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The standard of living in ancient societies: a comparison between the Han Empire, the Roman Empire, and Babylonia[1]

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Abstract

In recent years interest in welfare levels in ancient economies has increased considerably partly as a result of a quest to find the start of modern economic growth. These welfare levels can be calculated in two ways. First, it can be done using GDP per capita, capturing average income in a society. However, this tells us little about actual welfare of people at the bottom of the income distribution. Therefore, recently the focus has shifted towards so-called welfare ratios where the wage of an unskilled labourer is compared with the price of a basket of goods. In this paper we present new estimates for Han China and Babylonia as well as modifying existing estimates for Egypt and the Roman Empire to make them comparable. We find that the agricultural regions of Egypt and Babylonia had the lowest welfare ratios. Since in all societies unskilled workers in antiquity belonged to the bottom 80% of the income distribution, these figures are comparable. This only changed in the 14th century when in some Northwestern European countries the relative position of labourers in the income distribution deteriorated even though their welfare ratio's increased marking a start of the Great Divergence.

Keywords: Welfare, China, Seleucid Empire, Roman Empire, wages, prices, labourer

JEL Codes: J3, N30, N35, O11,

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1. Introduction

In recent years, increasing attention has been paid to welfare levels of the common labourer in past economies. Broadly speaking, two different (but complementary rather than mutually exclusive) approaches have been used to analyze the available data on income and consumption. First, the calculation of GDP per capita in order to measure average income in society has been successfully employed in attempts to quantify Early Modern and Medieval economies (e.g. Prados de la Escosura and Álvarez-Nogal 2009; Malanima 2009; Broadberry et al. 2011; Van Zanden and Van Leeuwen 2012). Moreover, in recent years similar methods have been applied to ancient economies as well (e.g. Amemiya 2007; Scheidel and Friesen 2009, Lo Cascio and Malanima 2009; Foldvari and Van Leeuwen 2012).

Even though these studies are very informative, they do not allow us to gauge the income of persons at the lower end of the income brackets. Therefore, increasingly a second conceptual tool is used, i.e. the wage of an unskilled labourer expressed in certain commodities or commodity baskets. In the more simplistic variant, wages are expressed in amounts of *grain.* Studies making use of this concept (e.g. Scheidel 2010, Jursa 2010, 811ff.) have shown a relatively low level of income during antiquity compared to the Early Modern period (cf. Van Zanden 1999), with two notable exceptions, namely Classical Athens and Babylonia in the 6th century BC. Yet, as the grain wage is a rather crude yardstick as regards actual consumption, a more sophisticated method is employed whenever possible to gauge actual purchasing power of the common man, which is the *welfare ratio* put forward by Bob Allen (2001). In this method, which has the principal advantage of being less sensitive to price ratios between grain and other commodities, the costs of acquiring a basket of vital goods for one household – not only grain but also other foodstuffs as well such as clothing and housing – is compared to the income of an unskilled labourer. For early economies only few such studies exist, mainly due to the limited availability of data. However, pioneering studies on the Roman Empire and in particular Roman Egypt (e.g. Allen 2009 and Scheidel 2010) point at a subsistence ratio – hence the ratio of income to bare bones expenditure – of ca. 0.7 to 1.1, which means that welfare level of an unskilled labourer hardly exceeded bare (household) subsistence.

The existing studies for the Roman Empire and in particular Roman Egypt are thus a good point of departure. However, it does tell us little about welfare levels in other ancient societies. In this paper we try to make a first comparison of welfare levels in ancient societies using the consumer basket approach. In Section 2, we review the existing literature on estimates on Ancient Roman Empire in general and Egypt more specifically. In Section 3 and 4, we deal with new data on Han China (206-6/9 BC) and Babylonia respectively. Since especially the Babylonia evidence is usually considered in isolation, we will at some length discuss the data available on incomes and consumption in Babylonia during the 6th century BC (Neo-Babylonian and early Achaemenid periods) and during the 2nd century BC (Seleucid and Parthian periods).[5] In Section 5 we then turn to a comparison across these regions as well as over time. We find that differences in welfare levels of unskilled labourers were rather small, but by no means insignificant, between ancient societies. However, the crucial difference to the economic take-off of early modern (and especially Northwestern) Europe is an increasingly smaller share of people at or below the income of a common labourer, implying amongst other a rising skill premium (e.g. Van Zanden 2009). We end with a brief conclusion.

2. Individual welfare in the Roman Empire and Egypt

In this section, we will re-calculate the bare bones ratio for Egypt and the Roman Empire, with a few modifications compared to earlier approaches. In order to calculate the bare bones ratio, most of the literature so far constructed a basket of goods that sums up to ca. 1940 kcalories and ca. 60-70 grams of proteins per day (e.g. Allen et al. 2011). However, in this paper we construct a basket summing up to roughly 2100 kcalories, in line with the World Bank Poverty Line and the USDA food security line. Further, rather than assuming the conventional 3 adult equivalents per household (i.e. a man, a woman and 2 children) we assume 4 persons per household to allow for higher number of children and additional household members (such as elderly grandparents).

[5] For a concise history of Babylonia during the 1st millennium BC see Joannès (2001).

A first treatment of the data for the Roman Empire and Egypt can be found in Allen (2009) and, with minor adjustments, in Scheidel (2010). However, in order to make them comparable to each other as well as to the estimates from Han China and Babylonia in the following sections, four factors need to be accounted for. First, as just stated, the level consumption of staple grain will be raised in such a way that it approaches 2100 kcalories per capita for a family consisting of 4 adult equivalents. This entails an increase of the staple crop (wheat) from 172 kg to 190 kg (see Table 1). Second, the data on prices and income for the Roman Empire discussed on the basis of Diocletian's edict on maximum prices by Allen (2009) been adapted here under due consideration of Scheidel's (2010, 432, footnote 15) criticisms that Allen's wages for Diocletian's Price Edict were overestimated since the food rations were most likely smaller and, in any case, have to be divided by 365 days instead of 250, meaning the earlier result is overestimated by 1/3. Also, the price edict aims at establishing a price ceiling; hence commodity prices (and services) may have actually been significantly higher than stipulated (and wages may have been significantly lower). There is, however, evidence that the prices of the edict reflect reality quite accurately, at least in the short/medium term.[6] Nevertheless, in Table 1 we also include a confidence interval of the welfare ratios under the assumption that actual prices were 10% higher and actual wages 10% lower. Whereas the value of 0.74 follows directly from our estimates, 0.65 is a minimum value under the assumption that wages are 10% lower and prices 10% higher than stipulated. Third, as regards Scheidel's (2010, 428) data

Table 1. *Bare bones basket in Roman Egypt 100 AD and 230 AD, and according to the edict of Diocletian, ca. 300AD.*

		Egypt, ca 100 AD		Egypt, ca 230 AD		Roman Empire, ca. 300 AD			
	Quantity per person	grammes of silver per unit	spending share	grammes of silver per unit	spending share	grammes of silver per unit	spending share	nutrients/day	proteins/day

[6] 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 (2000, 99f.[(+76)]) (For less optimistic assessments of the edict see the literature in footnote 4 on page 80 of this article). Note further that the edict seems to have been directed mainly at the eastern half of the empire, i.e. modern day Syria in a time of economic expansion triggered by increased demand (Meißner 2000, esp. 88-90).

	per year								
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	100.0%	118.07	100.0%	120.31	100.0%	2,108	72
unskilled monthly wage (grammes of silver)		18.46		22.13		31.43			
bare bones ratio		**0.55**		**0.56**		**0.65-0.78**			

on Egypt ca. 100 and 230 AD, we witness a doubling in prices which makes it difficult to convert the data for 230 AD in grammes of silver (even though this obviously does not affect the bare bones ratio; see Scheidel 2010, 430). However, in order to convert in silver, we assume that 100AD we have 0.55 grammes of silver per drachme, declining to 0.40 grammes ca. 230 AD (derived from Harl 1996, 98).

A more sophisticated approach is the construction of a respectability basket (e.g. Allen 2001). This basket reflects the income of a labourer in early modern London. Hence, given the increase in welfare compared to earlier periods, its consumption is far more elaborate (and hence the welfare ratio's are lower). For Egypt and the Roman Empire the evidence on such extended consumption basket comes from the same sources, with the same modifications. The most important difference is the inclusion of some dairy products and wine and an increased consumption of meat. However, except for the decline in the welfare ratio, no major changes take place suggesting that the relative price differences between bare bones and respectability basket in Roman Egypt and according to the

Table 2. *Respectability basket in Roman Egypt 100 AD and 230 AD, and the Roman Empire 300AD.*

		Egypt, ca 100 AD		Egypt, ca 230 AD		Roman Empire, ca. 300 AD			
	Quantity per person per year	grammes of silver	spending share	grammes of silver per unit	spending share	grammes of silver per unit	spending share	nutrients/day	proteins/day

		per unit							
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 stuks	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	100.0%	28980	100.0%	266.35	100.0%	2,096	86
unskilled monthly wage (grammes of silver)		18.46		22.13		31.43			
respectability ratio		**0.22**		**0.23**		**0.29-0.35**			

edict of Diocletian are roughly stable. This implies that within the ancient Roman world little differences existed in terms of the relative prices of the goods that make up the "respectability" and the "bare bones" baskets.

This picture changes considerably if we take a diachronic perspective. If we compare the respectability ratios with those prevailing during the 17th century, a period when the differences between Southern and Northwestern Europe were still not so pronounced (e.g., ca. 0.6 in Florence and ca. 1 in Amsterdam and London[7]), we find that labourers in the ancient Roman world were considerably worse off than their 17th century counterparts. Yet, if we move ahead one century, we find that in the 18th century, even though the welfare levels in Northwestern Europe had increased further, welfare in for example Florence had decreased to around 0.3. This implies that welfare levels in 18th century Italy were probably not much different from those in 3th century Roman Empire.

[7] E.g. Allen (2001). In these ratios we included a small correction for the use of 2100 kcalories (i.e. we lowered the respectability ratios).

3. Individual welfare in Han China

In the choice of the contents of the bare bones basket for Han China we focus on the Western Han Empire (206BC-9AD), for which the years around 100 BC provide us with the most abundant and best quality price data. In order to construct our basket for this period, we follow Allen et al. (2011) by using their basket for Canton in 1757. It is important to stress that they focused on rice as the main staple while consumption patterns of Southeastern China were perhaps different during Han times. However, as shown by Huang (1982, pp. 77-79) based on archaeological evidence, in the Han dynasty there was a clear division in which the Northern provinces ate mainly millet, sometimes with wheat and barley added (see also Wei, 2010), while in the Southeast rice was the predominant crop. As the Han dynasty was largely located in the South-East (and middle) of what is current day China and because rice is about equal in kcaloric contents to millet and barley (see Allen et al. 2011) rice is added to the basket as the preferred staple grain for the Southeastern regions.

The relatively scarce price data for this basket are nicely presented in three books. The oldest, and possibly most comprehensive source of price data for the Western Han is Wen (2002) who

Table 3. *Subsistence lifestyle: baskets of goods in China*

	South China			**North China**		
		Nutrients/day			**Nutrients/day**	
	Quantity per person per year	**Calories**	**Grams of proteins**	**Quantity per person per year**	**Calories**	**Grams of proteins**
Rice	187.4 kg	1,838	52			
Millet/Oats /Sorghum				177.5 kg	1,838	53
beans/peas	20 kg	187	14	20 kg	187	14
meat/fish	3 kg	8	2	3 kg	8	2
oils	3 l	67	0	3 l	67	0
soap	1.3 kg			1.3 kg		

Cotton/cloth	3 m			3 m	
candles	1.3 kg			1.3 kg	
lamp oil	1.3 l			1.3 l	
fuel	3MBTU			3MBTU	
		2100	68	2100	69

Allen et al. (2011, Table 3). Only rice/millet has been adapted to match 2100 kcalories

systematically collected price and wage data from a wide range of secondary studies and included price data from founds in graveyards, contemporary publications, and from wooden slips (i.e. *Hanjian*) found in Juyan. These bamboo wood slips were found in great numbers in Juyan, a fortress at the Great Wall, located in Gansu province in the north of China, and cover the period 102 BC-30 AD. They are mainly administrative and financial records left behind by officials and troops. These data from Juyan were also presented in a more comprehensive fashion by Wang (2004). A final pertinent work is Ding (2009) who, similarly to Wen (2002) attempts to give an overview of the sources of prices in the Han Dynasty.

Undeniably, most data are available for the period ca. 100 BC from the wood-slips from Juyan while only a relatively small remainder is derived from other sources. This immediately begs the question of the sort of prices recorded in the official documentation in one of the border provinces. Given that this source contains prices of a wide variety of products, mainly consumables, and that we sometimes find references to trade conflicts, it seems plausible these prices are indeed retail prices. This impression can be corroborated by comparing prices in Dunhuang (Gansu) published in Wen (2002) with those of the wood-slips in Juyan located in the same province. Both datasets give comparable price levels for rice, millet and chickens providing evidence that the Juyan data were indeed actual market prices.

As regards the most important product in our consumption basket, the actual price of rice shows some fluctuation, but on average the price was lower in the Southern provinces (roughly 5 wuzhuqian per litre in the South versus 10 in the Northern provinces; cf. Wen 2002). This estimate can be confirmed using the Shih-chi (Historical record) of China which was compiled by Ssu-ma T'an (early 2nd century BC) and his son Ssu-ma Ch'ien (ca. 145-ca. 86 BC), and which discusses the history and economy of China from the beginnings until ca. 100 BC. This source contained a price list for the period around 100 BC which compares how much quantities of which goods can be purchased for 200,000 wuzhuqian (for the source publication see Swann 1950, pp. 434-436). As argued by Sadao (1987, p. 590), one may conjecture from this price list that around 100 BC the average price of a litre of grain is 5 wuzhuqian which matches nicely with the 5 wuzhuqian per litre from other sources. Since 1 litre of rice equals about 0.89 kilogram, this boils down to 5.6 wuzhuqian per kg.

In a way it is simpler to obtain price data for other products since there is less information, and neither seems there to have been such distinct regional variation. Beans have a price of 2 wuzhuqian per litre (Wang 2004), i.e. 2.7 wuzhuqian per kg. For meat and fish we use the price of meat, being 26.4 wuzhuqian per kg. Innards are less expensive still, for example 1 kg of stomach amounts to 12 wuzhuqian (Wang 2004, p. 62). Cooking oils are more difficult to assess owing to the scarcity of data. Hence, we focus on fat instead, which is also commonly used for cooking purposes; its price being around 40 wuzhuqian per kg, or 36 wuzhuqian per litre (Wen 2002). For soap we have no direct information. However here we can also use animal lard as a proxy with a value of 40 wuzhuqian per kg.

Cottons are a bit more controversial since there are a lot of refinements ranging from rough hemp to refined silk. Obviously, as argued by Wen (2005), even though normal people were allowed to wear silk, not many people could actually afford it. The most common material for clothing among to less affluent strata of society was hemp. Cloth cost about 43.4 wuzhuqian per meter (Wen 2002), which also matches nicely with the 54 wuzhuqian per meter commonly found in the Juyan data from Wang 2004, p. 60). Yet, the question remains what quality this cloth represented. Fortunately, the Shih-chi also provides us with evidence on this point. It shows that a meter of rough cloth was about equal in price to about 6 liters of rice, i.e. about 30 wuzhuqian. This suggests that the estimate of 43.4 is most likely referring to at best average quality and material clothing.

For candles and lamp oil no direct observations can be reported. Yet, for both animal fat may be a fair approximation, with a value of 40 wuzhuqian per kg, or 36 wuzhuqian per litre (similarly Allen et al. (2011)). As regards fuel, the price of wood was quite expensive, since 23.5 wuzhuqian per chi of 23.1 cm imply that at least 2 to 3 litres of rice must be paid for 23.1 cm of wood. However, the ca. 2,000 wuzhuqian for a wooden coffin suggest that, even after subtracting labour costs, wood was indeed quite expensive (Wen 2002; Wang 2004). The most common source of fuel was thus simply straw from the fields (Pomeranz 2000, p. 232), which was considerably cheaper at 8.5 wuzhuqian per su bundle (approximately 15 kg), thus roughly 0.57 per kg. One kg of rice straw has about 14,350 BTU[8], which means a price of 39.7 wuzhuqian per MBTU.

Table 4. *Bare bones basket Han dynasty 100 BC compared with Beijing 1750*

		Han dynasty ca. 100 BC		**Beijing, ca 1750**	
product	Quantity per person per year	Grammes of silver per unit	percentage distribution	Grammes of silver per unit	percentage distribution
Rice	187.4 kg	0.70	60.5%		
Oats/sorghum	177.5 kg			0.48	44.3%
beans/peas	20 kg	0.34	3.1%	0.84	8.7%
meat/fish	3 kg	3.30	4.6%	2.04	3.2%
cooking oil	3 l	4.50	6.2%	4.00	6.2%
soap	1.3 kg	5.00	3.0%	1.65	1.1%
Cotton/cloth	3 m	5.43	5.0%	6.14	9.6%
candles	1.3 kg	5.00	3.0%	3.30	2.2%
lamp oil	1.3 l	4.50	2.7%	3.30	2.2%
fuel	3MBTU	4.96	6.9%	11.20	17.5%
rent			5.0%		5.0%
total			**100.0%**		**100.0%**

[8] http://www.calrecycle.ca.gov/Organics/Conversion/AgForestRpt/agriculture/Products5.htm energy contact of a pound of dry rice straw is about 6,500 Btu.

Unskilled monthly wage	**62.5**	**60**
Welfare ratio	**0.87**	**0.94**

Note: Beijing is takes from Allen et al. (2011, Table 5). However, we made two changes: a) We increased the share of oats/sorghum in order to arrive at 2100 kcalories and used 4 person household as we outlined earlier, and b) we included beans which seems to have been left out of the bare bones basket by Allen et al. (2011) even though they did include it in earlier tables.

All prices, converted into grammes of silver using a ratio of 0.125 grammes of silver per wuzhuqian (Wen 2002) are reported in above table. To arrive at the subsistence ratio, we still need to add the wage of an unskilled labourer. For Beijing we can take this directly from Allen et al. (2011), giving 0.077 tael a day, i.e. 2.85 grammes of silver. Following Allen et al and assuming 250 working days per year, this amounts to a wage of 60 grammes per month. For the Han dynasty China around 100 BC the wage was taken to be 62.5 grams of silver, which was equal to about 500 *wuzhuqian* per month, hence about a soldiers wage or 5 times the wage of a female maid around 100 BC (Wen 2002). One might argue, however, that a soldier's wage is not representative of that of a labourer. However, evidence that a soldier's wage can be taken as representative has been found by Sun (2010), who shows that the daily wage of a soldier is about equal to the daily cost of transporting 39.5 kilo of salt (not using a wagon) – a task which could be performed by any "unskilled laborer".

Let us now turn to the respectability basket including besides the products already mentioned before also more luxurious commodities such as wheat flour, fish, eggs, and rice. The

Table 5A. *Respectability basket Han dynasty 100 BC*

product	Quantity per person per year	grammes of silver per unit	spending share	nutrients/day	proteins/day
bread	197 kg				
rice	122 kg	0.70	26.0%	1,210	25
wheat flour	14 kg	1.12	4.8%	130	5
beans	40 kg				
soy beans	38 kg	0.34	3.9%	433	38
meat/fish	31 kg				
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	49 l				
rice wine	41 k	1.25	15.6%	151	1
cooking oil	5.2 kg				
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	3MBTU	4.96	4.5%		
house rent		34.61	5.0%		
total			**100.0%**	**2,094**	**83**
Unskilled monthly wage		**62.5**			
Welfare ratio		**0.57**			

Table 5B. *Respectability basket Beijing 1750 AD*

product	Quantity per person per year	grammes of silver per unit	spending share	nutrients/day	proteins/day
bread	197 kg	0.95	36.2%	1,322	54
rice	122 kg				
wheat flour	14 kg				
beans	40 kg	0.84	6.5%	371	23
soy beans	38 kg				
meat/fish	31 kg	2.04	12.2%	212	17
meat	16 kg				
fish	7 kg				
eggs	52 pieces	0.07	0.7%	11	1
rice wine	49 l	1.98	18.8%	180	1
rice wine	41 k				
cooking oil	5.2 kg	4.00	4.0%		
edible oil	1 l				
soap	2.6 kg	1.65	0.8%		
linen/cotton	5 m	6.14	5.9%		

Candles	2.6 kg	3.30	1.7%		
lamp oil	2.6 kg	3.30	1.7%		
fuel	3MBTU	11.20	6.5%		
house rent		54.60	5.0%		
total			**100.0%**	**2,097**	**96**
Unskilled monthly wage		**60**			
Welfare ratio		**0.35**			

Note: Data on Beijing taken from Allen et al. (2011). The only modification is an increase in the share of bread in order to arrive at ca. 2100 kcal. The Basket for the Han dynasty is based on Allen et al. (2005, Table 5) again with increasing the share of rice to make 2100 kcalories.

price for wheat flour is not directly given for this period. However, wheat costs around 4.5 wuzhuqian per litre (Wen 2002; Wang 2004), i.e. 5.8 wuzhuqian per kg. Given that in 1900 the price of a kg of wheat flour was around 1.55 times higher than that of wheat (Meng and Gamble 1926), and assuming *argumentis causa* a stable ratio over time, we set the price of wheat flour at 8.95 wuzhuqian per kg. For fish we find that one fish is about 3+ dou (i.e. more than 6 litres) of grain for 30 fish (Wang 2004), meaning about a minimum of 2 wuzhuqian per fish, or 4 wuzhuqian per kg. Likewise, in another observation we find that 30 fish are about 100+ wuzhuqian (Wang 2004), i.e. 6.6 wuzhu per kg. This means a minimum price of about 0.83 grammes of silver per kg, which we will round up to 0.9 grammes of silver per kg of fish. This suggests that fish is considerably cheaper than meat, a feature that is valid in China even today. Unfortunately, we do not have evidence for eggs, and, hence we assume that the ratio of eggs to meat is the same as in Canton in 1750. Finally, rice wine is abundantly recorded. According to Wang (2004), the exchange was roughly 1 litre wine for 2 litres grain, i.e. 10 wuzhuqian per litre, a value confirmed by Wen (2002).

The findings are quite remarkable. On a cross-region comparison, the respectability ratio for the Han Dynasty is significantly higher than those of the Roman areas; however, not disproportionately so, considering the respective bare bones ratios. This suggests that in all ancient societies, the relative prices of the more luxurious products contained in the respectability baskets are similar. However, the changes over time are more interesting: whereas the bare bones ratio remains fairly stable well into the 18th century, the respectability ratio drops considerably. This implies that what may be considered luxurious products became increasingly expensive in China. Hence, whereas the respectability ratios between ancient times and the 18th century improved in Northwestern Europe and remained stable in Southern Europe, they declined in China.

4. Individual welfare in Babylonia

Like China and the Roman Empire discussed before it is maybe appropriate to emphasize here from the outset that, contrary to received opinion, recent scholarship has largely abandoned the model of a redistributive economy for Babylonia as well, especially in the first millennium BC. Most succinctly this was stated by Jursa (2010, 799), according to whom a "growing urban population prompted agrarian change, stimulated the development of markets and money-based exchange, and allowed increasing economic specialisation and division of labour". It also seems that Babylonia was a reasonably well integrated economic space, mainly due to comparatively low transportation costs owing to an extended network of canals facilitating transport (Jursa 2010, 138-140). Furthermore, it has established beyond doubt that the rich (commodity) price data contained in the 'Astronomical Diaries' dating to the period between ca. 400 and 60 BC are indeed market prices.[9] In our context, it is also relevant to note that the concept of temple employees receiving rations from the institution they were attached to has been modified to a considerable extant; rather than speaking of rations (destined to fully satisfy consumption needs), this income is now qualified as "salaries in kind" (Jursa 2008).

[9] Temin (1997), Van der Spek (2001, pp. 295-297).

This approach opens up new paths in the research of welfare levels, as it can compensate the dearth of wage data in certain periods.

Unfortunately, even with the existence of a market economy, it is still a quite complicated task to calculate a welfare ratio for Babylonia, especially in a diachronic perspective since the data on prices and wages at our disposal are distributed in a rather uneven manner. Whereas the 'long 6th century' (the period between 626 and 484 BC, see Jursa 2010, 5) is fairly well documented in terms of commodity prices and different types of incomes – silver wages and salaries in kind ("rations") – due to the survival of a considerable number of both institutional (temple) and private archives from different cities (Babylon, Sippar, Borsippa and Uruk, to name just a few), the situation is different in later centuries. On the one hand, the Astronomical Diaries (edited in ADART 1 -3) provide us with one of the largest databases of prices for basic commodities (among which the staple foods barley and dates as well as wool) for any period of the pre-industrial world for the years between ca. 400 and 60 BC. [10] On the other hand, price information on other goods (sheep, slaves, house rents) which adequately documented in the earlier period is almost completely absent, as is information on income. This makes it difficult to establish a bare bone basket for the period after the 6th century BC.

We start thus with determining the consumption basket in Babylon in the 6th century BC. The main difference between Babylon and other pre-industrial societies such as Ancient Rome in terms of consumption is the existence of two-crop regime in Babylonia: barley and dates can be reckoned to account for minimum two thirds of the total caloric intake, and probably more (Jursa 2010, p.50, cf. the estimate of P. Garnsey 1983 that cereals accounted for 70-75% of total food consumption in the Ancient Mediterranean quoted in Jursa 2008, p. 411). Of course it is impossible to subsist on these two staples alone for lack of vital vitamins and nutrients. As in most pre-industrial economies, one has to reckon with a considerable share of non-marketed goods, i.e. fruit and vegetables cultivated on one's

[10] For an investigation of the price development in the 6th century BC see Jursa (2010). The Astronomical Diaries have been analyzed i.a. by Slotsky (1997), Vargyas (2001) and most recently by Pirngruber (2012). The price lists were also edited by Slotsky and Wallenfels (2009) and Van der Spek (2010).

own plot of land for home requirements.[11] Especially various types of legumes (rich in proteins!), and garlic and onions fall into this category. However, there are also two of these crop types about which price information is rather readily available, namely cress and sesame. Both commodities were regularly issued by Babylonian temples as part of rations and travel provisions (Janković 2008). On the basis of the latter we will assume monthly quantities of one litre of cress and 0.3 litres of sesame oil (corresponding to 1.8 litres of sesame, cf. Janković 2008, 447) as desirable. We will consider cress as a proxy for different sources of vitamins (rather than calories), and sesame oil as proxy for more prestigious foodstuffs (such as – unrelated but certainly part of the diet – dairy products; but note that sesame is also rich in proteins). In line with the remainder of this paper of 2100 kcal and 60-70 grams of proteins per day for a bare bones basket, we suggest a daily consume of 315 grams of barley (ca. 1,117 kcal) and 250 grams of dates (ca. 280 kcal), and 42 grams of sesame (ca. 240 kcal).[12] The result is reported in Table 6.

Table 6. *Subsistence lifestyle: baskets of goods in* Babylonia, 6th century BC.

Product	*Quantity annum**	*Silver value (in shekel per year)*	*kcalories/day*	*proteins/day*
Barley	115 kilos/191 litres	2.68 š	1,117	32
Dates	90 kilos/ 112.5 litres	0.76 š	705	6
Sesame	15.2 kilos/21.6 litres	1.60 š	240	17
Meat**	5 kilos	1.12 š	30	9
Cress	12 litres	0.36 š		
Clothing	5 minas of wool	1.40 š		
Fuel***	2MBTU	0.66 š		
House rent		0.45 š		
total value		8.99 š	2,092	64

[11] E.g., many rent contracts concerning of date gardens stipulate that the lessee is to cultivate the soil beneath the date palms with unspecified crops, the harvest of which constitutes his actual remuneration. See Ries 1976.

[12] Note that the historical proportions were indeed close to a ratio of 50:50 both according to 6th century ration lists and a study on Iraq in the 1950s AD, in case of the latter slightly skewed towards barley.

Note: *The conversion rates from litres to kilos are 0.6 for barley, 0.8 for dates (both Jursa 2010, 51), and 0.7 for sesame (own experiment, with not too finely calibrated kitchen scales).
** The amount of meat per year has been adapted from Scheidel (2010) and corresponds to one sheep every three years (see Janković (2008, 447ff). and footnote 89) per family.
***fuel based on ratio with Egypt (see Table 1).

As regards housing, Jursa (2010, 298) assumed for the house rent per family (not per person!) an absolute minimum value of 3 shekels of silver per year.[13] Since we have a multiplication factor of 4, this implies in turn that per person the house rent would amount to ca. 0.75 shekel. This value corresponds to ca. 8% of the total budget. In addition, similar evidence of house rents for mid-16th century Lyon, 17th century Holland and late 18th century England suggests house rents varying between 8 and 11% (Cipolla 1974, 39). Similar, and more detailed evidence, is available for England where Horrell (1996, table 1) showed that house rents for labourers and craftsmen were between ca. 7 and 13%. However, in line with Allen (2001) we decided to use 5% house rent uniformly across this paper to enhance comparability, bearing in mind that this value is an absolute minimum.

On that basis, a free Babylonian labourer should have earned 36.0 shekels of silver per year to maintain a hypothetical family of 4 adults in the 6th century BC. This result compares well with Jursa's (2010, 298) calculation of 27 shekels of silver for an urban household not affiliated to temple or palace during the reign of king Nabonidus (556-539BC), when the price level was significantly lower than during the 6th century BC at large and the total cost of the basket was probably closer to 25-30 shekels per year (see table 118 in Jursa 2010, p. 793 for a quick overview of the mean and median prices of the most important commodities during the 6th century and during the period 570-539 BC: barley was half as expensive in the latter period). Also the actual wage data at our disposal gives credibility to the calculated basket. With an average monthly income of 3.1 shekels of silver (based on

[13] The mean price of house rents during the 6th century actually amounts to 18.69 shekels per year. See Hackl/Pirngruber, *forthcoming*. Note, however, that the information is derived from the archives of the more affluent members of society and certainly is not applicable without further ado to the living conditions of the 'urban proletariat'.

the data collected in Jursa 2010, 674ff., table 103), a hired labourer would have earned about 37 shekels a year under full employment. Calculating with Scheidel's (2010) 250 working days per year, annual income would drop to 25.7 shekels a year, and hence a welfare ratio of around 0.71 (see Table 7). This value is close in range with the evidence provided by the edict of Diocletian and above that of Egypt. In addition, this value has to be considered an absolute minimum as the calculation also implies that under the favourable conditions prevailing during large parts of

Table 7. *Bare bones basket in 6th century BC Babylonia*

	Quantity per person per year	grammes of silver per unit	spending share	nutrients/day	proteins/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	100.00%	2,092	64
unskilled monthly wage (grammes of silver)		17.8			
bare bones ratio		**0.71 (- 1.04)**			

the 6th century BC (e.g. during the large scale building projects of the Neo-Babylonian kings such as Nebuchadnezzar II in the first half of the 6th century BC providing relatively steady work for thousands of people over several years and possibly decades, cf. Jursa 2010, 680), a life in relative prosperity was feasible for Babylonian urban labourers - even accounting for higher house rents than assumed here and the burden of taxation. At full employment, the welfare ration would increase to 1.04 thus slightly above subsistence. Also, these silver wages paid to free hirelings just discussed were on a significantly higher level than the income of temple staff – by itself another indicator of the relative welfare of free (i.e. not attached to an institution, temple or palace) urban labourers.

The rations, or more correctly salaries in kind (Jursa 2008 and 2010, 669ff.) of temple dependents of the Ebabbar-temple in Sippar in the long 6th century typically amounted to 180 litres of dates or, less often, barley, per month for fully trained workers. Expressed as wheat wage, free labourers almost earned twice the amount of labourers attached to temples. Whereas the latter earned ca. 6 litres per day (180 litre rations or rather 'salaries in kind' were the standard in 6th century Sippar, see below), the former earned up to 14.4 litres monthly (see Jursa 2010, 815 table 120). The main reason for this phenomenon is usually thought to be the scarcity of manpower available for the large-scale building projects (palaces, canals) of the Neo-Babylonian kings (Beaulieu 2005, Jursa 2010, 678). Even allowing for the fact that temple employees received their "rations"/salaries in kind throughout the year, this means that free labourers had a higher income by a factor of about 1/3 – the fact that temple employees normally will not had to cover housing expenses and additionally received a yearly allowance of wool (Jursa 2010, 297f.) from the temple was thus vital for their survival. Their situation seems to have even worsened in the 5th and 4th centuries BC (the Late Achaemenid and Early Hellenistic period) when the salaries dropped to 65 litres a month for an unskilled worker. However this drop is more apparent than real, as women (and children) now received separate salaries (women usually 45 litres per month), whereas the older standard of 180 litres was intended for an entire family only (Hackl/Pirngruber, forthcoming). Hence, actual family income of temple dependents was still close to the old 180 litres of barley per month. For later periods (hence, after ca. 300 BC), information on rations/salaries in kind runs dry. [14] However, the rich price data from the ADs also allows us to

[14] There are two references to wages (*īdu*) rather than rations (*kurummatu*): In both CT 49 150 and BRM I 99 (Van der Spek 1998, texts 13 and 18), millers (*ararru*) received 2.5 shekels of silver but unfortunately, the number of recipients is not stated. Also, there are only very few pieces of evidence on silver rations. The only

calculate a silver wage equivalent of hypothetical salaries in kind for the period under consideration. As it could be demonstrated that wage levels were tied to commodity prices during the 6th century (Jursa 2010, 679 and Fig. 25), such an approach should give us a reasonably accurate picture of the development of the approximate wage level during the 2nd century BC.

Table 8. *Hypothetical minimum wage equivalents of institutional labourers in Babylonia ca. 200-100BC.*

Period BC	Date equivalent (litres/shekel)	Silver wage equivalent (65 litres/month) in shekel
200-176	231.95	0.28
175-151	323.76	0.20
150-126	276.80	0.23
125-100	103.98	0.63

Period BC	Barley equivalent (litres/shekel)	Silver wage equivalent (65 litres/month) in shekel
200-176	126.24	0.51
175-151	148.7	0.44
150-126	89.27	0.73
125-100	44.9	1.45

indication we have for the 2nd century BC is the ration (*kurummatu*) of an astronomer – hardly an unskilled worker – amounting to 1 mina of silver per year, which can be expressed as 5 shekel per month (CT 49 144 dating to 119/8 BC, see van der Spek 1998, 252f.). Additionally, this astronomer had a plot of land (of unspecified size) at his disposal. The silver rations (*kurummatu*)[14] for various professions attested in the Rahim-Eşu archive – all dating to the year 218 Seleucid Era, i.e. 94/3 BC – align nicely with this isolated instance. For example, a parchment scribe (*sēpiru*) earned a monthly ration of 4 shekels of silver (CT 49 150, cf. Van der Spek 1998, 222f. and 252f.). According to the same text, a porter (*atû*) of the "Day-One Temple" was paid a ration of 1 shekel per month, the cleaners (*muremmiku*) employed in the same temple received 1.5 shekels of silver per month. Hence, a stratification of income according to education is clearly visible in these texts. It is important to note that these incomes are explicitly qualified as *rations* and thus cannot be compared directly to the *silver wages* of free hirelings of the 6th century BC. Rather, they correspond to the salaries in kind of temple dependents. Also the fact that additional income was drawn from sustenance land need not be forgotten.

At first glance, the silver equivalent of a 65 litres/month salary in kind seems impossibly low, especially for date wages. However, a closer look reveals that the 6th century Sippar standard of 180 litres of dates amounted to only 0.6 shekel of silver according to the sample price, which corresponds to circa 0.2 shekels for a 65 litre date income. This aligns very well with our findings for the first three quarters of the 2nd century BC.[15] Unfortunately, we have no means of comparing the wage level of free labourers over time, especially since one cannot postulate a priori the persistence of the background conditions (e.g. high demand of manpower for building projects) prevailing in the 6th century.

Nevertheless, on can try and use these few glimpses of information in order to obtain some insight in the development of bare bones ratio over time in Babylon (see Table 9). Our starting point is the wage of 2.5 shekel of silver paid to an unspecified number of millers for an unspecified period dating to 94/3 BC, and the question that shall be tackled is whether this value could constitute a plausible monthly income for one person (note that wages in the 6th century were on average higher by a full shekel). As the same document (CT 49 150 = Van der Spek 1998 text 13, see footnote 9) also mentions a barley equivalent (90 litres/shekel) that was rather favourable for the period in question (which impression is confirmed by the data of the Astronomical Diary's: the years 95-93 BC saw the lowest prices of the decade 99-90 BC), we experiment with two differing starting assumptions. In the first row (150-126 BC), we assume that this wage was representative for a monthly wage for the period 150-126 BC, when the average barley price was almost exactly the same as in the document in question. In the second row (125-100 BC) we assume that the wage was representative for the chronologically closest period (125-100 BC). The prices for barley, dates, sesame, cress and wool are given in columns 3-7 of below table. Unfortunately, we miss information on meat, fuel, and house rent.

[15] On the basis of the 6th century mean (date) price which is inflated by the high values prevailing after ca. 520 BC, the silver equivalent of the 180 litres of dates/month standard amounts to 1.24 shekels. This basically means that price rose less sharply in the last quarter of the 2nd century BC compared to the period ca. 520 -500 BC. For the period between 400 and 330 BC, the monthly silver wage corresponding to the 65 litres/month level amounted to one shekel of silver per month – not an unlikely value considering the high level of commodity price (and price fluctuations) in this period.

Hence, we will adopt the ratio of meat, fuel and house rent relative to the other prices from the 6th century BC. This results in the price of an annual bare bones basket (column 8). As in the previous tables, the bare

Table 9. *Bare bones ratio in Babylon, ca. 200BC-100BC*

Period BC	Monthly wages (predicted from 150-126/125-100 using 65 litre barley)	Price equivalents (litres per shekel)					Price annual basket (shekel)	Bare bones ratio
	(shekel/month)	Barley	Date	Sesame	cress	Wool (mina per shekel)		
150-126	2.5	89.3	276.8	17.1	34.0	2.3	8.4	0.90
125-100	2.5	44.9	104	10	30.3	1.5	14.8	0.51

Note: A mina equals 0.5 kilogram. Weights of the different products are taken from table 2. Ratio of meat and fuel to other commodities assumed to be constant from the 6th century.

bones basket is calculated by dividing the annual wage by the bare bones basket multiplied by 4 (see column 9).

During the last quarter of the second century BC, a monthly wage of 2.5 shekels of silver would mean a lower standard of living in Babylonia compared to the 6th century BC, but not impossibly low: the bare bones ratio is only slightly below the values for Roman Egypt (but clearly behind those of the Roman Empire and Han China). In more favourable years, this income would have easily sufficed to maintain a family, as is clear from the first value (150-126, applicable to 94/3 BC). Such a development would actually be commensurable with overall developments in the 2nd century BC when a worsening of climatic circumstances was accompanied by increasing political instability (as reflected by the growing number of instances of armed conflict) and higher commodity prices in Babylonia (Huijs, Pirngruber, and Van Leeuwen, *forthcoming*). Although we do not know whether the attested wage of 2.5 shekel constituted a monthly income for one person, it is thus at least possible that this value is not far off the mark. The important ramification is that the other attested silver rations (*kurummatu*) are now clearly shown to have been supplements to total income. Taking the ration of a cleaner (1.5 shekel) or a porter (1 shekel) (see footnote 9 for these values), we were to end up with subsistence ratio's in 125-100 BC of 0.29 and 0.19 respectively. This is of course far below the possibility of a family to survive.

5. Comparing welfare

5.1 A comparison of welfare in the ancient world

In the previous three Sections we dealt with the evidence on welfare of common labourers in major regions of the ancient world: Han China, Babylonia in the 6th and 2nd centuries BC, Roman Egypt, and the Roman Empire as approached via the edict of Diocletian. In this section, we would like to address the question of how these results compare to one another as well as over time.

Therefore, we first must address the issue of side-income. This is an important question since female and children's labour might have brought in a substantial part of household income, but essentially unanswerable since we do not have enough observations of female and children's incomes. Yet, the few data we do possess indeed indicate that their income was not trivial. In the previous section we already mentioned for Babylonia that, according to rations lists from 5th century BC Babylonia (Hackl/Pirngruber *forthcoming*; see also Joannès 2008 on female labour), female temple dependents earned rations of 45 litters of barley a month compared to 65 litters for men (i.e. 75% of a men's income). Even though not all women will have worked for a wage, this implies a significant contribution to the welfare ratio of the household. Something similar might be said of Han China. Indeed, Allen (2009) claims that women's work might have contributed significantly to the household budget in China, a point also made by Li (1998, pp. 150-5) and Pomeranz (2000, pp. 290, 319-320). We do not, unfortunately, have many observations on female wages for the Han dynasty. The only data point available for the Han period is a female maid earning ca. 300 *wuzhuqian* per month (Wen 2002), suggesting an income of about 60% of the wage of a male labourer. Likewise, Yin (2006) showed that in the Han Dynasty a female income from cloth making was about 70% of a male wage. Hence, even though it is evident that male labourer's wages in the societies under discussion was supplemented by significant female (and possible children's) income, this is difficult to quantify and we will refrain from further analyzing this question. With this caveat in mind, we will follow the literature and look at the male subsistence ratios only (e.g. Allen 2001; 2009) for a comparison.

Let's start with a comparison across our four regions. Labourers had clearly the lowest welfare ratios in Roman Egypt around 100AD and Babylonia in the Parthian period (early 1st century BC), at 0.55 and 0.51 respectively. Around 300 AD, labourers in the Roman Empire seem to have been considerably wealthier, at a welfare ratio interval of 0.65-0.78 in a period of favourable background conditions (see footnote 2). In Babylonia in the 6th century BC, welfare as conventionally calculated was slightly below these Roman levels, but in reality probably somewhat higher owing to the scarcity of labour (resulting in year-long occupation rather than the assumed 250 days). According to our results, Han China (100 BC) was the most prosperous region, with a level of 0.87. This clearly suggests that in Babylonia the position of a labourer deteriorated over time, the crucial turning point being probably the dislocation of the imperial core away from Babylonia first to Persia (Persepolis, Susa) and then in the Seleucid period towards the Mediterranean (Antiocheia).

These results seem to be fairly straightforward. However, they tell us little about the relative positions of labourers within these societies. After all, a welfare ratio of 0.55 in Egypt for a labourer versus one of 0.87 in Han China sounds very positive for China, but things change if this value applies, giving a fictitious example, to the bottom 10% of the population in Egypt, but to the bottom 90% in Han China. Hence, we are interested in the relative position of these labourers in ancient societies as well.

This kind of information is obviously scarce. Fortunately, there is a good point of departure in the work of Scheidel and Friesen (2009, p.79 and Tables 8-9). They apply a Pareto distribution on income of the Roman population, both elite and non-elite, simulating by what percentage the population share from total will decrease with doubling income. They found a plausible drop of 66% of the population each time wealth doubled, meaning in an optimistic scenario, about 65% of the total population lived at or below subsistence (and at 82% in a pessimistic scenario). Thus, combining our estimate of the wage an unskilled labourer in the Roman Empire with their income distribution means that our labourer was representative of the bottom 65-82% of the population, living at a welfare ratio of 0.7 or below.

For the other regions under discussion in this contribution, the method of Scheidel and Friesen cannot be readily adapted since no similar information is available. For China, it is, however, possible to start from an observation in the Han Shu (History of the Han) and Shih-chi (Swann 1950, p. 439) where it is said 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-tenth [of the wealth of the empire]." In other words, the text suggests that 30% of the empires population (living in the floodplain of Shaanxi) held 60% of the wealth. "Wealth" seems to refer to "income" as can be derived from the fact that in both documents frequently income from land as well from other occupations is referred to as "wealth". This provides us with a point at the Lorenz curve, enabling us under the assumption that the income distribution is lognormal (e.g. Soltow 1998) to calculate the Gini coefficient of inequality, which in this case would amount to 38.[16] However, this value is obviously too low since the main assumption is that all people living within the passes dispose of the same income (i.e. there is no income inequality in that area and, by extrapolation, in the remainder of the Han Empire). Hence, in order to arrive at a correct estimate of inequality, we need to apply assumptions about inequality within both the land of the Passes and the remainder of the Empire. This may be done by using the work of Milanovic, Lindert and Wiliamson (2007) who calculated ancient inequalities for several societies around the world. On that basis, we can assume a minimum

[16] First, we assume that the Lorenz-curve, under the assumption of log-normality, can be expressed as follows (Lopez and Servén 2006):

$$L(p) = \Phi(\Phi^{-1}(\mathrm{p}) - \sigma)$$

Where p denotes the poorest p^{th} quantile of the population, and σ is the standard deviation of the log income and Φ(.) denotes the cumulative normal distribution. The Gini coefficient (G) can thus be expressed as:

$$G = \sqrt{2}\Phi^{-1}\left(\frac{1+\mathrm{G}}{2}\right)$$

within-country inequality of 30 and a maximum around 50. If we apply these minimum and maximum figures to the both parts of the Chinese Empire, we can calculate a minimum and maximum possible inequality for China as a whole as 47.6 and 50.7.[17]

We now have the income distribution so we need two more pieces if information. First, we need to know what the total income in society is and, given the distribution, we also know the income of each of the population subgroups. There exist no per capita GDP for the Han dynasty, but we can with some level of confidence argue for a certain minimum and maximum per capita income level. The pessimistic view is proposed by Maddison (1998, 38) who claimed that the economic position of Han China was comparable to 5th century AD Europe. He set his per capita income measure around 450 GK dollars (Maddison 2007). On the other side, it has been argued that the Han Empire was quite rich and technologically advanced (e.g. Needham 1954, 1969, 1981, 1986; Elvin 1973).Therefore, we assume that per capita income during Han could not have been more than during the start of the Song dynasty (e.g. Guan and Li 2012, Table 2) which is often considered a peak in welfare in China, i.e. ca. 1,058 GK dollars. Second, assuming our labourer had a yearly income of 0.87*4*400=1,392 GK dollar (400 dollars being the subsistence minimum), we can calculate, by comparing with the earlier estimated income distribution, that our labourer belongs to the bottom 75-94% of the population. However, 94% seems grossly overestimated since that is based on an implausibly low per capita GDP estimate (based on available productivity and technological evidence [e.g. Needham 1954]) it seems unlikely that per capita income in the Han was significantly smaller than in the Song) and, hence, we prefer an estimate around 80%.

Consequently, the difference is the relative position of the unskilled labourer was not much different in the Roman Empire and Han China: in both cases, they made up the bottom ca. 80% of the

[17] The calculations are done by applying a log-normal distribution with a given maximum and minimum Gini on both regions for China. In this way we can calculate income for every decile within each region. Combining the individuals from the two regions together results in an over-all Gini.

population. We do not have similar information on Babylonia and Roman Egypt,[18] but we expect that the relative position of the labourers would be almost identical. For example, Bagnall and Frier (1994, p. 72-73) argue for Egypt that about 2/3 of the village population earned an income at the level of an unskilled labourer and lower, with somewhat bigger proportion of higher income the (sparse) cities. This boils down to on average 60% in the economy to which we have to add ca. 10% slave population to arrive at a realistic estimate of labourers at or below subsistence, which make up ca. 70% of the population in Roman Egypt.

5.2 A comparison of welfare over time

It thus seems that the wages for unskilled labourers are indicative of the bottom 70-80% of society in ancient times. Their welfare levels were generally below the subsistence necessary to maintain a family. We shall compare this income to later time periods.

For Asia we do not have many data. The evidence that exist, however, suggests that for China, not much changed in the relative position of a labourer household. Indeed, Adam Smith noted in 1776 (Chapter VIII, 24) that the situation in his time was about equal to that in the period of Marco Polo, concluding that "[t]he poverty of the lower ranks of people in China far surpasses that of the most beggarly nations in Europe." Basically, according to Smith's observations, agriculture

Table 10. *Bare bones basket in Antiquity and after*

	China	Egypt	Babylonia	Roman Empire	England
500 BC			0.71		
100 BC	0.87		0.51		
100 AD		0.55			
230 AD		0.56			
300 AD				0.65-0.78	
1290 AD					0.92

[18] However, Kron (2011) did make a distribution for 4th century BC Greece wealth.

1381 AD		1.44
1522 AD		2.60
1750 AD	0.94	2.50
1800 AD	0.91	2.10

Up to 300 AD data taken from this paper. China 1750 taken from Allen et al. (2011) and modified as given in this paper Section 3. 1800 is taken as rural wages in Beijing, also taken from Allen et al. (2007) and modified. England from, Broadberry et al (2013 forthcoming). These data were modified by increasing its consumption from 155 to 170 kg (to arrive at 2100 kcalories), and by increasing the days worked for 1750 and 1800 to 300 according to Cark and Van der Werf (1998, 838) and Voth (2001,1078).

and fisheries as well as artisan work hardly brought in more than enough food for bare survival. This picture seems to be confirmed by our modification of the work done by Allen et al. (2011) and presented in Section 3, where we showed that the welfare ratio in 18th century Beijing was essentially similar as during the Han Dynasty. Also, there seems to have been remarkable little change in the relative position of the labourer within society since Milanovic, Lindert, and Williamson (2007) showed for 1880 that 98% consisted of commoners. Obviously this includes also other categories, but their data is certainly congruent with the idea that ca. 80% of society lived at or below subsistence.

Comparing our data with the evidence for England (see Table 10), we find that its welfare ratio at around 1290 were more or less equal to Han China and not significantly above the value of 6th century BC Babylonia or the Roman Empire around 300 AD. The crucial turning point in this respect was the era of the Black Death, when the welfare ratio jumped to 1.44 in England, and continued to rise thereafter, probably triggered by rising wages and increased productivity. The exact mechanism of this transition remains under heated debate though. Some authors have stressed the transition to a pastoral economy with more animals to increase capital intensity and, hence output (Broadberry and Campbell 2009). Others have focused on the role of cities which strengthened the position of labourers when labour scarcity occurred during the Black Death (e.g. Acemoglu and Robinson 2012) or the reduction of fertility rates due to the stronger position of women in England (De Moor and Van Zanden 2010).

Yet, this development of the welfare of labourers even underestimates actual welfare development in English society as a whole. In ancient societies, the income of unskilled labourers was representative for the bottom 80% of society (in a pessimistic scenario). Broadberry et al. (2013 forthcoming) calculated a value of 70%[19] for England in 1290, a number not much different from that of ancient societies a thousand years earlier. However, a rapid change took place the following centuries: In 1688, the proportion of the population living at or below subsistence had already decreased to 45%, after which it declined even further to 40% in 1759. Hence, whereas the welfare ratio of the common labourer increased strongly, their relative share in total population decreased. This suggests that society as a whole witnessed even stronger economic growth than evidenced by the welfare ratio. This phenomenon did not occur in, for example, China. Even though there is little direct evidence, we may conclude for China, based on a sample of occupations collected by Wang (2000, p. 50) that around 77% of the population earned the income of a common labourer or less at the end of the 18th century. Hence, in China the relative proportion of the labourers was about the same in the 18th century as it was during the Han Dynasty, suggesting that average incomes in Chinese society stagnated between Han times and the 19th century. All in all, this evidence implies that the Great Divergence started already around the Black Death rather than around the 17th/18th century as claimed by scholars like Frank (1998) or Pomeranz (2000).

6. Conclusion

Recently, the focus in analyzing welfare in early societies has shifted to the so-called welfare ratio, which calculates the share of a subsistence basket of goods and products that a single wage of a male unskilled labourer may buy. Even with the obvious drawbacks (like extra income from wife and children), this is probably the best indicator available so far to gauge individual level welfare.

[19] We assumed that the category including skilled and unskilled laborers, small tradesman and small clergy consisted for 50% of unskilled laborers.

In this paper we aim to extend these analyses to the ancient world. We modify existing estimates for Roman Egypt (100 and 230 AD) and the Roman Empire according to the edict of Diocletian (ca. 300 AD) to make them consistent with other estimates and add our own estimates for the Han Dynasty in China ca. 100 BC and for Babylonia ca. 550 and 100 BC. The main conclusion is that in all societies the welfare ratios were substantially below subsistence. Yet, even within this low level there is a clear divergence between agricultural Roman Egypt (around ca. 100 AD) and Babylonia in the Parthian period (around 100 BC), which witnessed clearly lower levels of subsistence than especially the Han but also the Neo-Babylonian Empire.

Of course, this is only part of the story. After all, if unskilled labourers belonged to the bottom 90% in country A and the bottom 10% in country B, this means that the relative proportion unskilled labourers in society might have been wildly different irrespective of its welfare level. However, our tentative data does not suggest such a wide difference. Rather, we find that in all regions the unskilled labourer belonged to the bottom 80% of the workforce in ancient times.

A similar pattern may be distinguished over time until the Black Death. We find that also in England in 1290 the welfare ratio and the relative proportion of unskilled labourers was not much different from that in the Roman and Han Empires a thousand years earlier. However, this pattern changed after the Black Death. Whereas in China the position and welfare ratios, remained stable, in England the welfare ratio increased and the relative position of the unskilled labourer in society deteriorated suggesting that other social groups in society experienced even fast progress in their welfare levels.

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