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The wage curve after the Great Recession

David Blanchflower[1] | **Alex Bryson**[2] | **Jackson Spurling**[3]

[1]Dartmouth College, University of Glasgow and NBER

[2]University College London

[3]Member of the Dartmouth class of 2023

Correspondence
Professor Alex Bryson, Social Research Institute, University College London, 20 Bedford Way, London WC1H 0AL.
Email: a.bryson@ucl.ac.uk

Abstract

Most economists maintain that the labour market in the USA (and elsewhere) is 'tight' because unemployment rates are low, and the Beveridge curve (the vacancies-to-unemployment ratio) is high. They infer from this that there is potential for wage-push inflation. However, real wages fell rapidly in 2022, and prior to that, real wages had been stagnant for some time. We show that unemployment is *not* key to understanding wage formation in the USA, and has not been since the Great Recession. Instead, we show that rates of underemployment (the percentage of workers with part-time hours who would prefer more hours) and the rate of inactivity (the percentage of the civilian adult population who are out of the labour force) reduce wage pressure in the USA. This finding holds in panel data with state and year fixed effects in both annual and quarterly data for the period 1980–2022, and is supportive of a wage curve that fits the data much better than a Phillips curve. The unemployment rate no longer enters significantly negative in wage equations, however specified, in the years since 2008.

1 | INTRODUCTION

In the middle of the 19th century, Friedrich Engels (1845) described the unemployed as a 'reserve army' whose purpose was to keep wages down. Subsequently, Karl Marx argued famously that this reserve army was maintained by capitalists to keep wages down:

> Big industry constantly requires a reserve army of unemployed workers for times of overproduction. The main purpose of the bourgeois in relation to the worker is, of course, to have the commodity labour as cheaply as possible. (Marx 1847)

Ever since, economists have plugged unemployment rates into wage equations of various forms expecting to see a negative partial correlation. For over a century the unemployment rate

was negatively correlated with wage growth, but since the Great Recession things have changed. Today, the unemployment rate, which is at historically low levels both in the USA and elsewhere, no longer tells us anything about the state of the labour market; it is now uncorrelated with wage growth.

In the years before the Great Recession, the unemployment rate was the only labour market variable that you needed to summarize slack demand for labour; movements in the unemployment rate were essentially mirror images of the employment rate. This is no longer the case. Why this change has occurred is a matter of conjecture that we discuss below. One possibility is that workers became more fearful of losing their jobs, and perhaps their houses, after the seismic shift in the labour market with the onset of the Great Recession. It was a major financial crisis that involved a big rise in the unemployment rate in the USA and a collapse of the housing market. This involved loan defaults, especially of sub-prime mortgages, foreclosures, negative equity and even jingle mail.[1] Much economic dislocation resulted, which appears to have scared workers. As a result, the basic relations in the labour market changed, and it appears that the non-accelerating inflationary rate of unemployment (NAIRU) fell sharply. At any given unemployment rate, wage pressure was less than it had been in the years before 2008.

Since the unemployment rate is no longer associated with wage growth, there is no longer a wage curve in wage–unemployment space. We go on to show that there is also no wage Phillips curve, especially since the Great Recession. What we show is that the wage curve should be rewritten in underemployment and inactivity space.

2 | MEASURES OF LABOUR MARKET SLACK

The unemployment rate is defined as the number of unemployed divided by the sum of the employed and the unemployed.[2] Throughout the 20th century, there was a very high correlation between the unemployment rate and other measures of labour market slack that we examine below. Since the Great Recession, these correlations have broken down.

Since Layard *et al.* (1990), it has been assumed that non-employment rates—measured as the unemployed plus the economically inactive divided by the civilian adult population for those aged 15+[3]—should not enter wage equations because those who are not actively seeking work are unlikely to compete for waged employment, and thus will not lower wages. However, growing recognition that the unemployment rate alone did not seem to be a good indicator of labour market slack has led some analysts to revisit the issue by re-weighting different groups in the adult population according to their propensity to be active in the labour market (Abraham *et al.* 2020).

Hornstein *et al.* (2014) construct a non-employment index that includes all non-employed, weighted differentially according to their probabilities of transition into employment. They show that prior to the Great Recession, the narrow unemployment rate and the broader non-employment rate index that they devise moved together. This changed after the Great Recession. Similarly, Abraham *et al.* (2020) assess labour market tightness with a measure of the ratio of vacancies to effective searchers as opposed to a standard measure of vacancies to unemployment. 'Effective searchers' include the unemployed, those out of the labour force, and the employed. Their measure is a weighted sum of 22 different groups within the population, where weights are based on the relative base period job-finding rate for each of the groups. They find that between 1994 and 2019, a Beveridge curve constructed using vacancies and effective searchers is more stable than the curve constructed using vacancies and unemployment.

Marx and Engels made no such distinction between the unemployed and the non-employment rate in their discussions of the 'reserve army of labour'. Whether the non-employment rate acts

as a break on wage growth is an empirical question. If it does, then the labour market has greater amounts of slack in the USA than believed previously.

Table 1 presents the inactivity rate for those aged 15+ in the US and, where available in thirty-one other OECD countries between 2000 and 2022.

The bottom row of Table 1 shows that the inactivity rate rose by 5 percentage points in the USA between 2000 and 2021. Out of the other major OECD countries, since 2008 the

TABLE 1 Inactivity rates by major country, age 15+, 2000–22.

	2000	2008	2019	2020	2021	2022	2008–22
Australia	37	35	34	35	34	33	−1
Austria	42	40	39	39	39	38	−1
Belgium	48	46	46	46	46	45	−1
Canada	34	32	34	36	35	35	+2
Chile	46	44	37	44	43	40	−4
Czech Republic	40	42	40	40	40	40	−1
Denmark	34	35	38	38	37	37	+2
Estonia	41	39	36	36	36	34	−5
Finland	39	39	41	41	40	39	0
France		44	45	45	44	44	0
Germany		41	38		39	39	−2
Greece	48	47	48	49	49	48	+1
Hungary	50	50	43	43	40	40	−10
Iceland		18	19	21	27	25	+7
Ireland	40	34	38	39	37	35	+1
Israel	46	43	37	38	38	37	−7
Italy	52	51	50	51	51	51	0
Japan	37	40	38	38	38	37	−2
Korea	39	38	37	37	37	36	−2
Netherlands	36	35	35	35	33	32	−3
New Zealand	35	32	29	30	29	29	−3
Norway	27	26	36	36	34	34	+8
Poland	43	46	44	44	43	43	−3
Portugal	39	38	41	42	42	41	+3
Slovak Republic	40	41	40	41	39	38	−2
Slovenia	42	41	42	42	42	41	+1
Spain	47	41	42	43	42	42	+2
Sweden		36	34	34	33	33	−3
Switzerland		32	32	32	33	33	+2
Türkiye		54	47	51	49	47	−7
UK	37	36	36	36	37	37	+1
USA	33	34	37	38	38	38	+4

Notes: The inactivity rate is calculated as O/(U + O + E), where U means unemployed, E means employed, and O means not in the labour force. O individuals (i) are not employed during the survey reference week, and (ii) had not actively looked for work (or been on temporary layoff) in the last 4 weeks.
Source: OECD.

TABLE 2 USA inactivity rates by age group (seasonally adjusted).

	16+	16–19	20–24	25–54	55+
January 2000	33	48	22	16	67
January 2008	34	59	25	17	61
January 2020	36	64	27	17	60
February 2023	37	63	28	17	62

Source: US Bureau of Labor Statistics.

inactivity rate fell in 17 countries and was stable in Italy, Finland and France, with only Norway and Iceland having larger increases than the USA. Canada saw a 2 percentage point increase; Greece and Spain had smaller increases despite their unemployment rates having increased to over 20% in the post-recession years. The rise in the USA is unlikely to be linked to demographics or technology given that these are common phenomena across countries, and welfare benefits for non-work tend to be less generous in the USA than in most other OECD countries.

Table 2 shows the inactivity rate by age groups in the USA from January 2000 to February 2023. Across the whole population, it rises over the period from 35% to 40%. It rises for all age groups under 55, but is most notable among those aged under 25 years.

We now move on to look at the underemployment rate, which we define for workers only as an expressed desire for more hours. In an early study for the UK, Blanchflower *et al.* (1990) note that wages are set by a blend of insider and outsider forces. Using data for both the USA and the UK, Bell and Blanchflower (2021) conceived of underemployment as an indicator of weak bargaining power on the part of 'insiders'—that is, full-timers in the firm. The idea was that other workers' ability to disrupt the supply of labour to the employer diminished in the face of part-time co-workers who were signalling their desire to work more hours than they were being offered. They confirmed that underemployment was a brake on wage growth in the USA, the UK and internationally, confirming work from Hong *et al.* (2018) from the IMF that found similarly.

Our data source for the USA, the Current Population Survey, does not identify full-timers who want different or fewer hours. Nevertheless, it is possible to calculate an underemployment measure based on the number of part-time workers who say that they are part-time for economic reasons. We simply express this as a proportion of the employed and call it U7, as defined in Bell and Blanchflower (2021). There is a growing literature on the underemployed, including Sum and Khatiwada (2010), Cajner *et al.* (2014), Veliziotis *et al.* (2015), Golden (2016), Borowczyk-Martins and Lalé (2020) and Glauber (2017).

Figure 1 shows movements in the underemployment rate U7 in the USA, and the unemployment rate.[4] The unemployment rate was 5.0% in December 2007, rising to 10.0% in October 2009, and dropping below 5% in January 2016.[5] In February 2023, it jumped 0.2% on the month to 3.6%. The underemployment rate shot up after the Great Recession, but did not mean revert as quickly the unemployment rate did. It was 3.0% in December 2007 as recession hit, reached a peak at 6.7% in March 2010, and did not return to the 3.0% pre-recession level until July 2018. At the time of writing in January 2024, it is 2.5% and comparable to its level in 2001, just above its historic low of 2.3%. Figure 2 plots non-employment and inactivity rates, which track each other closely—using data from the US Bureau of Labor Statistics (BLS). Both rose steadily from around the start of 2000. Unlike the unemployment rate, they have still not mean reverted to pre-recession levels and are also below pre 2020 lockdown levels. As shown in Table 1, this is unusual among advanced countries.

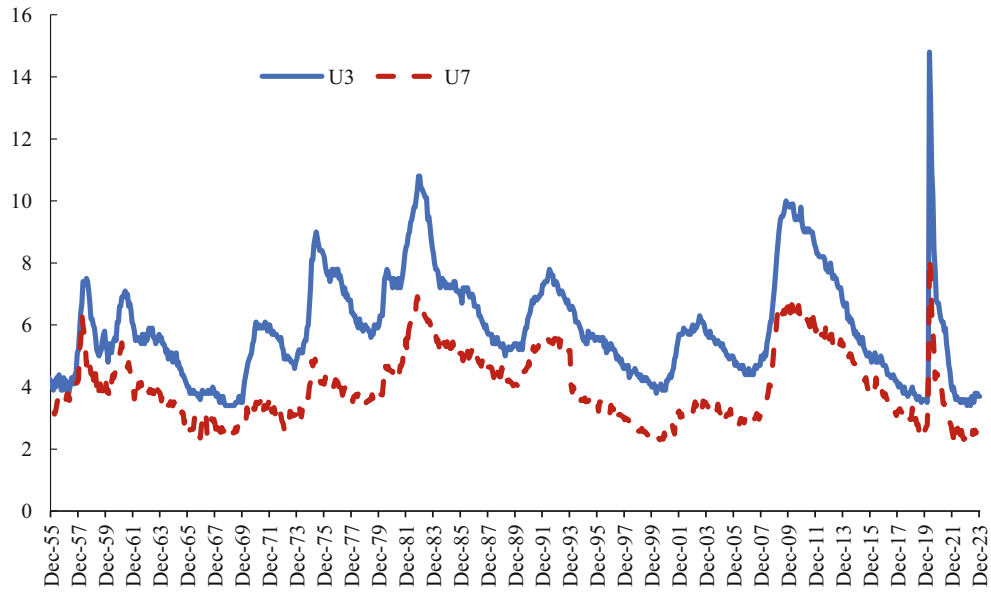

FIGURE 1 US unemployment and underemployment rates.

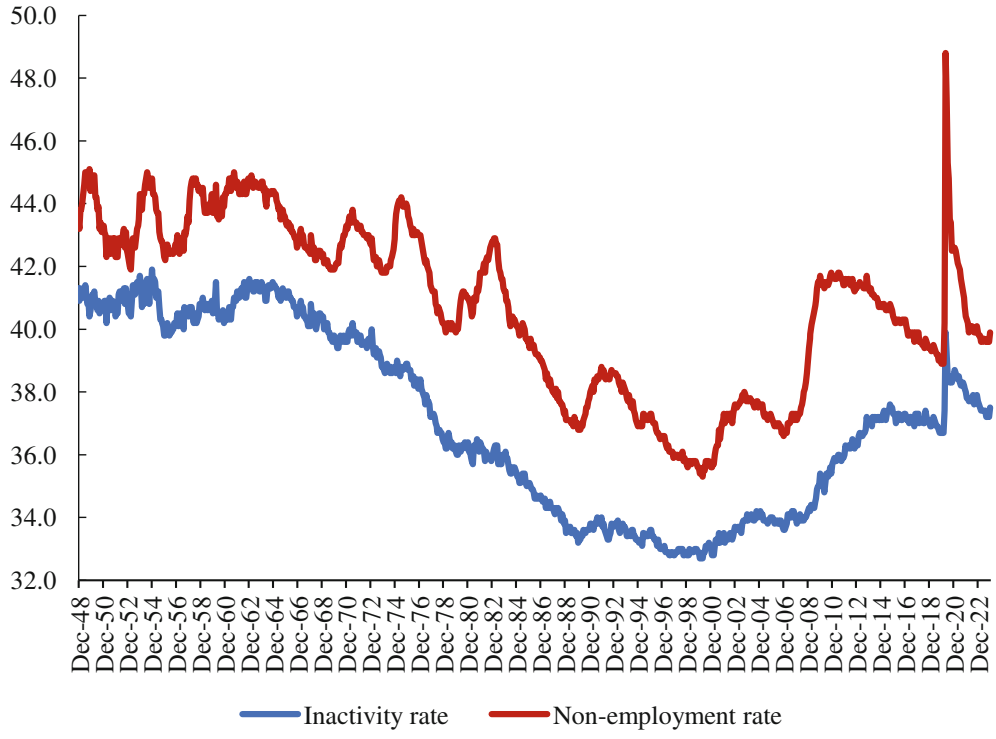

FIGURE 2 Non-employment and inactivity rates, 1948–2023.

We examine below the impact on wage changes of all four measures of labour market slack—the unemployment, underemployment, inactivity and non-employment rates. We will show that underemployment, inactivity and non-employment rates 'work' better in wage equations than the unemployment rate does, since the Great Recession. All three show larger levels of slack than the unemployment rate suggests, and have a significant negative impact on wages in the post Great Recession period, while the unemployment rate does not.

3 | WAGE CHANGES AND LABOUR MARKET SLACK

A major puzzle in the period 2010–19 was that despite low and falling unemployment, wage growth in the USA remained low, at around 2%, and well below pre Great Recession levels of around 4%. Figure 3 shows nominal weekly wage growth among private sector production and non-supervisory workers in the USA since 1990. These workers constitute three-quarters of private sector workers, and this is the longest wage series available. Nominal wage growth was around 4% at the start of the Great Recession when the unemployment rate was 5%. However, year over year wage growth averaged 2.2% between 2011 and 2017. The figure suggests that the reason for this sluggish wage growth was because the labour market had more slack than was indicated by the unemployment rate.

Figure 4 shows the relationship between annual median usual weekly nominal wage growth for full-time workers using data from the Outgoing Rotation files of the Current Population Survey. The BLS publishes median weekly earnings with these data on a quarterly basis. Below, in our wage regressions, we make use of the same microdata but use them to construct average mean wages at the state–year cell level.

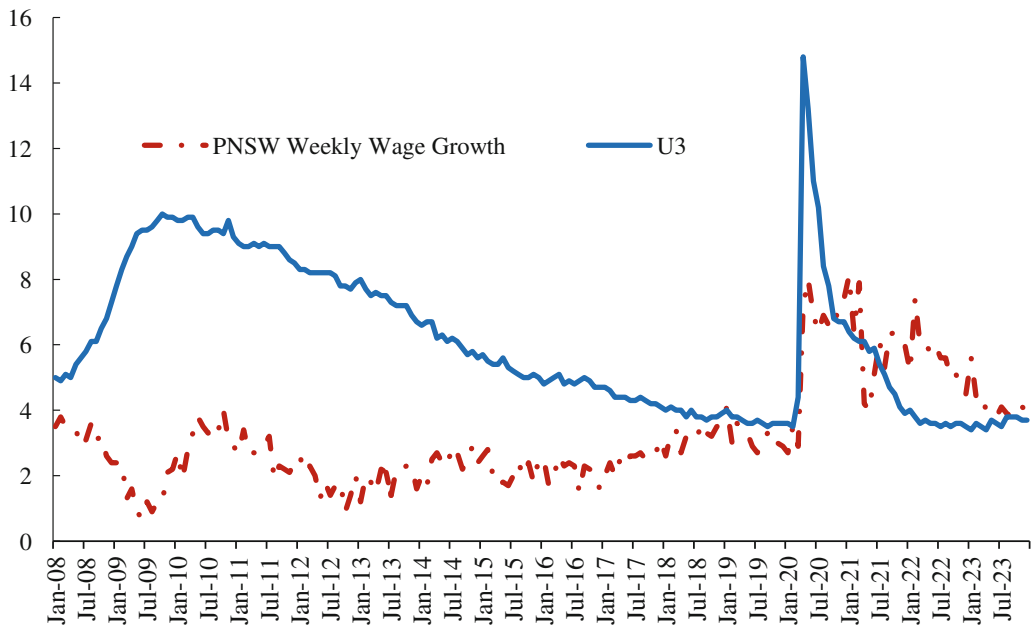

FIGURE 3 Weekly nominal wage growth (production and non-supervisory workers) and the unemployment rate, 2008–23.

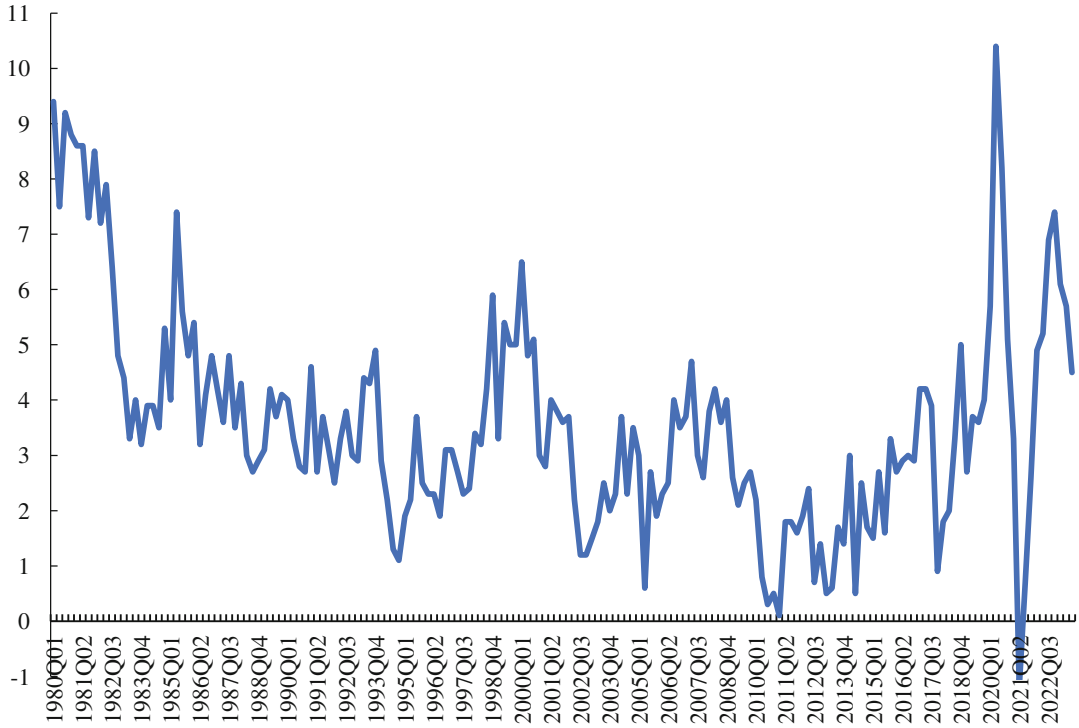

FIGURE 4 US quarterly annual median usual earnings growth for full-time wage and salary workers.

4 | THE PHILLIPS CURVE AND THE WAGE CURVE

In his original *Economica* paper, Phillips (1958) examines the relationship between unemployment and the *rate of change of money wage rates* in the UK from 1861 to 1957. He finds that wage growth fell as the unemployment rate rose, with the rate of change flattening out at higher rates of unemployment. He argues that this pattern was consistent with the proposition that, as with commodities other than labour, its price would fall in circumstances where demand was exceeded by supply.

Figure 5 revisits this issue, plotting weekly wage growth against the unemployment rate in the USA since 1965. The figure provides a scatterplot between the annual growth in weekly earnings of private sector production and non-supervisory workers by month between January 1965 and December 2023 ($n = 709$). These workers constitute four-fifths of the private sector workforce, and exclude the top end of the wage distribution. It shows that there is no evidence whatever of a Phillips curve in wage changes. If we restrict the data to the post Great Recession period, 2008–22, to establish whether there is evidence of a Phillips curve since the Great Recession, then we find no significant relation between wage growth and the unemployment rate either. We find similarly in our econometric analysis below.

In the 1990s, some consensus emerged that the relationship between wage growth and unemployment was better explained by a wage curve that estimates wages as a function of lagged wages and unemployment using data at the state–year cell level. Studies examining the wage curve (Blanchflower and Oswald 1990, 1994a, 1994b, 1995) estimate log wage equations with data from the Current Population Survey from 1963 to 1988 for the USA, supplemented with other data for 11 other countries—Australia, Austria, Canada, Germany, Ireland, Italy, the Netherlands, Norway, South Korea, Switzerland and the UK.

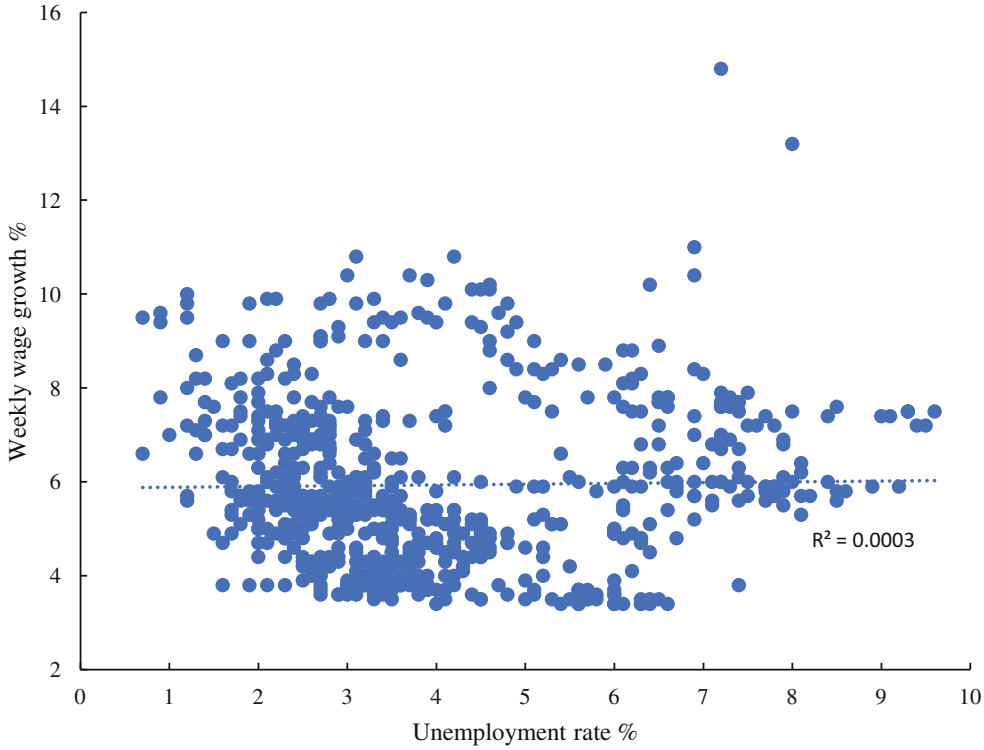

FIGURE 5 Private sector non-supervisory workers' weekly earnings and the US Phillips curve, 1965–2023.

Further evidence in support of a wage curve comes with further estimates from Blanchflower and Oswald (2005) using data up to 2001. They show, with references, that wage curves have been reported in a further 30 countries—Argentina, Belarus, Belgium, Brazil, Bulgaria, Burkina Faso, Chile, China, Côte d'Ivoire, Czech Republic, Denmark, Estonia, Finland, France, Hungary, India, Japan, Latvia, New Zealand, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Taiwan and Turkey. They also show that the evidence of a wage curve was robust to instrumenting wages along with the inclusion of benefits and union density rates. Evidence of a wage curve was especially strong in right-to-work states.

These various papers suggest that the unemployment elasticity of pay was −0.1, implying that a doubling of the unemployment rate lowered real wages by 10%. The results suggest that the USA had a wage curve rather than a Phillips curve.[6] In their meta-analysis study, Nijkamp and Poot (2005) find consistent evidence of a wage curve across numerous studies, concluding:

> the wage curve is a robust empirical phenomenon … but there is … evidence of publication bias. There is indeed an uncorrected mean estimate of about −0.1 for the elasticity. After controlling for publication bias by means of two different methods, we estimate that the 'true' wage curve elasticity at the means of study characteristics is about −0.07. (Nijkamp and Poot 2005, p. 445)

Rokicki *et al.* (2021) conclude in a recent study for Poland and the USA that the wage curve exists even when accounting for regional price differentials. Jokinen (2020) provides recent evidence of a wage curve in Finland. Baltaji and Başkaya (2022) provide support for a wage curve for formal and informal workers in Turkey, while Faryna *et al.* (2022) estimate a wage curve for Ukraine. Wage curves have also been found for Norway (Iacono and Ranaldi 2020; Johansen

et al. 2019), Russia (Shilov and Möller 2009), Greece (Cholezas and Kanellopoulos 2015), Korea (Park and Shin 2007), Japan (Inagaki 2015), Germany (Kosfeld and Dreger 2018) and the USA (Holmes and Otero 2022).

Blanchflower and Oswald (1995) are at pains to point to the differences between a Phillips curve and a wage curve. First, Phillips' construction is claimed to be a locus linking the rate of change of wages to the level of unemployment. The Phillips curve was proposed as a disequilibrium adjustment mechanism. The wage curve is instead an equilibrium locus that is not, in any useful sense, a description of inherently temporary phenomena or of transitory dynamics. Second, the Phillips curve links the rate of change of pay to the aggregate unemployment rate. The wage curve links the level of pay to the local unemployment rate. Third, the Phillips curve is traditionally estimated on time series macroeconomic data. The wage curve is estimated on pooled microeconomic data.

In his survey of the wage curve, David Card (1995) argues:

> [T]he tendency for the wage curve to show up for different kinds of workers, in different economies, and at different times, suggests that the wage curve may be close to an 'empirical law of economics.' … One can imagine future research that uses the negative correlation between unemployment and wages as a means to study other phenomena. One can also imagine a growing body of work that follows The Wage Curve's lead in using the diverse experiences of local labour markets as an 'intermediate-level' laboratory for economic research—part way between the individualistic focus of traditional microeconometric research, and the aggregate focus of traditional macroeconometrics. More than any other lesson, this may be the long-run contribution of The Wage Curve. (Card 1995, p. 798)

5 | ESTIMATING WAGE EQUATIONS IN THE USA

In this section, we estimate wage growth in the USA building on earlier work by Blanchflower and Posen (2014) that looks at the impact of inactivity rates on wages, and by Blanchflower and Levin (2015) that examines underemployment and the role of long-term unemployment. We use the same data as in Bell and Blanchflower (2021), updated from 2017 to October 2022.

We undertake an econometric analysis of the impact of rises in non-employment and inactivity on wages in the US economy. To the degree that the rise in unemployment in the USA is structural, movements in non-employment, unemployment and participation should have no impact on the wages of those employed; by definition, such individuals are unemployed because they cannot or do not want to compete for jobs. If anything, in a world where there is a sudden sharp rise in structural unemployment, wages should increase because of the negative shock to labour supply, all else equal. In contrast, if the rise in joblessness is largely cyclical, then labour markets will see downward pressure on wages, because of the possibility of re-entry by these idled workers.

Our data are from the Merged Outgoing Rotation Groups files of the Current Population Survey from 1979 to 2022. We aggregate the microdata to the state–year cell, and construct a lagged dependent variable leaving us with an overall sample size of 2193 (50 states and the District of Columbia across 43 years makes 2193 observations).

We then estimate a series of wage equations reported in Tables 3–7, which are variants of wage curves. They take the form

$$W_i = \beta_0 + \beta_1 Wage_{t-1} + \beta_2 Unemp + \beta_3 Inactive + \beta_4 Underemp + \beta_5' Year + \beta_6' State,$$

TABLE 3 Wage equations and the unemployment rate.

	1980–2022	1980–2007	2008–2022
Panel A: Weekly			
Lagged wages	0.8738 (89.00)	0.8619 (69.97)	0.5867 (19.67)
Unemployment rate	−0.0266 (9.17)	−0.0318 (9.40)	−0.0180 (2.73)
Adjusted R^2	0.9978	0.9967	0.9846
N	2193	1428	765
Panel B: Hourly			
Lagged wages	0.8447 (74.12)	0.8422 (59.05)	0.4912 (15.06)
Unemployment rate	−0.0220 (6.87)	−0.0263 (7.03)	−0.0116 (1.62)
Adjusted R^2	0.9973	0.9959	0.9814
N	2193	1428	765

Notes: t-statistics in parentheses. All variables in logs. Equations include full sets of state and year controls.

TABLE 4 Wage equations including the underemployment rate.

	1980–2022	1980–2007	2008–2022
Panel A: Weekly			
Lagged wages	0.8654 (88.36)	0.8523 (69.32)	0.5669 (19.25)
Underemployment rate	−0.0134 (4.37)	−0.0198 (5.67)	−0.0324 (6.37)
Unemployment rate	−0.0092 (2.11)	−0.0138 (2.98)	0.0034 (0.45)
Adjusted R^2	0.9978	0.9967	0.9865
N	2193	1428	765
Panel B: Hourly			
Lagged wages	0.8400 (73.60)	0.8353 (58.31)	0.4809 (14.83)
Underemployment rate	−0.0153 (5.18)	−0.0139 (3.62)	−0.0241 (3.69)
Unemployment rate	−0.0064 (1.60)	−0.0135 (2.62)	0.0043 (0.52)
Adjusted R^2	0.9973	0.9959	0.9818
N	2193	1428	765

Notes: t-statistics in parentheses. All variables in logs. Equations include full sets of state and year controls. Underemployment rate U7 is part-time for economic reasons/employment.

where W_i denotes log weekly or hourly wages and is a function of lagged wages, the underemployment rate, and then—depending on the precise model specification—a combination of labour market slack measures, in this case the unemployment and inactivity rates. All equations include a full set of year and state dummies.

We report wage Phillips curves in Table 7, and show that they do not perform as well as the wage curve specification as they omit an important variable, the lagged wage level. The difference between the wage curve and Philips curve specifications is that the latter excludes the lagged wage term.[7] Galí and Gambetti (2019) also report, using a VAR analysis, reduced importance of the unemployment rate in explaining wage formation since the Great Recession.

Finally, we repeat the analysis for the period 2008–22 using quarterly data (at the suggestion of a referee) and find the same. The unemployment rate does not enter wage equations in the most recent period (see Table 8).

Table 3 estimates a traditional wage curve as reported in Blanchflower and Oswald (1994a,b), using weekly and hourly earnings separately. We use the two earnings measures as increasing numbers of individuals are not paid by the hour, and over time there are restrictions on the

TABLE 5 Wage equations including the inactivity rate.

	1980–2022	1980–2007	2008–2022
Panel A: Weekly			
Lagged wages	0.8497 (82.62)	0.8498 (68.56)	0.5584 (18.93)
Unemployment rate	−0.0080 (2.05)	−0.0138 (3.00)	0.0046 (0.61)
Underemployment rate	−0.0170 (6.06)	−0.0188 (5.30)	−0.0332 (5.57)
Lag inactivity rate	−0.0587 (4.79)	−0.0237 (1.50)	−0.0926 (2.64)
Adjusted R^2	0.9979	0.9967	0.9854
N	2193	1428	765
Panel B: Hourly			
Lagged wages	0.8243 (69.42)	0.8325 (57.64)	0.4740 (14.56)
Unemployment rate	−0.0084 (1.93)	−0.0135 (2.63)	0.0054 (0.65)
Underemployment rate	−0.0114 (3.68)	−0.0128 (3.30)	−0.0244 (3.74)
Lag inactivity rate	−0.0589 (4.41)	−0.0254 (1.47)	−0.0783 (2.04)
Adjusted R^2	0.9974	0.9959	0.9812
N	2193	1428	765

Notes: t-statistics in parentheses. All variables in logs. Equations include full sets of state and year controls.

TABLE 6 Wage equations excluding year dummies and including a time trend.

	1980–2022	1980–2007	2008–2022	1980–2022
Panel A: Weekly				
Lagged wages	0.9707 (695.06)	0.9484 (339.55)	0.9910 (68.24)	0.8175 (82.8)
Unemployment rate	−0.0042 (1.26)	−0.0161 (3.80)	0.0128 (1.95)	0.0024 (0.75)
Underemployment rate	−0.0219 (8.42)	−0.0263 (8.49)	−0.0353 (5.30)	−0.0228 (9.27)
Lag inactivity rate	−0.1404 (7.97)	−0.0761 (2.28)	−0.0490 (0.77)	−0.0430 (3.79)
Year dummies	No	No	No	No
Time trend	No	No	No	Yes
State dummies	Yes	Yes	Yes	Yes
Adjusted R^2	0.9970	0.9956	0.9767	0.9973
N	2193	1428	765	2193
Panel B: Hourly				
Lagged wages	0.9712 (628.81)	0.9486 (309.32)	0.9748 (59.84)	0.7863 (70.6)
Unemployment rate	−0.0031 (0.86)	−0.0112 (2.42)	0.0086 (1.16)	0.0062 (1.79)
Underemployment rate	−0.0199 (6.96)	−0.0264 (7.80)	−0.0329 (4.41)	−0.0206 (7.63)
Lag inactivity rate	−0.1363 (7.01)	−0.0750 (2.06)	−0.0465 (0.64)	−0.0595 (4.88)
Year dummies	No	No	No	No
Time trend	No	No	No	Yes
State dummies	Yes	Yes	Yes	Yes
Adjusted R^2	0.9963	0.9946	0.9693	0.9968
N	2193	1428	765	2193

Notes: t-statistics in parentheses. All variables in logs.

TABLE 7 Weekly wage change Phillips curve equations minus the lagged dependent variable.

	1980–2022	1980–2007	2008–2022
Panel A			
Unemployment rate	−0.0291 (9.65)	−0.0357 (9.99)	−0.0163 (2.09)
Adjusted R^2	0.3435	0.3646	0.2116
N	2193	1428	765
Panel B			
Unemployment rate	−0.0158 (3.90)	−0.0231 (4.81)	−0.0018 (0.20)
Underemployment rate	−0.0140 (4.85)	−0.0140 (3.85)	−0.0220 (3.24)
Adjusted R^2	0.3505	0.3710	0.1982
N	2193	1428	765
Panel C			
Unemployment rate	−0.0158 (3.90)	−0.0237 (4.81)	−0.0013 (0.16)
Underemployment rate	−0.0140 (4.85)	−0.0145 (3.86)	−0.0221 (3.25)
Lag inactivity rate	−0.0014 (0.12)	0.0100 (0.56)	−0.0352 (0.88)
Adjusted R^2	0.3501	0.3707	0.2177
N	2193	1428	765

Notes: t-statistics in parentheses. All variables in logs. Equations include full sets of state and year controls.

TABLE 8 Wage equations using quarterly data, 2008–22.

	Weekly		Hourly	
Lagged wages	0.8652 (90.45)	0.2914 (17.34)	0.8520 (16.67)	0.2436 (14.26)
Unemployment rate	0.0083 (1.76)	0.0326 (6.48)	0.0045 (0.89)	0.0307 (5.72)
Underemployment rate	−0.0379 (8.24)	−0.0340 (8.52)	−0.0343 (6.94)	−0.0235 (5.58)
Lag inactivity rate	0.2262 (8.53)	−0.1192 (4.09)	0.2465 (8.60)	−0.1111 (3.59)
Year dummies	No	Yes	No	Yes
Adjusted R^2	0.9345	0.9564	0.9226	0.9501
N	3060	3060	3060	3060

Notes: t-statistics in parentheses. All variables in logs. Equations include full sets of state and year controls.

availability of hours through underemployment. The dependent variable is the log of the relevant wage measure. Equations include a lagged dependent variable and a full set of state dummies.

We examine the full period 1980–2022 and then look separately at 1980–2007 and 2008–2022. In panel A of Table 3, for weekly wages, the coefficient on the lagged dependent variable varies between 0.87 and 0.59. In the hourly wage equations in panel B it varies between 0.84 and 0.49. As the lagged dependent variable is significantly different from 1, the data are consistent with a wage curve, not a Phillips curve.

The log unemployment rate is negative and statistically significant in all three columns of Table 3 for weekly wages and for two of the hourly wage equations. It is weakly significant ($t = 1.62$) in the hourly wage equation post Great Recession.

Table 4 adds the underemployment rate U7 to the specifications in Table 3. The underemployment rate is always negative and significant in all periods for weekly and hourly pay. The unemployment rate is now *insignificant* in the period since the Great Recession for both weekly and hourly wages.

Table 5 adds the log inactivity rate to the models reported in Table 4, which includes both the unemployment and underemployment rates. The lagged inactivity rate is negative and

statistically significant over the whole period (1980–2022) and the later period (2008–2022), whereas it was negative but not statistically significant prior to the Great Recession (1980–2007). Underemployment remains negative and statistically significant throughout.

A referee has suggested that estimation should occur minus the highly significant year dummies. This does not change the results. Excluding the year dummies in Table 6 raises the coefficient on the lagged dependent variable, and the underemployment rate remains statistically significant. This is the case for weekly and hourly wages. Unemployment is negative and significant prior to the Great Recession, but becomes positive post Great Recession, so exhibiting the wrong sign, and even being statistically significant in the case of weekly wages. In the final column, we insert a time trend. Again, underemployment and inactivity rates are strongly negatively associated with wage growth, whereas unemployment is positively signed and, in the case of hourly wages, on the margins of statistical significance.

Table 7 presents Philips curves estimates of weekly wage change for the period 1980–2022 and pre and post 2008. Panel A incorporates the unemployment rate. Panel B adds the underemployment rate to the specification in panel A, while panel C adds the lagged economic inactivity rate to the specification in panel B. The equations do not incorporate the highly significant lagged wage terms on the right-hand side, which suggests that the equation is misspecified. If the equation for the full period in the first column was estimated in wage changes, taking W_{t-1} from both sides, the lagged dependent variable has coefficient $1 - 0.8745 = 0.1255$. The Phillips curve imposes a coefficient 1 on the lagged dependent variable, so deducting W_{t-1} from both sides results in no lagged wage term on the right-hand side. A test of whether it is a Phillips curve or a wage curve is whether the coefficient on the lagged dependent variable W_{t-1} is statistically different from zero. It always is.[8] So the Phillips curve is misspecified as it omits a crucial significant variable, the lagged wage term. In any case, the results are essentially the same. In the later period, the unemployment rate is insignificant, while the underemployment rate is significantly negative.

The data support a wage curve, not a Phillips curve written in underemployment and inactivity space in the post-recession period. The Phillips curve is misspecified because it suffers from omitted variable bias as it excludes the highly significant lagged wage variable.

6 | CONCLUSION AND IMPLICATIONS

Erceg and Levin (2014, p. 7) argue that 'labour market slack may not be well summarized by the unemployment rate and consequently the monetary policy rule developed for the Great Moderation may have to be adapted to account for broader measures of slack'. Judging by the evidence that we present in this paper, that seems right. They suggest that the participation rate should enter into wage equations, meaning that the higher the participation rate, the higher are wages, but do so without any empirical evidence. We present supporting evidence here that the underemployment rate, the non-employment rate and the inactivity rate play a role in wage formation, especially in the years since the Great Recession.

We find evidence of a statistically significant negative effect of non-employment and underemployment on wages post the Great Recession. Those not in the labour force or not employed exert additional downward pressure on wages over and above the unemployment rate. This pattern holds across previous decades in the US data, and the relationship strengthens in recent years when variation in participation increases. Our analysis is based on observations by state and year, and therefore are robust to the local impact on employment of, say, fracking in North Dakota or ongoing real estate overhang in Nevada.

There is no wage Phillips curve in wage growth and unemployment space in the years since the Great Recession. Our preferred specification is a wage curve, which dominates a Phillips curve specification due to the significance of the lagged dependent variable. There is no wage curve in

the wage/unemployment space, though in the years after the Great Recession, there is one in the wage/underemployment and non-employment combined space. The wage curve specification fits the data better, as there is an important role for the lagged wage term.

In the past, commentators have argued that the long-term unemployed were on the margins of the labour market (Krueger *et al.* 2014). As such, it was assumed that they had little or no impact on wages. Instead, it was suggested, one should focus on the short-term unemployment rate where labour market attachment was stronger. But there is no empirical evidence for this proposition. Some time ago, Blanchflower and Oswald (1990) noted that long-term unemployment is not 'an important element in the wage determination process'. Instead, what appears to matter is joblessness, whether captured by the inactivity rate or the non-employment rate. Underemployment also matters for wage growth. Since the Great Recession, it has been a brake on wage growth.

The implication for policymakers is that high non-employment and high underemployment *are* indeed additional measures of labour market slack, pushing down on US wages. A substantial portion of those American workers who became inactive should not be treated as gone forever but should be expected to spring back into the labour market if demand rises to create jobs.

In 1968 in his presidential address to the American Economic Association, Milton Friedman (1968) famously explained that

> the natural rate of unemployment, in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labour and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labour availabilities, the costs of mobility, and so on. (Friedman 1968, p. 8)

He went further, though, arguing that the rate could change in either direction:

> I do not mean to suggest that it is immutable and unchangeable. On the contrary, many of the market characteristics that determine its level are man-made and policy-made. In the United States, for example, legal minimum wage rates, the Walsh–Healy and Davis–Bacon Acts, and the strength of labour unions all make the natural rate of unemployment higher than it would otherwise be. Improvements in employment exchanges, in availability of information about job vacancies and labour supply, and so on, would tend to lower the natural rate of unemployment. (Friedman 1968, p. 9)

It is perfectly possible, and indeed likely, that the Great Recession scared workers and non-workers, reducing their bargaining power, hence lowering the NAIRU.

Demand deficiency appears to be a reasonable explanation for underemployment, which implies that workers are off their labour supply curves, which explains in part why they are discontented (Bell and Blanchflower 2020). There are obvious opportunities for the underemployed to adjust their hours upwards given that they could take second jobs. Of note is that the multiple jobholding rate, with the numbers expressed as a percentage of employment, has declined over time: according to the BLS, the rate was 5.8% in 2000, 5.2% in January 2008 and January 2020, and 4.9% in February 2023.

In the USA, there has been little evidence of any rise in nominal wage growth, despite the very low levels of the unemployment rate in the years since the Great Recession. Figures 3 and 4 illustrate this phenomenon. As the unemployment rate declined, there was little response from wage growth, which stayed steady at around 2% during the period 2010–20.

It seems that non-employment, inactivity and underemployment have replaced the unemployment rate as measures of US labour market slack. These measures enter wage

equations, whereas the unemployment rate does not. Wage growth did not mean revert to pre-recession levels, whereas the unemployment rate did; non-employment, inactivity and under-employment rates did not mean revert, and hence are more correlated with wages than the unemployment rate. We have shown that the unemployment rate is no longer a useful guide to what is happening in the US labour market.

ENDNOTES

[1] Jingle mail was where homeowners who were unable to pay their e-mortgage loans sent the keys in an envelope to the lender before they had a chance to foreclose. This also occurred in states that had 'non-recourse loans', which means that the lender cannot go after the borrower's other assets. Non-recourse loans exist in 12 states: Alaska, Arizona, California, Connecticut, Idaho, Minnesota, North Carolina, North Dakota, Oregon, Texas, Utah and Washington; see McMahon (2022) and Treece (2020).

[2] This is the U3 measure of the US Bureau of Labor Statistics; see https://www.bls.gov/cps/definitions.htm#unemployed (accessed 1 February 2024).

[3] The non-employment rate is the inverse of the employment rate. It is calculated as $(U + O)/(U + O + E)$, where U means unemployed, E means employed, and O means not in the labour force. O individuals (i) are not employed during the survey reference week, and (2) had not actively looked for work (or been on temporary layoff) in the last 4 weeks.

[4] Bell and Blanchflower (2021) create U7 as a measure of underemployment as part-time for economic reasons divided by employment.

[5] In April 2020, the official unemployment rate rose to 14.7%, but the Bureau of Labor Statistics noted that the true rate was 19.7% due to difficulties in data collection during Covid. Upward adjustments need to be made to these data over the next couple of years, although the extent of the bias fell over time. See https://www.bls.gov/news.release/archives/empsit_05082020.htm (accessed 1 February 2024).

[6] For an attempt to reconcile Phillips curves and the wage curve, see Montuenga-Gómez and Ramos-Parreño (2005).

[7] The wage curve is estimated at $\ln W_t = f(\ln W_{t-1}$ and other terms). This gives a Phillips curve as long as the coefficient on the lagged wage term is not significantly different from 1. We find that it is not so, hence the Phillips curve suffers from a missing variable bias. The data support wage curves not Phillips curves.

[8] For the UK, Bell *et al.* (2002), for example, find that the long-run elasticity of average regional wages with respect to regional unemployment is in the range 0.11–0.13 The long-run elasticity of individual wages with respect to regional unemployment is around −0.053. They find that while wages exhibit a high degree of autocorrelation at both the regional and individual level, 'the lagged dependent variable coefficient is well below unity'.

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