Searching for the Sources of Productivity

from Macro to Micro (and back)

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Overview

- Growth theory and empirics
  - Micro foundations of representative firm
  - Applied to macro/sectoral data
  - Limited role for policy
- Firm-level studies:
  - Single country applied micro analysis
- 'Macro' analysis with micro data
  - ICT (with Office of National Statistics, et al.)
  - Reallocation (with Haltiwanger, Scarpetta)
  - Labor Policy (with Perotti, Scarpetta; and with Gautier, de Wind)

Results from EUKLEMS

1995-2005	EU			US		
	VA%	--Kict	--TFP	VA%	--Kict	--TFP
Market	2.1	**.4**	**1.0**	3.7	**.6**	**1.7**
EleCom	**3.8**	.8	2.8	**10.5**	.8	8.7
MfgxElc	1.2	.2	1.7	1.8	.2	2.2
DISTR	2.6	.3	1.5	4.1	.5	2.1
FinBus	3.5	.9	-1.0	4.3	.7	.4

Source: Timmer, O'Mahony, and van Ark (2007)

Results from EU KLEMS

Questions still needing answers

- Why is contribution from IT capital lower in EU
  - Or… Why is ICT investment lower
- Why is growth in high-tech so much lower
  - Or… Why is high-tech sector small, especially in fast growing parts
- Why is unexplained growth so high? Why is TFP growth so much lower in EU
  - Or… Why is TFP growth especially low in ICT intensive sectors
- What, if anything, is the role of policy
  - Or… If policy affects firms and market interactions, what can industry data tell us about policy

Growth Theory

- Effects of policy on growth:
  - Production Factors
  - Externalities

$$y_i = A_i + \sum_{s \in \{klems\}} \alpha_s X_s$$

$$\Delta A_i = G(I_i, A_i, \bar{A})$$

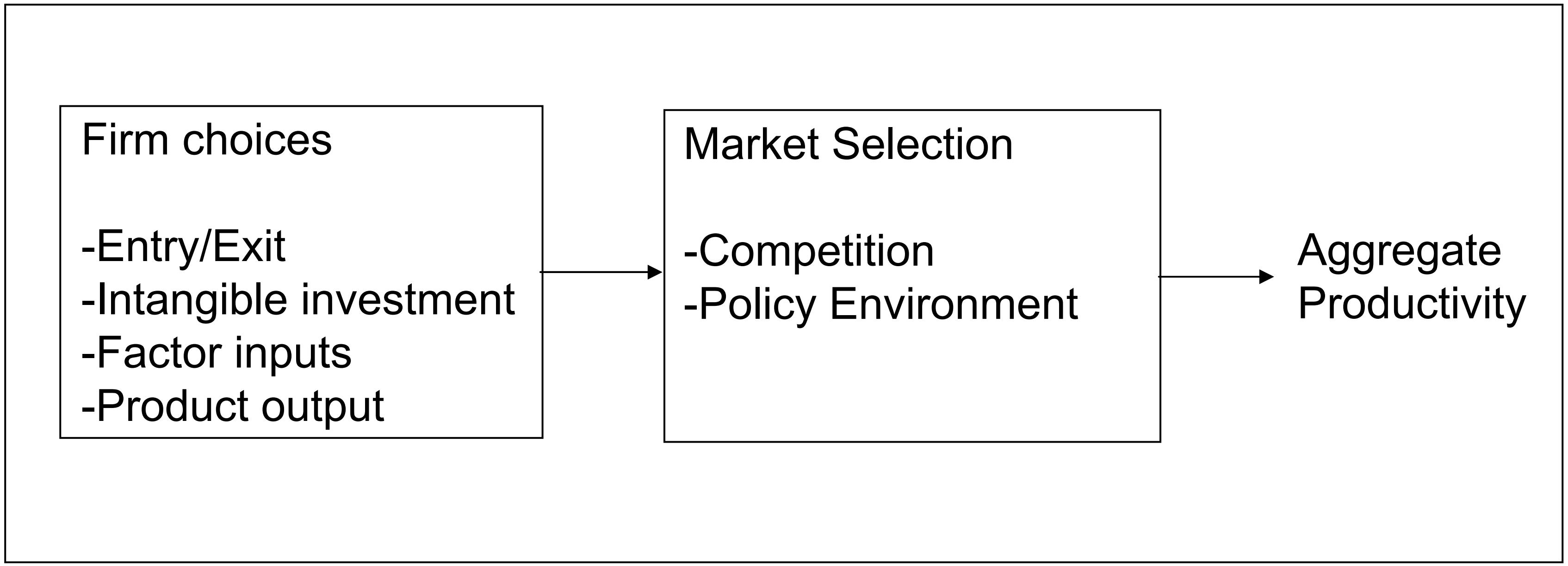
Searching for the Sources of Productivity

- How do the following policies affect productivity?
  - Employment protection
  - Trade policy
  - Competition policy
  - Business conditions
- Difficult to identify with standard theory, even using micro data

Models of Firm Dynamics

- Heterogeneous agents at micro level
  - Diversity in firm-level (innovation) strategies
  - Frictions, uncertainty, expectations
- Market selection
  - Sales and input growth, conditional on productivity and economic 'environment'
- Combination of firm-level productivity impact and market share evolution gives total impact on industry productivity

Models of Firm Dynamics



Models of Firm Dynamics

$S_i \in \{N, E, C\}$

conditional on C:

$$y_i = A_i + \sum_{s \in \{klems\}} \alpha_s X_s, \text{ where } i \in C$$

$$\Delta A_i = G(I_i, A_i, \bar{A})$$

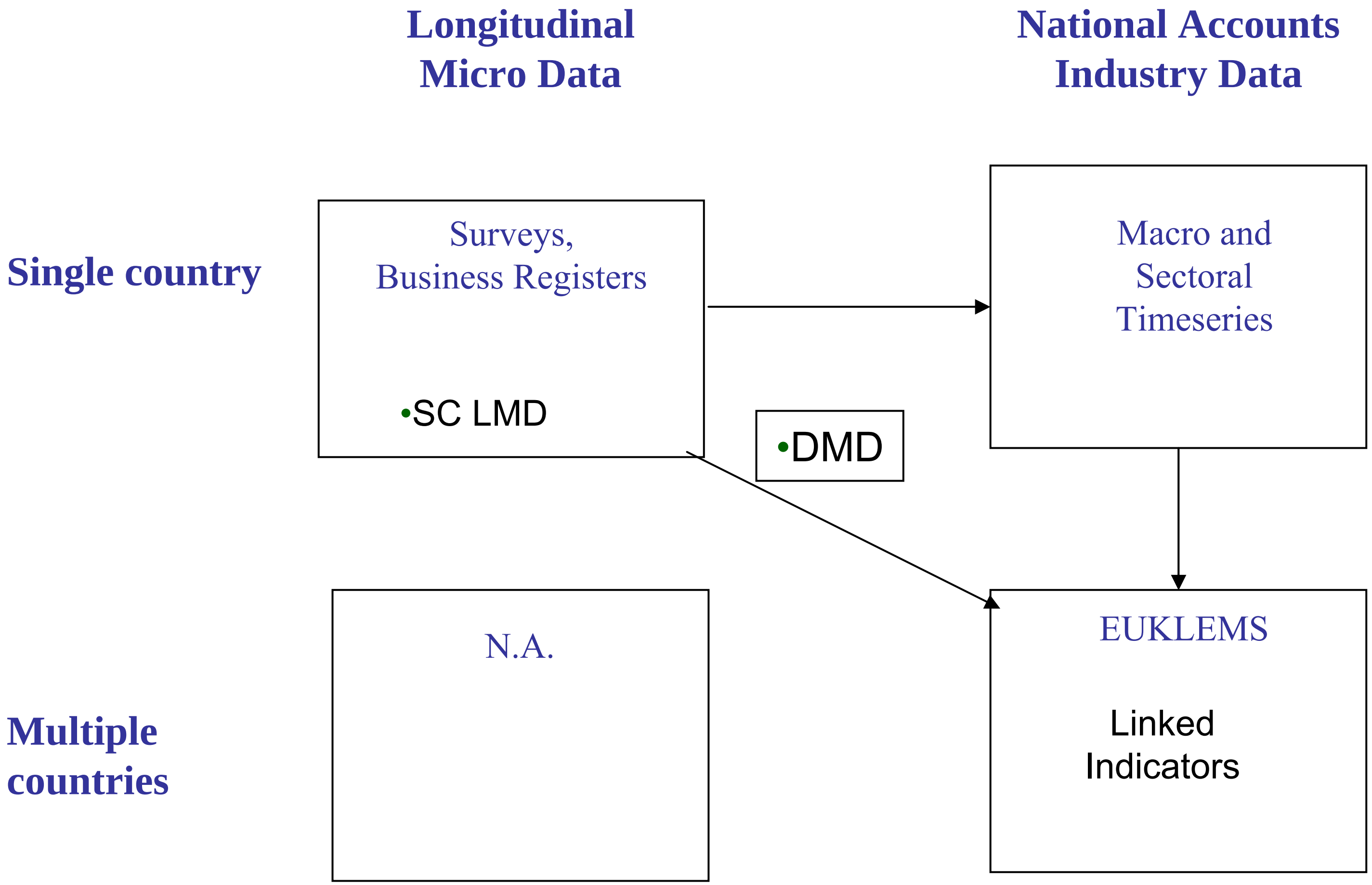
and aggregate productivity

$$\bar{A} = \sum_{i \in C} A_i + \sum_{i \in C} (\phi_i - \bar{\phi})(A_i - \bar{A})$$

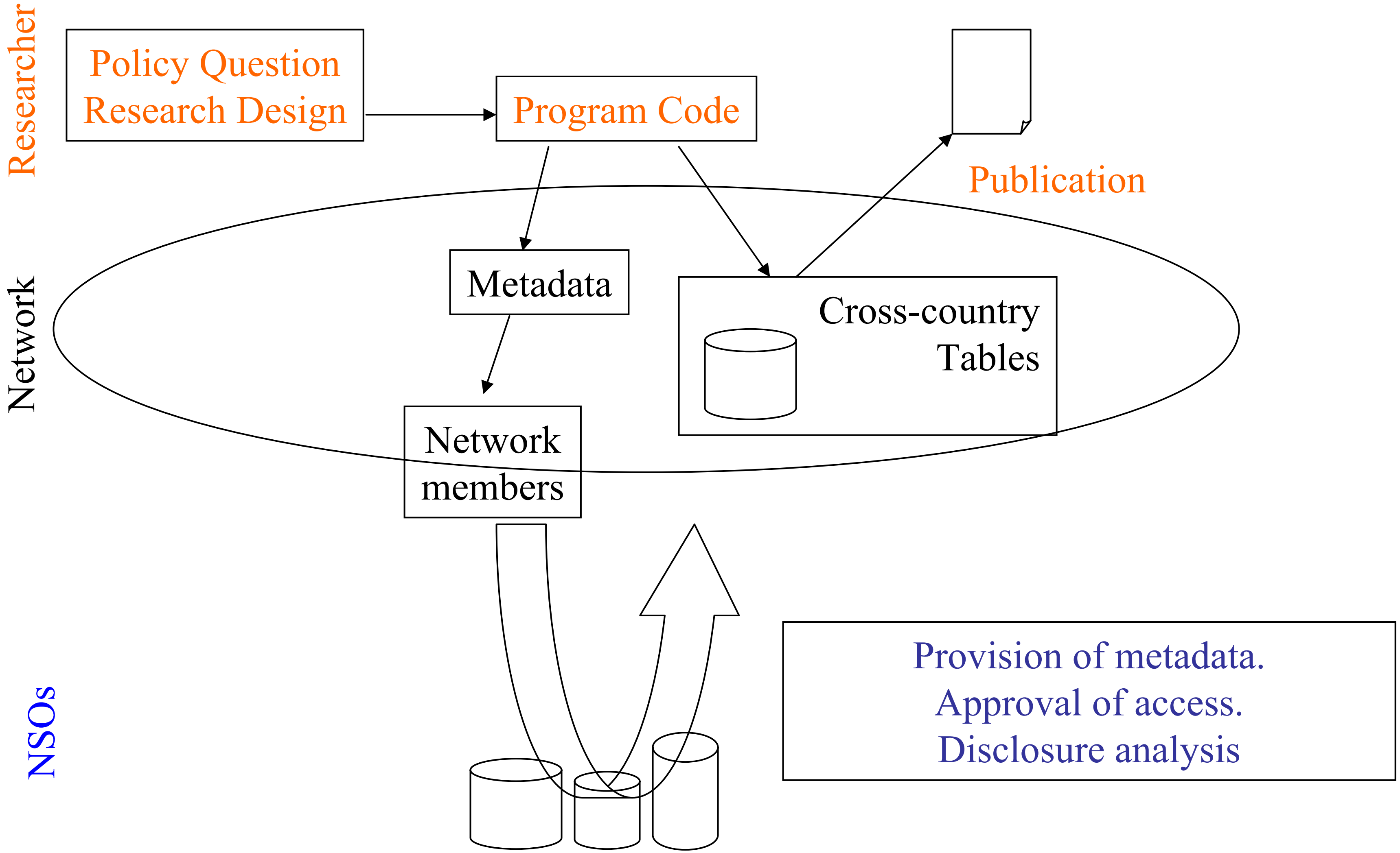
Firm-level, cross-country comparisons

- Policy environment affects all firms in country (and industry) in the same manner
- Cross-country firm-level comparisons may provide means to observe/identify the impacts of policy changes
- Policy affects:
  - Externalities, production factors
  - Selection
  - Allocation

From firm data to macro indicators



Distributed Micro Data Analysis



Selected Firm-level indicators

(percent)	US	EU	US	EU	US	EU
	Average Manuf		**ICT Producing**		**Non-ICT**	
Entrant Size rel. to incumbent	21.0	38.6	6.3	35.7	24.0	40.8
Productivity Gap of Exiters	10.0	15.4	1.2	9.1	7.9	17.7
Employment Share of Exiters*	18.9	23.1	20.2	31.8	19.8	22.3
Employment growth, top qrt.	68.6	50.1	91.8	65.1	70.8	45.0

Policy and productivity

- Allocation of resources across firms
  - Demand and supply conditions affect firm-level input decisions
- Selection
  - Entry and exit decisions
- Choice of innovation strategy
  - Intangible investments
  - Technology adoption

Covariance Between Size and Productivity?

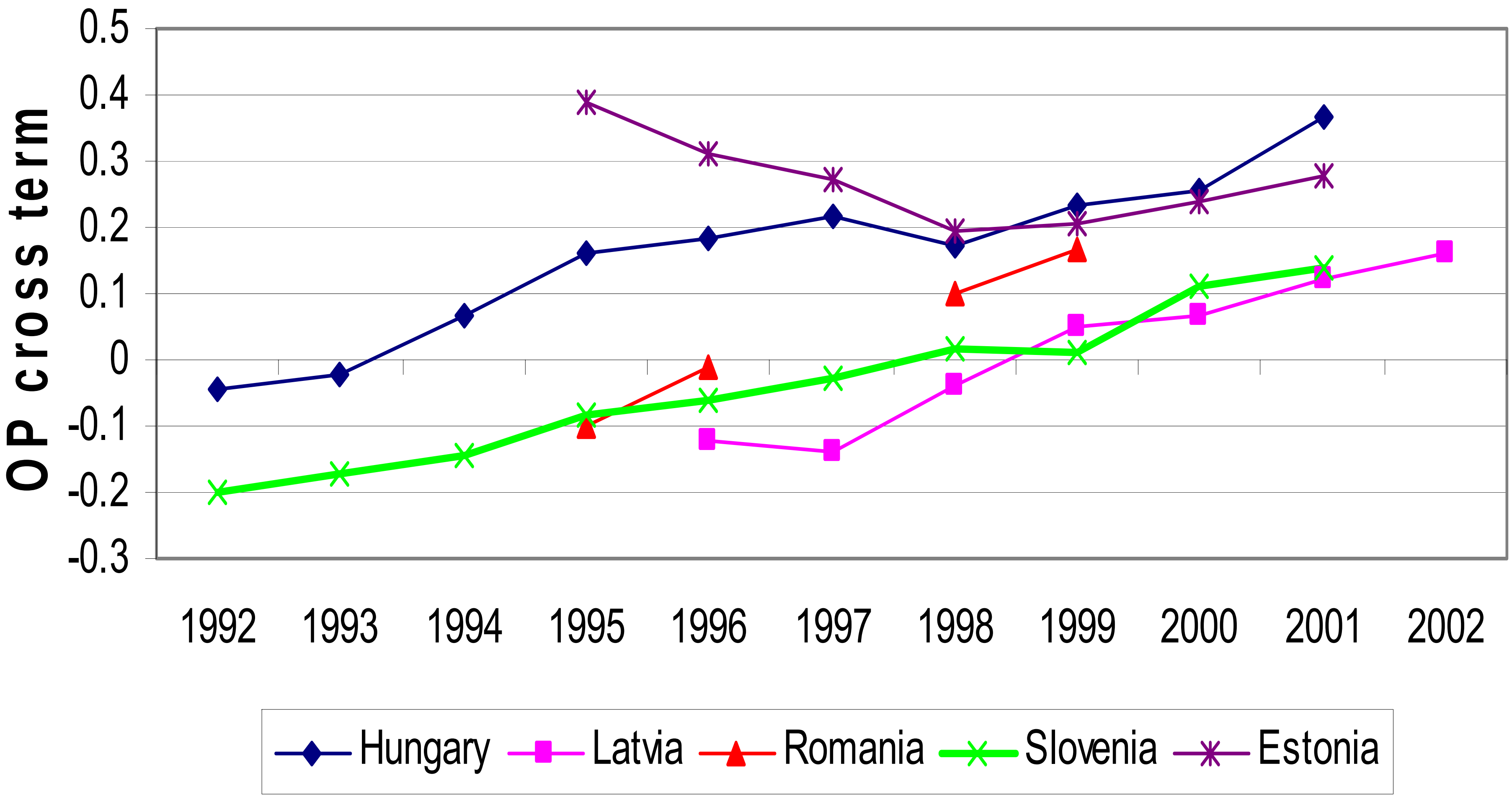
- Olley and Pakes (1996) static decomposition:

$$P_t = (1/N_t)\sum_i p_{it} + \sum_i (\theta_{it} - \bar{\theta}_t)(p_{it} - \bar{P}_t)$$

where: N: # of firms in a sector;

- ➢ The first term is the unweighted average of firm-level productivity
- ➢ The second term (OP cross term) reflects allocation of resources: do firms with higher productivity have greater market share.

Allocative Efficiency (OP Cross Term)
Transition Economies



Model-based analysis of OP-gap

- Idiosyncratic distortions to profit:
  - Opportunistic taxes, bureaucratic control of resources
- Lead to distortions in firm size
  - lowers correlation between productivity and size
- But also affect selection
  - Some good firms may not enter
  - Inefficient churn

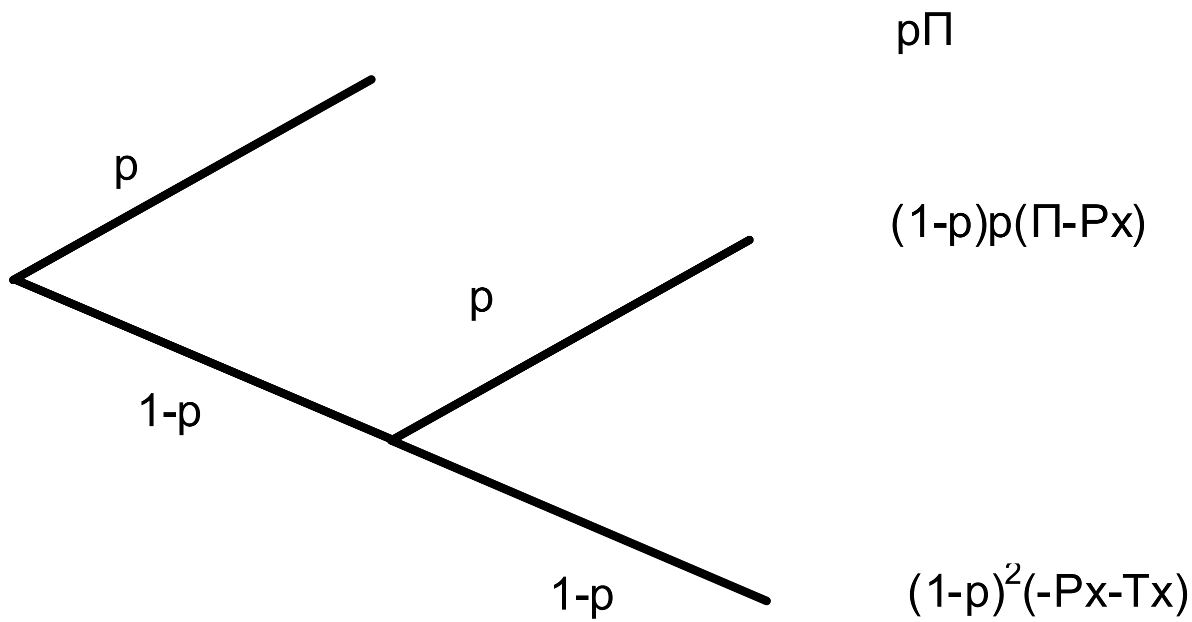
Why does old EU lag in new technology'?

- Stylized facts from firm-level data
  - Indicators from EU differ from those in US, especially in ICT industries
    - Firm demographics (entry/exit)
    - Firm-level inputs
    - Productivity distribution
  - Points towards 'safe' behavior of firms in EU

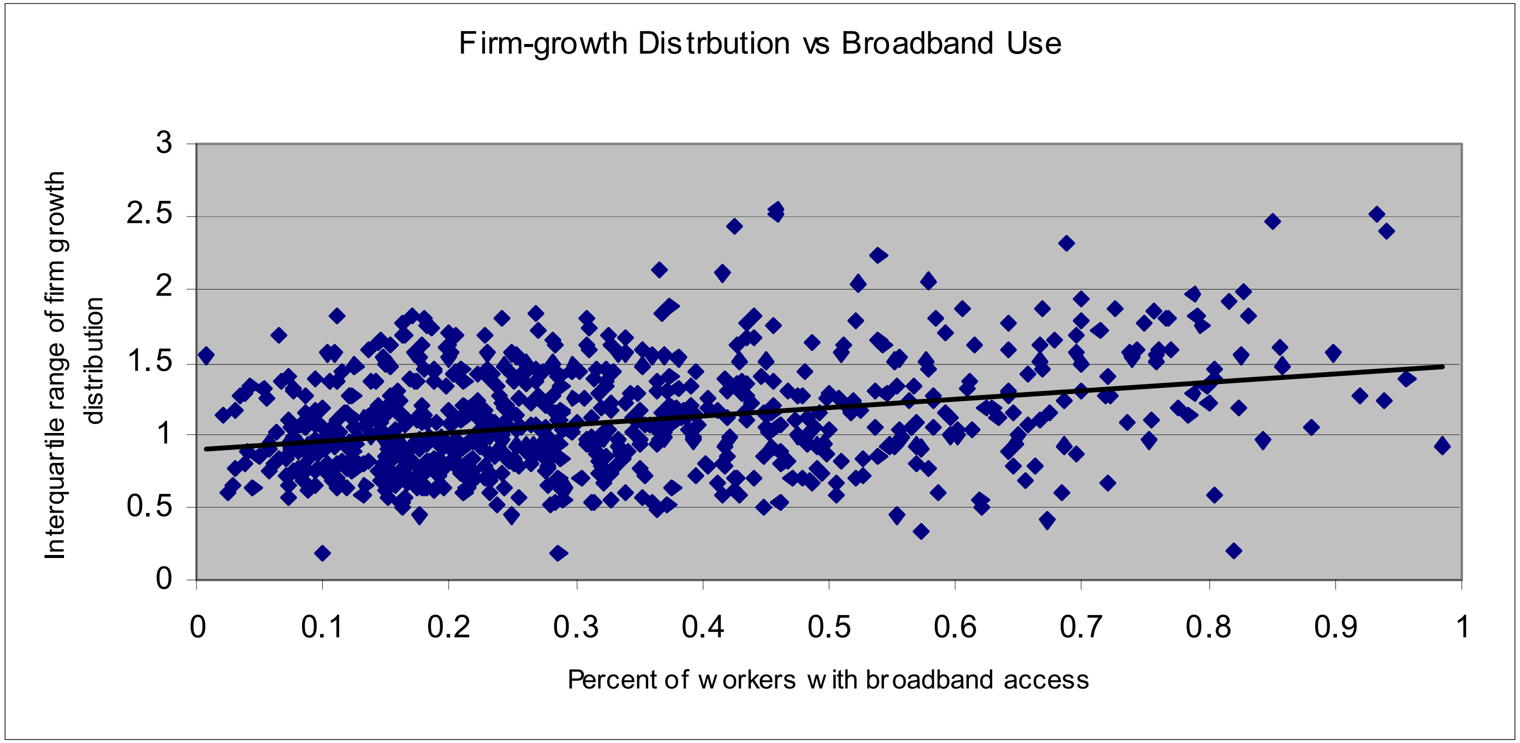
Choice of Innovation Strategy

- Experimental
  - High payoff, Π
  - very low probability of success, p.
- Follower
  - Low payoff, π;
  - diversifiable risk for follower strategy.
- When experiment fails: reconfigure, try again
  - Partial exit costs P_{EX}. (Firms continue to experiment)
  - Total exit cost T_{EX} (Firms give up experimentation)

Payoffs for Experimentation



FYI: ICT and variability of outcomes



Testable implications

- With more experimentation average productivity is higher
- With higher exit costs, experimentation is lower, especially at frontier
- So:
  - Exit costs lower productivity more in those sectors where potential gain from experimentation is higher
  - Exit costs lower experimentation, and more so near frontier

Data

Source	Periods	Countries	Coverage	Variables
EUKLEMS	1970-04	EU+US	All industries	Output, factor inputs, prices
OECD-EPL	1985-03	OECD	---	EPL indicators
WB-CDB	2004-07	World	--	Entry costs, firing costs, rigidities
BHS	1990s	Selection of OECD, Asia, Lat. Am.	30 industries, mostly mfg	Moments and correlations from underlying firm-level business surveys
ONS/Eurostat	2001-04	13 EU countries	All industries	Moments and correlations from underlying linked firm-level datasets

Empirical specification

- Main regression: TFP effect of exit costs

$$V_{c,i,t} = \alpha + \sum_{x \in lkk^{IT}} \beta_x X_{c,i,t} + I_{c,t}(\gamma_0 + \gamma_1 F)_i + \sum \delta_j D_j + \varepsilon_{c,i,t}$$

$$\text{where } I_{c,t} = EPL_{c,t} \text{ or } CDB_c$$

- Frontier indicators (by industry for US or UK):
  - Top quartile productivity relative to mean
  - Standard deviation of productivity
  - Adoption of Broadband

Exit costs and productivity

Dependent var:	Log(VA)	Log(VA)	Log(VA)
Regressor:			
Log: Kit,Knit,Hours	***	***	***
EPL	.47	.34	.46
	(0.02)	(0.14)	(0.19)
EPL x Rank	---	**-1.18**	**-1.13**
		(3.07)	**(3.08)**
Rank variable	---	Top quartile prod/mean	Broadband-use
Num. obs.	7032	6790	7031
R-sq	.97	.97	.97

Innovation strategy and employment

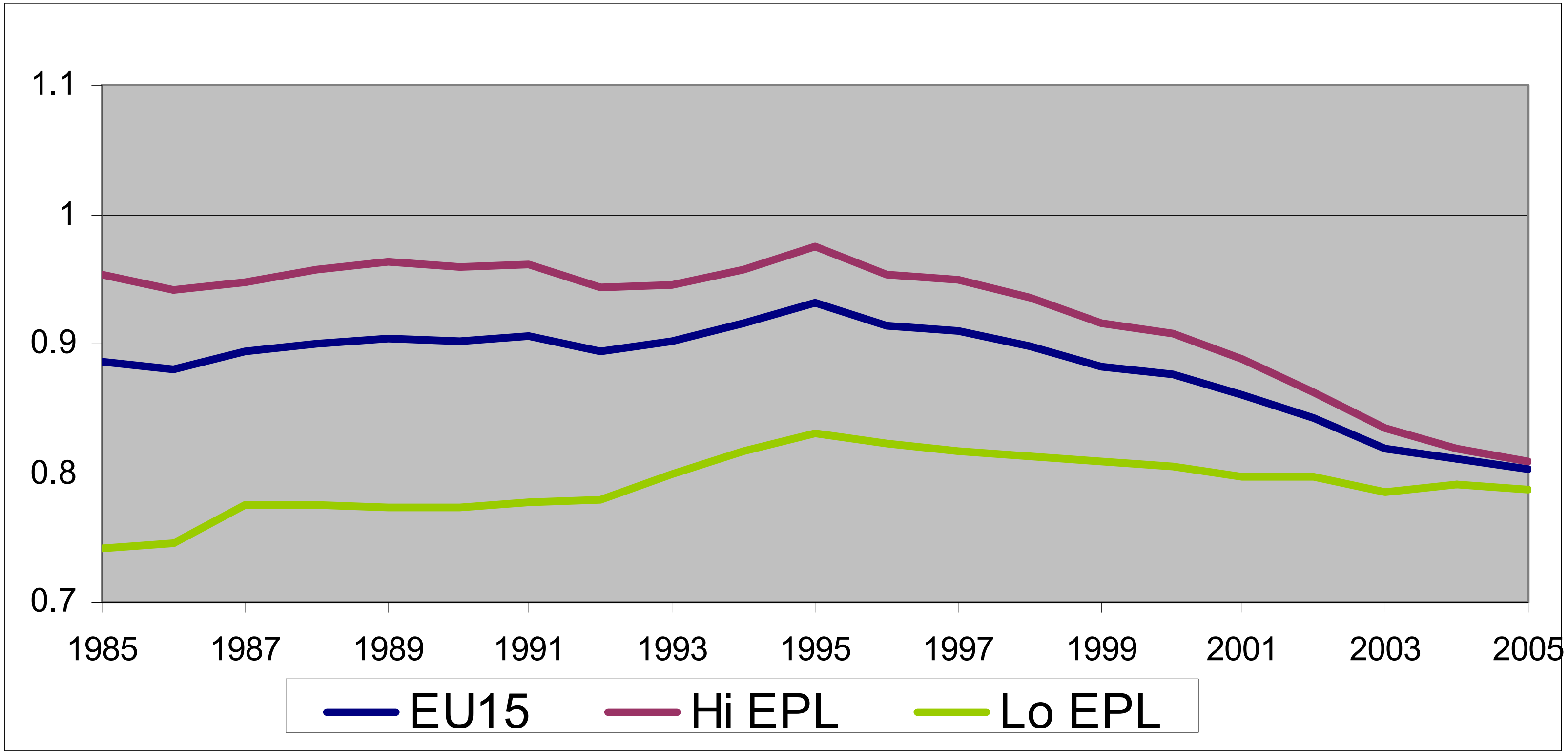
- Mortensons-Pissarides type model with 2 sectors
  - 1: safe sector, known technology
  - 2: risky sector, draw from prod. distribution
- With firing costs, option of closing down conditional on bad draw is more expensive
  - So, fewer jobs created in risky sector

Exit costs and employment

Dependent var:	Labor share in sector	Labor share in sector
Regressor:		
EPL	.02	.02
	(0.74)	(0.74)
EPL x Rank	**-0.82**	**-0.84**
	(10.30)	**(10.55)**
Rank variable	Top quartile prod/mean	Broadband-use
Num. obs.	5518	5518
R-sq	.84	.84

Value added per hour EU relative to US

(source: EU KLEMS, market sector, EU15)



Exit costs and productivity

- Productivity is reduced in industries that have potential gain from experimentation
- Employment share in innovative industries is reduced
- => High exit costs lower aggregate productivity

ICT Adoption

- Carrot and Stick:
  - Profits to be gained if succesful (taking into account market share gains)
  - Competitive pressure: Market share/profit losses when others adopt successfully
- Costs and benefits:
  - Readiness: skilled workers, high wages, complementary inputs
  - Profits from being successful and scaling up business

Broadband Adoption and Impact

$$a: v_{ijt} = a_0 + a_1 DSL\% + a_2 k^{IT} + a_3 k^{N} + a_4 hrs + dummies$$

$$b: DSL\%_{ijt} = b_0 + b_1 w_{-1} + b_2 Cap\%^{IT}_{-1} + b_3 HiSkl_{-1} + b_4 Churn + dummies$$

v	(log) real value added
Kit	ICT capital service
Kn	Non-IT capital service
Hrs	hours
w	Average wage
Cap%it	ICT-capital as share of cap.
HiSkl	High skilled worker share
DSL%	**Broadband penetration**
Churn	**Interquartile range of firm-level growth rate distribution**

Broadband Adoption and Impact

$$a: v_{ijt} = a_0 + a_1 DSL\% + a_2 k^{IT} + a_3 k^{N} + a_4 hrs + dummies$$

$$b: DSL\%_{ijt} = b_0 + b_1 w_{-1} + b_2 Cap\%_{-1}^{IT} + b_3 HiSkl_{-1} + b_4 Churn + dummies$$

	Variable	a:Log (value added); b:DSL%	
a1	Broadband Penetration (DSL%):	**1.24**	**.90**
a2	Non-ICT Capital	.35	.27
a3	ICT Capital	-.07	.05
a4	Labor Hours	.72	.68
b1	Wage(t-1)	.24	.02
b2	ICT capital share(t-1)	.31	.20
b3	High-skill labor share(t-1)	.18	.38
b4	Churn	**.30**	**.15**
	Fixed effects	c,t	i,t
	Num. Obs.	659	646

Conclusions

- Country/Industry/Time panel regressions are useful to assess role of policy
- Expanding modelling framework to include selection and allocation increases understanding/identification of policy-productivity link
- Frictions in resource reallocation reduce intangible investment (ICT)