Prices and Quantities in Historical Income Comparisons – New Income Benchmarks for the late Nineteenth and Early Twentieth Century*

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Summary

This paper argues that current price historical GDP benchmarks are feasible for the late nineteenth and early twentieth century. Towards that goal, we provide current price GDP benchmarks along modified ICP lines for thirteen currently developed economies. The benchmarks cover 1872 and 1910. They differ in fundamental respects from the familiar Maddison income projections. In particular, the current price estimates raise the relative income of the US while they lower the income of Belgium, the Netherlands, Switzerland and the UK. A striking example is Switzerland where previous estimates show the Swiss leading the world in terms of income per capita whereas the current price estimates show the Swiss as well down the pack.

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1. Introduction

Modern economic growth began in Western Europe and spread outwards. To study the central characteristics of growth - structural change, convergence/divergence and changes in economic leadership - requires comparable data on GDP. The last decade has seen important changes in how economists compare income that have important implications for long run income comparisons. In particular, the field has moved to comparing GDP with current prices - that is the prices closest in time to the desired comparison year - as compared to the fixed prices of previous approaches. The change in intellectual fashion is, for example, on view in the latest version of the Penn World Tables (henceforth the PWT) which compares income using multiple current price benchmarks; see Feenstra et al (2015).

This paper provides current price historical GDP comparisons for the major western economies covering 1872 and 1910. It fills a gap in the literature as for most countries, current price GDP comparisons do not reach before 1950. As it turns out, the new benchmarks differ from existing estimates in fundamental ways. To summarize, the current price estimates raise the relative income of the US while they lower the income of Belgium, the Netherlands, Switzerland and the UK. The case of Switzerland stands out. Consider 1910. Previous work shows the Swiss with the highest living standards for this year with income per capita forty percent above America. The current price estimates, however, show the US as the world leader with the Swiss well down the pack.

The current price approach departs from the standard approach in literature - popularized by the late Angus Maddison (1995, 2001 and 2003) and carried on by the Maddison Project, see Bolt and Van Zanden (2014). The Maddison estimates work as follows. First, he takes a purchasing power parity (PPP) adjusted GDP comparison for a recent year, 1990, from the International Comparison Program (henceforth the ICP). Second, he projects the ICP benchmark backwards using GDP growth rates.[1] The results are in 1990 prices.

To compare income in the past, projections must therefore solve three complex problems. They compare income across space for a recent year. They compare income over time for the base country and, finally, they compare income over time for the comparison country. Half a century ago, Robert Gallman projected income per capita for France, Britain and the US to 1840 using a 1950 base year comparison. His description of the conceptual difficulties he faced (Gallman (1966 page 6) holds for all subsequent efforts:

> *The procedure has one very important disadvantage: the results are difficult to interpret. As a first approximation, we are comparing 1840 (circa) national products valued in 1950 prices, since the extrapolated estimates are in 1950 prices. But the extrapolators are not based on 1950. The price base of a constant price national product series affects the rate of growth of the series; in general, the earlier the price base, the higher the rate of growth. Since the base years of the extrapolators are earlier than 1950, the extrapolated 1840 values are really smaller than 1840 national 'products in 1950 prices. If the extent of "bias" in the three series were identical, the comparisons would be unaffected, of course; but there is no good reason for supposing that they are. The date of the price base differs from series to series. In addition, the extent to which an*

[1] The first use of projections for long run income comparisons appears to be Clark (1940).

early price base raises the rate of growth of a national product series, compared with a late price base, depends on the extent of changes in the price structure over time. There is no good reason for believing that the price structures of the three economies changed at the same pace. (Gallman (1966, page 6.)

We would add one final difficulty to his litany. Suppose we compare GDP for two countries for a year in the distant past, say 1870. It should be obvious any change in the base year or any revision in the underlying GDP series for either economy *between 1870 and the base year* will change the 1870 projections. Since revisions are inevitable, projections are condemned to always rewriting history – a point also made by Kuznets (1956, page 7). Put simply, projections depend on the entire sequence of prices/quantities from the base year to the year compared. In contrast, the current price estimates are simple conceptually. They are in the prices of the comparison year and they depend only on these prices and quantities. History is written once.

Given the recent changes in the Penn World Tables, we might expect increased interest in current price historical income comparisons as economic historians seek to make their estimates consistent with the best practice in the field as exemplified by the Penn World Tables. As Lindert (2016) notes, a further stimulus to these efforts are ongoing debates which hinge on the relative merits of projections and current price estimates.[2] At a minimum, we would guess there is now an acceptance among

[2] An early debate concerns to the relative standing of the UK and US. The Maddison projections showed the UK with a substantial income lead for the nineteenth century with the US taking over in the early 1900's. Prados De la Escosura (2000) and Ward and Devereux (2003, 2004, 2005) argue for an early US income lead using current price estimates. Broadberry (2003) and Broadberry and Irwin (2006) defend the Maddison projections while Woltjer (2015) hews to the middle ground. The literature has recently taken an unexpected turn as Peter Lindert and Jeffrey Williamson, Lindert and Williamson (2016), find a larger US lead before 1870 and one that stretches further back in time than claimed by either Prados De la

historians that current price estimates are useful if only to crosscheck the Maddison projections.

To apply the PWT/ICP approach to the past requires current price historical GDP benchmarks constructed from disaggregated price and expenditure data. To date, there are no attempts to provide such historical benchmarks along consistent lines for the major western economies.[3] We aim fill part of this gap by comparing real income for thirteen countries - Australia, Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, the UK and the US – the core western economies.[4] The current price benchmarks cover 1872 and 1910. Thus, they bracket the beginning and the end of a great globalization episode.

To generate the current price historical estimates, we develop a methodology that adapts the ICP framework to the realities of historical data. Our approach departs from that of the ICP in that we emphasize quantity as well as price comparisons.

The next sections explain data sources and procedures. There are, as we might expect, formidable challenges when using historical data to build current price GDP

Escosura (2000) or Ward and Devereux (2005). The vigorous UK/US debates anticipated most the points raised in the later ICP/Penn World Tables literature.

[3] There are other current price approaches. Leandro Prados De la Escosura (2000) is the pioneer in this area. He compared GDP for the major developed economies in current prices from 1820 to 1990 using a short cut regression model. More recent work by Lindert (2016) supplies benchmarks for a wide range of countries over a much longer time spans using a different methodology with fewer data requirements.

[4] The recent literature provides some isolated pre-1950 current price benchmarks. O'Brien and Keyder (1978) consider France and the UK for the nineteenth century. Alan Heston and Robert Summers (Heston and Summers (1980)), two of the creators of the ICP, compare India and the US for 1870. The next work is by Haig (1989) and Thomas (1995) who compare Australia and the UK. The 2000's saw increased interest with, amongst others, Van Zanden (2003) for Java/Netherlands, Ward and Devereux (2003, 2005) for the US/UK, and Fukao, Ma and Yuan (2006, 2007) for China/Korea/Taiwan/US. Recent work includes Broadberry, Custodis and Gupta (2015) on India/UK.

benchmarks. On the other hand, there are also some rich data sources. Sections three and four provide the current price GDP benchmarks. As it turns out, the current price estimates differ in crucial respects from the Maddison GDP projections. This will surprise no one familiar with the ICP/PWT literature where divergences between projections and benchmarks are the norm.[5] As Deaton and Aten (2014, page 10) note - projections and benchmarks *cannot* be equal because comparisons over space (the current price estimates) and comparisons over time via projections involve different sets of prices and quantities and must yield different outcomes, except by chance.[6] For this reason, economists have abandoned the notion that projections and current price benchmarks should agree for the ICP/Penn World Tables. Economic historians will, presumably, follow suit.

The question then arises how to choose between current and fixed price estimates. For example, what income measure better captures the relative position of Switzerland for 1910, the projections or the current price estimates? The PWT resolves conflicts on theoretical grounds in favor of the current price estimates. Put simply, the current price comparisons have desirable theoretical properties while the projections do not. We do not advocate this *a priori* approach. Rather we argue that we should

[5] Differences between benchmarks and projections exist for every ICP round. The most famous examples are China and India where projections from the 1993 round of the ICP differed from the 2005 benchmarks by fifty percent. Remarkably, the release of the 2011 round of the ICP in 2014 reversed many of the 2005 changes see Deaton and Aten (2014).

[6] Kravis, Heston and Summers (1982), Summers and Heston (1988a, 1988b) and Aten and Heston (2002) provide early discussions of why projections do not equal benchmarks. Feenstra, Ma and Prasada Rao (2009), Deaton (2012) and Deaton and Aten (2014) give more recent treatments. The problem is long standing. It was noticed early on by Clark (1950 page 33) when he found that his projections from 1929 did not equal his benchmarks for the 1900's and that the differences were large.

resolve conflicts between projections and historical benchmarks by appealing to empirical evidence. To support this approach, we provide two tests. Building on Prados De la Escosura (2000), we test whether the current price benchmarks are consistent with what we know about relative price levels. Specifically, we test whether they are consistent with Balassa Samuelson and historical evidence on relative food prices. The second approach uses the different methodologies for international comparisons. The ICP compares real expenditures on GDP. As an alternative, Rostas (1948) and Paige and Bombach (1959) compare GDP using sectoral output data. Along similar lines, Alan Heston (1998), one of the founders of the ICP, advocates real wage comparisons as a GDP comparison from the income side.

Applying the various tests to the late nineteenth century, we find that the empirical evidence supports the current price benchmarks. In particular, the projections are inconsistent with evidence on relative prices, real wages and sectoral productivities. For the case of Switzerland, we show that the projections imply non-food prices and sectoral productivitities for agriculture and manufacturing that are highly unlikely.

2. The Price Benchmarks, 1872 and 1910

Following the ICP, we compare final spending on the components of GDP - consumption, investment and government. The first step computes relative price levels while the second compares GDP using the price benchmarks. This section outlines the data sources and methods for the price level comparisons. We save a complete account for the data appendix.

We compare price levels with the Fisher ideal price index - the geometric average of a price index constructed with base country weights and a price index constructed with partner country weights. The Fisher index is the most widely used index for historical comparisons. In addition, it has appealing theoretical properties. As Diewert (1976) showed it is a superlative index and thus approximates a true welfare measure.[7]

The US is the base economy. Following the standard terminology, we refer to the US weighted index as the Laspeyres price index and the partner weighted index as the Paasche.

Equation (1) is the Fisher Ideal Price index for year T for country I relative to the US.

$$(1) \qquad P^F(p^{us}, p^i, x^{us}, x^i)P = (P^{us}(p^{us}, p^i, x^{us})* P^i(p^{us}, p^i, x^i))^{0.5}$$

[7] The OEEC studies of the early 1950's, the forerunner to the ICP, used the Fisher ideal see Gilbert and Kravis (1954). The Fisher index, however, does not ensure transitivity. As a result, the ICP and the PWT rely on multilateral comparisons.

Where P^{us} and P^{i} are the prices indices calculated using US and partner expenditure weights and p and x are prices and quantities. To understand how the price comparison works, we focus for the moment on the US weighted price index. Equation (2) re-expresses the index as a weighted index of price relatives where the weights are US expenditure shares denoted by θ_j^{US}.

$$(2) \qquad P^{US}(p^{US}, p^{i}, x^{US}) = \sum \theta_j^{US} p_j^{i} / p_j^{us}$$

To compare price levels, we use price data from contemporary comparative price surveys outlined later. We also use unit values derived from quantity data.[8] The price comparisons are well known from the ICP. But such price comparisons are not feasible for all items. The ICP, for example, uses quantity comparisons for "comparison resistant services" such as education. As we shall see, the quantity/unit value approach is important to historical benchmarks because of the gaps in historical price data.

We illustrate a quantity/unit value comparison with a UK/US example. Let us define θ_i^{US} as the share of US expenditure on the i'th good and Y^{US} as US nominal GDP per capita. For concreteness, we term this item "beef". Suppose we do not have a price for beef. But suppose that we can measure beef consumption by pounds of beef consumed. In terms of notation, x_i^{US} is the quantity measure for beef. Equation (3)

[8] The World Bank (2013) provides a recent discussion of the ICP methodology. We are greatly influenced by the earlier OEEC studies of Gilbert and Kravis (1954, 1958) who faced similar data problems to those faced in historical comparisons.

gives the US price, or more correctly the unit value, denoted by $p_i^{US,}$ implied by the expenditure and quantity data.

(3) $$p_j^{US} = Y^{US}\theta_j^{US}/x_j^{US}$$

We obtain UK unit values in a similar fashion. The price indices in (1) and (2) therefore contain prices and unit values.[9]

Table 1 gives the expenditure breakdown for our comparisons. For consumption, we cover food, rent, fuel and light, clothing, alcohol, tobacco, communication, transportation, education and domestic service. Within the food group, we cover flour, beef, mutton, pork, butter, cheese, tea, coffee, sugar, potatoes, eggs, and milk. In total, we compare thirty-three categories of expenditure.[10]

The Table shows where we have price and quantity/unit values indicators for the expenditure categories.[11]

[9] Note, however, that the unit values depend on nominal GDP. Any change in income will change the unit values.

[10] There are some gaps in coverage. For example, we omit consumer durables such as furniture. The coverage of personal services is incomplete as we lack data on medical services, hotels, recreation etc. For food, we do not include vegetables, other than potatoes, or fruit. The gaps arise due to data limitations and our broad country coverage.

[11] We rely much more on quantity comparisons than the ICP. The OEEC studies of Gilbert and Kravis (1954, 1955, 1958), the forerunner to the ICP, also emphasized quantity comparisons. They did so because, like us, they lacked comparative price level surveys for many items.

Table 1
Expenditure Categories, Price and Quantity Indicators

	Price Indicator	Quantity Indicator
Consumption		
Food and Beverages		
Wheat Flour	x	x
Rye flour	x	x
Corn Meal	x	x
Beef	x	x
Mutton	x	x
Pork	x	x
Eggs	x	x
Fresh Milk	x	x
Butter	x	x
Cheese	x	x
Potatoes	x	x
Tea	x	x
Coffee	x	x
Sugar	x	x
Rent	x	
Fuel/Light	x	
Shoes and Clothing		
Shoes	x	
Clothing	x	
Alcohol		
Beer		x
Spirits		x
Wine		x
Tobacco		x
Domestic Service	x	
Travel		
Railway	x	x
Other		x
communications		
Letters		X
Telegrams		X
Telephone		
Education		x
Investment		
Construction	x	
Machinery	x	
Government		
Labor	x	
Other purchases	x	

The price comparisons cover rent, clothing, gross capital formation and government while quantitative indicators/unit value comparisons cover services, transportation, communication and tobacco/alcohol. For some items, most notably food, we have price and quantity indicators. We cannot apply quantity indicators to all items because quantity comparisons are not feasible for heterogeneous items such as clothing or investment. Overall, the price comparisons cover about eighty percent of spending for most countries while the quantitative indicators cover about fifty percent.

From equation (2), we need expenditure shares along with price and quantity/unit value indicators to determine price levels.

Expenditure Weights

The national accounts supply the overall weights for consumption, government and investment. We take the aggregate UK weights from Feinstein (1972), the Dutch weights from Smits *et al* (2000) and so on. As far as possible, we use the national accounts for disaggregated weights. Unfortunately, they do not always provide sufficient detail. In addition, the categories are not always consistent across countries – for instance expenditures on heat and water are sometimes included in housing and sometimes not. [12] To fill the gaps, we supplement the national accounts with expenditure studies such as the US Bureau of Labor (1890, 1891) and the Board of Trade (Board of Trade (1908, 1909, 1910, and 1911) and various country sources. A drawback of the budget studies is that their expenditure patterns often relate to relatively

[12] One of the few attempts to tackle these problems is Kuznets (1962, 1966) in his classic work on the structure of consumption.

low incomes. As a result, they show higher food shares than the national accounts. The budget studies also reflect mainly urban consumption patterns whereas we require overall (urban plus rural) expenditure weights.

The data appendix provides our expenditure shares for the food items as well as for the broad aggregates.

Sources for Price Data

For each country, we searched for retail price data collected by contemporary agencies specifically to compare price levels internationally. Ideally, the price sources would use a common price schedule that specified quality. To our surprise, we found a range of studies to satisfy many these requirements. As several of our sources are little known, we discuss them briefly.

Below are the sources for the benchmark years, 1872 and 1910

Price data - 1872

Labor in Europe and America (1875) and the Fifth Annual Report of the Massachusetts Bureau of Statistics of Labor (1874)

Edward Young (1875) provides price and expenditure data for towns in Belgium, Canada, Denmark, England, France, Germany, Italy, Netherlands and Norway. At the time of the study, Young was Chief of the Bureau of Statistics of the United States Treasury. He sought information from US consuls regarding the "rates of wages, the cost of subsistence and the conditions of labor". The consuls gathered retail prices

using a common price schedule that specified quality.[13] The schedule is quite detailed. There are nine categories of foodstuffs, ten categories of clothing, two categories of rent, and miscellaneous items.

These price data appear in a modified fashion in the Fifth Annual Report of the Massachusetts Bureau of Statistics of Labor (1874) –published by Carroll D. Wright. [14] The report lists prices for forty-five towns in Europe and various towns in Massachusetts. Altogether, Wright has data for fourteen English towns, twelve German towns, two Belgian towns, two Danish towns, three Swiss towns but only two Italian towns and three French towns. As mentioned, the sources of the price data in the Fifth Annual Report are Young's investigations. Wright improved upon Young (1875) as he standardized weights and measures. He also provides prices in US dollars rather than gold. For the most part, we use Wright rather than Young (1875). [15]

[13] The first appearance that we found of the Young schedule is Wells (1868), Appendix D page 117 prepared by Young. The Weeks Report (US Congress (1886)) also collected price data using the Young schedule.

[14] Wright is an important figure in the development of US official statistics. He served as the Chief of the Massachusetts Bureau of Statistics of Labor and then as the US Commissioner of Labor all the while developing a reputation for careful data collection based on the use of well-trained agents. Wright is remembered today for his budget studies – the first large systematic studies in this area. The Fifth Annual Report (1874) is the first of several reports compiled or directed by Wright that focused on the collection of comparable price data for the US and other countries. See Leiby (1960) for an account of his life and work.

[15] This short description does not exhaust sources of comparative price data for the early 1870's. Most notable are the British Consular Reports on the relative cost of living see Foreign Office (1870, 1871, 1872). These reports are less systematic than the US reports cited above as they do not use a common price schedule. In addition, there is the Colonization Circular issued by Her Majesty's Colonial Land and Emigration Commissioners that provides price data for Australia,Canada and other dominions. Nonetheless, these studies contain much valuable data. We used them to cross check our price data for 1872. There is reasonable agreement. There are also studies that provide comparative retail price data between 1872 and 1900. For example, the US Department of State issued circulars to consular officers on two occasions requesting information on prices and wages to "facilitate considerations of US trade with foreign countries" see US Department of State (1879), US house of Representatives (1885). There are 1879 reports for Australia, Belgium, Denmark, France, Germany, England, Ireland, Scotland, Wales, Italy,

Price data 1910 - The Board of Trade and the Dominion Reports

The Board of Trade, (Board of Trade 1908, 1909, 1910, 1911) provides food prices, rentals, coal and paraffin prices for the UK, Germany, France, Belgium and the US. These studies are well known, see Kravis (1984), and do not require further elaboration. As it turned out, the Board of Trade investigations led to follow up work from statistical authorities in Australia (Australia Commonwealth Bureau of Census and Statistics (1912)), South Africa (Union of South Africa (1914)) and Canada (Board of Inquiry into the Cost of Living. (1915)). The "dominion" reports are now forgotten. Yet they provide valuable comparative price data for countries not covered by the Board of Trade. In addition to these sources, there is a variety of other sources for comparative price data for the 1900's. Examples include the United States Bureau of Labor Statistics (1915) and Lodge (1911).

Where possible, we checked our price data against domestic sources- particularly food. For 1872, retail price data are scarce. By 1910, there are retail prices for all countries. For the most part, we found agreement across sources.

The contemporary sources outlined above provide a large volume of comparative price data. There are gaps in the sources. First, and most important, we found no comparative price data for capital goods. To compare investment price levels, we create benchmarks for construction and for equipment and machinery. The

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Holland and Switzerland. The 1885 study covered the same countries. The price data in these reports used similar commodity coverage to the Fifth Annual Report. Their drawback is weak data on rents and clothing. We used price data from these reports to generate food and other price benchmarks for 1879 and 1884 to cross check the 1872 estimates.

construction index is composed of raw materials prices and relative construction wages. For equipment and machinery, we compare wholesale prices of iron and steel and we also use tariff rates on capital goods. To be sure, the investment benchmarks are crude. In our defense, researchers have used similar price data to deflate investment in historical national accounts see Collins and Williamson (2001). Nonetheless, the reliance on raw material prices to compare investment price levels is a serious deficiency of historical price benchmarks.

The second limitation of the price sources is that they neglect tobacco, alcohol and services. For these items, we use the quantity comparisons discussed earlier.

Third, our price data refer almost exclusively to urban prices. To compare GDP the ICP requires average or "national" prices, see Deaton and Heston (2010) for a recent discussion. The urban rural adjustment is potentially an important one given the largely rural nature of our economies for 1872.[16] As outlined in the appendix, we discovered a fair amount of information on urban/rural price differences for the late nineteenth and early twentieth century. To summarize, prices differences were marked only for food and rent. The differences are also consistent across time and space - urban rents are typically between one and a half to two times rural rents while food prices are from ten to twenty percent lower outside the cities.

Finally, we encountered difficulties adjusting for quality differences. To give one example, we had to exclude bread from the benchmarks, despite a plethora of price data,

[16] For 1872, ten of the thirteen economies had more than seventy percent of their population in rural areas. By 1910, this was down to two – Norway and Sweden.

because we were unable to adjust for the different bread types of Europe – particularly between wheaten and rye breads.[17] Instead, we compare flour prices for wheat and rye. The appendix describes in detail the adjustments for clothing, alcohol, tobacco etc.

Quantitative Indicators/unit value

As we have noted, price data for tobacco, alcohol and personal services are scarce for the late nineteenth and early twentieth century. For these items, we use quantity comparisons and their associated unit values. For tobacco, we measure consumption as pounds of tobacco per capita. For alcohol, we measure consumption of beer, spirits and wine in gallons per capita. For communications, we look at letters and telegraphs sent per capita adding telephones for 1910. For education, we use students educated per capita. For transportation, we used miles travelled per capita by rail with automobiles added for 1910 and so on. The details are in the appendix.

The quantity data are widely available for 1910. There are gaps for 1872 and we rely partly on extrapolations and partly on more dubious sources such as Muhall (1899).

We also collected quantity measures for other items of expenditure to supplement the price comparisons. The most notable example is food. There are good data on sugar, coffee and tea consumption for both benchmark years. There is data for most food items for Australia, Canada, Italy, the Netherlands, Sweden, the US and the UK. There is data on cereals and meat for France and Germany. There are gaps for other countries especially for 1872.

[17] We are in good company as the differences in bread qualities also defeated the Board of Trade.

The data appendix provides price/unit value data for the food items and the broad aggregates.

Next, we provide the price and GDP comparisons.

3. The Current Price Benchmarks – Comparative Price Levels and Real GDP per capita

Table 2 provides the overall GDP price levels for 1872 and 1910. Turning to the results, the 1872 benchmarks show Australia with the highest price level followed by the US, Belgium and the UK. Denmark and Sweden show the lowest price levels. By 1910, the relative price levels of the Western Offshoots have increased and the US has the highest price level followed by Canada and Australia. For this year, price levels within Europe are within a narrow range with the exception of low price Belgium.[18]

To evaluate the benchmarks, we first check whether they exhibit the standard features of international price comparisons.

[18] The Belgian price level is also low in the Board of Trade Study (Board of Trade (1910)).

Table 2

Price Level Benchmarks for 1872 and 1910

(US = 1.0)

	1872	1910
Australia	1.20	0.95
Belgium	0.98	0.60
Canada	0.80	0.97
Denmark	0.76	0.73
France	0.84	0.71
Germany	0.83	0.70
Italy	0.82	0.74
Netherlands	0.84	0.70
Norway	0.88	0.70
Sweden	0.78	0.73
Switzerland	0.83	0.71
UK	0.90	0.77
US	1.00	1.00

Sources and methods: The price indices are Fisher Ideal price indices for overall GDP. The data appendix provides sources and data.

International price level comparisons typically exhibit two common features. First, we would expect the base country expenditure weights (the Laspeyres variant of the price index) to give a higher relative price level as compared to comparison country weights (the Paasche

variant).[19] Second, the spreads between Laspeyres and Paasche indices for countries at different levels of income should be large relative to spreads for countries at similar income levels reflecting divergent expenditure patterns, see Deaton and Heston (2010).

The price benchmarks in Table 2 show these regularities. To support this claim, Table 3 provides the ratio of the Paache to Laspayres price indices, the spread, for both years. From the Table, the spread is less than unity for all twenty-four cases. As required, prices and quantities are negatively correlated. In addition, the 1910 spreads are smaller in most cases, which is also expected given the convergence in price structures discussed in a later section.

To be sure, the spreads are smaller than for the 1950's OEEC studies of Gilbert and Kravis (1954, 1958). This is explainable by the lower precision of our price and expenditure data compared to the 1950's. On the other hand, the spreads are mostly higher than for developed economies over recent ICP rounds perhaps reflecting the fact that differences in expenditure patterns were greater in the past.[20]

[19] As stated by Kravis, Heston and Summer (1982 pg. 74) this is a "usual but not necessary consequence of negatively sloped demand curves".

[20] The spreads for the Board of Trade studies of the 1900's covering food prices and rents are much smaller than those in Table 3 for 1910. This remains a puzzle.

Table 3

The Ratio of Paache to Laspayres price indices for 1872 and 1910

	1872	1910
Australia	0.83	0.81
Belgium	0.75	0.88
Canada	0.96	0.95
Denmark	0.85	0.94
France	0.77	0.84
Germany	0.81	0.90
Italy	0.81	0.89
Netherlands	0.85	0.84
Norway	0.85	0.93
Sweden	0.85	0.94
Switzerland	0.79	0.90
UK	0.87	0.96

Sources and methods: The Table gives the ratio of the overall price index measured relative to the US with partner country weights as a ratio of the price index with US weights. See data appendix.

The price level benchmarks in Table 2 have various applications. In particular, they allow us to compare real GDP per capita in current prices.

GDP per Capita in Current Prices

We compare income with a Fisher Ideal quantity index. Equation (4) is the Fisher Ideal Price index for year T for country I relative to the US.

$$(4) \qquad Q^F(p^{us}, p^i, x^{us}, x^i)Q = (Q^{us}(p^{us}, x^i, x^{us})* Q^i(p^i, x^i, x^{us}))^{0.5}$$

The current price Fisher GDP volume index is the geometric average of quantity indices where output is valued at US and partner country prices. To understand how the comparison works we take a closer look at the index in US prices. Equation (5) re-expresses the index as a weighted index of quantity relatives where the weights are US expenditure shares.

$$(5) \qquad Q^{US}(p^{US}, x^{US}, x^i) = \sum \theta_j^{US} x_j^i / x_j^{us}$$

The price level comparisons used prices and unit values obtained from quantitative indicators. To construct (5), we have direct quantity measures from the unit value calculations. The ICP- price comparisons yield indirect quantity measures. To see how this works we return to our earlier example – beef. Define p^{US}_i as the US price of beef obtained from an ICP style comparative price level survey. We obtain the implied quantity of beef for the US, x^{US}_i by deflation:

$$(6) \qquad x^{US}_i = Y^{US}\theta^{US}_i / p^{US}_i$$

We generate the implied quantities for the partner economies in a similar fashion. The ICP calls its quantity measures "indirect" or "notional" quantities.

Table 4 illustrates the calculation of the current price GDP per capita benchmarks. Columns two and three give nominal GDP per capita for 1872 and 1910 in dollars relative to the US. The GDP data are from national sources detailed in the appendix. Population is from Mitchell (2003a, 2003b) and national sources. The GDP data refer to territories within the then borders. The next columns repeat the price benchmarks from Table 2 while the final columns show real income per capita in current prices obtained by deflating relative nominal GDP by the price benchmarks.[21]

From the Table, we see that Australia, the US, Belgium and the UK have commanding leads in nominal income per capita for 1872. Italy and Sweden are some distance behind. The differences across economies are large. Nominal income for Australia is five times greater than for Italy.

[21] Our price comparisons use both prices as well as unit values derived from quantitative indicators. From equation (3), the unit values depend on nominal income. This means the price level is not independent of nominal income.

Table 4

Real Income per Capita in Current Prices for 1872 and 1910

(US = 1.00)

	Nominal GDP		Price Benchmarks		Real GDP in current prices	
Country	1872	1910	1872	1910	1872	1910
Australia	1.69	1.15	1.20	0.95	1.41	1.21
Belgium	0.90	0.55	0.98	0.60	0.91	0.92
Canada	0.60	0.81	0.80	0.97	0.75	0.83
Denmark	0.55	0.51	0.76	0.73	0.72	0.70
France	0.59	0.44	0.84	0.71	0.70	0.63
Germany	0.56	0.51	0.83	0.70	0.67	0.72
Italy	0.31	0.29	0.82	0.74	0.37	0.39
Netherlands	0.62	0.38	0.84	0.70	0.74	0.55
Norway	0.53	0.44	0.88	0.70	0.60	0.63
Sweden	0.39	0.44	0.78	0.73	0.50	0.61
Switzerland	0.56	0.55	0.83	0.71	0.68	0.77
UK	0.88	0.59	0.90	0.77	0.98	0.76
US	1.00	1.00	1.00	1.00	1.00	1.00

Sources and methods: See data appendix.

Adjusting for price level differences, Australia leads in real income per capita for 1872 followed by the US and the UK. Italy and Sweden bring up the rear.[22] For 1910,

[22] The US was still recovering from the effects of the civil war in 1872. Lindert and Williamson (2016) argue that these years were likely a low point in relative US income levels. In terms of output per worker, the current price estimates for 1872 show the US had a commanding lead over the UK. This is because the ratio of the labor force to population was much lower for the US.

Australia remains the richest economy in terms of real income per capita followed closely by the US. After 1872, the UK and the Netherlands fall relative to the US and most European economies.

How do the current price GDP benchmarks in Table 4 compare to the familiar Maddison Projections? As it stands, the estimates are not comparable since the current price benchmarks are Fisher Ideal quantity indices whereas the Maddison projections value output with 1990 Geary Khamis international prices. To allow comparison, we transform his projections to a 1990 Fisher ideal index and take a US base. Table 5 shows the results. The first columns provide the current price estimates from Table 4. The next columns give the Maddison projections for 1872 and 1910 adjusted to a Fisher Ideal basis.

There are marked differences for some but not all countries. The Madison projections for 1872 show US income per capita lagging Australia, the UK, Belgium, the Netherlands and Switzerland. They show Australia and the UK with equal income. They show Sweden with a slight lead over Norway. They show Canada lags the UK by a large margin and Switzerland leads all of continental Europe. Indeed, Swiss income per capita exceeds US income by sixteen percent! In addition, the projections show relatively high income for Italy.

The current price estimates differ in all these respects.

Table 5

Comparing Estimates of Real Income per Capita

(US = 1.00)

	GDP in Current Prices		Maddison GDP Projections		Log Differences	
Country	1872	1910	1872	1910	1872	1910
Australia	1.41	1.21	1.29	1.03	0.09	0.16
Belgium	0.91	0.92	1.06	0.81	-0.15	0.13
Canada	0.75	0.83	0.70	0.82	0.07	0.02
Denmark	0.72	0.70	0.75	0.70	-0.04	0.00
France	0.70	0.63	0.74	0.59	-0.05	0.06
Germany	0.67	0.72	0.73	0.67	-0.08	0.07
Italy	0.37	0.39	0.58	0.42	-0.44	-0.07
Netherlands	0.74	0.55	1.07	0.75	-0.37	-0.31
Norway	0.60	0.63	0.52	0.42	0.15	0.41
Sweden	0.50	0.61	0.54	0.50	-0.09	0.19
Switzerland	0.68	0.75	1.16	1.37	-0.53	-0.60
UK	0.98	0.76	1.29	0.90	-0.28	-0.16
US	1.00	1.00	1.00	1.00		

Sources and methods: We take the GDP projections from the latest version of the Maddison project. We adjust the estimates to a Fisher Ideal basis using Maddison (1995) Table C-7 page 172. The differences between the Fisher Ideal and Geary Khamis projections are small.

Turning to 1910, we again find significant differences. Consider Switzerland. The projections show the Swiss as the world income leader followed at a distance by Australia

and the US. The Maddison projections also understate income for Norway relative to the current price estimates. They show Sweden leads Norway.

The final columns look at the differences between the current price benchmarks and the projections in logs. For 1872, the differences are twenty-eight percent for the UK, thirty-seven percent for the Netherlands, forty-four percent for Italy and a whopping fifty percent for Switzerland. For 1910, there are sizeable differences for Switzerland, Norway and the Netherlands.[23]

The current price estimates therefore provide a sharply different picture of economic leadership and convergence across the Western economies as compared to the Maddison projections. To summarize, the benchmarks show a higher income level for the US and Canada relative to Europe. They show a smaller UK income lead for 1872 relative to Europe. They show the Netherlands, Italy and Switzerland with sharply lower income and so on. Thus, the current price estimates provide a different perspective on classic debates in economic history – the relative position of the US and the UK, Frances versus the UK and much else.

To restate a point made earlier, the fact that divergences exist between the projections and the current price estimates should not surprise. On the contrary, we expect differences given that the current price benchmarks and projections embody a different set of relative prices. A crucial question yet to be addressed by the literature on long run income comparisons is how to choose between projections and current price estimates.

[23] Bear in mind that these results depend on the base year. We could use as a base, years from 1950 to 2012. Each would produce different results. In particular they would lead to large divergences for some countries and smaller for others as compared to Table 4.

Consider Switzerland again. Was it the world leader for 1910 as implied by the projections – the first miracle economy! Or was it somewhere in the middle as in the current price benchmarks?

The literature on the Penn World Tables holds that the current price estimates are superior on theoretical grounds because they are superlative measures. Viewed using this theoretical lens, projections have few appealing properties. This line of reasoning has led the Penn World Tables and the international comparison literature generally to favor current price measures.[24]

The situation with historical income comparisons is more complicated. With very good data, it is hard to argue against current price estimates. We do not have pristine data for historical comparisons. On the contrary, there are two fundamental sources of measurement error for the benchmarks. The first arises from the imperfections in the price, expenditure and quantity data used in the price benchmarks. These are discussed earlier. The second source of uncertainty is nominal GDP. All historical nominal GDP estimates contain some measurement error. Consider, for example, the well-known differences for the UK between nominal GDP measured from the income and expenditure sides, see Feinstein (1972). Other examples abound. To give one example Toutain (1987) and Levy-Leboyer and Bourguingon (1990) provide GDP estimates for France that can differ by twenty percent. For some countries, notably Belgium and Switzerland, we know little

[24] With complete data, we could reconcile projections with current benchmarks. So far, reconciliations have proved difficult even for recent years. The reason being that the data used in income comparisons over time differs from the data used in the current price comparisons.

about the quality of nominal GDP data. Given these data uncertainties, the current price historical benchmarks require supporting evidence before they can be accepted.[25]

The next section supplies such evidence.

4. Supporting Evidence

This section brings empirical evidence to bear on the current price income comparisons. We proceed in two steps. First, we look at an important crosscheck for the current price GDP benchmarks provided by direct quantity measures. Second, we examine possible ways to adjudicate between current price benchmarks and projections.

We begin by taking a closer look at implied quantities for food. The income benchmarks rely on the implied food quantities obtained using the deflation measure of equation (6). In addition, we have independent measures of food quantities from food balance sheets etc. This allows us to crosscheck the current price estimates for food - the largest items of consumer spending.

The results for the direct and indirect estimates of food consumption were similar for all economies with three exceptions. First, the deflation measure produced implausibly low 1872 levels of food consumption for France and Italy. Second, they showed Belgium with a suspiciously high 1872 food consumption - above the US! We use quantity comparisons for

[25] Summers and Heston (1988a, 1988b) suggest that the best way to think of the relationship between benchmarks and projections is to assume that measurement error exists in both. The latest version of the PWT forces annual projections through current price benchmarks. Ward and Devereux (2003) had earlier used this procedure to derive annual long run UK/US GDP. By emphasizing current price estimates over projections this implicitly assumes that the error in benchmarks is small relative to the errors in the projections. Rao, Rambaldi and Doran (2010), Rao and Rambaldi (2012) provide more recent treatments of benchmarks and projections.

these countries in the final benchmarks.[26] The more general point is that the implied quantities for individual items from expenditure comparisons should be checked against what is known about quantities. This approach cannot be used to evaluate current price estimates relative to projections because projections are usually at the level of GDP.

There are other ways to evaluate the projections. Most notably, Prados De la Escosura (2000) suggested that economists should evaluate historical income comparisons by comparing the price levels from current price estimates to the price levels implied by projections. We shall exploit his insight in two ways. First, we search for Balassa Samuelson – a staple of the trade and growth literatures – in current and constant price estimates. Second, we consider the implications of what we know about disaggregated relative food prices for overall relative price levels.

(i) Implied Price Levels

The Maddison projections yield GDP in 1990 Geary Khamis prices. To calculate the price levels implied by his projections, we divide relative nominal income per capita in Table Four by the Maddison projections. As we shall see, the implied price levels behave quite

[26] It is not obvious to us why the problems arise for France and Italy. Our urban food prices are certainly high for these countries. Yet the Foreign Office Studies (Foreign Office (1870, 1871 and 1872) and the later US consular reports, US Department of State (1879) and US House of Representatives (1885) also show high urban prices. For France, we suspect nominal GDP may be too low. Possible explanations for Italy include urban food taxes etc. For Belgium, as discussed in the data appendix, we suspect that the estimate of nominal GDP for 1872 is too high explaining the implausible results for food.

differently from the current price benchmarks. Most notably, Balassa Samuelson holds for the current price GDP data but not for the GDP projections.[27]

Recall that Balassa Samuelson predicts that price levels increase with real income per capita. The first panel of Figure 1 graphs the price level benchmarks for 1872 and 1910 against current price real GDP per capita. For the most part, a higher 1872 income per capita is associated with a higher price level. This is the case for Australia, the US and the UK. Similarly, low income is generally associated with lower price levels.[28] Balassa Samuelson is again present for the 1910 current price benchmarks albeit in a weaker fashion. There are cases of a poor economy with a relatively high price level (Italy) and a prosperous economy with a relatively low price level – Belgium.

In contrast, the Maddison projections contradict Balassa Samuelson. This is clear from the second panel of Figure 1, which graphs the relationship between the Maddison income per capita projections and their implied price levels.

[27] By construction, the Prados De la Escosura (2000) current price estimates incorporate a Balassa Samuelson effect.

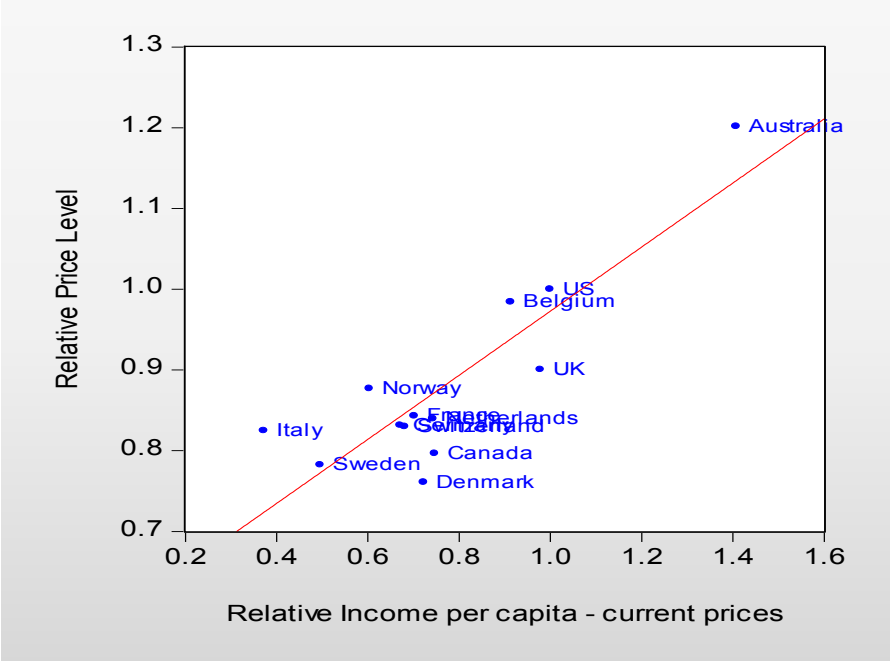
[28] We content ourselves with a graphic approach The regression line is for illustrative purposes only as there are formidable econometric problems when estimating the relationship between price levels and real income per capita with historical data. In simple terms, errors in price levels and real income are negatively correlated by construction which imparts a severe bias to the estimates.

Figure 1

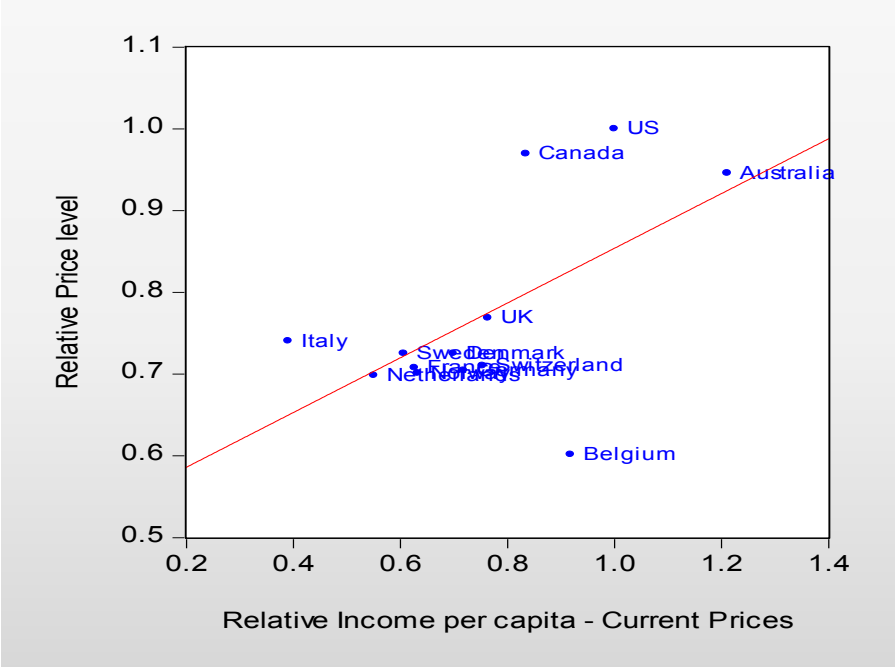
Price Levels and Income per capita

US = 1.0

I. Current price estimates

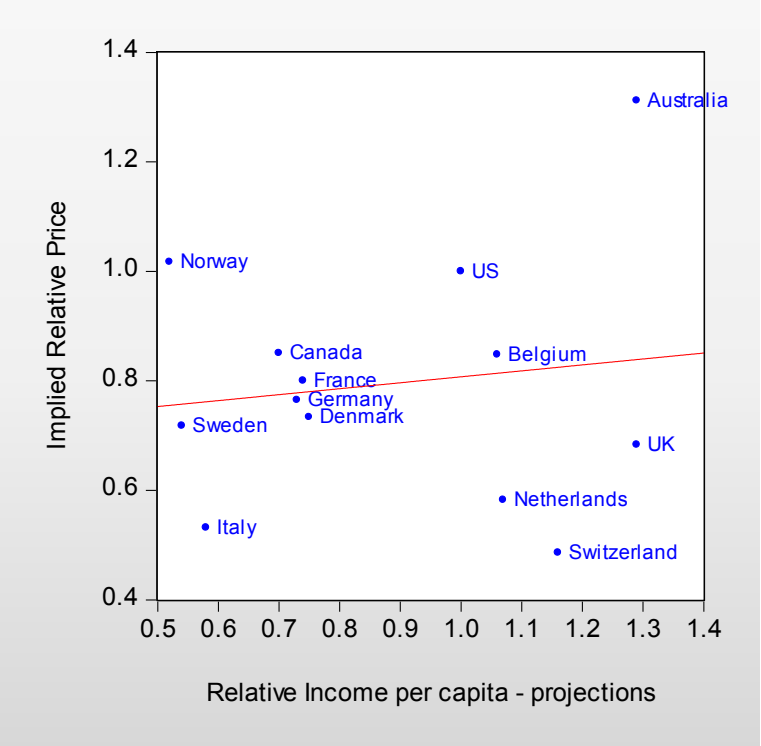


a. 1872

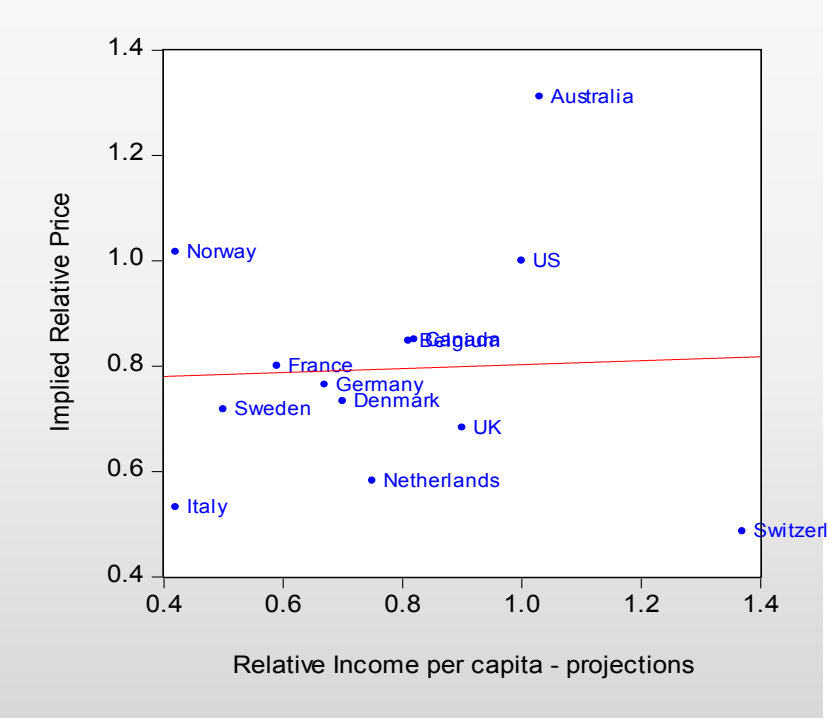


b. 1910

II. Income Projections



a. 1872



b. 1910

Source: Tables Three and Five.

From the Figure, Balassa Samuelson does not hold for either period. Consider 1872. Three countries, Switzerland, the UK, and the Netherlands appear in the southeast quadrant of the Figure. They combine a high income with a low price level. For 1910, we observe a low price level for a very rich economy Switzerland – only forty percent of the US - and a high price level for a poor country Norway – five percent above the US. More generally, the large differences in implied price levels for 1910 are surprising given the stable exchange rates of the period.

The Balassa Samuelson findings are, at best, suggestive. On their own, they are unlikely to convince skeptics. After all, the sample is small. Nor is it obvious why Balassa Samuelson should hold for all historical periods.[29] Yet Balassa Samuelson is a useful point of departure since it focuses attention on the question of whether relative price levels implied by the projections are plausible.[30] As we shall see, the reliability of the projections can be determined independent of Balassa Samuelson in a simpler fashion by considering relative food prices.

We start with 1872. Transport costs were high so we would expect food prices to be lower in the food exporters - the US, Canada, Australia, and Denmark.[31] Our price benchmarks are consistent with this prediction. As shown in the appendix, food prices for

[29] Along these lines, Bergin, Glick and Taylor (2006) find that Balassa Samuelson is a relatively recent phenomenon that does not hold in the past.

[30] To see how this works consider the following - Maddison shows Swedish income per capita slightly above Norway for 1872. His estimate also implies that the Norwegian price level is forty percent above Sweden. We can therefore evaluate his relative income estimates by enquiring how plausible are their implied price levels.

[31] Strictly speaking, this prediction holds at the wholesale price level only. Prices could be higher or lower at the retail level depending on retail margins.

1872 are lower in Australia, Canada, Denmark and the US. The differences between overall food price levels for food importers and exporters are up to fifty percent at the retail level.[32] The patterns for the individual food items are also as expected with flour and meat higher in importing countries with the larger differences for meat.

The food price results for 1872 are uncontroversial. But they have some stark implications for overall price levels. This is shown by Table 6. The second column in the Table gives the overall price level implied by the Maddison projections for three countries – the Netherlands, Switzerland the UK.[33] As noted earlier, the 1872 projections require low overall price levels for Switzerland (0.49), the Netherland (0.58) and the UK (0.68).

The third column in the Table gives relative 1872 food prices, as taken from the price benchmarks, for these countries. For Switzerland, food prices were fifty percent above the US. UK food prices are forty- four percent higher while the differences for the Netherlands are smaller.

[32] The price gaps at the wholesale level between Europe and the US, Canada and Australia for 1872 were likely higher reflecting their higher wholesale/retail food margins.

[33] We omit Italy from the Table as we compare food consumption using quantitative indicators.

Table 6

Food Price Levels for 1872

(US = 1.00)

	Overall Price Level Implied by the Maddison Projections	Food Prices	Required Non food Prices
Netherlands	0.58	1.32	0.26
Switzerland	0.49	1.51	0.05
The UK	0.68	1.44	0.36

Sources and methods: The price levels implied by the Maddison projections are described earlier. We take the food price estimates from the current price benchmarks given in the data appendix. To allow comparability we calculate food price levels for all countries using US weights. We obtain similar results with partner country weights. Food prices tend to be lower with these weights but the generally higher share of food in total expenditure offsets this.

The next step combines the food prices in column three with expenditure weights from the price benchmarks and the implied overall price level from the projections to generate the non-food GDP price level required by the Maddison projections. We generate this price level by *assuming that the food price benchmarks and expenditure weights are correct*. The final column Table 6 gives the results of this exercise. It shows remarkably low non-food price levels for the Netherlands and Switzerland – on the order *five* to *twenty-six* percent of the US. Such price levels are almost impossible. For the UK, the calculation implies non-food price levels that while possible are unlikely.

The calculations make an important point - if we believe that income per capita for the Netherlands and Switzerland exceed the US for 1872 and if we also accept that their

food prices levels were well above the US then this requires that prices for non-food GDP – clothing, housing, alcohol, fuel, travel etc. were a tiny fraction of the US levels.

We do not see how this is possible.

Transportation costs fell dramatically after 1872. [34] This means that food prices must increase in the exporters relative to the importers.[35] As it turns out, the price benchmarks show precisely these changes. By 1910, our estimates show food prices in the US, Canada and Australia are higher than Europe reflecting the decline in transport costs and their higher retail margins. It is, however, easy to show that the 1910 food price levels for Switzerland render the Swiss/US price level implied by the projections highly unlikely.

(ii) Real Wages – A GDP comparison from the Income side

Arising from Allen (2001) there is a large and important literature using data on real wages to inform discussions of growth and convergence/divergence. As mentioned in the introduction, Heston (1998) suggests that real wages be considered as part of a GDP comparison from the income side.[36]

To understand his argument, equation (7) provides an identity to capture the relationship between the economy wide real wage and relative output per worker. In terms of notation, $w_{i/us}$ is relative real wages in terms of the US, $\underline{y}_{i/us}$ is relative output

[34] O'Rourke and Williamson (1999) find that improvements in shipping and refrigeration reduced costs on Atlantic shipping routes by 45 percentage points between 1870 and 1913.

[35] We do not mean to imply that all food items were tradable. This was clearly not the case for milk, vegetables etc.

[36] Lindert and Willimson (2016) and Lindert (2016) build on the real wage literature, in particular on Allen, Murphy and Schneider (2012), to provide a simple yet powerful approach to comparing GDP for the past.

per worker in terms of the US, β the share of labor income in GDP and p/p_c is the relative GDP price level divided by the relative consumption price level. The wage here refers to the economy wide real wage and covers all labor income - that is unskilled, skilled, clerical and professional workers.

(7) $$w_{i/us} = (\beta_i/\beta_{us})(p/p_c)\, \underline{y}_{i/us}$$

The expression shows that relative output per worker can deviate from relative economy wide real wages only if there are differences in labor shares and/or differences in relative price levels for consumption relative to overall GDP. With the exception of the UK, the literature for the period provides little evidence that labor shares differ across economies in a systematic fashion see Prados De La Escosura and Roses (2003). As shown in the data appendix, relative consumption/GDP price levels were higher in Europe as compared to the Western Offshoots, which reduces their real wages as compared to output per worker. The differences are small. Thus, we expect as Heston (1998) suggests a close correspondence between economy wide real wages and output per worker.

We do not have real wage comparisons for this period that cover all labor income. For the most part, the real wage comparisons that exist are for urban workers. Most notably, there are Williamson's (1995) real wages indices for urban skilled/unskilled manual workers. We would not necessarily expect to see a perfect agreement between his urban indices and economy wide wages given that differences

exist across economies in the shares of urban workers in the labor force and urban/rural/skilled/nonskilled wage premiums. Nonetheless, we would still expect rankings based on urban real wages to bear *some* relationship to the rankings for overall output per worker.

Table 7 uses equation (7) to derive the economy wide real wages implied by the current price GDP benchmarks for 1872. The second column gives output per worker from the current price benchmarks. The next column gives the implied economy wide real wages. We assume a labor share of 0.7 for all economies except for the UK where we assume 0.6.[37] For comparison, we provide in the final column Williamson's (1995) real wage indices for urban workers.

The Table shows that the Western Offshoots (the US and Australia) have a larger lead in output per worker for 1872 as compared to income per capita reflecting the lower average age of these societies. As expected, the implied economy wide real wages are closely related to output per worker. For the most part, the implied economy wide real wages from the benchmark comparisons are also consistent with the Williamson (1995) real wage indices. In the case of Canada, the implied real wage is below Williamson. For Denmark, the Netherlands, Norway, Sweden and Switzerland the implied real wages are a little above Williamson. For the other economies, they are similar.

[37] Growth accountants for Great Britain typically assume a labor share of around 0.6 see Crafts (2004) Table 1. Mathews et al (1982) show slightly lower labor shares before the First War.

Table 7:

Output per Worker and Real Wages for 1872

US = 100

	Output per worker current prices	Real Wages implied by Current Price GDP Per Worker	Real Urban Wages Williamson (1995)
Australia	1.27	1.25	1.03
Belgium	0.59	0.53	0.55
Canada	0.74	0.76	0.90
Denmark	0.51	0.50	0.32
France	0.49	0.47	0.42
Germany	0.57	0.51	0.50
Italy	0.23	0.21	0.21
Netherlands	0.65	0.61	0.45
Norway	0.44	0.39	0.30
Sweden	0.42	0.39	0.32
Switzerland	0.50	0.45	0.36
UK	0.75	0.58	0.59
US	1.00	1.00	1.00

Notes and Sources: *GDP per worker* in current prices is from Table 4 while labor force data is from Mitchell (2003a, 2003b). *Real wages implied by current price benchmarks* – We derive the economy wide real wage using equation (4) where relative consumption and overall price levels are from the price benchmarks. We assume the share of labor in GDP of 0.7 for all economies except the UK where it is 0.6. *Real urban wages* for all countries except Switzerland - from Table A2-1 of the updated data appendix to Williamson (1995). We form the UK index by combining real wages for Great Britain and Ireland using labor force weights to obtain implied real wages. For Switzerland, we derive real wages using the real wage series from Studer (2008) and his 1905 benchmark excluding rents.

On the other hand, there are marked differences between the economy wide real wages implied by the projections and the Williamson (1995) urban real wages – particularly for the Netherlands and Switzerland. Without belaboring the point, it should be clear that what we know about real wages for the Netherlands and Switzerland are difficult to reconcile with the Maddison projections. Put differently, it may well be the case that these economies combined higher income per capita as compared to the US with lower real urban wages. It stretches credulity, however, to suppose that higher income per capita relative to the US could co-exist with the levels of urban real wages in Table 7.[38]

We can make similar arguments for 1910. For example, it is easy to shows that the projections imply Swiss real wages exceed US levels. This prediction strikes us as untenable.

(ii) Comparing GDP using Sectoral Labor Productivity

Rostas (1948) and Paige and Bombach (1959) show how to compare GDP using sectoral output data. For the most part, the data necessary to implement such output comparisons are not available for 1872 or 1910. Nonetheless, we still know enough about sectoral productivities for this period to provide a rough crosscheck of current price GDP comparisons.

[38] One might also argue that if living standards were higher in Switzerland and the Netherlands for 1872 as compared to the US then contemporary observers would have noticed. The opposite appears to be the case.

To see how this might work, we break the economy into three sectors, agriculture, manufacturing and the rest of the economy. For reasons of space, we focus on 1872 but the argument extends to 1910. For manufacturing, the evidence (as summarized in Broadberry (1997)) suggests US output per worker for the 1870's is twice UK levels for the early 1870's. For this year, the UK along with Germany is surely the manufacturing leader for Europe. Thus, manufacturing output per worker for the other European economies is at most half US levels. For agriculture, the available information, outlined in the appendix, suggests that US output per worker in agriculture for the 1870's was well above, probably twice, Western European levels. This claim is not controversial given the much higher endowments of land and horses per US agricultural worker. There is less information on relative productivities outside agriculture and manufacturing. We would hazard the guess that service productivity, which includes transportation and wholesale/retail trade where the US was far ahead, for most of Europe, at best, equals the US.

The appendix shows how to use these conjectures to place an upper bound on output per worker relative to the US. As shown there, the results are for the most part consistent with the current price benchmarks. The sectoral results are, to be sure, controlled conjectures. The point is simple; if the US had a large lead in output per worker for manufacturing and agriculture, as seems to have been the case, then the Maddison projections for some countries, most notably Switzerland and the Netherlands, are difficult if not impossible to reconcile with what is known about sectoral productivities.

5. Concluding Comments

This paper argues that current price historical GDP benchmarks are feasible for the late nineteenth and early twentieth century. Towards that goal, we provide current price GDP benchmarks along modified ICP lines for thirteen currently developed economies. The benchmarks cover 1872 and 1910. They differ in fundamental respects from the familiar Maddison income projections. In particular, the current price estimates raise the relative income of the US while they lower the income of Belgium, the Netherlands, Switzerland and the UK.

There various ways to see the role of current price benchmarks in economic history. One school holds that such comparisons are best used as a powerful crosscheck for income projections based on recent prices. The cases of the Netherlands and Switzerland fall into this category. Given the weight of the evidence, it is hard to see how projections showing 1872 income per capita above the US for these countries are sustainable. It is equally difficult to see how Swiss income for 1910 could exceed the US by a large margin.

We hope, however, that the current price benchmarks will do more than serve as crosschecks. Rather, they potentially provide a fresh perspective on modern economic growth since they show different patterns of economic leadership as well as catch up and convergence. Most notably, they suggest that the US was the world leader in income and productivity from very early on, generalizing a point made by Lindert and Williamson (2016). The benchmarks also allow us to study fundamental features of growth and development, such as the relative price of investment to consumption (Collins and Williamson (2001)), that cannot be addressed by projections.

The current price benchmarks are a work in progress. There is much more to be done. We require, for example, better data on expenditure shares, more information on urban rural price differences, more food balance sheets and, most importantly, better measures of capital goods prices. In addition, we have to increase the number of countries and provide additional benchmark years.[39] Finally, there is unfinished business with methodology. We require approaches to historical data that are robust to measurement error in nominal income, prices and expenditure shares– issues that we have barely touched on in this paper. In sum, the difficulties faced by current price historical comparisons should not be underestimated. On the other hand, the rewards will be substantial as the current price measures have the potential to sharpen our measures of growth and convergence for a crucial period of modern economic growth.

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[39] In addition, we have comparative price benchmarks for Austria, Ireland and New Zealand for 1872 and 1910. But we have not reported these results as we lack confidence in nominal Income for these countries. In addition, we have 1910 benchmarks for Russia and Japan and 1930 benchmarks for a much larger sample.

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Data Appendix

The appendix outlines sources and methods. We begin by describing sources for nominal GDP followed by sections on expenditure weights, prices and quantities. We conclude with the testimony of sectoral productivity data.

1. Nominal GDP Per Capita:

We use GDP at market prices from the sources detailed below. Where available, we use GDP from the expenditure side.

Table 1(a)

Nominal GDP Series, 1872, 1910

Country	GDP Data Sources
Australia	1872 - Mitchell (2003a). 1910 - Butlin (1977).
Belgium	Smits, Woltjer and Ma (2009) provide nominal GDP measured from the output side. Their estimates for 1872 are implausible as GDP per capita exceeds GDP per capita for the US and the UK. Instead, we use the 1870 estimate from Prados De la Escosura (2000).
Canada	Urquhart (1993).
Denmark	Mitchell (2003b).
France	Levy-Leboyer and Bourguingon (1990).
Germany	Mitchell (2003b). We raised NNP by 8% to get GDP.
Italy	Baffigi (2011).
Netherlands	Smits *et al*. (2000).
Norway	Grytten (2004).
Sweden	The Swedish Historical National Accounts 1800-2000 data base at http://www.ekh.lu.se/database/lu-madd/National%20Accounts/default.htm

Switzerland	Historical Statistics of Switzerland at http://www.fsw.uzh.ch/hstat/nls_rev/ls_files.php?chapter_var=./q&lang=en
UK	Feinstein (1972) compromise estimate from Mitchell (1988). We adopt the compromise estimate rather than the expenditure side measure to ensure consistency with earlier work on the UK/US.
US	1872, Gallman (1966) as given in Rhode (2002) adjusted to the commerce version of GDP by following the approach of Kendrick (1961). 1910, Kendrick (1961).

Population is from Mitchell (2003a, 2003b) and the domestic sources outlined above.

2. Expenditure Weights

We begin with aggregate weights for consumption, investment and government spending. Next, we outline sources for the disaggregated weights.

Aggregate Weights for Consumption, Investment and Government Spending

Where possible, we use the national account sources detailed above. For example, we take UK weights from Feinstein (1972), Table 2 and Dutch weights from Smits *et al.* (2000) etc. We lack aggregate consumption/investment/government weights for Belgium and Switzerland. Belgian GDP is measured from the output side and we have not yet found aggregate Swiss weights. We substitute aggregate Dutch weights for Belgium. For Switzerland, we use German weights. The disaggregated weights for both countries are from the domestic sources described below.

Disaggregated Consumption Weights

We break consumption into food, rent, fuel and light, clothing, alcohol, tobacco, domestic service, education, communications and transportation; see Table 1 in the text. Ideally, the disaggregated weights would also come from the national accounts. For most cases, however, the national accounts for the period cover only broad aggregates such as food, clothing and rent rather than the detail we need. In addition, classifications are not always consistent. For instance, beverages such as coffee/tea and alcoholic drinks are sometimes in food and sometimes not, housing can cover rent alone or it can cover rent and other household expenditures and so on.

To obtain weights for missing items of expenditure we turn to expenditure studies – most notably US Department of Commerce and Labor (1890, 1891) and the Board of Trade studies of the 1900's. We also use information from the domestic sources outlined below. Finally, we crosschecked the food weights with data on food prices and food quantities as described later.

The sources for the detailed consumption weights are:

Australia: *1872 and 1910.* McLean and Woodland (1991), Thomas (1995) and McLean (1999). Coghlan (1904).
Belgium: 1872: Segers (2004) supplemented by US Department of Labor and Commerce (1890, 1891).
1910: Segers (2004) and the Board of Trade (1910).
Canada: 1872: Firestone (1958), Kuznets (1962, 1966). Young (1875)
1910: Firestone (1958), Kuznets (1962, 1966), Board of Inquiry into the Cost of Living (1915).
Denmark: 1872 and 1910. Hansen (1974).
France: 1872: US Department of Commerce and Labor (1890, 1891) along with data on food quantities and prices described later.
1910: Board of Trade (1909).

Germany: 1872: Kuznets (1962). US Bureau of Commerce and Labor (1890, 1891) adjusted to 1872 based on expenditure information in Young (1875).
1910: Kuznets (1962) and Board of Trade (1908).
Italy: 1872: Kuznets (1962).
1910: Kuznets (1962) and Williamson (1995).
Netherlands: 1870 and 1910. Smits *et al*. (2000) for broad weights. We obtain food weights from quantities and prices described later.
Norway: 1872 and 1910: Kuznets (1962). We derive food expenditure weights from the food quantities and prices described later.
Sweden: 1870. Kuznets (1962). We derived food weights using consumption quantities for the period 1881-1900 and prices from the Institute for Social Sciences (1937), pp. 200-203.
1910: Kuznets (1962) and Williamson (1995).
Switzerland: For 1872, we use US Department of Commerce of Labor (1890, 1891). We derive food weights from the quantities and prices described later. We use Studer (2008) for 1910.
UK: 1872: Thomas, (1995), Young (1875), US Department of Commerce and Labor (1890, 1891), Jeffreys and Walters (1955) and Prest (1954).
1910: Prest (1954), Table 112. Board of Trade (1908).
US: *1872* Kuznets (1962). Kloft (1995).
1910: Lebergott (1996). The Board of Trade (1911a).

Investment Weights

We construct relative investment price levels from construction and equipment/machinery benchmarks. The shares of construction and equipment/machinery in capital formation are from Feinstein (1972), Table 39, columns 3, 4, and 5 for the UK, from Kuznets (1962), pp. 254-255 for the US, and Columns 1, 2, and 3 and from Kuznets (1962) for Germany, Denmark, Norway, Sweden and Canada. Thomas (1995) provides weights for Australia while weights for the Netherlands are from Smits *et al.* (2000). For France, Italy and Switzerland, we assign construction seventy percent of the investment weight for 1872 and sixty-five percent for 1910.

Government

For all countries, we assume a weight of 0.6 for nominal wages and 0.4 for goods and services prices.

Tables 2(a) and 3(a) show the expenditure weights used to construct the price benchmarks.

3. Price Data

These data cover consumption and investment.

Consumption

We searched for contemporary studies that used a common schedule to compare prices internationally. Young (1875) and the Massachusetts Bureau of Statistics of Labor (1874) fit these specifications. These sources provide rents and clothing, which are missing from other studies.

For 1910, the Board of Trade (1908, 1909, 1910, and 1911) collected price data for the UK, Germany, France, Belgium and the US for food, rent and fuel and lighting for a large sample of cities. For other countries, we rely, for the most part, on the dominion reports from Australia, Canada and South Africa along with BLS (1915). These studies differ from the Board of Trade in that they did not collect their own price data. Rather, they made matches from domestic retail price data after correcting for unit differences etc. Not all price data refer to 1910. When prices relate to a different year, we project them to 1910 using disaggregated components of the CPI or wholesale price indices

when we could not find the required CPI breakdown. Absent such data, we use the overall CPI.

Food Prices

We collected prices for wheat, rye and corn flour, beef, mutton, pork, milk, butter, cheese, potatoes sugar, tea and coffee. We follow Gilbert and Kravis (1954) and assume equal food quality. For some cases, quality clearly differs but we are unable to adjust.

Our sources are:

Australia: 1872: Wood (1901). Coghlan (1904).
1910: Australia (1912) – simple average of prices for Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. Board of Inquiry into the Cost of Living (1915).
Belgium: 1872. Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1910).
Canada: 1872. Young (1875), pp. 834-838.
1910: Board of Inquiry into the Cost of Living (1915).
Denmark: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: BLS (1915). Australia (1912).
France: 1872. Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1909). Australia (1912) and BLS (1915).
Germany: 1872. Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1908). Australia (1912) and BLS (1915).
Italy: 1872.Young (1875), pp. 630-631.
1910. Australia (1912) and BLS (1915).
Netherlands: 1872: Great Britain Foreign Office (1870, 1871) simple average of prices in Deventer, Rotterdam, the Hague and Amsterdam.
1910: Australia (1912) and Board of Inquiry into the Cost of Living (1915).
Norway: Great Britain. Foreign Office (1871), pg. 394.
1910: BLS (1915).
Sweden: 1872: Young (1875), pg. 860.
1910: BLS (1915), Institute for Social Sciences (1937), Table 27.
Switzerland: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: BLS (1915) and Studer (2008).
The UK: 1872. Massachusetts Bureau of Statistics of Labor (1874).
1910. Prest (1954).

US: 1872: Kloft (1995), pp. 476-647. (The original source is the Weeks Report) and Young (1875).
1910: Great Britain. Board of Trade (1911). Prest (1954).

Rent

Rents per room. Young (1975) for 1872 and the Board of Trade for the 1900's compare rents for workers dwellings. The South African Report (South Africa (1914)) also provides working class rents rents. So far, we have not found usable 1910 rent data for Denmark or the Netherlands. For these countries, we use a quantity comparison based on persons per room using information from Floud *et al.* (2011) with a UK base.

The rent sources are:

Australia: 1872 - Butlin (1962), page 238. Average rents per room.
1910: Australia (1912), Board of Inquiry into the Cost of Living (1915).
Belgium: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1910).
Canada: 1872: Young (1875).
1910: Board of Inquiry into the Cost of Living (1915).
Denmark: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Quantity comparison using persons per room from Floud *et al.* (2011) Table 5.7 page 570.
France: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1909).
Germany: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1908).
Italy: 1872: Young (1875), pp. 630-631.
1910: Williamson (1995).
Netherlands: 1872: Young (1875). Estimates refer to 1875.
1910: Quantity comparison using persons per room from Floud *et al.* (2011) Table 5. 7 page 570.
Norway: 1872: Young (1875). Rents for Christiana.
1910: Board of Inquiry into the Cost of Living (1915).
Sweden: 1872: Young (1875), pg. 860.
1910: BLS (1915)
The UK: 1872: Massachusetts Bureau of Statistics of Labor (1874).

1910: Great Britain. Board of Trade (1911).
US: 1872: Kloft (1995), pp. 476-647 and Young (1875).
1910: Great Britain: Board of Trade (1911).

Fuel and Light

For 1872, we calculate the fuel and light price level as a weighted average of relative coal, wood and coal oil prices (as available) for 1872. The 1910 benchmark uses coal and kerosene. So far, we have not located 1910 fuel prices for the Netherlands or Norway.

The sources are:

Australia: 1872: Second Annual report of the Ohio Bureau of Statistics of Labor (1879), pg. 321. Price of coal is for 1876.
1910 Australia (1912).
Belgium: 1872: Massachusetts Bureau of Statistics of Labor (1874).
Great Britain: Board of Trade (1910).
Canada: 1872: Young (1875), pp. 834-838.
1910: Board of Inquiry into the Cost of Living (1915).
Denmark: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: BLS (1915).
France: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1909).
Germany: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Great Britain. Board of Trade (1908).
Italy: 1872: Young (1875), pp. 630-631.
1910: BLS (1915)
Netherlands: 1872: Substitute Belgian Prices.
1910: Substitute Belgian prices.
Norway: 1872: Substitute Swedish Prices.
1910: BLS (1915).
Sweden: 1872. Young (1875), pg. 860.
1910: BLS (1915).
Switzerland: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: BLS (1915).
The UK: 1872: Massachusetts Bureau of Statistics of Labor (1874).
1910: Prest (1952) and Great Britain. Board of Trade (1911).
US: 1872: Kloft (1995), pp. 476-647 and Young (1875).
1910: Great Britain. Board of Trade (1911)

Clothing - 1872

It is difficult to compare internationally prices for heterogeneous items such as clothing. Fortunately, Young (1875) provides prices for comparable items for 1872. His price data covers textiles rather than finished items of clothing. The drawback with his estimates is that they, implausibly, show clothing prices in Europe above the US. We suspect that the explanation lies in quality differences between American and Europe.[40] In other words, the lower US prices reflect lower quality.

To form a clothing benchmark, we assume that quality is constant across Europe allowing us to compare clothing prices for Europe and the UK using Young (1875). Next, we obtain the UK/US price level from independent sources and adjust Young's (1875) estimates for all other countries based on the comparisons with the UK.

We construct the 1872 clothing benchmark as follows.

US and UK : We estimate the UK/US clothing price benchmarks using the sources outlined by Ward and Devereux (2003). The UK/US clothing index is 71 in 1872.
Australia: Thomas (1995), Table 4 estimates that clothing prices in Australia were 28 percent above the UK in 1891. We assume that this ratio also holds for 1872.
Belgium, Canada, France, Italy, Germany, Netherlands, Switzerland and Sweden : The Massachusetts Bureau of Statistics of Labor (1874) and Young (1875). We use the geometric mean of textile prices relative to the UK.
Netherlands: We adjust the UK/US relative price using the average level of duties on manufactured products in 1875 from Bairoch (1989), pg. 42.
Norway: Sweden.

[40] Taussig (1931) notes that the US tariff structure in the late nineteenth century led to US production of "standardized fabrics of medium grade". Higher quality in Europe would explain the higher European prices for fabrics.

Clothing - 1910

For 1910, the UK/US clothing relative is the weighted average of cotton and wool/worsted relative prices for the UK and US as taken from the US tariff commission (US House of Representatives (1912a, 1912b) as described in Ward and Devereux (2003). We obtain Relative clothing prices for other countries by adjusting the UK price with tariff rates on clothing manufactures exported from the UK. The tariff rates are from Webb (1911), pg. 102. This assumes that mark-up are constant which is unlikely to be the case

Domestic Service

We compare average yearly wages for live in domestic servants where we adjust weekly wages to a yearly basis by assuming a fifty-week year. In addition, we adjust cash earnings to account for board and lodging. For the US, the UK, Canada and Australia, we raise yearly cash earnings by fifty percent. For other economies, we increase yearly cash earnings by one hundred percent.

The sources of yearly cash earnings for 1872 are:

Belgium, Denmark, France, Italy, Germany and Switzerland: US Bureau of Labor (1900). French wages are for 1873.
Canada, Norway and Sweden: Young (1875). For 1873.
US: Lebergott (1964)
UK: Ward and Devereux (2003).
Netherlands: US House of Representatives (1879). Wages are for 1878.

The sources of yearly earnings for 1910 are:

US: Hansen and Douglas (1930), pp. 47-50. We convert weekly wages in Chicago to a US average using Lebergott's (1964) 1900 benchmark.

UK: Ward and Devereux (2003).
All other countries: US Bureau of Labor (1900). Servants' wages for 1891-1899. We assume that they also hold for 1910.

The Investment Price Benchmarks

The investment price level consists of separate benchmarks for construction and for equipment and machinery.

Construction - 1872

The construction sub-index is an equally weighted index of relative materials' prices and relative nominal wages. We determine materials prices for the UK, US and Germany using wholesale price data for pig iron, bar iron, steel and lead. For the other economies, we determine prices using tariff rates and transport costs from the UK taken Bairoch (1989).

The sources for the wholesale price data are listed below:

US: 1872*:* Pig Iron (average of Foundry and Gray Forge Pig Iron); Bessemer Steel Rails, Iron Rails, Bessemer Pig Iron - Temin (1964), pp. 284-285
Bar Iron – best refined rolled – US Congress (1893)
Lead, pig – US Congress. Senate. (1893).
UK: 1872*:* Pig Iron (average of Cleveland and Scottish Pig Iron) - Mitchell (1971)
Swedish bar Iron - US Congress, (1893)
Lead, English pig – US Congress (1893). United States War Industries Board (1919)
Iron and Steel Rails - Carr and Taplin (1962). McCloskey (1973)
Bessemer Pig Iron - Carr and Taplin (1962); McCloskey (1973)
Germany: 1872: Pig iron, bar iron, lead: US Congress (1893), pp. 257-278.
Germany/US relative price of steel rails, 1881-1890: Allen (1979), Table 1.

We obtain materials relative prices for countries outside the UK, the US and Germany by adjusting the UK prices to allow for transport costs and tariffs. Bairoch (1989)

provides transport costs for bar iron and manufactured iron goods for overland transport. He also estimates the costs of a transatlantic crossing in 1850 and 1880. Bairoch also provides average tariff levels on manufactured goods for the 1870's. For Belgium, Denmark, France, Italy, the Netherlands, Norway, Sweden and Switzerland transport costs are the costs of overland transport. The cost of overland transport for 1872 is a weighted average of overland transport costs in 1850 and 1880.

For Canada and Australia, we use transport costs for a transatlantic crossing. In the case of Australia, we add an additional 15% to cover the additional distance.

The second component of the construction benchmark is wages. Wages for 1872 are the average of weekly wages for blacksmiths, bricklayers, carpenters, masons, laborers and painters from the Bureau of Labor (1900). We supplement the Norwegian and Swedish wages with data from Young (1875). Swedish wages refer for 1873 while Norwegian wages refer to 1871. Australian wages refer to 1876. We convert foreign wages from US gold to US dollars using the gold/dollar market exchange rate.

Construction - 1910

The materials price index for 1910 is a geometric mean of the relative prices of copper, iron, lead, steel, and tin. The comparisons for the UK, Canada, and the Netherlands rely on 1905 price data projected to 2010. All other comparisons refer to 1913 projected backwards to 1910. We use Norwegian prices for Sweden. We use Dutch prices for Belgium. The sources are:

Canada: Board of Inquiry into the Cost of Living (1915).
Netherlands: http://www.iisg.nl/hpw/data.html
Australia, Denmark, France, Germany, Italy: "International Price Comparisons" (1919), a price bulletin compiled by the United States War Industries Board as part of *A History of Prices during the War.* The bulletin provides comparable wholesale prices for a wide variety of items in 1913.
UK: Pig Iron (average of Cleveland and Scottish Pig Iron) - Mitchell (1971)
Lead, Copper, and Tin –United States War Industries Board (1919)
Iron and Steel Rails - Carr, and Taplin (1962). McCloskey (1973)
Bessemer Pig Iron - Carr and Taplin (1962); McCloskey (1973)
US: Pig Iron (average of Foundry and Gray Forge Pig Iron); Bessemer Steel Rails, Bar iron, Bessemer Pig Iron - Temin (1964), pp. 284-285
Lead, Copper and Tin –United States War Industries Board (1919).

The nominal wages in the wage benchmark are the average of (as available) carpenters, bricklayers, masons, plumbers, plasterers, painters and laborers. The sources for these nominal wages are below:

Australia and Canada: Board of Inquiry into the Cost of Living (1915)
Belgium, France, Germany, the US, and the **UK**: Great Britain. Board of Trade (1908-1911)
Denmark and Norway: Great Britain. Board of Trade (1911).
Italy and Sweden: Williamson (1995), Table A3.1. Average of skilled and unskilled building wages.
Netherlands: Zamagni (1995), table A. 8. Daily wages are converted to weekly wages by assuming a 5.5 days per week.

Equipment and Machinery – 1872

Equipment and machinery relative prices for the UK and US are relative prices of iron and steel described earlier. The German relative price for 1872 is the average of a comparison based on wholesale prices and tariff rates. We obtain equipment and machinery relative prices for the other countries by adjusting UK prices with tariff rates and transport costs for manufactured iron goods from Bairoch (1989).

Equipment and machinery- 1910

The equipment and machinery relative price is the geometric mean of relative iron and steel prices from the construction sources outlined previously.

Government

The government price index is a weighted average of relative nominal wages and goods and services' relative prices. We follow the procedures described by Gilbert and Kravis (1954), pp. 197-199. The price index for goods and services is the geometric mean of rent along with the fuel and light relative prices, which we take from the consumption relative prices.

4. Urban-Rural Adjustments

The retail price data refer to urban prices. We adjust for urban/rural price differences to approximate the national prices required by the ICP. The evidence we uncovered suggests price differences during the years covered by our benchmarks were marked only for food and rent.

The sources for urban/rural price differences are:

Canada: Bellerby (1956) gives estimates of urban/rural prices differences for food, clothing, fuel and rent in 1949. He finds that rent was 70 percent more expensive in urban areas, and food prices were roughly equal. Based on evidence from other countries, we assume that food in 1872 was ten percent lower in rural areas.
Denmark: US House of Representative (1885), pg. 1328 suggests that the price difference in 1884 for rent between rural areas and provincial towns is 212.5. Webb (1911) provides information on food prices for 1905. The urban/rural price ratio for 1905 is 115.

Germany: Young (1875), pp. 493-494 estimates rents in urban areas at approximately twice rural rents in the early 1870s. Urban food prices are approximately fifteen percent above rural prices. US House of Representatives (1879), pg. 222 show that urban food prices are approximately 25 percent above rural food prices.
France: Sisic (1992) provides estimates of the overall urban/rural price level at 108 in 1852 and 117 in 1892.
Sweden: Young (1875), pg. 681 finds that the cost of subsistence in villages was 25% lower than in towns. Bellerby (1956) estimates of the overall urban/rural price level in 1905-1910, 1934 and 1941. For all years, urban prices were approximately ten percent higher than rural prices.
UK: Hunt (1973) and Bellerby (1956).
US: Hatton and Williamson (1991), Bellerby (1956), Koffsky (1946) and Reid (1946).
Australia: Despite a wealth of price data from the various Coughlin studies we have been unable to find data that allows us adjust for urban/rural differences. We suspect that they were significant.
Italy, the Netherlands, Norway and **Switzerland**: We found no estimates of urban rural price differences for these countries and we assume that urban food prices are ten percent higher than rural prices, and urban rents are twice rural rents.

In sum, the evidence on urban/rural differentials for the late nineteenth and early twentieth century's suggests that differences are important for food and rent. The differences were similar across economies.[41]

We determine national retail prices (P_N) for food and rent for each country using equation (2).

$$(2) \qquad P_N = uP_U + (1-u)P_R$$

[41] These estimates are similar to the results for recent decades. For example, Deaton and Dupriez (2011) finds price level differences across various economies for recent years that are similar to our estimates for the Western economies at the end of the nineteenth century.

Where P_U and P_R are the urban and rural retail prices and u and (1-u) are the proportions of the population living in urban and rural areas respectively.

Urbanization Rates

We define urbanization as the ratio of the urban population (towns with a population greater than 5,000) to the civilian resident population. Bairoch and Goertz (1986) page 288 provide urbanization rates in selected decades between 1850 and 1910. Table 2(a) lists our assumptions about the urban-rural price differences for food and rent, as well as urbanization rates.

Table 2(a)

Urban/ Rural Adjustment for Food and Rent. ($P_{rural} = 1$)

1872

	Food	Rent	Urbanization (% of the population in urban areas)
Australia	1.2	2.0	22
Belgium	1.1	2.0	40.5
Canada	1.1	1.7	13.5
Denmark	1.2	2.0	20.8
France	1.1	2.0	25.4
Germany	1.2	2.2	25.3
Italy	1.1	2.0	26.7
Netherlands	1.1	2.0	41.5
Norway	1.1	2.0	13.7
Sweden	1.3	2.0	11.2
Switzerland	1.1	2.0	18.0
UK	1.0	2.1	51.8
US	1.2	2.4	19.7

Table 2(a)

Urban/ Rural Adjustment for Food and Rent. ($P_{rural} = 1$)

1910

	Food	Rent	Urbanization (% of the population in urban areas)
Australia	1.2	2.0	41.6
Belgium	1.1	2.0	56.6
Canada	1.0	1.7	41.6
Denmark	1.2	2.0	35.9
France	1.2	1.2	38.5
Germany	1.2	2.2	48.0
Italy	1.1	2.0	40.0
Netherlands	1.1	2.0	50.5
Norway	1.1	2.0	25.1
Sweden	1.1	2.0	22.6
Switzerland	1.1	2.0	37.1
UK	1.0	2.7	69.2
US	1.3	2.0	41.6

5. **Quantities**

We adopt quantity/unit value measures for items where we do not have price data (as in the case of alcohol) or for comparison resistant services such as education. In addition, we have price and quantitative indicators for some items most notably food. For housing, we have 1910 quantity data for Europe from Floud *et al.* (2011).

The estimates refer to years around the benchmarks.

Alcohol

We measure consumption as beer, wine and spirits consumed in US gallons. We rely on standard sources for the US and the UK– The Historical Abstracts for the US and Prest (1954) for the UK.

1872: We take cross-country data from Pinella (2014), Rowntree and Sherwell (1899) and Mulhall (1899). Useful country sources include Firestone (1958) for Canada, Allamani and Prina (2007), ISAT (1976) for Italy and Gould (1894) for Sweden.

For 1910: we use the Board of Trade (1906, 1911) for all countries.

We compare consumption in two ways. First, we use US prices from Ward and Devereux (2003) to value consumption as we do not have consistent price data for other countries. Second, we also measure consumption in terms of alcohol where we set the alcohol content of beer at 0.05, wine at 0.125 and spirits at 0.4. The measures are close for most cases. The exceptions are the wine consumers - France, Switzerland and Italy. Here the price measure yields much higher consumption. Of course, the average quality of wine consumed for these countries did not approach that for the US and hence US wine prices will overstate

consumption. To construct the quantity index, we assume that wine quality is the same in all countries outside of France, Switzerland Italy. Next, we made a rough adjustment for quality differences by comparing wholesale prices in France with UK import prices. Note that US prices will likely overstate consumption relative to partner country prices. The final step adjusts for the difference between US and domestic prices by taking spreads from the Gilbert and Kravis (1954) comparisons for 1950.

Tobacco

We measure tobacco consumption by domestic disappearances in lbs. per capita. The 1910 data are from Hutson (1937) and the Department of Commerce (1915) while Jacobstein (1907), Hannah (2006) and Mulhall (1881, 1899) provide estimates for earlier years. Firestone (1958) covers Canada. The 1872 estimates rest on weaker data. Moreover, it is clear that tobacco quality is lower outside of Australia, Canada, the US and the UK but we are unable to adjust for the differences.

Travel

We measure travel by rail passenger kilometers per capita for 1872 and 1910. For 1910, we add automobiles. Our data are from Mitchell (2003a, 2003b) and US historical statistics. For 1872, we have passenger trips rather than passenger kilometers for some countries. In these cases, we use the average trip length implied by later data. Where the information is not available, we make assumptions. For the UK, we assume that the average trip is sixteen km. We assume that the average trip in Australia equals that for the US. Finally, the 1872 estimates

for Denmark and the Netherlands refer to 1875 and 1878. The implicit assumption is that the ratio of business and other intermediate travel is similar across all economies and that quality is similar.

We do not have automobile sales for 1910. We therefore assume that expenditure on cars is proxied by cars per capita.

Communications

We form a quantity index for 1872 with data on pieces of mail and telegraphs sent per capita. The 1910 index is an unweighted average of mail, telegraphs and telephones per capita. Our sources are Banks (1971) and the US Postmaster General (1914) for mail. For telephones per capita, we rely on the US Postmaster General (1914) and Wallsten (2001). These data do not distinguish between consumption and intermediate use. We assume that this ratio is the same across all economies.

Education

Following the ICP, we use a quantity comparison. In our case, we compare primary pupils per one thousand people. The data come from the online appendices to Lindert (2004). We experimented with other comparisons including secondary and third level enrollments without changing the results.

Food

We collected data on disappearances of wheat and rye flour, corn meal, beef, mutton and pork, butter, cheese, milk, coffee, tea and sugar. Ideally, these data should come from food balance sheets. For most countries, complete food balance sheets are not available. Consumption data for sugar, coffee and tea is available for all countries. We have information for Australia, Canada, Italy, the US and the UK covering most other food items. There is data on cereals and meat for France, Germany the Netherlands and Sweden. There are gaps for other countries, particularly for 1872. Even where data exist, we suspect that the margins of error for items such as potatoes and milk are considerable

Turning to sources, Crawford (1899), Webb (1911) and Mulhall (1899) provide comparative estimates for early years. Where data are not available, we projected our 1910 estimates to 1872 using data from Mulhall (1899) or other sources.

There is a wide range of comparative sources for 1910. Webb (1911) provides cross-country data for many items. Yeats (1960) provides fairly complete data for Belgium, France, Germany, Switzerland and the UK. Pirtle (1922) provides comparative data on dairy products, Holmes (1916) covers meat and Bennett (1933) covers wheat flour. The League of Nations (1937) provides comparative data on many items.

The following country sources are helpful:

Australia: Coghlan (1904).
Canada: Urquhart (1993) and Board of Inquiry into the Cost of Living (1915).
Italy: ISTAT (1976).
Netherlands: Van Zanden and Van der Veen (1989).
Sweden: Sundbärg (1904) and Institute for Social Sciences (1937).
UK: Prest (1954) and Floud *et al* (2011).

US: Bennett and Peirce (1961) and Floud *et al* (2011).

6. Sectoral Productivity

The data necessary to implement GDP comparisons from the output side are not available. Nonetheless, by making plausible assumptions about sectoral productivity we can provide a rough estimate of comparative income per capita. For reasons of space, we focus on 1872 but the results easily extend to 1910.

We break the economy into three sectors, agriculture, manufacturing and the rest of the economy. Table 4a illustrates the approach. The first column gives output per worker in agriculture for 1872 relative to the US. The UK/US estimate is from Ward and Devereux (2005). For other countries, save Belgium, we rely on Van Zanden (1991) with a rough adjustment of his gross output estimates to a value added basis. For Belgium, we use Bairoch (1973) as the Van Zanden (1991) estimates appear to us to be low. We do not have 1870 agricultural output comparisons for Canada or Australia.

The Table shows US output per worker in agriculture at generally more than twice European levels.[42] The estimates are believable given higher levels of land, horses and machinery per worker in the US as compared to Europe.[43]

[42] The comparison of output per worker for agriculture, particularly for Europe, is complicated by the large differences in how agricultural labor is measured in the census. This distorts our measures of output per worker in agriculture for Europe. This does not matter for our purposes since we use the same labor force to calculate overall output per worker from the income and output sides.

[43] The Van Zanden European rankings are similar, for the most part, with Federico (2004) and Bairoch (1973, 1992). Our UK/US rankings agree with those of Hayami and Ruttan (1971, 1985) and Bairoch (1992) if we use comparable labor force data and if we adjust to a value added basis. Broadberry (1997) finds higher relative UK output for agriculture. He obtains this result because his 1908 benchmark uses British rather than UK value added and because he greatly understates US value added. For further details along with reconciliation the Broadberry estimates with theirs see Ward and Devereux (2005). see Woltjer (2015) provides more recent discussion.

Next is manufacturing. Broadberry (1997) argues that US output per worker is twice UK levels for this period. We therefore assume that manufacturing output per worker for the other economies is at most half US levels. For the remaining sectors, we assume that labor productivity is equal to the US. This conjecture overstates the situation for Europe whether output per worker in sectors such wholesale/retail trade and transportation were well below the US. We adopt the assumption to provide an upper bound on output per worker.

Using these conjectures along with information on sectoral labor force shares and US sectoral output shares, we compute overall output per worker in US prices. Keep in mind that by valuing output at US prices we overstate GDP relative to the US for all countries as compared to the Fisher Ideal measure.[44]

Column six in Table 4a provides the resulting GDP per worker. The expenditure based current price estimates of GDP per worker, also in US prices, are in column seven. For the most part, there is a reasonable correspondence between the current price GDP benchmarks and the conjectural upper bound. Indeed, the current price benchmarks are above the conjectural estimates for Belgium, Germany and the Netherlands suggesting that, if anything, the current price estimates overstate income relative to the US.

[44] We do not have the data required to compare GDP with Fisher Ideal indices.

Table 4a

Comparing Output per Worker around 1870 using Sectoral Productivity

Country	Agriculture	Manufacturing	Services etc	GDP per worker in US prices implied by Sectoral Productivity	Expenditure Based GDP Per Worker in US Prices
Belgium	0.42	0.50	1.00	0.59	0.65
Denmark	0.41	0.50	1.00	0.52	0.55
France	0.46	0.50	1.00	0.52	0.54
Germany	0.42	0.50	1.00	0.51	0.63
Italy	0.26	0.50	1.00	0.31	0.24
Netherlands	0.35	0.50	1.00	0.59	0.71
Norway	0.56	0.50	1.00	0.56	0.46
Sweden	0.31	0.50	1.00	0.34	0.45
Switzerland	0.39	0.50	1.00	0.57	0.56
UK	0.56	0.50	1.00	0.83	0.81
US	1.00	1.00	1.00	1.00	1.00

Notes and Sources: Gross output per agricultural worker for all economies except the Belgium, the UK and the US is from an unpublished appendix to Van Zanden (1991). We adjust his estimates to a value added basis using estimates of non-agricultural inputs from Federico (2004). For the US and UK, we calculate relative GDP per worker using nominal value added and farm gate price benchmarks from Ward and Devereux (2005). For Belgium, we use Bairoch (1973). We calculate aggregate GDP per worker using the above estimates of sectoral labor productivity in US prices. Our US GDP sectoral shares are from Gallman (1960) and Gallman and Weiss (1969). These estimates refer to 1870. *Labor Force:* The sectoral distribution of the labor force for all economies is from Mitchell (2003a, 2003b). The estimates for agriculture labor differ across economies. The expenditure based estimates refer to 1872. They are in US prices.

There are sharp differences between the upper bounds in Table 4a and output per worker implied by the Maddison projections. The differences are largest for Netherlands and Switzerland where the projections show output per worker of 0.94 and 0.85 as compared to the upper bounds in Table 4a of 0.59 and 0.57.

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Table 2a
Expenditure Weights - 1872

	Australia	Belgium	Canada	Denmark	France	Germany	Italy	Neth	Norway	Sweden	Switz	UK	US
Wheat Fl	0.050	0.102	0.064	0.037	0.127	0.045	0.192	0.053	0.056	0.022	0.098	0.062	0.051
Rye flour	0.002	0.018	0.004	0.114	0.031	0.067	0.004	0.059	0.073	0.059	0.009	0.001	0.002
Corn Meal	0.002	0.001	0.004	0.002	0.002	0.003	0.049	0.002	0.002	0.002	0.001	0.000	0.013
Beef	0.056	0.050	0.040	0.039	0.048	0.031	0.051	0.055	0.036	0.079	0.045	0.044	0.045
Mutton	0.031	0.015	0.011	0.014	0.013	0.002	0.009	0.004	0.013	0.002	0.011	0.027	0.007
Pork	0.011	0.030	0.040	0.021	0.029	0.063	0.050	0.053	0.027	0.030	0.037	0.029	0.062
Eggs	0.012	0.023	0.014	0.006	0.012	0.006	0.027	0.023	0.010	0.017	0.009	0.012	0.012
Fresh Milk	0.028	0.019	0.023	0.037	0.034	0.034	0.035	0.036	0.045	0.040	0.042	0.021	0.013
Butter	0.022	0.036	0.044	0.031	0.033	0.021	0.010	0.039	0.034	0.036	0.015	0.028	0.027
Cheese	0.004	0.015	0.009	0.012	0.009	0.008	0.032	0.016	0.039	0.011	0.015	0.015	0.003
Patatoes	0.016	0.033	0.023	0.014	0.036	0.023	0.018	0.043	0.034	0.037	0.022	0.023	0.018
Tea	0.019	0.002	0.025	0.002	0.000	0.000	0.005	0.010	0.004	0.000	0.002	0.014	0.009
Coffee	0.001	0.038	0.006	0.025	0.023	0.011	0.011	0.030	0.025	0.015	0.010	0.002	0.012
Sugar	0.035	0.033	0.039	0.029	0.019	0.014	0.014	0.015	0.044	0.021	0.008	0.022	0.028
Rent	0.121	0.081	0.134	0.112	0.075	0.091	0.050	0.069	0.135	0.126	0.091	0.085	0.117
Fuel/Light	0.036	0.030	0.044	0.067	0.034	0.042	0.028	0.037	0.046	0.072	0.042	0.075	0.027
Clothing	0.151	0.121	0.138	0.112	0.099	0.097	0.075	0.149	0.098	0.123	0.097	0.160	0.151
Alcohol	0.094	0.081	0.039	0.082	0.148	0.108	0.132	0.047	0.041	0.067	0.108	0.127	0.067
Tobacco	0.016	0.020	0.015	0.019	0.017	0.014	0.016	0.019	0.009	0.014	0.014	0.014	0.018
Domestics	0.027	0.051	0.020	0.022	0.027	0.014	0.019	0.028	0.027	0.034	0.014	0.032	0.030
Travel	0.030	0.020	0.032	0.030	0.022	0.027	0.019	0.028	0.012	0.008	0.027	0.014	0.013
communications	0.013	0.008	0.010	0.007	0.007	0.007	0.005	0.014	0.007	0.004	0.007	0.002	0.008
Education	0.027	0.020	0.030	0.022	0.017	0.020	0.009	0.019	0.027	0.029	0.020	0.045	0.030
Investment	0.153	0.101	0.142	0.096	0.099	0.193	0.099	0.101	0.114	0.107	0.193	0.097	0.204
Government	0.042	0.052	0.052	0.045	0.041	0.060	0.041	0.052	0.038	0.044	0.060	0.050	0.036

Table 2a continued
Expenditure Weights - 1910

	Australia	Belgium	Canada	Denmark	France	Germany	Italy	Neth	Norway	Sweden	Switz	UK	US
Wheat Fl	0.049	0.082	0.045	0.046	0.116	0.030	0.153	0.036	0.061	0.032	0.074	0.074	0.035
Rye flour	0.002	0.038	0.000	0.077	0.006	0.042	0.003	0.034	0.053	0.045	0.007	0.001	0.001
Corn Meal	0.002	0.001	0.000	0.002	0.001	0.002	0.058	0.002	0.001	0.002	0.001	0.001	0.004
Beef	0.071	0.040	0.038	0.045	0.059	0.039	0.049	0.053	0.054	0.047	0.062	0.062	0.046
Mutton	0.041	0.010	0.007	0.014	0.013	0.004	0.009	0.005	0.020	0.001	0.014	0.026	0.008
Pork	0.011	0.033	0.036	0.027	0.035	0.078	0.055	0.055	0.034	0.049	0.044	0.042	0.034
Eggs	0.014	0.021	0.033	0.017	0.021	0.016	0.026	0.027	0.015	0.018	0.014	0.020	0.028
Fresh Milk	0.035	0.030	0.027	0.050	0.031	0.037	0.045	0.025	0.043	0.053	0.052	0.025	0.032
Butter	0.025	0.035	0.042	0.038	0.024	0.033	0.010	0.031	0.043	0.031	0.022	0.041	0.029
Cheese	0.004	0.011	0.011	0.009	0.014	0.008	0.027	0.014	0.023	0.006	0.016	0.011	0.004
Patatoes	0.018	0.029	0.014	0.017	0.023	0.020	0.020	0.031	0.031	0.035	0.018	0.018	0.016
Tea	0.015	0.000	0.008	0.001	0.000	0.000	0.000	0.011	0.003	0.000	0.001	0.021	0.002
Coffee	0.001	0.014	0.004	0.019	0.021	0.012	0.017	0.047	0.026	0.022	0.011	0.002	0.012
Sugar	0.034	0.018	0.019	0.028	0.015	0.011	0.019	0.018	0.044	0.035	0.018	0.023	0.016
Rent	0.099	0.102	0.137	0.115	0.115	0.118	0.076	0.106	0.105	0.111	0.118	0.112	0.158
Fuel/Light	0.032	0.039	0.044	0.069	0.053	0.056	0.028	0.055	0.041	0.032	0.056	0.042	0.031
Clothing	0.148	0.121	0.150	0.115	0.116	0.100	0.075	0.108	0.133	0.153	0.100	0.112	0.120
Alcohol	0.086	0.083	0.054	0.062	0.067	0.059	0.111	0.047	0.025	0.074	0.059	0.099	0.054
Tobacco	0.023	0.019	0.015	0.019	0.019	0.014	0.017	0.022	0.010	0.016	0.014	0.021	0.024
Domestics	0.026	0.044	0.020	0.023	0.031	0.014	0.019	0.033	0.030	0.022	0.014	0.023	0.025
Travel	0.034	0.049	0.065	0.031	0.045	0.028	0.028	0.055	0.013	0.024	0.028	0.059	0.049
communications	0.007	0.008	0.010	0.008	0.009	0.007	0.005	0.011	0.008	0.008	0.007	0.004	0.006
Education	0.026	0.019	0.029	0.023	0.022	0.021	0.009	0.022	0.030	0.032	0.021	0.016	0.025
Investment	0.153	0.101	0.142	0.096	0.099	0.193	0.099	0.101	0.114	0.107	0.193	0.097	0.204
Government	0.042	0.052	0.052	0.045	0.041	0.060	0.041	0.052	0.038	0.044	0.060	0.050	0.036

Table 3a
Relative Prices – 1872 (US = 1.00)

	Australia	Belgium	Canada	Denmark	France	Germany	Italy	Netherlands	Norway	Sweden	Switzerland	UK	US
Wheat Fl	0.933	1.617	1.062	1.210	1.017	1.613	1.275	1.535	2.039	1.555	1.881	1.354	1.000
Rye flour	1.466	0.922	0.871	1.331	1.910	1.759	1.061	0.773	0.947	1.153	2.369	1.586	1.000
Corn Meal	1.058	1.835	1.261	1.525	2.333	2.452	1.064	1.610	1.567	1.398	3.272	2.013	1.000
Beef	0.578	2.129	0.790	0.996	1.140	1.608	1.593	1.552	1.057	1.186	1.403	1.891	1.000
Mutton	0.422	0.659	0.698	0.876	0.240	1.207	0.304	0.944	0.901	1.012	1.198	1.638	1.000
Pork	1.330	2.823	0.929	0.861	1.579	1.756	2.046	1.257	1.255	1.106	1.777	1.587	1.000
Eggs	1.707	2.091	0.987	0.739	0.597	0.973	0.835	2.366	1.315	1.124	1.401	1.445	1.000
Fresh Milk	1.380	3.162	0.858	0.436	2.945	0.701	2.532	0.959	1.032	0.921	0.731	1.248	1.000
Butter	1.053	1.150	0.826	0.871	1.362	1.107	0.489	1.322	1.746	1.051	1.085	1.176	1.000
Cheese	1.215	2.093	0.882	0.575	0.642	0.951	1.161	0.778	1.295	1.156	1.083	1.131	1.000
Patatoes	0.886	0.560	0.516	0.426	0.476	0.635	0.780	0.598	1.164	0.708	1.044	1.575	1.000
Tea	0.463	0.934	0.739	0.506	0.313	0.881	9.048	0.478	1.026	1.037	1.243	0.705	1.000
Coffee	1.124	1.920	1.137	0.983	2.476	1.189	1.715	0.869	1.091	0.999	0.962	1.256	1.000
Sugar	0.772	1.957	0.983	1.022	0.910	1.236	1.280	1.313	1.779	0.991	1.053	0.764	1.000
Rent	2.150	1.095	0.691	0.644	0.819	0.937	0.475	1.171	0.720	1.043	0.937	0.677	1.000
Fuel/Light	1.196	1.332	1.110	2.210	2.030	1.283	1.577	1.332	1.142	1.142	1.283	1.028	1.000
Clothing	0.909	0.724	0.705	0.814	0.918	0.747	0.642	0.746	0.783	0.783	0.747	0.710	1.000
Alcohol	1.779	0.381	0.412	0.281	0.400	0.435	0.396	0.316	0.632	0.276	0.433	0.756	1.000
Tobacco	1.675	1.172	0.779	0.453	0.981	0.353	0.733	0.399	0.351	0.507	0.272	1.749	1.000
Domestics	1.320	0.500	0.720	0.500	0.500	0.466	0.434	0.470	0.326	0.330	0.466	0.810	1.000
Travel	5.055	2.608	1.647	4.119	1.586	1.771	1.853	0.808	6.970	2.129	1.299	0.831	1.000
communications	2.659	0.906	1.025	0.797	0.814	0.800	0.603	1.223	1.197	0.783	0.238	0.100	1.000
Education	2.164	1.163	0.637	0.658	0.572	0.549	0.358	0.649	0.741	0.603	0.561	2.314	1.000
Investment	1.132	0.642	0.896	0.711	0.718	0.599	0.631	0.636	0.627	0.651	0.599	0.547	1.000
Government	1.181	0.527	0.745	0.596	0.717	0.549	0.453	0.569	0.505	0.563	0.549	0.564	1.000

Note: the food price levels for Belgium, France and Italy are the price levels implied by the quantity comparisons.

Table 3a continued

Relative Prices – 1910 (US = 1.00)

	Australia	Belgium	Canada	Denmark	France	Germany	Italy	Netherlands	Norway	Sweden	Switzerland	UK	US
Wheat Fl	0.845	0.821	0.996	0.949	1.415	1.112	1.116	0.931	1.108	0.978	1.505	1.233	1.000
Rye flour	1.026	1.103	1.087	0.994	1.131	1.011	1.220	1.037	0.591	1.018	1.610	1.033	1.000
Corn Meal	1.026	0.853	1.087	0.766	0.881	1.308	0.735	0.798	0.812	1.000	1.282	0.795	1.000
Beef	0.795	0.920	1.131	1.025	1.062	1.229	1.194	1.490	1.084	0.756	1.180	1.067	1.000
Mutton	0.567	0.864	1.068	0.822	1.051	1.362	0.936	1.163	1.028	0.823	0.990	0.876	1.000
Pork	1.062	1.246	1.185	1.065	1.332	1.471	1.297	1.405	1.198	1.014	1.357	1.365	1.000
Eggs	1.062	0.879	1.557	0.843	0.825	1.039	0.678	1.379	0.649	0.593	0.763	0.874	1.000
Fresh Milk	1.566	0.867	1.572	0.753	0.958	1.040	1.424	0.640	0.769	0.668	0.940	0.667	1.000
Butter	0.772	0.752	0.860	0.754	0.719	0.855	0.836	0.842	0.760	0.740	0.906	0.767	1.000
Cheese	0.966	0.829	0.876	0.449	0.852	0.937	1.075	0.813	1.034	0.803	0.939	0.759	1.000
Patatoes	1.086	0.461	0.594	0.484	0.511	0.462	1.080	0.561	0.786	0.504	0.644	0.631	1.000
Tea	0.672	0.794	0.773	0.921	1.464	0.756	1.245	1.821	1.257	0.893	0.839	0.787	1.000
Coffee	1.624	0.709	1.757	1.095	1.843	1.076	1.650	2.271	1.345	1.031	1.256	1.688	1.000
Sugar	0.961	1.200	1.143	0.831	1.063	0.909	2.281	1.625	1.156	1.402	0.888	0.855	1.000
Rent	0.815	0.337	0.914	0.638	0.405	0.493	0.299	0.822	0.443	0.530	0.493	0.550	1.000
Fuel/Light	1.380	1.062	1.233	0.967	1.518	1.154	1.322	1.046	1.293	1.212	1.364	0.907	1.000
Clothing	0.721	0.768	0.796	0.802	0.911	0.850	0.864	0.700	0.762	0.836	0.850	0.680	1.000
Alcohol	2.519	0.364	1.434	0.340	0.208	0.319	0.420	0.408	0.471	0.609	0.354	0.837	1.000
Tobacco	2.159	0.442	0.885	0.562	0.824	0.567	0.962	0.291	0.374	0.499	0.374	1.356	1.000
Domestics	0.734	0.500	0.413	0.500	0.500	0.359	0.366	0.285	0.205	0.330	0.359	0.560	1.000
Travel	0.201	0.531	1.062	0.559	0.535	0.288	0.740	0.399	0.476	0.423	0.273	0.861	1.000
communications	1.048	1.009	1.538	0.846	1.385	0.884	1.442	1.727	1.155	1.212	1.052	0.443	1.000
Education	1.339	0.666	1.018	0.621	0.523	0.516	0.223	0.424	0.644	0.755	0.598	0.490	1.000
Investment	1.211	0.530	0.866	0.830	0.795	0.739	0.724	0.504	0.773	0.848	0.739	0.734	1.000
Government	0.813	0.388	0.891	0.570	0.517	0.483	0.652	0.339	0.525	0.627	0.483	0.508	1.000