Regulations and technology diffusion in Europe:
The role of business dynamics

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“Market competition and business churning (i.e. the rate of entry and exit of firms)—which are affected by country-specific framework conditions— influence the incentives and costs for firms to invest in new technology or adapt existing technologies.”

(ECB, 2018)

Direct and indirect effects of regulatory frameworks
New measure of technology diffusion
Outline of the presentation

1. Background
2. Our measure of technology diffusion
3. Data
4. Empirical model
5. Main results and limitations
- Labour flexibility ↓ firms incentives to invest in human capital formation

- Product market regulation may stimulate innovation in sectors lacking technology (e.g. green/sustainable technologies)

(Lucidi 2012, Égert 2016)

- Strict product market regulations discourage competition and investment

- Financial constraints and difficult access to capital slow down catch-up process

- Labour market rigidities slow down labour reallocation

Many ways to measure technology diffusion (Keller 2004)

▷ Market transactions (trade)

▷ Externalities (R&D spillovers)
  - R&D and TFP (Coe & Helpman 1995)
  - Patent citations (Jaffe et al. 1993)
  - FDI flows (Lichtenberg and van Pottelsberghe 1998)

▷ Catch-up (distance to frontier)
  - Disembodied technology flows from leader to follower at a rate proportional to level of human capital (Nelson-Phelps 1966, Benhabib & Spiegel 2005)
Our methodology to measure technology diffusion

\[ TT_{ijt} = \sum_j w_{jkt} \left[ \ln(TFP_{ikt}) - \ln(TFP_{jt}) \right] \]

where $\overline{TFP}_{jt}$ is the TFP of the frontier firm in sector $j$

\[ w_{jkt} = \frac{Z_{jkt}}{\sum_j Z_{jkt}} \quad \text{and} \quad \sum_j w_{jkt} = 1, \]

where $w_{jkt}$ measures the global intermediate use by sector $k$ of products $Z$ of sector $j$ (of the leader firm) at time $t$
Traditional DTF + all the other DTFs that are trade-related to firms in sectors that import products of the frontier’s sector

\[
TT_{ijt} = w_{jjt} \left[ \ln(TFP_{ijt}) - \ln(TFP_{jt}) \right] + \sum_{j \neq k} w_{jk} \left[ \ln(TFP_{ikt}) - \ln(TFP_{jt}) \right]
\]
Data

- TFP calculated as $\frac{Y}{L^\alpha K^{1-\alpha}}$ with firm-level data from Orbis for 18 EU countries (2007–2017)

- Labour and capital markets flexibility calculated as principal component-based weighted indices from country-level data (WEF)

- Product market regulation is OECD 2013 REGIMPACT sector-level indicator

- Business churn calculated with sector-level entry/exit data from SBS-Eurostat

- Human capital is growth rate of people with tertiary education at the sector-level (HRST, Eurostat)

- Intermediate inputs trade at sector level from WIOD
Mediated regression analysis (Preacher & Hayes 2008)

\[ TT_{it} = \beta_0 + \beta_1 TT_{it-1} + \beta_2 Churn_{jt-1} + \beta_R^* Reg_{jct-1} + \beta_4 HC + e_{it} \]
\[ Churn_{jt} = \beta_R Reg_{jct-1} + u_{jt} \]

Moderation regression analysis (low-churn VS high-churn)

- \( Reg = (LabFlex, CapFlex, ProdMarkReg)' \) are labour, capital and product market regulation
- \( HC \) is the growth rate of human capital
- sector, year, country dummies in each equation

\( \beta_R \beta_2 \) is the indirect effect of regulations on technology diffusion
\( \beta_R^* + \beta_R \beta_2 \) is the total effect
## Main results

<table>
<thead>
<tr>
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<th>3SLS Mediated model</th>
<th>2SLS</th>
<th>GLS Churn: Low</th>
<th>GLS Churn: High</th>
<th>GLS</th>
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<tbody>
<tr>
<td>$TT_{it-1}$</td>
<td>0.713*** (0.001)</td>
<td>0.688*** (0.001)</td>
<td>0.564*** (0.002)</td>
<td>0.642*** (0.002)</td>
<td>0.585*** (0.001)</td>
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<td>LabFlex Index</td>
<td>-0.033*** (0.001)</td>
<td>-0.041*** (0.002)</td>
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<td>0.010*** (0.002)</td>
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<td>Prod Mark Reg</td>
<td>-0.157*** (0.023)</td>
<td>0.907*** (0.059)</td>
<td>2.700*** (0.124)</td>
<td>-1.153*** (0.060)</td>
<td>-0.160*** (0.054)</td>
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<tr>
<td>CapFlex Index</td>
<td>0.109*** (0.001)</td>
<td>0.203*** (0.001)</td>
<td>0.131*** (0.002)</td>
<td>0.217*** (0.002)</td>
<td>0.180*** (0.001)</td>
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<tr>
<td>Churn</td>
<td>0.139*** (0.002)</td>
<td>0.290*** (0.034)</td>
<td>-</td>
<td>0.484*** (0.033)</td>
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<tr>
<td>HC growth</td>
<td>0.009*** (0.001)</td>
<td>0.011** (0.001)</td>
<td>0.053*** (0.001)</td>
<td>0.011*** (0.001)</td>
<td>0.014*** (0.001)</td>
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### Indirect effects

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### Summary statistics

- **N**: 3,260,637, 3,345,298, 1,952,775, 1,171,121, 3,350,416
- **R-sq**: 0.57/0.93, 0.44, 0.58, 0.63, 0.57
More regulation → lower productivity growth/technology diffusion (Scardetta & Tressel 2002, 2004; Crafts 2006)
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if we don’t consider the role of business churning

Moderating > mediating role
- firms in high-churn sectors catch up faster
- HC growth has a larger impact on tech diffusion in low-churn sectors
- more labour market regulation favourable for low-churn sectors (Lucidi 2012, Égert 2016)
- more product market regulation hinders the tech diffusion process of firms in high-churn sectors (Andrews et al. 2015)

One-size-fits-all regulatory model does not lead to broader technology diffusion
Under-representation of firms with less than 20 employees (more subject to entry/exit)

Better measures of TFP

No national frontiers

No additional control of market structure (concentration, fwd/bck linkages, capital intensity)
Thank you!
Questions?