REAL WAGE INDEX NUMBERS

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Economists who have worked on constructing a real wage index number have viewed the index as an indicator of the standard of material living of a typical worker. For the motivation behind much of the work on real wage index numbers, it is difficult to improve on Paul Douglas' statement (1930, p. 4) opening his research into the movement of real wages in the U.S. economy eighty years ago: "There is, indeed, no more important question in the field of social history than that of the 'condition of the people.' [A real wage index] is not only the best index of the relative success and failure of any economic or industrial system, but it also affords the best clue as to the permanency of such a system."

Although he examined other aspects of workers' standard of living, the central element in Dougas' research was the creation of a real hourly earnings index formed by dividing a series on money wages or earnings by an index of prices. Customarily the price index is a weighted aggregate of the prices of those items that constitute the typical worker's basket of consumer goods. This price index, sometimes called a cost-of-living index, dates at least from William Fleetwood's (1707) calculation of what the value of a property income flow of £5 per annum in 1440-60 was equivalent to in 1700, prices having risen substantially in the intervening two centuries.[1] After examining prices over the preceding 600 years paying particular attention to the prices of corn, meat, drink, and

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[1] All Souls' statutes at Oxford in the mid-fifteenth century called for a Fellow to surrender his appointment if his personal estate exceeded £5 per year. This became an increasingly disagreeable constraint in a time of rising prices and Bishop Fleetwood was asked whether a Fellow might with conscience retain his college position in an age when the value of money was much lower.

cloth, his answer was from £28 to £30. Because his four commodities increased at about the same rate, he did not have to confront the question of how his price index ought to treat commodities whose relative prices had changed.

This issue was addressed by Joseph Lowe (1822) who examined the course taken by prices during and after the Napoleonic wars. He studied the consumption budgets of different types of families including those of a "country labourer", a "town mechanic", and the "middle classes". He constructed a quantity weighted price index with the weights held constant at an initial year.

I. Paul Douglas and Albert Rees

A century ago, the topic of the movement in real wages in the United States was of major scholarly significance with regular articles in the American Economic Review. A common view was that, during the two or three decades before the First World War, real wages had risen little and, perhaps, had fallen. Douglas felt a comprehensive new research effort was called for and he created a new earnings series and a new price series. He concluded that real earnings in manufacturing increased between 1890 and 1914, but, compared with the decades before 1890, his estimated eight percent increase implied a retardation in real wage growth. Rees (1961) was surprised by this finding and, for manufacturing industry, he undertook a thorough reexamination of the evidence.[2] As Douglas had done, Rees constructed a new money wage series and a new price index.

In his series on money wages, Douglas had relied heavily for some of his manufacturing industries on union wage scales, a procedure that Rees questioned. Rees argued that union wages

[2] Douglas' indexes of real wages were not restricted to manufacturing, but also covered the building trades, coal mining, transport and public utilities, farming, public school teachers, Methodist and Congregational ministers, and some Federal government employees. Rees' critique concentrated on manufacturing as does the account in this paper.

tended to be less volatile and somewhat unrepresentative given the extent of unionism at that time. Rees made greater use of the Census of Manufactures and of payroll information collected by government agencies. Rees' money wages were lower than Douglas', but they increased more than Douglas': an increase 55 percent compared with Douglas' 44 percent.[3]

Rees also used different sources and methods to construct an index of "the prices paid by manufacturing wage earners for consumer goods" (p. 75). For some commodities, Douglas used wholesale prices whereas Rees drew upon price information in the catalogues of Montgomery Ward and Sears Roebuck. Douglas had omitted and Rees included estimates of rent for housing. Between 1890 and 1914, Douglas' cost-of-living index increased by one-third whereas Rees' increased by one-tenth.

Putting these differences in wages and prices together, from 1890 to 1914, Douglas' series on real hourly earnings in manufacturing rose by 8 percent while Rees' increased by 39 percent. Rees' series appears more volatile too. Is this difference between Douglas and Rees in the change in real wages over 24 years "large" or "meaningful"? What standard can be used to assess this?

One standard might be to ask whether the latest research corroborates one or the other. In fact, recent scholarship has yielded a new series of real compensation of production workers in manufacturing industry going back to 1800. Developed by Officer (2009), it suggests a rise in real hourly compensation between 1890 and 1914 of 36.4 percent, a figure between Douglas' and Rees' but closer to Rees'. Officer's price series implies an increase between 1890 and 1914 that is almost

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[3] In view of the different sources and methods, Rees expressed surprise at what he viewed as the two manufacturing wage series being "rather similar" (p. 37). For money wages, Douglas constructed a series on full-time weekly earnings whereas Rees compiled a series on daily earnings. However, Rees treated changes in the length of the full-time work week as changes in daily hours. Both Douglas and Rees wrote that their index described the average for "wage earners".

identical to Rees' so Officer's 3 percent lower growth in money earnings accounts for his slightly lower growth in real earnings compared with Rees.[4]

A different standard to assess Douglas' and Rees' research is to ask whether a difference of 8 percent and 39 percent over 24 years is something that modern methods and sources would countenance or whether the Douglas-Rees difference reflects the smaller and perhaps less representative samples of past data gatherers. To help answer this, we may draw on research undertaken by Meisenheimer (2005) who calculated the increase in real earnings or compensation implied by different contemporary data series from 1979 to 2003, also a 24 year period. Using for all the series the CPI as the deflator and depending on the survey, real earnings or compensation rose by as little as 4.6 percent or as much as 32.2 percent in the 24 years between 1979 to 2003. If we use the personal consumption expenditures price index to deflate earnings, the increases in real compensation over these years range from 9.9 percent and 38.9 percent. In other words, the gap between Rees' 39 percent and Douglas' 8 percent in real wage increases in the 24 years before the First World War is comparable to the difference between the 39 percent and 5 percent increases in real earnings or compensation in the 24 years from 1979 to 2003.

By both standards, Rees' and Douglas' series are enduring pieces of scholarship. They compare well with the most recent research of the 1890-1914 period and the difference between them is not palpable by contemporary measures of changes in real compensation in recent years.

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[4] This is a series of compensation and, as such, includes wage supplements or benefits. This is an important component of a wage series since the 1930s but less so from 1890 to 1914, as Rees himself observed. In his review of Rees' book, Douglas (1962) argued that Rees' price series understated the upward drift in prices. Douglas concluded, "If a scholar works in this field thirty years from now with still better methods and sources, he will probably find the truth lies between us.....". Indeed, 47 years from Douglas' review of Rees' book, Officer derived a real earnings series that, for 1890-1914, lies between Douglas' and Rees' series.

This comparison of Douglas' and Rees' estimates of real wage movements over a period of just over two decades illustrates some of the problems posed in forming such a series: which series on money wages should be selected as representative and which series on the price of consumer goods should be used to deflate money wages? These same general issues arise in attempts to construct real wage index numbers not merely over decades but over centuries.

II. Henry Phelps Brown and Sheila Hopkins and Gregory Clark

In 1955, Phelps Brown and Hopkins (subsequently PBH) published a series on the nominal daily wages of building laborers and craftsmen (especially carpenters and masons) from the thirteenth century to the mid-twentieth century in southern England. The sources for these data were principally the financial statements of church records and of Oxford and Cambridge University colleges. PBH label as "remarkable" the little movement in the wages of craftsmen relative to laborers: the pay of the skilled workers was about 1.5 times that of the unskilled from about the Battle of Agincourt (1415) to the Great War.[5]

PBH describe their somewhat impressionistic methods for handling the dispersion of wages for a given occupation in a single year: ".....we avoided any mechanical treatment of the [wage] series for the various crafts and their laborers, but graphed them: then, amid year-to-year movements, we looked for rates which we could regard as representative because they were recurrent" (1955, p. 196). "[T]he question how far they are representative must always be borne in mind" (*ibid*, p. 201). In a later paper, using the same sources as their wage data supplemented by information about the cost of provisioning the Navy, PBH (1956) form a fixed-weight price series

[5] They do not provide much explanation for this except "....we cannot believe that market forces always worked to keep the equilibrium prices of the two grades of labour in so constant a relation" (Brown and Hopkins,1955, p. 202).

of "consumables" from the mid-13th to the mid-20th centuries. PBH divide their money wage series for craftsmen by this price index. This noisy real wage series drifts upwards from the mid-14th century to the first decade of the 16th century at which time it falls for over a century.[6] Over the seven centuries, their real wage series reaches its lowest point during Shakespeare's time. The trend of real wages from 1800 onwards is positive and strong: real wages in 1954 are more than five times their level in 1800.

Phelps Brown and Hopkins' work has been revisited by Clark (2005) who has undertaken a wholesale reassessment of their results. He uses data from a wide range of primary sources to collect observations on wages and prices. By making use of conventional regression methods, Clark employs the more "mechanical treatment" that PBH proscribe. Clark fits error components regression models relating wages to a rich characterization of fixed effects for year, occupation, location, and their interactions. The estimated year effects constitute the basis for his money wage time series. The level of his nominal wage series is usually somewhat lower than that of PBH, but there is little systematic movement in the difference.

Using a wider range of commodities than had PBH, Clark constructs a cost-of-living index again using a regression error components specification that allows for systematic variations by year, characteristics, location, type of purchaser, and quality. Budget studies of manual workers are used to weight the price series with the weights fixed from 1200 to 1869. From 1300 to about 1750, Clark's cost-of-living index is about 43 to 67 percent higher than PBH's. Clark's lower nominal wages and higher cost-of-living implies lower real wages than PBH's series. The movement of

[6] PBH themselves refrain from calling this a measure of real wages "in the modern sense" partly because their price series has some important omissions such as housing costs though Douglas had also omitted housing rents in the U.S. cost-of-living series referred to above.

Clark's series differs in details from PBH's, but its broad outlines are similar. Though there are differences between PBH and Clark in the movement of their real wage series in the earlier centuries, their more recent movements are closer. Clark's real wages in the 1950s are 142 percent above their level in the 1850s whereas PBH's increase over the same period is 135 percent.

III. A New Index

Because they use a price index of consumer goods to deflate earnings, all the real wage index numbers reported above adopt the seller's (the worker's) perspective in the exchange of labor services. This is apposite given the goal of using a real wage index to trace movements in a typical worker's command over consumer goods. However, how might a real wage index be designed if it adopted the position of the buyer of labor services?

There has been no lack of theoretical discussion of production cost indices and of the national output deflator, but I know of no wage index that has actually been constructed from these theoretical contributions. What would a real wage index look like if it assumed the firm's (the typical buyer's) perspective and if it were grounded in established economic theory? To take up this question, consider the canonical price-taking firm that selects its inputs and, via an amenable production function, chooses its output to maximize net revenues. Its activities are embodied in a maximum profit function $\Pi = f(p, w, r, A)$ where Π denotes maximum profits given the output price, p, the price of labor, w, the price of non-labor inputs, r, and an indicator for the state of technology, A. With a tractable form, the profit function may be solved to express real wages as a function of the other variables:

$$w^S = p \cdot g\left(\frac{\Pi}{p}, \frac{r}{p}, A\right) \tag{1}$$

This is the wage rate solution of the maximum profit function and it shows the highest wage the firm can pay that is compatible with profit level Π given p , r , and A.[7] According to equation (1), money wages move proportionately with the firm's output prices holding constant real profits, real nonlabor input prices, and the state of the production technology. This correspondence between money wages and product prices is what is implied by the sliding scale (hence the S superscript on w in equation (1)) in which adjustments in money wages are made in accordance with changes in product prices. The sliding scale was used in several industries (especially mining and iron and steel) in the United States and Britain from the mid-nineteenth century to the 1930s. Equation (1) may be thought of as the formalisation of the sliding scale.

Equation (1)'s wage-price proportionality is conditional on the g (.) function that involves profits, nonlabor input prices, and technology. In fact, this is how the sliding scale operated because the conciliators or arbitrators who often implemented the sliding scale mechanism were known to depart from a one-to-one correspondence between wages and product prices if other circumstances had changed. For instance, if non-labor input prices fell and if technical progress permitted the firm to produce more output from given inputs, an arbitrator might be inclined to award higher wages provided the company earned some reference level of real profits. Denote this reference level of real profits by $(\Pi / p)_R$ in which case equation (1) determines the maximum wages attainable given

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[7]Write the maximand of this firm as $\Pi = p\, X (L , K , A) - w L - r K$. Rearrange this objective so that it reads $w = L^{-1} p [X (L , K , A) - (r / p) K - (\Pi / p)]$ where Π may be thought of as fixed contractual payments to creditors. Maximize this expression for w with respect to L and K given p , r , and Π . This program is the dual of the conventional firm's problem of selecting inputs to maximize Π given w , p , and r . The resulting maximized wage function of this dual program may be written $w^S = p.\, g [(r / p) , (\Pi / p) , A]$ which is the wage rate solution of the profit function in the text. It is straightforward to show that the maximized w is homogeneous of degree one in p, r, and Π and that $\partial w^S / \partial p \geq 0$, $\partial w^S / \partial r \leq 0$, and $\partial w^S / \partial \Pi \leq 0$.

prices and the state of technology:

$$w^S = p \,.\, g\left[\left(\frac{\Pi}{p}\right)_R, \frac{r}{p}, A\right] \tag{2}$$

Use this wage solution of the maximum profit function to derive a real wage index from the perspective of the firm. In a situation indexed by t, suppose product prices are p_t, nonlabor input prices are r_t, and the state of technology is given by A_t. Then the maximum wage the firm can pay in t and yet enjoy reference profits $(\Pi / p)_R$ is $(w^S)_t$ defined as

$$\left(w^S\right)_t = p_t \,.\, g\left[\left(\frac{\Pi}{p}\right)_R, \left(\frac{r}{p}\right)_t, A_t\right] \tag{3}$$

We compare $(w^S)_t$ with actual wages in situation t, w_t : if $w_t > (w^S)_t$, wages are higher than the wages that are consonant with reference profits and the other variables in equation (3) and workers have improved their distributional position within the firm; if $w_t < (w^S)_t$, wages have fallen relative to what the firm could afford without harming its reference profits. This is an assessment of real wages that views the firm as an organization in which, through tacit or explicit bargaining, custom and fairness help determine the division of gross returns between management (on behalf of the capital suppliers) and workers in the way that Alfred Marshall envisaged.[8]

Therefore, instead of constructing a real wage series by dividing money earnings by a price

[8] Marshall (1920, pp. 520-1) wrote that ".....nearly the whole income of a business may be regarded as a .....composite quasi-rent divisible among the different persons in the business by bargaining supplemented by custom and by notion of fairness.....Thus there is *de facto* some sort of profit-and-loss sharing between almost every business and its employees".

index of consumer goods, consider forming a real wage series by dividing money earnings by the sliding scale wage. Define $V(t) = w_t / (w^S)_t$. The use of $w_t / (w^S)_t$ as an indicator of real wages stresses the distribution of income between workers and capital suppliers. For this purpose, assume a form for $g(\,.\,)$ that is implied by a Cobb-Douglas production function. In keeping with the real wage series above, we restrict the application of these sliding-scale wage index numbers to U.S. manufacturing industry for which a Cobb-Douglas production function needs no apology. We use Douglas' (1948) consensus estimates of the production function parameters.

There are a number of possible candidates to serve as reference real profits but, here, we use real profits in 1960. Other values for real profits will affect the values of w^S_t but, provided reference profits remain constant, they will not affect the index number we compute from w_t / w^S_t which measures the changes in real wages relative to the base year. Since 1960, increases in p_t exert a positive influence on w^S_t as do the falling values of $(r/p)_t$ and technical progress. Thus, w^S_t rises over time. These increases in w^S_t outstrip the modest rises in w_t with the consequence that, from the early 1970s, the index number formed from $w_t / w^S_t = V(t)$ declines: from 1960 to 2008, the sliding scale wage index, $V(t)$, falls by 38 percent. Between 1960 and 2008, the ratio of hourly compensation in manufacturing to the personal consumption deflator rises 106 percent and the ratio of hourly compensation in manufacturing to the price of manufacturing output rises 114 percent. However, the ratio of hourly compensation in manufacturing to the maximum wage $(w^S)_t$ falls 38 percent.

If per worker compensation in 2008 is only about 60 percent of what manufacturing firms could have paid each worker, where has the real income of these firms gone? The answer is to profits, Π / p. Conventionally measured, average real compensation of manufacturing workers has

more than doubled between 1960 and 2008, but the values of *V(t)* indicate that manufacturing workers could have done even better if firms had been content with the level of profits they earned in 1960.[9] Measured by what their earnings commanded in the consumer goods market place, workers in manufacturing appear to have done well over the past fifty years. Measured by what they could have earned if profits had been shared more fully with workers, manufacturing workers have not done well at all over this period. Workers' distributional position within manufacturing industry deteriorated between 1960 (and especially 1972) and 2008.

IV. Conclusion

By how much have real wages changed over the past x years? This question asks for the information contained in a real wage index number whose base is x years ago. This essay has suggested that the appropriate response to this question might take the form of further questions: hourly or weekly or annual earnings? ; for what group of workers? ; the average or the median or some other point in the wage distribution? ; what index should be used to convert money into real wages? Reasonable people will offer different answers thereby confirming that, to gauge the well-being of workers over time, no single indicator suffices.

[9] The average annual values of real profits, (Π / p) , in 2005, 2006, and 2007 are 159 % of their annual values in 1960, 1961, and 1962.

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