Menu Costs, Aggregate Fluctuations and Large Shocks

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*The view expressed are those of the authors, and do not necessarily reflect the official position of the ECB, the Eurosystem or the Central Bank of Hungary
What we do?

- Price change distribution does not identify real effects in menu cost models.
- To show this:
  - Introduce a new menu cost model that matches price change distribution as Midrigan (2011) SS.
  - Has small and temporary real effects like Golosov and Lucas (2007) IRF.
- Use pricing responses to large aggregate value-added tax shocks to support our model Shock.
Steady state distribution of price changes

![Distribution of non-zero price changes, steady-state](image-url)

- Data
- Mixed
- Poisson
- Normal
Impulse responses to a monetary shock

![Graphs showing impulse responses to a monetary shock. The graphs are labeled as follows: Monetary shock, Inflation pass-through, and Output effects. Each graph includes a plot for Mixed, Poisson, Normal, and Calvo models over different time periods (in months).]
Distribution of price changes at the months of tax changes
GE macro model

- Representative household (Dixit-Stiglitz)

- Heterogeneous multi-product firms
  - Menu costs to change prices: to match inaction
  - Idiosyncratic technology shocks: to match price change distribution (like Golosov-Lucas, JPE 2007, Midrigan, E 2011)

\[
\ln A_t(i) = \ln A_{t-1}(i) + \varepsilon_t(i)
\]

\[
\varepsilon_t(i) = \begin{cases} 
N(0, \lambda^2 \sigma^2) & \text{with probability } p \\
N(0, \sigma^2) & \text{with probability } 1 - p
\end{cases}
\]

- Exogenous, preannounced aggregate policy shocks
Calibration

- Calibrate Parameters
  - Menu cost $\phi$
  - Idiosyncratic shock variance $\sigma_\varepsilon$
  - Poisson parameter $p$
  - Relative variance parameter $\lambda$

- To match Matched Moments
  - frequency and average absolute size of price change
  - kurtosis of the size distribution
  - interquartile range of the absolute size distribution
Calibrated parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mixed</th>
<th>Poisson</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi$</td>
<td>2.4%</td>
<td>1.8%</td>
<td>5.1%</td>
</tr>
<tr>
<td>$\sigma_A$</td>
<td>4.3%</td>
<td>4.3%</td>
<td>3.8%</td>
</tr>
<tr>
<td>$p$</td>
<td>91.2%</td>
<td>90.6%</td>
<td>0</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>8.8%</td>
<td>0</td>
<td>1</td>
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</table>
## Matched moments

<table>
<thead>
<tr>
<th>Used in calibration</th>
<th>Data</th>
<th>Models</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Midr. (2011)</td>
</tr>
<tr>
<td>Frequency</td>
<td>12.6%</td>
<td>11.6%</td>
</tr>
<tr>
<td>Size</td>
<td>9.9%</td>
<td>11%</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.98</td>
<td>4.02</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>8.13%</td>
<td>8%</td>
</tr>
<tr>
<td>Inflation</td>
<td>4.23%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Why would large shocks help?

- Fraction of adjusting firms identify the menu cost
- The desired price change distribution reveals itself
Large Shocks

- +5% VAT increase/decrease in Hungary in 2006
  - Government closed the gap between tax rates
  - Processed food sector
  - Gross prices are quoted
  - Easily identifiable cost shocks

- Use micro-price data (equivalent Bils-Klenow, 2004)

- Frequency: 12.6% (steady state)
  - +5% VAT: 62%, −5% VAT: 27%

- Inflation pass-through \(\left(\left(\pi_t - \bar{\pi}\right) / \Delta \tau_t\right)\):
  - +5% VAT: 99%, −5% VAT: 33%
Monthly inflation

![Graphs showing monthly inflation over time with different announcement points and varying inflation rates.](image-url)
How our model does?

- **Inflation pass-through**
  - Baseline: matches pass-through, asymmetry
  - Calvo: Small pass-through; no asymmetry
  - Normal shocks: underestimates pass-through, asymmetry
  - Poisson shocks: overestimates pass-through, asymmetry
How our model does?

- **Inflation pass-through**
  - Baseline: matches pass-through, asymmetry
  - Calvo: Small pass-through; no asymmetry
  - Normal shocks: underestimates pass-through, asymmetry
  - Poisson shocks: overestimates pass-through, asymmetry

- **Frequency effects**
  - Baseline: Matches well
  - Calvo: No frequency effect
  - Normal: Too small
  - Poisson: Too large
How our model does?

- **Inflation pass-through**
  - Baseline: matches pass-through, asymmetry
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- **Frequency effects**
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- **Distribution**
### Pass-through

<table>
<thead>
<tr>
<th>Moment</th>
<th>Size</th>
<th>Data</th>
<th>Mixed</th>
<th>Poisson</th>
<th>Normal</th>
<th>Calvo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass through</td>
<td>+5%</td>
<td>99%</td>
<td>91%</td>
<td>148%</td>
<td>39%</td>
<td>13.1%</td>
</tr>
<tr>
<td></td>
<td>-5%</td>
<td>33%</td>
<td>28%</td>
<td>13%</td>
<td>48%</td>
<td>13.1%</td>
</tr>
</tbody>
</table>
Frequency

<table>
<thead>
<tr>
<th>Moment</th>
<th>Size</th>
<th>Data</th>
<th>Mixed</th>
<th>Poisson</th>
<th>Normal</th>
<th>Calvo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>+5%</td>
<td>62%</td>
<td>55%</td>
<td>90%</td>
<td>25%</td>
<td>12.6%</td>
</tr>
<tr>
<td></td>
<td>-5%</td>
<td>27%</td>
<td>20%</td>
<td>11%</td>
<td>17%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>
## Kurtosis

<table>
<thead>
<tr>
<th>Moment</th>
<th>Size</th>
<th>Data</th>
<th>Mixed</th>
<th>Poisson</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kurtosis</td>
<td>+5%</td>
<td>8.1</td>
<td>12.9</td>
<td>20.9</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>-5%</td>
<td>9.2</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Selection

- Influence of varying the distribution

- Margins of adjustment \( \pi = \sum x^* \lambda \psi \),
  - \( x^* \): desired price change
  - \( \lambda \): probability of price change
  - \( \psi \): mass of firms

\[
\Delta \pi = \Delta \bar{x}^* \bar{\lambda} + \Delta \bar{\lambda} \bar{x}^* + \Delta \bar{\lambda} \Delta \bar{x}^* + \Delta \sum x^* (\lambda - \bar{\lambda}) \psi
\]

- Selection: width of the inaction band and mass at the band
Varying the relative variability $\lambda$

**Pass-through**

<table>
<thead>
<tr>
<th>$\lambda$</th>
<th>Intensive</th>
<th>Selection</th>
<th>Extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>0.05</td>
<td>0.15</td>
<td>0.2</td>
</tr>
<tr>
<td>0.1</td>
<td>0.15</td>
<td>0.3</td>
<td>0.25</td>
</tr>
<tr>
<td>0.15</td>
<td>0.25</td>
<td>0.35</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Cumulative real effects**

<table>
<thead>
<tr>
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<th>Intensive</th>
<th>Selection</th>
<th>Extensive</th>
</tr>
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<tbody>
<tr>
<td>0.05</td>
<td>0.05</td>
<td>0.15</td>
<td>0.2</td>
</tr>
<tr>
<td>0.1</td>
<td>0.15</td>
<td>0.3</td>
<td>0.25</td>
</tr>
<tr>
<td>0.15</td>
<td>0.25</td>
<td>0.35</td>
<td>0.3</td>
</tr>
</tbody>
</table>

The diagrams illustrate the pass-through and cumulative real effects for different values of $\lambda$. The graphs show how the effects change with varying $\lambda$ for intensive, selection, and extensive categories.
Desired price change distributions and inaction bands

Mixed normal

Normal

Poisson
Varying the relative variability $\lambda$, cont.
Conclusion

- Menu cost model with mixed normal distribution matches pricing facts well
- Implies small real effects of monetary shocks
- In contrast with robust macro-evidence on the real effects of monetary shocks
- Need other frictions: wage-rigidity, real rigidity, information frictions
Thank you!