WORKER CLASSIFICATION AND WAGES: LABOR MARKET PRICING DURING RECESSION IN AMERICA

A Thesis
submitted to the Faculty of the
Graduate School of Arts and Sciences
of Georgetown University
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ABSTRACT

Do economic recessions have to lead to unemployment? As workers in the 21st century increasingly opt for more flexible working arrangements, the nature of labor markets will change. The internet has allowed an explosion in peer-to-peer market transactions, in labor markets this phenomenon is often called the sharing economy. Academic literature suggests that workers in the sharing economy face different incentives than do traditionally employed workers. If these differences are significant, sharing economy labor markets are likely to respond differently to recessions than traditional labor markets. This paper examines the empirical relationship between unemployment-producing wage rigidity, as a proxy for these differences, and contract employment by occupation, as a measure of sharing economy workforce. A weak negative relationship is found between the two variables of interest among occupations in the United States from 2006-2012, this finding is supported by a review of theoretical literature. Further empirical research could examine a wider scope of occupations or broader range of years. Assuming the empirical findings are generalizable, a theoretical model is developed to show how contract-based labor market bifurcation would reduce employment losses following economic shocks and reduce the responsiveness of employment to government spending.
With special thanks to Dr. George Akerlof for his personal contributions to the development of this paper.

- A.J. Downs
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Introduction

When running for President in 1980, Ronald Reagan famously described economic downturns thusly:

“Recession is when your neighbor loses his job. Depression is when you lose yours.”

While economists often talk about aggregate growth, prices and interest rates to describe recessions, Reagan’s summation mirrors how most Americans understand a struggling economy - through the lens of employment. Economic theory since the time of David Hume has attributed increasing unemployment during recessions to a property of price adjustment called “rigidity,” or more commonly “stickiness.” But labor markets of the 21st century are undergoing a fundamental transformation that began before the turn of the millennium and could redefine the relationship between price shocks and employment.

Students first studying economics often have price rigidity explained in terms of the cost to a restaurant of reprinting their menu - the cost of adjusting prices can outweigh the increased revenue from offering the market clearing price, therefore producers may delay price changes in times of economic shock. Wage rigidity is a special case of price rigidity observed in labor markets - when the real wage falls, the cost of renegotiating nominal wages is often greater to firms than the cost of letting employees go or greater to workers than the cost of leaving the job. Some of the most common justifications for nominal wage rigidity include union negotiations, efficiency wage theory, wage insurance theory, and morale-reduction theory. All of these theories are developed assuming that employers have long term relationships with their employees.

This phenomenon is particularly relevant during a recession. When market clearing prices should fall, but price rigidity prevents this, the effects of a recession can be aggravated - particularly in labor markets, where a surplus of workers will arise from wages being set above the optimal level. Data from the U.S.
Bureau of Labor Statistics (BLS) show that during the Great Recession, the number of unemployed persons in the United States nearly doubled and the consumer price index fell by nearly 5 percent - despite this, nominal wages continued to grow. These observations, taken together, point to the existence of downward wage rigidity in the aggregate U.S. labor market.

While academic study of the exact causes of wage rigidity has yielded much debate, there is far less debate over the broad policy implications of its existence. In particular, the effectiveness of monetary policy in reducing unemployment during recessions has been widely accepted as dependent on labor market wage frictions. One of the most widely accepted theories amongst monetary policy-makers attributes wage rigidity to the long-term contracts between employees and employers that can only be adjusted on a fixed schedule and therefore are insensitive to economic shocks.

While official unemployment numbers have returned to pre-recession levels, BLS reports that the employment to population ratio has hardly increased. Part of this can be attributed to an aging population and more young adults attending post-secondary programs. However, when college age and those in or nearing retirement are removed, the employment to population ratio is still nearly two percentage points below pre-recession levels. This amounts to over two million more working age Americans out of work than before the Great Recession.

Given the unprecedented expansionary monetary policy since the Great Recession, this labor market surplus seems hard to explain with the wage rigidity theories of Fischer (1977) and Taylor (1998). If price setting in labor markets has substantially changed in the 21st century, this question may become easier to answer.
In the past two decades, the U.S. labor market has seen significant growth in self-employment and contract work, measured in Internal Revenue Service (IRS) 1099 forms. In the case of these independent contractors, there is no such employee-employer relationship that would create these frictions. As the number of independent contractors as an adjusted percentage of the total labor force has grown substantially, many policymakers have discussed the need for adjustments to regulatory and tax policy, but few have discussed the implications for monetary policy. If it is the case that wages become more flexible when work contracts are between independent parties, rather than an employer and employee, than a reevaluation of traditional monetary policy assumptions could be in order. This paper will examine the impact on wage rigidity of self-employed persons in an occupation and seek to define a model for flexible wage setting.

**Background**

*Price rigidity*

Instantaneous price adjustment following an economic shock provides the basis for nearly all classical economic models. Without adjustment to market clearing prices, demand and supply do not equilibrate and market inefficiencies arise. If prices fail to adjust, positive demand shocks and negative supply shocks lead to shortages, while negative demand shocks and positive supply shocks lead to surpluses.

Empirical research over the past few decades has shown that aggregate price levels in the economies of the United States and the European Union, among others, do not adjust very quickly which leads many economists to conclude that prices suffer from rigidity. More recent literature, however, has suggested that counting the days in between price changes does not accurately measure price rigidity and that micro-economic analysis shows that individual markets often face price movements very different from the movements seen in others.
The causes of price rigidity are most often attributed to the administrative expense of physically changing company materials that display a price, so-called “menu costs.” Theoretically, the increase of internet-based commerce this century should make prices more flexible, however, early research on the subject - using time-based measures of rigidity - found little evidence to support the “menu cost” theory. As more data has been collected on online commerce, new research has found that price rigidity varies significantly across markets, but Gorodnichenko & Talavera (2016) find evidence that “online prices are much more flexible than prices in regular stores.”

Wage rigidity

Wage rigidity is a special case of price rigidity, but its implications are broad. Labor markets fall into disequilibrium during times of economic distress, in part, because the market price for labor does not fall, which creates a surplus of labor supply. As explained by Hall, Sims, Solow & Gordon (1975), the high unemployment rates observed during recessions are attributable to the failure of wages to fall when demand for workers falls.

As conceived by Fischer (1977), Taylor (1998), and many others, downward wage rigidity is largely a symptom of employment contract structures and management relationships. While legally binding employment contracts may prevent wage reductions, downward price rigidity in labor markets could also be the result of psychological barriers resulting from the employee-employer relationship.

Many measurements of wage rigidity have been developed. This paper will use the measurement developed by the International Wage Flexibility Project (IWFP) to examine wage rigidity across
occupations as it has been found to most accurately reduce measurement error and requires the most plausible assumptions of the counterfactual.

Academic research of e-commerce pricing supports the theoretical claim that prices become more flexible when transaction costs of price changes decrease, but little research has been done to examine the implications of reducing friction in labor markets.

_Employment contracts_

Labor market transactions have historically been very different from the transactions occurring in goods and services markets because of the nature of the product. In contrast to one-time purchases of clothing or plumbing services, the purchase of labor traditionally involves a long-term commitment to the worker. This contract structure creates frictions to price adjustment that do not exist in other markets, for both the consumer (employer) and supplier (employee).

Independent contractors, those who offer their labor on an individual transaction basis, rather than the bundled contract seen in other labor transactions, may not face many of the frictions that arise from the employee-employer relationship. The U.S. Internal Revenue Service (IRS) records independent contractors with the 1099-MISC form, and analysis of IRS data show that these forms have been issued more frequently over the past decade.

The shift in the labor market towards less restrictive contracts has been attributed by some to the recent growth of the peer-to-peer transactions - like Uber, eBay, and TaskRabbit - however the trend began well before many web applications facilitating this type of work existed. About 15 percent of the
self-employed are engaging in the so-called “sharing economy” and this percentage is projected to grow rapidly in the near future.

The policy implications of wage rigidity are broad. Corrective monetary policy as an influencer of unemployment is largely dependent on the inability of labor market prices to adjust quickly. If wage contracts could be adjusted along with inflation expectations, the labor market impact of monetary expansion would be distortionary, rather than corrective.

**Literature Review**

Stone (2012), Koopman & Dourado (2015), and Grose & Kallerman (2016) have all empirically shown that, partly as a result of digital technology, the number of self-employed workers in the U.S. labor force has been growing relative to traditional employees. Sherk (2016) suggests that the growth found in these studies will continue, and at a higher rate, given the advantages for both consumers and workers created by digitally-facilitated contract labor. Similarly, Zulliger (2015) finds that 85 percent of new jobs since 2005 have been for self-employed, contingent workers, a percentage that has been growing rapidly since 1995. Holden & Wulfsberg (2014) find that downward nominal wage rigidity has been falling since the 1970s, while Elsby, Shin & Molon (2016) found that downward nominal wage rigidity was less binding in Great Recession than previous studies. This literature review will demonstrate how existing research implies a correlation between rate of self-employment and wage rigidity, but leaves a gap to be filled by the explicit examination of this paper.

The literature offers many possible explanations of wage rigidity in the case of traditional employees, which will be examined in detail shortly. However, independent contractors are substantially different across many of the factors that have been found to correlate to wage rigidity in traditional wage contracts.
Research has found that the U.S. labor market is becoming increasingly a spot employment market, and the growth in recent years of self-employment has been significantly attributed to advances in digital technology. Chakrabarti & Scholnick (2001) and Bergen, Kauffman & Lee (2004) find prices as rigid in online transactions as in brick and mortar, but more recent research by Gorodnichenko & Talavera (2016) has found the opposite. This difference may be due to structural frictions in firms to price adjustments that have declined as digitally-facilitated sales have become ubiquitous. If we assume that prices are less rigid given digitally reduced transaction costs, it is reasonable to assume that digitally contracted wages will also be subject to lower transaction costs and therefore be less rigid.

Academic literature on the subject of wage rigidity has generally concluded two things: aggregate nominal downward wage rigidity is observable and its causes most likely lie in the implicit and explicit relationship between firms and workers - the latter can be examined along legal, institutional, reputational, and psychological grounds.

The existence of downward nominal wage rigidity has been thoroughly empirically established in European economies by Fehr & Goette (2005), Dickens, et al. (2007), Holden (2008) and Babecky, et al. (2010). However, as argued by Gordon (1996) and Mankiw (1996), the high growth of the U.S. economy in the second half of the 20th century limited the ability of researchers to study the subject in America. Study of the impact of wage flexibility on employment during the high inflation, low employment period of the 1970s by Bell & Freeman (1985) found no correlation. Recent empirical analysis of U.S. labor markets by Daly, Hobijn & Lucking (2012), Nakamura & Steinsson (2013) and Fallick, Lettau & Wascher (2016) has shown that downward nominal wage rigidity did exist following the Great Recession.
The existence of downward nominal wage rigidity has been shown to create a long-run negative correlation between unemployment and inflation by Tobin (1972), Hall (1975) and Blanchard & Gali (2010), this finding informed the corrective monetary theories developed by Fischer (1977) and Taylor (1998). Akerlof, Dickens & Perry (1996) show that downward nominal wage rigidity leads to inefficient employment outcomes, particularly in times of economic shock. Frazee (1997) found that firms report choosing independent contract labor over traditional labor, in part, to facilitate flexible staffing responses to changing market conditions.

While the exact causes of wage rigidity are far from settled, much of the literature points to the costs of breaking long-term employment contracts and the monopoly power of unions in wage negotiation. Holden (2002) predicts that wages bound by collective bargaining agreements are more subject to downward nominal wage rigidity and that mutual consent negotiation creates friction in wage setting - predictions that are supported by empirical evidence in developed economies. Franz & Pfeiffer (2006) use survey data to show that wage flexibility, particularly in low-skilled labor markets, is significantly reduced by union contracts. Similarly, Oswald (1993) finds that union contracts can cause “extreme wage rigidity” and that recession-induced layoffs, rather than wage adjustment, are a result of union bargaining. On the other hand, Du Caju, Fuss & Wintr (2012) find that wages are less rigid when set in a decentralized fashion - that is at the individual or firm level, compared to the industry level.

As noted by Mayer (2004), “self-employed workers are, in effect, both employer and employee and, therefore, do not unionize.” As both employer and employee, the self-employed similarly don’t face frictions described by Holden (2002) in wage negotiations. Additionally, the Allan & Sienko (1998) finding that self-employed contractors report higher levels of motivation from “completion of a whole and
identifiable piece[s] of work” could imply that wage setting is related to individual tasks, in a decentralized manner.

Another common claim in the literature for the cause of wage rigidity is legal and institutional barriers. While past research, notably Stiglitz (1992) and Pissarides (2001), suggest that institutional rigidities are a phenomena separate from wage rigidities, Guerrazzi & Mecchari (2012) find that the two exhibit “complementarity” and cannot be disentangled. Three commonly studied instances of institutional rigidities, referenced in Guerrazzi & Mecchari (2012), are outlined by Pierrard & Sneessens (2004) as “unemployment benefits, employment protections, and...minimum wages.” All three rigidities are shown to have negative relationships with employment - particularly among low-skill labor - which Pierrard & Sneessens (2004) argue is due to the increased wage and search frictions. Akerlof & Miyazaki (1980) argue that firms are bound by their so-called “wage bill” - the total cost of labor - and do not set wages based on changes in output demand, which contributes to wage rigidity. However, the empirical findings of Frazee (1997) that firms report making employment contract decisions based on economic conditions raise questions about the practical validity of the wage bill argument.

The self-employed are not subject to these institutionally imposed wage rigidities in the United States. First of all, self-employed Americans are not eligible for federal unemployment insurance. Secondly, many legal employment protections - stylized by Pierrard & Sneessens (2004) as a “firing tax” - in the United States do not apply to the self-employed because the federal government does not define this group as “employees.” Finally, the case of minimum wage is less simple to dismiss, however data from the BLS show that the lowest average wage among hundreds of occupations surveyed was $9.09 per hour, this is roughly 25 percent higher than the federal minimum wage of $7.25 per hour. From this, it is reasonable to infer that the aggregate market clearing price of labor is above the federal wage floor,
therefore minimizing the distortionary effects of the policy. If the wage bill argument holds, it is unlikely that wage rigidity would be affected by changes in labor arrangements.

The recent body of literature has largely focused on the psychological causes of wage frictions, often broadly called implicit wage contracts. Ito (1982), building on the work of by Baily (1974), Gordon (1974) and Azariadis (1975), described economic modeling of implicit contracts as “a general equilibrium model with incomplete information,” and suggests that parties enter into implicit contracts to protect against risk, enforce unpriceable social norms, and develop interpersonal reputational assets like trust. Fehr & Falk (1999) and Agell & Lundborg (2003) find empirical evidence that wage rigidity is related to job protection concerns of workers, meaning that workers “underbid” their preferred wage level in contract negotiations to minimize the risk of being laid off and incurring future job search costs. Agell & Lundborg (1995, 2003) and Campbell & Kamlani (1997) find that wage rigidity is related to workers’ perception of wage fairness, relative to other employees within the firm - low-skill workers also are concerned with wage fairness relative to the entire industry - which creates frictions in wage adjustment. Krause & Lubik (2007) argue that wage rigidity is merely a symptom of job search frictions, which are the root cause of labor market failures. Stiglitz (1984) and Bewley (2002) attribute wage rigidity to worker morale, and therefore productivity, concerns of management. Employers report hesitancy to reduce wages for fear workers’ trust in management objectives, and therefore productivity will fall. Fehr & Falk (1999) find that worker effort is positively correlated to wage level, substantiating these employer concerns.

Baker, Gibbons & Murphy (1997) argue that “implicit contracts cannot exist if spot governance offers… [a] sufficiently palatable alternative.” Their analysis defines spot governance of employment as explicit and project-based, which Allan & Sienko (1998) found to be the strengths of self-employed independent
contractors. The explanation by Sherk (2016) of reputational market “governance” in the self-employer based sharing economy is nearly identical to the third-party spot governance defined by Baker, Gibbons & Murphy (1997) - this gives reason to believe that the self-employed are not subject to implicit contract frictions on wages, in general. Specifically, Hall & Krueger (2015) find that search frictions for self-employed workers in the sharing economy are so low that the work can act as a substitute for unemployment insurance, finding that “the flexibility...help[s] smooth the transition to another job.” This implies that self-employed workers would not face the same incentives as traditional workers to risk-adjust wage preferences because they are faced with significantly different implicit and explicit costs of job searching. Segal & Sullivan (1997) found that firms prefer contract labor to prevent morale-reducing employment decisions during economic downturns. This is confirmed by Zimmerman et al. (2013) which outlines how independent contractors are often not fully integrated with traditional employees. Taken with the results of Allan & Sienko (1998) study of the motivations of self-employed compared to traditional employees, it is inferred that group morale changes would be less impactful on the self-employed, even when integrated with traditional employees in a firm.
Hypothesis

Research on the behavior of independent contractors implies that the relationship between labor market buyer and seller is substantially different in the absence of a long term contract. Self-employed workers report different incentives and those who hire the self-employed do not face the same morale concerns as traditional employers.

The literature on wage rigidity suggests that psychological effects resulting from the relationship between employees and employers and, to some degree, the relationships among long-term contracted workers within a firm or industry. Further, the past several years has seen a large rise in self-employed workers engaging in the sharing economy, in which studies have shown the digitally facilitated transactions are less likely to be subject to menu cost rigidity.

While it is the case that the aggregate U.S. labor market appeared to be subject to downward nominal wage rigidity during the Great Recession, the percentage of workers under independent contracts varies across occupations.

Given the literature, there is theoretical reason to believe that labor market pricing for independent contract labor is different from that of traditional labor. Therefore, it is expected that occupational labor markets with a higher percentage of workers classified as self-employed will be subject to less downward nominal wage rigidity than markets with lower percentages of self-employed workers.
Theoretical Framework

While the scope of this paper is only to identify a possible relationship between the composition of labor contracts with nominal wage rigidity across occupations, it is valuable to examine why this would be the case.

Independent contractors make up a small portion of the aggregate U.S. workforce, therefore if there was an impact of overall wage rigidity, it may not be detectable in the aggregate economy. Several occupation markets have the self-employed as a majority of all workers, while others have a portion much smaller than the aggregate economy. As shown by Campbell (1997), and others, nominal wage rigidity varies across occupation.

The theoretical causes for this variation across occupation have been attributed to the relationships between employers and employees - relationships that largely do not exist in independent contract labor arrangements. If wage rigidity exists because workers seek long term insurance and therefore set initial wages below their market clearing level, then workers under short term contracts would not be subject to this. Similarly, the self-employed are not unionized in significant numbers to influence the rigidity of wages. Wage rigidity in traditional employment contracts imposed by employers that is the result of morale concerns also should not exist for independent contractors on short-term, project based contracts.

Some of the causes of wage rigidity noted in the literature will surely exist in the occupations, regardless of the composition of labor contracts. If the same occupations are analyzed across time, the resulting panel data can be used in a fixed effects model, which will isolate the impact of independent contractors on nominal wage rigidity.
As contract labor arrangements permeate the economy, will traditional fiscal and monetary policy tools become less effective?

**Data**

Two datasets are used: Current Population Survey (CPS) conducted by the United States Census Bureau and Employment Projections (EP) as estimated by the United States Bureau of Labor Statistics (BLS) based on their Occupational Employment Statistics (OES) survey. The unit of analysis is occupation-years for the same 821 occupations for the years 2006, 2008, 2010, and 2012. The population of observations is all jobs in the United States, as defined by the Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, for which BLS provides a legend to convert Census occupational codes to match. Occupations not containing information on self employed percentage of workforce for any year will be removed from the panel, leaving 204 occupations in each of the four years.

All of these data were collected by self-reported survey, therefore it is reasonable to expect misreporting. However, as shown by Moore, et al. (2005), response bias for wage and salary information is low. A more serious concern is the possibility of incorrect matching of occupations across coding systems and the underlying imprecision of attempting to clearly define occupations in a survey. This is partly addressed by the design of the survey, in which occupation titles are mostly left very broad. This presents its own problem, however, as too broad a description may pool workers that do not actually compete in the same labor market. Accurate calculations of market-specific price rigidity are obviously dependent on the market in question being properly defined.
The dependent variable, downward nominal wage rigidity, will be calculated from the CPS data, using a modified version of the IWFP formula developed by Dickens, et al. (2006). The IWFP calculation of downward nominal wage rigidity, \( n \), is the following:

- \( N = \frac{F}{F+C} \), where \( F \) is the fraction of workers with nominal wage freezes and \( C \) is the fraction with nominal wage cuts

Using the the IWFP measure, larger the values of \( N \) correspond to more downwardly rigid wages and values close to zero correspond to more downwardly flexible wages.

Since the observations of interest in this paper are occupation-years and not person-years and the available data is not identifiable by individual, downward nominal wage rigidity, \( R \), will be calculated by the following:

- \( R = \frac{M}{M+L} \), where \( M \) is the fraction of workers with wages in year \( t \) that would have fallen in the mid-decile of the occupational wage distribution from year \( t-1 \) and \( L \) is the fraction of workers with wages in year \( t \) that would have fallen below the 45th percentile of the occupational wage distribution from year \( t-1 \)

Similar to the IWFP measure, this modified measure has a lower bound of zero and higher values represent more downwardly rigid wages.

The independent variable of interest for each occupation-year is unincorporated self-employed workers as a percent of total workers in the occupation. BLS does not include incorporated self-employed in their data as they are considered employees of their own firm. Unincorporated self-employed represent a large majority of all self-employed workers, and given the rise of the sharing economy, this group is of particular interest.
Control variables will be year and occupation dummies, to capture the fixed effects across all occupations and all years, respectively. Occupation specific variables that do not vary over time - or are not expected to vary over the short period examined - like unionization rate and industry culture, have been shown to influence downward nominal wage rigidity. Similarly, confounding variables like the federal minimum wage and advances in digital technology, do not vary across occupations. In order to control for these effects, dummy variables for 2008, 2010, and 2012 will be included, as will entity-specific variables for each occupation but Retail Salesperson, as it is the most commonly held occupation in the data and will provide a baseline for analysis. The final control variable will be a measure of occupational demand, as reported in the BLS biennial survey. Real employment growth as a percentage of projected job growth from this data set is used as a proxy for real occupational demand, which undoubtedly has an effect on wages and therefore rigidity and varies across occupation and time.

Empirical Model

Given the panel data and the large number of potentially confounding variables like unionization rate, average wage, worker skill level, size of workforce, industry composition, firm culture and technological proclivity, national and industry specific labor laws, and many aggregate economic conditions, a fixed effects regression model will be used for this analysis.

The first model will use simple OLS regression to examine the relationship between self-employment and downward nominal wage rigidity, while controlling for two variables commonly proposed to impact wage rigidity - unionization rate and median occupational wage.

\[ R^\wedge = B0 + B1*(self-employed \ percentage)_{it} + B2*(union \ rate)_{it} + B3*(industry \ demand)_{it} + Qi + Pt + Eit \]

- \( Qi \) is the time-invariant effects contained in the error
• Pt is the entity-invariant effects contained in the error

• Eit is all error dependent on both time and entity

Next, we will run a time-fixed effect regression model:

$$R^\hat{} = B_0 + B_1 \times (\text{self-employed percentage})_{it} + B_2 \times Q_i + Pt + E_{it}$$

• Here, Qi becomes the occupation dummy variable

Followed by an entity-fixed effect regression model:

$$R^\hat{} = B_0 + B_1 \times (\text{self-employed percentage})_{it} + Q_i + B_2 \times Pt + E_{it}$$

• Here, Pt becomes the year dummy variable

**Regression Results**

After removing missing variables, there are 204 unique occupations in the dataset. The modified measure of wage rigidity spikes significantly during the recession, as is predicted in theory. The aggregate self-employed percentages holds near steady over the course of the series and the inflation-adjusted aggregate annual mean wage increases during 2008 and 2010, closest to the recession. This is likely because of the observed rigidity which would cause higher unemployment, particularly among the least skilled and lowest valued workers, thus pushing up the average wage of the employed. The percent self-employed does not shift meaningfully in the aggregate, however several occupations experienced significant increases, while others experienced a fall. Similarly, the unionization percentage holds steady in the aggregate over the time period in question.

While weak, the correlations observed between rigidity and the independent variables are all statistically significant to the 99 percent confidence level and in the direction predicted by theory. The negative
correlation between percent of self-employed in an occupation and downward wage rigidity shows that occupations in the sample are slightly less likely to experience unemployment due to rigidity during recessions when more workers are under non-traditional contracts. Similarly, the positive correlation between rigidity and unionization confirms the previously identified relationship. Because this relationship exists in the sample and if theory is assumed to hold, it is likely that this sample is subject to the other previously identified influences on rigidity from the literature.

Annual wage is also positively correlated with rigidity, this is supported by the literature as those workers in higher wage occupations are typically higher skilled and therefore more scarce. This scarcity gives the workers price setting power which prevents wage decreases during recession, meaning rigidity.

The data from 2008 and 2010 should yield the most interesting results as rigidity is most likely to be observed during recessions. Variation between these years in key variables is most significant in rigidity, which drops by nearly a quarter, and percentage of self-employed by occupation which increases by almost a full percentage point. This supports the hypothesis that downward nominal wage rigidity falls as percentage of self-employed rises.
Table 1. Aggregate mean values for key variables

<table>
<thead>
<tr>
<th>Year</th>
<th>Rigidity</th>
<th>% self-employed</th>
<th>% unionized</th>
<th>Annual wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0.0797711</td>
<td>13.6848</td>
<td>12.35637</td>
<td>44584.89</td>
</tr>
<tr>
<td>2008</td>
<td>1.013227</td>
<td>12.8201</td>
<td>12.87892</td>
<td>51690.86</td>
</tr>
<tr>
<td>2010</td>
<td>0.0855409</td>
<td>13.7348</td>
<td>12.46961</td>
<td>52450.67</td>
</tr>
<tr>
<td>2012</td>
<td>0.0914333</td>
<td>12.39853</td>
<td>11.91324</td>
<td>48314.98</td>
</tr>
<tr>
<td>Total</td>
<td>0.3174931</td>
<td>13.15956</td>
<td>12.40453</td>
<td>49260.35</td>
</tr>
</tbody>
</table>

Table 2. Sample correlations for key variables

<table>
<thead>
<tr>
<th>Correlation</th>
<th>% self-employed</th>
<th>% unionized</th>
<th>Annual wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigidity</td>
<td>-0.0178</td>
<td>0.0369</td>
<td>0.0491</td>
</tr>
</tbody>
</table>
### Table 3. Simple OLS Regression Results

```
reg rigid pct_se pct_un medwage
```

<table>
<thead>
<tr>
<th>Rigidity</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t</th>
<th>P</th>
<th>95% interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>% self employed</td>
<td>-0.001689</td>
<td>0.000854</td>
<td>-0.20</td>
<td>0.843</td>
<td>(-0.0018451, 0.0015074)</td>
</tr>
<tr>
<td>% unionized</td>
<td>0.0024872</td>
<td>0.0023</td>
<td>1.08</td>
<td>0.280</td>
<td>(-0.0020275, 0.0070019)</td>
</tr>
<tr>
<td>Median wage</td>
<td>7.27e-07</td>
<td>5.09e-07</td>
<td>1.43</td>
<td>0.154</td>
<td>(-2.72e-07, 1.73e-06)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.2530452</td>
<td>0.0450432</td>
<td>5.62</td>
<td>0.000</td>
<td>(0.1646303, 0.3414601)</td>
</tr>
</tbody>
</table>

R squared = 0.0040
Adj. R Sq. = 0.0003

### Table 4. Fixed Effects Regression

```
xtreg rigid pct_se c.year realgr, fe robust
```

<table>
<thead>
<tr>
<th>Rigidity</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t</th>
<th>P</th>
<th>95% interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>% self employed</td>
<td>-0.0113099</td>
<td>0.0043392</td>
<td>-2.61</td>
<td>0.010</td>
<td>(-0.019866, -0.0027543)</td>
</tr>
<tr>
<td>Year</td>
<td>-0.0847493</td>
<td>0.0044152</td>
<td>-19.19</td>
<td>0.000</td>
<td>(-0.0934549, -0.076044)</td>
</tr>
<tr>
<td>Sector demand</td>
<td>-0.0010135</td>
<td>0.000309</td>
<td>-3.28</td>
<td>0.001</td>
<td>(-0.001623, -0.0004043)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.6894621</td>
<td>0.0628196</td>
<td>10.98</td>
<td>0.000</td>
<td>(0.5655995, 0.8133248)</td>
</tr>
</tbody>
</table>

R-squared
within = 0.0763
between = 0.0038
overall = 0.0202
Economic Analysis

This empirical analysis gives evidence to the theoretical claim that contract labor markets experience less wage rigidity than do traditional labor markets. This means that, during a recession, unemployment for non-contract labor occurs because the price earned by the firm falls, but the wage does not - the contract workers face the same goods and services price drop, but don't get fired because their wages fall to clear the market. The implications of this finding can be modeled using standard Keynesian methods. First, consider the following aggregate market function, where aggregate demand, $D_a$, is a function of prices, government spending, and the money supply, and aggregate supply is defined by the sum of production functions for the two parts of the labor market:

1. $D_a (P, G, M) = F(N_n, K_n) + H(N_c, K_c)$

Notwithstanding identity effects that might make a consumer more likely to "look for the union label," the demand side will be indifferent to the goods and services produced by the two components of labor supply. On the supply side, firms choose contract over non-contract laborers in an effort to maintain profitability when prices fall. Assuming a meaningful quality difference between the non-contract and contract labor (reflected in the price of contract and non-contract labor produced goods and services) would break the rationale for firms opting for contract over non-contract labor when prices fall because any significantly lower quality output would not make up for the "savings" of offering a lower wage. Therefore, it is assumed that the marginal product of labor for contract and traditional labor is the same.

Here, the production functions $F$ and $H$ are assumed to be Cobb-Douglas, with identical marginal products of labor at full employment. The wage for non-contract labor, $\bar{w}_n$, is assumed to be rigid and therefore constant, while the wage for contract labor, $w_c$, is flexible and adjusts with price variation. The
variables $N_n$ & $N_c$ represent the supply of non-contract labor and contract labor, respectively, while $K$ is capital used by each type of labor.

2.  $F(N_n, K_n) = A \times N_n^\beta \times K_n^{1-\beta}$

3.  $H(N_c, K_c) = A \times N_c^\beta \times K_c^{1-\beta}$

4.  $F'(N_n) = A\beta \left( \frac{N_n}{K_n} \right)^{\beta-1} = \frac{\overline{w_n}}{P}$

5.  $H'(N_c) = A\beta \left( \frac{N_c}{K_c} \right)^{\beta-1} = \frac{\overline{w_c}}{P}$

Consider a period of full employment in which the market clearing wage prevails and $\overline{w_n}$ is equal to $\overline{w_c}$.

To demonstrate a recession, allow the price level, $P$, to fall in equations 4 and 5. If sticky wages and fixed capital in the short-run, then $N_n$ must fall when prices fall, showing an increase in unemployment for traditional labor markets during recession. In equation 5, the only changed assumption is that wages are flexible, so a fall in prices need not lead to a fall in employment, if the market is competitive, firms are able to find contract workers who will accept a lower wage.

If the contract and non-contract labor produced goods and services face the same supply and demand in a competitive market, firms hiring contract or non-contract labor would face the same price for goods and services. Additionally, if workers from the traditional workforce are able to become contract workers, upon being priced out during a recession, the supply of potential contract labor would rise and spot pricing would allow wages to drop to their market clearing rate. To further illustrate why a recession-induced fall in labor demand would only occur in the market for traditional labor, consider the following aggregate labor demand functions:
If it is the case that wages fall in the contract labor market to maintain the level of employment, while employment falls to maintain the level of wages in the traditional labor market, then equations 6 and 7 can be used to show that a higher value for the ratio of $N_c$ to $N_n$, that is a larger share of employment occurring via the spot market relative to the traditional market, would lead to a smaller increase in unemployment during recession. If contract labor markets indeed face less rigid wages and the share of contract labor continues to rise, unemployment effects of recession would be mitigated by market forces.

Further, consider how government monetary and fiscal policy during recession is meant to prevent a rise in unemployment. Expansionary monetary policy increases nominal aggregate price levels directly by increasing the money supply and increasing inflation, expansionary fiscal policy raises prices by increasing aggregate demand. In both of these cases, equations 6 and 7 show that, like a negative price shock, a positive price shock brought on by government policy would yield less change in employment as the share of contract labor grows.

**Policy Analysis**

The fixed effects model provides a much better picture of the relationship between self-employment and wage rigidity than the simple OLS regression. The latter offers no statistically significant correlations, while the former is significant to at least the 99% level for the variables for self-employment, year, and yearly industry-specific demand. The data tell the same story as the theory discussed earlier. The rigidity
measure used here is bound below by zero and has a maximum in the data at 1.22, therefore the
coefficient on self-employment means that a one percent increase in the share of an occupation employed
by spot contract, we can expect with 99% confidence an very nearly one percent drop in wage rigidity in
the market for that occupation.

These results tell us that a labor market composed entirely of spot contract workers would face very close
to zero wage rigidity during times of economic recession. The low R-squared value leaves room for many
other factors to be considered as influential in determining the rigidity of wages, and, as discussed, many
of these factors have been examined extensively by other papers.

These findings are consistent with the theoretical framework established by previous literature, the
economic model developed by this paper, and the cursory findings from first data analysis. Given the
trend towards more contract employment over the past few decades, and the projected acceleration of the
share of contract employment in the U.S. economy in the coming years, these results could have sweeping
implications.

If the sharing economy does indeed lead to the demise of wage setting frictions, the government will no
longer have a compelling economic case for enacting policy to impact employment. Counter cyclical
monetary policy meant to smooth employment falls during recession will only serve to inflate the
currency if flexible wages in spot employment markets dominate. Further, the model developed in this
paper predicts that fiscal policy will become impotent in the face of “Uber everything.” Programs meant
to smooth job transition frictions caused by wage rigidity will only will increasingly have little effect and,
if funded by deficits, could actually increase unemployment by crowding out private sector job-creating
investments.
Policymakers currently concerned with looming budget crises may relish the opportunity to redirect this money to deficit reduction, while others may lament the loss of control over economic activity. Federal jobs programs designed to serve dual purposes, like infrastructure spending, will become relatively more costly as the benefits of their enactment will be reduced to purposes other than job stimulation. Policymakers could decide that the purpose of these programs is solely for welfare transfers, and shift messaging on existing programs to meet the change.

If the private sector can solve a problem without state resources, government budgets are freed to core competencies more thoroughly or address new issues. A common criticism of the sharing economy is the lack of fringe benefits that have supplanted the wage growth for higher skilled workers over the past several decades - if the sharing economy ends the need for workforce development, some may argue those resources should be used to create welfare transfer programs targeting workers who cannot afford to provide themselves with the types of fringe benefits that are associated with traditional employment, like health care, retirement savings, transportation costs, meals, and so on.

Another argument can be made that the involvement of government in labor markets should end when the private sector has evolved beyond the need for state-provided support. If a program was originally created to address unemployment via policy levers that have been broken off due to cultural and technological change, then that program should end. That money could be removed from government budgets and taxes could be lowered, even targeting a tax cut on the income group most impacted by the policy when it was effective. This line of thinking seems most in line with the economic theory justifying government intervention in labor markets - unemployment is the result of an externality imposed by all of the market-created determinants of wage rigidity. The government taxes labor income to fund, among many
other things, a Pigovian correction to this externality by reducing job loss and wage frictions through fiscal and monetary policy, respectively. Spot employment, facilitated by changing attitudes about work and massive technological advances, is a market response to internalize this externality. Once the externality is gone, government intervention is not welfare increasing and should not be pursued.

**Conclusion**

Wage rigidity is known to cause unemployment during recessions, but has only to this point been examined in the traditional labor market with long term employment contracts assumed. Modern technologies have driven American workers increasingly into more efficient spot labor markets. This shift varies significantly across professions, with contract workers already being the majority in several major fields. The literature consistently gives reason to believe that spot market workers and those who hire them face far different incentives than do non-contract workers, and the commonly cited causes of wage rigidity are nearly all contingent upon a long term employment arrangement. These assumptions do not hold for contract workers, and labor markets with a high percentage of spot workers is shown by this paper to have been less likely to suffer from wage rigidity during the last recession. Economic modeling developed by this paper shows that not only will rigidity induced unemployment be reduced as a larger percentage of workers are under spot contracts relative to traditional employment, but the potential to decrease unemployment with government spending is diminished by a growing sharing economy. Policymakers could be encouraged that the market may solve the problem of unemployment without government direction and use the newly available resources on other priorities, like reducing the deficit, cutting taxes, or expanding welfare programs.
References


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