Aggregate labor market outcomes differ to a large extent across countries, possibly reflecting different policies/institutions:

- Unemployment differences and welfare system (Ljungqvist and Sargent,...).
- Trend differences in aggregate hours and taxes (Rogerson, Prescott, Ohanian et al.,...).

Business cycle literature has typically focused on the effects of policies on employment:

- Firing costs and employment dynamics (Hopenhayn and Rogerson, Veracierto...).
Motivation (2)

- Aggregate hours worked ($H$)

$$H = h \times e$$

hours per worker \ empl per pop

- Business cycle literature

$$\Delta H \approx \Delta e$$

- Ohanian and Raffo [2011]: *quarterly* dataset of $H$ for 14 OECD countries over the years 1960Q1-2010Q4.

- Finding: the intensive margin is more important that you think.
Great Recession: Changes in Total Hours and GDP
(Percent change from 2007:Q4 to 2009:Q4)
### Standard Deviation relative to Output

<table>
<thead>
<tr>
<th></th>
<th>( H )</th>
<th>( e )</th>
<th>( h )</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>0.95</td>
<td>0.77</td>
<td>0.29</td>
</tr>
<tr>
<td>EA-3*</td>
<td>0.75</td>
<td>0.55</td>
<td>0.49</td>
</tr>
<tr>
<td>Japan</td>
<td>0.67</td>
<td>0.35</td>
<td>0.48</td>
</tr>
</tbody>
</table>

* Average of France, Germany, and Italy.
Business cycle fluctuations in aggregate hours across countries:

1. There is significant variation in the volatility of aggregate hours across countries.

2. Countries that adjust more along the employment margin tend to display higher volatility in aggregate hours.
Figure 1. Volatility of Total Hours vs Relative Volatility of Intensive and Extensive Margins
This Paper: Theory

- Standard RBC model with one (TFP) shock.
- Break perfect substitutability of $h$ and $e$ on the household side.
- Analyze response of labor supply to costs in adjusting employment.
Figure 2. EPL and Relative Volatility of Intensive and Extensive Margins
Differences in firing costs can account for a significant proportion of differences in labor market fluctuations observed in the data.

Abstracting from the intensive margin has very important quantitative implications for the effects of firing costs.

- Small firing costs can virtually shut down fluctuations along the extensive margin.
- Estimates of firing costs found in the literature appear too high.
Empirical evidence.


Model.

Quantitative analysis.

- Calibration.
- Role of firing costs.

Conclusions.
Obtain a dataset of annual hours worked per worker which is comparable across countries and consistent with aggregate output (Source: GGDC and Conference Board).

- Main data used in the literature so far (Rogerson, Ohanian et al....)

Construct quarterly indicators of hours per worker using a variety of national and international sources (painful!).

- Merge official series with various survey data (regression over common samples, correction for outliers).

Ensure that the quarterly indicators inherit properties of the standardized annual data (Denton [1971]).

- In sum: impose same annual growth rate.
For the U.S., Germany, and Japan we have official data going back to 1960.

Suppose we did not and treated them as the other OECD countries.

What would our procedure deliver?
Testing the OR [2011] Procedure using U.S. Data
## Properties of OR [2011] Hours Series

\[ X = \text{OR [2011] series} \]
\[ Y = \text{Official series} \]

<table>
<thead>
<tr>
<th></th>
<th>( \frac{\text{STD}(X)}{\text{STD}(Y)} )</th>
<th>( \text{Corr}(X, Y) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Germany</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Japan</td>
<td>0.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Figures refers to HP-residuals.*
Fluctuations in labor supply across countries:

1. There is significant variation in the volatility of aggregate hours across countries.

2. Countries that adjust more along the employment margin tend to display higher volatility in aggregate hours.
Accounting for these facts

- Observed patterns may reflect differences in preferences.

- In this paper, we explore the role of policies (firing costs).
Basic framework: Standard neoclassical growth model.

Labor supply decision takes place along both intensive and extensive margin.

\[ U(c_t, e_t, h_t) = \log c_t - \frac{A}{1 + \gamma} h_t^{\gamma+1} e_t - \frac{B}{1 + \eta} e_t^{\eta+1} \]

where \( \gamma > 0, \eta > 0 \).

The Model (2)

- Employment is subject to (asymmetric) adjustment costs as in Hopenhayn and Rogerson [1993].

\[ c_t + k_t - (1 - \delta)k_{t-1} = z_t k_t^\theta N_t^{1-\theta} - F \times \max \{ e_{t-1} - e_t, 0 \} \]

- where

\[
F \geq 0 \\
N_t = e_t h_t \\
\log z_t = \rho \log z_{t-1} + \varepsilon_{t+1}
\]
Interpretation of firing costs: technology/policy that imposes administrative burdens on firms to adjust employment (output losses).

Literature: firing costs as distortionary taxes.

Our formulation would be consistent with this alternative interpretation as well if we assumed that revenues are used to finance $G$ and $U = u(C) + v(G)$. 
We take the U.S. as benchmark (most values are standard).

Key parameters: elasticity wrt intensive ($\gamma$) and extensive margin ($\eta$)

We follow Cho and Cooley [1994]

- Fix $\eta = 0.5$
- Calibrate $\gamma$ to match $\frac{\sigma_h}{\sigma_e}$ in the U.S.
Experiments

- **Experiment 1**: $F^US = 0$ (consistent with previous literature).
  - Main insight: substitution between $e$ and $h$ matters.

- **Experiment 2**: $F^US = 4.5\%$ of quarterly wages in the U.S. (small technological friction in U.S. labor market).
  - Consistent with OECD EPL index and within the range of estimates for hiring costs reported in Hagerdon and Manovskii [2008].
  - Main insight: this model can quantitatively account for the variation observed in the data.
Experiment 1

- Firing costs call for adjustment along the intensive margin.
  - Literature has largely ignored this substitution channel.
- Effects are largest for small firing costs.
- Model cannot account for cross-country evidence.
  - If $F^{US} = 0$ (literature), including the intensive margin yields bad fit and highest $F^i = 0.04$!
**Experiment 1:** $F^{US} = 0$

<table>
<thead>
<tr>
<th>$STD/STD(Y)^*$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H$</td>
<td>0.60</td>
</tr>
<tr>
<td>$e$</td>
<td>0.43</td>
</tr>
<tr>
<td>$h$</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*Figures refers to HP-residuals.*
Figure 3. Results under First Calibration ($F = 0$)
Experiment 2

- Firing costs still call for adjustment along the intensive margin.
- But elasticity of employment to higher firing costs is smaller.
- Model can now account for cross-country evidence.
  - Highest $F = 0.1$, still low compared to estimates in the literature (Veracierto, Garibaldi and Violante).
Experiment 2:

\[ F^{US} = 0.045 \]

<table>
<thead>
<tr>
<th>( \frac{STD}{STD(Y)}^* )</th>
<th>( F )</th>
<th>0.00</th>
<th>0.33</th>
<th>0.66</th>
<th>1.00</th>
<th>1.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H )</td>
<td>0.41</td>
<td>0.31</td>
<td>0.25</td>
<td>0.24</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>( e )</td>
<td>0.31</td>
<td>0.19</td>
<td>0.12</td>
<td>0.10</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>( h )</td>
<td>0.12</td>
<td>0.17</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

*Figures refers to HP-residuals.*
Figure 4. Results under Second Calibration ($F > 0$).
Conclusions

- **Data:** Using OR [2011] dataset, we document new facts about labor market fluctuations:
  - There is large variation in total hours volatility across countries.
  - Countries that adjust more along the employment margin tend to display higher volatility in total hours.

- **Theory:** Neoclassical growth model with both intensive and extensive margins and firing costs.

- **Findings:** Model can quantitatively account for the business cycle properties of labor supply across countries.
  - Substitution $e$ vs $h$ matters.
  - Need to have that $F^{US} > 0$.
  - Estimates of firing costs in the literature are too high.
Cho and Cooley [1994] Utility Function

- Time is divisible. Agents choose number of working days \((e)\) and number of working hours \((h)\).
- Average daily utility

\[
U(c, n) = u(c) - \nu(h)e
\]

- There are daily fixed costs associated with working (commuting, home production...): \(\psi(e)\)
- Average daily utility becomes

\[
U(c, n) = u(c) - \nu(h)e - \psi(e)e
\]

- Note. If \(\psi(e) = D\), then model reduces to Hansen-Rogerson indivisible labor.