

Innovation and Learning During the Crisis: Evidence From Firm Level Data for Eastern European Countries

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Road map for this talk

1. Motivation
2. Objective
3. Data
4. Methodology and results

Motivation

- “Creative destruction” as an essential engine of long term growth
 - Economic crises are times of industrial renewal, when a *purgative selection* process takes place to eliminate less efficient firms while more dynamic ones emerge
- Due to its magnitude, especially in the ECA region, the current economic crisis might not be synonymous with “creative destruction”
 - The crisis might be adversely affecting firms that could lead productivity growth in a context of normal business cycle and normal credit conditions

Motivation

- Two important sources of productivity growth are (i) **innovation** and (ii) **young firms**
 - (i) **innovation** and R&D tend to positively affect firm-productivity and sales performance [Klette and Kortum (2004); Aw, Roberts and Xu (2008)]
 - (ii) Conditional on size and survival rate, **young firms** are expected to grow faster than older firms, among other reasons, due to diminishing returns to learning [Klepper and Thompson (2007); Dunne, Roberts and Samuelson (1989)]
- Empirical analysis for Eastern European countries (in 2001-2004) show that:
 - Increasing innovation raises firm productivity growth
 - Young firms are often more productive than the incumbents

Source: World Bank (2008) – “Unleashing Prosperity: Productivity Growth in Eastern Europe and the Former Soviet Union”

Objective of the paper

- To understand how the crisis affected innovative and young enterprises in Eastern European countries
 - If firm learning and innovation are relevant sources of growth in the post-crisis period, examining the crisis impact on young and innovative firms helps comprehend Eastern European growth prospects

Data

- Unbalanced panel data for 3,363 firms in seven countries (Bulgaria, Hungary, Kazakhstan, Latvia, Lithuania, Romania, and Turkey) covering manufacturing, retail and other service sectors.
 - Four time period(2007, June 2009, January 2010, and June 2010)
- Resulting from the matching of two datasets
 - **World Bank's Financial Crisis Survey (FCS)**
 - implemented in June 2009, January 2010 and June 2010 and designed to capture the effects of the crisis on key elements of the private economy
 - **World Bank's Enterprise Survey (ES) carried out in 2008**
 - With most of data refereed to FY2007, the pre-crisis scenario, the ES 2008 provides information on firm characteristics, various performance measures and the business environment. The original sample is stratified by firm size, sector and region and representative of the private nonagricultural formal economy in each country

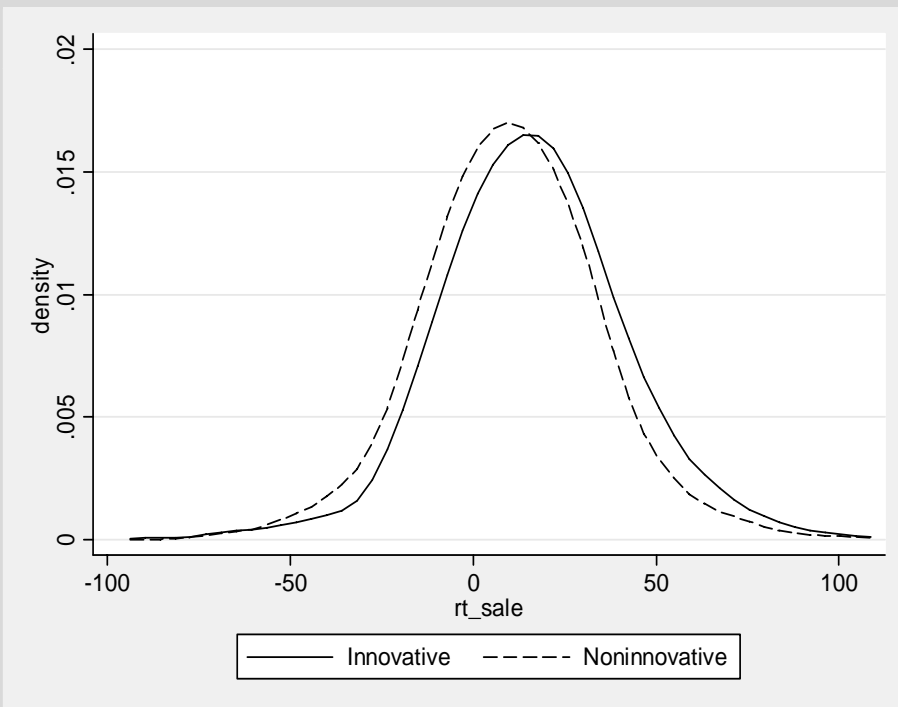
Data

- We classify the firms into groups of:
 - **i) young and older firms**
 - a dummy $Young_i$ for firms up to five years old before the crisis (2007)
 - **ii) innovative or non-innovative companies**
 - a dummy $Inov_i$ for firms that have introduced new product or process in the period 2005-2007, according to ES2008 or
 - a dummy $Inov_i$ for firms that have performed R&D in the period 2005-2007, according to ES 2008
- We examine a particular measure of firm performance: **growth in sales**
 - **i) Before the crisis**: annualized growth rate of sales in the 2004-2007 period (according to ES2008)
 - **ii) After** : annual growth rate of sales in the following periods: June2008-June2009 , January 2009-January2010, and June2009-June 2010 (according to FCS)

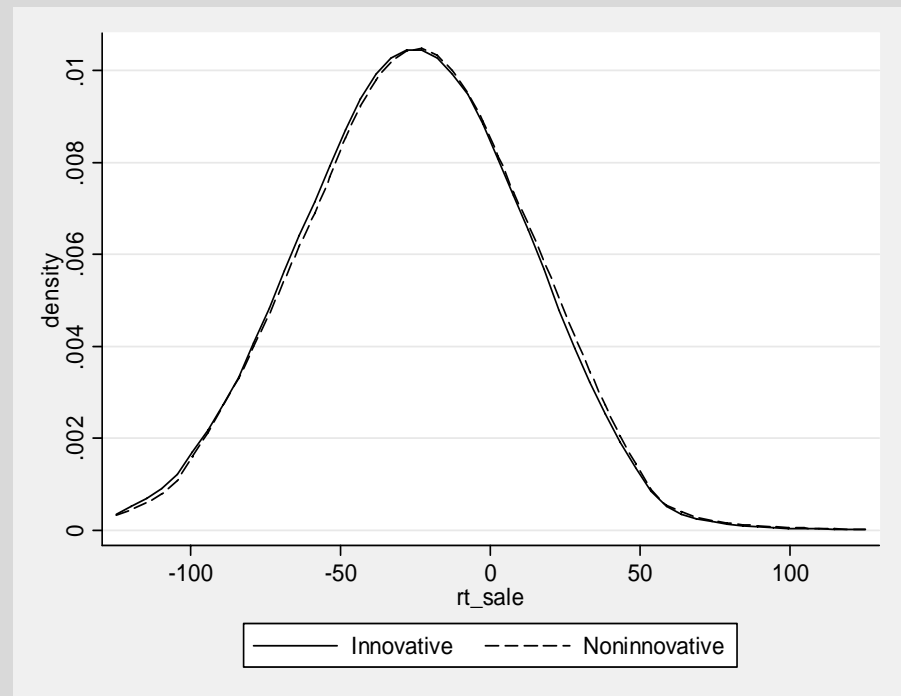
Innovative firms were growing faster before the crisis but not after

Sales Growth Rate of Innovative and Noninnovative Firms

Before the crisis (2004-2007)



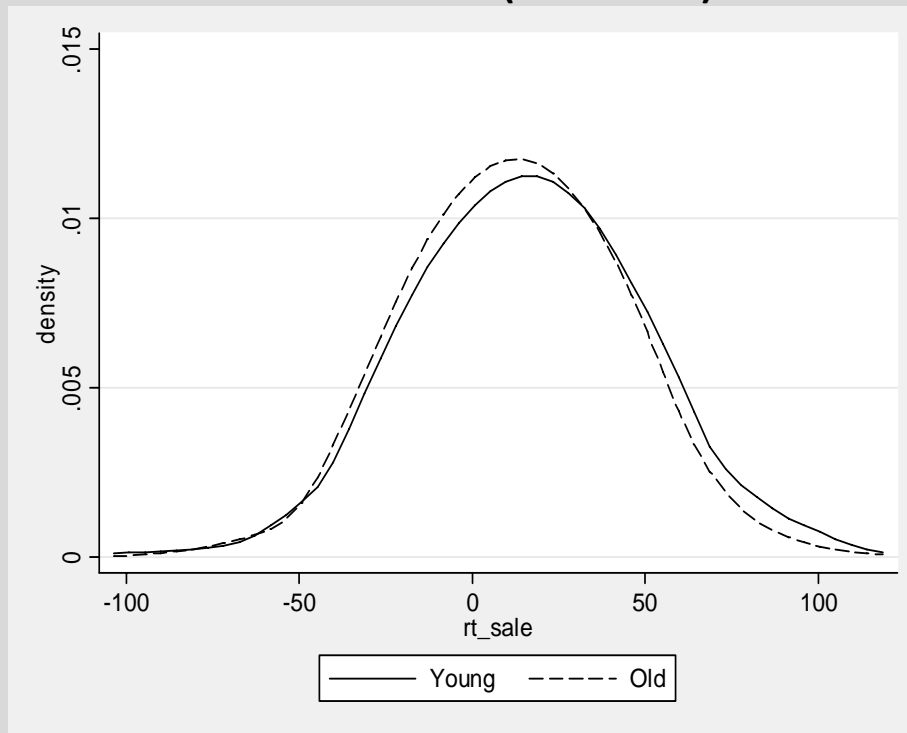
After



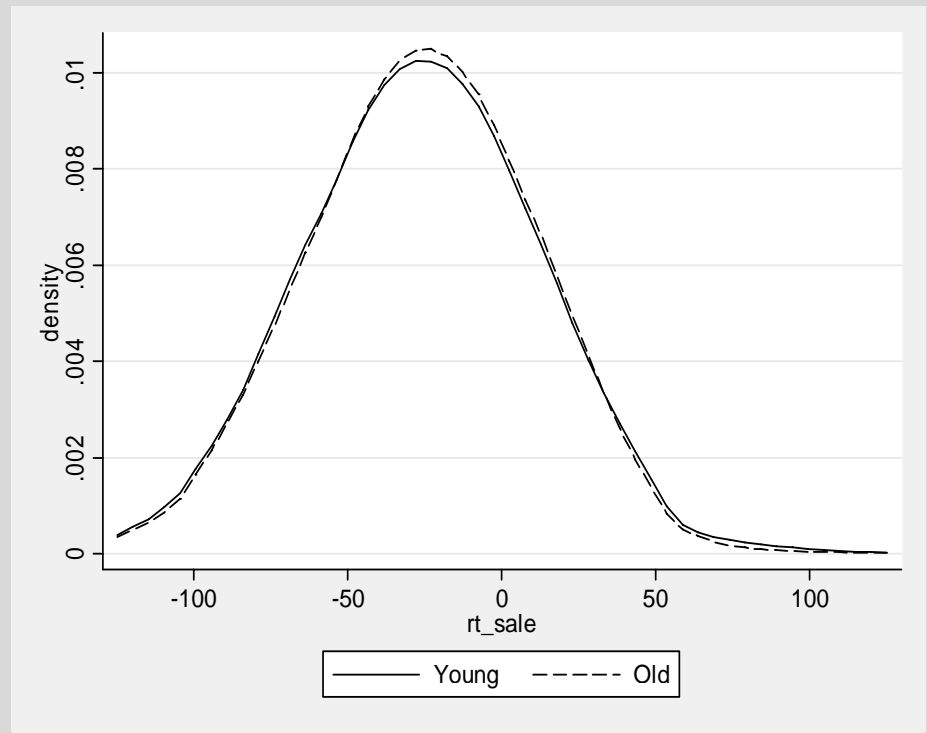
The same happened with young firms

Sales Growth Rate of Young and Older Firms

Before the crisis (2004-2007)



After



Methodology and results (1):

fixed effect model (after Hausman specification test)

$$g_{it} = \beta_0 + \beta_1 t + \beta_2 (t * Innov_i) + \beta_3 (t * young_i) + \theta Z_{it} + u_{it}$$

g_{it} = growth rate of sales of firm i in period t (2004-2007, June08-June09, January09-January10, and June09-June10)

t = categorical variable (0: pre-crisis period, 1: June08-June09, and so on)

$Innov_i$ = dummy for innovative status of before the crisis - due to data limitation, we model this as a time-invariant characteristic

$Young_i$ = dummy (<5 years old) controlling for firm age before the crisis

Z_{it} = dummies for control characteristics: size and export orientation (time variant characteristics); foreign ownership, use of skilled workforce, country and sector (time invariant characteristics)

u_{it} = error term, $\alpha_i + \varepsilon_{it}$ (α_i is the fixed effect; ε_{it} is the idiosyncratic error)

Hausman -Taylor estimator to control for endogeneity of innovation status of the firm

Methodology and results (1): fixed effect model

$$g_{it} = \beta_0 + \beta_1 t + \beta_2 (t * \text{Inov}_i) + \beta_3 (t * \text{young}_i) + \theta Z_{it} + u_{it}$$

Captures the sales growth variation that is common to all firms.

As our time-trend variable is categorical, it captures the common variation in each specific “post-crisis” period (June08-Jun09, January09-January10, and June09-June10)

It measures the crisis impact on sales growth performance of **innovative** firms

The impact is measured in each specific “post-crisis” period

The crisis impact on sales growth performance of **young** firms

The impact is measured in each specific “post-crisis” period

Methodology and results (1): fixed effect model with Hausman Taylor estimator

	Innovation measured as introduction of product/process	Innovation measured by the performance of R&D
_Itime_2	-39.499*** (0.271)	-41.773*** (0.219)
_Itime_3	-38.715*** (0.276)	-37.726*** (0.224)
_Itime_4	-29.254*** (0.295)	-28.274*** (0.236)
Inov	8.941*** (0.297)	13.333*** (0.358)
time2XInov	-10.707*** (0.384)	-14.735*** (0.463)
time3XInov	-6.054*** (0.396)	-17.535*** (0.479)
time4XInov	-6.035*** (0.413)	-16.676*** (0.501)
Young	14.161*** (0.326)	14.333*** (0.323)
time2XYoung	-16.864*** (0.553)	-16.489*** (0.547)
time3XYoung	-19.201*** (0.621)	-19.888*** (0.614)
time4XYoung	-17.300*** (0.605)	-18.579*** (0.598)
Firm specific controls	Yes	Yes
Country controls	Yes	Yes
Sector controls	Yes	Yes
_cons	-2.125*** (0.402)	-1.662*** (0.392)
N.obs	4178	4177

Methodology and results (1): fixed effect model

- The results showed a negative impact of the crisis on sales growth performance of innovative and young firms
- When considering innovation as measured by the introduction of new product/process, data show :
 - **A negative, though decreasing, impact on innovative firms** (a decline of: 10.7 percentage points in June08-June09; 6.05 in January09-January10; and 6.04 in June09-June10)
 - **An increasingly negative impact on young firms** (a reduction of: 16.8 percentage points in June08-June09; 19.2 in January09-January10, and 17.3 in June09-June10)
- Overall, the results are robust to :
 - the way innovative firms are classified
 - the estimation method (Hausman Taylor with and without the propensity score matching)



Methodology and results (2):

Juhn-Murphy-Pierce decomposition

- So far, data shown that innovative and young companies have been negatively affected by the crisis
- What can explain the differences in sales growth performance within innovative x noninnovative firms (and young x old firms) in each period?
- Juhn-Murphy-Pierce (JMP) decomposition

Methodology and results (2): Juhn-Murphy-Pierce decomposition

- The performance differential (g) between two firms' groups arises from
 - Differences in observable characteristics (characteristics effect)
 - it quantifies to what extent one group of firms has a more favorable “endowment” in terms of observable characteristics as compared to the other group
 - Differences in returns of these characteristics (return effect)
 - it measures to what extent the returns of those observable characteristics (on the sales performance) differ within the groups of companies
 - Differences in the distribution of unobservables (residual effect)
 - It captures the unmeasured factors that affect the performance of the two groups of firms
 - Innovative x noninnovative firms – it measures the differences in terms of some intangible assets as knowledge creation (**the innovation premium**)
 - Young x older firms – it measures the differences in terms of the ability to appropriate of learning benefits (**the ability to learn**)



Decomposing the total difference of sales growth rate between INNOVATIVE and NONINNOVATIVE firms

Period	Total Difference	Characteristics Effect	Return Effect	Residual Effect
Pre-crisis period (2004-2007)	6.785	-0.202	6.876	0.111
	100%	-3.0%	101.3%	1.6%
June 08 – June 09	-1.625	-0.185	-1.435	-0.004
	100%	11.4%	88.3%	0.2%
January 09-January 10	2.952	3.74	-0.783	-0.005
	100%	126.7%	-26.5%	-0.2%
June 09- June10	4.895	3.536	1.69	-0.33
	100%	72.2%	47.8%	-19.5%

Before the crisis

- Positive difference in sales growth performance (in favor of innovative companies)
 - mainly due to higher returns obtained by innovative firms
 - also due to positive differences in unobservables (in favor of innovative firms) => a positive premium for the ability to innovate

Afterwards

- Total difference was initially negative (for innovative firms) but returned to be positive in June 09-June 10 period
 - return effect followed the same path: returns obtained from innovative firms was initially inferior but turned to be higher in June 09-June10
 - however, the differences in unobservables turned to be increasingly negative against the innovative firms

Innovative firms might be preparing to bounce back, but the (increasingly) negative premium to innovation might hamper their growth prospects

Decomposing the total difference of sales growth rate between YOUNG and OLDER firms

Period	Total Difference	Characteristics Effect	Return Effect	Unexplained Effect
Pre-crisis period (2004-2007)	12.298	1.204	12.556	-1.462
	100%	9.8%	102.1%	-11.9%
June 08 – June 09	-0.569	-1.701	2.964	-1.832
	100%	298.9%	-520.9%	322.0%
January 09-January 10	-1.597	0.943	-0.144	-2.395
	100%	-59.0%	9.0%	150.0%
June 09- June10	-1.046	-4.066	6.13	-3.11
	100%	388.7%	-150.8%	-50.7%

Before the crisis

- Positive difference in sales growth performance (in favor of young companies)
 - mainly due to higher returns obtained by young firms
 - however, differences in unobservables was negative (against young firms); but this was not enough to revert the better performance of young firms

Afterwards

- Total difference was increasingly negative (against young firms)
 - though the returns obtained by young firms have been higher in the most part of time. However, this was not enough to revert the worse performance of young firms
 - residual effect declined even further (the ability of young firms to capture the learning benefits was continuously decreasing) and this contributed to explain the worse performance of young firms

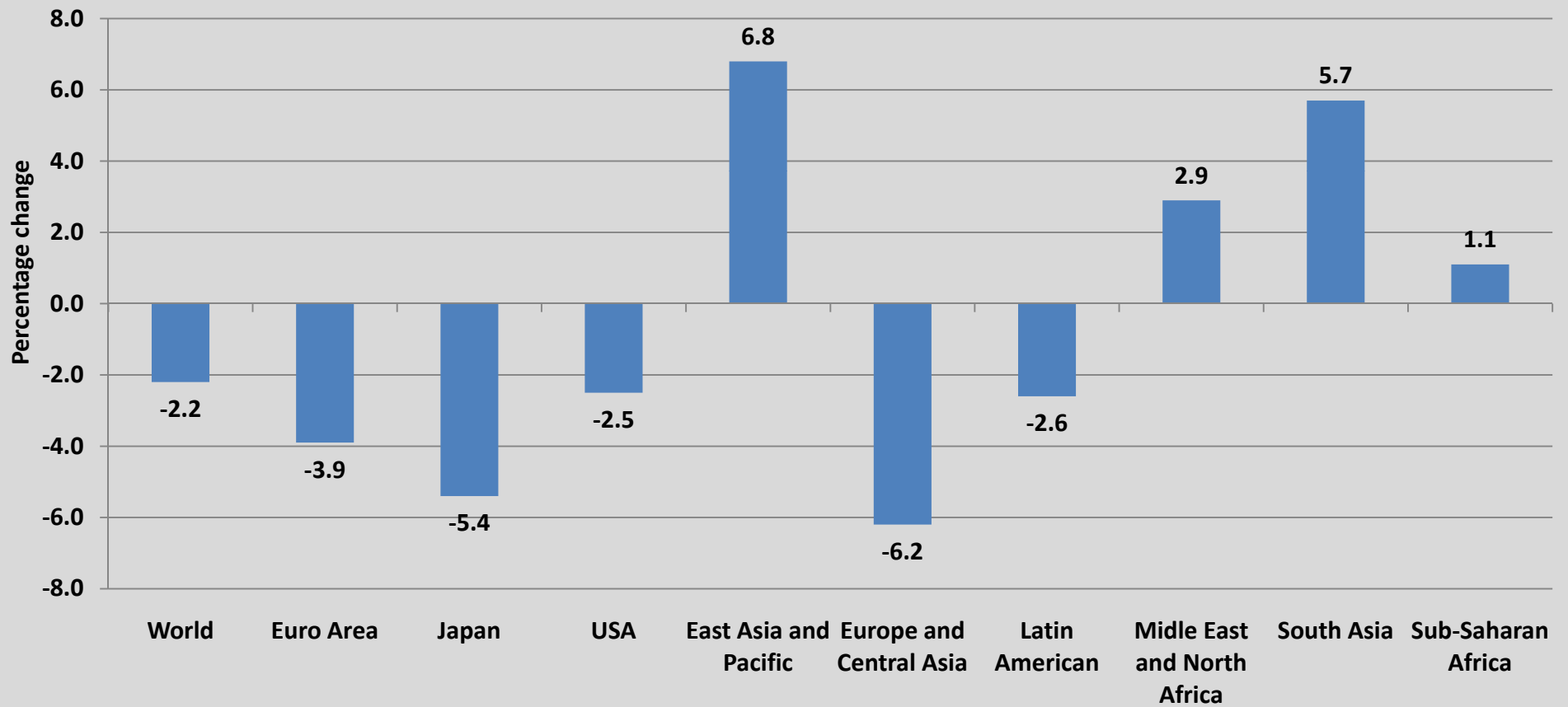
Young firms are performing even worse and their lower ability to learn might reinforce this negative course in the near future

Conclusions

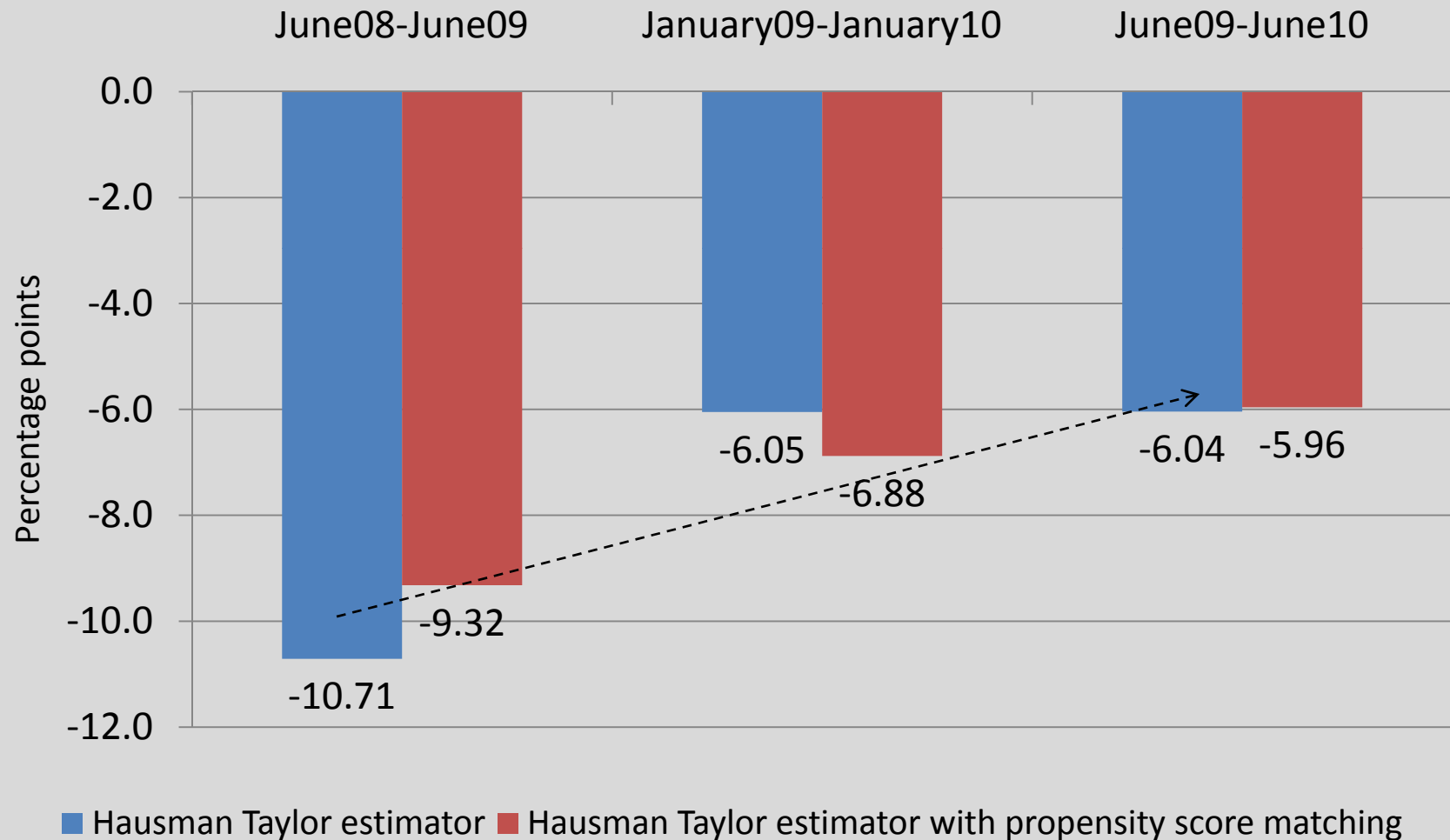
- We examined the crisis effects on sales growth performance of innovative firms and of young firms
- For innovative firms, data show that
 - The impact was negative, though decreasing
 - **Innovative firms might be preparing to bounce back, but the (increasingly) negative premium to innovation might hamper their growth prospects in the near future**
- For young firms, data show that:
 - The impact was increasingly negative
 - **Young firms are performing even worse and their lower ability to learn might reinforce this negative course in the near future**
- Possible consequences
 - Decline on innovation performance
 - Premature exit of young firms

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GDP growth in 2009: percentage change from previous year

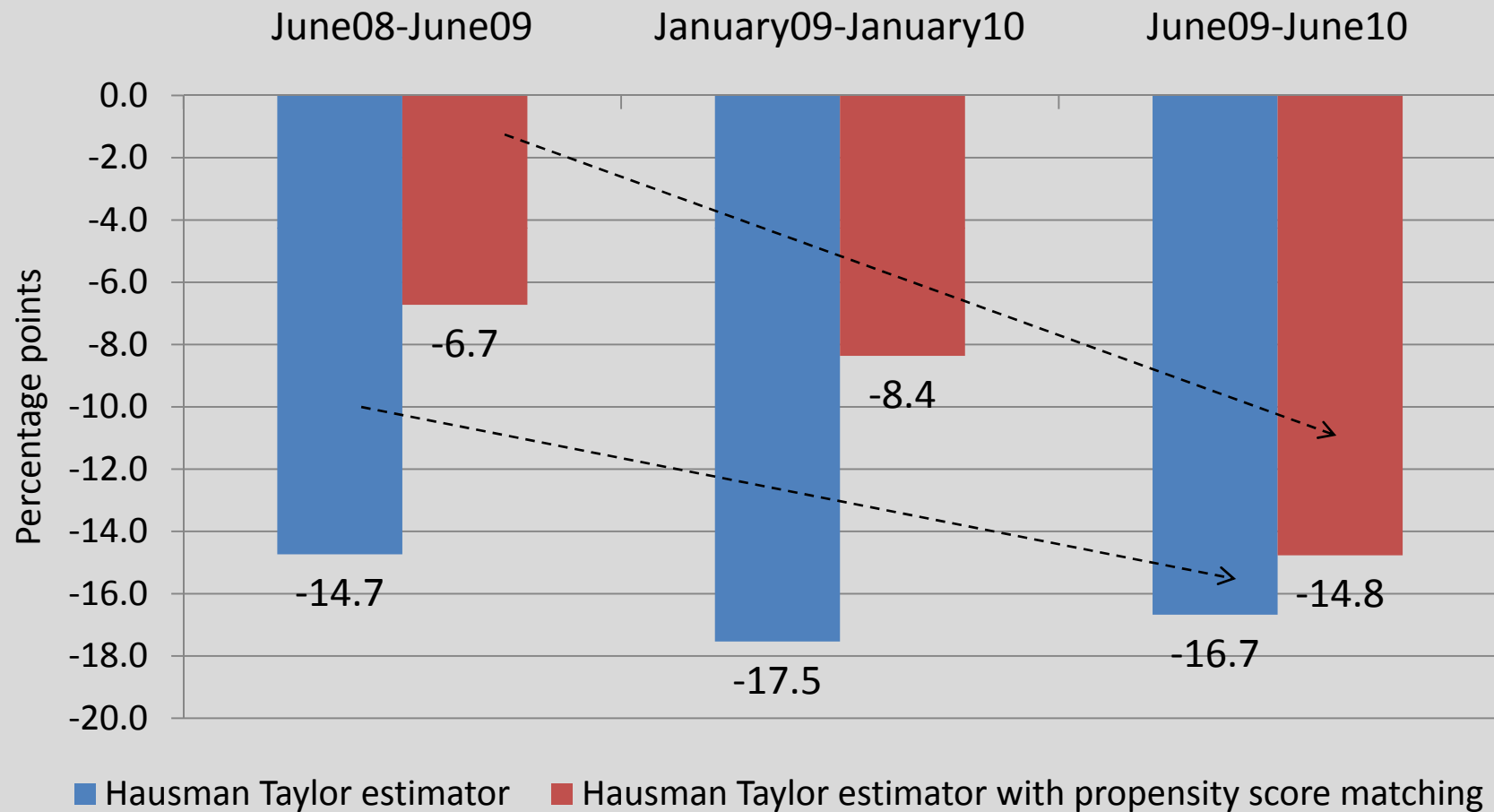


The crisis impact on sales growth rate of innovative firms: innovation measured by the introduction of new product/process



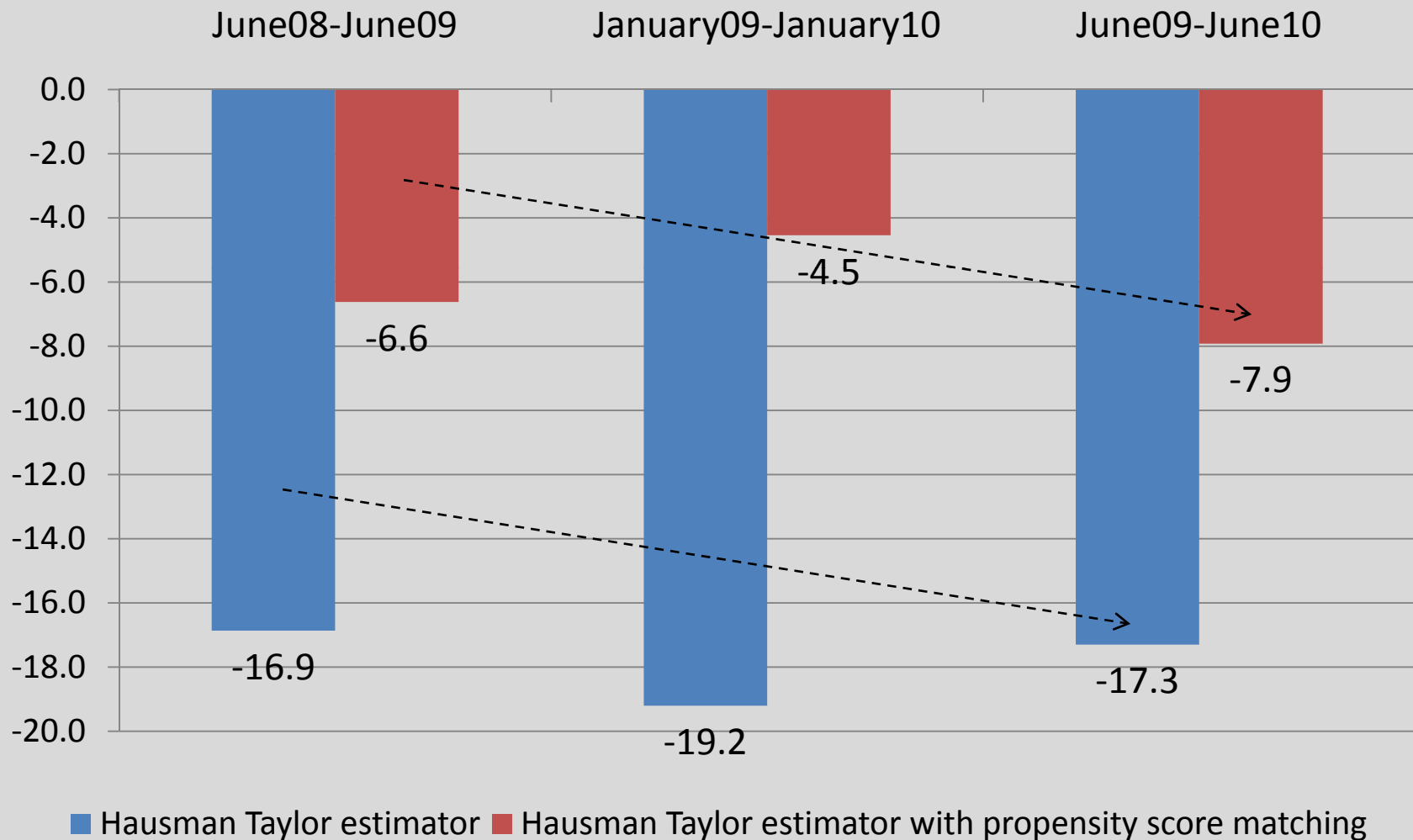
The crisis had a negative, yet declining, impact

The crisis impact on sales growth rate of innovative firms: innovation measured by R&D activities



The crisis had a negative, and increasing, impact

The crisis impact on sales growth rate of young firms



The crisis had a negative, and increasing, impact

Juhn-Murphy-Pierce decomposition

Three main steps

1. Estimate – for each firms' group (innovative and noninnovative, for instance) in a given period - simple OLS models to explain the sales growth rate (g) of firm i

$$g_i = X_i \beta_i + \varepsilon_i$$

where

$$\varepsilon_i = F^{-1}(\theta_i | X_i)$$

Observable characteristics: age, innovation status, skill of workforce, ownership, size, export orientation, country and sector

2. After results, we can define for each group:

$$g_{IN} = X_{IN} \beta_{IN} + F^{-1}(\theta_{IN} | X_{IN})$$

$$g_{NIN} = X_{NIN} \beta_{NIN} + F^{-1}(\theta_{NIN} | X_{NIN})$$

vectors with the values of the dependent variable - sales growth rate - in the group of innovative firms

Vector with estimated coefficients for the group of innovative firms

Vector with estimated residuals for the group of innovative firms

Data matrix with observable characteristics for the group of innovative firms

Juhn-Murphy-Pierce decomposition

3 - The performance differential (g) between the two firms' groups arises from differences in

$$\begin{aligned} g_{IN} &= X_{IN} \beta_{IN} + F^{-1}(\theta_{IN} | X_{IN} |) \\ g_{NIN} &= X_{NIN} \beta_{NIN} + F^{-1}(\theta_{NIN} | X_{NIN} |) \end{aligned}$$

a) X 's (observable characteristics)

it quantifies to what extent one group of firms has a more favorable "endowment" in terms of observable characteristics as compared to the other group

b) β 's (returns of these characteristics)

it measures to what extent the returns of those observable characteristics on the sales performance of one firms' group differ from another group of companies

c) F^{-1} 's (unobservables, i.e, unmeasured characteristics and returns)

Assuming that the OLS models are satisfactorily specified, any unmeasured factors that affect the performance of these two groups will be captured by this residual effect

Innovative x noninnovative firms – it measures the differences in terms of some intangible assets as knowledge creation (**the innovation premium**)

Young x older firms – it measures the differences in terms of the ability to appropriate of learning benefits (**the ability to learn**)

