Real Estate Collateral and Labor Demand

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Business and Asset Cycles are Related

Source: Claessens et al. (2011); see also Liu et al. (2013)

Correlation or causality?
Real estate price fluctuations *cause* movements in economic activity

- Real estate is collateral, it affects ability to borrow (Bernanke and Gertler (1986), Kiyotaki and Moore (1997))
- Its price conditions investment, consumption (already known)...
Real estate price fluctuations cause movements in economic activity

- Real estate is collateral, it affects ability to borrow (Bernanke and Gertler (1986), Kiyotaki and Moore (1997))
- Its price conditions investment, consumption (already known)...
- ... and labor demand (this paper):
  1. Labor and capital are complement.
  2. Employment has adjustment costs (regulatory, firm-specific human capital).
Our story

- This paper: real estate collateral → labor demand
Our story

- This paper: real estate collateral $\rightarrow$ labor demand
- Main challenge: Endogeneity
  - Economic booms boost real estate prices and labor demand

We deal with this using administrative French firm data:
- Allows to adopt a "diff-in-diff-in-diff" strategy
- Compares labor demand in high- vs low-price growth regions.
- Looks at how this depends on firm-level real estate ownership.
- Controls for local economic shocks
  - In doing this, we construct a proxy of actual market value of real estate collateral
  - Helps to make calibrations.
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Take-Away

Finding # 1: Sizable macro effects.

- 2002-2006 real estate inflation → 10% of aggregate job creation.
- Comparable figure for investment: 12.5%

Finding # 2: Labor responds less than capital to RE shocks

- 10 ppt increase in collateral → capital increases by 2%
- 10 ppt increase in collateral → labor increases by 0.2%

Inconsistent with CRS & zero labor adjustment cost...

...but consistent with average firm behavior

⋆ Investment rate > employment growth rate

⋆ In our French data, but also in the US

⋆ Reflects labor adjustment costs (Benmelech et al. (2010)).
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- Chaney/Sraer/Thesmar (TSE/Pton/HEC)
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Existing literature

- Credit constraints and labor demand
  - We have administrative data
  - We explore “normal times”, not a credit crisis
  - We focus on collateral, not credit supply shocks.
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- Collateral supply and economic activity
  - Household consumption and demand: Mian and Sufi (2011), Mian et al. (2013)
  - Corporate investment: Gan (2007), Chaney et al. (2012)
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- We estimate # jobs per m Euro of collateral
  - ...can help calibrating macro models.
Outline

1. Economic Framework & Empirical Strategy
2. Data
3. Results
4. Robustness
Economic Framework

Assume firm is Cobb-Douglas: \( Y = AL^\alpha K^{1-\alpha} \)
Economic Framework

- Assume firm is Cobb-Douglas: $Y = AL^\alpha K^{1-\alpha}$
- Adjustment costs on capital, but not on labor:
  - Then: $L_t = K_t \left( \frac{A\alpha}{w} \right)^{1-\alpha} = K_t \times \left( \frac{L}{K} \right)^*$
  - Dynamic optimization problem $\rightarrow$ path of $K_t$
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  - Dynamic optimization problem → path of \( K_t \)
- Imposes a link between the dynamics of \( L_t \) and \( K_t \):
  - Collateral shocks have “same” impact on \( K \) and \( L \).
  - Two alternative (equivalent) formulations:
    - \( \frac{\Delta L_t}{L_{t-1}} = \frac{\Delta K_t}{K_{t-1}} \)
    - \( \frac{\Delta L_t}{K_{t-1}} = \left( \frac{\Delta K_t}{K_{t-1}} \right) \times \left( \frac{K}{L} \right)^* \)
Empirical Strategy

- Firm $j$, département (i.e. French county) $d$, date $t$:

$$ Y_{jdt} = a_j + b_{dt} + \beta \times \text{RE Value}_{jdt} + \text{controls}_{jdt} + \epsilon_{jdt} $$

- $\text{RE Value}_{jdt} =$ firm-level collateral value / $K$ (more later)
- $Y_{jdt}$ change in labor, or investment (see next slide)
- Collateral matters if $\beta > 0$
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- $Y_{jdt}$ change in labor, or investment (see next slide)
- Collateral matters if $\beta > 0$

- Identification is sharp, controls for:
  - Firm fixed unobservables $a_j$
  - $b_{dt}$ capture département (& industry)-level shocks
  - Firm observables $\times$ local house prices
Dependent Variables Definitions

- **Investment** = $\Delta K / K$
  - where $K$ = property, plants and equipment.
  - $\Delta K$ = Capital Expenditures
  - $\beta_{\Delta K/K}$ simple to interpret: $\$ \text{of investment per } \$ \text{of collateral.}$
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Labor demand 1 = $\Delta L / K$

- $\Delta L$ = change in employment
- $\beta_{\Delta L / K}$ simple to interpret: # of jobs per $ of collateral.
- Basic framework predicts $\beta_{\Delta L / K} = \beta_{\Delta K / K} \times (L / K)^\ast$. 
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- **Labor demand 2** = $\Delta L / L$
  - $\beta_{\Delta L/L}$ harder to interpret directly.
  - But basic framework directly predicts: $\beta_{\Delta L/L} = \beta_{\Delta K/K}$.  

Data Sources

- Firm-level accounting data for *all* French firms who pay income tax
  - From tax files: firms big and small, listed and privately held
  - We exclude construction, finance, real estate.
  - Obtain: Investment, real estate holdings (book value)
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- Employment data from plant-level data
  - We merge plant-level info on employment with firm-level accounts
  - Focus on mono-plant firms (assume real estate held where the plant is)
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- About 100,000 firms per year, from 1998 to 2007
- Unbalanced; about 1m observations
Data on House Prices - Département-level

Panel A: All 95 Departements

Panel B: 20 Departements

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Constructing Firm-level Collateral Value

- Collateral value = market value of real estate holdings

Step # 1: We estimate average age of real estate holdings
  - Assume linear amortization over 25 years.
  - Age ≈ 25 × cumulative depreciation / gross book value.

Step # 2: We multiply by cumulative house price growth
  - Between $t - \text{age}$ and $t$
  - At the d´épartement level (95 d´épartements in France)

Equivalent to "diff-in-diff-in-diff" identification:
  - $\Delta \text{Collateral value} \approx \text{book RE holdings} \times \Delta \text{house price}$
  - Can control for $\Delta \text{house price} \times \text{firm observables}$. 
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Equivalent to “diff-in-diff-in-diff” identification:
- \( \Delta \) Collateral value ≈ book RE holdings × \( \Delta \) house price
- Can control for \( \Delta \) house price × firm observables.
In aggregate: +26bn Euro of collateral over 2002-2006
Effect of Collateral Shock on Investment

<table>
<thead>
<tr>
<th>RE Value&lt;sub&gt;t&lt;/sub&gt;</th>
<th>.22*** &lt;br&gt; (46)</th>
<th>.22*** &lt;br&gt; (48)</th>
<th>.19*** &lt;br&gt; (46)</th>
<th>.19*** &lt;br&gt; (45)</th>
<th>.29*** &lt;br&gt; (29)</th>
<th>.3*** &lt;br&gt; (26)</th>
<th>.17*** &lt;br&gt; (13)</th>
<th>.17*** &lt;br&gt; (13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dep. Prices</td>
<td>-.01** &lt;br&gt; (-2.1)</td>
<td>.013 &lt;br&gt; (.99)</td>
<td>-.0059 &lt;br&gt; (-.46)</td>
<td>-.09*** &lt;br&gt; (-3.8)</td>
<td>-.054 &lt;br&gt; (-1.5)</td>
<td>-.13*** &lt;br&gt; (-3.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(assets)&lt;sub&gt;98&lt;/sub&gt; × Dep. Prices</td>
<td>-.0013 &lt;br&gt; (.95)</td>
<td>.001 &lt;br&gt; (.85)</td>
<td>.0014 &lt;br&gt; (1.2)</td>
<td>-.0038 &lt;br&gt; (.95)</td>
<td>.0058* &lt;br&gt; (1.8)</td>
<td>.0066* &lt;br&gt; (1.9)</td>
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</tr>
<tr>
<td>ROA&lt;sub&gt;98&lt;/sub&gt; × Dep. Prices</td>
<td>-.099*** &lt;br&gt; (-10)</td>
<td>-.068*** &lt;br&gt; (-6.4)</td>
<td>-.071*** &lt;br&gt; (-6.1)</td>
<td>.022 &lt;br&gt; (.7)</td>
<td>.15*** &lt;br&gt; (5.1)</td>
<td>.15*** &lt;br&gt; (4.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverage&lt;sub&gt;98&lt;/sub&gt; × Dep. Prices</td>
<td>-.059*** &lt;br&gt; (-10)</td>
<td>-.065*** &lt;br&gt; (-11)</td>
<td>-.067*** &lt;br&gt; (-10)</td>
<td>.0066 &lt;br&gt; (.26)</td>
<td>-.02 &lt;br&gt; (-.72)</td>
<td>-.023 &lt;br&gt; (-.83)</td>
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<tr>
<td>Cash&lt;sub&gt;t&lt;/sub&gt; / PPE&lt;sub&gt;t−1&lt;/sub&gt;</td>
<td>.046*** &lt;br&gt; (30)</td>
<td>.046*** &lt;br&gt; (30)</td>
<td>.19*** &lt;br&gt; (44)</td>
<td>.19*** &lt;br&gt; (42)</td>
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<tr>
<td>Observations</td>
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<tr>
<td>Adj. R-Square</td>
<td>.26</td>
<td>.29</td>
<td>.3</td>
<td>.19</td>
<td>.03</td>
<td>.047</td>
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- +1m Euro of collateral → 170,000 Euro of debt
- +1m Euro of collateral → 190,000 Euro of investment

(our US paper on COMPUSTAT had 60,000)
## Effect of Collateral Shock on Employment

<table>
<thead>
<tr>
<th></th>
<th>$\Delta(\text{Employment})$</th>
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</thead>
<tbody>
<tr>
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<td>$PPE_{t-1}$</td>
<td>$\text{Emp}_{t-1}$</td>
<td>$\text{Emp}_{t}$</td>
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<tr>
<td>RE Value$_t$</td>
<td>2.5***</td>
<td>2.2***</td>
<td>1.5***</td>
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<tr>
<td></td>
<td>(28)</td>
<td>(23)</td>
<td>(15)</td>
</tr>
<tr>
<td>Dep. Prices</td>
<td>-1.2***</td>
<td>-3.7***</td>
<td>-4.1***</td>
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<td>(-10)</td>
<td>(-12)</td>
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<td>.38***</td>
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<td>(7.6)</td>
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<td>ROA$_{98} \times \text{Dep. Prices}$</td>
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<td>Leverage$_{98} \times \text{Dep. Prices}$</td>
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<td>-0.7***</td>
<td>-0.74***</td>
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<tr>
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<td>(-3.4)</td>
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</tr>
<tr>
<td>Cash$<em>t$/$PPE</em>{t-1}$</td>
<td>1.1***</td>
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<td>Industry FE $\times$ Dep. Index</td>
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<td>Dep. FE $\times$ Dep. Index</td>
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<td>Firm FE</td>
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<td>Yes</td>
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<td>No</td>
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- **+1m Euro of collateral $\rightarrow$ 1.5 new job**

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Finding #1: Aggregate Impact is Large

- Small $R^2$ does not mean small macro impact
- Aggregate increase in collateral value 2002-2006 = 26bn Euro

Job creation effect is large:
- $26,000 \times 1.5 \approx 40,000$ new jobs created
  (compared to about 400,000 jobs created in aggregate)

Same magnitude as investment:
- $26,000 \times 190,000 \approx 5.2$bn Euro additional investment
  (compared to about 30bn increase over 2002-2006)
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Finding #2: Labor Reaction “Small”

- $L$ reacts less than $K$ to collateral shocks.
  - Inconsistent with a “pure” complementarity effect.

Mathematical expression:

\[ \frac{\beta \Delta L}{L} < \frac{\beta \Delta K}{K} \times \left( \frac{L}{K} \right) \]

Example:

1 m Euro collateral shock → 190k Euro investment

\[ \frac{K}{L} = 45k \text{ Euro per job} \]

We expect $\frac{190}{45} = 4.2$ jobs created / m Euro collateral.

But we find, in the regressions, only 1.5 job.

Equivalently:

\[ \frac{\beta \Delta L}{L} \ll \frac{\beta \Delta K}{K} \]

\[ \frac{\beta \Delta L}{L} = 0.002 = \frac{\beta \Delta K}{K}/10 \]

Discrepancy consistent with average firm behavior

In micro-data, $\frac{\Delta L}{L}$ sensitivity to $\frac{\Delta K}{K} \ll 1$
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- Discrepancy consistent with average firm behavior
  - In micro-data, $\Delta L/L$ sensitivity to $\Delta K/K \ll 1 \rightarrow$
Average reaction of $\Delta L/L$ to $\Delta K/K$

- Regress: $\Delta L/L$ on $\Delta K/K$
- Assume (heroic) that $\Delta K/K$ is exogenous.

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<td>French Firms</td>
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<td>$\Delta K_t / K_{t-1}$</td>
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<td>.19***</td>
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<tr>
<td>Adj. R-Square</td>
<td>.15</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>No</td>
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</table>

- 1 ppt increase in $\Delta K/K \rightarrow 0.14$ ppt increase in $\Delta L/L$
- Consistent with $\beta_{\Delta L/L} = \beta_{\Delta K/K} / 10$
- Effect similar in the US (cols 3 and 4)
- ... more work need in this direction.
Robustness #1: Miscellanea

- Attrition not an issue
  - Balanced sample yields same estimate
- Internal capital markets do not interfere
  - Independent firms & group firms $\rightarrow$ same estimate
- Result extends to multi-plant firms
  - Estimate slightly smaller, but still roughly the same
  - RE Value less precisely measured
- Robust to outlier treatment
  - An issue for $\Delta L/K$
- Same effect for large and small firms
Robustness # 2: Sensitivity to local cycle?

- **RE Value** ≈ RE holdings × price shocks
- Problem if RE holdings = exposure to local cycle
- Check how $\beta$ differs in local vs global industries.

**Table: Sample Split by Industry Export Ratios**

<table>
<thead>
<tr>
<th></th>
<th>Local (1)</th>
<th>$\Delta(\text{Emp})<em>{PPE</em>{t-1}}$ Interm. (2)</th>
<th>Global (3)</th>
<th>Local (4)</th>
<th>$\Delta(\text{Emp})<em>{\text{Emp}</em>{t} + \text{Emp}_{t-1}}$ Interm. (5)</th>
<th>Global (6)</th>
</tr>
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<tbody>
<tr>
<td>RE Value$_t$</td>
<td>1.5***</td>
<td>1.8***</td>
<td>2***</td>
<td>.016***</td>
<td>.026***</td>
<td>.026***</td>
</tr>
<tr>
<td></td>
<td>(8)</td>
<td>(8.4)</td>
<td>(5.6)</td>
<td>(3.5)</td>
<td>(5.4)</td>
<td>(3)</td>
</tr>
<tr>
<td>Cash$<em>t$/$PPE</em>{t-1}$</td>
<td>.93***</td>
<td>1.1***</td>
<td>1.1***</td>
<td>.017***</td>
<td>.018***</td>
<td>.018***</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(21)</td>
<td>(8.4)</td>
<td>(13)</td>
<td>(20)</td>
<td>(9.1)</td>
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<td>Log(assets)$_{98} \times$ Dep. Prices</td>
<td>.37***</td>
<td>.41***</td>
<td>.45***</td>
<td>.0012</td>
<td>-.0009</td>
<td>-.0012</td>
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<tr>
<td></td>
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<td>(6)</td>
<td>(3.9)</td>
<td>(1.2)</td>
<td>(-1)</td>
<td>(-.63)</td>
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<tr>
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<td>-6.3***</td>
<td>-6.4***</td>
<td>-.02*</td>
<td>-.071***</td>
<td>-.034</td>
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<td>(-10)</td>
<td>(-3.8)</td>
<td>(-1.7)</td>
<td>(-5.7)</td>
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<td>Leverage$_{98} \times$ Dep. Prices</td>
<td>- .73***</td>
<td>-.9**</td>
<td>-2.4*</td>
<td>-.029***</td>
<td>-.039***</td>
<td>-.072***</td>
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<td>Yes</td>
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<td>Yes</td>
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<td>Year FE</td>
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<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Dep. × Industry × Year FE</td>
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<td>Yes</td>
<td>Yes</td>
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</table>

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Robustness # 3 : Placebo regressions

- For each firm-year draw a random RE Value
- Estimate the benchmark regression
- Repeat 50 times.
Robustness # 4 : Dynamics

- Regress $Y_{jt+k}$ on RE Value$_{jt}$, for $k = 0, 1, ..5$
- Most of the action occurs after 1 year.

<table>
<thead>
<tr>
<th></th>
<th>$\Delta(Emp_t)$</th>
<th>$\Delta(Emp_{t+1})$</th>
<th>$\Delta(Emp_{t+2})$</th>
<th>$\Delta(Emp_{t+3})$</th>
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<td>RE Value$_t$</td>
<td>$1.5^{***}$</td>
<td>$2.7^{***}$</td>
<td>$2.5^{***}$</td>
<td>$1.5^{***}$</td>
<td>$.54^{**}$</td>
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<tr>
<td></td>
<td>(16)</td>
<td>(23)</td>
<td>(15)</td>
<td>(8.4)</td>
<td>(2.4)</td>
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<tr>
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<td>$.58^{***}$</td>
<td>$.23^{***}$</td>
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<td>$PPE_{t-1}$</td>
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<td>(10)</td>
<td>(5.1)</td>
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<td>-.044</td>
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<td>$.39^{**}$</td>
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<td>(2.4)</td>
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<td>(.86)</td>
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<td>$-3.7^{***}$</td>
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<td>$-1.9^{**}$</td>
<td>1.3</td>
<td>$5.8^{***}$</td>
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<td>(-12)</td>
<td>(-8.2)</td>
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<td>(-2)</td>
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<td>(2.6)</td>
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<td>$-.57^{**}$</td>
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<td>(-4.4)</td>
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<td>Year FE</td>
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<tr>
<td>Firm FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Dep. × Industry× Year FE</td>
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<td>Yes</td>
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Panel B:

- $\Delta(Emp_t)$ on common sample

<table>
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<tr>
<td>RE Value$_t$</td>
<td>$1.5^{***}$</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
</tr>
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<td>Observations</td>
<td>745680</td>
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</table>

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Conclusion

Wrap-up

- Collateral effects explains large fraction job creation
- But at micro-level, labor effect smaller than capital
- This is consistent in aggregate: French firms invest, but hire little...
Conclusion

Wrap-up

- Collateral effects explains large fraction job creation
- But at micro-level, labor effect smaller than capital
- This is consistent in aggregate: French firms invest, but hire little...

Way forward

- Build a simple structural model with labor adjustment costs and financing frictions
- Simulate it
- Run our regressions on the simulated sample, see if we find similar parameters to ours.
- “indirect inference”


References III


### Descriptive Statistics

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<th></th>
<th>mean</th>
<th>median</th>
<th>min</th>
<th>max</th>
<th>sd</th>
<th>p25</th>
<th>p75</th>
<th>N</th>
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<td>( \frac{CAPX_t}{PPE_{t-1}} )</td>
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<td>0.08</td>
<td>-0.93</td>
<td>1.09</td>
<td>0.28</td>
<td>0.02</td>
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<td>1,078,211</td>
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<td>( \Delta(Debt) )</td>
<td>0.11</td>
<td>0.01</td>
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<td>1.05</td>
<td>-0.19</td>
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<td>( \frac{\Delta(\text{Employment})<em>{t-1}}{PPE</em>{t-1}} )</td>
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<td>0.00</td>
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<td>0.72</td>
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<td>0.00</td>
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<td>1.24</td>
<td>0.75</td>
<td>3.25</td>
<td>0.46</td>
<td>1.05</td>
<td>1.64</td>
<td>1,078,211</td>
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<tr>
<td>Cash_{t} ( \frac{PPE_{t-1}}{\text{PPE}_{t-1}} )</td>
<td>0.85</td>
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<td>-2.67</td>
<td>4.79</td>
<td>1.29</td>
<td>0.05</td>
<td>0.97</td>
<td>1,078,211</td>
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Regress: $\Delta L / L$ and $\Delta K / K$ on cash-flows

<table>
<thead>
<tr>
<th></th>
<th>$\Delta K_t / K_{t-1}$</th>
<th>$\Delta L_t / L_{t-1}$</th>
<th>$\Delta K_t / K_{t-1}$</th>
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<td>French Firms</td>
<td>US Firms</td>
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<td>Cash-Flows$<em>t / K</em>{t-1}$</td>
<td>0.019***</td>
<td>0.0095***</td>
<td>0.022***</td>
<td>0.033***</td>
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<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- In France, $\Delta K / K$ reacts more to cash flows than $\Delta L / L$
- In the US, it is the opposite.
- Needs refinement (extremely endogenous).