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ABSTRACT

Raising the Overtime Premium and Reducing the Standard Workweek: Short-Run Impacts on U.S. Manufacturing*

A nine-factor input model is developed to estimate the monthly demand for employment, capital, and weekly hours per worker/workweek in U.S. Manufacturing. The labor inputs correspond to production and non-production workers disaggregated by overtime and non-overtime employment. Policy simulations are conducted to examine the short-run effects on the monthly growth rates for employment, labor earnings, capital usage, and the workweek from either a) raising the overtime premium to double-time, or b) reducing the standard workweek to 35 hours. Although the growth rate policy effects are heterogeneous across disaggregated labor input categories, on aver- age both policy changes exhibit negative effects on the growth rates of industry-wide employment, earnings, and non-labor input usage. The growth rate of the workweek is virtually unaffected by raising the overtime premium but is negatively impacted by reducing the standard work week.

JEL Classification: J23, J88
Keywords: overtime, employment, workweek

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I. Introduction

Arguably, the potential economic impacts of overtime hours regulations might far exceed the economic impacts of minimum wage legislation. For the U.S., changes in federal and state minimum wage rates and coverage are relatively more frequent than regulatory changes in overtime hours policy. In February 1979,Congressman John Conyers of Michigan introduced HR 1784 to amend the Fair Labor Standards Act (FLSA) to reduce the standard workweek from 40 hours to 35 hours and to raise the overtime premium from time-and-a half to double-time. Although the proposal was motivated by a belief that the measure would reduce unemployment by spreading the work, it failed to become law. Three basic counter arguments against the proposal were 1) because overtime workers tend be more skilled than the unemployed at any given time, unemployed workers would not be good substitutes for the eliminated overtime hours, 2) many overtime workers would likely seek second jobs to compensate for their reduced earnings and would therefore compete with the current unemployed, and 3) production costs would rise and would eventually lead to reduced output with a concomitant reduction in labor inputs (Ehrenberg and Smith (1991), pp.148-152).

The Obama Administration proposed a rules change that would impact coverage of overtime provisions of the Fair Labor Standards Act (FLSA) that was to take effect on December 1, 2016. The new rules required that the minimum salary for white collar exemption from overtime regulation be raised from \$23,600/yr (about \$454/wk) to \$47,476/yr (about \$913/wk). This action was expected to extend mandatory overtime pay to approximately 4 million workers. Subsequent litigation struck down the proposed 2016 regulation. Previously, the minimum salary requirement was last changed in 2004.

Analysis of changes in the standard workweek and overtime premium is complicated by the existence of a number of margins of adjustment: workweeks for different types of workers, employment of different worker types, nonlabor input usage, and shifts between overtime and non-overtime regimes. In the long run, these margins of adjustment would incorporate the effects of changes in output and input prices.

The contribution of this paper is the development and estimation of a unified input demand model that simultaneously takes account of the short-run margins of labor market adjustments to changes in overtime hours regulation. We develop a conceptual framework based on a theoretical model of production and input demand under long-run profit maximization. The model incorporates the policy variables corresponding to the standard workweek and the overtime premium and guides the specification and estimation of a monthly time series, multi-equation model of labor and nonlabor input demands in U.S. manufacturing. This setup permits us to simulate counterfactual policy scenarios for an increase in the overtime premium and a reduction in the standard workweek. Along with nonlabor input usage, the outcome variables we examine are employment, weekly per capita and aggregate hours and earnings for a) overtime workers (production and nonproduction), and for b) non-overtime workers, (production and non-production).

II. Literature Review

There is an extensive literature on the effects of overtime regulation. An increase in the overtime premium could theoretically lead to increases in employment, decreases in hours worked and straight-time wages, and have no effect on worker earnings. The earlier work of Ehrenberg (1971) found that the increase in the overtime premium significantly decreases overtime hours worked and increases employment in manufacturing industries. Trejo (1991) tested for whether or not increases in the relative cost of overtime might lead firms to substitute employment for overtime hours. He finds that even if wage differentials arise from increased overtime costs, they are not large enough to completely neutralize overtime pay regulation in the sense that straight-time wages would be sufficient to maintain the original weekly compensation and hours of work. The 2012 reduction in the overtime premium in Portugal showed a significant increase in overtime hours (Martins (2016)). The study concluded that overtime pay flexibility promoted employment even during a recession.

There are some studies that do not support these predictions. For instance, the findings of Asai (2014) suggested that despite doubling the overtime premium in Japan, there has been no change in working hours. Bell and Hart (2003) in their study of Britain found no dependency between the overtime premium and the length of overtime hours and a negative relationship of the overtime premium to the standard hourly wage.

More research has been done on the effect of changes in the standard workweek. Reductions in standard hours can lead to a rise in employment and straight-time wages. However, it could potentially increase moonlighting and reduce overall employment as a result of higher labor costs. (Oaxaca (2014)). Hunt (1999) examined the effect of a change in the standard workweek on hours of work in Germany. She finds that a decrease in the standard workweek led to a decline in actual hours worked. The study for Canada by Friesen (2001) suggested that shortening the standard workweek led to increases in the straight-time hourly wages of covered workers.

The effect of a 1982 reduction in the standard workweek in France was investigated by Crépon and Kramarz (2002). They found that the reduction from 40 to 39 hours in the standard workweek increased the probability of losing a job for workers who worked for 40 hours or more. Another French study by Estevão et al. (2008) found no effect on aggregate employment but an increase in labor turnover. A cross-country analysis by Renna (2006) suggested that decreasing standard hours of work increases the probability of moonlighting, while the overtime premium has a negative effect on the probability of working overtime. Chen and Wang (2011) studied the effect of shortening the standard workweek in Taiwan. Their findings showed a decrease in working hours with the effect diminishing in the long run. Raposo and van Ours (2010) studied the consequences of a standard workweek reduction in Portugal in 1996. The results suggested that covered workers experienced reductions in job separation and increases in hourly wages, keeping monthly earning constant.

III. Conceptual Framework

We consider input demand under long-run profit maximization with a Cobb-Douglas technology. The production function is specified by

$$Q = Ae^{f(M,t)}E_1^{\alpha_1}E_2^{\alpha_2}E_3^{\alpha_3}E_4^{\alpha_4}h_1^{\beta_1}h_2^{\beta_2}h_3^{\beta_3}h_4^{\beta_4}K^{\gamma},$$

where $0 < \alpha_j, \beta_j, \gamma < 1, \alpha_j > \beta_j, \sum_{m=1}^{4} \alpha_j + \gamma < 1, j = 1....,4$

$$f(M,t) = \sum_{m=1}^{12}(g_{1m}t + g_{2m}t^2)M_m$$

$$M_m = 1\,(\text{month=m})$$

$$t = \text{time period.}$$

Variables E_1 through E_4 represent the employment of overtime production workers, non-overtime production workers, overtime production workers, and non-overtime, non-production workers, respectively. Variables h_1 through h_4 represent the respective workweeks (hours per week) of the four labor inputs. K represents the nonlabor inputs (Capital). The function $f(M,t)$ captures monthly output growth trends from neutral technological change:

$$g_{mt} = (g_{1m} + 2g_{2m}t)M_m, m = 1,2,...,12,$$

where t is a linear time trend.

Total cost (C) may be expressed as

$$\begin{aligned} C =& \{W_1\left[h^* + \lambda\left(h_1 - h^*\right)\right] + V_1\}E_1 + \left[W_2h_2 + V_2\right]E_2 \\ &+\{W_3\left[h^* + \lambda\left(h_3 - h^*\right)\right] + V_3\}E_3 + \left[W_4h_4 + V_4\right]E_4 + rK, \end{aligned}$$

where W_1 through W_4 are the corresponding straight-time hourly wage rates for the labor inputs, V_1 through V_4 are the corresponding weekly overhead labor costs (mainly, but not entirely, benefits per worker) for the labor inputs, r is the user cost of capital, h^* is the standard 40 hour workweek, and λ is the overtime premium of 1.5 (time and a half).

Below we sketch the derivations of the input demand functions under long run profit maximzation. To obtain the input demand functions for the workweek for each labor input, one simply equates the ratio of marginal products to marginal costs (efficiency conditions) and solves for the workweek, i.e.

$$\frac{MP_{E_j}}{MP_{h_j}} = \frac{MC_{E_j}}{MC_{h_j}}, j = 1, ..., 4.$$

It can be shown that the employments E_j cancel out to yield the following workweek demand functions:

$$h_j = \left(\frac{\beta_j}{\alpha_j - \beta_j}\right)\left[(1-\lambda)\,h^* + \frac{V_j}{W_j}\right]\left(\frac{1}{\lambda}\right), j = 1, 3 \quad (1)$$

$$h_j = \left(\frac{\beta_j}{\alpha_j - \beta_j}\right)\left(\frac{V_j}{W_j}\right), j = 2, 4 \quad (2)$$

or in terms of logs,

$$ln(h_j) = ln\left(\frac{\beta_j}{\alpha_j - \beta_j}\right) + ln\left[(1-\lambda)\,h^* + \frac{V_j}{W_j}\right] - ln(\lambda)$$

$$ln(h_j) = ln\left(\frac{\beta_j}{\alpha_j - \beta_j}\right) + ln\left(\frac{V_j}{W_j}\right).$$

Interestingly, the restrictions of the Cobb-Douglas technology under long-run profit maximization imply that own workweek demand is a function of only the own ratio of weekly overhead labor costs to straight-time hourly wage rates. Note that for overtime workers, $\alpha_j > \beta_j$ and $h_j > h^* > 0$ implies $\frac{V_j}{W_j} > \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right) h^* > 0 > (1-\lambda)\,h^*$. Thus, it follows from eq (1) that $(1-\lambda)\,h^* + \frac{V_j}{W_j} > 0$. For non-overtime workers who work less than the standard workweek, $0 < h_j < h^*$ and eq (2) imply $\frac{V_j}{W_j} < \left(\frac{\alpha_j}{\beta_j} - 1\right) h^*$.

We may now classify the workweek according to three mutually exclusive outcomes:

$$\frac{V_j}{W_j} > \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right) h^*, \quad \text{overtime } (h_j > h^*)$$

$$\frac{V_j}{W_j} < \left(\frac{\alpha_j}{\beta_j} - 1\right) h^*, \quad \text{non-overtime } (h_j < h^*)$$

$$\left(\frac{\alpha_j}{\beta_j} - 1\right) h^* \leq \frac{V_j}{W_j} \leq \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right) h^*, \quad \text{standard workweek } (h_j = h^*).$$

The employment and capital input demand functions are derived as follows. First, equate the marginal costs ratios to the ratios of marginal products (efficiency conditions) for an arbitrarily selected input relative to other inputs and solve for each input as a function of the arbitrarily selected reference input.[1] For convenience we will select overtime, production employment E_1 as the reference input:

$$\frac{MP_{E_1}}{MP_{E_j}} = \frac{MC_{E_1}}{MC_{E_j}}, j = 2, 3, 4$$

$$\Rightarrow E_j = \left(\frac{\alpha_j - \beta_j}{\alpha_1 - \beta_1}\right)\left(\frac{W_1}{V_j}\right)\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] E_1$$

$$\Rightarrow ln(E_j) = ln\left(\frac{\alpha_j - \beta_j}{\alpha_1 - \beta_1}\right) + ln\left(\frac{W_1}{V_j}\right) + ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + ln(E_1) \tag{3}$$

$$\frac{MP_{E_1}}{MP_K} = \frac{MC_{E_1}}{MC_K}$$

$$\Rightarrow K = \left(\frac{\gamma}{\alpha_1 - \beta_1}\right)\left(\frac{W_1}{r}\right)\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right](E_1)$$

$$\Rightarrow ln(K) = ln\left(\frac{\gamma}{\alpha_1 - \beta_1}\right) + ln\left(\frac{W_1}{r}\right) + ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + ln(E_1). \tag{4}$$

[1] In the marginal cost functions for the labor employments, h_j is replaced by the corresponding workweek input demand function $h_j(\cdot)$.

Next, we impose the profit maximization condition $MR = P$ to obtain the profit maximization condition for the input demand corresponding to E_1: $MP_{E_1} \cdot P = MC_{E_1}$, where MR and P are marginal revenue and output price. Upon substitution for the inputs as functions of E_1 derived from the efficiency conditions (3) and (4), collecting terms and simplifying, we obtain the demand function for E_1 under long-run profit maximization. The demand function for E_1 can then be substituted back into the efficiency conditions (3) and (4) to solve for the demand functions for the remaining inputs E_2, E_3, E_4, and K. For convenience we express the employment and capital input demand functions in natural logs and streamline the notation:

$$\begin{aligned}
ln(E_1) = \theta_{0\lambda} + ln(-\theta_8) - ln(\theta_1) + \sum_{m=1}^{12} (b_{1m}t + b_{2m}t^2) M_m \\
+ \theta_1 ln\left(\frac{P}{W_1}\right) + \theta_2 ln\left(\frac{W_1}{V_2}\right) + \theta_3 ln\left(\frac{W_1}{W_3}\right) + \theta_4 ln\left(\frac{W_1}{V_4}\right) + \theta_5 ln\left(\frac{V_2}{W_2}\right) \\
+ \theta_6 ln\left(\frac{V_4}{W_4}\right) + \theta_7 ln\left(\frac{W_1}{r}\right) + (\theta_8 - 1)\, ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] \\
+ \theta_9 ln\left[(1-\lambda)\, h^* + \frac{V_3}{W_3}\right],
\end{aligned}$$

$$\begin{aligned}
ln(E_2) =& \theta_{0\lambda} + ln(\theta_2 - \theta_5) - ln(\theta_1) + \sum_{m=1}^{12} (b_{1m}t + b_{2m}t^2) M_m \\
&+ \theta_1 ln\left(\frac{P}{W_1}\right) + (\theta_2 + 1) ln\left(\frac{W_1}{V_2}\right) + \theta_3 ln\left(\frac{W_1}{W_3}\right) + \theta_4 ln\left(\frac{W_1}{V_4}\right) + \theta_5 ln\left(\frac{V_2}{W_2}\right) \\
&+ \theta_6 ln\left(\frac{V_4}{W_4}\right) + \theta_7 ln\left(\frac{W_1}{r}\right) + \theta_8 ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + \theta_9 ln\left[(1-\lambda)\, h^* + \frac{V_3}{W_3}\right],
\end{aligned}$$

$$\begin{aligned}
ln(E_3) =& \theta_{0\lambda} + ln(-\theta_9) - ln(\theta_1) + \sum_{m=1}^{12} (b_{1m}t + b_{2m}t^2) M_m \\
&+ \theta_1 ln\left(\frac{P}{W_1}\right) + \theta_2 ln\left(\frac{W_1}{V_2}\right) + (\theta_3 + 1) ln\left(\frac{W_1}{W_3}\right) + \theta_4 ln\left(\frac{W_1}{V_4}\right) + \theta_5 ln\left(\frac{V_2}{W_2}\right) \\
&+ \theta_6 ln\left(\frac{V_4}{W_4}\right) + \theta_7 ln\left(\frac{W_1}{r}\right) + \theta_8 ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + (\theta_9 - 1) ln\left[(1-\lambda)\, h^* + \frac{V_3}{W_3}\right],
\end{aligned}$$

$$
\begin{aligned}
ln(E_4) =&\theta_{0\lambda} + ln(\theta_4 - \theta_6) - ln(\theta_1) + \sum_{m=1}^{12}(b_{1m}t + b_{2m}t^2)M_m \\
&+ \theta_1 ln\left(\frac{P}{W_1}\right) + \theta_2 ln\left(\frac{W_1}{V_2}\right) + \theta_3 ln\left(\frac{W_1}{W_3}\right) + (\theta_4+1) ln\left(\frac{W_1}{V_4}\right) + \theta_5 ln\left(\frac{V_2}{W_2}\right) \\
&+ \theta_6 ln\left(\frac{V_4}{W_4}\right) + \theta_7 ln\left(\frac{W_1}{r}\right) + \theta_8 ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + \theta_9 ln\left[(1-\lambda)\, h^* + \frac{V_3}{W_3}\right],
\end{aligned}
$$

$$
\begin{aligned}
ln(K) =& \theta_{0\lambda} + ln(\theta_7) - ln(\theta_1) + \sum_{m=1}^{12}(b_{1m}t + b_{2m}t^2)M_m \\
&+ \theta_1 ln\left(\frac{P}{W_1}\right) + \theta_2 ln\left(\frac{W_1}{V_2}\right) + \theta_3 ln\left(\frac{W_1}{W_3}\right) + \theta_4 ln\left(\frac{W_1}{V_4}\right) + \theta_5 ln\left(\frac{V_2}{W_2}\right) \\
&+ \theta_6 ln\left(\frac{V_4}{W_4}\right) + (\theta_7+1) ln\left(\frac{W_1}{r}\right) + \theta_8 ln\left[(1-\lambda)\, h^* + \frac{V_1}{W_1}\right] + \theta_9 ln\left[(1-\lambda)\, h^* + \frac{V_3}{W_3}\right],
\end{aligned}
$$

where

$$
\theta_{0\lambda} = \frac{1}{\Omega}[ln(A) + (\alpha_1 - \beta_1)ln(\alpha_1 - \beta_1) + (\alpha_2 - \beta_2)ln(\alpha_2 - \beta_2) + (\alpha_3 - \beta_3)ln(\alpha_3 - \beta_3)
$$
$$
+(\alpha_4 - \beta_4)ln(\alpha_4 - \beta_4) + \beta_1 ln(\beta_1) + \beta_2 ln(\beta_2) + \beta_3 ln(\beta_3) + \beta_4 ln(\beta_4) + \gamma ln(\gamma) - (\beta_1 + \beta_3)\, ln(\lambda)],
$$

$$
\Omega = 1 - \alpha_1 - \alpha_2 - \alpha_3 - \alpha_4 - \gamma,\ b_{1m} = \frac{g_{1m}}{\Omega}, b_{2m} = \frac{g_{2m}}{\Omega},
$$

$$
\theta_1 = \frac{1}{\Omega},\ \theta_2 = \frac{\alpha_2}{\Omega},\ \theta_3 = \frac{\alpha_3}{\Omega},\ \theta_4 = \frac{\alpha_4}{\Omega},\ \theta_5 = \frac{\beta_2}{\Omega,}\ \theta_6 = \frac{\beta_4}{\Omega},\ \theta_7 = \frac{\gamma}{\Omega},
$$

$$
\theta_8 = -\left(\frac{\alpha_1 - \beta_1}{\Omega}\right), \text{ and } \theta_9 = -\left(\frac{\alpha_3 - \beta_3}{\Omega}\right).
$$

IV. Empirical Model

A. Data

The period covered by our study is March 2006 to September 2018 (151 months). The data for our analysis originate from several sources. The main data source is the National Current Employment Statistics (CES) produced by the Bureau of Labor Statistics (BLS). The CES reports monthly data on employment, average weekly hours, average weekly overtime hours, average hourly earnings, and average hourly earnings excluding overtime for production and non-production workers in U.S. manufacturing.

Data on the Producer Production Index (PPI) and overhead employer costs are also reported by the BLS. Weekly overhead employer labor cost is calculated as Total Benefits minus Overtime Pay. Because these last two variables are reported on a quarterly basis, their imputed monthly values on a weekly basis do not vary within a given quarter.

The user cost of capital is constructed as $r = \dfrac{(i+\delta)}{P_K}$, where i is the nominal interest rate represented by the 3-month treasury bill rate (Federal Reserve Bank, St. Louis), P_K is price of capital as measured by the price index for private fixed investment in manufacturing (BEA), and δ is the capital depreciation rate (BEA).

In the BLS data employment is disaggregated into production and non-production categories. These data do not disclose the proportion of manufacturing employment working overtime. While some workers may routinely work overtime, others may work overtime only on occasion. Consequently, there is no specific overtime labor input per se. However, for analytic purposes it is useful to create the theoretical constructs of overtime and non-overtime labor inputs corresponding to production and nonproduction employment.

From CPS monthly data we were able to estimate the share of manufacturing workers who work overtime. We note that average overtime hours are always much higher among production workers compared with nonproduction workers. Accordingly, we create the empirical categories of overtime and non-overtime labor inputs by assuming that the ratio of overtime production employment to overtime non-production employment is equal to the ratio of average weekly overtime for production workers to average weekly overtime for non-production workers. From this assumption coupled with the share of manufacturing workers who work overtime, we are able to derive employment, hours, wages, and overhead labor costs corresponding to each of the four labor categories: overtime production workers, non-overtime production workers, overtime non-production workers, and non-overtime, non-production workers. These imputations necessarily aggregate to the observed totals reported by BLS for production and non-production workers, and hence the totals for manufacturing as a whole.[2]

Aggregate earnings Y_{jt} and earnings per worker y_{jt} for each of the four worker types are directly obtained from

$$\begin{aligned} Y_{jt} &= y_{jt}E_{jt}, \text{where} \\ y_{jt} &= W_{jt}\left[h^* + \lambda\left(h_{jt} - h^*\right)\right], j = 1, 3 \\ &= W_{jt}h_{jt}, j = 2, 4 \end{aligned}$$

or in terms of logs

$$\begin{aligned} ln(Y_{jt}) &= ln(y_{jt}) + ln(E_{jt}) \\ ln(y_{jt}) &= ln(W_{jt}) + ln\left\{\left[h^* + \lambda\left(h_{jt} - h^*\right)\right]\right\}, j = 1, 3 \\ &= ln(W_{jt}) + ln(h_{jt}), j = 2, 4. \end{aligned}$$

Table 1 provides an overview of the data. The overall percentage of workers who work overtime averages 33%. About 38% of production workers work overtime, while only 23% of non-production workers work overtime. The data show that the average straight-time hourly wage of production workers is about half that of non-production workers. Among production workers, overtime employees receive a 6% higher straight-time hourly wage than that of non-overtime workers. This is consistent with the notion that overtime workers are more skilled on average than non-overtime workers. On the other hand among non-production workers, overtime employees earn a straight-time hourly wage that is 60% of that earned by the non-overtime employees. This would suggest that for non-production workers, the non-overtime workers are employed in the more skilled occupations.

[2] Additional details on variable construction are provided in an appendix available upon request to the authors.

B. Model Estimation

For purposes of estimation and ease of expression, we introduce the simplyfing variable definitions and expressions given below.

$$Z_{1t} \equiv ln\left(\frac{P_t}{W_{1t}}\right),\ Z_{2t} \equiv ln\left(\frac{W_{1t}}{V_{2t}}\right),\ Z_{3t} \equiv ln\left(\frac{W_{1t}}{W_{3t}}\right),\ Z_{4t} \equiv ln\left(\frac{W_{1t}}{V_{4t}}\right),\ Z_{5t} \equiv ln\left(\frac{V_{2t}}{W_{2t}}\right),$$
$$Z_{6t} \equiv ln\left(\frac{V_{4t}}{W_{4t}}\right),\ Z_{7t} \equiv ln\left(\frac{W_{1t}}{r_t}\right),\ Z_{8t} \equiv ln\left[(1-\lambda)\,h^* + \frac{V_{1t}}{W_{1t}}\right],\ Z_{9t} \equiv ln\left[(1-\lambda)\,h^* + \frac{V_{3t}}{W_{3t}}\right].$$

A convenient way to express the (log) weekly hours demand functions is shown below.

$$\tau_{1t} = ln\left[\theta_8 + \theta_1 - (1 + \theta_2 + \theta_3 + \theta_4 + \theta_7)\right] - ln(-\theta_8) + \epsilon_{h1t},$$

$$\tau_{2t} = ln(\theta_5) - ln(\theta_2 - \theta_5) + \epsilon_{h2t},$$

$$\tau_{3t} = ln(\theta_3 + \theta_9) - ln(-\theta_9) + \epsilon_{h3t},$$

$$\tau_{4t} = ln(\theta_6) - ln(\theta_4 - \theta_6) + \epsilon_{h4t},$$

where

$$\tau_{1t} \equiv ln(h_{1t}) - ln\left[(1-\lambda)\,h^* + \frac{V_{1t}}{W_{1t}}\right] + ln(\lambda)$$
$$\tau_{2t} \equiv ln(h_{2t}) - ln\left(\frac{V_{2t}}{W_{2t}}\right),$$
$$\tau_{3t} \equiv ln(h_{3t}) - ln\left[(1-\lambda)\,h^* + \frac{V_{3t}}{W_{3t}}\right] + ln(\lambda),$$
$$\tau_{4t} \equiv ln(h_{4t}) - ln\left(\frac{V_{4t}}{W_{4t}}\right).$$

Given the time series nature of the data, we conducted the Phillips-Perron test for unit roots. We were unable to reject the null hypothesis of unit roots for the weekly hours demand variables τ_{1t} and τ_{2t}. Since the stochastic equations for these variables consist of constant terms plus an error process, first differencing eliminates the constants so that there is nothing to estimate. Unrestricted single equation Prais-Winsten regressions reveal evidence of first-order serial correlation in the log employment equations as well as the equations for τ_{3t} and

τ_{4t}. In the cases of the τ_{3t} and τ_{4t} hours equations, joint estimation of the model would involve estimating only serial correlation coefficients and constant terms without restrictions.[3] Since this does not really add much, we also drop these equations.

Our strategy is to jointly estimate the employment demand functions and the first-order serial correlation coefficients ($\rho_j, j = 1, ..., 4$) using nonlinear, seemingly unrelated regression (NLSUR) with cross-equation restrictions on the nonconstant term variables. Initial estimation of the model yielded estimates of the first-order serial correlation coefficients for $ln(E_{2t})$ and $ln(E_{3t})$ that were very nearly the same and estimates of the serial correlation coefficients for $ln(E_{1t})$ and $ln(E_{4t})$ that were quite different from one another and quite different from the estimates for $ln(E_{2t})$ and $ln(E_{3t})$. Consequently, we imposed the restriction $\rho_2 = \rho_3 = \rho$ while allowing for separate estimates of ρ_1 and ρ_4.

The empirical model is specified as

$$\begin{aligned}
ln(E_{1t}) =& \theta_{01\rho} + \rho_1 ln(E_{1t-1}) \\
&+ \sum_{m=1}^{12} \left\{ b_{1m} \left[tM_{mt} - \rho_1 (t-1) M_{mt-1} \right] + b_{2m} \left[t^2 M_{mt} - \rho_1 (t-1)^2 M_{mt-1} \right] \right\} \\
&+ \theta_1 \left(Z_{1t} - \rho_1 Z_{1t-1} \right) + \theta_2 \left(Z_{2t} - \rho_1 Z_{2t-1} \right) + \theta_3 \left(Z_{3t} - \rho_1 Z_{3t-1} \right) \\
&+ \theta_4 \left(Z_{4t} - \rho_1 Z_{4t-1} \right) + \theta_5 \left(Z_{5t} - \rho_1 Z_{5t-1} \right) + \theta_6 \left(Z_{6t} - \rho_1 Z_{6t-1} \right) \\
&+ \theta_7 \left(Z_{7t} - \rho_1 Z_{7t-1} \right) + (\theta_8 - 1) \left(Z_{8t} - \rho_1 Z_{8t-1} \right) + \theta_9 \left(Z_{9t} - \rho_1 Z_{9t-1} \right) + \varepsilon_{1t} \\
ln(E_{2t}) =& \theta_{02\rho} + \rho ln(E_{2t-1}) \\
&+ \sum_{m=1}^{12} \left\{ b_{1m} \left[tM_{mt} - \rho (t-1) M_{mt-1} \right] + b_{2m} \left[t^2 M_{mt} - \rho (t-1)^2 M_{mt-1} \right] \right\} \\
&+ \theta_1 \left(Z_{1t} - \rho Z_{1t-1} \right) + (\theta_2 + 1) \left(Z_{2t} - \rho Z_{2t-1} \right) + \theta_3 \left(Z_{3t} - \rho Z_{3t-1} \right) \\
&+ \theta_4 \left(Z_{4t} - \rho Z_{4t-1} \right) + \theta_5 \left(Z_{5t} - \rho Z_{5t-1} \right) + \theta_6 \left(Z_{6t} - \rho Z_{6t-1} \right) + \theta_7 \left(Z_{7t} - \rho Z_{7t-1} \right) \\
&+ \theta_8 \left(Z_{8t} - \rho Z_{8t-1} \right) + \theta_9 \left(Z_{9t} - \rho Z_{9t-1} \right) + \varepsilon_{2t}
\end{aligned}$$

[3]Convergence problems prevented us from imposing restrictions on the constant terms.

$$
\begin{aligned}
ln(E_{3t}) =& \theta_{03\rho} + \rho ln(E_{3t-1}) \\
& + \sum_{m=1}^{12} \left\{ b_{1m} \left[tM_{mt} - \rho(t-1)M_{mt-1} \right] + b_{2m} \left[t^2 M_{mt} - \rho(t-1)^2 M_{mt-1} \right] \right\} \\
& + \theta_1 \left(Z_{1t} - \rho Z_{1t-1} \right) + \theta_2 \left(Z_{2t} - \rho Z_{2t-1} \right) + (\theta_3 + 1) \left(Z_{3t} - \rho Z_{3t-1} \right) \\
& + \theta_4 \left(Z_{4t} - \rho Z_{4t-1} \right) + \theta_5 \left(Z_{5t} - \rho Z_{5t-1} \right) + \theta_6 \left(Z_{6t} - \rho Z_{6t-1} \right) + \theta_7 \left(Z_{7t} - \rho Z_{7t-1} \right) \\
& + \theta_8 \left(Z_{8t} - \rho Z_{8t-1} \right) + (\theta_9 - 1) \left(Z_{9t} - \rho Z_{9t-1} \right) + \varepsilon_{3t} \\
ln(E_{4t}) =& \theta_{04\rho} + \rho_4 ln(E_{4t-1}) \\
& + \sum_{m=1}^{12} \left\{ b_{1m} \left[tM_{mt} - \rho_4(t-1)M_{mt-1} \right] + b_{2m} \left[t^2 M_{mt} - \rho_4(t-1)^2 M_{mt-1} \right] \right\} \\
& + \theta_1 \left(Z_{1t} - \rho_4 Z_{1t-1} \right) + \theta_2 \left(Z_{2t} - \rho_4 Z_{2t-1} \right) + \theta_3 \left(Z_{3t} - \rho_4 Z_{3t-1} \right) \\
& + (\theta_4 + 1) \left(Z_{4t} - \rho_4 Z_{4t-1} \right) + \theta_5 \left(Z_{5t} - \rho_4 Z_{5t-1} \right) + \theta_6 \left(Z_{6t} - \rho_4 Z_{6t-1} \right) \\
& + \theta_7 \left(Z_{7t} - \rho_4 Z_{7t-1} \right) + \theta_8 \left(Z_{8t} - \rho_4 Z_{8t-1} \right) + \theta_9 \left(Z_{9t} - \rho_4 Z_{9t-1} \right) + \varepsilon_{4t}.
\end{aligned}
$$

where $\theta_{01\rho} = (1-\rho_1)\theta_{01}, \theta_{02\rho} = (1-\rho)\theta_{02}, \theta_{03\rho} = (1-\rho)\theta_{03}, \theta_{04\rho} = (1-\rho_4)\theta_{04}$.

The estimated model is reported in Table 2. Although all but two of the estimated parameters are statistically significant, the implied estimates of the structural Cobb-Douglas production function parameters were not always of the theoretically correct signs or magnitudes. Nevertheless, the cross-equation restrictions on the θ and ρ parameters afford parsimony in model specification and ensure internal consistency in predicting employment demand among the 4 labor inputs and capital.

Neutral technological change monthly growth rates for the employment and nonlabor inputs are estimated from

$$\hat{g}_{mt} = \hat{b}_{1m} + 2\hat{b}_{2m}t, m = 1, ..., 12.$$

We find that the neutral growth rates were increasing over the entire period of our data (2006m3-2018m9); however, these growth rates were negative until September 2014 and then turned positive starting in October 2014. Comparisons of growth rates between months is complicated by the fact that these comparisons are affected by the period (t) at which they are evaluated. For ease of comparison, we evaluate the growth rate for each month of the year at the average period t over the span of October 2014 to September 2018. The mean period is 127.5 (mid September 2016). The annualized growth rates were highest in the months of December, January, and February (1.5% to 1.6%) and the lowest in August and September (1.1%).

V. Policy Simulations

The policy simulations described below represent the short-run effects of the counterfactual policy changes for one month at a time. For each month we consider the economic effects of a policy if the policy were in effect for that month. By averaging these effects over all months, we obtain a sense of the central tendency for each counterfactual policy.

Because elements of the theoretical constant terms in the log employment equations involve logs of parameters that were estimated to be negative, we are unable to infer policy impacts on (log) employment levels. However, first-differencing nets out the constant terms. Consequently, we confine our evaluation of overtime policy effects to the monthly growth rates of employment, workweek hours, and earnings. These growth rates are obtained from first-differencing the estimated log employment equations associated with each policy scenario.

For our baseline (control solution) values we use the actual historical growth rates of the variables of interest. This strategy necessitates estimation of the residuals from the predicted historical growth rates. These residuals are then added to the estimated growth rates under the policy regimes to form our final estimate of the growth rates under the counterfactual policy. These in turn are compared against the historical growth rates to obtain the effects of the counterfactual policies on the growth rates of employment, hours, and earnings. Applying the efficiency conditions (3) and (4), we can express the historical employment growth rates as functions of the predicted historical growth rates for the reference input E_1:

$$
\begin{aligned}
\Delta ln(E_{1t}) = & \sum_{m=1}^{12} \left\{ \hat{b}_{1m} \left[Mm_t t - (t-1) Mm_{t-1} \right] + \hat{b}_{2m} \left[Mm_t t^2 - Mm_{t-1}(t-1)^2 \right] \right\} \\
& + \hat{\theta}_1 \Delta Z_{1t} + \hat{\theta}_2 \Delta Z_{2t} + \hat{\theta}_3 \Delta Z_{3t} + \hat{\theta}_4 \Delta Z_{4t} + \hat{\theta}_5 \Delta Z_{5t} + \hat{\theta}_6 \Delta Z_{6t} + \hat{\theta}_7 \Delta Z_{7t} \\
& + (\hat{\theta}_8 - 1) \Delta Z_{8t} + \hat{\theta}_9 \Delta ln(h_{3t}) + \hat{\varepsilon}_{1t} \\
\Delta ln(E_{2t}) = & \Delta Z_{2t} + \Delta Z_{8t} + \Delta ln(E_{1t}) + \hat{\epsilon}_{2t} \\
\Delta ln(E_{3t}) = & \Delta Z_{3t} + \Delta Z_{8t} - \Delta ln(h_{3t}) + \hat{\epsilon}_{3t} \\
\Delta ln(E_{4t}) = & \Delta Z_{4t} + \Delta Z_{8t} + \Delta ln(E_{1t}) + \hat{\epsilon}_{4t} \\
\Delta ln(K_t) = & \Delta Z_{7t} + \Delta Z_{8t} + \Delta ln(E_{1t}),
\end{aligned}
$$

where $\Delta ln(h_{3t})$ replaces ΔZ_{9t} for simulation purposes on account that ΔZ_{9t} yields implausibly large estimates of $\Delta ln(h_{3t})$.[4] The residuals $\hat{\epsilon}_{jt}, j = 2, 3, 4$ are implicitly defined above as the employment demand functions for these labor categories were not originally estimated as first-differences. Also, there is no residual for the nonlabor input K_t since its corresponding demand function is simply inferred from the estimated parameters of the employment demand functions.

In the case of workweek hours, we also use the historical growth rates $(\Delta ln(h_{jt}), j = 1, ..., 4.)$ for the baseline (control) solution. For the total hours worked by each category of labor H_{jt}, we construct $\Delta ln(H_{jt}) = \Delta ln(h_{jt}) + \Delta ln(E_{jt}), j = 1, ..., 4.$

The historical growth rates for earnings are determined as shown below:

$$
\begin{aligned}
\Delta ln(y_{jt}) = & \Delta ln(W_{jt}) + \Delta ln \left\{ \left[h^* + \lambda \left(h_{jt} - h^* \right) \right] \right\}, j = 1, 3 \\
= & \Delta ln(W_{jt}) + \Delta ln(h_{jt}), j = 2, 4
\end{aligned}
$$

[4]Historically, the values of $\frac{V_{3t}}{W_{3t}}$ were relatively small which give rise to implausibly large policy changes in Z_{9t} and ΔZ_{9t}.

$$\Delta ln(Y_{jt}) = \Delta ln(y_{jt}) + \Delta ln(E_{jt}), j = 1, ..., 4.$$

Counterfactual monthly growth rates under the policy (p) are denoted by $\Delta ln(K_t^p), \Delta ln(E_{jt}^p), \Delta ln(Y_{jt}^p), \Delta ln(y_{jt}^p), \Delta ln(h_{jt}^p), \Delta ln(H_{jt}^p) \quad \text{for} \quad j = 1, ..., 4.$[5]

Let Δ^p be the policy operator such that for a variable X_t, $\Delta^p(\Delta X_t) = \Delta X_t^p - \Delta X_t$. The simulated percentage point (ppt) policy effects on monthly growth rates are computed as

$$\begin{aligned}
\Delta^p \left[\Delta ln(E_{jt})\right] =& \Delta ln(E_{jt}^p) - \Delta ln(E_{jt}), j = 1, ..., 4 \\
\Delta^p \left[\Delta ln(K_t)\right] =& \Delta ln(K_t^p) - \Delta ln(K_t), \\
\Delta^p \left[\Delta ln(h_{jt})\right] =& \Delta ln(h_{jt}^p) - \Delta ln(h_{jt}), j = 1, ..., 4 \\
\Delta^p \left[\Delta ln(H_{jt})\right] =& \Delta^p \left[\Delta ln(h_{jt})\right] + \Delta^p \left[\Delta ln(E_{jt})\right], j = 1, ..., 4 \\
\Delta^p \left[\Delta ln(y_{jt})\right] =& \Delta ln(y_{jt}^p) - \Delta ln(y_{jt}), j = 1, ..., 4 \\
\Delta^p \left[\Delta ln(Y_{jt})\right] =& \Delta^p \left[\Delta ln(y_{jt})\right] + \Delta^p \left[\Delta ln(E_{jt})\right], j = 1, ..., 4
\end{aligned}$$

A. Overtime premium

Consider an increase in the mandated overtime premium from $\lambda = 1.5$ to $\lambda^p = 2.0$. For the overtime labor inputs, it is the case that $(1 - \lambda^p) h^* + \frac{V_{jt}}{W_{jt}} < 0 \quad \forall t$. This condition implies that overtime hours would be completely eliminated by an increase in the overtime premium to double-time. Since the lower bound condition $\frac{V_j}{W_j} < \left(\frac{\alpha_j}{\beta_j} - 1\right) h^*$ for the standard workweek is unchanged, the former overtime workers would now have their hours reduced to the standard workweek, i.e. $h_{jt}^{(\lambda_p)} = h^* = 40, j = 1, 3$. By the same token, the absence of a change in the lower bound condition for the standard workweek implies that there would be no change in the weekly hours of the non-overtime work force, i.e. $h_{jt}^{(\lambda_p)} = h_{jt}, j = 2, 4$.

[5]The expressions for calculating the counterfactual growth rates of the outcome variables under the two policies considered are provided in an appendix available upon request to the authors.

For purposes of deriving the overtime premium policy change on employment and earnings growth, the weekly hours for each category of worker are now treated as parametric in the production function: $Q = Ae^{f(M,t)}E_1^{\alpha_1}E_2^{\alpha_2}E_3^{\alpha_3}E_4^{\alpha_4}(h^*)^{(\beta_1+\beta_3)}h_2^{\beta_2}h_4^{\beta_4}K^{\gamma}$.

Input-specific policy effects are obtained by weighting the initial simulated outcomes by the corresponding baseline input employment shares. These weighted measures are aggregated to obtain industry-wide policy effects. If we let Δ^{λ_p} denote the overtime premium policy change operator and j index the employment input, the simulated percentage point growth rate effects of the counterfactual overtime premium policy change are determined according to

Inputs

$$\Delta^{\lambda_p}\left[\Delta ln(E_j)\right] = T^{-1}\sum_{t=1}^{T}\left(\frac{E_{jt}}{E_t}\right)\left[\Delta ln(E_{jt}^{(\lambda_p)}) - \Delta ln(E_{jt})\right], j = 1, ..., 4$$

$$\Delta^{\lambda_p}\left[\Delta ln(E)\right] = \sum_{j=1}^{4}\Delta^{\lambda_p}\left[\Delta ln(E_j)\right]$$

$$\Delta^{\lambda_p}\left[\Delta ln(K)\right] = T^{-1}\sum_{t=1}^{T}\left[\Delta ln(K_t^{(\lambda_p)}) - \Delta ln(K_t)\right]$$

$$\Delta^{\lambda_p}\left[\Delta ln(h_j)\right] = T^{-1}\sum_{t=1}^{T}\left(\frac{E_{jt}}{E_t}\right)\left[\Delta ln(h_{jt}^{(\lambda_p)}) - \Delta ln(h_{jt})\right], j = 1, ..., 4$$

$$\Delta^{\lambda_p}\left[\Delta ln(h)\right] = \sum_{j=1}^{4}\Delta^{\lambda_p}\left[\Delta ln(h_j)\right]$$

$$\Delta^{\lambda_p}\left[\Delta ln(H_j)\right] = \Delta^{\lambda_p}\left[\Delta ln(h_j)\right] + \Delta^{\lambda_p}\left[\Delta ln(E_j)\right], j = 1, ..., 4$$

$$\Delta^{\lambda_p}\left[\Delta ln(H)\right] = \sum_{j=1}^{4}\Delta^{\lambda_p}\left[\Delta ln(H_j)\right]$$

Earnings

$$\Delta^{\lambda_p}\left[\Delta ln(y_j)\right] = T^{-1}\sum_{t=1}^{T}\left(\frac{E_{jt}}{E_t}\right)\left[\Delta ln(y_{jt}^{(\lambda_p)}) - \Delta ln(y_{jt})\right], j = 1, ..., 4$$

$$\Delta^{\lambda_p}\left[\Delta ln(y)\right] = \sum_{j=1}^{4}\Delta^{\lambda_p}\left[\Delta ln(y_j)\right]$$

$$\Delta^{\lambda_p}\left[\Delta ln(Y_j)\right] = \Delta^{\lambda_p}\left[\Delta ln(y_j)\right] + \Delta^{\lambda_p}\left[\Delta ln(E_j)\right], j = 1, ..., 4$$

$$\Delta^{\lambda_p}\left[\Delta ln(Y)\right] = \sum_{j=1}^{4}\Delta^{\lambda_p}\left[\Delta ln(Y_j)\right].$$

B. Standard Workweek

We now consider a reduction in the standard workweek from $h^* = 40$ to $h^{*p} = 35$. For overtime workers, the theoretical model requires $\frac{V_j}{W_j} > \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^{*p}$ for $j = 1, 3$. Given that $\left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^* > \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^{*p}$, it follows that $\frac{V_j}{W_j} > \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^{*p}$. Therefore, employments E_1 and E_3 will remain in the overtime regime, i.e. $h_1^{*p}, h_3^{*p} > h^{*p}$. In the case of those working less than the standard workweek, the theoretical model requires $\frac{V_j}{W_j} < \left(\frac{\alpha_j}{\beta_j} - 1\right)h^*$ for $j = 2, 4$. For those non-overtime workers whose hours were originally less than h^{*p}, it is the case that $\frac{V_j}{W_j} < \left(\frac{\alpha_j}{\beta_j} - 1\right)h^{*p}$. This follows from the fact that $0 < h_j = \frac{\beta_j}{\alpha_j - \beta_j}\frac{V_j}{W_j} < h^{*p}$. Therefore, $h_j^{*p} = h_j$. On the other hand for those non-overtime workers for whom $h^{*p} \leq h_j < h^*$, it is theoretically possible for $h_j^{*p} \geq h^{*p}$ so that in some periods these workers could become overtime workers. It turns out that in the periods for which the original hours exceeded h^{*p}, the excess hours over the new standard workweek averaged less than 1 hour. It is therefore most probable that $\left(\frac{\alpha_j}{\beta_j} - 1\right)h^{*p} \leq \frac{V_j}{W_j} \leq \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^{*p} < \left(\frac{\alpha_j}{\beta_j}\lambda - 1\right)h^*$. Accordingly, we assume that the modest excess hours for originally non-overtime workers are reduced to the new standard workweek, i.e. $h_j^{*p} = h^*$.

We now have 4 distinct regimes under the new standard workweek.

R1: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h^{*p}_{4t} = h^{*p}$

R2: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h^{*p}, h^{*p}_{4t} = h_{4t} < h^{*p}$

R3: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h_{2t} < h^{*p}, h^{*p}_{4t} = h^{*p}$

R4: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h_{2t} < h^{*p}, h^{*p}_{4t} = h_{4t} < h^{*p}$.

In the case of the workweek policy simulations, the input-specific policy outcomes are weighted measures obtained by weighting the initial simulated policy growth rate effects by a) the corresponding input baseline employment shares, and b) the corresponding time-series sample shares for the four distinct workweek regimes. These weighted measures are aggregated to obtain industry-wide policy effects. The subscripts j and k respectively denote employment inputs and workweek regimes. If we let Δ^{*p} represent the policy change operator for the counterfactual change in the standard workweek, the simulated monthly growth rate effects of the counterfactual policy change in the standard workweek are determined according to

Inputs

$$\Delta^{*p}\left[\Delta ln(E_{jk})\right] = T^{-1}\sum_{t\in R_k}\left(\frac{E_{jt}}{E_t}\right)\left[\Delta ln(E^{*p}_{jt}) - \Delta ln(E_{jt})\right], j,k = 1,...,4$$

$$\Delta^{*p}\left[\Delta ln(E_j)\right] = \sum_{k=1}^{4}\Delta^{*p}\left[\Delta ln(E_{jk})\right], j = 1,...,4$$

$$\Delta^{*p}\left[\Delta ln(E_k)\right] = \sum_{j=1}^{4}\Delta^{*p}\left[\Delta ln(E_{jk})\right], k = 1,...,4$$

$$\Delta^{*p}\left[\Delta ln(E)\right] = \sum_{j=1}^{4}\Delta^{*p}\left[\Delta ln(E_j)\right] = \sum_{k=1}^{4}\Delta^{*p}\left[\Delta ln(E_k)\right]$$

$$\Delta^{*p}\left[\Delta ln(K_k)\right] = T^{-1}\sum_{t\in R_k}\left[\Delta ln(K^{*p}_t) - \Delta ln(K_t)\right], k = 1,...,4$$

$$\Delta^{*p}\left[\Delta ln(K)\right] = \sum_{k=1}^{4}\Delta^{*p}\left[\Delta ln(K_k)\right]$$

$$\Delta^{*p}\left[\Delta ln(h_{jk})\right] = T^{-1}\sum_{t\in R_k}\left(\frac{E_{jt}}{E_t}\right)\left[\Delta ln(h^{*p}_{jt}) - \Delta ln(h_{jt})\right], j,k = 1,...,4$$

$$\Delta^{*p}\left[\Delta ln(h_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(h_{jk})\right], j = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(h_k)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(h_{jk})\right], k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(h)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(h_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(h_k)\right]$$

$$\Delta^{*p}\left[\Delta ln(H_{jk})\right] = \Delta^{*p}\left[\Delta ln(h_{jk})\right] + \Delta^{*p}\left[\Delta ln(E_{jk})\right], j, k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(H_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(H_{jk})\right], j = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(H_k)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(H_{jk})\right], k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(H)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(H_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(H_k)\right]$$

Earnings

$$\Delta^{*p}\left[\Delta ln(y_{jk})\right] = T^{-1} \sum_{t \in R_k} \left(\frac{E_{jt}}{E_t}\right) \left[\Delta ln(y_{jt}^{*p}) - \Delta ln(y_{jt})\right], j, k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(y_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(y_{jk})\right], j = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(y_k)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(y_{jk})\right], k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(y)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(y_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(y_k)\right]$$

$$\Delta^{*p}\left[\Delta ln(Y_{jk})\right] = \Delta^{*p}\left[\Delta ln(y_{jk})\right] + \Delta^{*p}\left[\Delta ln(E_{jk})\right], j, k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(Y_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(Y_{jk})\right], j = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(Y_k)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(Y_{jk})\right], k = 1, ..., 4$$

$$\Delta^{*p}\left[\Delta ln(Y)\right] = \sum_{j=1}^{4} \Delta^{*p}\left[\Delta ln(Y_j)\right] = \sum_{k=1}^{4} \Delta^{*p}\left[\Delta ln(Y_k)\right].$$

In principle we could estimate the policy changes in log hours for overtime workers as

$$\Delta^{*p} ln(h_{1t}) = \Delta^{*p} Z_{8t} = ln\left[(1-\lambda)\, h^{*p} + \frac{V_{1t}}{W_{1t}}\right] - ln\left[(1-\lambda)\, h^{*} + \frac{V_{1t}}{W_{1t}}\right]$$

$$\Delta^{*p} ln(h_{3t}) = \Delta^{*p} Z_{9t} = ln\left[(1-\lambda)\, h^{*p} + \frac{V_{3t}}{W_{3t}}\right] - ln\left[(1-\lambda)\, h^{*} + \frac{V_{3t}}{W_{3t}}\right].$$

Although $\Delta^{*p} Z_{8t}$ yielded quite plausible values for $\Delta^{*p} h_{1t}$, relatively low values of $\frac{V_{3t}}{W_{3t}}$ yielded implausibly large magnitudes in absolute value for $\Delta^{*p} Z_{9t}$, and by implication for $\Delta^{*p} h_{3t}$. Consequently, we restrict the policy change in h_{3t} to be the same as the change in h_{1t}, i.e.,

$$\begin{aligned} h^{*p}_{3t} - h_{3t} =& h^{*p}_{1t} - h_{1t} \\ =& h_{1t}\left[exp(\Delta^{*p} Z_{8t}) - 1\right], \end{aligned}$$

where $h^{*p}_{1t} = h_{1t} exp\left(\Delta^{*p} Z_{8t}\right) > 0$. Therefore, $h^{*p}_{3t} = h_{3t} + h_{1t}\left[exp(\Delta^{*p} Z_{8t}) - 1\right] > 0$.[6]

Simulated values of the workweek hours for overtime workers are invariant across regimes:

$$\begin{aligned} ln(h^{*p}_{1t}) &= ln(h_{1t}) + \Delta^{*p} Z_{8t} \\ ln(h^{*p}_{3t}) &= ln\left\{h_{3t} + h_{1t}\left[exp(\Delta^{*p} Z_{8t}) - 1\right]\right\}. \end{aligned}$$

It follows that the simulated growth rates for the workweek hours for overtime workers are also invariant across regimes:

$$\begin{aligned} \Delta ln(h^{*p}_{1t}) &= \Delta ln(h_{1t}) + \Delta(\Delta^{*p} Z_{8t}) \\ \Delta ln(h^{*p}_{3t}) &= \Delta ln\left\{h_{3t} + h_{1t}\left[exp(\Delta^{*p} Z_{8t}) - 1\right]\right\}. \end{aligned}$$

Below we specify the theoretical production function under each Regime.

[6] Positive simulated values of h^{*p}_{3t} require that $h_{3t} + h^{*p}_{1t} > h_{1t}$ which is always satisfied in the data.

Regime 1

For Regime 1, the non-overtime workers would now be working the new standard workweek: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h^{*p}_{4t} = h^{*p}$. Accordingly, the production function is re-specified to incorporate the new regime:

$$Q^{*p} = Ae^{f(M,t)}(E^{*p}_1)^{\alpha_1}(E^{*p}_2)^{\alpha_2}(E^{*p}_3)^{\alpha_3}(E^{*p}_4)^{\alpha_4}(h^{*p}_1)^{\beta_1}(h^{*p}_3)^{\beta_3}(h^{*p})^{(\beta_2+\beta_4)}(K^{*p})^{\gamma}.$$

Regime 2

Under Regime 2, non-overtime production workers would be working the new standard workweek and non-overtime, non-production workers would be working their original weekly hours: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h^{*p}, h^{*p}_{4t} = h_{4t} < h^{*p}$. Under these circumstances the production function is given by

$$Q^{*p} = Ae^{f(M,t)}(E^{*p}_1)^{\alpha_1}(E^{*p}_2)^{\alpha_2}(E^{*p}_3)^{\alpha_3}(E^{*p}_4)^{\alpha_4}(h^{*p}_1)^{\beta_1}(h^{*p}_3)^{\beta_3}(h^{*p})^{\beta_2}h_4^{\beta_4}(K^{*p})^{\gamma}.$$

Regime 3

For Regime 3, non-overtime production workers would now be working their original hours and non-overtime, non-production workers would be working the new standard workweek: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h_{2t} < h^{*p}, h^{*p}_{4t} = h^{*p}$. Accordingly, the production function becomes

$$Q^{*p} = Ae^{f(M,t)}(E^{*p}_1)^{\alpha_1}(E^{*p}_2)^{\alpha_2}(E^{*p}_3)^{\alpha_3}(E^{*p}_4)^{\alpha_4}(h^{*p}_1)^{\beta_1}(h^{*p}_3)^{\beta_3}h_2^{\beta_2}(h^{*p})^{\beta_4}(K^{*p})^{\gamma}.$$

Regime 4

The Regime 4 scenario is the same as the historical period with E_1 and E_3 employment incurring overtime, and E_2 and E_4 employment working less than the standard workweek: $h^{*p}_{1t}, h^{*p}_{3t} > h^{*p}; h^{*p}_{2t} = h_{2t} < h^{*p}, h^{*p}_{4t} = h_{4t} < h^{*p}$. Therefore, the Regime 4 simulated growth rates under the counterfactual standard workweek are easily calculated because the input demand functions remain unchanged.

C. Simulation Results

The simulated monthly growth rate effects of raising the overtime premium to double-time and reducing the standard workweek to 35 hours are reported on an annualized percentage point basis in Table 3.

Overtime premium simulation results

Raising the overtime premium to double-time would modestly lower the growth rate of manufacturing employment (-0.50ppt). The weighted effects are negligible for overtime workers but are more substantial and offsetting among non-overtime workers (-0.81ppt for production workers and 0.44ppt for non-production workers). The overtime policy would reduce the growth rate of nonlabor input usage by a modest amount (-0.21ppt).

The weighted effects of the policy are negligible to nonexistent on the growth rates of the workweeks among the four labor inputs. Consequently, the growth rate effects of imposing double-time are negligible for the industry-wide average workweek and correspondingly on earnings per worker. Hence, the policy effects on total hours employed and total earnings mirror the policy effects on employment growth rates - a modest growth rate reduction for total hours worked in the industry (-0.49ppt) and total earnings (-0.51ppt) with large offsetting growth rate effects among production and non-production, non-overtime workers.

Standard workweek simulation results

Four distinct workweek regimes emerge from the counterfactual standard workweek policy. Because the overtime work force would continue working overtime under the new 35 hour standard workweek, the four workweek regimes are distinguished only by whether the non-overtime production and non-production workers would be working less than the new standard workweek or would be working exactly the new standard workweek. Within each regime, industry-wide growth rate effects for the labor inputs are obtained as employment weighted averages. Industry-wide policy effects also incorporate the implicit weighting associated with the proportion of time periods occupied by each regime.

Regime 1 was by far the most extensive regime, encompassing 114 months (76% of the monthly periods in the data). Non-overtime workers would be working the new reduced standard workweek. Lowering the standard workweek to 35 hours would significantly raise the manufacturing employment growth rate by 2.14ppt during these periods. This increase is almost entirely driven by the increased employment growth rates associated with non-overtime production workers (0.72ppt) and non-overtime, non-production workers (1.18ppt).

During the periods encompassed by Regime 1, the shortened standard workweek would significantly reduce the growth rate of the nonlabor inputs (-2.1ppt).

Workweek monthly growth rates would be uniformly lower for all labor inputs, especially among the non-overtime workers. The average workweek across all workers would be subject to a reduced growth rate of -0.74ppt. The monthly growth rate in total hours worked in Regime 1 would increase across all four labor inputs with an overall increase of 1.40ppt. This pattern is driven by the employment growth rate increases in Regime 1 induced by reducing the standard workweek. These results suggest that employment is being substituted for capital and hours, especially among non-overtime, non-production workers.

The implications of a reduced standard workweek for growth rates of worker earnings in Regime 1 mirror the policy effects on growth rates of hours worked. The growth rate in average earnings per worker would fall by -0.77ppt while the growth rate in aggregate earnings would rise by 1.37ppt.

The remaining work week regimes collectively account for 24% of the sample. We briefly summarize the findings. Regime 2 corresponds to the periods (12%) in which non-overtime production workers would work the new lower standard workweek while non-overtime, non-production workers would continue to work their pre-policy schedule of less than 35 hours per week. With the reduced standard workweek, simulated industry-employment growth rates would decline significantly for the non-overtime workers culminating in an overall drop in the total employment growth rate by -4.19ppt. Simultaneously, there would be a 0.88ppt increase in the monthly growth rate of the nonlabor inputs. There would be small reductions in the growth rates of the workweek and earnings per capita. On the other hand there would be substantial reductions in the growth rates of overall aggregate hours (-4.35ppt) and total industry earnings (-4.36ppt).

With a few exceptions, the overall standard workweek policy impacts for Regimes 3 and 4 are negligible. In Regime 3, the reduction in the standard workweek would increase the growth rate of the nonlabor inputs by a sizable 1.26ppt. In Regime 4 the workweek policy effects on growth rates would be around 0.47ppt for total employment, aggregate work hours, and aggregate earnings.

We now examine the average growth rate effects of a shortened standard workweek on industry-wide outcomes across all regimes combined. In the case of total industry employment, the reduced standard workweek would lead to a -1.54ppt reduction in the employment growth rate. Among the four labor inputs, non-overtime production employment (E_2) has the largest impact with a weighted employment growth rate effect of -1.46ppt. Regimes 1 and 2 have the largest impacts on overall employment growth of 2.14ppt and -4.19ppt, respectively.

Reducing the standard workweek would leave the manufacturing capital growth rate virtually unchanged (0.08ppt). Regimes 1 and 3 exhibit the largest impacts on the total nonlabor input growth rate, -2.07ppt and 1.26ppt, respectively. Combined with the 0.88ppt growth rate increase for nonlabor inputs in Regime 3 and no effect in Regime 4 (0.01ppt), the regime-specific growth rate effects are mainly offsetting.

The workweek policy effect on the growth rate in the average workweek in manufacturing is a -1.04ppt reduction. This stems largely from the growth rate reductions in the average workweeks of non-overtime production workers (-0.41ppt) and non-overtime, non-production workers (-0.62ppt). With a weighted average growth rate reduction in the average workweek of -0.74ppt, Regime 1 accounts for by far the largest portion of the industry-wide growth rate reduction in the average workweek.

The simulation results predict that the growth rate in aggregate hours worked in manufacturing would be lowered in the amount of -2.58ppt if the standard workweek were reduced to

35 hours. Among the separate labor inputs, the weighted policy growth rate reduction among non-overtime production workers (-1.46ppt) has the largest single effect on the industry-wide employment growth rate. Regimes 1 and 2 have the largest impacts on the overall aggregate hours growth rate with 1.40ppt and -4.35ppt, respectively.

In terms of the standard workweek policy effects on per capita and total earnings growth rates, these effects mirror almost exactly the negative growth rate effects associated with the workweek and total hours worked, respectively.

V. Discussion

The original data disaggregates manufacturing employment into production and non-production employment. Total overtime hours, average weekly overtime hours, and average hourly wages are reported separately for these broad categories of manufacturing employment. Clearly, in any given month not all workers are working overtime. Rather than assume that every worker works the average overtime, we preferred to develop a methodology for partitioning employment into overtime and non-overtime employment within the broad categories of production and non-production workers. This partitioning affords a richer set of substitution possibilities when considering four categories of labor inputs as opposed to two categories.

Focus on the counterfactual policy effects on monthly growth rates rather than on (log) employment and (log) capital levels was necessitated by the general absence of identification of the employment and capital constant term relationships from the estimated model.

Our study of the potential effects of increasing the overtime premium and decreasing the standard workweek is confined to U.S. Manufacturing. Our approach analyzes only the demand side of the input market under long-run profit maximization and is loosely inspired by a theoretical Cobb-Douglas production function. This approach afforded us a parsimonious specification for the empirical model that could parametrically incorporate the historical overtime premium and standard workweek. Our simulation exercises relied on an estimated model in which straight-time hourly wages, overhead labor costs, and output price were treated as exogenous.

VI. Summary and Conclusions

While policy effects were heterogeneous across the separate labor input categories, the simulation results suggest that raising the overtime premium to double-time would have a modest negative impact on employment and aggregate earnings growth, -0.50ppt and -0.51ppt. Overall, the growth rate effects on weekly hours and earnings per worker were negligible.

Our simulation results predict that lowering the standard workweek from 40 hours to 35 hours would reduce the industry-wide employment growth rate by a substantial -1.54ppt. Overall, the growth rate effects for capital, aggregate hours, total earnings, and weekly hours and earnings per worker would also be substantially negative.

What the overtime premium and standard workweek policies have in common is that both are predicted to negatively impact the industry-wide growth rates of employment and aggregate hours and have either negative or no effect on the growth rates of capital and the workweek. This suggests that output growth would also be reduced under both policies.

It is difficult to say what the long term effects of these policy changes would be because there would inevitably be changes in output prices and input prices as well as the distinct possibility of the introduction of non-neutral technological change induced by the policy changes. Arguably, it is the anticipated short-run effects that might be most salient in the political arena.

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Table 1: Summary Statistics

Variable	**Mean**	**Std Dev**	**Min**	**Max**
Total Production Employment, thousands	8807.81	645.65	7938.00	10258.00
E_1 (Overtime)	3336.09	438.43	2079.84	4613.97
E_2 (Non-Overtime)	5471.72	379.74	4800.01	6445.25
Total Non-production Employment	3663.98	159.88	3402.00	4045.00
E_3 (Overtime)	821.56	149.93	382.08	1262.68
E_4 (Non-Overtime)	2842.42	212.06	2425.06	3644.92
Straight-Time Hourly Wage of Production Workers	18.17	1.19	15.84	20.50
W_1 (Overtime)	18.65	2.58	9.69	22.88
W_2 (Non-Overtime)	17.59	1.21	15.36	22.26
Straight-Time Hourly Wage of Non-production Workers	36.48	2.72	31.43	41.27
W_3 (Overtime)	26.46	5.86	8.54	36.28
W_4 (Non-Overtime)	43.65	5.51	33.81	56.37
Weekly Hours of Production Workers	44.12	0.48	42.30	44.90
h_1 (Overtime)	50.90	0.92	47.98	53.91
h_2 (Non-Overtime)	35.67	0.54	33.82	36.63
Weekly Hours of Non-production Workers	38.88	1.24	36.43	40.00
h_3 (Overtime)	44.55	0.44	43.38	45.79
h_4 (Non-Overtime)	35.96	0.90	32.73	37.90
Weekly Overhead Labor Cost per Worker)	453.91	48.14	387.20	538.40
V_1 (Overtime, Prod.)	672.08	125.72	296.40	862.44
V_2 (Non-Overtime, Prod.)	309.00	26.51	262.83	370.42
V_3 (Overtime, Non-prod.)	570.55	135.64	177.88	804.02
V_4 (Non-Overtime, Non-prod.)	434.77	55.91	316.40	554.25
Share of Workers Working Overtime	0.33	0.02	0.22	0.37

Table 2: Results of NLSUR Estimation

Parameter	**Estimate**	**Std Errors**
b_{1_1}	-0.00501***	(0.00041)
b_{2_1}	0.00002***	(0.00000)
b_{1_2}	-0.00493***	(0.00041)
b_{2_2}	0.00002***	(0.00000)
b_{1_3}	-0.00487***	(0.00040)
b_{2_3}	0.00002***	(0.00000)
b_{1_4}	-0.00477***	(0.00040)
b_{2_4}	0.00002***	(0.00000)
b_{1_5}	-0.00465***	(0.00040)
b_{2_5}	0.00002***	(0.00000)
b_{1_6}	-0.00447***	(0.00039)
b_{2_6}	0.00002***	(0.00000)
b_{1_7}	-0.00448***	(0.00040)
b_{2_7}	0.00002***	(0.00000)
b_{1_8}	-0.00434***	(0.00039)
b_{2_8}	0.00002***	(0.00000)
b_{1_9}	-0.00449***	(0.00039)
b_{2_9}	0.00002***	(0.00000)
b_{1_10}	-0.00461***	(0.00039)
b_{2_10}	0.00002***	(0.00000)
b_{1_11}	-0.00460***	(0.00039)
b_{2_11}	0.00002***	(0.00000)
b_{1_12}	-0.00485***	(0.00040)
b_{2_12}	0.00002***	(0.00000)
θ_1	0.0117	(0.02986)
θ_2	-0.57710***	(0.01729)
θ_3	0.01989***	(0.00524)
θ_4	-0.12816***	(0.01564)
θ_5	0.00363	(0.03453)
θ_6	0.05126*	(0.02384)
θ_7	0.04936**	(0.01820)
θ_8	0.31086***	(0.01702)
θ_9	0.03390***	(0.00238)
ρ_E	0.89468***	(0.01386)
ρ_{E_1}	0.97422***	(0.01298)
ρ_{E_4}	0.84591***	(0.02729)
$\theta_{01\rho}$	0.20689*	(0.10411)
$\theta_{02\rho}$	0.90230***	(0.11696)
$\theta_{03\rho}$	0.44119***	(0.07398)
$\theta_{04\rho}$	1.27067***	(0.22908)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Simulated Growth Rate Effects
(Annualized Percent Rates)

Variable	**Overtime Premium**	**Standard Workweek**				
		Overall	**Regime 1**	**Regime 2**	**Regime 3**	**Regime 4**
$\Delta^{\lambda p}[\Delta ln(E_{1t})]$	-0.0187	-0.1098	0.1322	-0.0514	-0.1842	-0.0064
$\Delta^{\lambda p}[\Delta ln(E_{2t})]$	-0.8147	-1.4610	0.7156	-2.4134	-0.0487	0.2855
$\Delta^{\lambda p}[\Delta ln(E_{3t})]$	-0.1115	-0.2583	0.1123	-0.4164	0.0067	0.0390
$\Delta^{\lambda p}[\Delta ln(E_{4t})]$	0.4434	0.2913	1.1822	-1.3108	0.2759	0.1441
$\Delta^{\lambda p}[\Delta ln(E_{t})]$	-0.5014	-1.5378	2.1423	-4.1920	0.0497	0.4622
$\Delta^{\lambda p}[\Delta ln(K_{t})]$	-0.2060	0.0756	-2.0724	0.8832	1.2558	0.0090
$\Delta^{\lambda p}[\Delta ln(h_{1t})]$	0.0116	-0.0121	-0.0762	0.0195	0.0345	0.0102
$\Delta^{\lambda p}[\Delta ln(h_{2t})]$	0.0000	-0.4086	-0.2170	-0.1916	0.0000	0.0000
$\Delta^{\lambda p}[\Delta ln(h_{3t})]$	-0.0044	-0.0007	-0.0185	0.0114	0.0061	0.0004
$\Delta^{\lambda p}[\Delta ln(h_{4t})]$	0.0000	-0.6218	-0.4283	0.0000	-0.1935	0.0000
$\Delta^{\lambda p}[\Delta ln(h_{t})]$	0.0072	-1.0431	-0.7400	-0.1607	-0.1529	0.0105
$\Delta^{\lambda p}[\Delta ln(H_{1t})]$	-0.0070	-0.1219	0.0560	-0.0319	-0.1497	0.0038
$\Delta^{\lambda p}[\Delta ln(H_{2t})]$	-0.8147	-1.8696	0.4986	-2.6050	-0.0487	0.2855
$\Delta^{\lambda p}[\Delta ln(H_{3t})]$	-0.1159	-0.2590	0.0938	-0.4050	0.0128	0.0393
$\Delta^{\lambda p}[\Delta ln(H_{4t})]$	0.4434	-0.3304	0.7539	-1.3108	0.0824	0.1441
$\Delta^{\lambda p}[\Delta ln(H_{t})]$	-0.4942	-2.5809	1.4022	-4.3527	-0.1031	0.4727
$\Delta^{\lambda p}[\Delta ln(y_{1t})]$	0.0151	-0.0126	-0.1006	0.0131	0.0596	0.0153
$\Delta^{\lambda p}[\Delta ln(y_{2t})]$	0.0000	-0.4086	-0.2170	-0.1916	0.0000	0.0000
$\Delta^{\lambda p}[\Delta ln(y_{3t})]$	-0.0256	-0.0033	-0.0263	0.0121	0.0102	0.0007
$\Delta^{\lambda p}[\Delta ln(y_{4t})]$	0.0000	-0.6218	-0.4283	0.0000	-0.1935	0.0000
$\Delta^{\lambda p}[\Delta ln(y_{t})]$	-0.0104	-1.0463	-0.7722	-0.1664	-0.1237	0.0161
$\Delta^{\lambda p}[\Delta ln(Y_{1t})]$	-0.0035	-0.1224	0.0316	-0.0383	-0.1246	0.0090
$\Delta^{\lambda p}[\Delta ln(Y_{2t})]$	-0.8147	-1.8696	0.4986	-2.6050	-0.0487	0.2855
$\Delta^{\lambda p}[\Delta ln(Y_{3t})]$	-0.1370	-0.2616	0.0860	-0.4043	0.0169	0.0397
$\Delta^{\lambda p}[\Delta ln(Y_{4t})]$	0.4434	-0.3304	0.7539	-1.3108	0.0824	0.1441
$\Delta^{\lambda p}[\Delta ln(Y_{t})]$	-0.5119	-2.5841	1.3701	-4.3584	-0.0740	0.4783
Number of Months	150	150	114	18	12	6
Proportion of the Sample	100%	100%	76%	12%	8%	4%