Resurrecting the Role of the 
Product Market Wedge in Recessions

Mark Bils, University of Rochester and NBER
Pete Klenow, Stanford University and NBER
Ben Malin, Federal Reserve Bank of Minneapolis

Federal Reserve Bank of San Francisco
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1Views expressed here are those of the authors and do not necessarily reflect the views of the Federal Reserve System.
Hours worked appear to be inefficiently low in recessions.

- Labor Wedge is high: $\mu \equiv \frac{mpn}{mrs}$
Decomposing the Labor Wedge

Hours worked appear to be inefficiently low in recessions.

- Labor Wedge is high: $\mu \equiv \frac{mpn}{mrs}$

Labor Wedge is the product of:

1. Labor Market Wedge: $\mu^w \equiv \frac{w/p}{mrs}$

2. Product Market Wedge: $\mu^p \equiv \frac{mpn}{w/p} \equiv \frac{p}{mc}$
The Standard Decomposition Approach

Uses (aggregate) wage data

- Measure of Price of Labor: \( \frac{w}{p} = \text{average wage} \)
- Key Assumption: all workers employed in spot markets.
- Conclusion: \( \mu w \) accounts for nearly all cyclicality of \( \mu \).

BUT, conclusion depends critically on wage measure used.

- Alternative theories emphasize durable nature of employment and wage smoothing.

\[ \frac{w}{p} \text{ can be much more procyclical using other wage measures.} \]
The Standard Decomposition Approach

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- Key Assumption: all workers employed in spot markets.
- Conclusion: $\mu^w$ accounts for nearly all cyclicality of $\mu$.

BUT, conclusion depends critically on wage measure used.

- Alternative theories emphasize durable nature of employment and wage smoothing.
- $w/p$ can be much more procyclical using other wage measures.
Decomposes Labor Wedge $\mu$ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$
Decomposes Labor Wedge $\mu$ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$

Consider 2 alternative inputs:
This Paper

Decomposes Labor Wedge $\mu$ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$

Consider 2 alternative inputs:

1. Self-Employed

   $\frac{p}{mc} = \frac{p}{p \cdot mrs/mpn} = \frac{mpn}{mrs}$,
Decomposes Labor Wedge $\mu$ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$

Consider 2 alternative inputs:

1. Self-Employed
   
   $\frac{p}{mc} = \frac{p}{p \cdot mrs / mpn} = \frac{mpn}{mrs}$, or $\mu^p = \mu$
Decomposes Labor Wedge $\mu$ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$

Consider 2 alternative inputs:

1. **Self-Employed**
   
   $\frac{p}{mc} = \frac{p}{p \cdot mrs/mpn} = \frac{mpn}{mrs}$, or $\mu^p = \mu$

2. **Intermediate Inputs**
   
   $\frac{p}{mc} = \frac{p}{p_m/mpm}$
Our point estimates: $\mu^P$ accounts for the cyclical variation in $\mu$

- Self-Employed $\mu$ is just as cyclical as all-worker $\mu$
- Intermediate Inputs $\mu^P$ is just as cyclical as $\mu$

Thus, countercyclical price markups deserve a central place in business cycle research, alongside labor market frictions.
Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data
Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1 Self-Employed
2 Intermediate Inputs
\[ \ln(\mu_t) \equiv \ln(\text{mpn}_t) - \ln(\text{mrs}_t) \]

\[ = \ln\left(\frac{y_t}{n_t}\right) - \left[\frac{1}{\sigma}\ln(c_t) + \frac{1}{\eta}\ln(h_t)\right] \]

- \(h_t = \) hours per worker
- \(\eta = 0.5\)
- \(\sigma = 0.5\)
Cyclicality of Intensive-Margin Labor Wedge

\[
ln(\mu_t) = \alpha + \beta \cdot ln(cyc_t) + \epsilon_t
\]

<table>
<thead>
<tr>
<th>Elasticity wrt GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor Wedge</td>
</tr>
<tr>
<td>Labor Productivity</td>
</tr>
<tr>
<td>Cons per capita</td>
</tr>
<tr>
<td>Hours per worker</td>
</tr>
</tbody>
</table>

- Quarterly data, 1987-2012 with \( \sigma = 0.5, \eta = 0.5 \)
Decomposing the Wedge

Decomposition:

\[ \ln(\mu_t) = \left[ \ln \left( \frac{y_t}{n_t} \right) - \ln \left( \frac{w_t}{\rho_t} \right) \right] + \left[ \ln \left( \frac{w_t}{\rho_t} \right) - \frac{1}{\sigma} \ln(c_t) - \frac{1}{\eta} \ln(h_t) \right] \]

\[ = \ln(\mu_t^p) + \ln(\mu_t^w) \]

Cyclicality:

\[ \ln(\mu_t) = \alpha + \beta \cdot \ln(cyc_t) + \epsilon_t \]
\[ \ln(\mu_t^p) = \alpha^p + \beta^p \cdot \ln(cyc_t) + \epsilon_t \]
\[ \ln(\mu_t^w) = \alpha^w + \beta^w \cdot \ln(cyc_t) + \epsilon_t \]

Note: \( \beta = \beta^p + \beta^w \).
## Elasticity wrt GDP

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu$</td>
<td>-1.91 (0.13)</td>
</tr>
<tr>
<td>$\mu^p \left( \frac{w}{p} = AHE \right)$</td>
<td>-0.04 (0.13)</td>
</tr>
</tbody>
</table>
Elasticity wrt GDP

\[
\begin{align*}
\mu & \quad -1.91 \ (0.13) \\
\mu^p \left( \frac{w}{p} = AHE \right) & \quad -0.04 \ (0.13) \\
\mu^p \left( \frac{w}{p} = NH \right) & \quad -0.70 \ (0.16) \\
\mu^p \left( \frac{w}{p} = UC \right) & \quad -1.89 \ (0.21)
\end{align*}
\]
Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs
Approach 1: Self-Employed

Idea:

- Compare the wedge for the self-employed ($\mu_{se}$) to the wedge for all workers ($\mu$).

- Assuming $\mu_{se} = \mu_{se}^p = \mu^p$, comparison yields $\mu^p$ vs. $\mu$.

Focus on intensive (hours) margin

- Extensive movements could reflect costs of starting business
Data on Self-Employed

Hours and Earnings: March CPS

- “Self-employed”
  - Primary job is (nonag) self-employment.
  - 95% of earnings from primary job

- Trim sample to deal with top and bottom coding
- Hours: usual weekly hours (also total annual hours)
- Earnings from primary job
- Examine year-to-year changes for “matched” workers

Consumption: Consumer Expenditure Survey

- Construct relative consumption of self-employed
<table>
<thead>
<tr>
<th>Elasticity wrt</th>
<th>Labor Wedge (1)</th>
<th>Labor Wedge (2)</th>
<th>Labor Wedge (3)</th>
<th>Labor Wedge (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>-1.87 (0.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours</td>
<td>All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPN</td>
<td>Agg. $y/n$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>NIPA PCE</td>
<td></td>
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### Cyclicality of the Labor Wedge: All vs. Self-Employed

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<tr>
<td></td>
<td>(1)</td>
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<tr>
<td>Real GDP</td>
<td>-1.87 (0.10)</td>
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</tbody>
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<p>| Hours               | All         | SE          |
|---------------------|-------------|
| MPN                 | Agg. $y/n$  | Agg. $y/n$  |
| Consumption         | NIPA PCE    | NIPA PCE    |</p>
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<tr>
<td>MPN</td>
<td>Agg. $y/n$</td>
<td>Agg. $y/n$</td>
<td>SE earn/hr</td>
</tr>
<tr>
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<th>(4)</th>
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<tbody>
<tr>
<td>Real GDP</td>
<td>-1.87 (0.10)</td>
<td>-2.06 (0.17)</td>
<td>-1.97 (0.25)</td>
<td>-3.23 (1.00)</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>All</th>
<th>SE</th>
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</tr>
<tr>
<td>Consumption</td>
<td>NIPA PCE</td>
<td>NIPA PCE</td>
<td>NIPA PCE</td>
<td>NIPA PCE + CE adj.</td>
</tr>
</tbody>
</table>
Labor Wedge for Self-Employed vs. All Workers

-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06

88 90 92 94 96 98 00 02 04 06 08 10 12

All-worker Labor Wedge
Self-employed Labor Wedge

-0.06
-0.04
-0.02
-0.00
0.00
0.02
0.04
0.06

88 90 92 94 96 98 00 02 04 06 08 10 12

All-worker Labor Wedge
Self-employed Labor Wedge
(Baseline) self-employed wedge is at least as countercyclical as all-worker wedge.

Robustness:

1. Use only *unincorporated* self-employed
2. Weight CPS observations by industry
3. Weight CPS observations by share of self-employed in industry-occupation that have employees

**Conclusion:** $\mu^p$ accounts for the bulk of cyclical variation in $\mu$. 
Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs
Approach 2: Intermediate Inputs

Production function:

\[ y = \left[ \theta m^{\frac{1}{\varepsilon}} + (1 - \theta) \left[ z_v \left[ \alpha k^{\frac{\omega - 1}{\omega}} + (1 - \alpha)(z_m n^{\frac{\omega - 1}{\omega}}) \right]^{\frac{\omega}{\omega - 1}} \right]^{\frac{\varepsilon - 1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon - 1}} \]

Marginal Product wrt Intermediates:

\[ mpm_t = \theta \left( \frac{y_t}{m_t} \right)^{\frac{1}{\varepsilon}} \]

Product Market Wedge:

\[ \mu^p_t = \frac{p_t}{mc_t} = \frac{p_t}{p_{mt}/mpm_t} \]
Constructing $\mu^p_{it}$

Product Market Wedge

$$\mu^p_{it} = \frac{p_{it} y_{it}}{p_{m,it} m_{it}} \left( \frac{y_{it}}{m_{it}} \right)^{1/\varepsilon} - 1$$

BLS Multifactor Productivity Database

- Annual data, 1987-2012
- 60 industries (18 manufacturing)
- Output and KLEMS inputs, nominal and real

Baseline: $\varepsilon = 1$

- Robustness: $\varepsilon < 1$
Cyclicality of Intermediate Share

The graph illustrates the cyclicality of intermediate share and GDP from 1987 to 2011, showing how the HP-filtered logs of these variables vary over time.
Cyclicality of Intermediates-based $\mu^p$

$$\ln (\mu_{it}^p) = \alpha_i + \beta^p \cdot \ln (\text{cyc}_t) + \epsilon_{it}$$

<table>
<thead>
<tr>
<th>Elasticity wrt GDP</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>All Industries</td>
<td>-0.94 (0.24)</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.95 (0.32)</td>
</tr>
<tr>
<td>Non-Manufacturing</td>
<td>-0.94 (0.24)</td>
</tr>
</tbody>
</table>

- Baseline estimates with $\varepsilon = 1$. 
Cyclicality of *Industry-level* Labor Wedge \((\mu_i)\)

\[
\ln(\mu_i) = \ln \left(\frac{p_i v_i}{p n_i}\right) + \ln \left(\frac{y_i}{v_i}\right) - \left[\frac{1}{\sigma} \ln (c) + \frac{1}{\eta} \ln (h_i)\right]
\]

<table>
<thead>
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<th>Elasticity wrt GDP</th>
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</thead>
<tbody>
<tr>
<td>All Industries</td>
<td>-0.89 (0.26)</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.72 (0.39)</td>
</tr>
<tr>
<td>Non-Manufacturing</td>
<td>-0.93 (0.24)</td>
</tr>
</tbody>
</table>

• Baseline estimates with \(\varepsilon = 1\).
Intermediates-based $\mu^P$ vs. Total Labor Wedge $\mu$
Role of $\mu^p$ in $\mu$, with $\varepsilon < 1$

- $\varepsilon < 1 \Rightarrow \mu^p_i$ more countercyclical

$$\ln(\mu^p_{it}) = \ln\left(\frac{p_{it} y_{it}}{p_{m,it} m_{it}}\right) + \left(\frac{1}{\varepsilon} - 1\right) \ln\left(\frac{y_{it}}{m_{it}}\right)$$

- $\varepsilon < 1 \Rightarrow \mu_i$ less countercyclical

$$\ln(\mu_{it}) = \ln\left(\frac{p_{it} y_{it}}{p_{t} n_{it}}\right) + \left(\frac{1}{\varepsilon} - 1\right) \ln\left(\frac{y_{it}}{v_{it}}\right) - \ln\left(mrs^h_{it}\right)$$

- $\therefore \varepsilon < 1 \Rightarrow \mu^p$ accounts for > 100% of cyclicalty of $\mu$. 
Conclusion

Our point estimates: $\mu^P$ accounts for the cyclical variation in $\mu$

• Self-Employed $\mu$ is just as cyclical as all-worker $\mu$
• Intermediate Inputs $\mu^P$ is just as cyclical as $\mu$

Countercyclical price markups deserve a central place in business cycle research, alongside labor market frictions.

• Sticky prices
• Customer base and/or learning-by-doing + financial shocks
• Countercyclical risk or risk-aversion
Representative-Agent Labor Wedge

Preferences:

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1-1/\sigma} - \nu \frac{n_t^{1+1/\eta}}{1+1/\eta} \right\} \]

Production:

\[ y_t = z_t \alpha n_t^{1-\alpha} \]

Labor Wedge:

\[ \ln(\mu_t) \equiv \ln(mpn_t) - \ln(mrs_t) \]
\[ = \ln \left( \frac{y_t}{n_t} \right) - \left[ \frac{1}{\sigma} \ln(c_t) + \frac{1}{\eta} \ln(n_t) \right] \]
Consider extensive and intensive margins of labor supply

Why?

Can base Frisch elasticity on micro estimates using hours margin

Self-employed wedge will be on intensive margin only

Product market distortions should impact wedge on both margins

If wedge is only important on one margin, product market distortions must have little cyclical importance.
Theory with Both Extensive and Intensive Margins

Preferences:

\[
\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1 - 1/\sigma} - \nu \left( \frac{h_t^{1+1/\eta}}{1 + 1/\eta} + \psi \right) e_t \right\}
\]

Production:

\[
y_t = z_t k_t^\alpha (e_t h_t)^{1-\alpha}
\]

Search Frictions:

- Matching Technology: \( m_t = v_t^\phi f(u_t) \)
- Vacancy-posting cost: \( \kappa \)
- Separation rate: \( \delta \)
Consider spending today to generate one more matched worker, then reduce spending next period to cut matches by $1 - \delta$ workers:

$$EMW \approx \ln(y/n) - 1/\sigma \cdot \ln(c) - \text{dynamic cost of vacancy matching}$$

So:

$$EMW - IMW = \frac{1}{\eta} \ln(h) - \text{dynamic cost of vacancy matching}$$
EMW vs. IMW

In Logs
EMW (based on VAR) IMW
Semi-elasticities wrt the Unemployment Rate (s.e.’s):

<table>
<thead>
<tr>
<th>Measure</th>
<th>Semi-elasticity</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Hourly Earnings</td>
<td>-1.8</td>
<td>0.7</td>
</tr>
<tr>
<td>New-hire Wage</td>
<td>-3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>User Cost of Labor</td>
<td>-5.2</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Source: Kudlyak (2015) using the NLSY
Wedge Decomposition: Avg Wage
Wedge Decomposition: User Cost of Labor

The graph shows the changes in tax-adjusted MRS, MPN, and wage UC from 1987 to 2011.

- **Tax-adjusted MRS** exhibits fluctuations throughout the years, with notable peaks in certain years.
- **MPN** also shows variability, peaking in 1991 and 2001, among others.
- **Wage (UC)** demonstrates significant variations, especially around 1999 and 2007.

The data points are marked for each year from 1987 to 2011, illustrating the trends over time.
Weekly Hours: Wage-Earn vs. Self-Emp (Matched)

Cyclicality (wrt GDP): 0.17 (0.03), 0.28 (0.07)
Cyclicality (wrt GDP): -0.21 (0.07), -0.13 (0.19)
Figure 6: Alternative Consumption Measures

Cyclicality (wrt GDP): 0.64 (0.04), 1.27 (0.56)
Cyclicalities of Labor Wedge: Robustness

- All Workers Labor Wedge
- Self-employed Wedge, Earnings per hour excluding incorporated
- Self-employed Wedge, Mimicing all-worker industry mix
## Industry Composition of the Self-Employed

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>17.2</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>15.9</td>
</tr>
<tr>
<td>Business</td>
<td>12.7</td>
</tr>
<tr>
<td>Medical &amp; Legal</td>
<td>8.6</td>
</tr>
<tr>
<td>FIRE</td>
<td>8.5</td>
</tr>
<tr>
<td>Other Professional</td>
<td>7.8</td>
</tr>
<tr>
<td>Personal Services</td>
<td>6.3</td>
</tr>
<tr>
<td>Repair</td>
<td>5.0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6.0</td>
</tr>
<tr>
<td>Other</td>
<td>4.7</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>4.3</td>
</tr>
<tr>
<td>Recreation</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Entries are percent of all self-employed.

Other = Transportation, Communications, Utilities and Mining.
Measuring the Labor Wedge

- Examine both Extensive and Intensive Margins
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs

Discuss Other Non-Wage Decompositions
Other ways to get price markups without wage data

- Capital expenditures (Galeotti and Schiantarelli, 1998)
- Advertising (Hall, 2014)
- Inventories
  - Finished goods inventories
    - Bils and Kahn, 2000
    - Kryvtsov and Midrigan, 2012
  - Work-in-process inventories (appendix)
Summary of other ways to get price markups

- Capital expenditures ⇒ countercyclical markups
- Advertising ⇒ acyclical markups (maybe)
- Inventories ⇒ countercyclical markups

All involve dynamics, requiring one to measure any adjustment costs and the stochastic discount factor.

Self-Employed and Intermediates require only static measurements.
Implication of simple theory:

- $\max_{p,A} \{(p - c) Z p^{-\epsilon} A^\alpha - \kappa A\} \Rightarrow \frac{\kappa A}{pQ} \propto \left[ 1 - \frac{1}{p/c} \right]$
- Thus, acyclical $\frac{\kappa A}{pQ} \Leftrightarrow$ acyclical $\frac{p}{c}$.

But this implication is not robust to reasonable alterations:

1. Advertising could affect the reservation price
   $\max_{p,A} \left\{ (p - c) Z \left( \frac{p}{A^\alpha} \right)^{-\epsilon} - \kappa A \right\} \Rightarrow \frac{\kappa A}{pQ}$ independent of desired markup movements.
Figure 2: This figure displays U.S. firms’ planned changes (% per year) in technology expenditures, capital expenditures, marketing expenditures, total number of domestic employees, cash holdings, and dividend payments as of the fourth quarter of 2008 (crisis peak period). Responses are averaged within sample partitions based on the survey measure of financial constraint. See text for additional details.
Constructing Extensive-Margin Wedge

Optimal vacancy creation:

\[
\phi \frac{m_t}{v_t} \left[ u'(c_t) \frac{y_t}{n_t} h_t - \Omega_t h_t \right] - u'(c_t) \kappa \frac{y_t}{n_t} h \\
+ \beta (1 - \delta) \mathbb{E}_t \left\{ u'(c_{t+1}) \kappa \frac{y_{t+1}}{n_{t+1}} h \frac{m_{t+1}/v_t}{m_{t+1}/v_{t+1}} \right\} = 0.
\]

Can re-arrange to get

\[
EMW_t = \ln \left( \frac{y_t}{n_t} \right) - \left[ \frac{1}{\sigma} \ln(c_t) + \ln(\Omega_t) \right] - S_t,
\]

where

- \( \Omega_t = \left( \frac{h_{t+1/\eta}^{1+1/\eta} + \psi}{1+1/\eta} \right) / h_t \)
- \( S_t = f(m_t, v_t, h_t, \mathbb{E}_t g(r_{t+1}, y_{t+1}/n_{t+1}, v_{t+1}, m_{t+1})) \)
<table>
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<tr>
<td>IMW</td>
<td>-1.91 (0.13)</td>
</tr>
<tr>
<td>EMW</td>
<td>-1.89 (0.28)</td>
</tr>
</tbody>
</table>

- Quarterly data, 1987-2012
- $\sigma = 0.5$, $\eta = 0.5$
- $\delta = 0.105$, $\phi = 0.5$, $\gamma = 0.16$
- $r_{ss} = 0.004$, $(\frac{\kappa \nu}{m})_{ss} = 0.4$
- Expectational terms in EMW constructed using VAR approach
Cyclicality of EMW and IMW

<table>
<thead>
<tr>
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<th>Elasticity wrt</th>
<th>GDP</th>
<th>Total Hours</th>
</tr>
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<tr>
<td></td>
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<td></td>
<td></td>
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<tr>
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<td>-1.89</td>
<td>-1.54</td>
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<td></td>
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<td>(0.15)</td>
<td></td>
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<tr>
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<td>-1.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.05)</td>
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- Quarterly data, 1987-2012
- $\sigma = 0.5$, $\eta = 0.5$
- $\delta = 0.105$, $r = 0.004$, $\phi = 0.5$, $\frac{\kappa}{m} = 0.4$, $\gamma = 0.16$
- Expectational terms in EMW constructed using VAR approach
EMW and IMW Decomposition

\[ EMW = \left[ \ln \left( \frac{y/n}{w/p} \right) - \tilde{S} \right] + \left[ \ln \left( \frac{w}{p} \right) + \tilde{S} - S - \frac{1}{\sigma} \ln(c) - \ln(\Omega) \right], \]

where \( \tilde{S} = S \), but with \( \phi = 1 \).

\[ IMW = \left[ \ln \left( \frac{y/n}{w/p} \right) \right] + \left[ \ln \left( \frac{w}{p} \right) - \frac{1}{\sigma} \ln(c) - \frac{1}{\eta} \ln(h) \right] \]

<table>
<thead>
<tr>
<th>Elasticity wrt GDP</th>
<th>EMW</th>
<th>IMW</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu )</td>
<td>-1.89 (0.28)</td>
<td>-1.91 (0.13)</td>
</tr>
<tr>
<td>( \mu^p \left( \frac{w}{p} = AHE \right) )</td>
<td>-0.32 (0.13)</td>
<td>-0.04 (0.13)</td>
</tr>
<tr>
<td>( \mu^p \left( \frac{w}{p} = NH \right) )</td>
<td>-0.98 (0.16)</td>
<td>-0.70 (0.16)</td>
</tr>
<tr>
<td>( \mu^p \left( \frac{w}{p} = UC \right) )</td>
<td>-2.17 (0.21)</td>
<td>-1.89 (0.21)</td>
</tr>
</tbody>
</table>
Weekly Hours cyclicality (wrt GDP): 0.37 (0.14), 0.20 (0.02)
Annual Hours cyclicality (wrt GDP): 0.57 (0.18), 0.39 (0.04)
Annual Hours: Self-Emp vs. Wage Earn (Matched)

Cyclicality (wrt GDP): 0.54 (0.13), 0.57 (0.07)
Self-Employed Consumption in the PSID

Real GDP Growth (Right Axis)

Growth of Self-Employed/Employed Consumption (Left Axis)

Industry-level Labor Wedge ($\mu_i$)

Preferences:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1 - 1/\sigma} - \nu \sum_i \left[ \left( \frac{h_{it}^{1+1/\eta}}{1 + 1/\eta + \psi} \right) e_{it} \right] \right\}$$

Marginal Product wrt Labor (for $\varepsilon = \omega = 1$):

$$mpn_{it} = \frac{y_{it}}{n_{it}}$$

Labor Wedge (intensive-margin):

$$\ln(\mu_{it}) = \ln \left( \frac{p_{it} mpn_{it}}{p_t mrs_{it}} \right) = \ln \left( \frac{p_{it} y_{it}}{p_t n_{it}} \right) - \left[ \frac{1}{\sigma} \ln(c_t) + \frac{1}{\eta} \ln(h_{it}) \right]$$
Intuition for Intermediates Results

• If $w$ and $p_m$ reflect true shadow prices, then (for $\varepsilon = 1$)

$$\frac{wn}{p_{mm}} = \text{const}.$$  

• But empirically, intermediate expenditures more procyclical than labor expenditures $\Rightarrow$ intermediates-based $\mu^p$ is more countercyclical.

$$\ln(\mu^p) = \ln\left(\frac{py}{p_{mm}}\right) = \ln\left(\frac{py}{wn}\right) + \ln\left(\frac{wn}{p_{mm}}\right)$$

• Possible reconciliation: $w$ doesn’t reflect true shadow price.
(Simplified) Bils-Kahn and Kryvtsov-Midrigan first order condition:

\[
\frac{mc}{p} u_c = \mathbb{E} \left[ \phi \frac{s}{a} u_c + \beta \left( 1 - \phi \frac{s}{a} \right) \frac{mc'}{p'} u_{c'} \right]
\]

\(a = \text{finished inventories}, \ s = \text{sales}\)

Gives:

\[
\mathbb{E} \left[ \left( \phi \frac{s}{a} \Gamma + 1 \right) \left( \frac{p/mc}{p'/mc'} \right) \frac{u_{c'}}{u_c} \right] = \frac{1}{\beta}
\]

where

\[
\Gamma = \frac{p - mc' / \left( \frac{p'}{p} \frac{u_c}{\beta u_{c'}} \right)}{mc' / \left( \frac{p'}{p} \frac{u_c}{\beta u_{c'}} \right)}
\]
Cyclicality of Finished-Inventory/Sales, All Manufacturing

Graph showing the cyclicality of finished-inventory/sales and GDP from 1988q1 to 2013q4.
1. Could be scale effects for holding or ordering finished inventories.

2. Impact of inventories on sales could vary over cycle – i.e., expect lower elasticity in recessions if demand less elastic.
Work-in-Process Inventories


Gives:

\[
E \left[ \left( \psi \frac{y'}{q'} + 1 \right) \left( \frac{p/mc}{p'/mc'} \right) \frac{u_{c'}}{u_c} \right] = \frac{1}{\beta}
\]

\(q = \text{work-in-process inventories}\)

\(y = \text{production}\)
Cyclicality of WIP-Inventory/Output, All Manufacturing

- HP-filtered-logs
- WIP Inventories / Output
- GDP

Quarter:
- 1988q1
- 1993q1
- 1998q1
- 2003q1
- 2008q1
- 2013q1
Inventory-based $\mu^p$ vs. Total Labor Wedge $\mu$

Note: For Manufacturing Industries
Production Technology:

\[ y_{it} = g(z_{it}, k_{it}, n_{it})q_{it}^{\varphi_{it}} \]

\[ q_{i,t+1} = (1 - \delta_q)q_{it} + y_{it} - s_{it} \]

Marginal Product wrt Inventories:

\[ mpq_{it} = \varphi_{it} \frac{y_{it}}{q_{it}} \]

Euler equation for shifting from WIP to sales (and back next period):

\[ \frac{mr_{it}}{p_t} = \mathbb{E}_t \left[ \beta u'(c_{t+1}) \left( 1 - \delta_q + \varphi_{i,t+1} \frac{y_{i,t+1}}{q_{i,t+1}} \right) \frac{mr_{i,t+1}}{p_{t+1}} \right] \]
Iterate forward and take logs to get

\[ \ln \left( \mu_{it}^p \right) = -\frac{1}{\sigma} \ln(c_t) + \ln \left( \frac{p_{it}}{\rho_t} \right) - \mathbb{E}_t \sum_{s=1}^{\infty} \frac{\varphi_{i,t+s} y_{i,t+s}}{1 - \delta_q q_{i,t+s}} \]

NIPA Underlying Detail Tables

- Quarterly data, 1987-2012
- 22 Manufacturing industries (aggregated to 14)
- \( q_{it} \): Work-in-process inventories
- \( y_{it} \): Sales plus change in (total) inventories
- \( p_{it} \): Sales price deflator
Return to Inventories vs. MUC
Cyclicality of Inventory-based $\mu^p$
Cyclicality of Inventory-based $\mu^p$

\[ \ln (\mu^p_{it}) = -\frac{1}{\sigma} \ln(c_t) + \ln \left( \frac{p_{it}}{p_t} \right) - \mathbb{E}_t \sum_{s=1}^{\infty} \phi_{i,t+s} \frac{y_{i,t+s}}{1 - \delta q q_{i,t+s}} \]

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| $\mu^p$           | -0.80 (0.12)  
| MUC               | -1.23 (0.06)  
| Relative Price    | 0.67 (0.11)   
| Output/Inventory Path | 0.25 (0.03)  |
Role of $\mu^p$ in $\mu$, based on Inventories

\[
\frac{\partial \ln (\mu^p_{it})}{\partial \ln (\text{cyc}_t)} / \frac{\partial \ln (\mu_{it})}{\partial \ln (\text{cyc}_t)}
\]

$\mu^p$ vs. $\mu$

Manufacturing 109%