WHAT IS DIFFERENT?
The unemployment hike has proven to be very persistent.
WHY FINANCIAL MARKETS?

Strong comovement unemployment and debt flows
Recessions more severe and long-lasting with banking crisis.
WHAT DOES THIS SUGGEST?

• One interpretation is that in periods of credit contraction employers lack the liquidity for investment and hiring:
  – *Credit Channel*.

• Although the credit channel has played an important role in the midst of the crisis, some doubts it is the main driver of the sluggish recovery:
  – *Businesses appear to hold plenty of cash*. 
Liquidity dropped during the crisis but rebounded quickly.
Should we conclude that de-leveraging is irrelevant for the post crisis dynamics of the labor market?
CONTRIBUTION

- We propose a theoretical framework where de-leveraging can have persistent effects on (un)employment.

- The mechanism we propose is different from the typical credit channel. It is NOT the limited ability or the higher cost to finance investment.

- The mechanism works through the wage determination process based on bargaining.
THEORETICAL INTUITION

• Suppose that there are only two periods. No discounting.
  – **Period 1**: The firm issues debt $b$ and hires a worker.
  – **Period 2**: The firm produces $z$ and splits the net surplus:
    \[
    \text{Wage} = \frac{1}{2}(z - b), \quad \text{Dividend} = \frac{1}{2}(z - b)
    \]

• The value of hiring a worker in period 1 (**Value of a Match**) is:
  \[
  b + \frac{1}{2}(z - b)
  \]
MODEL

• Agents have utility $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t c_t$.
  
  - They could be employed or unemployed.
  - They are the owners of firms. The interest rate is $r = 1/\beta - 1$.

• A firm is created when a vacancy is filled with an unemployed worker.
  
  - The cost of posting a vacancy is $\kappa$.
  - A vacancy is filled with probability $q_t = m(v_t, u_t)/v_t$.
  - An unemployed worker finds a job with probability $p_t = m(v_t, u_t)/u_t$.
  - The match is separated with probability $\lambda$.

• Wages are determined through bargaining ($\eta=$Workers’ Power).
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• Added features:
  1. Firms can issue debt $b_t$ and pay dividends $d_t = z_t - w_t + b_{t+1} - b_t$.
  2. There are credit shocks ($\phi_t$) that affect the borrowing limit.
TIMING FOR INCUMBENTS
Standard model

$z_t$  
Wage bargaining, $w_t$

$z_{t+1}$  
Payment of dividends, $d_t$

Separation with probability $\lambda$
TIMING FOR INCUMBENTS
Standard model with \textit{added features}

$z_t, \phi_t, b_t$

\begin{align*}
\text{Wage bargaining, } w_t \\
\text{Choice to default}
\end{align*}

$\lambda$

$z_{t+1}, \phi_{t+1}, b_{t+1}$

\begin{align*}
\text{Payment of dividends, } d_t. \\
\text{Choice of new debt, } b_{t+1}
\end{align*}
BORROWING LIMIT

Firm’s value:

\[ J_t(b_t) = d_t + \beta(1 - \lambda) \mathbb{E}_t J_{t+1}(b_{t+1}) \]

Enforcement constraint:

\[ \phi_t \mathbb{E}_t J_{t+1}(b_{t+1}) \geq b_{t+1} \]
WAGE BARGAINING

Bargaining problem:

$$\max_{w_t} \left\{ \hat{J}_t(b_t, w_t)^{1-\eta} \left[ \hat{W}_t(b_t, w_t) - U_t \right]^\eta \right\}$$

Wage equation:

$$w_t = \eta \cdot (z_t - b_t) + \eta \cdot \left\{ \frac{[p_t + (1 - \lambda)\phi_t]\kappa}{q_t(1 + \phi_t)(1 - \lambda)} \right\}$$
TIMING FOR NEW FIRMS AND JOB CREATION

Vacancies are filled with probability $q_t$

Job posting (vacancy)

Payment of dividends, $d_t$.
Choice of new debt, $b_{t+1}$
FREE ENTRY AND JOB CREATION

\[ q_t Q_t = \kappa \]

- \( q_t \) = Probability of finding a worker.
- \( Q_t \) = Value of a filled vacancy.
- \( \kappa \) = Cost of posting a vacancy.
SENSITIVITY OF $Q_t$ TO CREDIT SHOCK

\[
\frac{\partial Q_t}{\partial \phi_t} = \eta \cdot \left[ \frac{\beta E_t J_{t+1}(b_{t+1})}{1 + \phi_t(1 - \eta)} \right]
\]
STRUCTURAL ESTIMATION

- Three AR(1) shocks:
  1. Productivity, $z_t$
  2. Credit, $\phi_t$
  3. Matching, $\xi_t$

- Three empirical variables in first differences:
  1. Log-GDP, $Y_t$
  2. Log-employment, $N_{t+1}$
  3. New debt over GDP in business sector, $\frac{B_{t+1}-B_t}{Y_t}$

- Three parameters are pre-determined: $\beta$, $\lambda$, $\kappa$. 
## PARAMETERS

<table>
<thead>
<tr>
<th>Estimated parameter</th>
<th>Prior[mean, std]</th>
<th>Mode</th>
<th>Posterior thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Below 5%</td>
</tr>
<tr>
<td>Matching share parameter, $\alpha$</td>
<td>Beta[0.5,0.1]</td>
<td>0.649</td>
<td>0.621</td>
</tr>
<tr>
<td>Bargaining power workers, $\eta$</td>
<td>Beta[0.5,0.1]</td>
<td>0.672</td>
<td>0.665</td>
</tr>
<tr>
<td>Utility flow unemployed, $a$</td>
<td>Beta[0.4,0.1]</td>
<td>0.468</td>
<td>0.442</td>
</tr>
<tr>
<td>Mean enforcement parameter, $\bar{\phi}$</td>
<td>IGamma[8,5]</td>
<td>3.637</td>
<td>3.589</td>
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<tr>
<td>Productivity shock persistence, $\rho_z$</td>
<td>Beta[0.5,0.20]</td>
<td>0.944</td>
<td>0.922</td>
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<tr>
<td>Productivity shock volatility, $\sigma_z$</td>
<td>IGamma[0.001,0.05]</td>
<td>0.005</td>
<td>0.004</td>
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<tr>
<td>Credit shock persistence, $\rho_{\phi}$</td>
<td>Beta[0.5,0.20]</td>
<td>0.965</td>
<td>0.945</td>
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<tr>
<td>Credit shock volatility, $\sigma_{\phi}$</td>
<td>IGamma[0.001,0.05]</td>
<td>0.143</td>
<td>0.130</td>
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<tr>
<td>Matching shock persistence, $\rho_{\xi}$</td>
<td>Beta[0.5,0.20]</td>
<td>0.983</td>
<td>0.977</td>
</tr>
<tr>
<td>Matching shock volatility, $\sigma_{\xi}$</td>
<td>IGamma[0.001,0.05]</td>
<td>0.056</td>
<td>0.053</td>
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</tbody>
</table>
Response credit shock

A) STOCK OF DEBT
B) EMPLOYMENT
C) OUTPUT
D) PER-WORKER WAGE
## VARIANCE DECOMPOSITION

<table>
<thead>
<tr>
<th></th>
<th>TFP shock $z$</th>
<th>Credit shock $\phi$</th>
<th>Matching shock $\xi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>45.9</td>
<td>27.9</td>
<td>26.2</td>
</tr>
<tr>
<td>Employment</td>
<td>0.4</td>
<td>51.4</td>
<td>48.2</td>
</tr>
<tr>
<td>New debt/output</td>
<td>0.2</td>
<td>65.7</td>
<td>34.1</td>
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<tr>
<td>Wages</td>
<td>0.1</td>
<td>40.5</td>
<td>59.4</td>
</tr>
</tbody>
</table>
CONCLUSION

• We have proposed a mechanism through which leverage affects the hiring decision of employers.

• The mechanism is not based on the typical credit channel but on the wage determination process.

• This may explain why in a tight credit market firms do not invest and hire even if they have sufficient cash.
Empirical analysis: VAR

- Linearized model:

\[
\begin{pmatrix}
  z_t \\
  \phi_t \\
  b_t \\
  e_t
\end{pmatrix} =
\begin{pmatrix}
  \rho_z & 0 & 0 & 0 \\
  0 & \rho_\phi & 0 & 0 \\
  a_{bz} & a_{b\phi} & a_{bb} & a_{be} \\
  a_{ez} & a_{e\phi} & a_{eb} & a_{ee}
\end{pmatrix}
\begin{pmatrix}
  z_{t-1} \\
  \phi_{t-1} \\
  b_{t-1} \\
  e_{t-1}
\end{pmatrix} +
\begin{pmatrix}
  \epsilon_{z,t} \\
  \epsilon_{\phi,t} \\
  0 \\
  \epsilon_{\xi,t}
\end{pmatrix}
\]

- We can use the third equation to eliminate \( \phi_t \) and \( \phi_{t-1} \),

\[
\begin{align*}
  b_t &= a_{bz}z_{t-1} + a_{b\phi}\phi_{t-1} + a_{bb}b_{t-1} + a_{be}e_{t-1} \\
  b_{t+1} &= a_{bz}z_t + a_{b\phi}\phi_t + a_{bb}b_t + a_{be}e_t
\end{align*}
\]
Three variables VAR

\[
\begin{pmatrix}
z_t \\
b_{t+1} \\
e_t
\end{pmatrix}
= 
\begin{bmatrix}
\rho_z & 0 & 0 \\
\psi_{bz} & \psi_{bb} & \psi_{be} \\
\psi_{ez} & \psi_{eb} & \psi_{ee}
\end{bmatrix}
\begin{pmatrix}
z_{t-1} \\
b_{t} \\
e_{t-1}
\end{pmatrix}
+ 
\begin{bmatrix}
0 & 0 & 0 \\
0 & \gamma_{bb} & 0 \\
0 & \gamma_{eb} & 0
\end{bmatrix}
\begin{pmatrix}
z_{t-2} \\
b_{t-1} \\
e_{t-2}
\end{pmatrix}
+ 
\begin{bmatrix}
\pi_{zz} & 0 & 0 \\
\pi_{bz} & \pi_{bb} & \pi_{be} \\
0 & 0 & \pi_{ee}
\end{bmatrix}
\begin{pmatrix}
\epsilon_{z,t} \\
\epsilon_{\phi,t} \\
\epsilon_{\xi,t}
\end{pmatrix}
\]
IRF private credit to credit shock
IRF employment to credit shock
IRF private credit to productivity shock
IRF employment to productivity shock
95% Confidence interval Structural impulse response

Quarter

95% Confidence interval
Structural impulse response
SEPARATING WAGE BARGAINING FROM CREDIT CHANNEL - Four variables VAR

\[ z_t = \text{growth rate of TFP}; \]

\[ b_{t+1} = \text{growth rate of private credit}; \]

\[ e_t = \text{growth rate of employment}. \]

\[ r_t = \text{interest rate spread (Baa-Aaa)}. \]
IDENTIFICATION WITH CREDIT SPREADS

\[
(I - A_1 L - ... - A_n L^n) \begin{pmatrix} z_t \\ b_{t+1} \\ e_t \\ r_t \end{pmatrix} = \begin{pmatrix} p_{zz} & 0 & 0 & 0 \\ p_{bz} & p_{bb} & p_{be} & p_{br} \\ 0 & 0 & p_{ee} & 0 \\ p_{rz} & 0 & p_{re} & p_{rr} \end{pmatrix} \begin{pmatrix} \epsilon_{z,t} \\ \epsilon_{\phi,t} \\ \epsilon_{\xi,t} \\ \epsilon_{r,t} \end{pmatrix}
\]

1. Since TFP is exogenous, credit and other shocks cannot affect TFP.

2. Since employment reacts with one period lag, innovations to productivity, credit and interest rate spreads cannot affect employment at impact.

3. A credit shock that is propagated through the ‘bargaining channel’ does not impact on the interest rate spread.
CONCLUSION

• We have proposed a mechanism through which leverage affects the hiring decision of employers.

• The mechanism is not based on the typical credit channel but on the wage determination process.

• This may explain why in a tight credit market firms do not invest and hire even if they have sufficient cash.
STRUCTURAL ESTIMATION WITH WAGES

• Three AR(1) shocks:
  1. Productivity, $z_t$
  2. Credit, $\phi_t$
  3. Matching, $\xi_t$
  4. Measurement errors on wages, $e_t$

• Four empirical variables in first differences:
  1. Log-GDP, $Y_t$
  2. Log-employment, $N_{t+1}$
  3. New debt over GDP in business sector, $\frac{B_{t+1} - B_t}{Y_t}$
  4. Hourly wages, $w_t/l_t$
## Parameters

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<thead>
<tr>
<th>Estimated Parameter</th>
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<th>Below 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matching share parameter, $\alpha$</td>
<td>Beta [0.5, 0.1]</td>
<td>0.762</td>
<td>0.749</td>
<td>0.793</td>
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<tr>
<td>Bargaining power workers, $\eta$</td>
<td>Beta [0.5, 0.1]</td>
<td>0.272</td>
<td>0.252</td>
<td>0.268</td>
<td></td>
</tr>
<tr>
<td>Utility flow unemployed, $\alpha$</td>
<td>Beta [0.4, 0.1]</td>
<td>0.768</td>
<td>0.765</td>
<td>0.794</td>
<td></td>
</tr>
<tr>
<td>Mean enforcement parameter, $\bar{\phi}$</td>
<td>IGamma [8, 5]</td>
<td>8.009</td>
<td>7.987</td>
<td>8.002</td>
<td></td>
</tr>
<tr>
<td>Negotiation frequency, $\psi$</td>
<td>Beta [0.25, 0.05]</td>
<td>0.188</td>
<td>0.174</td>
<td>0.195</td>
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<tr>
<td>Std measurement error wages, $\sigma_w$</td>
<td>IGamma [0.001, 0.05]</td>
<td>0.009</td>
<td>0.008</td>
<td>0.010</td>
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<tr>
<td>Mark-up parameter, $\varepsilon$</td>
<td>Beta [0.8, 0.05]</td>
<td>0.958</td>
<td>0.952</td>
<td>0.973</td>
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<tr>
<td>Elasticity of effort, $\varphi$</td>
<td>Beta [1, 0.1]</td>
<td>0.907</td>
<td>0.906</td>
<td>0.934</td>
<td></td>
</tr>
<tr>
<td>Productivity shock persistence, $\rho_z$</td>
<td>Beta [0.5, 0.20]</td>
<td>0.923</td>
<td>0.919</td>
<td>0.934</td>
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</tr>
<tr>
<td>Productivity shock volatility, $\sigma_z$</td>
<td>IGamma [0.001, 0.05]</td>
<td>0.005</td>
<td>0.004</td>
<td>0.006</td>
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<tr>
<td>Credit shock persistence, $\rho_\phi$</td>
<td>Beta [0.5, 0.20]</td>
<td>0.967</td>
<td>0.959</td>
<td>0.975</td>
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<tr>
<td>Credit shock volatility, $\sigma_\phi$</td>
<td>IGamma [0.001, 0.05]</td>
<td>0.136</td>
<td>0.135</td>
<td>0.152</td>
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<tr>
<td>Matching shock persistence, $\rho_\xi$</td>
<td>Beta [0.5, 0.20]</td>
<td>0.982</td>
<td>0.976</td>
<td>0.986</td>
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<tr>
<td>Matching shock volatility, $\sigma_\xi$</td>
<td>IGamma [0.001, 0.05]</td>
<td>0.032</td>
<td>0.029</td>
<td>0.037</td>
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</tbody>
</table>
## VARIANCE DECOMPOSITION

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<tr>
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<th>Measure error wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>50.8</td>
<td>22.0</td>
<td>27.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Employment</td>
<td>6.3</td>
<td>42.0</td>
<td>51.7</td>
<td>0.0</td>
</tr>
<tr>
<td>New debt/output</td>
<td>3.2</td>
<td>73.8</td>
<td>23.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Hourly wage</td>
<td>0.1</td>
<td>1.6</td>
<td>1.5</td>
<td>96.8</td>
</tr>
</tbody>
</table>
Quarter-by-quarter decomposition