Discussion paper

What money can buy?
Three centuries of Norwegian
wage and price development

BY
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Abstract

On the basis of newly utilized data from one of the largest manual historical archives on wages and prices internationally and unpublished data from Statistics Norway this article offers new wage and price series for Norway 1726-2006, which enable us to calculate real wages. These cover all main industries and sub-industries as well as an aggregated series for the entire economy. We conclude that long run real wages stayed fairly stable until the 1820s. Thereafter a modest increase took place until the 1870s, followed by rapid growth. Thus, the development of real wages seems to follow the pattern of modernization of the Norwegian economy.

Introduction

The present work offers aggregated series of newly established nominal wages 1726-2006. These are deflated by a new historical consumer price index in order to arrive at real wages. The nominal wage series are basically constructed on previously and newly utilized data kept at the Professor Dr. Ingvar B. Wedervang's Historical Archive on Wages and Prices at the Norwegian School of Economics and Business Administration along with public records kept by public institutions.

All in all 19 different series of nominal and real wages are presented here, representing a vide range of industries within all major industrial sectors of the economy. Some series stretches back to 1726, when others start in nineteen century.

All present series are calculated into annual wages measured in Norwegian kroner. In order to make the series in annual wages we also had to establish new estimates of normal working hours per man-year for the different industries. After having arrived at series of nominal wages, we deflate these by a new historical

consumer price index to arrive at real wages as indicator of the development of the standard of living.

Classification

Table 1 reports the industries and sub-industries we present annual nominal and real wages for. Note that the aggregated numbers on the industrial level are not averages of the quoted sub-industries, but representative numbers for the entire industries. In the same way the last group "total" is not the average of the quoted industries, but representative numbers for the over all economy.

Table 1. Wage series by industry.

Number	Classification	Industry and sub-industry
1	1.0.	Primary industries
2	1.1.	Agriculture and forestry
3	2.0.	Secondary industries
4	2.1.	Construction
5	2.2.	Crafts
6	2.2.1.	Manufacturing
7	2.2.2.	Textile
8	2.3.	Engineering
9	3.0.	Transport and communication industries
10	3.1.	Merchant fleet (sailors)
11	3.2.	Domestic transport
12	3.3.	Communications
13	4.0.	Public services
14	4.1.	Public administration
15	4.2.	Public education
16	5.0.	Private services
17	5.1.	Domestic services
18	5.1.1.	Housekeeping
19	6.0.	Total

It is not a straightforward task to construct real wage series for a period covering almost 300 years. In the methodological field we have to come up with a number of creative solutions to numerous data challenges.

One problem has to do with the definition and classification. The nature and title of most industries and professions have changed dramatically over the decades and centuries. E.g. professions, which in nature belonged to crafts in the eighteenth century, became manufacturing industry in the nineteenth century and lately service industries. Thus, it is very difficult to make valid classifications of industries and occupations over time. The present approach is to use the same classifications as were used at the time, i.e. historically. However, we will then have to remember that the character of the work changed substantially over the time.

Unit of account

An important methodological challenge is time units of wages. Some data are given in hourly wages, some in daily, weekly, monthly or annual wages. Some data are given for piecework, when some are given as fixed time unit salaries. In order to compare these different time units, we have basically tried to recalculate all wages within each industry into one unit of time account, i.e. different series, with different time units are spliced together into one time unit of account.

As for piecework versus fixed wages we try to recalculate the piecework wages into time unit wages according to their average salary per time unit worked. Then we find average wages for both piecework hired and fixed wage hired employees within the same industry or sub-industry.

There is also the challenge of dealing with different currencies used as unit of value account. In 1671 the Danish-Norwegian currency Rigsdaler Species was officially set to a silver value of 9.25 dalers per mark fine silver. Rigsdaler Courant was formally set to a value of 81.6 per cent of the Rigsdaler Species. In 1795 the relation was set to 80 per cent. During the Danish-Norwegian King's involvement on the French side during the Napoleonic wars, Norway went into a period of monetary turbulence, with strong inflation and currency depreciation. New currencies were introduced. This turned out unsuccessfully, and Norway went into monetary chaos 1813-16. It is hard to come up with consistent series of wages and prices for this period.

Additionally, for the period from 1726-1842 the sources tend to present manipulated data. This is done by correcting the data according to deviations from the par rates of the currencies. Moreover, in 1874-77 the daler ceased as the key currency, which now became the krone.

In order to obtain continuous series of wages and prices in current values we use krone as our unit of account. The data adjusted for exchange rate fluctuations have been readjusted and data in other units of currencies principally transformed into krone by their formal values at the time when the observations were taken.

Paasche wage index and Laspeyres price index

In order to go from nominal to real wages we have to deflate the nominal series. The deflation procedure is taken care of by using Norges Bank's consumer price index (CPI) for the period in question. This price index is like most other general historical CPIs constructed as a Laspeyres index (P_L) with weighted arithmetic averages, according to equation (1):

$$P_L = \frac{\sum (p_{it} \cdot q_{i0})}{\sum (p_{i0} \cdot q_{i0})} \tag{1}$$

Here p denotes price, q volume, i product and t year of observation.

The wage data are added up from micro series to sub-industry and main industry series. Ideally we would use annual quantity weights for each micro series in our aggregated series according to the Paasche approach (V_P). That is, we would prefer to use the annual number of employed persons in each micro series in order to compute running annual aggregated series of average wages, as shown in equation (2):

$$V_P = \sum (v_{jt} \cdot q_{jt}) \tag{2}$$

Here v denotes nominal wages, q volumes, and, j industry and t year of observation. When this approach has been possible we have done so. However, in most cases it has not been possible, due to shortage of employment observations. In consequence, we have used aggregated Laspeyres series with fixed weights during time intervals, according to equation (3):

$$V_L = \sum (v_{jt} \cdot q_{j0}) \tag{3}$$

New weights have been used according to the availability of employment data. The nominal wage series are, thus, principally Laspeyres price deflated Paasche wage series (4) and secondary Laspeyres price deflated Laspeyres wage series (5), as stated in equation (4) and (5):

$$\frac{V_P}{P_L} = \frac{\sum (v_{jt} \cdot q_{jt})}{\sum (p_{it} \cdot q_{i0}) / \sum (p_{i0} \cdot q_{i0})} \tag{4}$$

$$\frac{V_L}{P_L} = \frac{\sum (v_{jt} \cdot q_{j0})}{\sum (p_{it} \cdot q_{i0}) / \sum (p_{i0} \cdot q_{i0})} \tag{5}$$

The Wedervang Archive

In the present paper we are able to construct continuous nominal and real wage series for the total economy, main industries and sub-industries basically on the basis of utilization of hitherto unused or under used data from one of the largest manual historical archives on prices and wages in the world, i.e. Professor Dr. Ingvar B. Wedervang's Historical Archive on Wages and Prices, kept at the Norwegian School of Economics and Business Administration in Bergen.

The archive was first set up in the 1930s by the two Norwegian professors Ragnar Frisch and Ingvar Wederang. It was partly financed locally, but chiefly by the Rockefeller Foundation. Up to 46 assistants were engaged in collecting data on wages, prices and business accounts. The idea was that the data should be used as decisive information in an ongoing project examining the Norwegian economic structure and the nature of business cycles. The Second World War brought a considerable halt to the work connected to the archive, which has been under utilized ever since.

The data in the archive is stretching back to 1641 and cover the period till 1940. It holds several million direct observations on prices and wages, and reflects some two digit million observations drawn from different accounts with wage and price data. The data are compiled from market places, institutions, stores, private firms, merchant houses, product bourses, price currents, employers' and employees' organizations, and public records and offices. They reflect most kinds of labor costs

and wages and different kinds of price data, e.g. product prices, import and export prices, gross prices, consumer prices, factor prices and market prices.

Wage data

Substantial effort has been put into research on the development of real wages in Norway. Most of this work has been rather fragmental, however, and few aggregated series on a nation wide level have been published. Most studies concentrate on local industrial plants, communities or branches of industries.[1]

The major sources for the period up till the first decades of the nineteenth century are previous research conducted by writers on Norwegian economic history and files from the Wedervang Archive. For the period stretching from 1820-1920 the Wedervang is the key source, when Statistics Norway takes over as the major provider of data thereafter.

1. Primary industries

We have been able to construct a dataset of wages in the primary sector as a whole back to 1899. However, for agriculture and forestry we have been able to trace the development back to 1820.

1.1. Agriculture and forestry

Historical wage data for hired labor on farms can basically be found in accounts from 57 major farms. These are kept in the Wedervang Archive.[2] Most observations are cash-wages for hired labor, where board and lodging are not included. Thus, they have to be added.[3]

In public records published by Statistics Norway, we find observations of daily wages for agricultural workers for every fifth year from 1850 onwards, where board and lodging is included.[4] The five-annual series can be complimented with annual figures found in the Wedervang Archive as indicator of the annual development. From 1915 we use annual and more detailed wage series published by

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[1] See e.g.
[2] Wedervang Archive, W027, W028, W204, W205 and W207.
[3] Gjølberg 1974, 135-153 and Lønningdal 1984, 141-163.
[4] NOS 1949, 366-367.

Statistics Norway, including most sorts of farm occupations.[5] Finally, from 1946 we use quotations on wages in agriculture, forestry and fisheries drawn from the national accounts' department at Statistics Norway.[6]

Both the Wedervang staff, Lønningdal and Gjølberg tried to map the value of non-cash payments.[7] They all conclude that board and lodging was by far the most important factor of income for hired labor in agriculture in the nineteenth century. A problem with most of these estimates is that they add a fixed share of compensation to the cash wages. Here, we try to examine annual values of compensation independently of cash wages.[8] We estimate food provided to labor on the farms according to a consumption basket, where the estimated consumption volumes are multiplied by annual prices.[9] This operation provides us with more reliable series of non-cash wages in agriculture than hitherto.[10]

2. Secondary industries

The available sources enable us to construct consistent series of wages within the secondary sector as far back as 1726. We have been able to trace the development of the construction industry, the manufacturing and mining industry with its two sub-industries, engineering and textile, and finally, crafts.

2.1. Construction

The main source of wages within construction work is the Wedervang Archive up to 1920 and thereafter Statistics Norway. On the basis of these sources we are able to follow five different occupations over some time. These are road construction, railway construction, bricklayers, telecommunication and harbor construction and maintenance. The road construction data from the Wedervang Archive is the most impressive part of this material and reflects more than 13.4 million observations of daily wages for piecework 1850-1920. The corresponding number for workers on fixed salaries was almost 1.1 million. The data are reported practically from the entire

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[5] NOS 1949, 366-367.
[6] Data provided by Tor Skoglund, Statistics Norway 2007.
[7] Wedervang Archive, W089 and W091, Gjølberg 1974, 139-144, Lønningdal 1984, 37-43.
[8] Statistical Office of Kristiania 1915, 144-149, Ramstad 1982, 482-492, Minde and Grytten 1997, 79 and Grytten and Minde 1998, 52-55,
[9] Grytten 2004, 78-93.
[10] Lønningdal 1984, 108, Wedervang Archive, W089 and W091

country.[11] The second most important group of wage data in the construction industry stems from public railway construction. The records in the Wedervang Archive rest on 11.6 and 1.7 million observations of piecework and fixed daily wages respectively. The number of observations of hourly wages reflected in the archive is astonishingly 139.3 and 22.8 million respectively.[12]

For the interwar period and till 1945 we also include annually published records by Statistics Norway with coverage for up to 40 main Norwegian urban areas.[13] Thereafter, draw our information from the wage statistics from the national accounts department at Statistics Norway.[14]

2.2. Manufacturing and mining

Wage data on manufacturing and mining are compiled from a number of sources. They have to be modified in order to arrive consistent time series. We have been able to follow numerous occupations within the manufacturing industry 1726-1806, and thereafter, annual series from 1820 onwards.

Our source 1726-1806 is Ingeborg Fløystad's wage series from the major iron manufacturing plant Baasland and Næs Jernverk 1726-1806.[15] These include cash, board and lodging.

A second source is Matti Goksøyr's wages series from the Alvøen industrial plant. The company was founded in 1797 and was a pioneer in paper production based on hydraulic power.[16] Here we utilize wage data covering the period 1820-65 combined with records from the Wedervang Archive. The employees had fixed individual contracts for their families. Thus, cash wages stayed fairly constant over intervals. Board and lodging have to be added. Surveys from the mid 1800s provide us with information on the size of these non-cash payments. We arrive at about 60 per cent in 1850 and around 70 per cent in the early 1820s. By drawing information on annual price movements and linking this to our consumption basket making up for

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[11] Wedervang Archive, W118, W119A, W120A and W249.
[12] Wedervang Archive, W245 and W249 and Alme 1993, 64-65.
[13] NOS 1920-1940.
[14] Data provided by Tor Skoglund, Statistics Norway 2007.
[15] Fløystad 1979, 595-596.
[16] Goksøyr 1982.

non-cash payments we arrive at the values of the salaries paid by other means than money.[17]

From the 1820s the Wedervang Archive gradually takes over as the key source. Women are included in the material for most years. From the 1870s the archive reports annual data on the basis of some thousands observations of hourly, daily, weekly monthly and annual wages.[18]

Statistics Norway becomes our main source for manufacturing wages prior to 1920, as the office recorded data from almost 50 towns and industrial communities.[19] Covering the bulk of the manufacturing labor force, they represent both valid and reliable aggregate series till World War II.[20] Finally we use data connected to the national accounts' wage statistics 1946-2006.[21]

2.3. Crafts

Ingeborg Fløystad offers five-annual wage series for craftsmen in iron production 1726-1806, including board and lodging.[22] Thereafter, the Wedervang Archive is the main source.[23] We first use wage data for senior blue-collar workers at the Kongsberg Sølvverk and the Cappelen-Ulefoss industrial plant.[24] From 1875 the data have substantially better coverage, reporting daily wages for painters, masons, carpenters, bakers, tailors, shoe makers in urban areas of Norway. From 1915 they include thousands of observations of eleven occupations.[25] After 1915 Statistics Norway takes over as our most important source.[26] From 1940 onwards it constitutes our only source.[27]

3. Transports and communications

This group of industries, stretching back to 1751, includes maritime transport, domestic transport and other forms of transports communications.

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[17] Grytten and Minde 1998, 52-54 and Grytten 2004, 90-93.
[18] See e.g. Wedervang Archive. W284.
[19] NOS 1918-1941.
[20] NOS 1949, 364-365 and NOS 1918-1941.
[21] NOS 1949, 364-365 and data provided by Tor Skoglund, Statistics Norway 2007.
[22] Fløystad 1979, 595-596.
[23] Wedervang Archive, W417.
[24] Wedervang Archive, W046 and W055.
[25] Wedervang Archive, W284.
[26] NOS 1915-1941 and NOS 1949, 364-365.
[27] Data provided by Tor Skoglund, Statistics Norway 2007.

3.1. Merchant fleet

We use data from the Wedervang Archive on sailors' wages 1751-1921. Then, we use data from Frode Akstun till 1940 and Statistics Norway till present. The series from the Wedervang Archive are based on 26 capacities of crew in 26 Norwegian ports.[28] Sailor's wages were basically measured without board and lodging until the last decades.[29] The data from the Wedervang Archive was collected from basically three types of sources, i.e. reicrutment lists, crew lists and dischargement lists, of which the first category is the one mostly used by us.[30] Note that domestic ocean transport is excluded from the data. The total number of monthly wage observations taken from the archive and used here is 688.368.[31] The empirical bases of the series are quite strong from the early 1800s, and particularly from 1816 onwards.

For the interwar period we use data from Akstun and Statistics Norway. These were originally taken from crew lists kept and reported by the ship owner's association.[32] For the World War II-period we draw information from Lars Chr. Jenssen.[33] For the post-war period we use records from Statistics Norway only.

3.2. Domestic transport

Our series start in 1850 and are compiled from The Wedervang Archive. An important group of labor for the first decades is public road construction workers providing their own horse. The number of daily observations taken from all over the country varied between 225 and 29,685.[34] For the period 1854-1910 the Wedervang Archive also provides records of daily wages from railway companies, taken from the

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[28] Wedervang Archive, file W043 and W044..
[29] Akstun 1960, 45-52 and NOS 1921-1941.
[30] Wedervang Archive, files W030, W032, W034, W035, W036, W038, W039, W063, W172, W173, W174, W176, W182, W184, W185, W186, W187, W188, W189, W193, W320, W327, W329, W330 and W407.
[31] Wedervang Archive, files W030, W032, W034, W035, W036, W038, W039, W043, W044, W063, W172, W174, W176, W182, W184, W185, W186, W187, W188 and W189, W248, and W349.
[32] Akstun 1960, 45-52 and NOS 1921-1941.
[33] Jenssen, Lars Chr. 1992, 17-53.
[34] Wedervang Archive, W118, W119A, W120A and W249.

railway workers union.[35] From 1915 we use data from Statistics Norway for this industry.[36] For the years 1940-2006 we use data from Statistics Norway only.[37]

3.3. Communications

This series includes all other forms of transport and communication. It starts in 1850 and increases its coverage significantly in the 1870s.[38] The major profession we have data for during the first decades is railway workers. Then, from 1918 onwards, Statistics Norway reports hourly wages for telegraph workers, and from 1921 daily wages paid by port authorities. Data are given for both fixed wages and piecework.[39] Finally, Statistics Norway serves as our only source from 1940 till present. For the first five years of this period we trace data from different sources published by the bureau.[40] Thereafter we use the wage data set from the national accounts department from 1946 onwards.[41]

4. Private services

As for private services the sources are scarce up to the twentieth century. However, there is basically one exception, i.e. private domestic services, and within this group chiefly housekeeping. A problem connected to this sub-industry is that domestic services were basically low paid jobs, when some professions within private services, e.g. finance and consulting were well paid. Aggregated series are found by splicing Statistics Norway's data on annual wages in the private sector 1946-2006 with other series of private services 1915-1940 and private domestic services 1830-1915.

4.1. Domestic services

The Wedervang Archive also serves as the most important source for domestic services. Our series start in 1830. We use data on wages for female domestic servants on farms.[42] We are also in a position to construct estimates of annual wages for male

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[35] Wedervang Archive, W058.
[36] NOS 1949, 367.
[37] Data provided by Tor Skoglund, Statistics Norway 2007.
[38] Wedervang Archive, files W058, W118, W119A, W120A, W245 and W249
[39] NOS 1918-1941.
[40] NOS 1949, 366-367 and NOS 1940-1948.
[41] Data provided by Tor Skoglund, Statistics Norway 2007.
[42] Wedervang Archive, files W028 and W204.

domestic servants from 1850 onwards.[43] From about 1850 till their conclusion in 1920 the records in the Wedervang Archive improve significantly. In addition we utilize five-annual data kept by Statistics Norway from 1850.[44]

According to the records cash-wages stayed fairly stable over intervals. The board and lodging part was stable as volumes, but the prices on these items fluctuated considerably. By examining the composition of consumption expenditures from the nineteenth century and link these to current prices we arrive at running values for non-cash payments.

From 1915 Statistics Norway provides wage data for domestic servants, and from 1918 also for cleaning and laundry ladies.[45] Again, by using cash-wages and adding estimated non-cash wages on the basis of consumption surveys and price developments we obtain representative series of their full wages.[46]

From 1940 till 2006 Statistics Norway is our major source for wages in domestic services. A historical survey of 1948 serves as our most important source 1940-1945, when data from the national accounts department of the bureau is our main provider of data from 1946 onwards.[47]

5. Public services

The best available source for public services for the nineteenth century is Kjell Bjørn Minde's, study on the profitability of higher education in Norway 1885-1955, which offers annual tariff salaries for public servants.[48] By drawing on information from his work we are able to give representative estimates of wages for public services till 1940. Thereafter we use data published by Statistics Norway on annual wages in public services.[49]

5.1. Public administration

Minde primarily pays attention to public administration and education. He offers wage data on public servants in the central and local public administration. Most of

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[43] Gjølberg 1974, 85-107.
[44] NOS 1949, 366-367.
[45] NOS 1949, 364-365 and NOS 1918-1941.
[46] NOS 1978, 530-532 and 576 and Grytten 2004, 92-93.
[47] NOS 1949, 365-368 and data provided by Tor Skoglund, Statistics Norway 2007.
[48] Minde 1993, 25-123* (appendix).
[49] Data provided by Tor Skoglund, Statistics Norway 2007.

his data report wages of senior bureaucrats. Thus, they are higher than the average of the sector. However, he also gives wages for technical personnel and assistants and some junior staff. By adding extra payments to the tariff wages and constructing a normal distribution of employees according to the tariffs, we arrive at reliable estimates of public administration wages, inclusive central ministries up to 1946.[50]

For the period after 1946 we use data provided by Statistics Norway.[51] This is spliced to the former series, and thus we arrive at annual wages for public administration from the late nineteenth century till present.

5.2. Public education

Kjell Bjørn Minde also reports wages for educators. Again, these are tariff wages. However, by diving deeper into his material we find reliable sizes of actual salaries.[52] By linking these to Statistics Norway's data on over-all salaries in education from 1946, we arrive at representative series from the 1890s till present.[53]

6. Total

By summing up all industries we arrive at average wages for the total Norwegian labor force for the 280 years 1726-2006. In order to do so, we have to give all series by industry and sub-industry weights and come up with the same unit of account, which is chosen to be kroner per man-year.

Man-years

In order to establish comparable figures, all series are presented as annual wages in here. From 1946 we have man-year data for all industries and sub-industries. For the pre-1945 period we have annual wages for some industries, like public administration, education, domestic services and partly farming. Thus, for the rest of the industries we have to estimate man-years for the period previous to 1946.

Most of our sources provide data in daily wages. These take into account that the number of working hours shifted over time. Thus, it is for us to find the number of

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[50] Minde 1993, 25-123* (appendix).
[51] Data provided by Tor Skoglund, Statistics Norway 2007.
[52] Minde 1993, 25-123* (appendix).
[53] Data provided by Tor Skoglund, Statistics Norway 2007.

working days during a year. When the working hours in manufacturing were set down to 40 hours per week in 1919, a man-year became significantly shorter. We have taken this into account in our calculations. Before 1919 we assume six hours working week. Holidays are excluded. The number of actual working days stayed almost constant before 1900, despite the number of working hours was falling. The number of working days also varied between different types of industry. Agriculture had more than other industries, when public administration had less.

Chart 1 below reports the number of normal working hours per man-year, as assumed in this work.

Chart 1. Number of working hours per normal man-year 1726-1945.
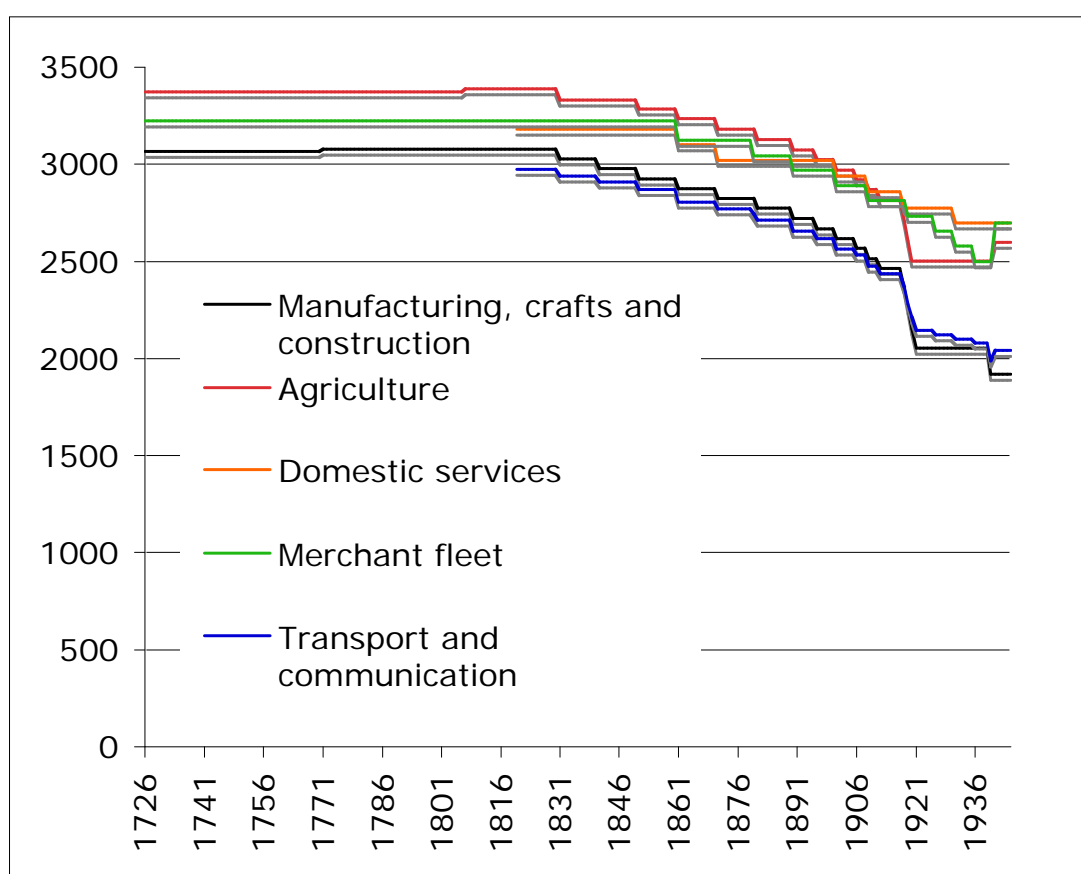
Sources, Wedervang Archive, files W089 and W091, Minde 1993, 65-78 and Grytten 1994. 238-267.

We have been able to find estimates of the number of working hours per man-year by dividing reported annual salaries by reported hourly wages. Again, the Wedervang Archive and Statistics Norway serve as the most important sources. The time efficiency of work probably increased substantially during the nineteenth century. Thus, the formal working hours were significantly lower in the late nineteenth century

than in the eighteenth century. However, the utilization of the working time was considerable higher in the nineteenth than the eighteenth century. It may be a valid assumption that general efficient working hours were at least as high in 1850 as in 1750. Nevertheless, this is not mirrored in the formal working hours, which we have to use here in order to arrive at representative annual wages.

Weights

In order to arrive at aggregated series at industrial levels, we have to sum up different series. For the period 1946-2006 we use the same weights as Statistics Norway have used in their series. For the period 1930-1945 we use annual weights according to the historical national accounts statistics on man-years.[54] Thus, the total average wages 1930-2006 are calculated by a Paasche approach. For the years previous to 1930 we use benchmark year estimates of employment by sector according to historical national accounts along with data from population censuses.[55] Hence, we use a Laspeyres approach for the period 1726-1929.

Nominal wages

By weighting the nominal wages by industry with their share of total employment and we then arrive at different aggregates of wage series for the period 1726-2006. Some key series of annual wages are presented in chart 2.

For the period 1946-2006 these are quite similar to the newest series form Statistics Norway. For the period 1935-39 they are similar to separate calculations under process at the bureau. For the period 1911-34 they match tax records from the Inland Revenue satisfactory.[56] As for the years prior to 1911, we find a tendency towards somewhat lower nominal wages in the secondary sector than believed hitherto. This is however due to the fact that our new series have better coverage than previous figures.
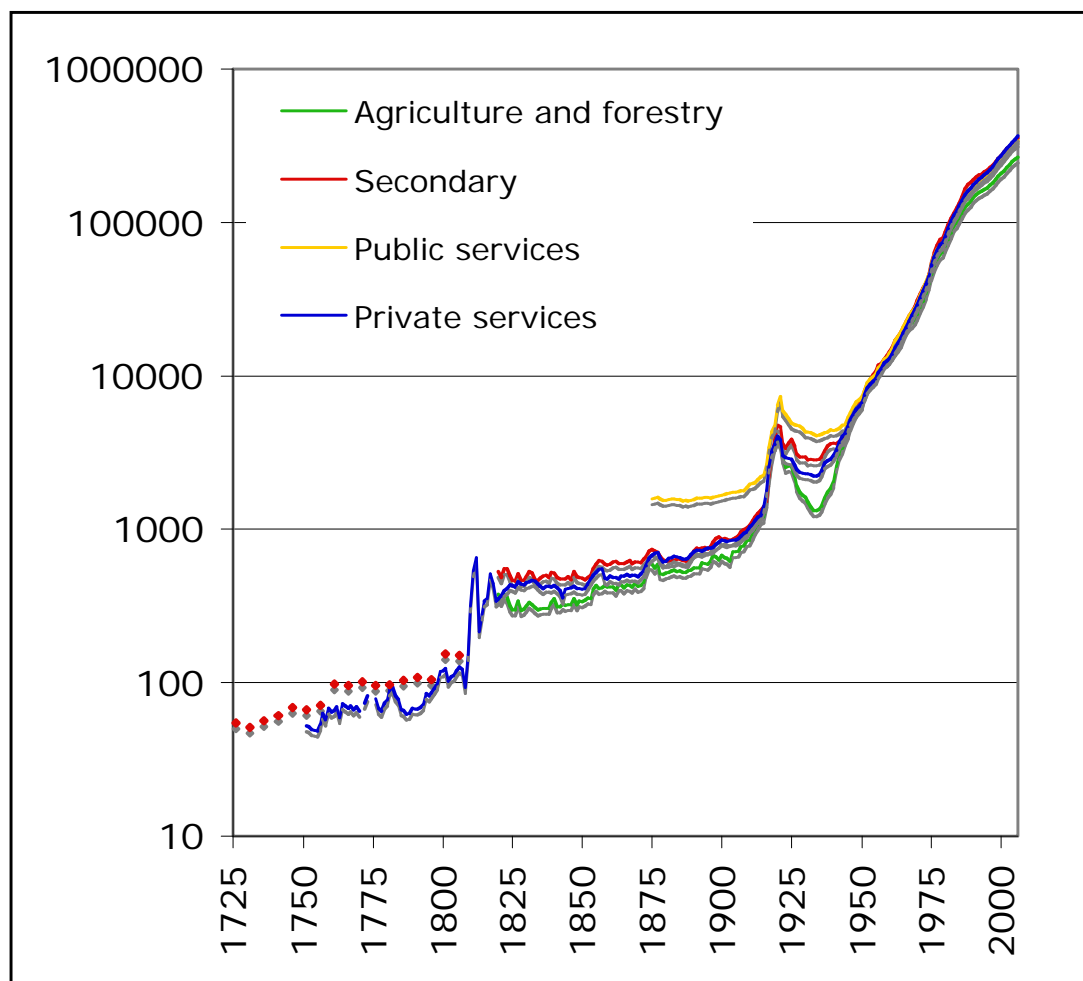
Chart 2 reveals significant wage differences between sectors. In particular public services were comparatively well off until the World War II. Thereafter, we find rapid convergence and highly correlated developments up till present days.

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[54] NOS 1965, 328-337.
[55] Bjerke 1966, 30-65.
[56] Grytten 2000, 22-41.

Chart 2. Nominal wages in Norwegian key industries 1726-2006, semi-logarithmic scale.

Sources, Agriculture and forestry: Wedervang Archive, files W009, W013, W014, W021, W027, W028, W204, W205, W207, NOS 1949, 366-367, Gjølberg 1974, 31-103, Lønningdal 1984, 141-163 and data provided by Tor Skoglund, Statistics Norway. Secondary: Wedervang Archive, files W045, W046, W047, W048, W049, W054, W055, W056, W071, W072, W074, W074, W080, W081, W082, W118, W119A, W120A, W121, W245, W249, W284, W417, NOS 1949, 364-365, NOS 1915-1941, Petersen 1950, 670-671, Fløystad 1979, 595-596, Goksøyr 1982, Grytten 1992, 159-167, Alme 1993, 64-65, Hodne, Grytten and Alme 1995, 240-243 and data provided by Tor Skoglund, Statistics Norway. Public services: Minde 1993, 25-123* (appendix) and data provided by Tor Skoglund, Statistics Norway. Private services: Wedervang Archive, files W009, W013, W014, W021, W028W030, W032, W034, W035, W036, W038, W039, W043, W044, W058, W063, W118, W119A, W120A, W172, W174, W176, W182, W184, W185, W186, W187, W188, W189, W204, W245, W248, W249, W349, 52 NOS 1949, 364-367, NOS 1918-1941, NOS 1978, 530-532 and 576 Akstun 1960, 45-62, Gjølberg 1974, 61-68 and 85-107, Lønningdal 1984, 23-36, 104-109 and 141-163, Minde and Grytten 1997, 61-82, Gryttten 2004a, 92-93, Grytten and Minde 1998, 42-58 and data provided by Tor Skoglund, Statistics Norway.

Deflator

In order to construct real wage series we have to deflate our new nominal wage series for price changes. In doing so, we use a consumer price index, namely the newly constructed CPI from the Norwegian central bank. Thus, the deflation procedure is carried out in line with equation (4) and (5).

The CPI of the central bank stretches back to 1516.[57] From 1666 it offers annual observations of the consumer price movements till present days. During the eighteenth century both its validity and reliability increase. From 1819 it includes 29 product items in eight consumption groups. The numbers increase to 47 commodities representing nine consumption groups from 1830 and 55 items representing ten consumption groups from 1850, when the cost of living index (CLI) by Ramstad has been adopted.[58] From 1901 the CLI index adopted from the Krisitania Statistical Office by Statistics Norway. The bureau then adopted the Social Ministry's CLI 1916-1919, and thereafter constructed a CLI 1919-1959. From then on it was substituted with Statistics Norway's own CPI.[59]

Like most historical CPIs and CLIs our deflator is constructed by a Laspeyres approach, meaning we have fixed commodity weights during periods. The key source for price data during the eighteenth century is accounts by merchants in one of the most important commercial cities in the Nordic countries at the time, i.e. Bergen. Though, market prices are also taken from other locations along the country. Bergen still serves as the most important source of price data until 1830. From then on price data collected almost all over the country by request from the central government, serve as our most important source. In the 1930s these price data were assembled by the staff of the Wedervang Archive, They now serve as one of the richest sources for market prices on consumer goods in nineteenth century Europe. Both their validity and reliability seem high. In the first place they do reflect market prices to consumers. Secondly, the price data were recorded by local civil servants on a monthly or at least a quarterly basis according a strict regime set by the central authorities. Thirdly, the price quotations and the procedure of collecting the data were both controlled by civil servants by the central administration.[60]

The commodity weights in the new CPI of the central bank were decided on the basis of different consumption surveys.[61] The deflator seems reasonably reliable for the period 1726-1819, fairly reliable for the years 1819-1830 and considerably reliable 1830-1919. Thereafter our deflator is very reliable, holding price observations on up to around 700 items till 1959 and thereafter about a thousand or more items. In

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[57] Grytten 2004a, 47-98
[58] Ramstad 1982, 158-238.
[59] Grytten 2005, 72.
[60] Grytten 2004b, 61-80.
[61] Grytten 2004a, 63-66.

sum the latter index comprises 40.000 to 45.000 observations per month. The CPI of the Norwegian central bank is printed along with the annual series of nominal wages for the period 1726-2006 in chart 3.

Chart 3. Development of CPI and nominal wages for Norway 1726-2006, semi-logarithmic scale.
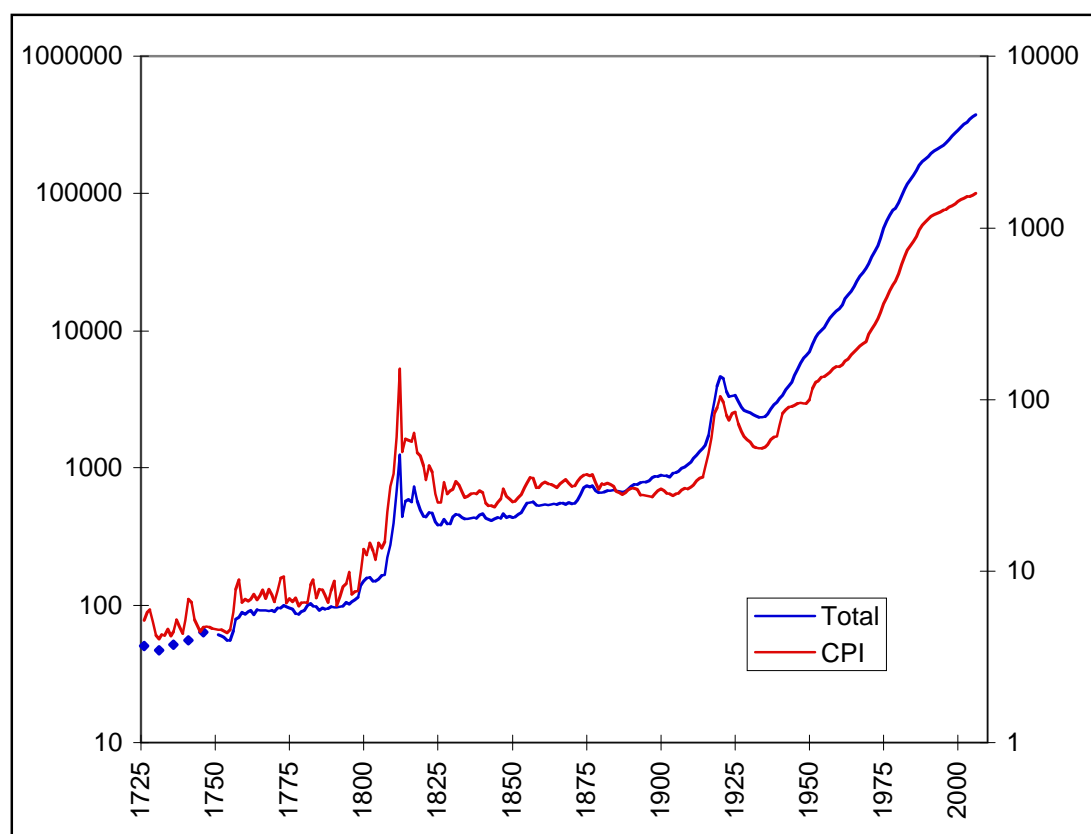
Left hand side-scale = nominal annual wages.
Right hand side scale = CPI, where 1950=100.
Sources, CPI: Grytten 2004, 92-93. Wages: Wedervang Archive, files W009, W013, W014, W021, W027, W028, W030, W032, W034, W035, W036, W038, W039, W043, W044, W045, W046, W047, W048, W049, W054, W055, W056, W058, W063, W071, W072, W074, W074, W080, W081, W082, W118, W119A, W120A, W121, W172, W174, W176, W182, W184, W185, W186, W187, W188, W189, W204, W205, W207, W245, W248, W249, W284, W349, W417, NOS 1949, 363-368, NOS 1915-1941, NOS 1978, 530-532 and 576, Petersen 1950, 670-671, Akstun 1960, 45-62, Gjølberg 1974, 31-107, Fløystad 1979, 595-596, Goksøyr 1982, Lønningdal 1984, 141-163, Minde 1993, 25-123* (appendix), Alme 1993, 64-65, Hodne, Grytten and Alme 1995, 240-246, Lønningdal 1984, 23-36, 104-109 and 141-163, Minde and Grytten 1997, 61-82, Grytten and Minde 1998, 42-58, Grytten 1992, 159-167, Gryttten 2004a, 92-93, and data provided by Tor Skoglund, Statistics Norway.

We observe from chart 3 that nominal wages and prices move in the same direction both in the short and in the long run. However, prices seem to fluctuate more than wages. This implies the existence of rigid nominal wages, as they were often set in fixed terms. We can also see that wages started to increase significantly faster than the

price level from the 1820s, indicating increasing standard of living and economic growth.
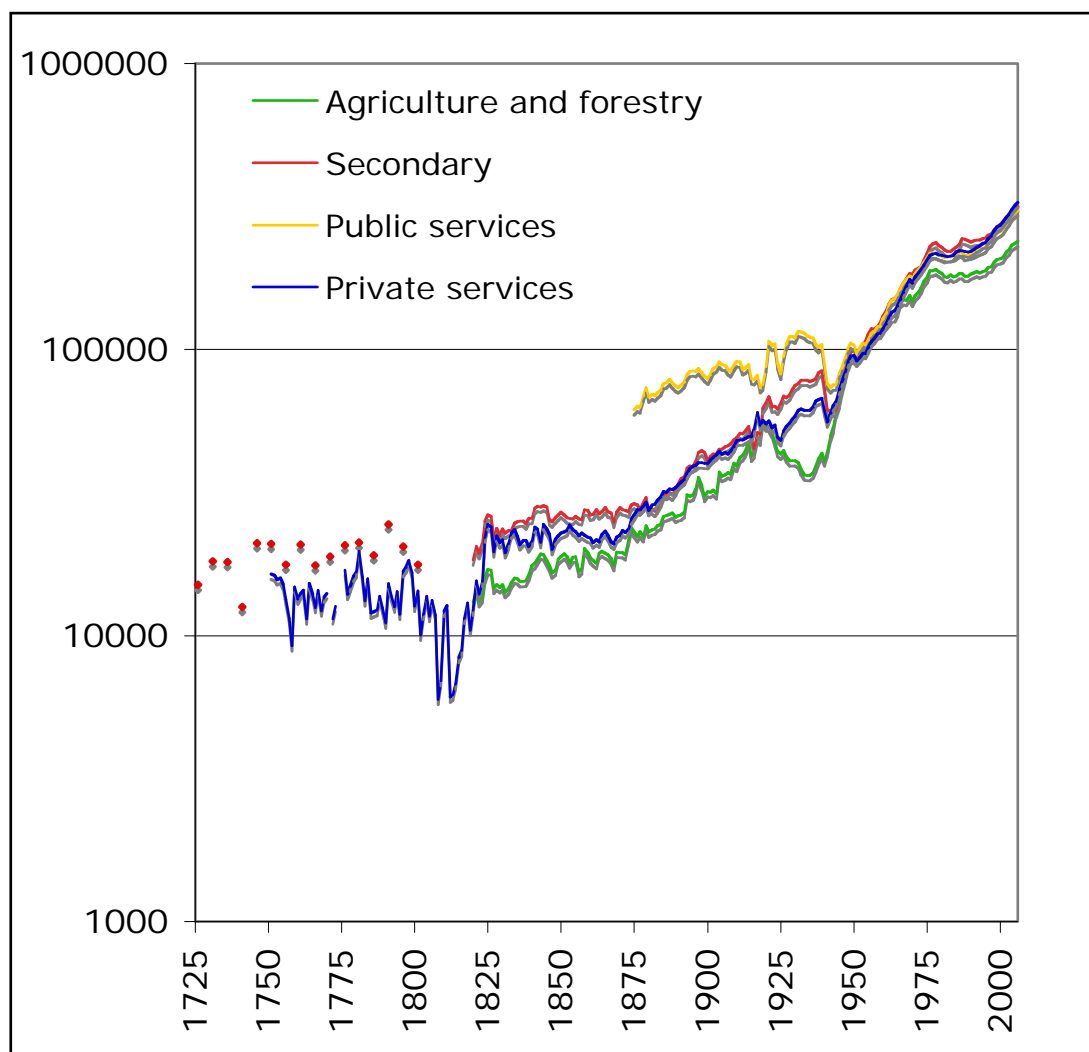
By examining the accountability of the different sub-indices we can conclude that the CPI from the Norwegian central bank should serve as a suitable deflator in order to arrive at real wage series for Norway 1726-2006.

Real wages

Having arrived at new series of Norwegian annual wages 1726-2006 and presented the new CPI, we are now in a position to conclude with real wage series. This is done by deflating the new nominal series by the mentioned CPI according to equation (4) and (5). In other words we deflate the constructed Paasche and Laspeyres wage series with a Laspeyres deflator. Again we present four series graphically, i.e. real wages for agriculture and forestry, secondary industries, private services and public services. These are shown in chart 4. (For the other 14 series by industry and sub-industry, along with a series for total aggregates, see the appendices).

According to chart 4 long-term real wages stayed fairly stable until the 1820s. However, in the short run there were huge fluctuations, mostly due to volatile prices. From the late nineteenth century we observe increasing rates of real wage growth. During the 1870s, 1880s and the first half of the 1890s this was very much due to deflation, when the growth of real wages between 1905 and 1916 easily can be seen as a consequence of rapid industrialization and economic growth. In the interwar period we see divergence between sectors and industries, with agriculture and forestry as the dominant losers, due to over production and very harsh deflation in product prices of primary products. After World War II we find rapid and steady real wage growth in all sectors until the mid 1970s. Thereafter the rates of growth dive significantly and differences between industries start to increase again, with agriculture as the loser. Finally, in the 1990s and till now we find a dramatic increase in real wages for most industries again.

Chart 4. Annual real wages for Norway 1726-2006 in NOK-2000, semi-logarithmic scale.

Sources, Agriculture and forestry: Wedervang Archive, files W009, W013, W014, W021, W027, W028, W204, W205, W207, NOS 1949, 366-367, Gjølberg 1974, 31-103, Lønningdal 1984, 141-163 and data provided by Tor Skoglund, Statistics Norway. Secondary: Wedervang Archive, files W045, W046, W047, W048, W049, W054, W055, W056, W071, W072, W074, W074, W080, W081, W082, W118, W119A, W120A, W121, W245, W249, W284, W417, NOS 1949, 364-365, NOS 1915-1941, Petersen 1950, 670-671, Fløystad 1979, 595-596, Goksøyr 1982, Grytten 1992, 159-167, Alme 1993, 64-65, Hodne, Grytten and Alme 1995, 240-243 and data provided by Tor Skoglund, Statistics Norway. Public services: Minde 1993, 25-123* (appendix) and data provided by Tor Skoglund, Statistics Norway. Private services: Wedervang Archive, files W009, W013, W014, W021, W028W030, W032, W034, W035, W036, W038, W039, W043, W044, W058, W063, W118, W119A, W120A, W172, W174, W176, W182, W184, W185, W186, W187, W188, W189, W204, W245, W248, W249, W349, 52 NOS 1949, 364-367, NOS 1918-1941, NOS 1978, 530-532 and 576 Akstun 1960, 45-62, Gjølberg 1974, 61-68 and 85-107, Lønningdal 1984, 23-36, 104-109 and 141-163, Minde and Grytten 1997, 61-82, Gryttten 2004a, 92-93, Grytten and Minde 1998, 42-58 and data provided by Tor Skoglund, Statistics Norway. Deflator: Grytten 2004a, 92-93.

Chart 5 we compares the developments real wages and GDP per capita.[62] As the chart reveals, GDP per capita has grown significantly faster than real wages, reflecting that private consumption has become a continuously smaller part of the expenditure side

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[62] Grytten 2004c, 241-288, NOS 1965, 348-351 and

of the GDP. When real wages multiplied itself with a factor of 16.08 from 1830 till 2006, the per capita GDP volume multiplied itself with 32.77. At the same time the private consumption level per capita according to the historical national accounts, stepped up 17.33 times, similar to our measure of real wages.[63] The minor differences can be explained by increasing tax and propensity to save.

Chart 5. Real wages and GDP per capita in Norway 1830-2006 in NOK-2000, semi-logarithmic scale.
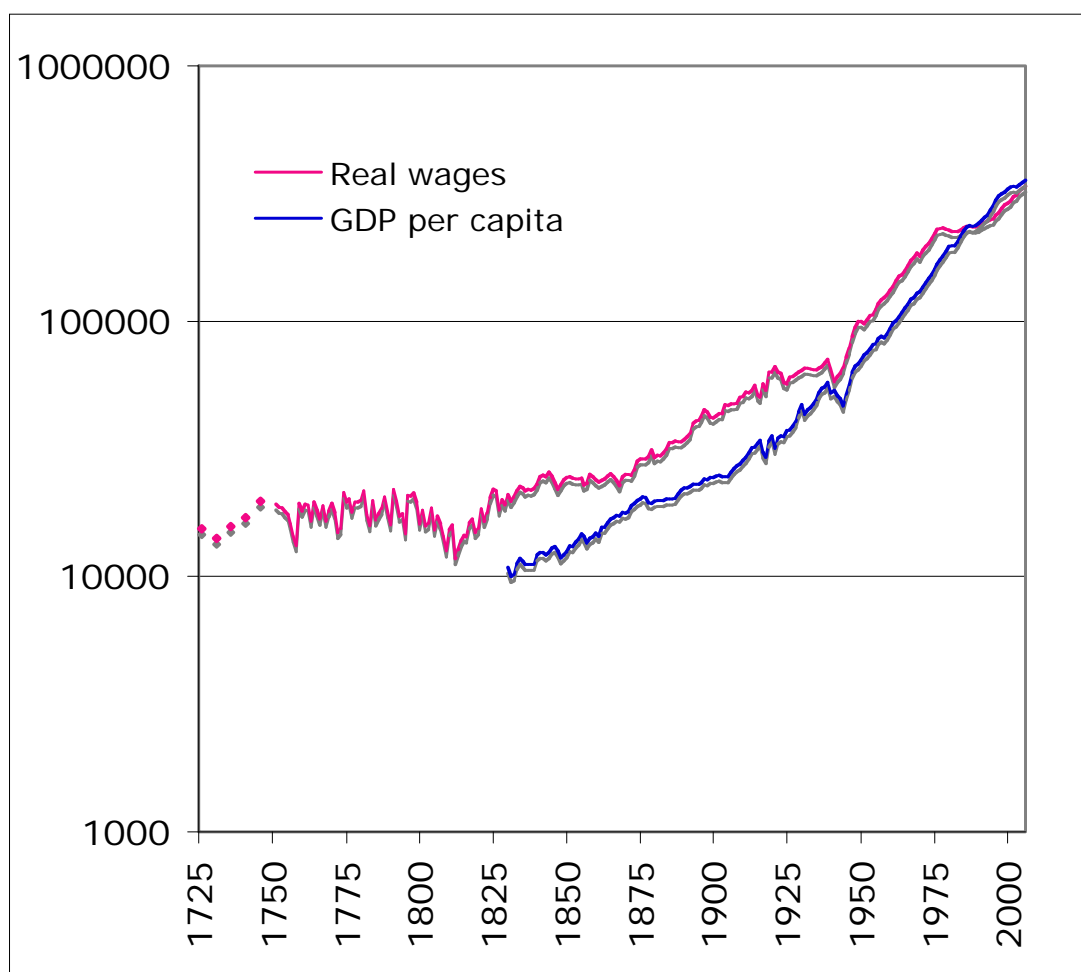
Sources, GDP per capita volume: Grytten 2004b, 277-280. Real wages: Wedervang Archive, files W009, W013, W014, W021, W027, W028, W030, W032, W034, W035, W036, W038, W039, W043, W044, W045, W046, W047, W048, W049, W054, W055, W056, W058, W063, W071, W072, W074, W074, W080, W081, W082, W118, W119A, W120A, W121, W172, W174, W176, W182, W184, W185, W186, W187, W188, W189, W204, W205, W207, W245, W248, W249, W284, W349, W417, NOS 1949, 363-368, NOS 1915-1941, NOS 1978, 530-532 and 576, Petersen 1950, 670-671, Akstun 1960, 45-62, Gjølberg 1974, 31-107, Fløystad 1979, 595-596, Goksøyr 1982, Lønningdal 1984, 141-163, Minde 1993, 25-123* (appendix), Alme 1993, 64-65, Hodne, Grytten and Alme 1995, 240-246, Lønningdal 1984, 23-36, 104-109 and 141-163, Minde and Grytten 1997, 61-82, Grytten and Minde 1998, 42-58, Grytten 1992, 159-167, Gryttten 2004a, 92-93, and data provided by Tor Skoglund, Statistics Norway.

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[63] Grytten 2004c, 277-280.

During the last years, however, real wages have grown faster then the GDP per capita volume. At the same time the implicit GDP deflator has increased significantly faster than the consumer prices. This is mirrored in a positive shock in Norway's terms of trade during the last years.

All in all our new real wage series in the long run seem to correspond well with volume figures from the historical national accounts. In the short run we do not expect the same degree of uniformity, which is also mirrored in the series.

Growth rates

The annual growth rates of real wages in different industries are reported in table 2. Note that for the years 1946-2006 total wages show the highest growth rates. This reflects higher growth among independents and other industries than those presented here.

Table 2. Growth rates of real wages by industry for Norway 1726-2006.

	1.0 Agriculture and forestry	2.0 Secondary industries	3.0 Transport and communication	4.0 Private services	5.0 Public services	6.0 Total
1726-1751		0.95				0.90
1726-1820		0.11				0.00
1751-1820		-0.19	-0.66	-0.66		-0.32
1820-1850	1.23	1.29	2.89	2.65		1.56
1850-1900	1.05	0.83	1.15	1.13	1.01*	1.08
1900-1940	0.62	1.46	1.15	1.06	0.28	1.11
1945-2006	2.15	2.52	2.54	2.51	2.17	2.55
1726-2006		1.06				1.11
1751-2006		1.07	1.18	1.18		1.13
1820-2006	1.57	1.54	1.87	1.87		1.67
1850-2006	1.64	1.59	1.68	1.72		1.70
1875-2006	1.80	1.85	1.90	1.94	1.23	1.89
1900-2006	1.92	1.95	1.93	2.00	1.28	1.99

* 1875-1900

As reported by table 2 the annual growth of total real wages 1726-2006 is calculated to 1.11 per cent. In the long run transports and communications along with private services seem to have been the winners, when public services lost ground to all other sectors. However, one has to bear in mind that public services started at considerably higher levels.

It is also worth noticing that general wealth seems to have been about the same level around 1820 as around 1720. The economic growth that took place in the eighteenth century was fully reversed during the turbulent two first decades of the nineteenth century.

From 1820 to 1940 real wages grew steadily, and surprisingly substantial 1820-1850. However, this was partly due to a recovery from the war-years in the early nineteenth century. Finally, the period after 1945 saw the highest growth in real wages, and with tendency towards convergence between industries in line with the social democratic income policy at the time.

Conclusions

The present paper offers new estimates of nominal and real wages in Norway as far back as 1726 till 2006 for eighteen different industries and sub-industries in addition to one for the total economy. Thus, all in all we present 19 continuous series of annual nominal wages. These are collected and compiled from various sources. The most important ones are files kept at the Professor Ingvar Wedervang's Historical Archive on Wages and Prices and records held by Statistics Norway.

In order to make the series comparable they are calculated into man-years and annual wages. Thereafter they are deflated by a new historical Laspeyres consumer price index for Norway. By deflating the nominal series we arrive at real wages 1726-2006. These conclude with an annual growth rate of 1.11 per cent for the period as a whole. There was virtually no growth between the 1720s and 1820s. Thereafter, we find significant growth in real wages up until present times. The growth reached its highest levels after World War II. The new series also confirm that convergence of real wages between industries took place in the twentieth century. In particular public services lost ground as high wage industry.

Held against alternative measures, the general economic development and historical events, the new series seem sound and should serve as reliable indicators of nominal and real wage development in Norway during the last 280 years.

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