THE STANDARD OF LIVING IN ANCIENT SOCIETIES: A COMPARISON BETWEEN THE HAN EMPIRE, THE EASTERN ROMAN EMPIRE AND BABYLONIA[1]

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Abstract

In recent years, interest in the welfare levels of ancient economies has increased considerably, partly in a quest to find the origins of present-day income differences. A popular method for calculating income differences is the use of subsistence ratios that indicate whether the wage of an unskilled male labourer is sufficient to purchase enough products and services to maintain his family. In this paper, we present new estimates for the southeastern part of Han China and modify existing estimates for the eastern half of the Roman Empire (Egypt and Syria) and Babylonia to make them comparable. We find that the agricultural regions of Egypt and Babylonia experienced substantially lower subsistence ratios than Syria and southeastern Han China. We find that the main reason for the difference was that unskilled male workers belonged to the higher income brackets in southeastern Han China and Syria. This finding can be explained by the small group of free wage workers in these societies, combined with excess demand for this type of labour in the Eastern Roman Empire and southeastern Han China.

Keywords: Welfare, ancient economies, standard of living, income distribution, economic growth, China

[1] An earlier version of this paper was written with Reinhard Pirngruber. His part was subsequently published as "Reinhard Pirngruber, 'The value of silver: wages as guides to the standard of living in 1st millennium BC Babylonia', in Kristin Kleber and Reinhard Pirngruber, eds., *Silver, money and credit. A tribute to Robartus J. van der Spek on the occasion of his 65th birthday on 18th September 2014* (PIHANS 128), Leiden: NINO, 2016". Since it is already published, we refer to this work in this paper as secondary literature.

Welfare in ancient economies is rapidly becoming a field of heated scholarly debate, partly driven by the continuing incentive to trace present day income differences back to their historical roots. Whereas one influential branch of the literature initially located these origins in the Industrial Revolution, followed by another one focussing on the Early Modern and Medieval periods,[2] over the past decade a third one has extended this debate to ancient economies.[3] Indeed, studying income differences in antiquity tells us not only that income differences are persistent over time, but that they are crucial in explaining the global trade patterns and investment possibilities considered to be paramount in shaping economic development in later centuries.

Most studies based on per capita gross domestic product (GDP) seem to agree that its value was lowest in the agricultural regions of Babylonia and Egypt.[4] Yet debates on the income levels of the other major empires continue, with various authors claiming that (parts of) the Roman Empire were richer than Han China,[5] and others claiming that China was at the economic forefront.[6] Nevertheless, these conclusions remain vague for various reasons. First, per capita GDP, representing the average income in society, can be highly skewed in terms of income distribution if a few rich people earn very large incomes. In such a society, the mean income tells us little about the earnings of the majority of the population. Second, GDP generally refers to marketed products, thus ignoring

[2] See, e.g., Jan de Vries and Ad van der Woude, *The first modern economy: success*, *failure, and perseverance of the Dutch economy, 1500–1850*, Cambridge: Cambridge University Press, 1997; Jan Luiten van Zanden, 'The 'revolt of the early modernists' and the 'first modern economy': an assessment', *Economic History Review*, 55, 4, 2002, pp. 619–41; Stephen Broadberry et al., *British economic growth, 1270–1870*, Cambridge: Cambridge University Press, 2015.

[3] See, in particular, Takeshi Amemiya, *Economy and economics of Ancient Greece*, London and New York: Routledge, 2007; Walter Scheidel and Steven Friesen, 'The size of the economy and the distribution of income in the Roman Empire,' *Journal of Roman Studies*, 99, 2009, pp. 61–91; Elio Lo Cascio and Paolo Malanima, 'GDP in pre-modern agrarian economies (1–1820 AD). A revision of the estimates', *Rivista di Storia Economica* 25, 3, 2009, pp. 387–415; Peter Foldvari and Bas van Leeuwen, 'Comparing per capita income in the Hellenistic world: the case of Mesopotamia', *Review of Income and Wealth*, 58, 3, 2012, pp. 550–68.

[4] Foldvari and Van Leeuwen, 'Comparing per capita income in the Hellenistic world'.

[5] See, e.g., Angus Maddison, *Contours of the world economy, 1–2030 AD. Essays in macro-economic history*, Oxford: Oxford University Press, 2007; Peter Temin, *The Roman market economy*, Princeton: Princeton University Press, 2012; Ian Morris, *The measure of civilization: how social development decides the fate of nations*, Princeton: Princeton University Press, 2013.

[6] See, e.g., Josef Needham, *Science and civilization in China,* vol. 1, Cambridge: Cambridge University Press, 1954. For a similar argument covering the period from the fifth to the eighteenth century AD, see Morris, *The measure of civilization.*

home production, which made up the largest share of the economy in antiquity. Finally, GDP uses current purchasing power parity (PPP) to compare incomes across countries, and projects it retroactively using some price index. As recent research has shown, such an approach may lead to a bias even when going back just a few decades, let alone to antiquity.[7]

For these reasons, the so-called *subsistence ratio* has become popular within the field of economic history. In this method, the cost of acquiring a basket of vital goods for one household – other foodstuffs in addition to grain, as well as clothing and housing – is compared to the income of an unskilled male labourer. The wage is divided by the price of this basket of goods to obtain the subsistence ratio; i.e., the proportion of an unskilled male labourer's wage that he needs to purchase enough food and services to maintain his household. When the ratio is 1, the labourer can purchase just enough food and services to maintain his family, whereas a higher ratio represents a surplus and a lower ratio implies a deficit.

This subsistence ratio has been widely applied in studies of medieval and early modern periods around the world but, with some exceptions, has yet to find its way into ancient history.[8] This is partly due to the denial by historians of the ancient world of the existence of a labour market, an argument that renders wage data unreliable. This view, starting with the work of Karl Polanyi and later popularized by Moses Finley in the field of ancient history, has been dominant over the past half

[7] See, e.g., Nuno Palma and Jaime Reis, 'From convergence to divergence: Portuguese demography and economic growth, 1500-1850,' https://ssrn.com/abstract=2839971 or http://dx.doi.org/10.2139/ssrn.2839971 (consulted 13 September 2016).

[8] Robert Allen, 'The great divergence in European wages and prices from the Middle Ages to the First World War,' *Explorations in Economic History,* 38, 2001, pp. 411–47; Jan Luiten van Zanden, 'Wages and the standards of living in Europe, 1500–1800,' *European Review of Economic History*, 3, 1999, pp. 175–98. For studies on ancient societies, see Walter Scheidel, 'Real wages in early economies: evidence for living standards from 1800 BCE to 1300 CE,' *Journal of the Economic and Social History of the Orient*, 53, 2010, pp. 425–62; Robert Allen, 'How prosperous were the Romans? Evidence from Diocletian's price edict (AD 301)', in Allan Bowman and Andrew Wilson, eds., *Quantifying the Roman economy*, Oxford: Oxford University Press, 2009, pp. 327–45; Reinhard Pirngruber, 'The value of silver: wages as guides to the standard of living in 1st millennium BC Babylonia', in Kristin Kleber and Reinhard Pirngruber, eds., *Silver, money and credit. A tribute to Robartus J. van der Spek on the occasion of his 65th birthday on 18th September 2014* (PIHANS 128), Leiden: NINO, 2016, pp. 107–18.

century.[9] For example, motivated by the Finleyan idea of traditional societies, Keith Hopkins claimed that ancient Rome was a slave society without a labour market.[10] However, this theory has been rejected by various authors who increasingly find signs that labour markets, which included a substantial share of free hired labour, did indeed exist.[11] If Roman society can be regarded as having had at least a partly free labour market, this arguably applies even more to contemporaneous empires where the proportion of slaves was even lower. As Scheidel noted, whereas the percentage of slaves in the Roman Empire might have been close to 10%, in Han China this number amounted to ca. 5%.[12] Likewise, Bagnall and Frier estimated a maximum of 10% for Egypt, while Jursa concluded that the percentage of slaves in Babylonia must have been "small".[13]

Since four important regions in antiquity (the Eastern Roman Empire [Egypt and Syria], Babylonia and Han China) had, at least in part, a working labour market, it is relevant to use the subsistence ratio to elaborate on the literature on income differentials by comparing unskilled male labourers' wages across these regions. Indeed, this method has several advantages besides remedying the above-mentioned disadvantages of using GDP. First, the subsistence ratio compares the income of an unskilled male worker, which is argued to have been roughly identical in terms of technology and skill content across regions before the nineteenth century. Second, the ratio makes it possible to directly compare the absolute values of incomes across regions using comparable baskets of goods and services.[14]

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[9] Karl Polanyi, *The great transformation,* New York: Academic Press, 1944; Moses Finley, *The ancient economy,* Berkeley: University of California Press, 1999 (first published 1973).
[10] Keith Hopkins, *Conquerors and slaves*.
[11] See, e.g., Peter Temin, 'The labor market of the early Roman empire,' *Journal of Interdisciplinary History*, 44, 2004, pp. 513–38.
[12] Walter Scheidel, 'Slavery and forced labor in early China and the Roman world,' *Princeton/Stanford Working Papers in Classics,* April 2013.
[13] R. Bagnall and B. Frier, *The demography of Roman Egypt*, Cambridge: Cambridge University Press, 1994; Michael Jursa, *Aspects of the economic history of Babylonia in the first millennium BC: economic geography, economic mentalities, agriculture, the use of money and the problem of economic growth* (with contributions by J. Hackl, B. Janković, K. Kleber, E.E. Payne, C. Waerzeggers and M. Weszeli), Münster: Ugarit Verlag, 2010, pp. 232.
[14] It is an implicit measure of purchasing power parity.

The remainder of the paper is structured as follows. In the following section, we review the literature on the subsistence ratios for an adult male unskilled labourer in the Eastern Roman Empire (Syria and Egypt) and Babylonia, and provide corrections to the estimates to make them comparable across regions. In the second section, we deal with new data on the southeastern part of Han China ca. 100 BCE. Because some people might have lived above a bare subsistence level and thus might also have purchased more expensive products and services, in the fourth section we follow the literature in expanding the subsistence ratio to include such products, resulting in an estimate of the so-called respectability ratio. Defined as a subsistence basket with the addition of more costly products, the respectability ratio is important because it not only tells us something about the consumption pattern of those above a bare subsistence level (the foodstuffs of more affluent classes might be relatively more expensive than subsistence foods), but also suggests that there was sufficient room for alternative expenses such as children's education, employing teachers or hiring labour.[15] It also improves the price basket, thus generating more accurate comparisons of incomes across regions for labourers living above the bare subsistence level. In the fifth section, we compare our estimates and find higher subsistence ratios in southeastern Han China and Syria. We also find that the income position of unskilled male labourers in the income distributions of these regions is higher. In other words, average incomes diverged less than those of unskilled male labourers. Because the skill content of the latter was roughly similar, this finding implies that there was a local excess demand for unskilled labour in southeastern Han China and Syria.

The subsistence ratio in the Eastern Roman Empire (Syria and Egypt) and Babylonia

As pointed out in the introduction, several studies have already dealt with the subsistence ratio for the Eastern Roman Empire (Syria and Egypt) and Babylonia. However, the way that they are

[15] Miriam Groen-Vallinga and Laurens Tacoma, 'The value of labour: Diocletian's price edict', in Olivier Hekster, ed., *Impact of empire: Roman Empire, c. 200 B.C. – A.D. 476,* Leiden: Brill, 2016, pp. 104–32, 121.

constructed renders comparison difficult, if not impossible. Hence, in this section we re-calculate the subsistence ratio for these three regions by applying modifications of earlier approaches. Before turning to the details of the estimates in these three regions, we need to address several general issues regarding the calculation of the subsistence ratio.

First, it is necessary to obtain the annual wage of an adult male unskilled labourer, although most wages are given per day or month. Hence, in the literature it has become standard practice to assume 250 working days per year, and we follow the same approach. Second, it is important to calculate how many goods and services should be considered as basic. Most studies to date have constructed a basket of goods for one adult person that amounts to about 1,940 kilocalories (kilo [=1000] calories) and ca. 60–70 grams of protein per day.[16] However, following the suggestion of Robert Allen, in this paper we construct a basket that is equivalent to roughly 2,100 kcalories, in line with the World Bank Poverty Line and the USDA food security line.[17] Third, to calculate the amount spent per household, we need to multiply the per capita basket by the number of household members. Rather than assuming the conventional three adult equivalents per household (i.e., a man, a woman and two children), we again follow Allen in assuming four adult equivalents per household to allow for more children and other household members (such as elderly grandparents), which better reflects the historical evidence.

A final general issue concerning this method is that it ignores income from other household members (e.g., wife and children). This may be important because it is possible that other family members were more active in earning a wage in some regions than in others. Hence, calculations based simply on male incomes might obscure a global comparison of well-being. In the literature, the solution has been to simply ignore this problem, as few observations of female and children's

[16] Amongst others: Robert Allen, R.C., Jean Pascal Bassino, Debin Ma, Christine Moll-Murata, and Jan Luiten van Zanden, 'Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India,' *Economic History Review*, 64, 2011**,** pp. 8–38.
[17] Robert Allen, 'Poverty lines in history, theory, and current international practice,' *Oxford, Department of Economics Discussion Paper Series,* No. 685, Oxford, 2013.

incomes exist. However, some data are available. According to ration lists from Babylonia from the fifth century BCE, female temple dependents earned rations of 45 litres of barley a month compared with 65 litres for men (i.e., 75% of a man's income).[18] Even though not all women would have earned a wage, this implies a significant contribution to the subsistence ratio of the household. Something similar might also apply to Han China. Indeed, Allen claims that women's work could have contributed significantly to the household budget in China, a point also made by both Li and Pomeranz. [19] We do not, unfortunately, have many observations on female wages during the Han dynasty. The only data point available for the Han period indicate that a female maid earned ca. 300 *wuzhuqian* (a coin of 0.125 grams of silver) per month,[20] suggesting an income of about 60% of the wage of a male labourer. Likewise, Yin estimated that in the Han Dynasty, a female weaver could earn about 70% of a male wage.[21] These figures show that even though other family members must have made a substantial contribution to household incomes, the contribution as a proportion of a male wage was roughly identical across regions. Because omitting these data will not bias a cross-regional comparison, we follow the standard in the literature and consider only male subsistence ratios.[22]

With the above considerations in mind, we can now turn to the estimates of the male subsistence ratios for ancient societies available from secondary sources. The data for Babylonia are

[18] Joannes Hackl and Reinhard Pirngruber, 'Prices and related data from Northern Babylonia in the late Achaemenid and early Hellenistic periods, ca. 480–300 BC), in Robartus van der Spek, Bas van Leeuwen and Jan Luiten van Zanden, eds., *A history of market performance from Ancient Babylonia to the modern world*, London and New York: Routledge, 2014, pp. 107–27. See also Francis Joannès, 'Place et role des femmes dans le personnel des grands organismes néo-babyloniens', in Pierre Briant *et al*., eds., *L'archive des fortifications de Persépolis. État des questions et perspectives de recherches,* Persika 12, Paris, 2008, pp. 465–80, on female labour.

[19] Allen, 'How prosperous were the Romans?'; Bozhong Li, *Agricultural Development in Jiangnan, 1620–1850,* Basingstoke: Houndmills, 1998, pp. 150–55; Kenneth Pomeranz, *The great divergence: China, Europe, and the making of the Modern World*, Princeton: Princeton University Press, 2000, pp. 319–20.

[20] L. Wen, *Qinhan Dynasty Price Research* (History Culture and Tourist Department, Jiangxi Normal University, 2002). (Wēn Lèpíng, qínhàn wùjià yánjiū, jiāngxi shīfàn dàxué lìshǐ wénhuà yǔ lǚyóu xuéyuàn 2002 nián 5 yuè).

[21] J. Yin, *A Study on peasantry's life in Dong-han Dynasty,* History and Culture Department, Guangxi Normal University, 2006. (Dōnghàn xiǎonóng shēnghuó zhuàngkuàng yánjiū, lìshǐ wénhuà yǔ lǚyóu xuéyuàn, guǎngxi shīfàn dàxué, yǐnjiànqiáng 2006 nián 4 yuè April, 2006).

[22] See, for example, Allen, 'The great divergence'; Allen, 'How prosperous were the Romans.'

the most straightforward and can be obtained directly from Reinhard Pirngruber's research.[23] Based on sparse wage and more abundant price data, he arrives at a subsistence ratio of 0.71 for the sixth century BCE and, by extrapolation, 0.9 for around 140 BCE and 0.51 around 110 BCE (see Table 1).

Table 1. *Bare bones basket in sixth century BCE Babylonia*

	Quantity per person per year	Grams of silver per unit	Spending share	Nutrients/day	Protein/day
Barley	191 l	0.12	29.81%	1,117	32
Dates	112.5 l	0.06	8.45%	705	6
Sesame	21.6 l	0.62	17.80%	240	17
Meat	5 kg	1.87	12.46%	30	9
Cress	12 l	0.25	4.00%		
Cotton (wool)	5 minas	2.33	15.57%		
Fuel	2MBTU*	2.74	6.90%		
House Rent		7.94	5.00%		
Total		74.88	100%	2,092	64
Unskilled monthly wage (grams of silver)		17.8			
Subsistence ratio		**0.71**			

Source: Pirngruber, 'The value of silver'.
* MBTU= 1000 British thermal units (BTU, equal to ca. 1055 joule).

Data for the Roman Empire is derived mainly from Allen's study, which was based on Diocletian's price edict from ca. 300 CE.[24] However, we need to state three caveats. First, as Meißner pointed out,

[23] Pirngruber, 'The value of silver'.
[24] Allen, 'How prosperous were the Romans?'

rather than focussing on the Roman Empire as a whole, the Diocletian edict seems to have been directed primarily at the eastern half of the empire, meaning modern day Syria, during a time of economic expansion triggered by increased demand.[25] In the following discussion, therefore, we refer to Syria rather than regarding these findings as representative of the 'Roman Empire'. Second, as stated above, we raise the consumption level of the staple grain to almost 2,100 kcalories per capita for a family consisting of four adult equivalents. This entails an increase in the staple crop (wheat) from 172 to 190 kg (see Table 2). Third, we adapt the data on prices and incomes for the Roman Empire, discussed by Allen on the basis of Diocletian's edict on maximum prices. We stress, however, that due consideration was given to Scheidel's criticism that Allen overestimated the wages for the edict because the food rations were probably smaller. Furthermore, figures based on such rations should be divided by 365 days instead of 250 because people need to eat every day; consequently, the earlier subsistence ratio was overestimated by a third.[26] Again, it is worth noting that the edict aimed to establish a price ceiling; hence, it has been argued that commodity prices (and services) may have actually been significantly higher than stipulated and the edict was intended to bring them down (and wages may have been significantly lower than stipulated with the edict aiming to provide an increase). There is, however, evidence that the prices of the edict provide a fairly accurate reflection of reality, at least in the short and medium term.[27] Nevertheless, in Table 2 we also include a minimum and maximum estimate for the subsistence ratios under the assumption that actual prices were 10% higher and actual wages 10% lower. Whereas the value of 0.78 follows directly from our estimates, 0.65 is a minimum value under the assumption that wages were 10% lower and prices 10% higher than stipulated.

[25] Burkhard Meißner, 'Über Zweck und Anlaß von Dioklatians Preisedikt,' *Historia*, 49, 2000, pp. 79–100, esp. 88–90.
[26] Allen, 'How prosperous were the Romans?'; Scheidel, 'Real wages in early economies', p. 432, footnote 15. The basic idea is that whereas people may work only 250 days a year, they have to eat every day.
[27] For about 10 years, wheat prices in Egypt seem to have moved within the limits decreed by Diocletian's edict, before inflation on a large scale set in, see Meißner, 'Über Zweck und Anlaß,' 99f (for a less optimistic assessment of the edict, see the literature in footnote 4 on page 80 of this article).

Table 2. *Bare bones basket in Roman Egypt 100 CE and 230 CE, and according to the edict of Diocletian, ca. 300 CE*

		Egypt, ca. 100 CE		Egypt, ca. 230 CE		Syria, ca. 300 CE			
	Quantity per person per year	Grams of silver per unit	Spending share	Grams of silver per unit	Spending share	Grams of silver per unit	Spending share	Nutrients/day	Protein/day
Wheat	190 kg	0.20	37.8%	0.22	35.8%	0.39	61.6%	1,775	55
Beans/peas	20 kg	0.19	3.7%	0.51	8.7%	0.41	6.8%	187	14
Meat	5 kg	1.51	7.4%	1.47	6.2%	1.29	5.4%	34	3
Olive oil	5 l	2.74	13.4%	2.83	12.0%	1.16	4.8%	112	0
Soap	1.3 kg	2.72	3.5%	3.85	4.2%	1.16	1.3%		
Cotton/ linen	3 m	5.13	15.1%	5.61	14.3%	4.03	10.1%		
Candles	1.3 kg	2.72	3.5%	3.85	4.2%	1.16	1.3%		
Lamp oil	1.3 l	2.72	3.5%	2.82	3.1%	1.16	1.3%		
Fuel	2MBTU*	3.72	7.3%	3.85	6.5%	1.59	2.6%		
House rent		5.11	5.0%	5.90	5.0%	6.02	5.0%		
Total		**102.14**	**100%**	**118.07**	**100%**	**120.31**	**100%**	**2,108**	**72**
Unskilled monthly wage (grams of silver)		**18.46**		**22.13**		**31.43**			
Subsistence ratio		**0.55**		**0.56**		**0.65–0.78**			

Sources: Allen, 'How prosperous were the Romans?'; Scheidel, 'Real wages in early economies', Pirngruber, 'The Value of Silver.' Modifications as described in the text.

*MBTU=A measure of energy that is 1,000 BTU (equal to ca. 1,055 joules).

For Roman Egypt, we use the work of Scheidel as a basis,[28] but with two modifications. First, as for the Roman Empire, we increase wheat consumption to 190 kg per annum to reach 2,100 kcalories. Second, our price data are expressed in grams of silver. Because we witness a doubling of prices in Egypt between ca. 100 and 230 CE, this adjustment makes it difficult to convert the data for 230 CE into grams of silver (even though this obviously does not affect the subsistence ratio).[29] To

[28] Scheidel, 'Real wages in early economies'.
[29] Ibid, pp. 430.

convert into silver, we follow Harl, who shows that the number of grams of silver per drachma declined from 0.55 in 100 CE to 0.40 grams ca. 230 CE.[30]

The subsistence ratio in southeastern Han China

Thus far, we have focussed on modifying existing estimates. However, we still lack the subsistence ratio for the fourth major empire, namely Han China. In choosing the contents of the subsistence basket for Han China, we focus on the Western Han Empire (206 BCE–9 CE) because the years around 100 BCE provide us with the most abundant and best quality price data. Although commonly called 'Western Han', this empire was located in southeast and central China, and we have therefore tried to obtain estimates that are representative for the southeastern region of this empire.

To construct our basket of products and services, we use the weights of the basket for Canton (present day Guangzhou) in southeastern China in 1757, proposed by Allen et al.[31] It is important to stress that the Canton basket assumed that rice was the main staple, while consumption patterns of that region were perhaps different during Han times. However, based on archaeological evidence, Huang[32] showed that during the Han dynasty there was a clear division in which people in the northern provinces ate mainly millet, sometimes with wheat and barley added,[33] while rice was the predominant crop in the southeast, as it was in 1757. Hence, rice is added to our basket as the preferred staple grain for the southeastern regions of Han China.

[30] Kenneth Harl, *Coinage in the Roman economy, 300 B.C. to A.D. 700,* Baltimore and London: Johns Hopkins University Press, 1996, pp. 98.
[31] Allen et al., 'Wages, prices, and living standards'.
[32] Z. Huang, 'Han People diet,' *Agriculture Archaeology* 1, 1982, pp. 77–9. (Zhōngguó shèhuì kēxuéyuàn kǎogǔ yánjiū suǒ, hàndài rén de yǐnshí shēnghuó, Nóngyè kǎogǔ, 1982 nián 01 qī Term 1)
[33] See also X. Wei, 'Exploration of Han dynasty Hexi (Shaan'xi) region food consumption,' *Agricultural Archaeology*, Sino-French College of Guangzhou University, 2010. (Wèixiǎomíng, hàndài héxī dìqū de yǐnshí xiāofèi chūtàn, nóngyè kǎogǔ 2010 nián 04 qī, guǎngzhōu dàxué zhōng fǎ lǚyóu xuéyuàn).

The relatively scarce price data available for the basket are nicely presented in three separate studies. The first source is Leping Wen,[34] who systematically collected price and wage data from a wide range of secondary works that cited material derived from sources ranging from contemporary texts to graveyards and wooden slips (*Hanjian*). Bamboo wood slips were found in great numbers in Juyan, a fortress at the Great Wall (Gansu province, in central China) and covered the period 102 BCE–30 CE. These slips were mainly administrative and financial records left behind by officials and troops. The second work, by Helen Wang, presents the Juyan data in a more comprehensive fashion.[35] The final pertinent study is by Ding,[36] who, like Wen, attempted to provide an overview of the sources of prices in the Han Dynasty.

Undeniably, most of the data for the ca. 100 BCE period were derived from the Juyan wood-slips, with only a relatively small proportion derived from other sources. This immediately begs the question of what sort of prices were recorded in the official documentation in one of the border provinces. Given that this source contains the prices of a wide variety of products, mainly consumables, and that we sometimes find references to trade conflicts, it seems plausible that these prices were indeed retail prices. This impression can be corroborated by comparing the prices in Dunhuang (Gansu), published by Wen,[37] with those of the wood-slips from Juyan located in the same province. Both datasets give comparable prices for rice, millet and chicken, providing evidence that the Juyan data were indeed actual market prices.

With this in mind, we can move towards the construction of a subsistence basket. The price of rice, the most important product in our consumption basket, shows some fluctuations, but on average the cost was lower in the rice producing southern provinces (roughly five *wuzhuqian* per litre

[34] Wen, *Qinhan Dynasty Price Research*.
[35] Helen Wang, *Money on the Silk Road: The evidence from Eastern Central Asia to c. AD 800* (London, 2004).
[36] B. Ding, *New explorations of Han Dynasty prices,* Beijing, 2009. (Dīngbāngyou, hàndài wùjià xīn tàn, zhōngguó shèhuì kēxué chūbǎn shè 2009 nián 6 yuè June, 2009).
[37] Wen, *Qinhan Dynasty Price Research.*

in the south versus ten in the northern provinces).[38] This estimate can be confirmed using the *Shih-chi* (historical record) of China compiled by Ssu-ma T'an (early second century BCE) and his son Ssu-ma Ch'ien (ca. 145–ca. 86 BCE), which discusses the history and economy of China from its beginning as a recognizable state until about 100 BCE. It contains a price list for the period around 100 BCE, which compares the quantity of various goods that can be purchased for 200,000 *wuzhuqian*.[39] As argued by Sadao, one may conjecture from this price list that the average price of a litre of grain around this time was five *wuzhuqian*, which matches nicely with the five *wuzhuqian* per litre from other sources. As a litre of rice equals about 0.89 kg, this translates to 5.6 *wuzhuqian* per kg.[40]

In one sense, obtaining price data for products other than rice is simpler because there is less information and there does not seem to have been the same distinct regional variation. Beans were priced at 2 *wuzhuqian* per litre[41], or 2.7 *wuzhuqian* per kg. For meat we use a price of 26.4 *wuzhuqian* per kg. Innards were even less expensive; for example, 1 kg of tripe cost 12 *wuzhuqian*.[42] However, a significant lack of data (as in the case of cooking oils) renders assessment much more difficult. Hence, we focus on animal fat instead, which was also commonly used for cooking purposes, with a price of around 40 *wuzhuqian* per kg, or 36 *wuzhuqian* per litre.[43] We have no direct information for soap; however here we can again use animal lard as a proxy, with a value of 40 *wuzhuqian* per kg.

Textiles are rather more controversial because there are many different refinements, ranging from rough hemp to refined silk. Obviously, as Wen argues, income levels created differences; for

[38] Ibid.
[39] For the source publication see Nancy Swann, *Food & money in ancient China: the earliest economic history of China to AD 25. Han Shu 24 with related texts, Han Shu 91 and Shih-Chi 129*, Princeton: Princeton University Press, 1950, pp. 434–36.
[40] Nishijima Sadao, 'The economic and social history of Former Han', in Denis Twitchett and John Fairbank, eds., *The Cambridge History of China: The Ch'in and Han Empires, 221 BC–AD 220,* Cambridge: Cambridge University Press, 1987, pp. 545–607, 590.
[41] Wang, *Money on the Silk Road.*
[42] Ibid, p. 62.
[43] Wen, *Qinhan Dynasty price research.*

instance, even though ordinary people were allowed to wear silk, not many could actually afford it. [44] The most common material for clothing among the less affluent strata of society was hemp. Cloth cost about 43.4 *wuzhuqian* per metre,[45] which also matches nicely with the 54 *wuzhuqian* per metre commonly found in the Juyan data from Wang.[46] Yet there remains a question regarding the quality that this cloth represented. Fortunately, the *Shih-chi* also provides us with evidence on this point. It shows that a metre of rough cloth cost about the same as six litres of rice, about 30 *wuzhuqian*. This suggests that the estimate of 43.4 probably refers to average quality clothing at best.

No direct observations can be reported for candles and lamp oil. However, following the literature on subsistence baskets, animal fat may be a fair approximation for both products,[47] with a value of 40 *wuzhuqian* per kg, or 36 *wuzhuqian* per litre. As regards fuel, the price of wood was quite expensive; the price of 23.5 *wuzhuqian* per chi (a measure of length of 23.1 cm) is equivalent to at least 2 to 3 litres of rice. High as this seems, the ca. 2,000 *wuzhuqian* for a wooden coffin suggests that even after subtracting labour costs, wood was indeed quite expensive.[48] The most common source of fuel was thus simply straw from the fields,[49] which was considerably cheaper at 8.5 *wuzhuqian* per su bundle (approximately 15 kg), or roughly 0.57 per kg. One kg of rice straw provides about 14,350 BTU (ca. 1055 joules)[50], which means a price of 39.7 *wuzhuqian* per MBTU (1000 BTU).

[44] L. Wen, *On the study of social consumption in Qin and Han Dynasties* (Doctoral Dissertation, Institute of History & Culture, Central China Normal University 2005). (Wēn lèpíng (2005), qínhàn shèhuì xiāofèi wèntí yánjiū, huánán shīfàn dàxué bóshì xuéwèi lùnwén).
[45] Wen, *Qinhan Dynasty price research.*
[46] Wang, *Money on the Silk Road*, p. 60.
[47] Allen et al., 'Wages, prices, and living standards'.
[48] Wen, *Qinhan Dynasty Price Research;* Wang, *Money on the Silk Road.*
[49] Pomeranz, *The great divergence*, pp. 232.
[50] http://www.calrecycle.ca.gov/Organics/Conversion/AgForestRpt/agriculture/Products5.htm energy content of a pound of dry rice straw is about 6,500 BTU (1 BTU equals ca. 1055 joules).

Table 3. *Subsistence basket in the Han dynasty, 100 BCE, in Southern China*

Product	Quantity per person per year	Grams of silver per unit	Spending share	Calories	Grams of protein
Rice	187.4 kg	0.70	60.5%	1,838	52
Beans/peas	20 kg	0.34	3.1%	187	14
Meat	3 kg	3.30	4.6%	8	2
Cooking oil	3 l	4.50	6.2%	67	0
Soap	1.3 kg	5.00	3.0%		
Cotton/cloth	3 m	5.43	5.0%		
Candles	1.3 kg	5.00	3.0%		
Lamp oil	1.3 l	4.50	2.7%		
Fuel	3MBTU*	4.96	6.9%		
Rent			5.0%		
Total			**100%**	**2,100**	**68**
Unskilled monthly wage		**62.50**			
Subsistence ratio		**0.87**			

Note: Weights basket from Allen et al. (2011, Table 3), with rice adapted to match 2,100 kcalories; for the remainder, see the text.

*1,000 British thermal units (BTU, ca. 1055 joules).

All prices, converted into grams of silver using a ratio of 0.125 grams per *wuzhuqian,*[51] are reported in Table 3. However, to arrive at the subsistence ratio, we still need to add the wage of an unskilled male labourer. We assume a wage of 62.5 grams of silver for Han dynasty China around 100 BCE, which was equal to about 500 *wuzhuqian* per month, about the same as a soldier's wage.[52] One might argue that a soldier's wage is not representative of that of a labourer. Nonetheless, Sun[53] provides evidence that a soldier's wage can be taken as representative by showing that the daily

[51] Wen, *Qinhan Dynasty price research.*
[52] Wen, *Qinhan Dynasty price research.*
[53] G. Sun, *Study of Han Dynasty employees.* (Shanhai Normal University, Humanities and Media Department, 2010). (Sūngānghuá 2010, hàndài gùyōng láodòng yánjiū, shànghǎi shīfàn dàxué shuòshì xuéwèi lùnwén, rénwén yǔ chuánbò xuéyuàn).

wage of a soldier was about equal to the daily cost of transporting 39.5 kg of salt (not using a wagon) – a task that could be performed by any 'unskilled worker'.

Respectability ratios in antiquity

So far, we have discussed the subsistence ratio, i.e., the cases in which the wage of an unskilled male labourer could sustain a hypothetical family consisting of four adult equivalents. One can assume, however, that richer individuals would have bought greater quantities and higher qualities of goods and services. Therefore, as outlined in the introduction, it is important to add more of these goods and services to the subsistence basket not just to improve the comparison across countries in terms of consumer baskets, but also to assess the possibility of unskilled labourers purchasing more goods and services such as education, which may be crucial for economic and institutional development.

Obviously, for historical periods there is often a lack of more detailed data, especially on services. Hence, in the welfare ratio literature, the so-called 'respectability ratio' is usually calculated, which aims to cover more luxurious goods and services by adding more, and more expensive, basic products. In addition to assuming a greater consumption of cloth, the main differences from the subsistence basket are the inclusion of bread, wine, meat and dairy products.[54] Given the increase in consumption compared with the subsistence basket, these so-called respectability ratios are lower than the subsistence ratios. Because the prices of 'luxury products' may vary strongly among regions, the resulting 'respectability ratios' may also differ.

Although a lack of data prevents propositions for Babylonia, it is possible to obtain data pertaining to the respectability basket for the Eastern Roman Empire (Syria and Egypt) and the southeastern part of Han China. For Egypt and the Roman Empire, the evidence for the extended consumption basket comes from the same sources, with the same modifications, as outlined in the

[54] Robert Allen, 'The Great Divergence in European wages and prices'.

second section. The most important difference is the inclusion of some dairy products and wine, and higher meat consumption.

Table 4. *Respectability basket in Roman Egypt 100 CE and 230 CE, and Syria 300 CE*

		Egypt, ca. 100 CE		Egypt, ca. 230 CE		Syria, ca. 300 CE			
	Quantity per person per year	grams of silver per unit	Spending share	grams of silver per unit	Spending share	Grams of silver per unit	Spending share	Nutrients/day	Protein/day
Bread	182 kg	0.22	19.0%	0.27	20.0%	0.39	31.8%	1,378	56
Beans/peas	52 l	0.05	1.1%	0.20	3.7%	0.41	8.4%	160	10
Cheese	5.2 kg	2.06	4.4%	2.21	4.2%	1.29	2.6%	53	3
Eggs	52 items	0.12	2.6%	0.13	2.4%	0.05	1.1%	11	1
Meat	26 kg	2.06	22.2%	2.21	20.8%	1.29	13.2%	178	14
Oil	5.2 l	2.49	5.4%	2.83	5.3%	1.16	2.4%	104	0
Wine	68.25 l	0.48	13.6%	0.45	11.2%	0.77	20.8%	212	2
Soap	2.6 kg	2.50	2.7%	2.84	2.7%	1.16	1.2%		
Cotton/linen	5 m	5.60	11.6%	6.75	12.2%	4.03	7.9%		
Candles	2.6 kg	2.50	2.7%	2.84	2.7%	1.16	1.2%		
Lamp oil	2.6 l	2.50	2.7%	2.84	2.7%	1.16	1.2%		
Fuel	5 MBTU*	3.42	7.1%	3.88	7.0%	1.59	3.1%		
Rent		12.06	5.0%	13.80	5.0%	12.68	5.0%		
Total		253.30	100%	28,980	100%	266.35	100%	2,096	86
Unskilled monthly wage (grams of silver)		18.46		22.13		31.43			
Respectability ratio		**0.22**		**0.23**		**0.29–0.35**			

Sources: see Table 2 notes.

* 1,000 British thermal units (BTU, equal to ca. 1055 joules).

For the southeastern area of Han China, we calculate the respectability basket by including more luxurious commodities such as wheat flour, fish, and eggs. We also include fish as a replacement for meat in the Chinese respectability basket, as suggested by Allen et al.,[55] because its relative price was much lower in southeastern Han China than in Diocletian's edict, where fish was double to quadruple the price of beef. The price for wheat flour is not directly given for this period, although wheat cost around 4.5 *wuzhuqian* per litre,[56] i.e., 5.8 *wuzhuqian* per kg. Given that in 1900

[55] Allen et al., 'Wages, prices, and living standards'.

[56] Wen, *Qinhan Dynasty price research;* Wang, *Money on the Silk Road.*

CE, the price of 1 kg of wheat flour was around 1.55 times higher than that of wheat,[57] and assuming, *argumenti causa,* a stable ratio over time, we set the price of wheat flour at 8.95 *wuzhuqian* per kg. For fish, we find a price of about 3+ dou, equivalent to more than 6 litres of grain for 30 fish (Wang 2004). This implies a minimum of about 2 *wuzhuqian* per fish, or 4 *wuzhuqian* per kg. Likewise, in another observation we find that 30 fish cost

Table 5. *Respectability basket Han dynasty 100 BCE in southeastern China*

Product	Quantity per person per year	Grams of silver per unit	Spending share	Nutrients/day	Protein/day
Rice	122 kg	0.70	26.0%	1,210	25
Wheat flour	14 kg	1.12	4.8%	130	5
Soy beans	38 kg	0.34	3.9%	433	38
Meat	16 kg	3.30	16.1%	110	9
Fish	7 kg	0.90	1.9%	25	4
Eggs	52 pieces	0.06	0.9%	11	1
Rice wine	41 k	1.25	15.6%	151	1
Edible oil	1 l	4.50	1.4%	24	0
Soap	2.6 kg	5.00	4.0%		
Linen/cotton	5 m	5.43	8.3%		
Candles	2.6 kg	5.00	4.0%		
Lamp oil	2.6 kg	4.50	3.6%		
Fuel	3 MBTU*	4.96	4.5%		
House rent		34.61	5.0%		
Total			**100%**	**2,094**	**83**
Unskilled monthly wage		**62.5**			
Respectability ratio		**0.57**			

*1,000 times a British Thermal Unit (BTU, ca. 1055 joules).

[57] T'ien-p'ei Meng and Sidney Gamble, *Prices, wages and the standard of living in Peking, 1900-1924* (Peking, 1926).

about 100+ *wuzhuqian;*[58] i.e., 6.6 *wuzhuqian* per kg. This means a minimum price of about 0.83 grams of silver per kg, which we round up to 0.9 grammes of silver per kg of fish. This suggests that fish was considerably cheaper than meat, which is still the case in China even today. Unfortunately, we do not have evidence for eggs, and therefore assume that the ratio of eggs to meat was the same as in Canton in 1750. Finally, rice wine is abundantly recorded. According to Wang,[59] the rate of exchange was roughly one litre of wine for two litres of grain, i.e., 10 *wuzhuqian* per litre, a value confirmed by Wen.[60]

The findings regarding the products in the respectability basket yield two conclusions. First, there were no major changes in the relative positions of Syria and Roman Egypt. Accordingly, the relative price differences between subsistence and respectability baskets in both regions of the eastern Roman Empire were roughly stable. Second, even though the respectability ratio for the southeastern regions of the Han Dynasty is significantly higher than those of the Roman areas, it is not disproportionately so, considering the respective subsistence ratios. This suggests that in the ancient societies considered in this paper, the relative prices of the more luxurious products contained in the respectability baskets were similar.

Comparing welfare levels

In the previous sections, we dealt with the evidence regarding the welfare of common labourers in four major regions of the ancient world: southeastern Han China, Babylonia in the sixth and second centuries BCE, Roman Egypt and Syria, from the perspective of the edict of Diocletian. Labourers clearly had the lowest welfare ratios in Roman Egypt around 100 CE and Babylonia in the Parthian period (early first century BCE), at 0.55 and 0.51, respectively. Around 300 CE, labourers in Syria

[58] Wang, *Money on the Silk Road.*
[59] Ibid.
[60] Wen, *Qinhan Dynasty price research.*

seem to have been considerably wealthier, with a subsistence ratio interval of 0.65–0.78 in a period of favourable economic conditions. According to our results, the southeast part of Han China (100 BCE) was the most prosperous region, with a subsistence ratio of 0.87.

However, this does not tell us much about the average incomes in these societies because an unskilled male labourer's position in the income distribution is unknown. After all, a subsistence ratio of 0.55 in Egypt for a male unskilled labourer versus one of 0.87 in Han China seems to be very positive for China, but the assessment would change if this value applied (using a fictitious example) to the top 90% of income earners in Egypt (meaning that only 10% of people were poorer than our labourer), but to the top 10% in Han China (meaning that 90% of people were poorer). Accordingly, it is important to obtain some insights into the relative income positions of labourers in these ancient societies.

Such information is obviously scarce. Fortunately, Scheidel and Friesen's work on the Roman Empire[61] provides a good starting point. They applied an income distribution to the Roman population, both elite and non-elite, and simulated the percentage by which the population share decreased as incomes doubled. They found a plausible drop of 66% of the population each time wealth doubled, meaning that in an optimistic scenario, about 65% of the total population lived at or below subsistence level (82% in a pessimistic scenario). Thus, taking the mental leap of combining our estimate of an unskilled labourer's wage in Syria based on Diocletian's edict with the income distribution cited by Scheidel and Friesen for the Roman Empire, we conclude that our labourer's income was in the top 28–35% of incomes, with a subsistence ratio of 0.7.

However, with the exception of Babylon, the method adopted by Scheidel and Friesen cannot be readily applied to the other regions under discussion here because no similar information is available. If we again take a mental leap and assume that Han China as a whole can proxy for the

[61] Scheidel and Friesen, 'The size of the economy', p. 79, tables 8 and 9; they apply a Pareto (i.e., power law) distribution. For an alternative, see Branko Milanovic, 'Income level and income inequality in the Euro-Mediterranean region', unpublished paper presented at the ENIUGH conference, Dublin, 2011.

southeastern areas, for which there are no data, observations in the *Han Shu* (History of the Han) and *Shih-chi* may be useful. Here, it is recorded that 'the land within the Passes [occupied only] one-third of that of the empire, and the mass of its population was not more than three-tenths [of that of the empire], in measurement of its riches it held six-tenths [of the wealth of the empire].'[62] In other words, the text suggests that 30% of the empire's population, living on the floodplain of Shaanxi, held 60% of the wealth. 'Wealth' seems to mean 'income' as can be deduced from the fact that both documents frequently refer to income from land and other occupations as 'wealth'. Combining this information with economic theory on income distribution, we calculate the Gini coefficient, a measure of inequality ranging from 0 (perfect equality) to 1 (perfect inequality), for the whole of Han China and find that the minimum and maximum possible coefficients are 47.6 and 50.7.[63]

With the Gini coefficient, we now have the income distribution, which means we need two more pieces of information to be able to calculate the relative income position of an unskilled male labourer in Han China. First, we need to know the total income of the society and, given that we already know the income distribution, we also know the income of each of the population subgroups. There is no per capita GDP available for the Han dynasty, but we can argue, with some level of confidence, for certain minimum and maximum numbers. Angus Maddison claimed that the economic position of Han China was relatively low, being comparable to that of Europe in the fifth

[62] Swann, *Food and money in ancient China*, p. 439.

[63] The distribution across the land within the Passes provides us with a point at the Lorenz curve (representing the relation between the cumulative population and the cumulative percentage of income), at which we calculate the Gini coefficient as 38, under the assumption that the income distribution has a lognormal shape (see, e.g., Lee Soltow, 'The measures of inequality,' in Lee Soltow and Jan Luiten van Zanden, eds., *Income and wealth inequality in the Netherlands 16th-20th century*, Amsterdam: Het Spinhuis, 1998, pp. 7–22. (For the method, see J. López, and L. Sérven, 'A normal relationship? Poverty, growth, and inequality', *World Bank Policy Research Working Paper* 3814, 2006. Yet, this value is incorrect because it assumes that all people 'within the Passes' have the same income. Hence, based on the work of Milanovic, Lindert and Wiliamson (Branko Milanovic, Peter Lindert and Jeffrey Williamson, 'Measuring Ancient Inequality,' *NBER Working Paper Series,* Working Paper 13550, 2007, http://www.nber.org/papers/w13550), we assume a minimum within-country inequality of 30 and a maximum of around 50. We apply these minimum and maximum figures to both parts of the Chinese Empire and apply a log-normal distribution with a given maximum and minimum Gini coefficient on both regions of China, and then calculate the minimum and maximum possible inequality for Han China as a whole as 47.6 and 50.7.

century CE.[64] He set his per capita income measure at around 450 international dollars.[65] Alternatively, it has been argued that the Han Empire was quite rich and technologically advanced.[66] Because China is often considered to have reached the peak of its wealth during the Song dynasty, we assume that per capita income during the Han could not have been more than at the beginning of the Song dynasty, i.e., ca. 1,058 international dollars.[67] Second, assuming our labourer had a yearly income of $0.87 \times 4 \times 400 = 1{,}392$ international dollars (400 dollars being the subsistence minimum), by comparing these figures with the earlier estimated income distribution, we can calculate that our labourer belongs to the top 6–25% of income earners in the population. However, 6% seems grossly overestimated because it is based on an implausibly low estimate of per capita GDP. Based on the available productivity and technological evidence,[68] it seems unlikely that per capita income in the Han was significantly lower than in the Song, so we prefer an estimate of around 20%.

The data for Babylonia are arguably the most tentative. Yet, recently, Jursa provided, based on the method of Scheidel and Friesen[69], an income distribution for Borsippa, a city southwest of Babylon.[70] According to this estimate, we may arrive at a Gini coefficient of ca. 38. Yet, since this refers to a subordinate city, and is based on a "positive" inequality scenario, actual inequality in Babylon is likely higher. Therefore, we try to make an alternative estimate by looking house sizes. Indeed, as argued by Baker, the development of larger house sizes suggests that inequality increased

[64] Angus Maddison, *Chinese economic performance in the long run,* Paris: OECD, 1998, p. 38.
[65] Angus Maddison, *Contours of the world economy, 1–2030 AD. Essays in Macro-Economics*.
[66] See, for example, Josef Needham, *Science and civilization in China,* vol. 1; Josef Needham, *The grand titration: science and society in East and West*, London: Routledge, 1969; Josef Needham, *Science in traditional China: a comparative perspective,* Cambridge: Cambridge University Press, 1981; Josef Needham, 'Introduction.' in R. Temple (ed.), *China, land of discovery and invention*, Wellingborough, 1986; Mark Elvin, *The pattern of the Chinese past*, Stanford: Stanford University Press, 1973.
[67] Stephen Broadberry, Hanhui Guan, and David Li, *China, Europe and the great divergence: a study in historical national accounting*, 2014, URL: http:eh.net/eha/wp-content/uploads/2014/05/Broadberry.pdf (consulted 6 January 2016).
[68] Needham, *Science and civilization in China.*
[69] Scheidel and Friesen, 'The size of the economy'.
[70] R.J. van der Spek, J.G. Dercksen, K. Kleber, and M. Jursa, 'Money, silver and trust in Mesopotamia.' in R.J. van der Spek and B. van Leeuwen (eds.). *Money, Currency and Crisis: In Search of Trust, 2000 BC to AD 2000.* Oxon and New York: Routledge, 2018, pp. 102-131, p. 119.

considerably in the first millennium BCE.[71] Unfortunately, she does not quantify this increase, but we can use data on house sizes to obtain an indication of the possible magnitude of inequality in Babylonia. We start by taking Baker's categorization of houses and their sizes: 'small houses' (105 sq. metres on average), 'slightly bigger houses' (240 sq. metres), 'average houses' (417 sq. metres), 'double courtyard houses', 'large houses', 'official residences', 'local governor's palace' and 'royal palace'. [72] It is clear that these sizes are very large, but it is important to note that not only did they often include yards, but also, according to written texts, that they were often inhabited by more than one family. Indeed, it has been argued that a family of five individuals typically inhabited an area of about 73 m^2.[73] So, we start by assuming that with the exception of small houses, at least two families (i.e., ten persons) lived in each house. Therefore, we have now the approximate number of square metres per household for every class of house, which may be considered a rough proxy for income.

Nevertheless, to calculate the Gini coefficient, we also need some gauge of the number of people associated with each class of house. If the average house was about 417 sq. metres, the number of houses at or below 417 sq. metres must have been 50%. The remaining distribution is unknown, but we can make a fair guess. Because small houses would have dominated, we assume that 20% of houses must have been 'small', 20% 'slightly bigger' and 10% 'average'. For the top tier, it is rather more straightforward because the share of total housing accounted for by 'local governor's palace' and 'royal palace' would have been close to zero. Hence, we set 'double courtyard houses' and 'large houses' each at 20%, with 'official residences' at 9.9%, leaving the remainder for palaces. The resulting house distribution must be multiplied by the number of people per type of house (i.e. five or ten, depending on the type of house), to arrive at the number of persons by income class.

[71] Heather Baker, 'From street altar to palace: reading the built environment of urban Babylonia', in Karen Radner and Eleanor Robson, eds., *The handbook of cuneiform culture*, Oxford: Oxford University Press, 2011.
[72] Heather Baker, 'House size and household structure: quantitative data in the study of Babylonian urban living conditions, in Heather Baker and Michael Jursa, eds., *Documentary sources in ancient Near Eastern and Greco-Roman economic history: methodology and practice,* Oxford and Philadelphia: Oxbow Books, 2014, pp. 7–23, 8.
[73] Baker, 'House size and household structure', p. 19.

Now that we have both an income and a population distribution, we can estimate a Gini coefficient of 52, which is indeed slightly above the estimate of Borsippa mentioned earlier. However, as in the case of Han China, we need two additional pieces of information: the average income in society and the yearly income of a labourer. The former was calculated by Foldvari and van Leeuwen as 722 international dollars.[74] A labourer's income is calculated as $0.71 \times 4 \times 400 = 1{,}136$ international dollars (400 dollars being the subsistence minimum), arriving at a ranking in the top 50% of the income distribution.

We do not have similar information for Roman Egypt[75] but estimates of wealth inequality, which are generally higher than those of income inequality, vary between ca. 40 and 80.[76] Yet, in terms of income inequality, we would expect the relative position of labourers to have been almost identical to that in Babylonia. Indeed, Bagnall and Frier argue that about two-thirds of the village population, excluding slaves, in Egypt earned the same as an unskilled labourer or less, with a somewhat larger proportion of higher incomes in the cities.[77] This amounts to unskilled labourers' incomes ranking in the top 50% of the economy to which we, assuming slave income is below that of an unskilled labourer, have to add ca. 10% slave population to arrive at a realistic estimate of labourers ranking at about the top 40% of the income distribution in Roman Egypt.

[74] Foldvari and Van Leeuwen, 'Comparing per capita income in the Hellenistic World'.
[75] However, Kron did make a distribution for fourth century BC Greek wealth (G. Kron, 'The distribution of wealth at Athens in comparative perspective,' *Zeitschrift für Papyrologie und Epigraphik*, 179, 2011, pp. 129–38).
[76] W. Scheidel, 'Stratification, deprivation and quality of life.' in M. Atkins and R. Osborne (eds), *Poverty in the Roman World,* Cambridge: Cambridge University Press, 2006, pp. 40 – 59, pp. 52-53.
[77] Roger S. Bagnall and Bruce W. Frier, *The demography of Roman Egypt*, Cambridge: Cambridge University Press, 1994, pp. 72–3.

Table 6. *Comparison of unskilled male labourers' subsistence ratios and their relative income positions in the economies of southeastern Han China, Babylonia and the Eastern Roman Empire (Syria and Egypt)*

	China	Babylonia	Egypt	Syria
500 BCE		0.71 (50%)		
100 BCE	0.87 (20%)	0.51 (50%)		
100 CE			0.55 (40%)	
230 CE			0.56 (40%)	
300 CE				0.65–0.78 (30%)

Note: the top percentage of incomes to which the male unskilled adult labourer belongs is given in parentheses.

The results are summarized in Table 6. As mentioned above, the subsistence ratios of 0.51 (around 110 BCE) and 0.55 for Babylonia and Egypt were much lower than the 0.7 and 0.87 for Syria and the southeastern Han Empire, respectively. However, looking at the relative positions of the labourers in each of these four societies, we find that they made up the top 40–50% in Babylonia and Roman Egypt, but around the top 20% in Syria and the eastern part of Han China. To phrase it differently, even though the subsistence ratio of unskilled labourers was higher in the latter two regions, unskilled labour ranked among the higher incomes, contrary to the situation in Babylonia and Egypt. Hence, the income differences found by comparing subsistence ratios do not necessarily reflect the differences in average incomes among these four societies. Indeed, average incomes (e.g., GDP per capita) diverged less than the subsistence ratio. Whereas the GDP per capita for Han China (not solely the southeastern part) was ca. 750 international dollars (the average of the amounts mentioned earlier), it was 722 dollars for Babylonia and ca. 650–700 dollars for the Roman Empire.[78]

[78] Scheidel and Friesen, 'The size of the economy', p. 79, tables 8 and 9. They apply a Pareto (i.e., power law) distribution); Foldvari and Van Leeuwen, 'Comparing per capita income in the Hellenistic world'.

Hence, the average income differences are much smaller than the differences based on subsistence ratios.

These differences in relative income positions are consistent with other studies from as early as the 1920s, when Rostovcev argued that the relative position of a labourer was lower in Egypt than in more central parts of the Roman Empire.[79] What explanation can be offered for this income differential in unskilled wages? The standard economic literature predicts income differences within an occupation based on the skill content, job tasks and geographic location. Yet as pointed out in the introduction, unskilled male labourers have roughly similar skills and technology contents regardless of location. This implies that it follows from economic theory that the differences in relative income were mostly due to regional variation; i.e., an excess demand for unskilled labour in southeastern Han China and Syria. Nevertheless, economics does not take sufficiently into account the differential character of ancient economies. Even though, as outlined in the introduction, the idea that ancient economies were based purely on exchange rather than on economic rationale was incorrect, it would also be incorrect to assume (as is often the case today) that largely free labour existed. Both the small size of the wage economy and the excess demand for labour can influence the income position of unskilled male labourers.

First, as regards the economic structure of ancient economies, paid labour made up a relatively small part of the economy, so shortages easily occurred. As Rathbone (1991) pointed out, paid workers may have made up 50–70% of labour on an estate in third century CE Egypt, but many of them must have worked only part-time for wages.[80] Similar information is available for Babylonia, the Roman Empire and Han China.[81] Among these regions, however, free wage labour may have

[79] Michail Ivanovič Rostovcev, *The social and economic history of the Roman Empire*, Oxford: Clarendon Press, 1926, pp. 293–300.
[80] Dominic Rathbone, *Economic rationalism and rural society in third-century A.D. Egypt,* Cambridge: Cambridge University Press, 1991, pp. 153.
[81] Jursa, *Aspects of the economic history of Babylonia*; Huiming Zhuang, 'A further discussion on the physical characteristics of the employed laborers in the Han Dynasty,' (Hàndài gùyōng láodòng zhě shēntǐ tèdiǎn de zài tàntǎo) *Journal of Chinese Social and Economic History* (Zhōngguó shèhuì jīngjì shǐ yánjiū), 1, 1990, p. 6–7.

been especially limited in Han China. Indeed, as Zhuang pointed out, the government tried in particular to curb private enterprise in industry and services, thus limiting migration from agricultural areas to cities. This surely drove up the price for the few free wage labourers, especially in urban areas.

A second effect was the imbalance between the supply and demand of free wage labourers. Indeed, in agricultural societies with fast population growth such as Babylonia and Egypt, the supply of unskilled labour was higher than the demand, thus lowering their relative wage.[82] In cases of labour scarcity, however, the wages of an unskilled labourer might have been very high. For example, as shown earlier, the subsistence ratio of unskilled labourers was high in sixth century Babylonia, a period of almost total employment.[83] We find more evidence of the effect of the demand for labour in Babylonia, where around 305 BCE Seleucus I founded a completely new city named Seleucia on the Tigris, replacing Babylon as the king's city. As a new city of no less than 550 hectares, it must have taken a massive toll on labour from nearby Babylon,[84] and indeed, as indicated above, we see a very high subsistence ratio in Babylonia around the third century BCE. We witness a much lower ratio by the time the project was finished in the late first century BCE. The importance of excess demand leading to a relatively high subsistence ratio is also corroborated by third century CE Syria, which was a period of intense building activities.[85] Similarly, it is suggested that labour shortage also existed in Han China, partly because there was a great demand from labour-intensive agriculture. This was sometimes so pressing that soldiers were summoned to add to the unskilled labour force.[86]

[82] For a similar argument for sixteenth-century Netherlands, see R. van Uytven, 'What is new socially and economically in the sixteenth-century Netherlands', *Acta Historiae Neerlandicae*, 7, 1974, pp. 18–53, 27.
[83] Pirngruber, 'The value of silver'.
[84] Robartus van der Spek, 'Feeding Hellenistic Seleucia on the Tigris', in R. Alston and O. M. van Nijf, Eds., *Feeding the ancient city*, Leuven: Peeters, 2008, pp. 33–45.
[85] Meißner, 'Über Zweck und Anlaß'.
[86] Low Shui Pheng, 'Managing building projects in Ancient China: a comparison with modern-day project management principles and practices', *Journal of Management History*, 13, 2, 2007, pp. 192–210, 194; Zhuang, 'A further discussion on the physical characteristics of the employed laborers in the Han Dynasty'.

Conclusion

Interest in income differences in ancient societies has increased recently, because they not only tell us about persistence in income differences over time, but also supply corroborative information about global trade and investment patterns that are deemed to have been crucial for economic development in subsequent centuries. In calculating income differences, the so-called subsistence ratio—the wage of one unskilled male labourer to that of a subsistence basket of goods and services necessary for survival of his household—has become increasingly popular. Even with obvious drawbacks, such as the omission of additional income from the wife and children, this is probably the best available indicator by which to gauge individual-level welfare because it compares one comparable occupation over time rather than estimating a national average such as GDP.

To existing estimates for Babylonia in the sixth and first centuries BCE, we added modified estimates for Roman Egypt (100 and 230 CE) and Syria according to the edict of Diocletian (ca. 300 CE). We also added our own estimates for the southeastern part of the Han empire in China ca. 100 BCE. The main conclusion is that in all of these societies the subsistence ratios were substantially below 1, and thus below the level required to maintain a family. Nonetheless, even within this low level there was a clear divergence between agricultural Roman Egypt (around ca. 100 CE) and Babylonia in the Parthian period (around 100 BCE), which witnessed lower subsistence ratios than the southeastern regions of the Han dynasty and Syria.

To explain the income difference among these four regions, we also need to look at the relative position of the unskilled labourer in terms of the income distribution. After all, it makes a lot of difference whether a labourer belongs to the richest or the poorest group in his society. Using some tentative measures, we find, surprisingly, that the incomes of labourers in Babylonia and Egypt were in the top 50%, whereas those in China and the Roman Empire were in the top 20%. Hence, we find little evidence that the higher subsistence ratios in southeastern Han China and Syria implied substantially higher average incomes than in Babylonia or Egypt. This suggests that even though

individual incomes may have differed, average incomes must have been comparable. Given that unskilled male labour is roughly comparable in terms of skill content, we speculate that the higher relative income positions in Syria and southeast Han China can be explained by the different structures of the ancient economy (lower share of unskilled male wage labour) and an excess demand for unskilled labour.