Changes in firms’ regimes of competitiveness during the Great recession. Evidence for French manufacturing industries

S. Dobbelaere  E. Jousselin  R. Lecat  J. Mairesse

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2. Theoretical model
3. Econometric model
4. Data
5. Results
6. Conclusion
Motivation I

Understanding the dynamic nature of market power in general and the response of market power to recessionary pressure in particular is conductive for analysing:

▶ changes in firms' optimal factor demands;
▶ the distribution of economic rents between capital and labor;
▶ changes in the share of income accruing to the workers.

What do we know about the joint evolution of market power in product markets and labor markets?

▶ Understanding the joint responses of firms' pricing behavior in product and labor markets to recessionary pressure complements recent empirical evidence on the increase of firm's wage-setting power during economic downturns.
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Our study starts from the belief that product and labor markets are intrinsically characterized by imperfections and by the finding that variable input factors’ estimated marginal products are not equal to their measured payments. Most microeconometric studies on matching the dynamic nature of factor inputs are still subject to a fundamental omitted variable bias due to persistent lack of direct data on factor utilization at the firm or establishment level. Firms change their demand for inputs more slowly than the shocks to input demand warrant. Rather, they instantaneously alter the degrees of factor utilization.
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- Firms change their demand for inputs more slowly than the shocks to input demand warrant. Rather, they instantaneously alter the degrees of factor utilization. ▶ Evolution of the CUR

  - Capacity utilization is the main short-term adjustment factor to demand shocks (Cette et al., 2016)
This paper

We identify a firm’s regime of competitiveness, corresponding to a product market setting and a labor market setting, taking the dependence in pricing rules in both market into account.

We document time variation in firms’ market power in product and labor markets.

We examine switches in a firm’s product/labor market setting before, during and after the financial crisis which we define to be the period 2007-2009.

We document:

⋆ shifts in the extensive margin of product and labor market power, that is, shifts in the prevalence of price-marginal cost pricing, and wage markup versus wage markdown pricing (what we have done so far), but also

⋆ shifts in the intensive margin of product and labor market power, that is, shifts in the intensity of price-marginal cost pricing, and wage markup versus wage markdown pricing, conditional on a particular pricing rule (what we still have to do)
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Theoretical model with imperfect product and labor markets

To model a firm's product and labor market power, we follow Dobbelaere and Mairesse (2013):

Each firm at any point in time produces output using labor, intermediate input and capital. Intermediate input and labor are free of adjustment costs whereas capital is predetermined in the short run.

The first-order condition for output yields the firm's price-cost markup as

\[ \mu_{it} = \frac{P_{it}}{(C_{it}Q_{it})_{it}} \]

with \( P_{it} \) the output price and \( (C_{it}Q_{it})_{it} \) the marginal cost of production.

The FOC for intermediate input is given by setting the marginal revenue product of intermediate input equal to the price of intermediate input:

\[ (Q_{it}M_{it})_{it} = \mu_{it} J_{it} P_{it} Q_{it} \]

We thus obtain an expression for firm \( i \)'s price-cost markup:

\[ \mu_{it} = (\varepsilon Q_{it}M_{it})_{it} \alpha_{M_{it}} (1) \]

with \( (\varepsilon Q_{it}M_{it})_{it} \) the output elasticity with respect to intermediate input and \( \alpha_{M_{it}} = J_{it} M_{it} P_{it} Q_{it} \) the share of intermediate input expenditure in total revenue.
Theoretical model with imperfect product and labor markets

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The first-order condition for output yields the firm’s price-cost markup

\[ \mu_{it} = \frac{P_{it}}{(CQ)_{it}} \], with \( P_{it} \) the output price and \( (CQ)_{it} \) the marginal cost of production.

The FOC for intermediate input is given by setting the marginal revenue product of intermediate input equal to the price of intermediate input:

\[ (QM)_{it} = \mu_{it} \frac{J_{it}}{P_{it}}. \]

We thus obtain an expression for firm \( i \)'s price-cost markup \( \mu_{it} \):

\[ \mu_{it} = \frac{(\varepsilon Q)_{it}}{\alpha_{it}^M} \]  

(1)

with \( (\varepsilon Q)_{it} \) the output elasticity with respect to intermediate input and \( \alpha_{it}^M = \frac{J_{it}M_{it}}{P_{it}Q_{it}} \) the share of intermediate input expenditure in total revenue.
Theoretical model with imperfect product and labor markets

The value of $\mu$ determines the firm's type of competition prevailing in the product market or its product market setting (denoted $PMS$).

- The product market setting is defined to be perfectly competitive if the firm engages in marginal cost pricing ($PMC$).

- The product market setting is defined to be imperfectly competitive if the firm sets a price-cost markup ($PMU$).

We consider 3 types of competition prevailing in the labor market or its labor market setting (denoted $LMS$).

- $LMS$ is defined to be perfectly competitive if the firm engages in marginal product pricing ($WMP$).

- $LMS$ is defined to be imperfectly competitive if the firm either pays a wage markup ($WMU$), or sets a wage markdown ($WMD$).
Theoretical model with imperfect product and labor markets

- The value of $\mu_{it}$ determines the firm’s type of competition prevailing in the product market or its product market setting (denoted $PMS$).
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  - or sets a wage markdown ($WMD$).
Theoretical model with imperfect product and labor markets

$LMS = WMP$

- The perfectly competitive labor market setting arises when the wage-employment contract lies on the firm’s labor demand curve, which characterizes profit-maximizing employment levels.
- Under $LMS = WMP$, FOC of labor is given by setting the marginal revenue product of labor equal to the price of labor: $(Q_N)_{it} = \mu_{it} W_{it} / P_{it}$, with $(Q_N)_{it}$ the marginal product of labor and $\alpha^N_{it} = \frac{W_{it} N_{it}}{P_{it} Q_{it}}$ the share of labor input expenditure in total revenue.
- In that case, there exists no wedge between the output elasticities of intermediate inputs and labor and their respective revenue shares.
- Since this wedge is derived using the first-order conditions for output, intermediate input and labor, we call this wedge the firm’s joint market imperfections parameter $\psi_{it}$:

$$\psi_{it} = \left( \frac{\varepsilon^Q_M}{\alpha^M_{it}} \right)_{it} - \left( \frac{\varepsilon^Q_N}{\alpha^N_{it}} \right)_{it} = 0 \quad (2)$$
Theoretical model with imperfect product and labor markets

$LMS = WMU$

- Wage-markup pricing might arise when workers' bargaining power forces employers to pay a wage markup.
- Dobbelare and Mairesse (2013) show that the first-order condition for labor is given by: 
  \[ (\varepsilon_N^Q)_{it} = \mu_{it} \alpha_{it}^N - \mu_{it} \gamma_{it} (1 - \alpha_{it}^N - \alpha_{it}^M) \]
  with \( \gamma_{it} = \frac{\phi_{it}}{1 - \phi_{it}} \geq 0 \) the relative extent of rent sharing and \( \phi_{it} \in [0, 1] \) the part of economic rents going to the workers or the degree of workers' bargaining power during worker-firm negotiations.
- Hence, the firm’s joint market imperfections parameters \( \psi_{it} \) under \( LMS = WMU \) is equal to:
  \[ \psi_{it} = \frac{(\varepsilon_Q^M)_{it}}{\alpha_{it}^M} - \frac{(\varepsilon_Q^N)_{it}}{\alpha_{it}^N} = \mu_{it} \frac{\phi_{it}}{1 - \phi_{it}} \left[ \frac{1 - \alpha_{it}^N - \alpha_{it}^M}{\alpha_{it}^N} \right] > 0 \] (3)
Theoretical model with imperfect product and labor markets

$LMS = WMD$

- Wage-markdown pricing might arise from firms' monopsony power that enables them to set a wage markdown.

- Dobbelaere and Mairesse (2013) show that the first-order condition for labor is given by: 
  \[ (\varepsilon^Q_N)_{it} = \mu_{it} \alpha^N_{it} \left( 1 + \frac{1}{(\varepsilon^N_w)_{it}} \right) \]
  with \((\varepsilon^N_w)_{it} \in \mathbb{R}_+\) the wage elasticity of the labor supply of firm \(i\), measuring the degree of wage-setting power that firm \(i\) possesses.

- Hence, the firm's joint market imperfections parameters \(\psi_{it}\) under \(LMS = WMD\) is equal to:

  \[ \psi_{it} = \frac{(\varepsilon^Q_M)_{it}}{\alpha^M_{it}} - \frac{(\varepsilon^Q_N)_{it}}{\alpha^N_{it}} = -\frac{\mu_{it}}{(\varepsilon^N_w)_{it}} < 0 \]  
  \(\text{(4)}\)
Theoretical model with imperfect product and labor markets

In summary,

<table>
<thead>
<tr>
<th>Regime R</th>
<th>LMS = WMD: ( \psi_{it} &lt; 0 )</th>
<th>LMS = WMP: ( \psi_{it} = 0 )</th>
<th>LMS = WMU: ( \psi_{it} &gt; 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMS = PMC: ( \mu_{it} - 1 = 0 )</td>
<td>(PMC-WMD)</td>
<td>(PMC-WMP)</td>
<td>(PMC-WMU)</td>
</tr>
<tr>
<td>PMS = PMU: ( \mu_{it} - 1 &gt; 0 )</td>
<td>(PMU-WMD)</td>
<td>(PMU-WMP)</td>
<td>(PMU-WMU)</td>
</tr>
</tbody>
</table>
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In order to obtain $(\varepsilon_Q^N)_{it}$ and $(\varepsilon_Q^M)_{it}$, we only consider production functions with

- a scalar Hicks-neutral productivity term which is observed by the firm but unobserved by the econometrician (denoted by $\omega_{it}$)
- a common technology parameters, governing the transformation of inputs to units of output, across a set of producers (denoted by the vector $\beta$)

These two assumptions imply the following expression for the production function:

$$Q_{it} = F(N_{it}, M_{it}, K_{it}, CUR_{it}, DUM; \beta) \exp(\omega_{it}).$$  \hspace{1cm} (5)

We denote the logs of $Q_{it}$, $N_{it}$, $M_{it}$ and $K_{it}$ by $q_{it}$, $n_{it}$, $m_{it}$ and $k_{it}$, respectively.
Econometric model (II)

- In order to obtain consistent estimates of the production function coefficients ($\beta$) for each of our 22 two-digit industries, we need to control for unobserved productivity shocks $\omega_{it}$, which are potentially correlated with the firm’s input choices.
  - We apply the two stages estimation procedure proposed by Ackerberg, Caves, and Frazer (2015).
  - To deal with the omitted variable bias arising from ignoring factor utilization at the firm level, we control for firm-year varying capacity utilization degrees ($CUR_{it}$).

Timing assumptions:
- $k_{it}$ is assumed to be decided a period ahead (at $t - 1$) because of planning and installation lags.
- $n_{it}$ is "less variable" than $m_{it}$
  - $n_{it}$ is chosen by firm $i$ at time $t - b$ ($0 < b < 1$), after $k_{it}$ being chosen at ($t - 1$) but prior to $m_{it}$ being chosen at ($t$).
**Econometric model (III)**

- Productivity \( (\omega_{it}) \) evolves according to an endogenous first-order Markov process. We allow a firm’s decision to export \( (EXP_{it-1}) \) to endogenously affect future productivity. We can decompose \( \omega_{it} \) into its conditional expectation given the information known by the firm in \( t-1 \) (denoted \( I_{it-1} \)) and a random innovation to productivity (denoted \( \xi_{it} \)):

\[
\omega_{it} = E[\omega_{it} | I_{it-1}] + \xi_{it} = E[\omega_{it} | \omega_{it-1}, EXP_{it-1}] + \xi_{it} = g(\omega_{it-1}, EXP_{it-1}) + \xi_{it}
\]  

(6)

- Given these timing assumptions, the following structure on optimal intermediate input demand is imposed:

\[
m_{it} = m_t(n_{it}, k_{it}, CUR_{it}, EXP_{it}, \omega_{it}).
\]  

(7)

- The scalar unobservable assumption and the assumption that \( m_t(\cdot) \) is strictly increasing in \( \omega_{it} \) allow to invert \( \omega_{it} \) as a function of observables:

\[
\omega_{it} = m_t^{-1}(m_{it}, n_{it}, k_{it}, CUR_{it}, EXP_{it}).
\]  

(8)
Econometric model (IV)

- Considering the logarithmic version of Eq. (5) and allowing for an idiosyncratic error term including non-predictable output shocks and potential measurement error in output and inputs ($\epsilon_{it}$) gives:

\[ y_{it} = f(n_{it}, m_{it}, k_{it}, CUR_{it}; \beta) + \omega_{it} + \epsilon_{it}, \]  

where $y_{it} = q_{it} + \epsilon_{it}$ with $\epsilon_{it}$ assumed to be mean independent of current and past input choices.

- We approximate $f(\cdot)$ by translog production function, with the $CUR$ variable:

\[ y_{it} = \beta_0 + \beta_n n_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_{nn} n_{it}^2 + \beta_{mm} m_{it}^2 + \beta_{kk} k_{it}^2 
+ \beta_{nm} n_{it} m_{it} + \beta_{nk} n_{it} k_{it} + \beta_{mk} m_{it} k_{it} + \beta_{CUR} CUR_{it} + \beta_{DUM} DUM + \omega_{it} + \epsilon_{it} \]  

where $\beta_0$ has to be interpreted as the mean efficiency level across firms.
Econometric model (V)

- Substituting Eq. (8) in Eq. (10) results in a first-stage equation of the form:

\[ y_{it} = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, CUR_{it}, EXP_{it}) + \epsilon_{it} = \varphi_t(n_{it}, m_{it}, k_{it}, CUR_{it}, EXP_{it}) + \epsilon_{it} \]  

(11)

- purpose: eliminating the portion of output \( q_{it} \) determined by unanticipated output shocks, measurement error or any other random noise (\( \epsilon_{it} \))

- The first stage involves using Eq. (11) and the moment condition \( \mathbb{E}[\epsilon_{it}|l_{it}] = 0 \) to obtain an estimate \( \hat{\varphi}_{it} \).

  - implemented by regressing output on a second-order polynomial series expansion
  - to allow for time variation in \( \phi_{it} \), these polynomial terms are interacted with a time trend
Econometric model (VI)

- Given a particular set of parameters $\beta$, we can compute (up to a scalar constant) an estimate of $\omega_{it}$:

$$
\hat{\omega}_{it}(\beta) = \varphi_{it} - \beta_0 - \beta_n n_{it} - \beta_m m_{it} - \beta_k k_{it} - \beta_{nn} n_{it}^2 - \beta_{mm} m_{it}^2 - \beta_{kk} k_{it}^2
\quad - \beta_{nm} n_{it} m_{it} - \beta_{nk} n_{it} k_{it} - \beta_{mk} m_{it} k_{it} - \beta_{CUR} CUR_{it}.
$$

(12)

- In order to implement the second stage and to identify $\beta$, we need to recover the innovation to productivity $\xi_{it}$ to form moments on. Using Eq. (12), a consistent approximation to $\mathbb{E}[\omega_{it} | \omega_{it-1}, EXP_{it-1}]$ is given by the predicted values from regressing nonparametrically $\hat{\omega}_{it}(\beta)$ on $\hat{\omega}_{it-1}(\beta)$ and $EXP_{it-1}$.

  - the residual from this regression provides us with an estimate of $\xi_{it}$

- Given the timing assumptions on input use, the following population moment conditions can be defined: $\mathbb{E}[\xi_{it}(\beta) d] = 0$ where the set of instruments is:

$$
d_{it} = \{ n_{it-1}, m_{it-1}, k_{it}, n_{it-1}^2, m_{it-1}^2, k_{it}^2, n_{it-1} m_{it-1}, n_{it-1} k_{it}, m_{it-1} k_{it} \}
$$

(13)
Econometric model (VII)

- Exploiting these moment conditions, we can estimate $\beta$ using standard GMM and rely on block bootstrapping for the standard errors.

- $\hat{\beta}$ are then used together with data on inputs to compute the output elasticities at the firm-year level:

\[
(\hat{\varepsilon}_Q^Q)_{it} = \hat{\beta}_n + 2\hat{\beta}_{nn}n_{it} + \hat{\beta}_{nm}m_{it} + \hat{\beta}_{nk}k_{it}.
\]  

\[
(\hat{\varepsilon}_M^Q)_{it} = \hat{\beta}_m + 2\hat{\beta}_{mm}m_{it} + \hat{\beta}_{mn}n_{it} + \hat{\beta}_{mk}k_{it}.
\]  

- we can compute $\hat{\mu}_{it}$ and $\hat{\psi}_{it}$ as follows:

\[
\hat{\mu}_{it} = \frac{(\hat{\varepsilon}_M^Q)_{it}}{\hat{\alpha}_M^M_{it}},
\]  

\[
\hat{\psi}_{it} = \frac{(\hat{\varepsilon}_M^Q)_{it}}{\hat{\alpha}_M^M_{it}} - \frac{(\hat{\varepsilon}_N^Q)_{it}}{\hat{\alpha}_N^N_{it}}.
\]
Based on the estimates $\hat{\mu}_{it}$ and $\hat{\psi}_{it}$, we are able to determine for each firm $i$ at time $t$ the product market setting $PMS \in \{PMC, PMU\}$ and the labor market setting $LMS \in \{WMP, WMU, WMD\}$

- to determine firm $i$’s $PMS$ at time $t$, we use the 95% confidence interval of $\mu_{it}$
- to determine firm $i$’s $LMS$ at time $t$, we compare the 95% confidence intervals for $\text{gap}_{Nit} = \frac{(\varepsilon_{N})_{it}}{\alpha_{it}}$ and $\mu_{it}$
- hence, firm $i$’s regime of competitiveness $R \in \mathbb{R} = \{PMC-WMP, PMU-WMP, PMC-WMU, PMU-WMU, PMC-WMD, PMU-WMD\}$
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Data

- FiBEn, Fichier bancaire des entreprises (Banque de France)
- Business Survey on Economic Conditions (Banque de France)
  - \( \approx 5,500 \) firms in 22 manufacturing industries covering the period 1995-2014
## Data

<table>
<thead>
<tr>
<th>IND</th>
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<td>22</td>
<td>repair</td>
<td>284</td>
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<td>total</td>
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# Data

<table>
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<th></th>
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<th>Q2</th>
<th>Q3</th>
<th>#Obs.</th>
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<tr>
<td>Real firm output growth rate $\Delta q_{it}$</td>
<td>0.008</td>
<td>0.160</td>
<td>-0.075</td>
<td>0.010</td>
<td>0.094</td>
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<td>Labor growth rate $\Delta n_{it}$</td>
<td>-0.002</td>
<td>0.098</td>
<td>-0.044</td>
<td>0.000</td>
<td>0.039</td>
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<tr>
<td>Materials growth rate $\Delta m_{it}$</td>
<td>0.015</td>
<td>0.177</td>
<td>-0.078</td>
<td>0.015</td>
<td>0.110</td>
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<tr>
<td>Capital growth rate $\Delta k_{it}$</td>
<td>0.052</td>
<td>0.120</td>
<td>0.000</td>
<td>0.033</td>
<td>0.082</td>
<td>57117</td>
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<tr>
<td>$\alpha_{it}^N(\Delta n_{it} - \Delta k_{it}) + \alpha_{it}^M(\Delta m_{it} - \Delta k_{it})$</td>
<td>-0.041</td>
<td>0.162</td>
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<td>-0.031</td>
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<td>$\alpha_{it}^N(\Delta k_{it} - \Delta n_{it})$</td>
<td>0.016</td>
<td>0.045</td>
<td>-0.003</td>
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<td>Solow Residual $SR_{it}^a$</td>
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<td>Materials share in total sales $\alpha_{it}^M$</td>
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<td>Capital share in total revenue $^b$</td>
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Note: $^{a}SR_{it} = \Delta q_{it} - s_{Nit}\Delta n_{it} - s_{Mit}\Delta m_{it} - (1 - s_{Nit} - s_{Mit})\Delta k_{it}$

$^{b}(1 - \alpha_{it}^N - \alpha_{it}^M)$
Plan

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2. Theoretical model
3. Econometric model
4. Data
5. Results
6. Conclusion
# Results

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<tr>
<th>YEAR</th>
<th>Obs.</th>
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<th>PMU-WMP</th>
<th>PMC-WMU</th>
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Results - Evolution of the regimes during the period
Results - All transitions during the period

1998 - 1999

[Bar chart showing transitions between different codes (e.g., PMC-WMP, PMU-WMP, PMC-WM)]
Results - All transitions during the period

1999 - 2000

[Bar chart showing transitions between different categories such as PMC-WMP, PMU-WMP, PMC-WM, etc., for the years 1999-2000.]
Results - All transitions during the period

2000 - 2001

[Bar chart showing transitions between different categories during the period 2000-2001. The chart includes transitions such as PMC-WMP - PMU-WMP, PMU-WMU - PMU-WMP, and others.]
Results - All transitions during the period

2001 - 2002

PMU-WMP - PMU-WMP
PMU-WMU - PMU-WMU
PMU-WMD
PMC-WMD
Exit

Dobbelaere-Jousselin-Lecat-Mairesse
Results - All transitions during the period

2002 - 2003
Results - All transitions during the period

2003 - 2004

[Bar chart showing transitions between different WMPs and WMDs]
Results - All transitions during the period

2004 - 2005

[Bar chart showing transitions between different categories, such as PMU-WMP, PMU-WMU, PMC-WMP, and Exit, with PMU-WMU to PMU-WMU being the highest transition.]
Results - All transitions during the period

2005 - 2006
Results - All transitions during the period

2006 - 2007

[Bar chart showing transitions between different nodes such as PMU-WMU, PMU-WMD, PMC-WMP, PMU-WMP, and PMC-WMD, with PMU-WMU - PMU-WMU having the highest frequency.]
Results - All transitions during the period

2007 - 2008
Results - All transitions during the period

2008 - 2009
Results - All transitions during the period

2009 - 2010

[Graph showing transitions between different states: PMC-WMP, PMU-WMP, PMC-WMU, PMU-WMU, PMC-WMD, PMU-WMD, Exit. The graph indicates the number of transitions for each pair.]
Results - All transitions during the period

2010 - 2011

Dobbelaere-Jousselin-Lecat-Mairesse

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Results - All transitions during the period

2011 - 2012
Results - All transitions during the period

2012 - 2013
Results - All transitions during the period

2013 - 2014
Results - All transitions during the period
## Results - 3 main regimes

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Results - Evolution of the 3 main regimes

- PMU-WMU
- PMU-WMP
- PMC-WMP
Results - PMU-WMU towards PMC-WMP

- Coefficient plots based on the linear probability model
Results- PMU-WMU towards PMC-WMP (balanced sample)

- Coefficient plots based on the linear probability model
Results - PMU-WMP towards PMC-WMP

- Coefficient plots based on the linear probability model
Results - PMU-WMP towards PMC-WMP (balanced sample)

- Coefficient plots based on the linear probability model
Plan

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Conclusion - to go further

- The dynamic of market power has been strongly affected by the great recession, during which we are witnessing an intensification of changes in regime of competitiveness in our sample.
- The main changes are a decrease in the PMU-WMU and PMU-WMP regimes and an increase in the PMC-WMP regime which plead for a more perfect competition in the product and labor markets.
- Given that changes in regimes have been identified, what is left is understanding heterogeneity in the changes:
  
  1. Distinguish profiles of industries based on common shifts in regimes
  2. Within these profiles, look at exit behavior
  3. Select a few manufacturing industries to document heterogeneous behavior (made at manufacturing level)
  4. Document shifts in the intensity of market power (market imperfections), conditional on a particular PMS/LMS
Evolution of the CUR