 2 are extrapolated from the estimates for Period 1 by multiplying the latter by 2.25 to reflect the 125 per cent increase in the median wheat price from 8 to 18 drachms between Periods 1 and 2. For beans and lentils, see Drexhage 1991: 34-5. Meat prices are particularly poorly known: the estimate for Period 1 rests on only two price points (ibid. 54-5) and there is no independent information for Period 2. Oil and wine: Scheidel 2002: 103, based on Drexhage 1991: 43-50 and Rathbone 1997. (The volume of the principal unit of measurement for oil is contested: the range in the table reflects high and low estimates of 18 and 7 liters per *keramion*, respectively, for which see Drexhage 1991: 59 and Rathbone 1997: 199.) Eggs: Drexhage 1991: 55-8. In the textile category, I have arbitrarily substituted 2 *chitons* (dresses) for 5 meters of linen, each priced at 20 drachms (the lowest price in Period 1) and 45 drachms (based on two prices for Period 2), respectively: see Drexhage 1991: 354-63. I do not distinguish between oil for human consumption and lamp oil. There are no usable price data for cheese, soap, candles, or firewood: see Drexhage 1991: 58, 112-8; and for wax prices and candles cf. Chouliara-Raios 1989: 170-4, 180-1. Wages: Scheidel 2002: 104-5, based on Drexhage 1991: 402-39. Following Allen 2007: 6, I assume that day-laborers worked 250 days per year. For the adjusted totals, household requirements, and welfare ratios, see in the text below.

The gross results in Table 1 were adjusted by filling the gaps with the help of comparative evidence. In Allen’s three “respectability baskets” drawn up using data from Diocletian’s price edict and from eighteenth-century Strasbourg and Naples, aggregate expenses for cheese, soap, candles, and fuel account for between 12.7 and 13.9 percent of the total budgets. The internal consistency of these findings encourages extrapolation to Roman Egypt. Conjecturing that these four categories may have made up 13.7 percent of total spending (the mean for Strasbourg and Naples), I raised the gross tallies by 15.875 percent.¹² In keeping with Allen’s own calculations, I increased the resultant totals by 5 percent to account for housing and then multiplied them by three to scale them up to the requirements of a family.¹³ Once again, these overly schematic adjustments are undertaken simply to ensure comparability with Allen’s results.

¹² This method exposes me to the charge of circular reasoning. However, given the small share of these expenses in the total budget, this adjustment does not greatly affect the outcome. I believe that the benefit of being able to account for these items outweighs the hazard of circular reasoning.

¹³ Allen 2007: 5. For the cost of housing, see ibid. (5-10 percent of household spending in later periods); Drexhage 1991: 78-91, 450-2: 14 to 25 days’ worth of wages sufficient to rent a home for a year).

Even allowing for wide margins of error, the overall picture is clear. Workers could not expect to earn more than a relatively modest fraction of this notional “respectability basket.” The “welfare ratio,” which equals annual earnings divided by required expenditure, ranges from less than 0.25 to less than 0.5. By comparison, according to Diocletian’s price edict, a day laborer could expect to be able to afford approximately half of this consumption basket.¹⁴ Unskilled workers in Roman Egypt were as far removed from a “respectable” lifestyle as their peers in Delhi, Beijing, and Florence in the early nineteenth century.¹⁵

The requirements set out in this particular consumption basket deliberately exceed those for bare subsistence by a considerable margin. For instance, it seems a priori unlikely that more than a relatively small proportion of all pre-modern Egyptian households could ever have hoped to spend more money on meat than on bread. In reality, many workers and their families would seek to control costs by reducing expenditure on non-food items, alcohol, animal protein, and even grain processing. This approach underlies Allen’s aptly named “bare bones subsistence basket” that ensures the same caloric intake (of 1,920 calories per day) as the ‘respectability basket’ but at much lower cost (Table 2).¹⁶

¹⁴ Allen 2007: 3 calculates the daily silver wage of an unskilled laborer by adding a monthly allowance of 5 Italic *modii* (43.1 liters, equivalent to 3.33 *modii castrenses*) of wheat that is prorated by dividing it by 30 to estimate the daily amount. This leads to a ‘welfare ratio’ of 0.56 for the ‘respectability basket’ (ibid. 7). There are two problems with this approach. First of all, the price edict does not specify the daily food allowance that was to accompany the stated maximum cash wage of 25 *denarii*: 1.4 liters or 1.1 kilograms of wheat per day would have provided 3,670 calories, (at least) equal to the total caloric requirement of a physically hard-working adult man. Actual food allowances may well have been smaller. Secondly, since Allen reckons with only 250 work-days per year, the daily food allowance would only have been available 68.5 per cent of the time. Therefore, the monetary value of a properly prorated monthly food allowance of 3.33 *modii castrenses* (43.1 liters) of wheat priced at 100 *denarii* per *modius* would have been 7.6 rather than 11.1 *denarii*, for a daily wage of 32.6 instead of 36.1 *denarii*. In this case, the ‘welfare ratio’ would have been 0.51 instead of 0.56.

¹⁵ Allen 2007: 14 fig.2. For ‘welfare ratios’ derived from differently constructed ‘consumption baskets’ for Byzantine society c.1000 CE, see Milanovic 2006: 452-5.

¹⁶ Allen 2007: 7-8.

Table 2 Bare bones subsistence basket

	Quantity per person per year	Price in drachms	
		Period 1	Period 2
Wheat	172 kg	45.4	102.2
Beans	20 kg	(?)4.9	(?)27.4
or lentils	(20 kg)	3.9	?
Meat	5 kg	(?)9.8	((?)19.6)
Oil	5 l	17.8	37.8
Soap	1.3 kg	?	?
Linen	3 m	20	45
Candles	1.3 kg	-	-
Lamp oil	1.3 l	4.6	9.8
Fuel	2.0m BTU	?	?
Gross total		102-103	242
Adjusted total		112-113	266
Household requirement (mean)		354	838
Annual income (daily pay)		250	571
Annual income (monthly pay)		288	708 (768)
Welfare ratio (daily pay)		0.7	0.68
Welfare ratio (monthly pay)		0.81	0.85 (0.92)

Note: See above, note for Table 1. Here I reckon with the annual acquisition of one *chiton* rather than two. Using silver prices for eighteenth-century Naples (cf. Allen 2007: 11 table 2), the aggregate cost for soap, candles, and fuel in this basket would have accounted for 9 percent of the total; thus, the adjusted totals raise the gross totals by 10 percent.

Table 2 suggests that by himself, an unskilled worker could expect to earn somewhere between 70 and 90 percent of a “bare bones subsistence basket” for the whole family. This real income (for Roman Egypt from the late first into the mid-third centuries CE) is some 20 to 40 percent lower than in Allen’s simulation based on Diocletian’s price edict (which yields a “welfare ratio” of 1.04).¹⁷ It is worth stressing that these indices relate the needs of an entire family to the income of a single adult male worker. If the

¹⁷ Adjusted from Allen 2007: 8, who gives a ratio of 1.16, according to my calculations in n.14. It is a moot point whether this apparent difference is a function of the considerable margins of error involved in these estimates or of a possible politically motivated tendency in the priced edict of 301 CE to balance wages and prices in favor of the former.

worker is viewed in isolation, his income considerably exceeds the costs associated with the “bare bones subsistence basket” and under all but the most pessimistic assumptions meets the requirements of the “respectability basket.” The present calculations adopt Allen’s focus on the contribution of a single breadwinner for the sole purpose of ensuring cross-cultural comparability. In order to get a better idea of actual real income levels we have to consider the earnings potential of adult women and children. The papyrological record provides us with some relevant information. Wet-nurses are by far the best-documented group of female workers in Roman Egypt. Contracts from Period 1 report monthly wages of 5, 6, or 7 drachms, in each case supplemented by 0.5 liters of oil, as well as an average monthly wage of 6.67 drachms without food.¹⁸ Long-term employment was common: 2 and 2.5 years were the most popular periods.¹⁹ Under full employment, an average monthly wage of 6 drachms plus 0.5 liters of oil works out at 93 drachms per year, equivalent to about one-third of a male wage-laborer’s annual pay in Period 1.²⁰ Children could contribute as well.²¹ Documents from Period 1 record a number of daily wages for a *pais* (child/minor) ranging from 0.57 to 1.14 drachms.²² The median wage in this sample, of 0.86 drachms per day, would have enabled a *pais* to earn 108 drachms per year even if he or she had found employment on only half as many days per year as an adult worker. This suggests that a de facto annual household income of around 450 to 500 drachms may be a more realistic estimate. By improving the “welfare ratio” to 1.27 to 1.41 times the total cost of the “bare bones subsistence basket” for Period 1, this would have provided extra revenue for tax payments and modest non-essential expenses. At the same time, even if a less meat-rich “respectability basket” need not have cost more than 600 drachms per year, this standard would nevertheless have remained beyond the reach of most unskilled workers and their families.

Table 3 compares several of the caps on prices and wages imposed by the price edict of 301 CE with actual prices and wages from Roman Egypt. To facilitate comparison, all amounts are expressed in fractions or multiples of the price of 1 liter of wheat.

¹⁸ Drexhage 1991: 437-9.

¹⁹ Masciadri and Montevicchi 1984: 32-5.

²⁰ For women’s labor more generally, see Scheidel 1995/96.

²¹ Child labor was common from an early age: see Bradley 1991: 103-24; Petermandl 1997.

²² Drexhage 1991: 413-22. Analogous evidence from Period 2 is inadequate for our purposes.

Table 3 Price and wage ratios in Egypt and Diocletian's price edict

	Price edict (301 CE)	Roman Egypt	
		Period 1	Period 2
Wheat (1 liter)	100	100	100
Beans (1 liter)	60	(?)36	(?)89
Lentils (1 liter)	100	57	?
Wine (1 liter)	192-720	200-514	146-375
Oil (1 liter)	576-960	1,728	1,629
Salt (1 liter)	100	?	(?)56
Honey (1 liter)	576-960	(?)18,772	?
Meat (1 kilogram)	641-1,922	952-1,904	?
Cloak	51,720	(?)19,417	(?)21,552
Shirt/dress	16,162-25,860	11,650	(?)<13,362
Adult slave (generic)	c.259,000-388,000		
Adult slave (skilled)	c.517,000-776,000		
Adult slave (all)		c.534,000	
Daily wage (unskilled)	467	485	493

Note: See the references in the note for Table 1, with Drexhage 1991: 41-2 (honey), 351-70 (garments), and Scheidel 2005 (slaves).

The price ratios in the price edict tend to resemble the Egyptian ones for wine, a commodity that is frequently attested in the papyrological record,²³ as well as for meat, shirts, and slaves. The “soldier’s mantle as in the *indictio* [i.e., paid as tax in kind], best quality” mentioned in the price edict was probably of higher quality than the cloaks mentioned in the papyri, and the isolated Egyptian price points for legumes, salt, and honey need not be representative. Only the discrepancy in the relative price of oil – a good that is repeatedly priced in Egyptian documents – arguably reflects reality: olive trees may well have been more abundant in the coastal regions of the Mediterranean than in Egypt proper.²⁴ Most importantly, the “wheat wage” for unskilled labor was the same in Egypt and in the price edict. This suggests that at least in this case, wheat wages may serve as a rough proxy for more elaborate consumption baskets.

²³ Egyptian wine was more likely to resemble the cheap *vinum rusticum* of the price edict than pricier Italian varieties that account for the price spread in Table 3.

²⁴ However, papyrological references to oil need not refer to *olive* oil. Relatively high prices for oil are also attested for late Roman Egypt: compare the schematic price ratios in Bagnall 1985: 4, of 100 (1 liter of wheat) to 60 (1 liter of beans) to 751 (1 kilogram of meat) to 1,440 (1 liter of oil) to 900 (1 liter of wine), based on late price Roman data. (It is unclear why wine should have been so much dearer in late antiquity.)

3. Wheat wages: Afroeurasia, 1800 BCE – 1300 CE

A simplified means of assessing real incomes is provided by calculation of the “wheat wage,” the daily wage of an unskilled laborer expressed in liters of wheat. This approach was revived by Jan Luiten van Zanden in 1999: his survey of wheat wages in seven European cities from 1500 to 1800 shows that daily wages fell from (mostly) 10-15 liters/day to (generally) 6-10 liters/day. The highest wheat wages were observed in Holland (9.9-16.6 liters) and the lowest in Florence and Milan (5.3-9.3 liters).²⁵ Although wheat wages are a much cruder measure of living standards than consumption baskets – thanks to variation in the cost of grain processing as well as in the ratio of grain prices to those of other basic goods –, this approach holds greater promise for early economies which tend to be poorly documented and where data on wages and grain prices are not always accompanied by additional information on processing and other commodity costs. In fact, a more limited focus on wheat wages allows us greatly to extend the study of real incomes in both space and time.²⁶

In the cases surveyed in this section, daily wages are either reported as such in the sources or are derived by dividing monthly wage totals by 30.5 days.²⁷ Given the sometimes incomplete or ambiguous nature of the available evidence, two caveats are in order. First of all, this survey focuses on the compensation of hired laborers who – as best as we can tell – appear to have been free to enter employment for wages but were not formally coerced into doing so. Evidence for the compensation of ‘forced’ laborers (which span a broad spectrum of statuses from ‘free’ or ‘semi-free’ workers laboring under institutional constraints to debt-bondsmen and slaves) is therefore omitted, primarily because the frequently modest size of rations apportioned to such workers would cause us to understate real incomes in the labor market.²⁸ Secondly, we cannot always rule out the possibility that wage laborers received supplements in kind – especially food provided at the workplace – that are not properly documented in the sources. This problem stems from the impossibility to prove a negative: the fact that such supplements are sometimes recorded mentioned does not automatically establish their absence in those cases in which they are not explicitly mentioned. Whenever supplements are known, they are included in the following estimates of daily real wages. However, the sources’ failure to report existing supplements might introduce a downward bias into an

²⁵ Van Zanden 1999: 185 table 3. Stronger variation is observed for rye wages in seven other areas.

²⁶ The only existing comparative survey of ancient real wages that I am aware of, Duncan-Jones 1978, is much more limited in scope (only five comparanda for unskilled workers: *ibid.* 161 table 1). Early China has been excluded from the present survey. While the tens of thousands of wood and bamboo slips found at the frontier garrison of Juyan (in what is now Gansu province) provide ample price information for the Han period (mostly for the first centuries BCE and CE: see the convenient survey in Wang 2004: 59-64), civilian wage data for commoners are exceedingly scarce. Most references from this period pertain to public officials or military officers (Bielenstein 1980: 125-31). The very few wages from the Tang and Song periods reported by Peng 1994: 306, 403, 426 are generally of dubious value. A thorough survey of relevant evidence from early East and South Asia remains a desideratum.

²⁷ Neither daily nor monthly wage rates tell us how many days workers were employed in a given year and therefore cannot be used to reconstruct actual long-term mean daily income.

²⁸ I hasten to add that the very notion of a (free) ‘labor market’ may be a problematic concept for the earliest societies reviewed here. However, detailed consideration of the specifics of ancient labor relations is well beyond the scope of any article-length study. For rations in Mesopotamia, see below, n.30.

indeterminate number of other estimates. While there is no obvious way to control for this possibility, the internal consistency of most of the data set would seem to speak against the notion of widespread substantial omissions.²⁹

Constructing a database

Two law codes from southern Mesopotamia, the “Laws of Eshnunna” (18th c. BCE) and the “Code of Hammurabi” (around 1700 BCE), provide some of the earliest information about the wages of hired laborers.³⁰ The former text refers to a daily wage of 1 *sutu* or approximately 9.4 to 10 liters of barley for a winnower and a donkey-driver, while the monthly compensation of a generic hireling is set at 1 shekel of silver (conventionally equal to 30 *sutu* of barley) plus an additional 6 *sutu* of barley as a food allowance, for a daily mean income of 11.1 to 11.8 liters of barley.³¹ The “Code of Hammurabi” mentions daily wages of 5 or 6 *uttetu*, or 0.028-0.033 shekels, of silver (c.0.23-0.28g). Applying the notional standard conversion rate of 1 *kurru* (= 300 *qu*) of barley per shekel of silver, this works out at anywhere from 7.8 to 10 liters of barley per day.³² In terms of caloric value (which is the same for wheat and barley), 1 liter of barley (at 0.62kg) corresponds to 0.8 liters of wheat. Therefore, the reported amounts translate to daily wheat wages of between 7.5 and 9.4 liters (“Laws of Eshnunna”) and 6.2 to 8 liters (“Code of Hammurabi”), respectively. However, slightly later documentary evidence points to lower real wages than those envisioned in the normative tradition: in the seventeenth century BCE, higher barley prices and lower silver wages translated to monthly wages of the order of 150 to 280 liters of barley for adults, equivalent to daily wheat wages of not more than 4 to 7.5 liters.³³ Clay tablets from Nuzi, a city in what is now Iraq east of the Tigris river and south-west of contemporary Kirkuk, show that in the fifteenth and fourteenth centuries BCE a wage laborer was expected to receive the equivalent of 6 to 6.4 liters of wheat per day.³⁴

Mesopotamian evidence for the income of unskilled free hired workers clusters in the sixth century BCE. References to a monthly compensation in kind of 450 to 540 liters

²⁹ Moreover, it is likewise conceivable that real wage estimates for the early modern period, which will be used to provide a comparative standard, suffer from comparable shortcomings.

³⁰ As stated above, I exclude evidence for the (generally smaller) rations of forced laborers and focus on compensation for putatively free(ly) hired workers: for evidence for the former, now esp. Jursa in press b. Owing to the complexities of metrology and workers’ status, I also refrain from considering evidence for labor compensation from the Pre-Sargonic, Akkadian, and Ur III periods (in the third millennium BCE), for which see, e.g., the classic study by Gelb 1965 and more recently the three contributions in Powell 1987: 49-141 as well as Krecher 1993/97: 158-9. For other Old Babylonian data, see briefly Stol 1993/97: 171, but cf. Powell 1990: 96-8 for metrological problems inherent in comparisons between Old Babylonian and Neo-Babylonian compensation tallies.

³¹ “Laws of Eshnunna” 8, 10, 11. The lower barley wages of between 6.6 and 7.9 liters per day calculated by Zaccagnini 1988: 47 are based on what is now widely considered an outdated estimate of the underlying capacity measure *qu* (10 *qu* = 1 *sutu*). For a *qu* equivalent to between 0.94 and 1 liters, see Powell 1987/90: 503.

³² “Code of Hammurabi” 273 (6 *uttetu* per day in the first five months of the year and 5 for the remainder of the year, presumably reflecting different seasonal work loads), 274 (5 *uttetu* for a textile worker as well as for a worker whose profession is missing from the extant text).

³³ Richardson 2002: 279ff, 301ff. I owe this reference to Michael Jursa.

³⁴ Corrected from Zaccagnini 1997: 361-2, applying once again the higher value of 0.94-1 liter per *qu*.

of barley (equivalent to a very substantial daily wheat wage of 12 to 14 liters) for construction work in a palace dossier from Eanna can be supplemented by a sample of twelve monthly silver wages for hired laborers engaged in earth works, brick making, and general building activities dating from the late seventh to the early fifth centuries BCE.³⁵ Although both work wages and barley prices varied considerably during this period, there are sufficient data to match individual wage records to roughly concurrent barley prices.³⁶ The implied real wage is very high by historical standards, equivalent to a mean of almost 11 liters and a median of 12 liters of wheat per day. Even so, the fact that these values conceal a wide range of variation from 4 to 17 liters urges caution. Moreover, related data show that the price of dates (the other major local staple food) was sensitive to the scale of the transaction: smaller quantities commanded significantly higher market prices.³⁷ Thus, if the reported silver wages of construction workers are expressed in terms of barley prices near the upper end of the documented range for the latter – in order to reflect retail prices for small-scale purchases –, their implied mean and median daily wheat wage drops to around 8 liters.³⁸ Far lower real wages are recorded for later periods of Mesopotamian history. In 321 BCE, workers hired to remove debris from a temple in Babylon received a monthly silver wage which in that year bought 48 liters of barley, for a very low daily wheat wage of 1.3 liters.³⁹ In 93 BCE, some cleaners and porters in Babylon received silver worth 60 to 72 liters of barley, for a daily wheat wage of 2 to 2.4 liters.⁴⁰ It is unclear why these rates are so much lower than earlier ones from the same region or whether they were supplemented in kind.

In Eleusis near Athens in the 320s BCE, epigraphic records report that unskilled construction workers received 1.5 drachms per day, compared to 1.25-2.5 drachms for skilled workers. At that time, wheat sold for 5 to 6 drachms per *medimnos* (c.52 liters).⁴¹ This translates to a daily wheat wage of 13-15.6 liters. For the second half of the fifth century BCE, we hear of Athenian daily wages of 1 drachm for skilled as well as generic construction workers as well as militia soldiers, and the wheat price was probably around 6 drachms, for a daily wage of 8.7 liters.⁴² In this case, it is impossible to establish a separate wage estimate specifically for unskilled workers but the differentials may have been modest given a slight overlap of skilled and unskilled wages in the 320s BCE.⁴³

³⁵ Jursa in press a, with Jursa forthcoming. These wage data come from archives in Ebabbar, Eanna, Uruk, Sippar, and Babylon in southern Mesopotamia. Jursa forthcoming offers more elaborate calculations and discussion. Somewhat earlier wage data from the end of the Neo-Assyrian period (c.631-616 BCE) cannot readily be related to pertinent barley prices, which are poorly known: see now Radner 2007.

³⁶ Based on the preliminary tabulation of dated barley prices in Jursa forthcoming.

³⁷ Jursa forthcoming.

³⁸ However, the explicit reference to monthly barley wages of 450 to 540 kg in the same period may speak against this reduction. In any case, even if relatively high barley prices are applied in order to estimate daily wheat wages, 8 of the 12 results exceed the “core” range of 3.5-6.5 liters established below (see Table 4).

³⁹ Jursa 2002: 120-1 (wage of 4 silver shekels); van der Spek n.d. (barley price of 12 liters per shekel).

⁴⁰ Van der Spek n.d. (2/3 shekels of silver when 1 shekel bought 90-108 liters of barley). In the same year, a scribe is known to have received three times as much (equivalent to 6-7.2 liters, surely a low real wage for a member of this profession).

⁴¹ Loomis 1998: 111-3, with Markle 1985: 293-4.

⁴² Loomis 1998: 38-44, 105-7, with Markle 1985: 293. Military stipends dropped to 0.5 drachms in the wake of disasters (Loomis 1998: 44-5).

⁴³ See esp. Loomis 1998: 105 n.5 (and cf. 236-9). In the 320s BCE, skilled workers received 1.25, 1.5, 2, and 2.5 drachms, compared to 1.5 drachms for unskilled workers (ibid. 111-3). An isolated reference to a daily wage of 0.67 drachms for a farmworker in the late fifth century BCE comes from the second century

Even at – hypothetically – between 5.8 (i.e., two-thirds of 8.7) and 8.7 liters, unskilled laborers would have received 20 to 80 percent more than in the Roman average discussed in Section 2, while the late fourth-century BCE rate is approximately three times as high as the latter. Moreover, freedom from taxation would have raised incomes in real terms relative to other systems where this need not have been the case. These elevated levels of real incomes merit especial attention (see Section 4).

Epigraphic temple accounts from the Aegean island of Delos in the third and second centuries BCE preserve a substantial body of evidence for the prices of commodities such as olive oil, pork, and firewood.⁴⁴ However, uncertainties about daily wage levels hamper modern reconstructions of real incomes.⁴⁵ In the third century BCE, a few unskilled workers reportedly earned 0.83, 1, and 1.33 drachms per day when a *medimnos* of wheat might have cost anywhere from 4.5 to 10 drachms (although 6 to 7 drachms seems to have been the most common range).⁴⁶ This would suggest a daily wheat wage of 4.6 to 8.6 liters (for a wheat price of 6 to 7 drachms) or possibly even from 3.2 to 11.1 liters (for wheat prices from 4.5 to 10 drachms). It remains unclear whether lower compensation rates of 0.33 to 0.5 drachms per day for temple servants and flute-players – and thus a daily wheat wage of 1.8 to 3.2 (or 1.3 to 4.3) liters – are representative of daily wages for hired labor or more akin to (traditionally smaller) rations for slaves.⁴⁷

Contemporaneous papyrus documents from Hellenistic Egypt permit rough comparisons.⁴⁸ In the 260s and 250s BCE, wheat prices ranged from 1.17 to 3 drachms per *artaba* while recorded daily (or sometimes putatively daily) wages varied from 0.083 to 0.33 drachms. In theory, a median/mean wheat price of 1.75/1.96 drachms per *artaba* and a median/mean daily wage of 0.17/0.19 drachms work out at a daily wheat wage of between 3.4 and 4.2 liters. However, the fact that the price and wage samples are both split into two fairly distinct “high” and “low” bands suggests that these medians and means may conceal a much greater degree of variation. Thus, half of the 14 wheat prices vary from 1.17 to 1.5 drachms whereas the other seven range from 2 to 3 drachms. In a similar fashion, wages cluster both around 0.083 to 0.17 as well as around 0.33 drachms per day. Since this patterning does not seem to reflect chronological variation, it may not be legitimate to match “high” prices and wages on the one hand and their “low” counterparts on the other, a procedure that would indicate daily wheat wages of 3.6 liters (for “low” prices and wages) and 5.1 liters (for the “high” rates). The evidence for the following generations reflects various currency reforms. For the years from c.210 to 183 BCE, daily wages of 15 to 20 drachms (for adults) coincide with wheat prices of 120 to 180 drachms per *artaba*, for a daily wheat wage of 3.2 to 6.2 liters if one atypically low adult wage rate is omitted from the calculation. Wheat prices of 400 to 500 drachms per *artaba* and daily wages of 10 to 40 drachms from 168 to 130/27 BCE point to lower real

CE and need not be historical (ibid. 105). Even so, if skilled workers received 1 drachm, unskilled wages may have ranged from 0.67 to 1 drachm, in analogy to the situation in the 320s BCE.

⁴⁴ Reger 1994: 127-88 and Reger 1997.

⁴⁵ For (overly confident) attempts, see esp. Glotz 1913; Tarn 1923: 119-26; Larsen 1938: 408-14; but cf. the more recent critique of Reger 1994: 9 n.19.

⁴⁶ Tarn 1923: 118, 123-4; Larsen 1938: 384, and cf. 409 n.3. Craftsmen enjoyed higher incomes: see Heichelheim 1930: 125.

⁴⁷ Larsen 1938: 411.

⁴⁸ Maresch 1996: 181-2 (wheat), 192-4 (wages).

incomes of anywhere from 0.8 to 3.9 liters, or perhaps more narrowly 1.6 to 1.9 liters if the most common wage of 20 drachm is taken to be customary. Data from the 120s to the 90s BCE once again show a substantial amount of variation, from 50 to 120 drachms per day for wages and from 720 to 2,000 drachms for an *artaba* of wheat. In this sample, median and mean daily wheat wages amount to 3.1 and 2.6 liters, respectively, while the overall range (omitting the highest and lowest price and wage records) extends from 1.3 to 5.8 liters. We may conclude that even allowing for considerable margins of error, real wages in the third and early second centuries BCE – of somewhere around 4 liters – had been higher than they were later on.⁴⁹

Notwithstanding the historical prominence of the center of the Roman Empire, our sources shed very little light on wages and prices in the city of Rome and its hinterland. The best indirect evidence for wheat prices is provided by the observation that in the third quarter of the first century CE, ordinary wheat flour cost 10 sesterces per *modius* (8.62 liters) while superior varieties were priced at 12 and 20 sesterces.⁵⁰ Given grain prices of the order of 2 to 4 sesterces per *modius* in various parts of the empire,⁵¹ these amounts are so large that they ought to refer to conditions in the capital. Even allowing for unusually high milling costs, it is hard to imagine that a *modius* of the cheapest wheat would have sold for less than 6 sesterces.⁵² However, wages are empirically unknown. The modern notion of a daily wage of 3 or 4 sesterces is essentially unfounded.⁵³ Two simple thought experiments help sketch out the limits of the plausible. If in the mid-first century BCE, a (hired-out) slave could be expected to bring in 3 sesterces of net revenue per day, and we assume, for the sake of argument, that this slave satisfied his entire caloric needs by consuming the equivalent of 1kg of wheat per day, the daily gross daily wage might have been as low as 4 sesterces, equivalent to 5.7 liters of wheat. These are a lot of “ifs,” and this estimate is surely too low due to the omission of expenditure on the slave’s clothing and other items. A hypothetical upper limit might be established by assuming that the daily wage of an unskilled worker was unlikely to exceed the daily income of a member of the Praetorian Guards, an elite military unit that was stationed in the capital. The annual base stipend of a Praetorian guardsman in the early Principate was 3,000 sesterces, for a daily wage of 8.2 sesterces or 11.8 liters of wheat. However, if a civilian laborer had worked only (say) 250 days per year, the equivalent daily rate would have been as high as 12 sesterces or 17.2 liters. The resultant range from approximately 6 to 17 liters is so wide as to be almost meaningless:⁵⁴ it spreads across the estimates for most of the other economies discussed so far and makes it impossible to pin down the *relative* level of income of metropolitan wage laborers.

⁴⁹ Thus already Heichelheim 1930: 102-6.

⁵⁰ Pliny the Elder, *Natural History* 18.90.

⁵¹ Rathbone 2009. 1 denar = 4 sesterces.

⁵² Jasny 1944: 166 infers from Pliny’s statement a wheat price of 8 sesterces per *modius*; but see Rickman 1980: 240 (with earlier literature) and Duncan-Jones 1982: 346 in favor of an estimate of closer to 6 sesterces.

⁵³ *Contra* Temin 2006: 44. For the lack of information, see Scheidel 2007: 335 n.51). Cicero, *For the Actor Roscius* 28, claimed that an unskilled slave could be expected to bring in 3 sesterces per day. If this refers to a hired-out slave, we do not know if this amount is meant to signify gross or net income.

⁵⁴ While it is tempting to raise the lower limit of this range by 1.4 liters per day to account for the contribution of the late Republican and early imperial grain dole (of 5 *modii*/month), we cannot tell whether or not employers discounted for this subsidy and thus whether or not it raised net incomes.

Inscriptions from the city of Pompeii south of Rome may – but need not – refer to a daily wage of 4 sesterces plus bread and to two wheat prices of 3 and 7.5 sesterces per *modius*, whereas a wheat price of 4 sesterces per *modius* is reported from another Italian town (albeit as the result of price controls).⁵⁵ As in the case of Rome, there are too many imponderables to estimate real incomes: in different configurations, these data suggest a daily wage of anywhere from 4.6 to 11.5 liters of wheat plus some indeterminate amount of bread. While comparative evidence makes it seem likely that the actual figure fell somewhere within this range, it is impossible to be more precise.

Much the same is true for references to daily wages and grain prices in Roman Palestine that are preserved in the early Rabbinic tradition.⁵⁶ Although the number of pertinent references is comparatively large, their reliability and representative nature are often doubtful: round figures abound, and for rhetorical purposes the authors may have chosen unusually large or small amounts whose nature would have been obvious to a contemporary audience but remains obscure to us. The sheer range of variation in this data set calls for great caution: reported daily wages range from 0.5 to 8 drachms/denars while wheat prices vary from 0.83 to 8 drachms/denars per *se'ah* (probably equivalent to a *modius*). 1 drachm/denar seems to be the most common daily wage and 1 or 2 drachms/denars repeatedly occur as the price of a *se'ah*/?*modius*; however, flour prices of 1 to 1.3 drachms/denars per *se'ah*/?*modius* speak in favor of a wheat price of closer to 1 drachm/denar. At 1 drachm/denar each for a day's work and a *se'ah*/?*modius*, the daily wage would correspond to 8.6 liters of wheat. However, different but equally possible ratios (between a 2 drachm/denar wage and a 1 drachm/denar grain price or vice versa) produce very different outcomes from roughly 4 to 17 liters per day. Thus, the Jewish evidence merely replicates the problem that we have already encountered with respect to Rome and Italy.

Egyptian wheat wages in the first three centuries CE have already been discussed in the previous section (see esp. Table 3). A single document from Roman Egypt that dates from 314 CE records daily wages for casual labor from 400 to 650 drachms as well as a wheat price of 8,000 drachms for an *artaba*, suggesting an unusually low daily wheat wage of 1.9 to 3.2 liters.⁵⁷ However, wheat prices per *artaba* of 852 drachms in 301 CE, 1,200 drachms in 305, 1,333 drachms in 312, 2,000 drachms in 312/3, and 3,000 drachms in 315 CE – a time of steady price inflation – indicate that the price level for 314 CE is atypical.⁵⁸ Assuming the same wages as in 314 CE, a reported wheat price of 3,000 drachms in the following year implies much higher real daily incomes of 5.1 to 8.5 liters. Thus, if we were to take the lower end of the wage range of 400 drachms as typical of unskilled labor, the resultant daily wheat wage of 5.1 liters would have been virtually the same as in the two preceding centuries. Unfortunately, the rapid pace of inflation in the fourth century CE forestalls further estimates of real wages in this period.⁵⁹

Evidence from the following centuries finally puts us on firmer ground. For the fifth and sixth centuries CE, official commutation rates of 40 *modii* (345 liters) per

⁵⁵ Duncan-Jones 1982: 145-6, with Rathbone 2009.

⁵⁶ Sperber 1991: 101-25.

⁵⁷ *Corpus Papyrorum Raineri* 8.22, cited by Banaji 2001: 66.

⁵⁸ Bagnall 1985: 64.

⁵⁹ It is particularly unfortunate that the detailed price data for a variety of foodstuffs in the surviving account of the expenses incurred by the dignitary Theophanes on a journey from Egypt to Antioch in the 320s CE is not matched by contemporaneous evidence for wages. See now Matthews 2006: 138-62.

solidus (the late Roman gold currency) in North Africa and Egypt resemble an alternative commutation rate of 10 *artabas* (388 liters) per *solidus* in Egypt and a mean and median market price of 12 *artabas* (466 liters) per *solidus* in the same region.⁶⁰ Around 600 CE, a hagiographer from the eastern half of the empire mentioned a daily wage of 5 *folles* (i.e. 1/120 of a *solidus*) for a laborer digging a well. In the sixth century CE, another source refers to a worker who was paid 3 *solidi* per year “although the man had a wife and two children,” thus indicating that this wage seemed low.⁶¹ The former wage works out at between 2.9 and 3.9 liters per day and the latter at 2.8 to 3.8 liters for each day of the year. Two comparanda put these estimates in perspective. In Egypt around 557 CE, a camel-driver could expect 1.34 *solidi* plus 16 *artabas* of wheat per year, for a daily wheat wage of 3.4 liters, whereas in 569 CE, a man who indentured himself as a servant for four years received a food allowance whose cash value has been estimated as between 2.5 and 4 *solidi* per year, for a daily average of 3.2 to 5.1 liters. Commutation rates for soldiers in the fifth and sixth centuries CE stood at 4 or 5 *solidi* per year, equivalent to 3.8 to 5.3 liter per day.⁶² It catches the eye that while these wage ranges for civilian workers of 2.8-3.8, 2.9-3.9, 2.8-3.8, 3.4, and 3.2-5.1 liters per day are all very similar, the implied military rate tends to be somewhat higher, which seems a priori plausible.⁶³

By contrast, we encounter a series of wage rates for Egyptian unskilled workers from the second half of the sixth century to the early eighth century CE that far exceed the levels that had previously been documented in that region. Pertinent cases include a laborer who received 0.83 *solidi* per month (equivalent to 10.6 liters of wheat per day at 10 *artabas* per *solidus*), a monthly wage of 0.67 *solidi* that was probably supplemented by a food allowance (for a daily wheat wage of anywhere from 8.5 to 10.6 liters), and monthly payments to river-men of 0.5 and 0.75 *solidi* plus food, equivalent to 6.4 to 9.6 liters for the cash wages and in excess of 7.7 to 10.9 liters including food.⁶⁴ Similarly elevated rates are attested for groups of irrigation workers: in two instances in the 570s and some time in the seventh century CE, each month each worker received 0.87 or 0.89 *solidi* in cash wages plus an *artaba* of wheat and another 0.063 *solidi* specifically for

⁶⁰ Jones 1964: 446, 1185-6 n.87; Johnston and West 1949: 177-8. Egyptian wheat prices occasionally dropped to 776 liters per *solidus*: Worp 1994. Cf. also a rate of 259 liters to the *solidus* in northern Mesopotamia in 495 CE. In the mid-fourth century CE, 129 liters/*solidus* could be considered as an acceptable price in Antioch, one of the largest cities of the Roman empire.

⁶¹ Banaji 2001: 67, with references.

⁶² Jones 1964: 447, with Ostrogorsky 1932: 296-7 and Banaji 2001: 237 (P.Strasb. 40), and P.Oxy 1911, line 156.

⁶³ A series of annual wages of approximately or exactly 1 *solidus* for unskilled workers in fifth- and (especially) sixth-century CE Egypt cannot represent total compensation for free laborers (9 cases with 0.83, 0.83, <1, 1, 1, 1, 1, 1.38, and 1.58 *solidi* per year in Johnston and West 1949: 194-6; and cf. also *ibid.* 196 for 2 even lower wages in the seventh century CE). This implies extraordinarily low daily wheat wages of the order of 1.3 liters which are more reminiscent of slave rations than of market salaries. These wages may primarily represent part-time incomes; cf. also Morelli 1996: 154-5.

⁶⁴ Morelli 1997: 735, with references. For the calculation of the total compensation of the river-men (*nautai*) who received 0.75 *solidi*/month plus food, see Morelli 1996: 100-1. I reckon with 10 *artabas*/*irdabbs* per *solidus* (or its Arabian equivalent, the *dinar*): for wheat prices in the seventh and eighth centuries CE, see Grohmann 1930; Johnston and West 1949: 178 (10, 10, 10, 12, and 15 *artabas* per *solidus*); and Ashtor 1969: 77-8) (8, 10, 10, 10, 12, 13, 14 *irdabbs* per *dinar*). Note that Ashtor 1969: 77-9, 90 and 1976: 93-4 arrives at greatly inflated real wages for this period by adopting a “heavy” *irdabb* of 109.7kg (and thus *c.* 142 liters), which is incorrect: cf. the incisive discussion by Morelli 1996: 101-2 n.89. Egyptian measurements changed only afterwards.

provisioning, for a total daily wheat wage of 13.1 to 13.4 liters.⁶⁵ It is significant that in this case public as well as private – rather than merely public – employment was associated with comparable wage levels, and there is no reason to believe that longer-term (i.e., monthly or multi-monthly) contracts generated average daily incomes that were much higher than those for short-term employees.⁶⁶ What is more, the fact that a variety of skilled workers earned even higher wages confirms that these records are not anomalous outliers but representative of broader income patterns at the time (see the following section).⁶⁷ All this suggests that in this period real wages for unskilled workers were indeed substantially higher than they had been in previous centuries.⁶⁸

Despite the fact that hundreds of price and wage data have survived from the Byzantine world, very little can be said about wheat wages for civilian unskilled workers.⁶⁹ A reference to a daily wage of 12 *folles* a wage-laborer (*misthios*) in the “Farmer’s Law” (around 700 CE) cannot readily be converted into its gold and thus wheat equivalents.⁷⁰ The superficially appealing notion of an unskilled wage of approximately 10 *nomismata/solidi* per year and a wheat price of 12 *modioi thalassioi* per *nomisma/solidus* from the ninth to the eleventh century CE,⁷¹ and hence of a daily wheat wage of 5.6 liters, rests on shaky foundations.⁷² Later on, three reported wages for two servants and a cook in Constantinople in the twelfth and thirteenth centuries CE point to daily wheat wages of anywhere from 4.2 to 9.3 liters: once again, however, the potential for error is considerable.⁷³

Reported wages for unskilled workers in Baghdad in the 760s CE suggest a daily wheat wage of 3.6 to 5.3 liters.⁷⁴ Attempts to assess real wages in post-Umayyad Egypt are beset by uncertainties concerning the standards of measurement. What seems to me

⁶⁵ Morelli 1997: 732-4, 736.

⁶⁶ For an earlier period, cf. above, Tables 1-2.

⁶⁷ Ibid. 735, for monthly wages of 1.25 *solidi* plus food, 1.33, 1.5, 1.67, 1.83, and 2 *solidi* (equivalent to between >15.9 and 25.4 liters of wheat per day). Only indentured laborers drew lower incomes: e.g., Banaji 2001: 237.

⁶⁸ Cf. Morelli 1996: 164, *pace* Carrié 1999: 341.

⁶⁹ See the comprehensive survey of data in Morrisson and Cheynet 2002. Most of the information on wages pertains to officials, clerics, and soldiers.

⁷⁰ “Farmer’s Law” 22, 62. At 288 *folles* to the *solidus* and a wheat price of between 1/15 and 1/30 of a *solidus* per *modios thalassios* (17 liters) (Morrisson and Cheynet 2002: 822 with 865 n.122), this would translate to 11 to 21 liters per day. However, *pace* Morrisson and Cheynet, a less favorable *solidus/follis* conversion rate may well have applied: cf. Harl 1996: 197, 203, for the chaotic debasement of the *follis* at the time. The actual wheat wage may therefore have been (much?) smaller.

⁷¹ As intimated by Morrisson and Cheynet 2002: 830 in conjunction with 869. Milanovic 2006: 455 reckons with a ‘modest wage’ of 9-12 *nomismata/solidi* around 1000 CE but does not seek to calculate wheat wages per se.

⁷² Unless we are prepared to believe that military base wages (cf. Morrisson and Cheynet 2002: 861) are representative of civilian wages for unskilled labor, which is possible but unprovable.

⁷³ Morrisson and Cheynet 2002: 865-6: a servant paid 6 *hyperpera* and 30 *modioi (thalassioi)* per year in 1136 CE; a cook and a domestic servant each paid 10 *hyperpera* per year in the late thirteenth century. It appears from the tabulation *ibid.* 824 that a price of the order of 0.05-0.1 *hyperpera* per *modios thalassios* might be a defensible guesstimate for this period, although most of these data do not refer to conditions in the capital and outliers beyond this price range are quite numerous: thence my figures and skepticism in the main text.

⁷⁴ Ashtor 1969: 42-3 (the equivalent of 100kg of wheat priced at 0.125 dinar or 3 dirhems), 64 (1.25-1.88 dirhems monthly pay). In view of the data reviewed in the present paper, there is no need to consider these incomes particularly low and infer the provision of subsidized food by the state (*contra* *ibid.* 64).

the most defensible reconstruction posits daily wheat wages of 3.2 to 10 liters in the late eighth and early ninth centuries CE.⁷⁵ Eliyahu Ashtor's conjectures imply daily wheat wages of the order of 6 liters in the eleventh and 9 liters in the thirteenth centuries CE for unskilled labor in Iraq.⁷⁶ Records for the first half of the eleventh century CE point to monthly wages of about 1 to 1.25 dinars for unskilled workers and convey the impression that the price of (the equivalent of) 100 kilograms of wheat was not expected to exceed 1 dinar or might even have been lower than that.⁷⁷ This translates to a daily wheat wage of (a least) 4.3 to 5.3 liters. After a period of price instability in the second half of the eleventh century, the average price of wheat in the twelfth century CE has once again been put at approximately 1 dinar per (modern) hectoliter while monthly wages ranged from 1.5 to 2.5 dinars, for a daily wheat wage of 6.4 to 10.6 liters.⁷⁸

This last estimate owes much to the documents from the famous Cairo *geniza* (a synagogue depository) which provide valuable insight into real incomes in the Egyptian capital from the tenth to the thirteenth centuries CE. A number of records show that unskilled workers could expect to receive daily wages between 2 and 3.5 dirhems without food supplements, with wages of 2.5 to 3 dirhems being the most common ones.⁷⁹ Price data for wheat varied more widely depending on supply, and putative averages can only be arrived at by delimiting "high" and "low" prices. Prices of 0.125 dirhems for a one-pound loaf of bread and of 10 dirhems for an *irdabb* (c.90 liters) of grain were considered low while prices of 0.67 for a loaf and 40 dirhems for an *irdabb* counted as high. Prices of 0.2 or 0.28 dirhems per loaf in 1107 and 1219 CE appear to have been viewed as more common; 13.3 dirhems for an *irdabb* of fresh wheat and 13.3-15 dirhems for an *irdabb* of imported grain were thought reasonable, while a price of 30 dirhems per *irdabb* could be taken as a harbinger of an upcoming shortage.⁸⁰ This suggests that a bread price of 0.2-0.3 dirhems per pound and wheat prices between 20 and 25 (or even 30) dirhems per *irdabb* may have reflected "normal" conditions.⁸¹ Daily wages of 2.5-3 dirhems and a wheat price of 20 to 30 dirhems per *irdabb* translate to a daily wheat wage of anywhere

⁷⁵ For the problems, see above, n.61. For this period, wheat prices of 0.3-0.7 dinars per *irdabb* (Ashtor 1969: 78) translate to 0.0033-0.0077 dinars per liter (for an *irdabb* of 90 liter, or 0.0022-0.51 dinars per liter for a "heavy" *irdabb*), and monthly wages of 0.75-1 dinar (ibid. 92) imply a daily wheat wage of anywhere from 3.2 to 10 (or 4.8 to 15) liters.

⁷⁶ Ashtor 1976: 220. This increase, if real, might also have been linked to epidemics (cf. ibid., and in the text below at the end of Section 4).

⁷⁷ Ibid. p. 223-4 – wages of 1-1.25, 1-1.2, and 1 dinars per month –, (ibid. 124) – a guess of a "normal" grain price of 1 dinar for 100kg of wheat, noting that prices of 1.42 and 1.48 dinars were considered very high at the time.

⁷⁸ Ibid. 223-5 (monthly wages of 2, 1.5-1.67, 2.5 dinars); Ashtor 1976: 239 (wheat).

⁷⁹ Goitein 1967: 95-9 (2.5 dirhems for a helper in 1199 CE; 2.5 dirhems for a water-carrier, undated; 2.5 dirhems for a helper and 2 dirhems for a "boy" in 1183 CE; 2 dirhems for a helper, undated; 2.75 dirhems for a helper in 1040 CE; 3-3.5 dirhems for mortar mixers and runners; 2 dirhems for a debtor in 1057 CE; 3 dirhems for a debtor hired for 10 months in 1217 CE). By comparison, skilled workers received between 4 and 7 dirhems per day, often accompanied by lunch.

⁸⁰ Goitein 1983: 234-44. A price of 12 dirhem/*irdabb* in Tunis was also considered low.

⁸¹ This fits with a reported flour price of 1.13 dirhem for 5 pounds (ibid. p.243): if 4 pounds of bread could cost 1.13 dirhems and 5 pounds of flour produced 6 pounds of bread priced at 0.28 per pound, the baking and retail process may have added 50 percent to the value of the flour, a reasonable assumption. If 5.5 pounds of grain produced 5 pounds of flour priced at 0.225 dirhems per pound and milling added 10-20 percent to the cost, an *irdabb* of wheat (c.70kg) would have been worth 27-33 dirhems. A lower price of 0.2 dirhems per loaf would imply a lower flour price and a wheat price of 19-24 dirhems.

from 7.5 to 13.5 liters. Despite considerable margins of uncertainty, this indicates that real wages in medieval Cairo were higher than in most of the earlier economies reviewed above.⁸²

Discussion

Table 4 reveals a strong concentration of estimates within what we might label a “core” range from 3.5 to 6.5 liters per day: 9 of the 19 relatively safely documented figures or ranges and one “highly uncertain” estimate fall completely within this bracket while 6 other safely documented figures or ranges as well as 7 “uncertain,” “highly uncertain,” or “single-source” ranges overlap with it, for a total of 23 out of 32 entries overall (or 72 percent).⁸³ In addition, we observe a distinct higher income band for mid-first-millennium BCE Babylonia, classical Athens, Byzantine and early Arabic (or “early medieval”) Egypt, and high medieval Cairo, and to a lesser degree for thirteenth-century CE Mesopotamia. Hellenistic Delos, Rome, central Italy, and Roman Palestine occupy what might be called a “gray area” in between where real wages *may* have been higher than in the “core range” but it is impossible to be certain.⁸⁴ For the most part, 3.5 liters constitutes a lower limit: only mid-second-century BCE Egypt as well as a few poorly supported ‘single-source’ cases (Hellenistic Babylon and Egypt in 314 CE) fall short of this threshold. It would probably be unwise to attach much weight to these outliers.

⁸² For comparative purposes, see the tabulation of real wages in Cairo and Istanbul from 1400 to 1800 compiled by Sevket Pamuk in 2004 (http://gpih.ucdavis.edu/files/Cairo_wages_wheat_1400-1800.xls). Daily wheat wages for unskilled construction workers (the same category of people as in the Cairo *geniza*) amounted to 9.3 liters in 1400/1420, 9.7 liters in 1500-1520, 6.6 liters in 1600/1620, 7.7 liters in 1680/1700, and 9 liters in 1780/1800. Four of these five figures fall within my bracket for Cairo in the High Middle Ages. Real wages in Istanbul (1400-1800) were a little higher but generally similar.

⁸³ Owing to the disparate nature of the underlying data, it was not feasible to provide sample sizes for each entry. Instead of calculating means and/or median wages that might create a false impression of precision, I report ranges except in cases in which the sources convey only a single number or representative figures may safely be established from large samples. This inconsistency reflects the shortcomings of the available evidence.

⁸⁴ It has been argued that Rome and Italy in the first century BCE experienced a convergence of circumstances that were likely to have boosted real incomes: Scheidel 2007. However, we lack the wage and price data that would be necessary to substantiate this argument.

Table 4 Daily wheat wages of unskilled workers, 1800 BCE – 1300 CE

Date	Location	Wheat wage (in liters)
18 th c. BCE	Southern Mesopotamia (prescriptive/conventional)	<u>(6.2-9.4?)</u>
17 th c. BCE	Southern Mesopotamia	<u>4-7.5</u>
15 th /14 th c. BCE	Nuzi	<u>6-6.4</u>
7 th /5 th c. BCE	Southern Mesopotamia	<u>4-17.3 (8-12?)</u>
late 5 th c. BCE	Athens	8.7
320s BCE	Athens	13-15.6
321 BCE	Babylon	(1.3*)
3 rd /early 2 nd c. BCE	Delos	<u>3.2-11.1 (4.6-8.6?)</u>
260s/250s BCE	Egypt	<u>3.4-4.2</u>
210-180s BCE	Egypt	<u>3.2-6.2</u>
160s-120s BCE	Egypt	1.6-1.9
120s-90s BCE	Egypt	<u>1.3-5.8 (2.6-3.1?)</u>
93 BCE	Babylon	(2-2.4*)
1 st c. BCE/CE	Rome	(> <u>5.9??</u> <11.8-17.2??)
1 st c. CE	Pompeii	<u>(4.6-11.5??)</u>
1 st /2 nd c. CE	Palestine	(8.6?? <u>4.3-17.2??</u>)
100-160s CE	Egypt	<u>4.9</u>
190s-260s CE	Egypt	<u>4.9</u>
301 CE	Roman Empire	<u>4.7</u>
314 CE	Egypt	(1.9[-3.2]*)
315 CE	Egypt	<u>(5.1[-8.5]??*)</u>
5 th /6 th c. CE	Eastern Mediterranean	<u>2.8-3.9</u>
570s/early 8 th c. CE	Egypt	> 7.7-13.4
760s CE	Mesopotamia	<u>3.6-5.3</u>
late 8 th /early 9 th c.	Egypt	<u>(3.2-10?)</u>
c.1000 CE	Constantinople	<u>(5.6??)</u>
c.1000-1050 CE	Egypt	(>?) <u>4.3-5.3</u>
11 th c. CE	Mesopotamia	<u>6.1</u>
11 th /13 th c. CE	Cairo	7.5-13.5
12 th c. CE	Egypt	<u>6.4-10.6</u>
12 th /13 th c. CE	Constantinople	<u>(4.2-9.3?)</u>
13 th c. CE	Mesopotamia	9

Note: “?”= uncertain; “??”= highly uncertain; “*”= single source. All uncertain estimates are in parentheses. Underlined figures or ranges fall within, overlap with, or encompass a “core” range of 3.5-6.5 liters while bold figures or ranges in their entirety exceed the upper limit of this “core” range.

What do these data tell us? Comparison with later periods is made difficult by the heterogeneous provenance of much of the ancient and early medieval evidence. Whereas existing datasets for the wheat wages of unskilled workers usually pertain to urban environments, the majority of the earlier samples document rural incomes. In some cases, moreover, the context remains unclear. Only a few entries in Table 4 are known to record

urban unskilled wages: Athens, Rome, ?Pompeii, Constantinople, and Cairo, as well as some of the ancient and medieval Mesopotamian data. This raises the possibility that in as much as urban real wages exceeded rural ones, straightforward comparisons between Table 4 and later historical income data might underestimate the relative performance of early economies. Yet even with this caveat, the overall picture is fairly bleak. The mean unskilled wheat wage for 28 data points from seven European locales from 1500 to 1800 established by Van Zanden is 9.9 liters and the median is 9 liters. Even at the nadir at the end of the eighteenth century, the mean and median values still stood at 7.5 and 6.9 liters, respectively.⁸⁵ This means that with few exceptions, real wages in ancient and medieval economies were low by early modern *urban* European standards: the – necessarily unduly crude – average of the 32 entries in Table 4 is 6.5 liters and the median is 6.15 liters, the latter being lower than all but four of Van Zanden’s 28 European data points and lower than all but six of the 33 data points for European unskilled wheat wages from 1500 to 1849 recalculated by Stephen Broadberry and Bishnupriya Gupta.⁸⁶ Since wages for adult male workers were often so modest, labor force participation for both adult women and minors must have been high in order to fend off starvation.

During the early stages of human civilization, it was a rare economy that managed to rise beyond this bare-bones level of performance.⁸⁷ As noted above, it is difficult to determine the margin by which the grain wages of Neo-Babylonian construction workers did in fact exceed the “core” range: judgment will have to be deferred until the publication of Michael Jursa’s detailed study of the economic history of this period. In the case of classical Athens, the impression of high real wages is consistent with other indicators of improved living standards such as a strong presence of cash crops relative to subsistence farming and a large non-agricultural sector.⁸⁸ More generally, systematic consideration of the archaeological evidence, from average house size to body height, supports the notion of real economic growth over several centuries until the fourth century BCE.⁸⁹ Ian Morris has argued that a beneficial combination of institutions and belief systems that fostered a strong tradition of citizenship, promoted (male) egalitarianism, curtailed taxation, and protected property rights contributed to this development.⁹⁰ Even so, we cannot be sure to what extent the reported wages – which tend to be associated with public building programs – were representative of wage levels in the private labor market. At the same time, the suspicion that the reported wages were somehow atypical – that is, significantly higher than ‘usual’ – is not actually supported by anything in the record. It is true that per diem rates meant to compensate Athenian citizens for jury duty and eventually also for attendance of assembly meetings were much lower, mostly 3 obols or 4.3 liters of wheat equivalent in the late fifth and early fourth centuries BCE, but there is no way of telling whether or to what extent these emoluments were intended to match basic labor wages. It is only by assuming that those rates roughly approximated the daily income of unskilled workers that we would be able to lower Athenian wheat wages into the conventional “core” range. Any such attempt, however,

⁸⁵ Van Zanden 1999: 185 table 3.

⁸⁶ Ibid. and Broadberry and Gupta 2005: 6 table 2.

⁸⁷ Additional cases may certainly have existed but we do not know about them: cf. above, n.84.

⁸⁸ Moreno 2007: 37-76: farming); Jew 1999 and Amemiya 2007: 106-114: GDP; cf. also Cohen 1992.

⁸⁹ Morris 2004, 2005.

⁹⁰ Morris 2004: 729-33.

would conflict with the fact that by the 320s BCE, per diem pay for assembly attendance had risen to 1 drachma or 8.7-10.4 liters of wheat equivalent per day, at a time when unskilled construction workers could earn one and a half times as much.⁹¹ Even if that revised per diem rate had been more typical of actual wages, it would nonetheless have significantly exceeded the upper limit of the “core” real income range, thereby preserving the notion of Athenian exceptionalism at least for the late fourth century BCE.

High medieval Cairo, another environment characterized by relatively high unskilled real wages, was a rent-taking metropolis where earning opportunities may well have risen above customary levels. It also merits attention that in this context, the high cost of non-tradable goods and services may well have offset elevated grain wages. This notion receives support from a simple comparison between real house prices in Middle Egypt in the first two centuries CE and in high medieval Cairo, which were more than twice as high in the latter location.⁹² Moreover, as already noted above, these Cairoan wages are broadly in line with real incomes of unskilled urban laborers in both Cairo and Istanbul from 1400 to 1800.⁹³

By contrast, the presence of relatively high wheat wages among what were undoubtedly unskilled rural workers in Byzantine and early Arabic Egypt (from the second half of the sixth into the eighth centuries CE) is anomalous and very much in need of explanation. It may be significant that all of these references date from after the initial appearance of the pandemic known as the “Justinianic Plague” in 541 CE and fall in the period that experienced recurrent outbreaks (up to 750 CE).⁹⁴ In 541 CE, the disease first appeared in Egypt, supposedly with devastating consequences. Subsequent occurrences are specifically reported for Egypt for c.619, 672/3, 689/90, 714/5, 724, 732/5, and 743/4 CE, in addition to more numerous outbreaks in the eastern Mediterranean or “Orient” in general – which includes Egypt – in 551/2, 567/8, 573/4, 590/1, 599, and ?607/8 CE, and in the neighboring regions of Syria and Palestine in 542, 580/1, 591/2, 599, 626/7, 634/5, 639, 646/7, 683/4, 687, 698, 699/700, 704/5, 706, 713, 718/9, 725/6, 744/5, and 748/50 CE, events that could easily have affected Egypt as well. This raises the possibility that demographic contraction may temporarily have driven up real incomes.⁹⁵ Unfortunately, this scenario has barely begun to be explored by historians specializing in this period.⁹⁶ While published surveys of price data do not currently allow the creation of a valid consumption basket for rural Egypt in the plague period, more intensive engagement with the existing papyrological evidence might make it possible to test my conjecture with reference to a wider range of consumer goods.⁹⁷ If my conjecture is correct, it suggests

⁹¹ Loomis 1998: 15-17, 20-6, and above, Section 3.

⁹² See Drexhage 1991: 74-91, for a median (mostly rural) house value of 2,700 liters of wheat (n=28), and Goitein 1983: 275-88, for a median of 6,500 liters for urban houses in Cairo (n=86).

⁹³ See above, n.82.

⁹⁴ For these epidemics, see most recently Little 2007 and Rosen 2007. Stathakopoulos 2004: 278-386 catalogs all known outbreaks.

⁹⁵ Thus Findlay and Lundahl 2006: esp. 173, 177. The population of Egypt grew for the two centuries after 750 CE, presumably with adverse consequences for real wages: e.g., Shatzmiller 1994: 56-7.

⁹⁶ Sarris 2006: 224, briefly touches on possible short-term economic consequences. Cf. also very briefly Treadgold 2002: 149-50. Alston 2001: 182-91 more generally speculates about the effects of the epidemic on Egypt. Scheidel 2002 argued that the so-called “Antonine Plague” of the late second century CE (probably a smallpox epidemic) had raised real incomes in Roman Egypt.

⁹⁷ Federico Morelli (Vienna) is working on a comprehensive collection and analysis of prices and wages from Egypt in this period.

that just as in the late Middle Ages, plague mortality was an agent powerful enough substantially to improve real incomes for workers.

This notion is readily compatible with a conventional Malthusian reading of premodern economic history. By contrast, evidence suggestive of elevated real wages in settings such as late Neo-Babylonian and early Achaemenid Mesopotamia and classical Athens defies straightforward explanation. It is cases such as these that most powerfully highlight the importance of this perspective: the comparative study of variation in real incomes provides a vital and previously unappreciated means of improving our understanding of geographical and chronological differentiation in early economic development in general.

References

- Allen, Robert C. 2001. The Great Divergence: Wages and Prices from the Middle Ages to the First World War. *Explorations in Economic History* 38: 411-47.
- . 2005. Real Wages in Europe and Asia: A First Look at the Long-Term Patterns. In *Living Standards in the Past: New Perspectives on Well-Being in Asia and Europe*, ed. Robert C. Allen, Tommy Bengtsson, and Martin Dribe. Oxford: Oxford University Press: 111-30.
- . 2007. How Prosperous were the Romans? Evidence from Diocletian's Price Edict (301 AD). University of Oxford, Department of Economics, Discussion Paper Series No. 363, October 2007.
- , Jean-Pascal Bassino, Debin Ma, Christine Moll-Murata, and Jan Luiten van Zanden. 2005. Wages, Prices, and Living standards in China, Japan, and Europe, 1738-1925. GPIH Working Paper No. 1, October 2005.
- Alston, Richard. 2001. Urban Population in Late Roman Egypt and the End of the Ancient World. In *Debating Roman Demography*, ed. Walter Scheidel. Leiden: Brill: 161-204.
- Amemiya, Takeshi. 2007. *Economy and Economics of Ancient Greece*. London and New York: Routledge.
- Ashtor, Eliyahu. 1969. *Histoire des prix et des salaires dans l'Orient medieval*. Paris: S.E.V.P.E.N.
- . 1976. *A Social and Economic History of the Near East in the Middle Ages*. Berkeley: University of California Press.
- Bagnall, Roger S. 1985. *Currency and Inflation in Fourth Century Egypt*. Chico: Scholars Press
- Banaji, Jairus. 2001. *Agrarian Change in Late Antiquity: Gold, Labour, and Aristocratic Dominance*. Oxford: Oxford University Press.
- Bielenstein, Hans. 1980. *The Bureaucracy of Han Times*. Cambridge: Cambridge University Press.
- Bowman, Alan and Andrew Wilson, ed. 2009. *Quantifying the Roman Economy*. Oxford: Oxford University Press.
- Bradley, Keith R. 1991. *Discovering the Roman Family*. New York: Oxford University Press.
- Broadberry, Stephen and Bishnupriya Gupta. 2005. The Early Modern Great Divergence: Wages, Prices and Economic Development in Europe and Asia, 1500-1800. *Economic History Review* 59: 2-31.
- Carrié, Jean-Michel. 1999. Économie et société romano-byzantine (IVe-VIIe siècle). A propos de quelques publications récentes. *Antiquité Tardive* 7: 331-52.
- Chouliara-Raïos, Hélène. 1989. *L'abeille et le miel en Égypte d'après les papyrus grecs*. Ioannina: Panepistemiou Ioanninon.
- Cohen, Edward E. 1992. *The Athenian Economy: A Banking Perspective*. Princeton: Princeton University Press.
- Drexhage, Hans-Joachim. 1991. *Preise, Mieten/Pachten, Kosten und Löhne im römischen Ägypten bis zum Regierungsantritt Diokletians*. St Katharinen: Scripta Mercaturae Verlag.
- Duncan-Jones, Richard P. 1978. Two Possible Indices of the Purchasing Power of Money in Greek and Roman Antiquity. In *Les dévaluations à Rome*. Rome: Ecole Francaise de Rome: 159-79.
- . 1982. *The Economy of the Roman Empire: Quantitative Studies*. 2nd ed. Cambridge: Cambridge University Press.
- . 1994. *Money and Government in the Roman Empire*. Cambridge: Cambridge University Press.
- Findlay, Ronald and Mats Lundahl. 2006. Demographic Shocks and the Factor Proportion Model: From the Plague of Justinian to the Black Death. In *Eli Heckscher, International Trade, and Economic History*, ed. Ronald Findlay, Rolf G. H. Henriksson, Hakan Lindgren, and Mats Lundahl. Cambridge MA: MIT Press: 157-98.

- Frézouls, Edouard. 1977/78. Prix, salaires et niveaux de vie: quelques enseignements de l'Edit du Maximum. *Ktèma* 2: 253-68 and 3: 289-300.
- Gelb, Ignace J. 1965. The ancient Mesopotamian ration system. *Journal of Near Eastern Studies* 24: 230-43.
- Glötz, Gustave. 1913. Les salaires à Delos. *Journal des Savants* 11: 206-15 and 251-60.
- 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*. Berkeley: University of California Press.
- . 1983. *A Mediterranean Society: The Jewish Communities of the Arab World as Portrayed in the Documents of the Cairo Geniza. Volume IV: Daily Life*. Berkeley: University of California Press.
- Grohmann, Adolf. 1930. Zum Weizenpreis im arabischen Ägypten. *Bulletin de l'Institut Francais d'Archéologie Orientale* 30: 541-3.
- Harl, Kenneth W. 1996. *Coinage in the Roman Economy, 300 B.C. – A.D. 700*. Baltimore and London: Johns Hopkins University Press.
- Heichelheim, Fritz. 1930. *Wirtschaftliche Schwankungen der Zeit von Alexander bis Augustus*. Jena: Gustav Fischer.
- Hoffman, Philipp T., David S. Jacks, Patricia A. Levin, and Peter H. Lindert. 2002. Real Inequality in Western Europe since 1500. *Journal of Economic History* 62: 322-55.
- , David S. Jacks, Patricia A. Levin, and Peter H. Lindert. 2005. Sketching the Rise of Inequality in Early Modern Europe. In *Living Standards in the Past: New Perspectives on Well-Being in Asia and Europe*, ed. Robert C. Allen, Tommy Bengtsson, and Martin Dribe. Oxford: Oxford University Press: 131-72.
- Jasny, Naum. 1944. Wheat Prices and Milling Costs in Classical Rome. *Wheat Studies of the Food Research Institute* 20: 137-68.
- Jew, Daniel. 1999. Food, Silver, Trade and Liturgies: Modeling the Athenian Economy. Unpublished MPhil thesis, Cambridge University.
- Johnston, Allan C. and Louis C. West. 1949. *Byzantine Egypt: Economic Studies*. Princeton: Princeton University Press, Princeton.
- Jones, Arnold H. M. 1964. *The Later Roman Empire 284-602: A Social, Economic, and Administrative Survey*. Oxford: Oxford University Press.
- Jursa, Michael. 2002. Florilegium babylonicum: Neue Texte aus hellenistischer und spätachämenidischer Zeit. In *Mining the Archives: Festschrift for Christopher Walker on the Occasion of his 60th birthday, 4 October 2002*, ed. Cornelia Wunsch. Dresden: ISLET: 107-30.
- . In press a. Hired Labour in Babylonia in the First Millennium BC. In *Proceedings of the Symposium on Labour in the Ancient Near East (Dresden 2005)*, ed. Piotr Steinkeller.
- . In press b. The Remuneration of Institutional Labourers in an Urban Context in Babylonia in the First Millennium BC. In *Actes de la Rencontre sur les Archives des Persépolis (Collège de France, 3-4 novembre 2006)*, ed. Pierre Briant and Wouter Henkelman.
- . Forthcoming. Money and Prices in Babylonia in the Sixth Century BC.
- Krecher, Joachim. 1993/97. Miete. A. In *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*. Volume 8, ed. Dietz O. Edzard. Berlin and New York: De Gruyter: 156-62.
- Larsen, Jakob A. O. 1938. Roman Greece. In *An Economic Survey of Ancient Rome. Volume IV*, ed. Tenney Frank. Baltimore: Johns Hopkins University Press: 334-414.
- Little, Lester K., ed. 2007. *Plague and the End of Antiquity: The Pandemic of 541-750*. Cambridge: Cambridge University Press.
- Loomis, William T. 1998. *Wages, Welfare Costs and Inflation in Classical Athens*. Ann Arbor: University of Michigan Press.
- Maresch, Klaus. 1996. *Bronze und Silber: Papyrologische Beiträge zur Geschichte der Währung im ptolemäischen und römischen Ägypten bis zum 2. Jahrhundert n. Chr.* Opladen: Westdeutscher Verlag.

- Markle, M. M. 1985. Jury Pay and Assembly Pay at Athens. In *Crux: Essays in Greek History Presented to G. E. M. de Ste. Croix*, ed. Paul A. Cartledge and F. D. Harvey. London: Duckworth: 265-97.
- Masciadri, Madradele M. and Orsolina Montevocchi. 1984. *I contratti di baliatico*. Private printing.
- Matthews, John. 2006. *The Journey of Theophanes: Travel, Business, and Daily Life in the Roman East*. New Haven and London: Yale University Press.
- Milanovic, Branko. 2006. An Estimate of Average Income and Inequality in Byzantium around Year 1000. *Review of Income and Wealth* 52: 449-70.
- , Peter H. Lindert, and Jeffrey G. Williamson. 2007. Measuring Ancient Inequality. NBER Working Paper No. 13550, October 2007.
- Morelli, Federico. 1996. *Olio e retribuzioni nell'Egitto tardo (V-VIII d.C.)*. Florence: Istituto Papirologico G. Vitelli.
- . 1997. Sulle retribuzioni nell'egitto bizantino: il caso dei *potamitai*. In *Akten des 21. Internationalen Papyrologenkongresses Berlin, 13-19.8.1995*, ed. Bärbel Kramer et al. Stuttgart and Leipzig: Teubner: 727-37.
- Moreno, Alfonso. 2007. *Feeding the Democracy: The Athenian Grain Supply in the Fifth and Fourth Centuries BC*. Oxford: Oxford University Press.
- Morris, Ian. 2004. Economic Growth in Ancient Greece. *Journal of Institutional and Theoretical Economics* 160: 709-42.
- . 2005. Archaeology, Standards of Living, and Greek Economic History. In *The Ancient Economy: Evidence and Models*, ed. Joseph G. Manning and Ian Morris. Stanford: Stanford University Press: 91-126.
- Morrisson, Cecile and Jean-Claude Cheynet. 2002. Prices and Wages in the Byzantine World, In *The Economic History of Byzantium: From the Seventh through the Fifteenth Century*, ed. Angeliki Laiou. Dumbarton Oaks: 807-70.
- Ostrogorsky, Georg. 1932. Löhne und Preise in Byzanz. *Byzantinische Zeitschrift* 32: 293-333.
- Özmucur, Süleyman and Sevkett Pamuk. 2002. Real Wages and Standards of Living in the Ottoman Empire, 1489-1914. *Journal of Economic History* 62: 293-321.
- Peng, Xinwei. 1994. *A Monetary History of China*. Bellingham: Western Washington University.
- Petermandl, Werner. 1997. Kinderarbeit im Italien der Prinzipatszeit: ein Beitrag zur Sozialgeschichte des Kindes. *Laverna* 8: 113-36.
- Powell, Marvin A. ed. 1987. *Labor in the Ancient Near East*. New Haven: American Oriental Society.
- Powell, Marvin A. 1987/90. Maße und Gewichte. In *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*. Volume 7, ed. Dietz O. Edzard. Berlin and New York: De Gruyter: 457-517.
- Powell, Marvin A. 1990. Identification and interpretation of long term price fluctuations in Babylonia: more on the history of money in Mesopotamia. *Altorientalische Forschungen* 17: 76-99.
- Radner, Karen. 2007. Hired labour in the Neo-Assyrian empire. *State Archives of Assyria Bulletin* 16: 185-226.
- Rathbone, Dominic W. 1996. Monetisation, not Price-Inflation, in Third-Century A.D. Egypt? In *Coin Finds and Coin Use in the Roman World*, ed. C. E. King and D. G. Wigg. Berlin: Mann Verlag, Berlin: 321-39.
- . 1997. Prices and Price Formation in Roman Egypt. In *Prix et formation des prix dans les économies antiques*, ed. Jean Andraeu, Pierre Briant, and Raymond Descat. St-Bertrand-de-Comminges: Musée Archéologique Départemental: 183-244.
- . 2009. Living Standards and the Economy of the Roman Empire (I-III c. AD). In *Quantifying the Roman Economy*, ed. Alan Bowman and Andrew Wilson. Oxford: Oxford University Press.

- Reger, Gary. 1994. *Regionalism and Change in the Economy of Independent Delos, 314-167 B.C.* Berkeley: University of California Press.
- . 1997. The Price Histories of Some Imported Goods on Independent Delos. In *Prix et formation des prix dans les économies antiques*, ed. Jean Andraeu, Pierre Briant, and Raymond Descat. St-Bertrand-de-Comminges: Musée Archéologique Départemental: 53-72.
- Richardson, Seth. 2002. The collapse of a complex state: a reappraisal of the end of the first dynasty of Babylon, 1683-1597 B.C. Unpublished Ph.D. thesis Columbia University.
- Rickman, Geoffrey. 1980. *The Corn Supply of Ancient Rome*. Oxford: Oxford University Press.
- Rosen, William. 2007. *Justinian's Flea: Plague, Empire, and the Birth of Europe*. New York: Viking.
- Sarris, Peter. 2006. *Economy and Society in the Age of Justinian*. Cambridge: Cambridge University Press.
- Scheidel, Walter. 1995/96. The Most Silent Women of Greece and Rome: Rural Labour and Women's Life in the Ancient World. *Greece and Rome* 42: 202-17, and 43: 1-10.
- . 2002. A Model of Demographic and Economic Change in Roman Egypt after the Antonine Plague. *Journal of Roman Archaeology* 15: 97-114.
- . 2005. Real Slave Prices and the Relative Cost of Slave Labor in the Greco-Roman World. *Ancient Society* 35: 1-17.
- . 2007. A Model of Real Income Growth in Roman Italy. *Historia* 56: 322-46.
- Shatzmiller, Maya. 1994. *Labor in the Medieval Islamic World*. Leiden: Brill.
- Sperber, Daniel. 1991. *Roman Palestine 200-400: Money and Prices*. 2nd ed. Ramat-Gan: Bar-Ilan University Press.
- Stathakapoulos, Dionysios C. 2004. *Famine and Pestilence in the Late Roman and Early Byzantine Empire: A Systematic Survey of Subsistence Crises and Epidemics*. Aldershot and Burlington: Ashgate.
- Stol, Marten. 1993/97. Miete. B. In *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*. Volume 8, ed. Dietz O. Edzard. Berlin and New York: De Gruyter: 162-74.
- Tarn, William W. 1923. *The Hellenistic Age: Aspects of Hellenistic Civilization*. Cambridge: Cambridge University Press.
- Temin, Peter. 2006. Estimating GDP in the Early Roman Empire. In *Innovazione tecnica e progresso economico nel mondo romano*, ed. Elio Lo Cascio. Bari: Edipuglia: 31-54.
- Treadgold, Warren. 2002. The Struggle for Survival (641-780). In *The Oxford History of Byzantium*, Oxford University Press, ed. Cyril Mango. Oxford: Oxford University Press: 129-50.
- Van der Spek, Robartus J. n.d. Commodity Prices in Babylon, 385-61 BC. www.iisg.nl/hpw/babylon.php.
- Van Zanden, Jan Luiten. 1999. Wages and the Standards of Living in Europe, 1500-1800. *European Review of Economic History* 3: 175-98.
- Wang, Helen. 2004. *Money on the Silk Road: The Evidence from Eastern Central Asia to c.AD 800*. London: British Museum Press.
- Worp, Klaas A. 1994. Abermals zum Weizenpreis im arabischen Ägypten. *Tyche* 9: 225.
- Zaccagnini, Carlo. 1988. On Prices in Nuzi. *Altorientalische Forschungen* 15: 45-52.
- . 1997. Prices and Price Formation in the Ancient Near East: A Methodological Approach. In *Prix et formation des prix dans les économies antiques*, ed. Jean Andraeu, Pierre Briant, and Raymond Descat. St-Bertrand-de-Comminges: Musée Archéologique Départemental: 361-84.