Shocking Capital: 
Firm-level Responses to a Large Local Business Tax Reform in France

Antonin Bergeaud  Clément Carbonnier  Édouard Jousselin  Clément Malgouyres

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Motivation I

▶ How do firms respond to tax policy affecting the cost of investment?
▶ Important for both long-run growth and short-run stabilization
▶ Firm-level evidence is mixed
▶ Mixed evidence on corporate income tax (Bond and Van Reenen, 2007) and limited real effects of tax on dividends (Yagan, 2015)
▶ In contrast, accumulating credible evidence that investment tax incentive seem to work and stimulate investment, employment and sales (e.g. House and Shapiro, 2008; Zwick and Mahon, 2017)
▶ Not all variation in the cost of capital leads to the same responses
▶ Tax policies directly and immediately reducing the cost of investment might be more effective than policies that more broadly affect the cost of capital and pay off gradually over time.
▶ Such policies are also typically temporary.
▶ Research question: How did firms respond to the permanent abolition of a business tax that was directly raised on equipment capital?
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Motivation II

- **Taxes on production** are particularly high in France
  - 3% of GDP in France versus 1.6% in Euro zone, less than 0.5% in Germany (DG trésor, 2018).
  - encompasses taxes on sales, value-added, real-estate, wage bill ...
- Recurrent governmental projects to reform such taxes.
- These taxes are claimed to be **very detrimental to competitiveness** by a wide range of observers (e.g. Conseil National de l’Industrie, 2018 and OFCE, 2018)
  - **Theoretical or indirect** academic foundations to these claims:
    - Taxing intermediate goods is widely considered as inefficient (Diamond & Mirlees 1971)
    - Taxes on sales for BtB transactions generate cascading distortions and encourages inefficient vertical integration (Hansen et al., 2017).
- **Little ex-post evaluation** of such taxes, in particular on firm-level outcomes.
  - Data hardly available
  - No policy-induced variation in tax rates, except for real estate taxes but variation is small ...
This paper

1. We analyze the abolition of the “taxe professionnelle” a large reform of local business taxation in France in 2010.
   ▶ 1.1 percentage point of GDP before and 0.8 after (-5bn€) (DG Tresor)
   ▶ Prior to 2010:
     Tax base = historical cost of equipment; Tax rate = locally set
   ▶ Reform: Tax base is shifted to value-added, rates set nationally

2. We use newly available data from TP returns to precisely measure ex-ante exposure to the reform.
   ▶ Data on equipment capital and real estate capital at the plant-level
   ▶ Measure of exposure = weighted average of tax rates where weights are determined by the size and K intensity of plants owned by a given firm.

3. Implement DiD estimation in order assess the impact on:
   i. tax burden
   ii. capital
   iii. sales and value-added
   iv. wage bill and employment
So far...
Main results

1. Prior to the reform we see
   i. robust negative (resp. positive) correlation between plant-level capital (resp. labor) intensity and local taxes
   ii. this holds within-industry and within-firm (multi-plant firm).

2. Most firms are ex-ante winners from the reform. The magnitude of the gains varies a lot, even within sector.

3. Firms who benefited most from the reform expanded.
   i. Average increase in sales and value added $\approx 3-4\%$
   ii. Similar increase in wage bill, 90% of which explained by hours.

4. Positive but small effect on hourly wage. $\Rightarrow$ labor born a very small share of the incidence (simple computation suggests less than 5%).

5. Results robust to a variety of checks:
   i. Inclusion of rich set of sectoral and size fixed-effects
   ii. Varying definition measure of ex-ante exposure (year of reference)
   iii. Graphical evidence (mostly) supports causal interpretation of the findings.
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Descriptive findings

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Relation to Previous Literature

- **Previous analysis of TP and its reform**
  - Rathelot & Sillard (EJ 2008): little if any impact of variation in local rates on firm location (1990s)
  - Ly and Paty, forthcoming RSUE: effect of the reform on tax setting behavior by local governments

- **Empirical Studies of Business Tax**
  - CIT: investment and employment (Bond and Van Reenen, 2007), wage incidence (Suárez Serrato & Zidar, AER, ’16; Fuest et al., AER ,’18)
  - Tax on dividends: Yagan, AER, ’15; Boissel & Matray ’19
  - Investment bonus: House and Shapiro, 2008; Zwick and Mahon, 2017
  - Payroll taxes: Saez et al., AER ,’18; Ku et al., 2019

- **Related to literature on misallocation of factors of production**
  - Dispersion in tax rates is likely to amplify dispersion in marginal productivity of capital and misallocation (Fagjelbaum et al. Restud 2018)
  - Aggregate TFP growth would have been 30% higher in mfg sector between of 1990-2015 if factors had been optimally allocated: Libert, 2017; Restuccia Rogerson RED 2008; Hsieh & Klenow QJE 2009
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Local business taxation before 2010

The taxe professionnelle

- Declare at $t - 1$ value of real-estate and equipment owned at $t - 2$ (base at $t$)
- Local authorities vote at $t - 1$ the tax rate for year $t$
- Taxation floor at 1.5% of VA (if sales > 7.5M€) and ceiling at 3.5% of VA

Formalization

- Firm $i$ owning $n(i, t)$ establishments in cities $C_i$.
- Baseline tax burden:
  - Tax base of $i$ in city $c$: $KB_{c,i,t-2} + KE_{c,i,t-2}$.
  - Sum of tax $\times$ base across plants:
    $$TP_{i,t} \equiv \sum_{c \in C_{i,t-2}} \tau_{c,t} \times (KB_{c,i,t-2} + KE_{c,i,t-2})$$
- $z_{i,t-2} = 1$ if sales $S_{i,t-2} > 7.5M€$
- Actual tax burden writes as:
  $$T_{i,t} = \min [\max \{0.015z_{i,t-2}VA_{i,t-2}, TP_{i,t}\}, 0.035VA_{i,t-2}]$$
Local business taxation after 2010

CET = CFE + CVAE

▶ In February 2009, Nicolas Sarkozy, announced the removal of productive investments from the business tax base to sustain the competitiveness of industrial companies.

“The business tax will be abolished in 2010 because we want to keep factories in France.” N. Sarkozy, February 5, 2009 on TF1

▶ Replacement consists of two parts:
  ▶ CFE: TP part on real estate
  ▶ CVAE: tax on value added (national rate depending on sales)

\[
T_{i,t} = \max \left\{ \left( \tau_t^n (S_{i,t-2}) V A_{i,t-2} + \sum_{c \in C_{i,t-2}} \tau_c^c K B_{c,i,t-2} \right) , 0.03 V A_{i,t-2} \right\}
\]

where : \( S_{i,t-2} \) refers to sales of firm \( i \) at \( t - 2 \)

Details on CVAE rate
Distribution of overall tax rate in 2008
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Administrative databases

BIC-BRN database
- Standard balance sheet based on firm’s tax returns
- Restriction to manufacturing and service sectors (NFCs)
- Allows to measure precisely the firm-level total TP and then CET burden net of deductions (as opposed to FICUS-FARE). Denoted $T_{it}$

TP tax returns
- Establishment data on KB and KE (and L but we use the DADS)

International trade database (Douane)
- Value and volume and value per firm*product*destination
- Used to study pass-through of taxes into export prices

Social contribution database (DADS)
- Work hours and gross wage at employee-level
- Possible to match at the establishment level
Descriptive statistics from our estimation sample

Estimation sample:

- Balanced sample 2005-2015 present in BRN, DADS and TP returns over the period 2004-2010 and BRN, DADS past 2011-2015. (Preliminary results suggests no effect of the policy on survival.)

- Additional restriction: drop firms below 0.5 and above 99.5 percentile in terms several accounting ratios: VA/L, T/VA and S/K.

<table>
<thead>
<tr>
<th>Year</th>
<th>Workforce (full time equiv.)</th>
<th>Value Added (in M euros)</th>
<th>KE/VA (in %)</th>
<th>KB/VA (in %)</th>
<th>T/VA (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>26.67</td>
<td>1.34</td>
<td>9.80</td>
<td>1.96</td>
<td>2.52</td>
</tr>
<tr>
<td>2006</td>
<td>27.46</td>
<td>1.44</td>
<td>9.62</td>
<td>1.94</td>
<td>2.51</td>
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<tr>
<td>2007</td>
<td>28.14</td>
<td>1.55</td>
<td>9.42</td>
<td>1.92</td>
<td>2.34</td>
</tr>
<tr>
<td>2008</td>
<td>28.60</td>
<td>1.61</td>
<td>9.61</td>
<td>1.96</td>
<td>2.33</td>
</tr>
<tr>
<td>2009</td>
<td>28.42</td>
<td>1.55</td>
<td>10.60</td>
<td>2.18</td>
<td>2.46</td>
</tr>
<tr>
<td>2010</td>
<td>28.47</td>
<td>1.59</td>
<td>10.97</td>
<td>2.25</td>
<td>1.76</td>
</tr>
<tr>
<td>2011</td>
<td>28.86</td>
<td>1.66</td>
<td></td>
<td></td>
<td>1.69</td>
</tr>
<tr>
<td>2012</td>
<td>29.07</td>
<td>1.68</td>
<td></td>
<td></td>
<td>1.79</td>
</tr>
<tr>
<td>2013</td>
<td>29.11</td>
<td>1.70</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2014</td>
<td>29.18</td>
<td>1.71</td>
<td></td>
<td></td>
<td>1.84</td>
</tr>
<tr>
<td>2015</td>
<td>29.27</td>
<td>1.72</td>
<td></td>
<td></td>
<td>1.85</td>
</tr>
</tbody>
</table>

Number firms 110987 Share manuf 21.3%
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Capital intensity at the plant level

For each plant, we have: $KB_j$, $KE_j$, $WB_j$.

We compute cost share at the plant level.

$$s_{j,v} = \frac{v_j}{KB_j + KE_j + WB_j} \text{ for } v = KB, KE, WB$$

$$s_{j,K} = s_{j,KB} + s_{j,KE} \text{ (overall K intensity)}$$

How does $s_{j,v}$ vary with local tax rates? We regress $s_K$ on local tax rate $\ln(1 + \tau_j)$.

$$b_v = \frac{\hat{\text{Cov}}(s_{v,j}, \tau_{c(j)})}{\hat{\text{Var}}(\tau_j)} \text{ with } b_{KB} + b_{KE} + b_{WB} = 0$$

We can identify this covariance from within sector variation and for multi-plant firms, within firm.
Cross-sectional correlation between K share and $\tau_{c(j)}$

Table: L, KB and KE intensity at the plant level

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$s_{KB}$</td>
<td>$s_{KE}$</td>
<td>$s_{WB}$</td>
</tr>
<tr>
<td><strong>within-industry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln(1 + \tau)$</td>
<td>0.014</td>
<td>-0.102***</td>
<td>0.089***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.018)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Adj R-sq</td>
<td>0.104</td>
<td>.18</td>
<td>.18</td>
</tr>
<tr>
<td>N</td>
<td>501709</td>
<td>501709</td>
<td>501709</td>
</tr>
<tr>
<td><strong>within-firm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln(1 + \tau)$</td>
<td>0.006</td>
<td>-0.057***</td>
<td>0.051***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.018)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Adj R-sq</td>
<td>0.39</td>
<td>0.568</td>
<td>0.583</td>
</tr>
<tr>
<td>N</td>
<td>180834</td>
<td>180834</td>
<td>180834</td>
</tr>
<tr>
<td>Sample average $\bar{s}$</td>
<td>0.04</td>
<td>0.135</td>
<td>0.82</td>
</tr>
</tbody>
</table>

▶ Cannot evaluate effect the reform on this outcome (no taxation implies no information), so we focus on **firm-level outcomes**
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Static model

- Multi-plant firm $i$ with CES across plants $j$ (ES=$\sigma$, weight = $\alpha_j$) and CES within plants between $K$ and $L$ ($\varepsilon$, weight on $L$ $\beta_j$)
- Monopolistic competitive with constant elasticity of demand $\gamma$

Taxation

- National corporate tax $\tau_c$ (we ignore it today, no changes over the period)
- Tax on $K$ ($\tau_K$)
- Tax on production ($\tau_Y$)

Objective of the firm: max after tax profits with respect to inputs and price

$$\max \Pi_i = p_i Y_i - \sum_{j \in i}(w_j L_j + rK_j(1 + \tau_{K,j})) - Y_i \tau_Y$$

$$- \tau_c(p_i Y_i - \sum_{j \in i}(\theta_L w_j L_j + \theta_K rK_j(1 + \tau_j)) - \theta_Y Y_i \tau_Y)$$
Unit cost and sales

- $u_i$ unit cost of production by firm $i$.
- We denote $\tilde{u}_j$ unit cost of production by plant $j$:
  
  $$
  \tilde{u}_j = (\beta^\varepsilon w_j^{1-\varepsilon} + (1 - \beta)^\varepsilon (r(1 + \tau_{K,j}))^{1-\varepsilon})^{\frac{1}{1-\varepsilon}}
  $$

- Unit cost at the firm level is:
  
  $$
  u_i = \frac{1}{1 - \tau_Y} \left[ \sum_{j \in i} \alpha_j^\sigma \tilde{u}_j^{1-\sigma} \right]^{\frac{1}{1-\sigma}}
  $$

- MC+Cst elasticity of demand $\Rightarrow$ cst markup
  
  $$
  p_i = \frac{\gamma}{\gamma-1} u_i
  $$

- Sales:
  
  $$
  p_i Y_i = \text{cst.} \times u_i^{1-\gamma}
  $$
Stylized tax reform
Impact on unit cost, sales and factor demand

► Stylized reform:
  ► Introduction of national tax on VA: $\Delta \tau_Y = \tau_Y$ (national)
  ► Delete tax on KE: $\Delta \tau_{K,j} = -\tau_{K,j}$ (decrease larger for places for higher rates)
► Denote $s^Y_j$: cost share of plant $j$ in total cost of firm $i$, $s^K_j$: KE intensity of $j$
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- Denote $s_{Yj}^i$: cost share of plant $j$ in total cost of firm $i$, $s_{Kj}^i$: KE intensity of $j$
- Impact on **sales** is proportional to change in unit cost.
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\[
\Delta \ln Sales_i = (1 - \gamma) \Delta \ln u_i
\]
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- Impact on sales is proportional to change in unit cost.

$$\Delta \ln u_i \approx_{f.o.} - \ln(1 - \tau_Y) - \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j)$$
Stylized tax reform
Impact on unit cost, sales and factor demand

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  $$\Delta \ln u_i \approx_{f.o.} -\ln(1 - \tau_Y) - \left( \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j) \right)$$

We build the empirical counterpart of shock$_i$. 
Stylized tax reform

Impact on unit cost, sales and factor demand

▶ Stylized reform:
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$$
\Delta \ln u_i \approx \text{f.o.} \left( -\ln(1 - \tau_Y) - \left( \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j) \right) \right)
$$

We build the empirical counterpart of shock$_i$.

▶ Impact on plant-level employment can be studied:

$$
\Delta \ln L_j \approx (\gamma - \sigma) \ln(1 - \tau_Y) + (\gamma - \sigma) \left( \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j) \right) \\
+ (\gamma - \varepsilon) s^K_j \times \ln(1 + \tau_j)
$$
Stylized tax reform

Impact on unit cost, sales and factor demand

- Stylized reform:
  - Introduction of national tax on VA: $\Delta \tau_Y = \tau_Y$ (national)
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- Impact on sales is proportional to change in unit cost.

\[
\Delta \ln u_i \approx_{\text{f.o.}} -\ln(1 - \tau_Y) - \left( \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j) \right).
\]

We build the empirical counterpart of $\text{shock}_i$.

- Impact on plant-level employment can be studied:

\[
Delta \ln L_j \approx_{\text{f.o.}} \left( \gamma - \sigma \right) \ln(1 - \tau_Y) + \left( \gamma - \sigma \right) \left( \sum_{j \in i} s^Y_j \times s^K_j \times \ln(1 + \tau_j) \right) + (\gamma - \varepsilon) s^K_j \times \ln(1 + \tau_j)
\]
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How is a $Y_{it}$ outcome affected by a variation in the tax burden $(\frac{T}{VA})_{it}$?

▶ **Standard issue of simultaneity:** Outcome $Y$ might affect the average tax rate, especially when tax rate depends on size.

▶ **Instrumentation following principle of Auten & Carroll (REStat 1999)**

▶ Compute theoretical tax change applying the rule change to firm-level data prior to the reform (2008)

▶ **Definition of the instrument:** $Z_i$ predicted reduction in tax burden as a percentage of the initial tax base. Baseline year: 2008.

\[
Z_i = \left( \sum_{j \in i} KE_j + KB_j \right)^{-1} \times \sum_{j \in i} \tau_{c(j)} \times KE_j \\
= \sum_{j \in i} \tau_{c(j)} \times \frac{KE_j}{KE_j + KB_j} \times \frac{KE_j + KB_j}{\sum_{j \in i} KE_j + KB_j}
\]

- Plant $j$ KE intensity
- Plant $j$ in firm $i$ tax base
Distribution of the instrument

Z: instrument (in %)

Fraction

0 20 40 60

0 .02 .04 .06 .08
Substantial variation within sector

[Diagram showing variation in the instrument: deleted tax base x rate over entire taxe base for different ranks of 4-digit sectors, with median (p50), mean, and 90/10 percentile (p90/p10) levels indicated.]

Details on distribution of ex-ante gains
DiD Specification

- **DiD specification:**

  Reduced-form

  \[ Y_{it} = \beta_Y Z_i \times 1\{t > 2008\} + \psi_{s(i),t}^{RF} + \alpha_i^{RF} + \varepsilon_{i,t}^{RF} \]

  First-stage

  \[ \ln \left( \frac{T_{i,t}}{V_{Ai,t}} \right) = \beta_{FS} Z_i \times 1\{t > 2008\} + \psi_{s(i),t}^{RF} + \alpha_i^{RF} + \varepsilon_{i,t}^{RF} \]

  where (i) \( Z_i \) is the instrument for firm \( i \), (ii) \( \psi_{s(i),t} \) 2-digit sector \( \times \) year FE, (iii) \( \alpha_i \) is a firm FE.
DiD Specification

- **DiD specification:**
  Reduced-form
  \[
  Y_{it} = \beta_Y Z_i \times \mathbb{1}\{t > 2008\} + \psi_{s(i),t}^{RF} + \alpha_i^{RF} + \epsilon_{i,t}^{RF}
  \]

  First-stage
  \[
  \ln \left( \frac{T_{i,t}}{VA_{i,t}} \right) = \beta_{FS} Z_i \times \mathbb{1}\{t > 2008\} + \psi_{s(i),t}^{RF} + \alpha_i^{RF} + \epsilon_{i,t}^{RF}
  \]

  where (i) \(Z_i\) is the instrument for firm \(i\), (ii) \(\psi_{s(i),t}\) 2-digit sector \(\times\) year FE, (iii) \(\alpha_i\) is a firm FE.

- **Identification:** we assess the *common trend assumption* by estimating a dynamic DiD comparing firms above T3 to firms below T1:
  \[
  \ln Y_{it} = \sum_{l \neq 2008} \beta_{lT3,i} Z_i \times \mathbb{1}\{t = l\} + \psi_{s(i),t} + \alpha_i + \epsilon_{i,t}
  \]

  - We additionally group firm within a given sector into 3 tertiles of treatment intensity and trace-out first stage and outcomes before and after the reform T3 versus T1.
  - Note: the reform is announced in February 2009 and decided upon by summer 2009.
  \(\Rightarrow\) Firms were likely to know that they were not going to pay taxes on future investment. \(\Rightarrow\) We take 2008 as our reference year.
Plan

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First stage: $\ln(T/VA)$

\[ \ln Y_{it} = \sum_{l \neq 2008} \beta_{l3} T_{3i} Z_i \times 1\{t = d\} + \psi_{s(i),t} + \alpha_i + \epsilon_{i,t} \]
First stage: $\ln(T/VA)$

$\ln Y_{it} = \sum_{l \neq 2008} \beta_l T_{3,i} Z_i \times \mathbb{1}\{t = d\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t}$

- Decline in tax rate $T3 - T1 \approx -0.50$; Average $T/VA \approx 2.5\%$
First stage: $\ln(T/VA)$

$\ln Y_{it} = \sum_{l \neq 2008} \beta_l T_{3,i} Z_i \times 1\{t = d\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t}$

\[\text{Decline in tax rate } T_3 - T_1 \approx -0.50; \text{ Average } T/VA \approx 2.5\% \Rightarrow -1.25 \text{ pp decline in tax rate. As a comparison: Corporate taxe on profits } = 3.7 \% \text{ of } VA \text{ over the period 2005-2015 (National accounts)}\]
First stage: $\ln(\text{all taxes on production}/\text{VA})$

$\ln Y_{it} = \sum_{l \neq 2008} \beta_l T_{3,i} Z_i \times 1\{t = d\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t}$

- Decline in tax payment from TP to CET is not offset by rise in other taxes on production.
Assets

\[ \ln Y_{it} = \sum_{l \neq 2008} \beta_{lT3,i} Z_i \times \mathbb{1}\{t = d\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

† Positive effect on assets (effects driven by tangible assets).
Sales

\[ \ln Y_{it} = \sum_{l \neq 2008} \beta_l T_{3,i} Z_i \times \mathbb{1}\{t = d\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

- Positive impact on sales, same magnitude as on asset.
- Divergence between T3 and T1 occurs in 2009: anticipation effect or differential effect of the crisis?
- Attentive firms which trusted the government knew that they were not going to pay taxes on investment undertaken in 2009.
High exposure versus low exposure

Sales

We compute 3 quantiles of $Z$ per 2d-sector and trace the evolution of average sales relative to 2008 (not just the gap between T1 and T3).
High exposure versus low exposure

Sales
We compute 3 quantiles of $Z$ per 2d-sector and trace the evolution of average sales relative to 2008 (not just the gap between T1 and T3).

- ◊ 2009 is a bad year for all firms. But perhaps less so for firms in T3.
High exposure versus low exposure

Sales

We compute 3 quantiles of $Z$ per 2d-sector and trace the evolution of average sales relative to 2008 (not just the gap between T1 and T3).

- ◊ 2009 is a bad year for all firms. But perhaps less so for firms in T3.
- ◊ T2 are in an intermediate position.
High exposure versus low exposure

Value-added

The first and second vertical lines correspond to the announcement and the implementation of the reform respectively.

Same pattern for VA.

Note: Value-added exclusive of tax on production (va brute prix de marché)
High exposure versus low exposure

Value-added

The first and second vertical lines correspond to the announcement and the implementation of the reform respectively.

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Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]
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Observations 1,260,544  1,260,544  1,260,390  1,260,390

Firm Fixed Effect √ √ √ √
Sector \times Year 2-digit 4 digit 2 digit \times size 4 digit \times size

Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Average value $\bar{Z} \approx 0.22$
Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{S(i),t} + \alpha_i + \varepsilon_{i,t} \]

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| Observations      | 1,260,544   | 1,260,544   | 1,260,390          | 1,260,390         |
| Firm Fixed Effect | √           | √           | √                  | √                 |
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Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Average value \( \bar{Z} \approx 0.22 \) \( \Rightarrow \) Average effect: Sales + 3.26%
Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

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Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Average value \( \bar{Z} \approx 0.22 \) \( \Rightarrow \) Average effect: Value added + 4.11%
Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

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Observations 1,260,544 1,260,544 1,260,390 1,260,390

Firm Fixed Effect √ √ √ √
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Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Expansion of wage bill and VA are of the same magnitude ⇒ Stable share of compensation over VA.
### Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

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90% of increase in wage bill is driven by increase in hours, 10% hourly wage.
Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

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</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
</tbody>
</table>

| Observations   | 1,260,544   | 1,260,544   | 1,260,390          | 1,260,390          |
| Firm Fixed Effect | √           | √           | √                   | √                  |
| Sector × Year  | 2-digit     | 4 digit     | 2 digit × size      | 4 digit × size     |

Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Results fairly robust to controlling for tighter sectoral specification. Including size (5 categories based on sales in 2008).
Baseline results

\[ \ln Y_{it} = \beta Z_i \times 1\{t > 2008\} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-digit</td>
<td>4 digit</td>
<td>2 digit \times size</td>
<td>4 digit \times size</td>
</tr>
<tr>
<td>Sales</td>
<td>0.148***</td>
<td>0.141***</td>
<td>0.096***</td>
<td>0.091***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Value Added</td>
<td>0.187***</td>
<td>0.183***</td>
<td>0.117***</td>
<td>0.116***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Capital</td>
<td>0.123***</td>
<td>0.111***</td>
<td>0.101***</td>
<td>0.091***</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.022)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Wagebill</td>
<td>0.169***</td>
<td>0.165***</td>
<td>0.120***</td>
<td>0.113***</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.016)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Total hours</td>
<td>0.150***</td>
<td>0.146***</td>
<td>0.102***</td>
<td>0.100***</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Wage per hour</td>
<td>0.019***</td>
<td>0.019***</td>
<td>0.018***</td>
<td>0.019***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
</tbody>
</table>

Observations 1,260,544 1,260,544 1,260,390 1,260,390
Firm Fixed Effect √ √ √ √
Sector \times Year 2-digit 4 digit 2 digit \times size 4 digit \times size

Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

Results suggest that the reform led to an expansion of business but do not see an increase in capital intensity. Compatible with a low ES between KE and other inputs.
2SLS: Overall tax burden ln(T) instrumented by Z

\[ \ln Y_{it} = \beta \ln T_{it} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-digit</td>
<td>4 digit</td>
<td>2 digit × size</td>
<td>4 digit × size</td>
</tr>
<tr>
<td>Sales</td>
<td>-0.057***</td>
<td>-0.053***</td>
<td>0.041***</td>
<td>-0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Value Added</td>
<td>-0.070***</td>
<td>-0.067***</td>
<td>-0.048***</td>
<td>-0.048***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Capital</td>
<td>-0.045***</td>
<td>-0.040***</td>
<td>-0.041***</td>
<td>-0.037***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Wagebill</td>
<td>-0.063***</td>
<td>-0.060***</td>
<td>-0.049***</td>
<td>-0.048***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Total hours</td>
<td>-0.057***</td>
<td>-0.053***</td>
<td>-0.042***</td>
<td>-0.041***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Wage per hour</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>

**First Stage:** dependent variable: log(T)

| Z                  | -0.309*** | -0.321*** | -0.282*** | -0.288*** |
|                    | (0.005)   | (0.004)   | (0.005)   | (0.005)   |

Observations: 1,260,544 | 1,260,544 | 1,260,390 | 1,260,390
KP Wald F-stat.: 5130 | 6043 | 4166 | 4720

◊ Given an average ratio of T/VA = 2.5% and worker compensation over VA = 0.7. Exogenous decline of €1 in tax burden ⇒
**2SLS:** Overall tax burden \( \ln(T) \) instrumented by \( Z \)

\[ \ln Y_{it} = \beta \ln T_{it} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-digit</td>
<td>4 digit</td>
<td>2 digit × size</td>
<td>4 digit × size</td>
</tr>
<tr>
<td>Sales</td>
<td>-0.057*** (0.006)</td>
<td>-0.053*** (0.006)</td>
<td>0.041*** (0.007)</td>
<td>-0.039*** (0.007)</td>
</tr>
<tr>
<td>Value Added</td>
<td>-0.070*** (0.006)</td>
<td>-0.067*** (0.006)</td>
<td>-0.048*** (0.007)</td>
<td>-0.048*** (0.007)</td>
</tr>
<tr>
<td>Capital</td>
<td>-0.045*** (0.008)</td>
<td>-0.040*** (0.008)</td>
<td>-0.041*** (0.009)</td>
<td>-0.037*** (0.009)</td>
</tr>
<tr>
<td>Wagebill</td>
<td>-0.063*** (0.006)</td>
<td>-0.060*** (0.006)</td>
<td>-0.049*** (0.007)</td>
<td>-0.048*** (0.007)</td>
</tr>
<tr>
<td>Total hours</td>
<td>-0.057*** (0.006)</td>
<td>-0.053*** (0.006)</td>
<td>-0.042*** (0.006)</td>
<td>-0.041*** (0.006)</td>
</tr>
<tr>
<td>Wage per hour</td>
<td>-0.007*** (0.002)</td>
<td>-0.007*** (0.002)</td>
<td>-0.007*** (0.002)</td>
<td>-0.007*** (0.002)</td>
</tr>
</tbody>
</table>

**First Stage:** dependent variable: \( \log(T) \)

<table>
<thead>
<tr>
<th>( Z )</th>
<th>[-0.309*** (0.005)]</th>
<th>[-0.321*** (0.004)]</th>
<th>[-0.282*** (0.005)]</th>
<th>[-0.288*** (0.005)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>1,260,544</td>
<td>1,260,544</td>
<td>1,260,390</td>
<td>1,260,390</td>
</tr>
<tr>
<td>KP Wald F-stat.</td>
<td>5130</td>
<td>6043</td>
<td>4166</td>
<td>4720</td>
</tr>
</tbody>
</table>

\[ \diamond \text{Given an average ratio of } T/VA = 2.5\% \text{ and worker compensation over } VA = 0.7. \]

\( \text{Exogenous decline of } €1 \text{ in tax burden } \Rightarrow +€2.8 \text{ in value-added in the long-run;} \)
**2SLS:** Overall tax burden \( \ln(T) \) instrumented by \( Z \)

\[ \ln Y_{it} = \beta \ln T_{it} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1)</th>
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</tr>
</thead>
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<tr>
<td></td>
<td>2-digit</td>
<td>4 digit</td>
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<td>4 digit × size</td>
</tr>
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<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Wage per hour</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
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</tr>
</tbody>
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**First Stage:** dependent variable: \( \log(T) \)

<table>
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<tr>
<th>( Z )</th>
<th>-0.309***</th>
<th>-0.321***</th>
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<table>
<thead>
<tr>
<th>Observations</th>
<th>1,260,544</th>
<th>1,260,544</th>
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<td>5130</td>
<td>6043</td>
<td>4166</td>
<td>4720</td>
</tr>
</tbody>
</table>

\( \diamond \) Given an average ratio of \( T/VA = 2.5\% \) and worker compensation over \( VA = 0.7 \). Exogenous decline of \( \varepsilon 1 \) in tax burden \( \Rightarrow +\varepsilon 1.76 \) spent on wagebill;
2SLS: Overall tax burden \( \ln(T) \) instrumented by \( Z \)

\[ \ln Y_{it} = \beta \ln T_{it} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1) 2-digit</th>
<th>(2) 4 digit</th>
<th>(3) 2 digit ( \times ) size</th>
<th>(4) 4 digit ( \times ) size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>-0.057***</td>
<td>-0.053***</td>
<td>0.041***</td>
<td>-0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
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</tr>
<tr>
<td>Value Added</td>
<td>-0.070***</td>
<td>-0.067***</td>
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<td>-0.048***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
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<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Capital</td>
<td>-0.045***</td>
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</tr>
<tr>
<td></td>
<td>(0.008)</td>
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<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Wagebill</td>
<td>-0.063***</td>
<td>-0.060***</td>
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</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Total hours</td>
<td>-0.057***</td>
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</tr>
<tr>
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<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Wage per hour</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
<td>-0.007***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
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</tr>
</tbody>
</table>

First Stage: dependent variable: \( \log(T) \)

<table>
<thead>
<tr>
<th>( Z )</th>
<th>-0.309***</th>
<th>-0.321***</th>
<th>-0.282***</th>
<th>-0.288***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
</tbody>
</table>

Observations 1,260,544 1,260,544 1,260,390 1,260,390
KP Wald F-stat. 5130 6043 4166 4720

\( \diamond \) Given an average ratio of \( T/VA = 2.5\% \) and worker compensation over \( VA = 0.7 \). Exogenous decline of \( €1 \) in tax burden \( \Rightarrow \) +\( €1.60 \) goes to increasing hours and +\( €0.16 \) goes to increasing hourly wages.
2SLS: Overall tax burden $\ln(T)$ instrumented by $Z$

$\diamond \ln Y_{it} = \beta \ln T_{it} + \psi_{s(i),t} + \alpha_i + \varepsilon_{i,t}$

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>(1)</th>
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<td>2-digit</td>
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<td></td>
<td>(0.006)</td>
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<td>(0.007)</td>
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<tr>
<td>Value Added</td>
<td>-0.070***</td>
<td>-0.067***</td>
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<tr>
<td></td>
<td>(0.006)</td>
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<td>Capital</td>
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<td>Wage per hour</td>
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<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>

First Stage: dependent variable: $\log(T)$

| $Z$               | -0.309*** | -0.321*** | -0.282*** | -0.288*** |
|                  | (0.005) | (0.004) | (0.005) | (0.005) |
| Observations     | 1,260,544 | 1,260,544 | 1,260,390 | 1,260,390 |
| KP Wald F-stat.  | 5130 | 6043 | 4166 | 4720 |

Positive but small incidence on labor. Simple computations based estimates suggest that incidence share $\approx 5\%$
Robustness test

- Using ln(all prod taxes / VA) as endogenous variable
- Different baseline years to define the instrument: average 2005-2008 or 2006

<table>
<thead>
<tr>
<th>Dep. Var.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endog var: ln(Impot/VA)</td>
<td>-0.121***</td>
<td>-0.152***</td>
<td>-0.100***</td>
<td>-0.137***</td>
<td>-0.122***</td>
<td>-0.015***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.017)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Instrument w/ baseline year 2006</td>
<td>-0.028***</td>
<td>-0.020***</td>
<td>-0.006</td>
<td>-0.032***</td>
<td>-0.028***</td>
<td>-0.004***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Instrument w/ year 05-08</td>
<td>-0.044***</td>
<td>-0.036***</td>
<td>-0.025***</td>
<td>-0.047***</td>
<td>-0.042***</td>
<td>-0.005***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.007)</td>
<td>(0.005)</td>
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<td>Observations</td>
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<td>1,260,544</td>
<td>1,260,544</td>
</tr>
<tr>
<td>Sector × Year</td>
<td>2-digit</td>
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Plan

Introduction

Institutional background

Data

Some descriptive findings

Empirical approach
  Motivating conceptual framework
  Empirical strategy

Results
  Graphical results
  Static specification

Conclusion
Conclusion

- **Assessing tax on capital factor: *taxe professionnelle* reform in 2010**
  - Generates substantial tax burden decrease heterogeneously distributed
  - Measurement thanks to rich set of administrative databases
  - Implement difference-in-differences setting on instrument of tax reform

- **Substantial impact on firms decisions/output**
  - Increase in capital, sales and value-added
  - Increase in wage bill, mostly driven by hours
  - Labor born a small share of the burden of the tax.

- **Empirical work remaining**
  - Robustness tests (more precise matching)
  - *Douane database*: export volumes and unit values (pass-through)
  - *DADS*: (1) employment reallocation across establishments (2) wage and employment per socioprofessionnal categories

- **Other on-going work**
  - Model-based aggregation of the relative effect of the reform estimated in DiD with I-0 linkages (start with sector specific effects)
  - Pre-reform event-study around large changes in local rate to study the capital and labor reallocation across plants, across and within-firms
Back up slides
Details on CVAE

\[ \tau_t^n(S) = \begin{cases} 
0 & \text{if } S < 0.5 \\
0.005 \frac{S-0.5}{2.5} & \text{if } 0.5 \leq S < 3 \\
0.005 + 0.009 \frac{S-3}{7} & \text{if } 3 \leq S < 10 \\
0.014 + 0.001 \frac{S-10}{40} & \text{if } 10 \leq S < 50 \\
0.015 & \text{if } S \geq 50 
\end{cases} \]
Evolution of aggregates

Based on the estimation sample
Evolution of aggregates

National accounts

- Nonwage tax on production paid by NFCs (left)
- Value added by NFCs (right)
Overall tax rate in 2008, by municipality
Ex-ante gains by aggregated sector

Ex-ante gains = \( \frac{TP_{08} - (\hat{CVAE}_{08} + \hat{CFE}_{08})}{VA_{08}} \) (estimation sample)

He were substract the CET = CVAE + CFE based on 2008 tax base from the actual 2008 tax burden divided by VA 2008.
Ex-ante gains within sector

Back
\section*{2SLS: ln(T/VA)}

\begin{table}[h]
\centering
\begin{tabular}{lcccc}
\hline
 & (1) & (2) & (3) & (4) \\
\hline
Sales & -0.054*** & -0.050*** & -0.040*** & -0.038*** \\
 & (0.006) & (0.005) & (0.006) & (0.006) \\
Value Added & -0.067*** & -0.064*** & -0.047*** & -0.047*** \\
 & (0.006) & (0.006) & (0.007) & (0.006) \\
Capital & -0.043*** & -0.039*** & -0.039*** & -0.036*** \\
 & (0.008) & (0.007) & (0.009) & (0.009) \\
Wagebill & -0.060*** & -0.057*** & -0.048*** & -0.047*** \\
 & (0.005) & (0.005) & (0.006) & (0.006) \\
Total hours & -0.054*** & -0.051*** & -0.041*** & -0.040*** \\
 & (0.005) & (0.005) & (0.006) & (0.006) \\
Wage per hour & -0.006*** & -0.006*** & -0.007*** & -0.007*** \\
 & (0.002) & (0.002) & (0.002) & (0.002) \\
\hline
Observations & 1,260,544 & 1,260,544 & 1,260,390 & 1,260,390 \\
\hline
\textbf{First stage} & & & & \\
log of average tax rate \( \ln(T/VA) \) & & & & \\
KP Wald F-stat. & 6654 & 7848 & 5210 & 5951 \\
1st stage coef. & -2.847*** & -2.924*** & -2.552*** & -2.582*** \\
 & (0.035) & (0.033) & (0.035) & (0.033) \\
\hline
Firm Fixed Effect & $\checkmark$ & $\checkmark$ & $\checkmark$ & $\checkmark$ \\
Sector $\times$ Year & 2-digit & 4 digit & 2 digit $\times$ size & 4 digit $\times$ size \\
\hline
\end{tabular}
\end{table}
## Robustness checks: 2SLS

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</thead>
<tbody>
<tr>
<td>Endog var: ln(Impot/VA)</td>
<td>-0.121***</td>
<td>-0.152***</td>
<td>-0.100***</td>
<td>-0.137***</td>
<td>-0.122***</td>
<td>-0.015***</td>
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<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.017)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Instrument w/ baseline year 2006</td>
<td>-0.028***</td>
<td>-0.020***</td>
<td>-0.006</td>
<td>-0.032***</td>
<td>-0.028***</td>
<td>-0.004***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Instrument w/ year 05-08</td>
<td>-0.044***</td>
<td>-0.036***</td>
<td>-0.025***</td>
<td>-0.047***</td>
<td>-0.042***</td>
<td>-0.005***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.002)</td>
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<tr>
<td>Observations</td>
<td>1,260,544</td>
<td>1,260,544</td>
<td>1,260,390</td>
<td>1,260,390</td>
<td>1,260,544</td>
<td>1,260,544</td>
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<tr>
<td>Sector × Year</td>
<td>2-digit</td>
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<td>2 digit</td>
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Share of the burden born by labor

- Workers have QL preference with indirect utility $V(w)$.
- Firms have the same profit function as before:
  \[ \Pi = pY - wL - rK(1 + \tau_K) - Y\tau_Y \]
- Overall changes in welfare following a marginal change in the instrument $dZ$:
  \[ dW = LdV + d\Pi \]
- Envelop theorem implies:
  \[
  dV = L \frac{dw}{dZ} dZ \quad \text{and} \quad d\Pi = -\frac{dw}{dZ} dZ L - rK \frac{d\tau_K}{dZ} dZ
  \]
  We assume that $\frac{d\tau_Y}{dZ} = 0$.
  Overall change in welfare writes as: \[ dW = -rK\frac{d\tau_K}{dZ} dZ \]
- Labor share:
  \[
  I_L \equiv \frac{dV}{dV + d\Pi} = \frac{dw}{dZ} wL / rK \left( \frac{d\tau_K}{dZ} \right) = \hat{\beta}_RF^{\w} \frac{\alpha_L}{1 - \alpha_L} / \left( \frac{d\tau_K}{dZ} \right) = 4.43\% / \left( \frac{d\tau_K}{dZ} \right) = 4.43\%
  \]
  Assuming our instrument maps one-to-one with changes in marginal rate and calibrating the labor share $\alpha_L = 0.7$ and choosing $\hat{\beta}_RF^{\w} = 1.9\%$. 

Back