How wage and productivity growth relate to inflation in Idaho

IDAHO DEPT. OF LABOR

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Introduction

Labor productivity is an important indicator for not just the labor market but Idaho's overall economy. Wages are closely linked to labor's marginal product, or the last unit of revenue produced from the last unit of labor employed. When markets are competitive and lack any frictions that impede price adjustments, wage and productivity growth will be equal.

If productivity increases at a high growth rate and appears to continue for the foreseeable future (for example, continued investments in research and development, improved education and workforce training), it might be inferred that wages will grow at a similar pace; if productivity is expected to grow at a negligible rate or decline, however, wages can be expected to move similarly.

For any number of reasons, however, wages may diverge from workers' marginal product, creating subsequent price pressures that work to clear the market of these imbalances. The wage-productivity growth differential – the difference between wage growth and productivity growth in percentage terms – can therefore serve as a predictor for future price inflation.

From the demand side, if wages are growing faster than productivity, then any additional spending power from workers above and beyond the last unit they produce means more money chasing after relatively fewer goods and services. On the supply side, wages growing faster than productivity reduce firms' profitability as costs grow faster than revenues, and sofirms will eventually pass that cost onto their consumers by either raising prices directly or indirectly by reducing supply.

Idaho's large wage-productivity growth differential in 2020 contributed to its inflation in 2021 as measured by prices for final goods and services produced, and while its growth differential in 2021 was negative, it was the still above its neighbor, implying an expected inflation rate above adjacent states.

An analysis of labor productivity in Idaho and how it relates to wages and inflation can be found at labor.idaho.gov (link). The report provides insight to future trends in Idaho's wages and productivity, comparisons with neighboring states and a look at influencing factors.

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Labor productivity and how it relates to wages and inflation

Labor productivity – how much output a worker produces – is measured in two ways.

The more easily estimated quantity is average labor productivity, also referred to as labor's average product. This is measured by dividing the value of labor's output - like gross domestic product - for a given time period by the amount of labor employed that period, typically measured in hours worked.

Economic theory, however, presupposes individuals' decisions are made on the margin, meaning people balance the marginal benefits of an action with their marginal costs. In the labor market, workers increase the intensity of the labor they supply until the benefit of the last unit of time worked, such as the wage rate, just equals the cost of that last unit of labor supplied, or the opportunity cost of not working that last unit of time.

Firms demand labor up to the point the benefit of the last unit of labor employed, or the last unit of revenue produced with the last unit of labor, just equals the cost of that unit, such as the wage rate. Thus, labor's marginal product is informative. In a competitive and frictionless labor market, the wage equates the firm's marginal benefit of employing the worker with the marginal cost of employment incurred by the worker.

Even though marginal quantities are not directly observed or measured, an economic model can infer their change from readily available data published from government statistical agencies. Under plausible assumptions of a representative firm's technology for transforming inputs like labor and capital into output, percentage changes in labor's marginal product from changes in labor's average product can be inferred. [1]

Trends in labor's marginal product could be used to inform wage forecasts. If productivity has recently grown at a high rate and appears to continue for the foreseeable future (for example, continued investments in research and development, improved education and workforce training), it might be inferred wages will grow at a similar pace; if productivity is expected to grow at a negligible rate or decline, however, wages can be expected to move similarly.

Comparing labor's marginal product with wages is also helpful in understanding inflation from a couple of perspectives. If wages are growing faster than productivity, then any additional spending power above and beyond the last unit produced by workers means more money chasing after relatively fewer goods and services. So, unless the savings rate increases to match this excess wage growth, inflation is sure to follow. This is referred to as demand-pull inflation.

Alternatively, wages growing faster than labor's marginal product means a reduction in firms' profits. If firms expect to make at least positive profits, this cannot continue indefinitely, or firms begin to operate at a loss. So, output prices will need to rise as well either by firms increasing prices directly or indirectly by scaling back production or exiting the market and thereby reducing supply. This is referred to as cost-push inflation.

This begs the question then of whether wages should be expected to move in-line with labor's marginal product or always moving out-of-step with

[1] Specifically, if the representative firm's technology is some power function of hours of labor L_t,

$$Y_t = \alpha_t L_t^{\beta},$$

where $\alpha_t > 0$ is a potentially time-varying factor (e.g., a term capturing capital intensity and total factor productivity) and $\beta \in (0,1)$ is the labor elasticity of output (a constant), then the percentage change in average productivity is equal to the percentage change in marginal productivity. Denoting one-period percentage change by the operator $\%\Delta$ and labor's marginal product by the partial derivative of Y with respect to L_t, $\partial Y_t/\partial L_t$,one can easily show that

$$\%\Delta\left(\frac{Y_t}{L_t}\right) = \%\Delta\left(\frac{\partial Y_t}{\partial L_t}\right).$$

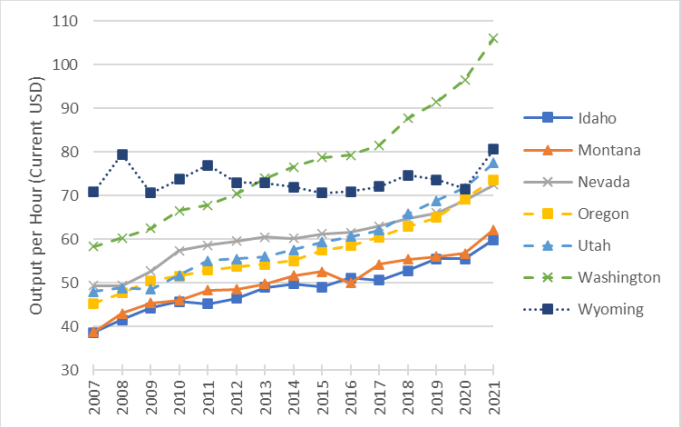
it. Macroeconomists typically expect short-term deviations between wage and productivity growth due to several frictions that prevent the instantaneous and costless adjustment of wages and prices when unexpected market shocks occur. These frictions could include penalties for breaking or renegotiating existing contracts, reputational effects for changing wages or prices too often, costs for searching for and switching jobs or relocating for work, costs for posting and filling job vacancies and more. In the long term, however, these growth rates will balance out as price inflation gives way to falling demand, putting downward pressure on demand for workers and therefore wages. In other words, periodic short-run deviations of wage growth from productivity growth would be expected, but these create offsetting effects that will eventually balance them out over time given there are no further deviations.

Observed trends in productivity and wages

The U.S. Bureau of Labor Statistics' (BLS) Office of Productivity and Technology (OPT) has surveyed private nonfarm businesses across each state since 2007 to estimate such quantities as annual hours worked, output produced and price deflator indexes to account for changes in prices for final goods and services produced over time and across industries. Unlike other BLS products, this data is published on an annual basis as opposed to monthly or quarterly.

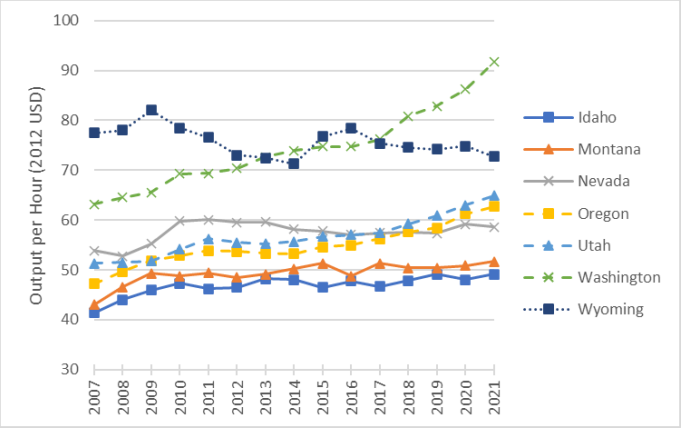
Figures 1 and 2 respectively present the nominal and price-deflated average labor productivity per hour worked for Idaho and its neighboring states. While most states exhibit upward trends in nominal and real terms, there are noticeable differences in levels as well as growth rates. Among its neighbors, Idaho consistently has the lowest labor productivity level along with one of the lower cumulative growth rates over the 15 years of data available at 55%. Contrast this with Washington at the other end of the spectrum, which has had the highest productivity level for the past several years and has the highest cumulative growth rate among these seven states at 82%. Even after adjusting for changes in output prices, however, cumulative productivity growth in Idaho (19%) and a few of its neighbors including Montana (20%), Nevada (9%) and Wyoming (-6%) have been slow or even negative since 2007, whereas Oregon (33%), Utah (26%) and Washington (45%) have been consistently and considerably more positive.

Figure 1: Value-added output per hour



Notes: Private nonfarm business, author's calculations.
Source: U.S. Bureau of Labor Statistics.

Figure 2: Real value-added output per hour



Notes: Private nonfarm business, value-added price deflator by state in 2012 US dollars, author's calculations.
Source: U.S. Bureau of Labor Statistics.

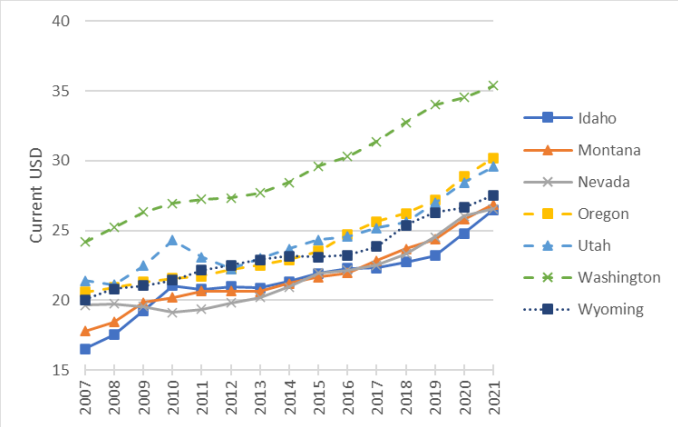
Such discrepancies between states' productivity levels and growth rates can be explained by several factors. Washington and Oregon, owing to their coastal ports, have closer access to foreign markets and supply chains that would reduce their reliance on intermediate transportation and warehousing services relative to landlocked states like Idaho. Additionally, Washington, Oregon and Utah have higher population densities than the other four states. With higher density comes efficiency gains from agglomeration and network effects such as reduced search and transportation costs and greater knowledge diffusion. Other possible factors to consider are industry composition; different tax environments for incentivizing research and development; and disparities in spending on education and workforce training. In addition, dissimilar rates of public sector investment would reduce costs such as transportation and energy as well as help to crowd-in complementary private sector investment.

Looking just at nominal labor productivity, lowest nominal wages can be expected in states like Idaho and Montana and highest in Washington. Additionally, by extrapolating recent productivity trends into the future, real wages can be expected to grow fastest in Washington, Oregon and Utah compared with others like Idaho, Montana, Nevada and Wyoming.

Turning to wages, the BLS's Current Employment Statistics (CES) program estimates average hourly earnings for private sector workers in each state and the nation monthly. These estimates divide total payrolls in each month by the number of hours worked by all employees. For ease of comparisons to the previous productivity figures, the seasonally unadjusted values were averaged annually.

Figure 3 plots the same seven states over the same 2007-2021 period. Unlike productivity levels and trends, however, there appears to be more uniformity in average hourly earnings with a notable exception for Washington, which has a considerably higher level throughout this period. Like productivity, a typical Idahoan's average earnings have lagged their neighbors' in adjacent states for most of this period, closely following their peers in Montana. In terms of cumulative growth, however, Idaho has seen the highest growth rate at 60% between 2007 and 2021, compared with Montana at 51%, Nevada at 35%, Oregon at 46%, Utah at 38%, Washington at 46% and Wyoming at 37%.

Figure 3: Average hourly earnings



Notes: Total private, annual average, not seasonally adjusted.
Source: U.S. Bureau of Labor Statistics.

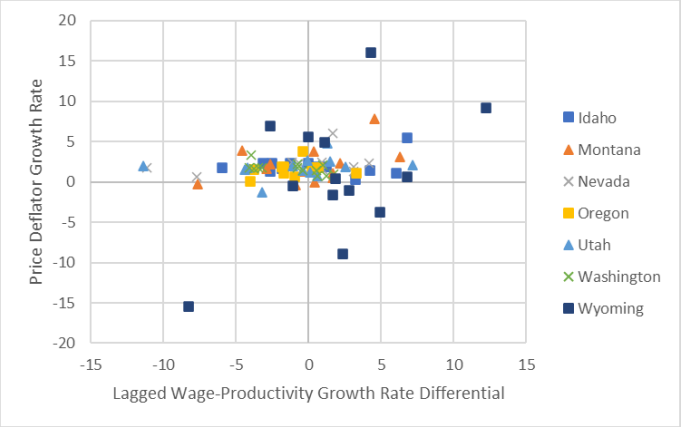
The greater uniformity of earnings compared to productivity could be attributed to workers largely focusing on the nominal wage level when deciding upon where they live and perhaps ignoring local prices. In other words, they are prone to some degree of money illusion. Assuming workers are relatively mobile and relocation costs are not too high, they will move to areas with nominally higher wages, thereby putting downward pressure on wages there while putting upward pressure in areas where wages lag, thereby compressing the wage distribution. Alternatively, employers in high price states may be hesitant to offer compensation premiums relative to competitors in low price states, owing perhaps to their market power and reluctance to compete with out-of-state firms.

The wage-productivity growth differential and inflation

As noted earlier, the difference in growth rates between nominal productivity and wages can help to inform differences in inflation rates across states. To recap, one would expect a positive wage-productivity growth differential to be followed by a subsequent increase in inflation as prices adjust upward to clear any excess demand in the market. Because productivity and price deflator measurements are only taken annually, the choice of lag between the wage-productivity growth differential and inflation is limited. Ideally, there would be higher-frequency data - such as quarterly or monthly - to vary this lag and econometrically test where the effect is greatest. But given the data limitations and for demonstration purposes, it's assumed this hypothesized inflationary effect comes at a one-year lag.

Figure 4 presents a scatterplot of annual percentage changes in each state's value-added price deflator (again, a price index for final goods and services produced) against the state's one-year-lagged wage-productivity growth differential. The unweighted correlation between output inflation and the one-year-lagged wage-productivity differential is positive and statistically significant at the 0.01 level with an estimated elasticity of 0.23. In other words, wages growing one percentage point faster than productivity is associated with an increase in prices for final goods and services by a further 0.23 percentage points.

Figure 4: Output inflation versus wage-productivity growth differential



Notes: Total private hourly earnings, annual average, not seasonally adjusted; value-added output and value-added price deflator of private nonfarm businesses; year-over-year percentage changes for all; author's calculations.
Source: U.S. Bureau of Labor Statistics, Idaho Department of Labor.

To make this more concrete, look at wage and productivity growth in 2020 for two opposing outliers in the data – Idaho and Washington – as well as observed price changes in 2021. Figures for all states are provided in Table 1. According to BLS estimates, average hourly earnings in Idaho grew 6.85% in 2020 while nominal labor productivity grew by 0.04% that same year, yielding a growth differential of 6.81%. Prices for final goods and services meanwhile grew by 5.43% in 2021. Had Idaho's productivity growth matched wage growth, Idaho's 2021 inflation rate implied by the estimated elasticity would have been 3.86%, a reduction of 1.57 percentage points.

By comparison, Washington's average hourly earnings grew by 1.56% in 2020 versus nominal labor productivity by 5.53%, yielding a wage-productivity growth differential of -3.97%. Had Washington's wages kept pace with productivity, prices for final goods and services in the state would have grown by 4.27% instead of the observed 3.35%, an increase of 0.92 percentage points.

Table 1: Observed hourly earnings and productivity growth rates, and price inflation

	Annual Change, 2019-2020			
	Average Hourly Earnings	*Average Product of Labor*	*Difference*	Observed Inflation 2020-21
Idaho	6.85	0.04	6.81	5.43
Montana	5.95	1.41	4.54	7.78
Nevada	6.20	4.54	1.66	6.07
Oregon	6.22	6.64	-0.42	3.73
Utah	5.49	4.20	1.28	4.79
Washington	1.56	5.53	-3.97	3.35
Wyoming	1.37	-2.92	4.29	16.05

Notes: All values as percentage points; total private hourly earnings as annual average, not seasonally adjusted; average product of labor for private nonfarm as annual average; observed inflation as change in private nonfarm value-added price deflator; author's calculations.
Source: U.S. Bureau of Labor Statistics, Idaho Department of Labor

Looking ahead to 2022, Idaho's inflation outlook appears to be the worst among its neighbors despite productivity growth outpacing hourly earnings. Wage-productivity growth differentials for the seven states in 2021 and the implied effects on their inflation rates are found in Table 2. All the states saw average nominal productivity growth outpacing average hourly earnings, but the magnitude of this difference varied. Idaho had the smallest differential in absolute terms at -1.03% while Wyoming had the largest at -7.46%. This would imply that Idaho will see the highest inflation for final goods and services produced this year. Hypothetically, if Idaho's productivity had grown at the same pace as, Wyoming's, for example, the additional 4.81 percentage points of growth would be expected to reduce inflation in Idaho by a further 1.11 percentage points this year.

Table 2: Implied inflationary effects of wage-productivity growth differentials

	Annual Change, 2020-2021			
	Average Hourly Earnings	*Average Product of Labor*	*Difference*	Predicted Effect 2021-22
Idaho	6.86	7.89	-1.03	-0.24
Montana	4.11	9.58	-5.47	-1.26
Nevada	2.00	5.03	-3.04	-0.70
Oregon	4.61	6.23	-1.62	-0.37
Utah	3.94	7.99	-4.05	-0.93
Washington	2.46	9.92	-7.46	-1.72
Wyoming	3.34	12.70	-9.36	-2.16

Notes: All values as percentage points; total private hourly earnings as annual average, not seasonally adjusted; average product of labor for private nonfarm as annual average; predicted effect as deviation in annual percentage change of private nonfarm value-added price deflator; author's calculations.
Source: U.S. Bureau of Labor Statistics, Idaho Department of Labor

Conclusions

While the ultimate responsibility for controlling inflation falls on the shoulders of the Federal Reserve, there are several local factors shaping local inflation including the growth rate of wages relative to labor productivity. The larger this growth differential, the more pressure is placed on prices to correct this imbalance.

From 2007 to 2021, average hourly earnings in Idaho grew faster than all its neighboring states and 5.33 percentage points faster than its labor productivity, contributing to the 30.56% cumulative growth in prices for final goods and services produced over that same period. Based upon an unweighted regression, every one percentage point difference between growth in average hourly earnings and productivity is associated with a 0.23 percentage points higher inflation rate for final goods and services the subsequent year.

If local and state leaders are concerned with rising prices and the associated loss in competitiveness or Idahoans' take-home pay net of inflation, recent productivity trends may cause some concern. Languid labor productivity growth will place

constraints on long-run wage growth. Moreover, despite the recent uptick in productivity growth relative to average hourly earnings, the general trend since 2007 has been Idahoans' earnings outpacing productivity, adding fuel to inflationary pressures as firms are forced to pass this imbalance on to their customers.

While public policy typically does not steer prices and wages directly, it can influence productivity trends. As previously mentioned, factors to consider may include greater investment in traditional infrastructure like transportation and utilities as well as human capital such as early childhood programs, schooling, workforce training and programs that improve health outcomes; incentives for research and development in addition to private sector investment; and an economic development framework that emphasizes population density to capitalize on agglomeration and network effects. Some of these have already been considered and applied in the state with varying success. Decisionmakers concerned with the long-term outlook might want to take a closer look at what has already been done in addition to seeing what can be learned from policy experiments elsewhere.