Supplemental Appendix to
The Cyclical Behavior of the Price-Cost Markup

Christopher J. Nekarda
Board of Governors of the Federal Reserve System

Valerie A. Ramey
University of California, San Diego and NBER

March 8, 2020

Contents

Table A1. Unconditional Cyclicality of the Price-Cost Markup - Robustness

	Baxter-King		*First difference*	
Measure	*Elasticity*	*Std. err.*	*Elasticity*	*Std. err.*
CD production function, 1947–2017				
1. Labor compensation	$.18^{*}$	(.08)	$.46^{***}$	(.05)
2. Wages and salaries	.08	(.08)	$.40^{***}$	(.06)
CD production function, overhead labor, 1964–2017				
3. All worker wages and salaries	.05	(.10)	$.51^{***}$	(.08)
4. Prod. worker wages and salaries	−.03	(.10)	$.45^{***}$	(.08)
CES production function, 1947–2017				
5. μ_L, naive technology trend	$.40^{***}$	(.12)	1.06^{***}	(.09)
6. μ_L, SVAR technology trend	$.40^{***}$	(.10)	$.85^{***}$	(.07)
7. μ_K, constant capital utilization	$-.34^{***}$	(.08)	−.05	(.05)
8. μ_K, variable utilization (Shapiro)	$-.20^{**}$	(.08)	.10	(.05)
9. μ_K, variable utilization (Fernald)	−.01	(.09)	$.22^{***}$	(.05)
CES production function, overhead labor, 1964–2017				
10. μ_L, naive technology trend	.17	(.17)	1.07^{***}	(.12)
11. μ_L, SVAR technology trend	.17	(.16)	$.87^{***}$	(.10)
12. μ_K, constant capital utilization	$-.61^{***}$	(.05)	−.11	(.08)
13. μ_K, variable utilization (Shapiro)	$-.45^{***}$	(.08)	.05	(.08)
14. μ_K, variable utilization (Fernald)	$-.30^{**}$	(.11)	.14	(.08)

Notes: Elasticity of detrended log markup with respect to detrended log real GDP; detrending method listed in column heading. Standard errors that are robust to serial correlation are reported in parentheses; '***', '**', '*' indicates significance at the 0.1-, 1-, and 5-percent level. For CES production function, elasticity of substitution between capital and labor $\sigma = 0.5$. See section 4.3 of the main text for a description of the CES markup measures.

A Robustness and alternative specifications

A.1 Alternate detrending methods

Table A1 reports the unconditional cyclicality of the markup measures from the main text using two alternative detrending methods. The first two columns show results for the Baxter-King (BK) filter, while the second uses a first-difference filter. The results for the BK filter are similar to those from the Hodrick-Prescott (HP) filter that we reported in the main text. Detrending using the first-difference filter yields much more procyclical markups.

A.2 Alternate markup measures

Figure A1 plots our baseline markup measure together with three alternatives. The blue line is our baseline, which is the inverse of the labor share in private business. The orange and gold lines show the markup measured as the inverse of the labor share in two different sectors of the U.S. economy, private nonfarm business and private nonfinancial corporate business. The nonfinancial corporate business sector is somewhat smaller than the whole private business sector, but may be better measured. The markups in private business and private nonfarm business are essentially the same.

The purple line plots a measure of the markup in private business from De Loecker, Eeckhout and Unger (2019), which comes from aggregating firm-level markups estimated from Compustat data. They use the same cost minimization problem outlined in section 3 of the main text, but choose cost of goods sold (COGS) as their variable input. COGS is an accounting concept that includes all expenses that can be directly related to the production of goods, combining the costs of labor, materials, energy, and other intermediate goods. For their baseline measure, they use sector-year specific Cobb-Douglas (C-D) production functions to estimate the output elasticity.

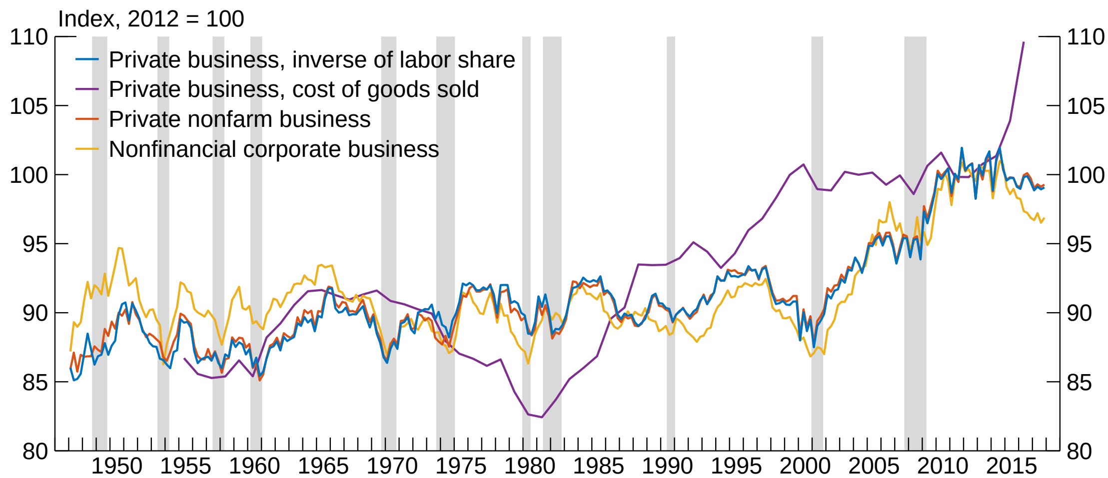
All four markup measures have upward trends, but the timing and magnitude is somewhat different. The measures based on the inverse of the labor share display little trend until the early 2000s and then rise through the early 2010s. In contrast, the De Loecker, Eeckhout and Unger (2019) markup shows a pronounced trend starting in the early 1980s, rising from a nadir in 1980 to a series high in 2016.

As shown in the lower panel of figure A1, these markup measures generally appear to peak near the middle of expansions, to decline going into a recession, and then to rise coming out a recession.

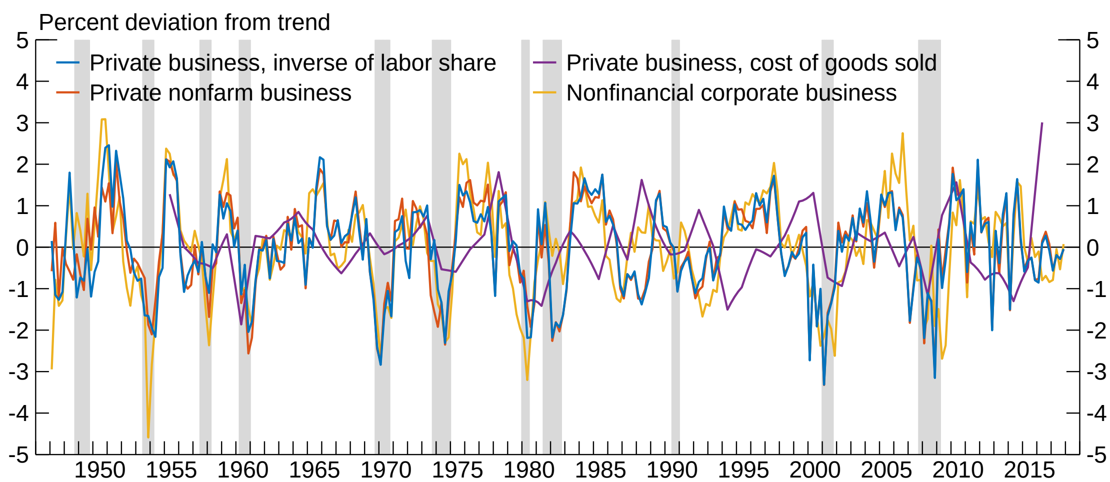
Table A2 reports the elasticities of the markup when measured in different sectors of the U.S. economy (in rows) and using the three detrending methods we consider (in columns). Across all three methods, the markup in the entire private business sector is the most procyclical while that in the nonfinancial corporate business sector is the least procyclical. The elasticities range from 0.1 to 0.5, depending on the measure and method. Finally, note that the markup measured using the COGS (line 5) is roughly

Figure A1. Measures of the Price-Cost Markup

(a) Level



(b) Detrended



Source: Authors' calculations using BLS data; De Loecker, Eeckhout and Unger (2019).

Notes: Markup based on cost of goods sold, from De Loecker, Eeckhout and Unger (2019), is annual. Series detrended using the HP filter. Shaded areas represent periods of business recession as determined by the NBER.

Table A2. Unconditional Cyclicality of the Price-Cost Markup - Robustness (II)

	Hodrick-Prescott		*Baxter-King*		*First-difference*	
Measure	*Elast.*	*Std. err.*	*Elast.*	*Std. err.*	*Elast.*	*Std. err.*
Quarterly, 1947–2017						
1. Private business	.20**	(.07)	.18*	(.08)	.46***	(.05)
2. Private nonfarm business	.13*	(.07)	.13	(.08)	.44***	(.05)
3. Nonfin. corp. business	.11	(.08)	.13	(.09)	.32***	(.05)
Annual, 1950–2014						
4. Labor compensation	.12	(.09)	.14	(.09)	.13	(.07)
5. Cost of goods sold	.24	(.24)	.28	(.23)	.31	(.25)

Notes: Elasticity of detrended log markup with respect to detrended log real GDP; detrending method listed in column heading. Markup measured using C-D production; data are from the BLS. Markup based on cost of goods sold is from De Loecker, Eeckhout and Unger (2019). Standard errors that are robust to serial correlation are reported in parentheses; '***', '**', '*' indicates significance at the 0.1-, 1-, and 5-percent level.

twice as procyclical as the markup measured using the inverse of the labor share (line 4), when compared at the same frequency and over the same time period.

A.3 Capital utilization

Our estimated series for the workweek of capital in private business was based on estimated elasticities of the workweek to output. As a robustness check, we also considered the alternative based on elasticities of the workweek of capital to labor hours, specifically to hours per worker and to the number of workers in case they had different relationships with the workweek of capital. To explore this alternative, we used Shapiro's (1986) quarterly manufacturing workweek from 1952 to 1982. We first compared the elasticity of the cyclical component in the workweek of capital to the cyclical component of total hours versus output in manufacturing.[1] In both cases, the elasticity was estimated to be 0.32.

We then regressed the workweek capital in manufacturing on employment and average hours per worker in manufacturing (all involving cyclical components and logarithms). The estimated elasticity with respect to employment was 0.164 (SE = .07) and

1. All cyclical components were extracted using a standard HP filter.

to average hours was 0.925 (SE = .21). They are significantly different from each other. We created an alternative utilization series for private business using the estimated coefficients for the two hours margins (i.e. employment and average hours) in private business. When we studied the unconditional elasticity of the CES-based markup with this new measure of utilization, the result was virtually the same as for our baseline measure.

A.4 Robustness of monetary SVAR

Figure A2 plots the responses of all the variables in the monetary structural vector autoregression (SVAR). (The top two panels duplicate the figures from the main text.) As shown in the lower left panel, the price level declines and remains below trend for three years after an expansionary monetary shock. Thus, our monetary SVAR exhibits the same "price puzzle" that Ramey (2016) showed to be pervasive.

In our main results, the recursive ordering in the monetary SVAR puts the markup last, implying that the markup is the most rapidly moving variable in the system. Because the markup is a function of variables that are by long tradition assumed to move slowly, or at least more slowly than interest rates, we check the sensitivity to this ordering.[2] Figure A3 shows that estimated impulse response functions are not sensitive to whether the markup is ordered after the funds rate ("μ ordered last") or the markup is ordered before the funds rate ("r ordered last").

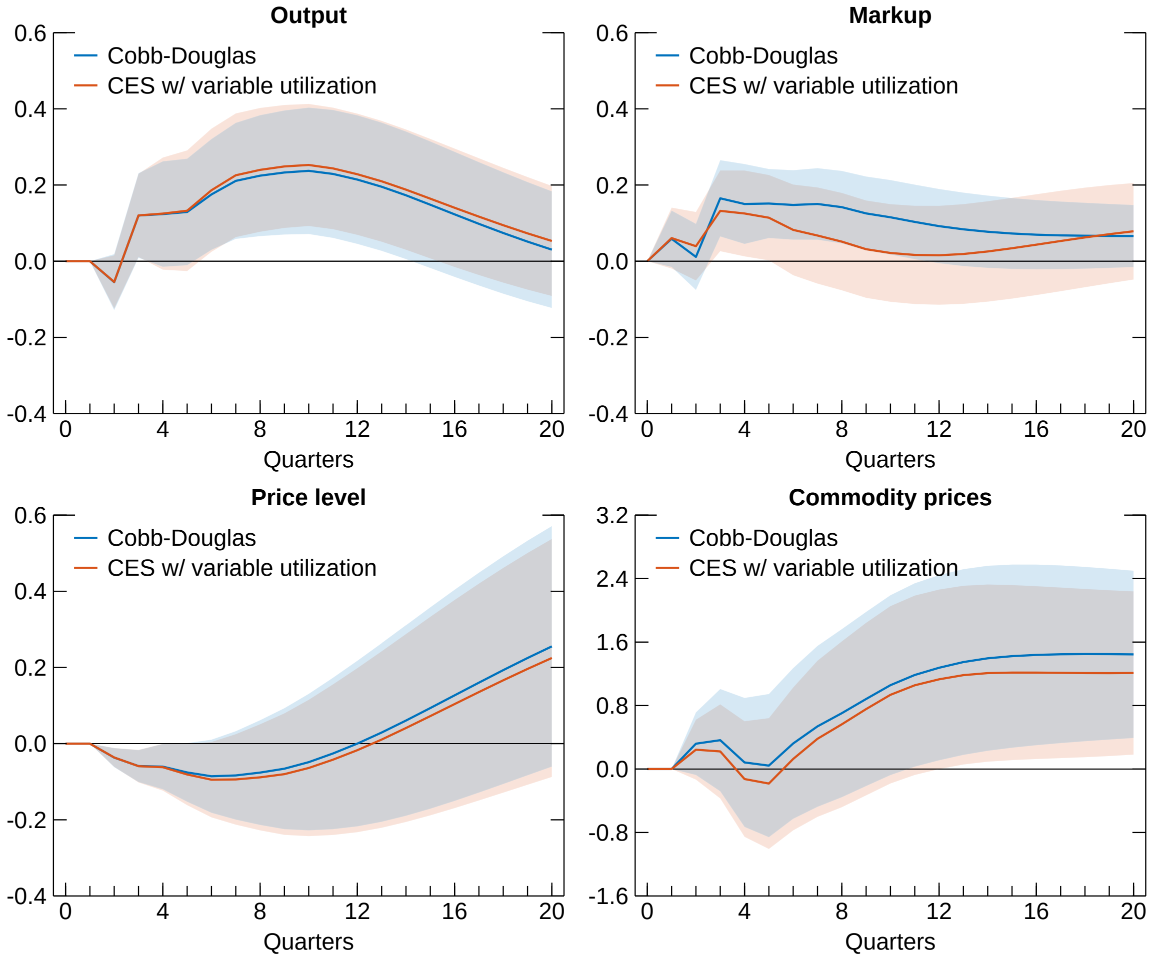
B Structural break in markup cyclicality

The unconditional cyclicality of the markup changed dramatically in the mid-1990s, switching from procyclical to countercyclical. This section describes this structural break and suggests a possible explanation. We find that the investment-specific technological change shock, which leads to countercyclical movements in markups, became relatively more important in the later period.

Figure B1 plots a rolling 40-quarter elasticity of the detrended markup with respect to detrended real GDP. The blue shaded area is the 90-percent confidence interval

2. The only system in which the ordering could make a difference is in the monetary SVAR, since the others either identify shocks using external instruments (i.e. Ramey's (2011) military news and Fernald's (2014) utilization-adjusted total factor productivity) or from a long-run restriction (investment-specific technological change).

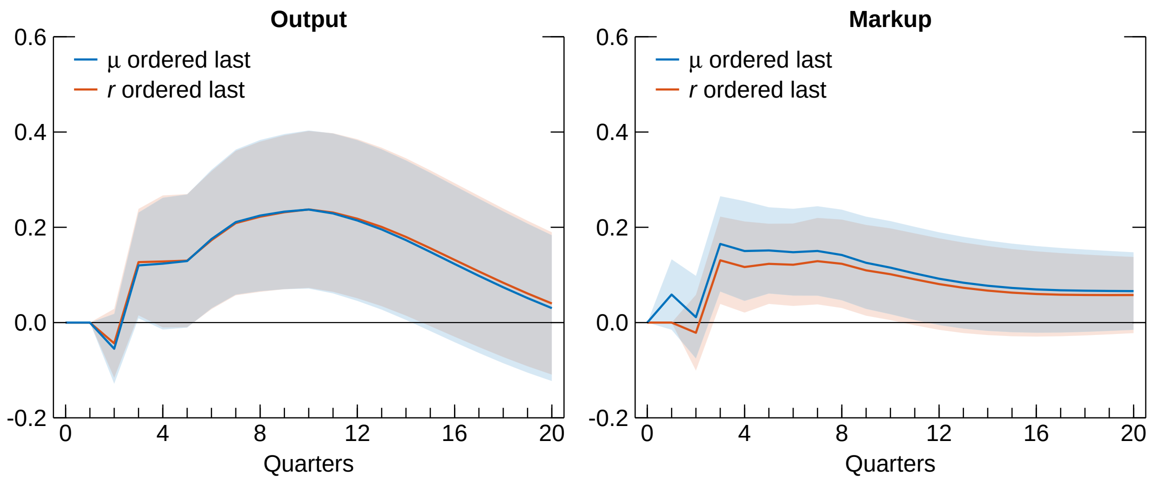
Figure A2. Response of All Variables in Monetary SVAR



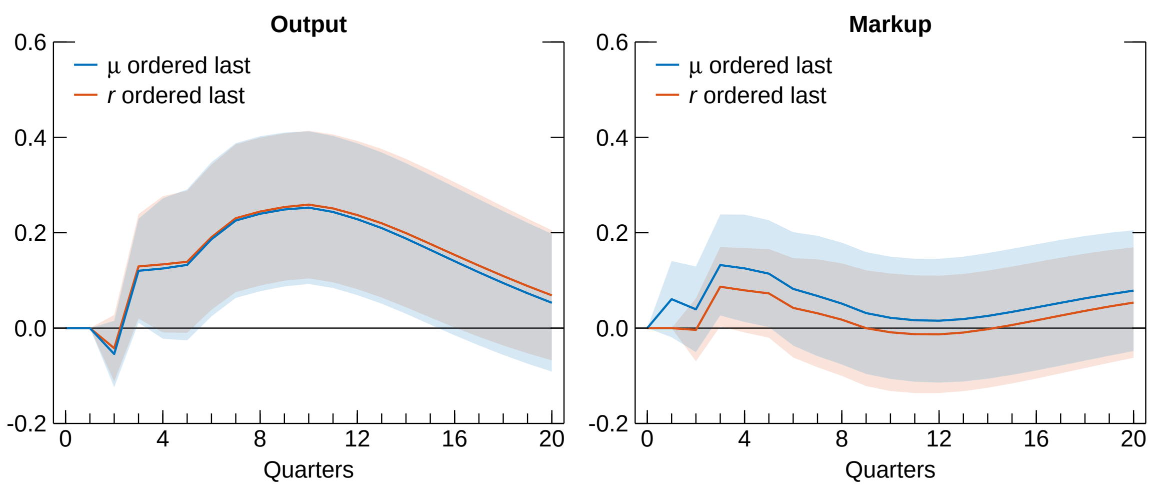
Notes: Impulse response of indicated variable to an expansionary shock to federal funds rate; shaded areas indicate 90-percent confidence interval around estimate. CES markup measure based on output-capital ratio and workweek of capital. SVAR estimated from 1954:Q3 to 2017:Q4.

Figure A3. Impulse Response in Monetary SVAR with Alternate Ordering

(a) Cobb-Douglas

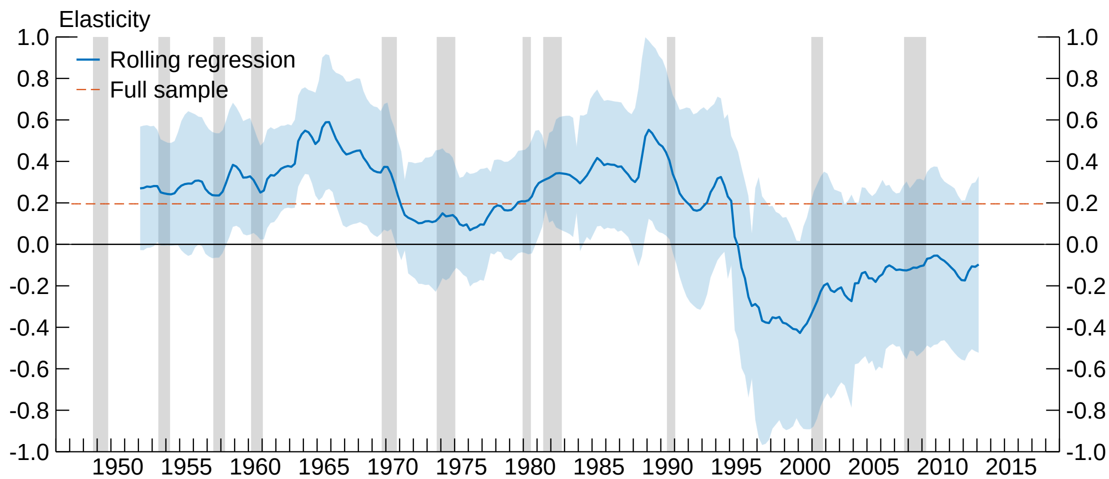


(b) Constant elasticity of substitution



Notes: Impulse response of indicated variable to an expansionary shock to federal funds rate; shaded areas indicate 90-percent confidence interval around estimate. CES markup measure based on output-capital ratio and workweek of capital. SVAR estimated from 1954:Q3 to 2017:Q4.

Figure B1. Rolling Elasticity of the Markup with respect to Real GDP



Notes: Rolling 40-quarter regressions of detrended log markup on detrended log real GDP. Each point is plotted at the mid-point of the estimation sample. Shaded areas show 90-percent confidence band, based on Newey-West standard errors.

around the point estimate, based on Newey and West (1987) standard errors to account for autocorrelation in the residuals. The orange line is the full-sample elasticity. The markup is somewhat more procyclical, on average, than the full-period estimate through the late 1990s. However, the markup turns countercyclical in samples ending in the late-1990s and beyond. Indeed, by the mid-2000s the markup is significantly countercyclical.

To identify the timing of the break more accurately, we run a standard test for a structural break with an unknown break date.[3] The break test finds overwhelming evidence of a structural break, with the maximum value for the test statistic (19.7) occurring in 1995:Q1. We take this date as our structural break and explore the unconditional cyclicality of the markup in two subsamples.

Table B1 reports the elasticity of the markup with respect to real GDP. The first column reports the estimate for the full sample (1947–2017), while the second and third columns report estimates from the two subsamples. The final column reports the change in the elasticity from the early period to the later period. As expected given figure B1, the elasticity switches from procyclical (0.3) in the sample from 1947–94 to countercyclical (—0.2) in the sample from 1995–2017.

3. Andrews (1993).

Table B1. Changing Cyclicality of Markup in Private Business

	1947–2017	*1947–1994*	*1995–2017*	*Change*
Elasticity w.r.t. real GDP	.20**	.26***	−.20	−.46

Notes: Elasticity of detrended log markup with respect to detrended log real GDP; series detrended using the HP filter. Standard errors are robust to serial correlation; '***', '**', '*' indicates significance at the 0.1-, 1-, and 5-percent level.

Table B2. Ratio of Variances of Estimated Shocks, 1995–2017 to 1947–1994

	Monetary policy	*Govt. spending*	*TFP*	*IST*
Ratio	.43	.11	.51	.63

Notes: Markup measure is baseline C-D markup. The shocks are estimated on the full sample from 1947 to 2017, using the SVARs described in section 6.1 of the main text. Because federal funds rate data do not start until 1954, the monetary SVAR is estimated from 1954:Q3 through 2017:Q4.

Table B2 shows that the structural break in the cyclicality of the unconditional elasticity is consistent with the changes in the variances of our estimated shocks to monetary policy, government spending, technology, and investment-specific technological change. Recall that only investment-specific technological change led to countercyclical movements in the markup. The table shows the ratio of the variances of the estimated shocks, whose estimation is described in section 6. The variance of all four shocks fell in the post-1995 period, but the fall was the least for investment-specific technological change. Thus, this shock became relatively more important in the later period, which may explain the markup becoming more countercyclical then.

C The marginal wage versus the average wage

This section revisits Bils's (1987) argument that the marginal hourly wage is more procyclical than the average hourly wage because of the additional cost of overtime hours. The first section begins by generalizing the theory we presented in the paper to distinguish hours per worker from the number of workers. It then develops a relationship between marginal and average wages based on parameters and variables that can be measured. The second section uses that relationship to measure the ratio of marginal to average wages in the aggregate data and to assess its cyclicality.

C.1 Theory

We generalize the labor input by decomposing total labor hours, L, into hours per worker, h, and the number of workers, N — that is, $L = hN$. The firm chooses h to minimize

$$\text{Cost} = W_{\text{A}}(h) \cdot hN + \text{other terms not involving } h, \tag{C.1}$$

subject to $\bar{Y} = F(Z\,hN, \ldots)$. W_{A} is the average hourly wage (which is potentially a function of average hours), N is the number of workers, Y is output, and Z is the level of labor-augmenting technology. Letting λ be the Lagrange multiplier on the constraint, we obtain the first-order condition for h as:

$$W_{\text{A}}'(h) \cdot h + W_{\text{A}}(h) = \lambda \cdot F_1(Z\,hN, \ldots) \cdot Z, \tag{C.2}$$

where W_{A}' is the derivative of the average wage with respect to h and F_1 is the derivative of the production function with respect to effective labor, $Z\,hN$. The multiplier λ is equal to marginal cost, so the marginal cost of increasing output by raising hours per worker is given by:

$$MC = \lambda = \frac{W_{\text{A}}' \cdot h + W_{\text{A}}}{Z \cdot F_1(Z\,hN, \ldots)}. \tag{C.3}$$

The denominator of equation C.3 is the marginal product of increasing hours per worker; the numerator is the marginal increase in the wage bill (per worker). The markup is the price divided by marginal cost.

Following Bils, we specify the average wage function as:

$$W_{\text{A}}(h) = W_{\text{S}}\left[1 + \rho \cdot \theta \cdot \frac{v}{h}\right]. \tag{C.4}$$

where W_{S} is the straight-time wage, ρ is the premium for overtime hours, θ is the fraction of overtime hours that command a premium, and v/h is the ratio of average overtime hours to total hours. The term $\rho \cdot \theta \cdot \frac{v}{h}$ captures the idea that firms may have to pay a premium for hours worked beyond the standard workweek.[4] Bils did not include the θ term in his specification because he used data for manufacturing from the BLS's establishment survey, in which overtime hours are *defined* as those hours commanding a premium (that is, $\theta = 1$). In our data, we define overtime hours as those hours in excess of 40 hours per week. Because overtime premium regulations do not apply to all workers, we must allow for the possibility that θ is less than unity.

We assume that the firm takes the straight-time wage, the overtime premium, and the fraction of workers receiving premium pay as given, but recognizes the potential effect of raising h on overtime hours v. With this functional form, the marginal cost of increasing output by raising hours per worker is given by:

$$MC = \lambda = \frac{W_S\left(1 + \rho \cdot \theta \cdot \frac{\partial v}{\partial h}\right)}{Z \cdot F_1(ZhN, \ldots)}. \tag{C.5}$$

Equation C.5 makes it clear that the marginal cost of increasing hours per worker is not necessarily equal to the average wage, as is commonly assumed. Following Bils (1987), we call the term in the numerator the "marginal wage" and denote it by W_M:

$$W_M = W_S\left(1 + \rho \cdot \theta \cdot \frac{\partial v}{\partial h}\right). \tag{C.6}$$

To the extent that the marginal wage has different cyclical properties from the average wage, markup measures that use the average wage may embed cyclical biases. Bils (1987) used approximations to the marginal wage itself to substitute for marginal cost in his markup measure. We instead derive an expression that does not require approximation. In particular, we combine the expressions for the average wage and the marginal wage to obtain their ratio:

$$\frac{W_M}{W_A} = \frac{1 + \rho \cdot \theta \cdot \frac{\partial v}{\partial h}}{1 + \rho \cdot \theta \cdot \frac{v}{h}}. \tag{C.7}$$

This ratio can be used to convert the observed average wage to the theoretically-correct marginal wage required to estimate the markup. We show below that the ratio of overtime hours to average hours, v/h, is procyclical. Thus, the denominator in equation C.7

4. It would also be possible to distinguish wages paid for part-time work versus full-time work. However, Hirsch (2005) finds that nearly all of the difference in hourly wages between part-time and full-time workers can be attributed to worker heterogeneity rather than to a premium for full-time work.

is procyclical. How $W_{\mathrm{M}}/W_{\mathrm{A}}$ evolves over the business cycle depends on the relative cyclicality of $\partial v/\partial h$.

In the case where the wage is increasing in average hours, the markup in any of the previous formulations can be adjusted by multiplying W_{A} by $\frac{W_{\mathrm{M}}}{W_{\mathrm{A}}}$. For example in the C-D case, the markup is given by:

$$\mathcal{M}_{\mathrm{M}}^{\mathrm{CD}} = \frac{P}{W_{\mathrm{M}}/\left[\alpha\left(\frac{Y}{hN}\right)\right]} = \frac{\alpha}{s\left(\frac{W_{\mathrm{M}}}{W_{\mathrm{A}}}\right)}, \tag{C.8}$$

where we use equation C.7 to convert average wages to marginal wages.

C.2 Measuring marginal wages

We now consider the cyclicality of the marginal-average wage factor and how it affects the cyclicality of the markup. In this case, the measured markup for the C-D case (in natural logarithms) is given by

$$\mu_{\mathrm{M}}^{\mathrm{CD}} = -\ln s - \ln\left(\frac{W_{\mathrm{M}}}{W_{\mathrm{A}}}\right), \tag{C.9}$$

where $\mu \equiv \ln \mathcal{M}$. The last term is the log of the wage factor used in the average-marginal wage adjustment factor (equation C.7).

To construct the ratio of marginal to average wages, we require (1) estimates of the marginal change in overtime hours with respect to a change in average total hours, $\partial v/\partial h$; (2) estimates of the ratio of overtime hours to average hours, v/h; (3) the fraction of overtime hours that command a premium, θ; and (4) the premium for overtime hours, ρ.

The series for $\partial v/\partial h$ is the most challenging to measure. Bils (1987) speculated that $\partial v/\partial h$ was procyclical because a given increase in average hours would be more likely to come from an increase in overtime hours if the starting level of average hours was higher. He implemented this idea by regressing the change in average overtime hours, Δv, on the change in average total hours, Δh, in annual two-digit standard industrial classification manufacturing data, and allowing the coefficient in the regression to be a polynomial of average hours.

Average hours based on industry or aggregate data are not ideal for measuring this component for several reasons. As Bils pointed out, higher moments of the average hours distribution could matter because all workers do not work the same average hours. For example, it matters for the marginal wage whether average hours are increasing because more workers are moving from 38 to 39 hours per week or more workers are moving from 40 to 41 hours per week. Ideally, we want to compute the ratio of the change in overtime hours to the change in average hours at the level of the individual worker and then average over all workers at each point in time. That is, we want to construct the "average marginal" change in overtime hours with respect to a change in average hours. The ideal way to do this is to use panel data on individual workers.[5]

We measure both $\partial v/\partial h$ and v/h using individual-level data from Nekarda's (2013) Longitudinal Population Database, a monthly panel data set constructed from CPS microdata that matches individuals across all months, available for 1976 to 2017. In order to match the BLS private business data, we limit the sample to private-sector workers. We calculate v/h as follows. For all employed workers in each month we sum average weekly overtime hours (defined as those hours in excess of 40 per week) and average weekly hours. We seasonally adjust these two series separately (as discussed below) and then form our series as $\sum v/\sum h$.

To calculate $\partial v/\partial h$, for each matched individual i who is employed in two consecutive months we calculate

$$\left(\frac{\Delta v}{\Delta h}\right)_{it} = \frac{v_{it} - v_{i(t-1)}}{h_{it} - h_{i(t-1)}}. \tag{C.10}$$

Then for each month t we take the average over all individuals N_t:

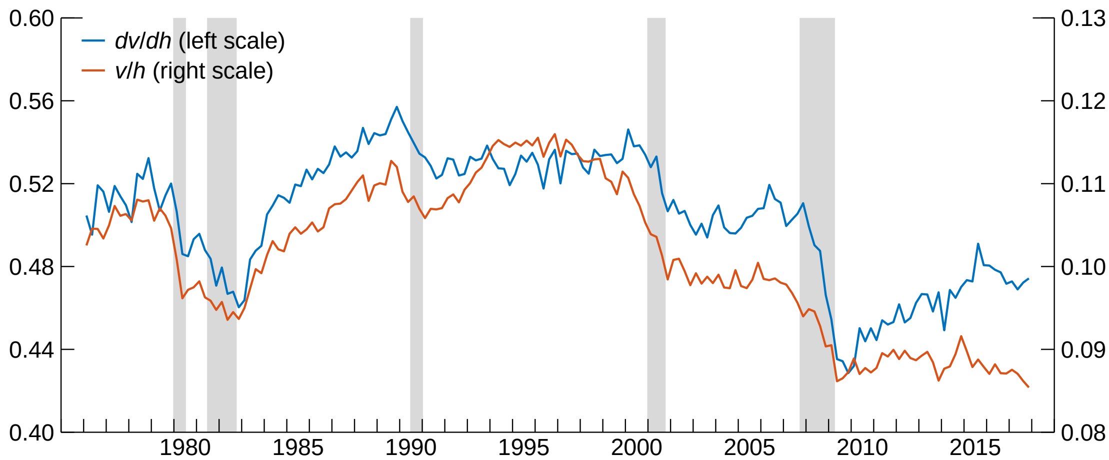
$$\left(\frac{\Delta v}{\Delta h}\right)_{t} = \frac{1}{N_t}\sum_{i=1}^{N_t}\left(\frac{\Delta v}{\Delta h}\right)_{it}. \tag{C.11}$$

Ideally, we would limit the matches to individuals employed in the same job over the two consecutive months, but the same-job measure does not exist prior to 1994. However, we found that the matched same-job measure was nearly identical to the matched employment measure after 1994, so we used the matched measure for individuals employed in consecutive months for the entire sample.

The raw data have significant seasonal variation. The CPS asks respondents to report actual hours worked during the week of the month containing the twelfth. Two

5. We are indebted to Steven Davis for suggesting this method for calculating $\partial v/\partial h$.

Figure C1. $\partial v/\partial h$ **and** v/h



Source: Authors' calculations from Nekarda (2013).
Notes: Shaded areas represent periods of business recession as determined by the NBER.

holidays, Easter and Labor day, periodically fall during the reference week. When one of these holidays occurs during the reference week, actual hours worked falls substantially.

We seasonally adjust the series we calculate from the LPD (h, v, and dv/dh) using the Census Bureau's X-12-ARIMA program. We include exogenous variables for the Easter and Labor day holidays that fall during the reference period and remove the estimated effect of these holidays on each series. We then take the quarterly average of the monthly series to match our other aggregate data.

The blue line in figure C1 shows the value of $\partial v/\partial h$. The series shows obvious procyclicality: it tends to rise during expansions and fall during recessions. It also exhibits some low frequency movements, rising from the mid-1970s to late 1990s and then trending lower thereafter. Because $\partial v/\partial h$ appears in the numerator of the wage factor, its procyclicality makes the wage factor more procyclical. But because the wage factor appears in the denominator of the markup, procyclicality of $\partial v/\partial h$ has a countercyclical influence on the markup.

The orange line in figure C1 shows the fraction v/h. It is procyclical as well, though it tends to peak a bit before the peak of the business cycle. Like $\partial v/\partial h$, it also displays low frequency movements, although the decline since the late-1990s is more pronounced. Thus, the wage factor in equation C.7 contains a procyclical series in both the numerator and denominator. Hence, the cyclicality of the factor depends in large part on the relative cyclicality of $\partial v/\partial h$ versus v/h.

Two more parameters are also required to construct the marginal-average wage factor. One is the fraction of overtime hours that command a premium, θ. We define as overtime hours, any hours worked greater than 40 hours per week. As some of those hours may come from salaried workers or persons with second jobs, not all hours over 40 are paid a premium. The only direct information is from the May supplements to the CPS in 1969–81, which asked workers whether they received higher pay for hours over 40 hours per week.

We calculate the share of overtime hours that are paid a premium using data from CPS May extracts provided by the NBER.[6] The overtime variable (`x174`) is a dummy for whether an individual receives higher pay for work exceeding 40 hours in a week. (Note that the value 0 indicates that a worker received premium pay.)

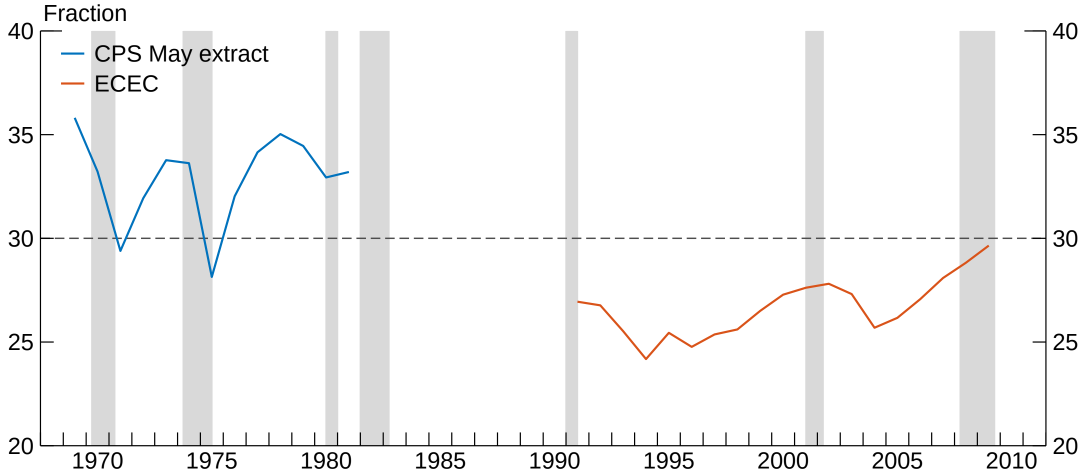
We drop all individuals that do not report total hours (variable `x28`). We calculate overtime hours as hours worked at primary job (variable `x182`) less 40 when this is reported; otherwise, overtime hours is calculated as total hours worked less 40. An individual's paid overtime hours is the product of overtime hours and the indicator for whether overtime hours are paid a premium. We aggregate overtime hours, paid overtime hours, and total hours by year using the individual sampling weights (variable `x80`). For a given year, the share of overtime that is paid a premium is the ratio of paid overtime hours to total overtime hours.

Unfortunately, the key question on premium pay was dropped from the May supplement after 1985. A potential alternative source of information is the BLS's Employer Costs for Employee Compensation (ECEC) survey which provides information on total compensation, straight time wages and salaries, and various benefits, such as overtime pay, annually from 1991 to 2001 and quarterly from 2002 to the present. If one assumes a particular statutory overtime premium, then one can construct an estimate of θ from these data. We assume that the statutory premium is 50 percent and construct a θ accordingly.

Figure C2 shows annual estimates of θ based on these two sources. From 1969 to 1981, θ averages 0.33, meaning that only one-third of hours over 40 command a premium. From 1991 to 2009, θ averages 0.27. Although it appears that the estimate of θ from the Current Population Survey falls during recessions, regressing θ on average

6. `http://www.nber.org/data/cps_may.html`

Figure C2. Fraction of Overtime Hours Worked Paid a Premium



Source: Authors' calculations using data from May CPS extracts (NBER) and the Employer Costs for Employee Compensation survey (BLS).
Notes: The implied θ for the early sample is based on individual worker reports on hours and whether they are paid a premium from the May CPS extract. The implied θ for the later sample is based on aggregated data on wages and salaries and overtime compensation from the ECEC survey, coupled with our constructed measure of v/h.

hours does not yield a significant relationship.[7] On the other hand, the fraction of hours paid a premium is slightly countercyclical in the ECEC data.[8] It is difficult to tell whether the structure of the economy actually changed or whether the two surveys are simply not comparable. Because there is little cyclical variation in θ in either survey, we assume that θ is a constant equal to the average across the two surveys of 0.3.[9] Based on the information from these two data sources, we use a value of $\theta = 0.3$ for the private economy.

The final input required for the wage factor is the premium paid for overtime hours, ρ. The Fair Labor Standards Act requires that employers pay a 50 percent premium for hours in excess of 40 per week for covered employees. Evidence from Carr (1986) indicates that in 1985, 92 percent of those who earned premium pay received a 50 percent premium.[10] Although there is considerable evidence that the implicit premium

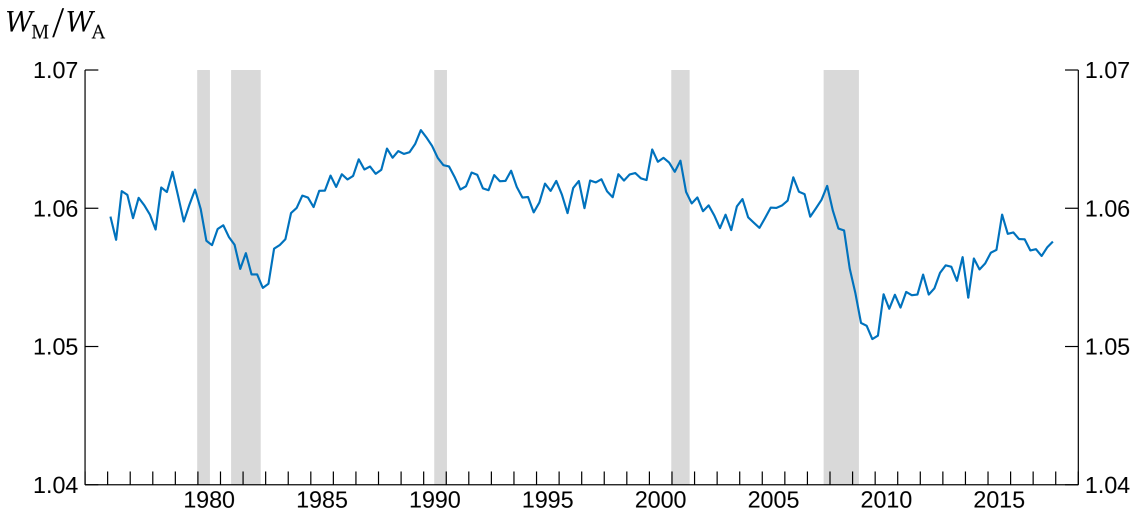
7. The coefficient from this regression is 0.02 and has a t statistic of 1.40.

8. Regressing θ estimated from the ECEC on CPS average hours yields a coefficient of −0.03 with a t statistic of −3.2.

9. If we instead assume that θ is procyclical with the coefficient of 0.024 on average hours, our estimates of the marginal-average wage factor change little.

10. See Wetzel (1966) and Taylor and Sekscenski (1982) for other estimates.

Figure C3. Ratio of Marginal to Average Wages



Source: Authors' calculations from Nekarda (2013).
Notes: Shaded areas represent periods of business recession as determined by the NBER.

could be closer to 0.25, we use a ρ of 0.50 to reflect the statutory premium.[11] Using the higher overtime premium will bias the analysis toward finding countercyclical markups.

C.3 Cyclicality of the markup using marginal wages

Figure C3 shows the marginal-average wage factor. Although the movements in the wage factor are procyclical, the magnitude of the variation is small enough that it does not change the cyclicality of the markup appreciably. Specifically, the estimated elasticity from 1976 to 2017 of the baseline markup in private business to real GDP is 0.13 (SE = 0.11). This falls to 0.07 (SE = 0.12) measured using marginal wages. Neither of these estimates is statistically different from zero.

These results stand in contrast to those of Bils (1987), who found countercyclical markups in two-digit annual manufacturing data from 1956 to 1983. Our explorations suggest that Bils' results are due to the combination of details in the implementation

11. Trejo (1991) has questioned whether the true cost of an extra overtime hour for those covered is actually 50 percent. He shows that the implicit cost of overtime hours is lower than 50 percent because straight-time wages are lower in industries that offer more overtime. Hamermesh (2006) updates his analysis and finds supporting results: The implicit overtime premium is 25 percent, not 50 percent. The results using a 25 percent premium lie between those using the average wage and those using the 50 percent premium.

of his method for estimating $\partial v/\partial h$. We show that even within his framework, small adjustments in the method eliminate the finding of countercyclicality.[12]

References

Andrews, Donald WK. 1993. “Tests for Parameter Instability and Structural Change with Unknown Change Point.” *Econometrica: Journal of the Econometric Society*, 821–56.

Bils, Mark. 1987. “The Cyclical Behavior of Marginal Cost and Price.” *American Economic Review*, 77(5): 838–55.

Carr, Darrell E. 1986. “Overtime Work: An Expanded View.” *Monthly Labor Review*, 109(11): 36–9.

De Loecker, Jan, Jan Eeckhout, and Gabriel Unger. 2019. “The Rise of Market Power and the Macroeconomic Implications.” KU Leuven. Working paper.

Fernald, John. 2014. “A Quarterly, Utilization-Adjusted Series on Total Factor Productivity.” Federal Reserve Bank of San Francisco Working Paper 2012-19, San Francisco, CA.

Hamermesh, Daniel S. 2006. “Overtime Laws and the Margins of Work Timing.” University of Texas, Austin. Unpublished paper.

Hirsch, Barry T. 2005. “Why Do Part-Time Workers Earn Less? The Role of Worker and Job Skills.” *Industrial and Labor Relations Review*, 58(4): 525–51.

Nekarda, Christopher J. 2013. “The Longitudinal Population Database.” Board of Governors of the Federal Reserve System. Unpublished paper.

Nekarda, Christopher J., and Valerie A. Ramey. 2013. “The Cyclical Behavior of the Price-Cost Markup.” National Bureau of Economic Research Working Paper 19099.

Newey, Whitney K., and Kenneth D. West. 1987. “A Simple, Positive, Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix.” *Econometrica*, 55(3): 703–8.

12. See Appendix B of Nekarda and Ramey (2013) for details.

Ramey, Valerie A. 2011. "Identifying Government Spending Shocks: It's All in the Timing." *Quarterly Journal of Economics*, 126(1): 1–50.

Ramey, Valerie A. 2016. "Macroeconomic Shocks and their Propagation." In *Handbook of Macroeconomics*. Vol. 2, , ed. John B. Taylor and Harald Uhlig, 71–162. Elsevier.

Shapiro, Matthew D. 1986. "Capital Utilization and Capital Accumulation: Theory and Evidence." *Journal of Applied Econometrics*, 1(3): 211–34.

Taylor, Daniel E., and Edward S. Sekscenski. 1982. "Workers on Long Schedules, Single and Multiple Jobholders." *Monthly Labor Review*, 105(5): 47–53.

Trejo, Stephen J. 1991. "The Effects of Overtime Pay Regulation on Worker Compensation." *American Economic Review*, 81(4): 719–40.

Wetzel, James R. 1966. "Overtime Hours and Premium Pay." *Monthly Labor Review*, 89(9): 973–7.