Productivity and Reallocation

Motivation

- Recent studies highlight role of reallocation for productivity growth. Market economies exhibit:
  - Large pace of output and input reallocation with substantial role for entry/exit.
  - Large differences in measured productivity across producers
  - Productivity enhancing market selection and reallocation from less to more productive businesses
  - Magnitude depends upon sector, country, measure (labor vs. TFP) – open questions:
    - Impact on workers vs. Impact on firms
    - Role of institutions/market structure

The challenge of cross-country analysis

- Macro data
  - e.g. SNA, PWT
  - Difficult to identify effects (e.g. 2 million growth regressions)
- Sectoral data
  - e.g. OECD-STAN; Unido
  - aggregate sectors obscure causal mechanism
- Meta-analysis of results from micro studies
  - A challenge to control for data, method, and context
  - Little within-country variation in policy (e.g. before and after)
- Cross-country longitudinal micro dataset
  - Generally not possible (disclosure)
  - EUROSTAT attempting to build EU panel, but from existing databases

Distributed micro-data collection

- OECD sample
  - Demographics (entry/exit) for 10 countries
  - Productivity decompositions for 7 countries
  - Survival analysis 7 countries
- World Bank sample
  - Same variables, 14 Central and Eastern Europe, Latin America and South East Asia
- EU Sample (10 countries), updates and a few new countries
  - Productivity decompositions
  - Sample Stats and correlations by quartile

Data sources

- Business registers for firm demographics
  - Firm level, at least one employee, 2/3-digit industry
- Production Stats, enterprise surveys for productivity analysis
- Countries:
  - 10 OECD
  - 5 Central and Eastern Europe
  - 6 Latin America
  - 3 East Asia
- Data are disaggregated by:
  - industry (2-3 digit);
  - size classes 1-9; 10-19; 20-49; 50-99; 100-249; 250-499; 500+ (for OECD sample the groups between 1 and 20 and the groups between 100 and 500 are combined)
  - Time (late 1980s – late 1990s)

Measurement Error

- Three sources of error potentially affect comparability of indicators built from firm level data:
  - Classical Error of firm-level measure
    $$X = X^{*} + \varepsilon$$
  - Errors in sample
    $$\Omega = \Omega^{*} + \Psi$$
  - Method of Aggregation of Indicator
    $$I = A\left[X_f \mid f \in \Omega\right]$$
- Aggregation is harmonized in our approach, but other errors may or may not cancel out in aggregation

Cross-country Comparisons

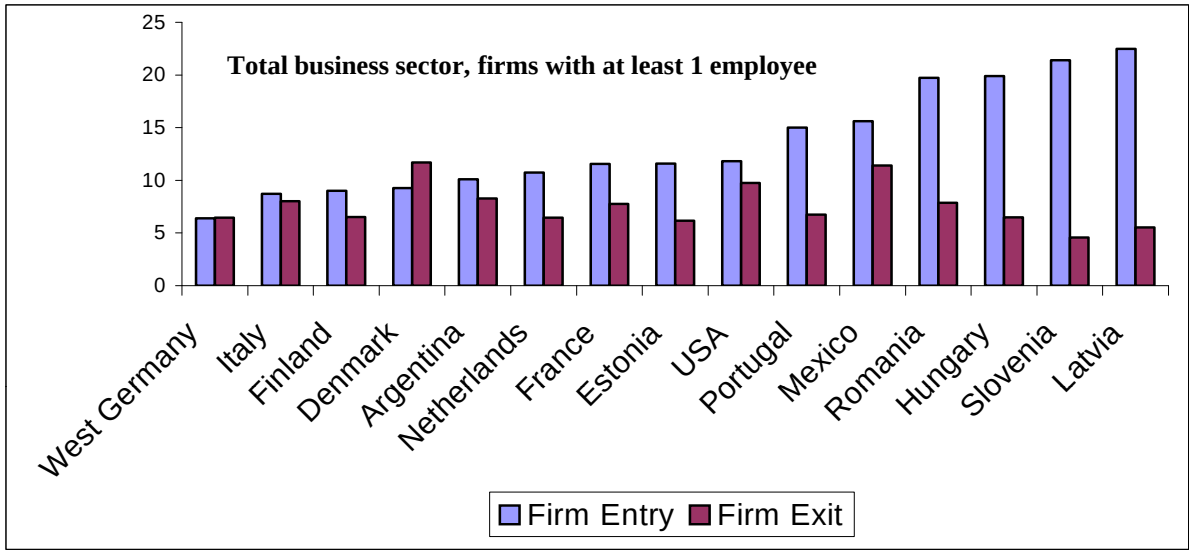
- Harmonization
  - Sample frames; Variable definitions; Classifications; Aggregation Methods
- Make comparisons that ‘control’ for errors
  - Exploit the different dimensions of the data (size, industry, time)
  - Use *difference in difference* techniques
- Even in absence of measurement error, interpretation of cross-country indicators requires theory

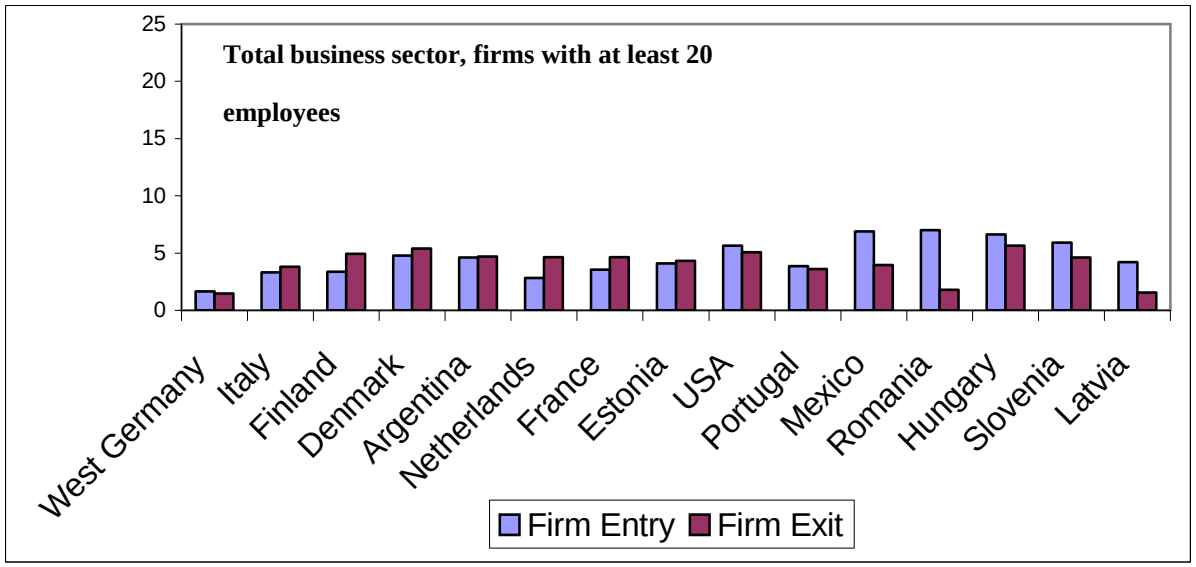
The different dimensions of producer dynamics

1. Firm size
2. Firm demographics:
    1. Employment and # of firms for entry, exit, continuers: by industry and size class
3. Firm survival :
    1. Employment and # of survivors, by cohort, industry, year
4. Static and dynamic analysis of allocative efficiency:
    1. Decompositions of entry/exit contribution
    2. Higher moments, covariances, means by quartile

- In lecture, focus on 2 and 4

Evidence of firm turnover





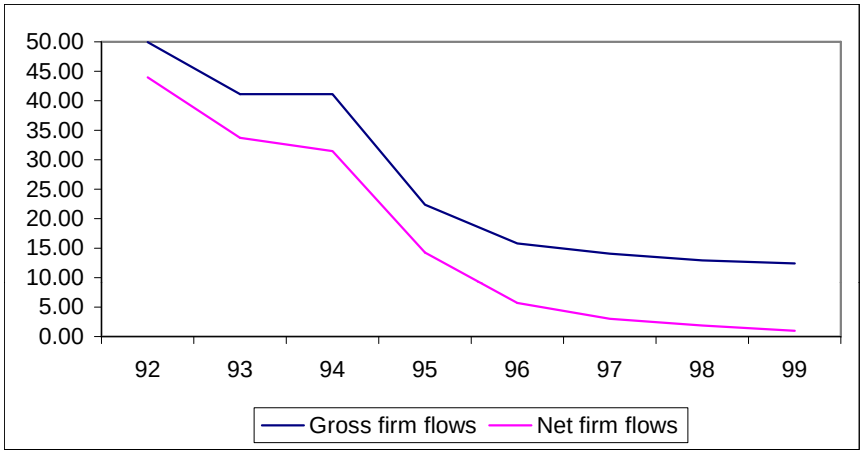
- No major differences across OECD countries, especially after controlling for sector and size effects
- But large differences in size at entry
- Large net entry in transition economies: filling the gaps (?)

Interpretation of Gross Turnover

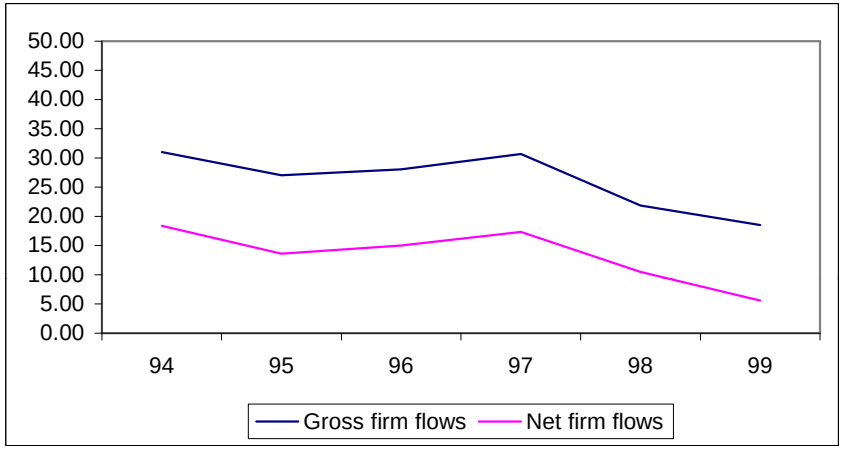
- Theoretical explanations
  - Entry explained by ‘push’ and ‘pull’ factors
  - Exit barriers may effect characteristics of exiting firm more than number of exits
- Measurement errors
  - Conceptual differences in measure (e.g. labor)
  - Differences in underlying data sources

Gross and net firm turnover: how the time dimension sheds light on the evolution of market forces in transition economies

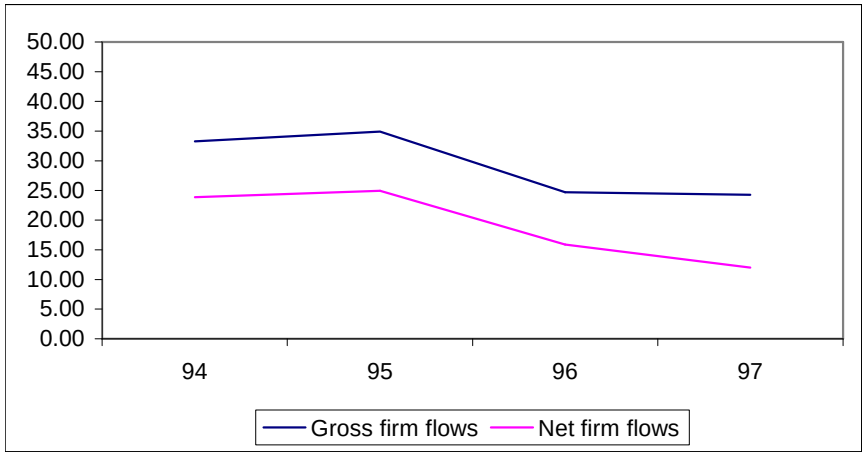
Slovenia



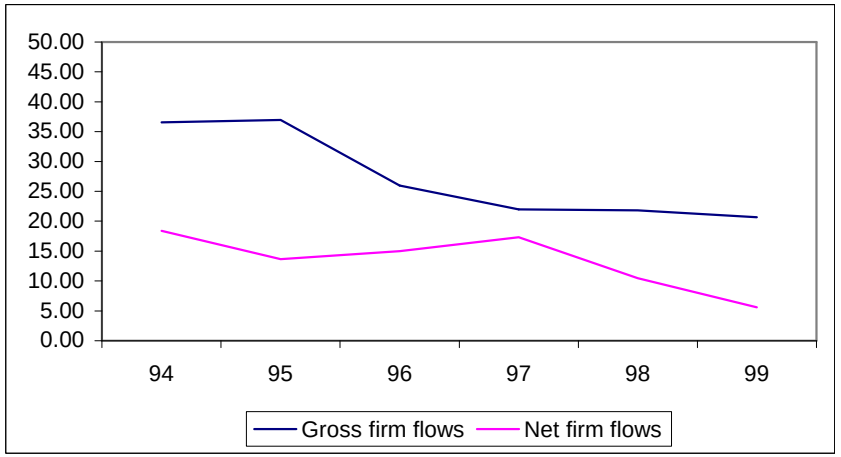
Hungary



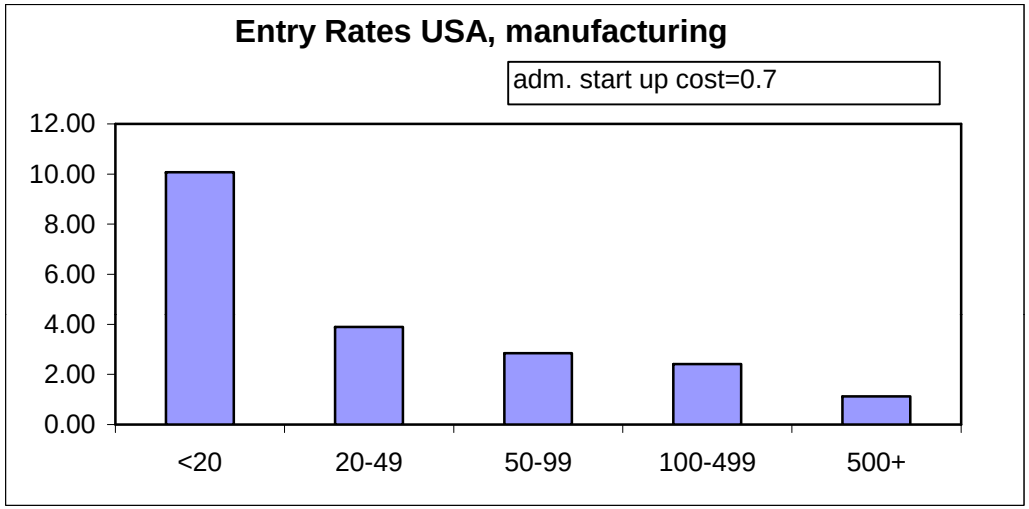
Latvia

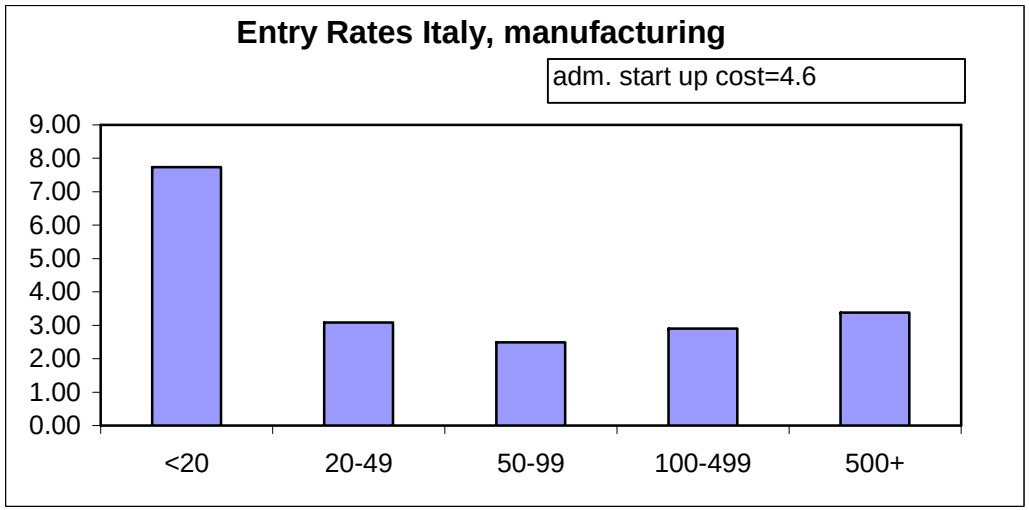


Romania



Entry rate by size: how the size dimension may shed light on the nature of firm dynamics

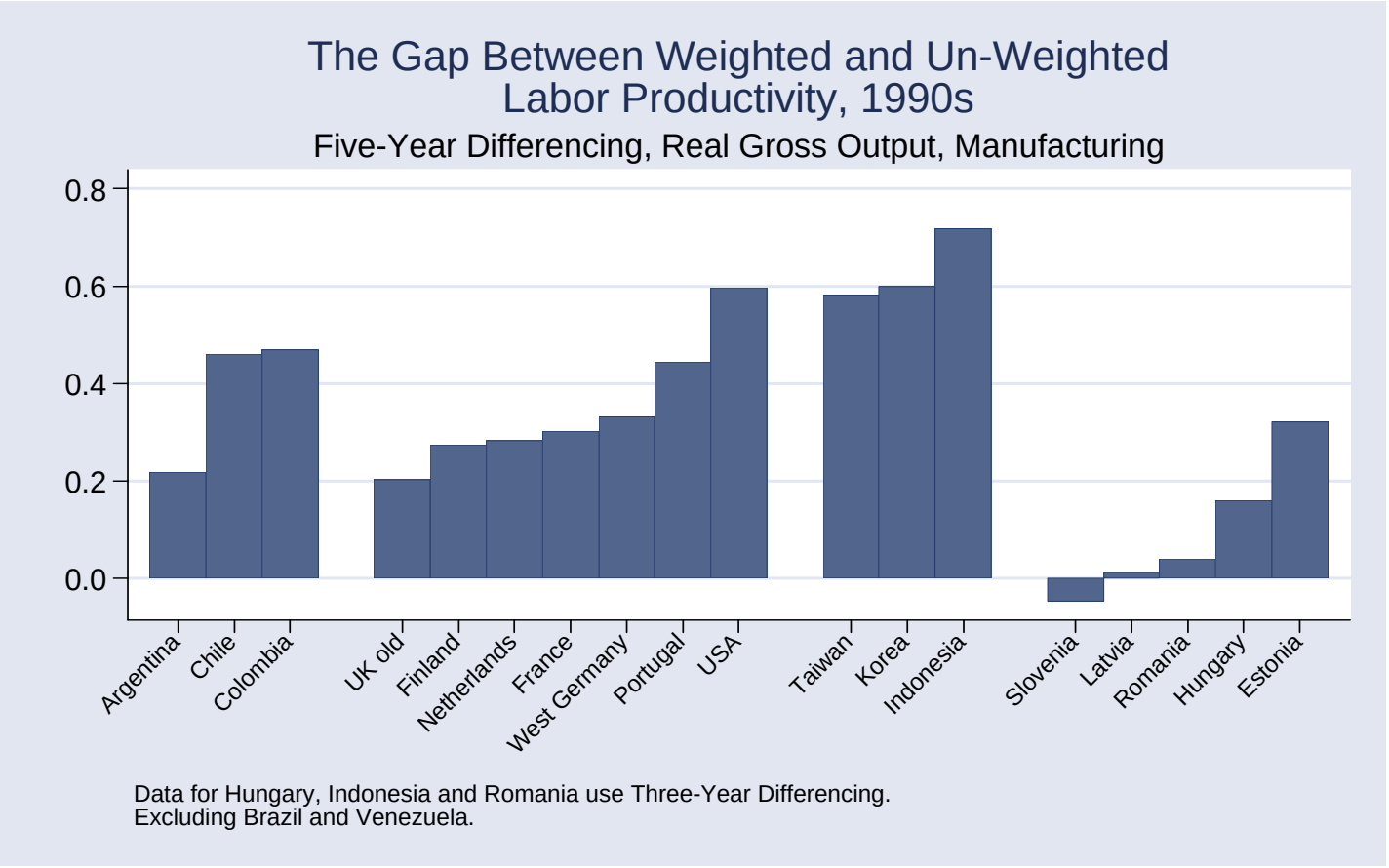




- Monotonic decline in entry rate by size in US
- Less clear link between size and entry rate in other EU countries;
- Any role for entry costs ?

Allocative efficiency : static analysis – Olley-Pakes decompositon

$$P_t = (1/N_t)\sum_i P_{it} + \sum_i \Delta\theta_{it}\Delta P_{it}$$

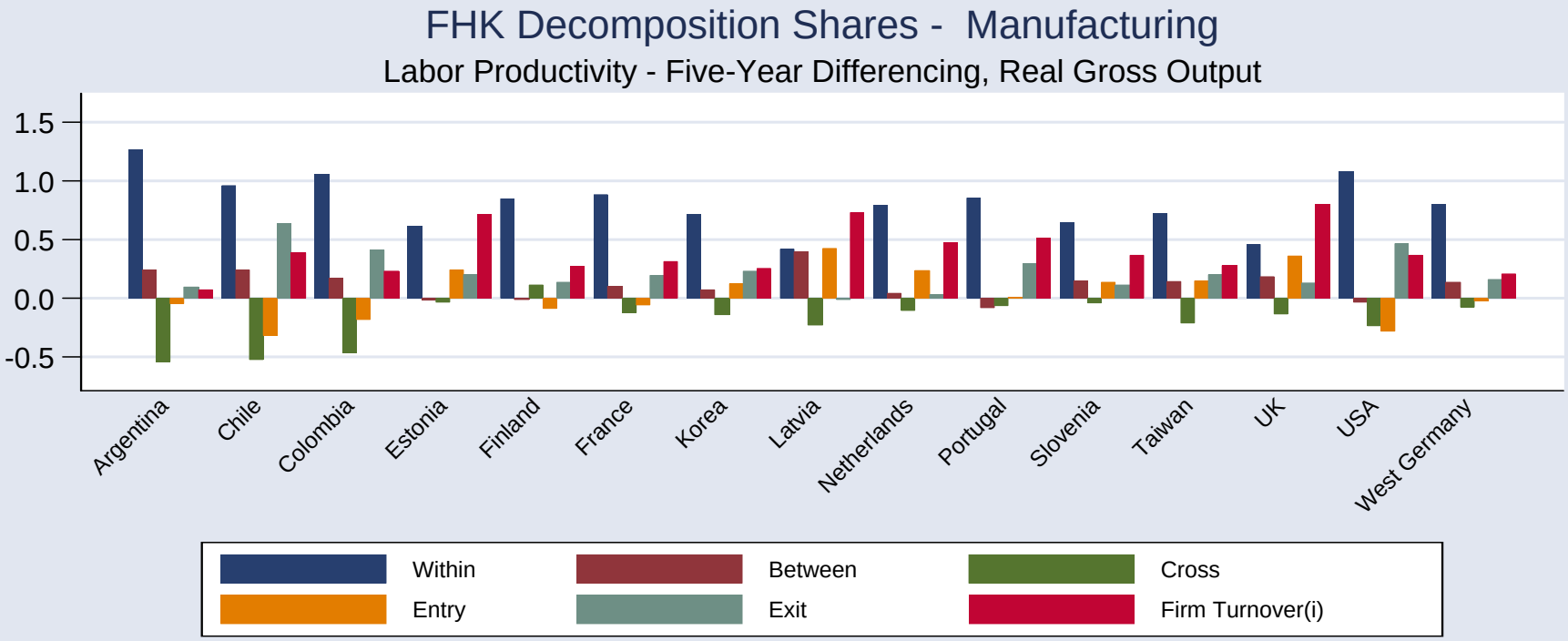


Allocative efficiency : how the allocative efficiency evolved over time in transition economies

Dynamic allocative efficiency: the role of entry and exit in reallocating resources towards more productive uses

We used the FHK approach, but also compared with Griliches-Regev and Baldwin-Gu

$$\Delta P_t = \sum_{i \in C} \overline{\theta}_i \Delta p_{it} + \sum_{i \in C} \Delta \theta_{it} (\overline{p_i} - \overline{P}) + \sum_{i \in N} \theta_{it} (p_{it} - \overline{P}) - \sum_{i \in X} \theta_{it-k} (p_{it-k} - \overline{P})$$



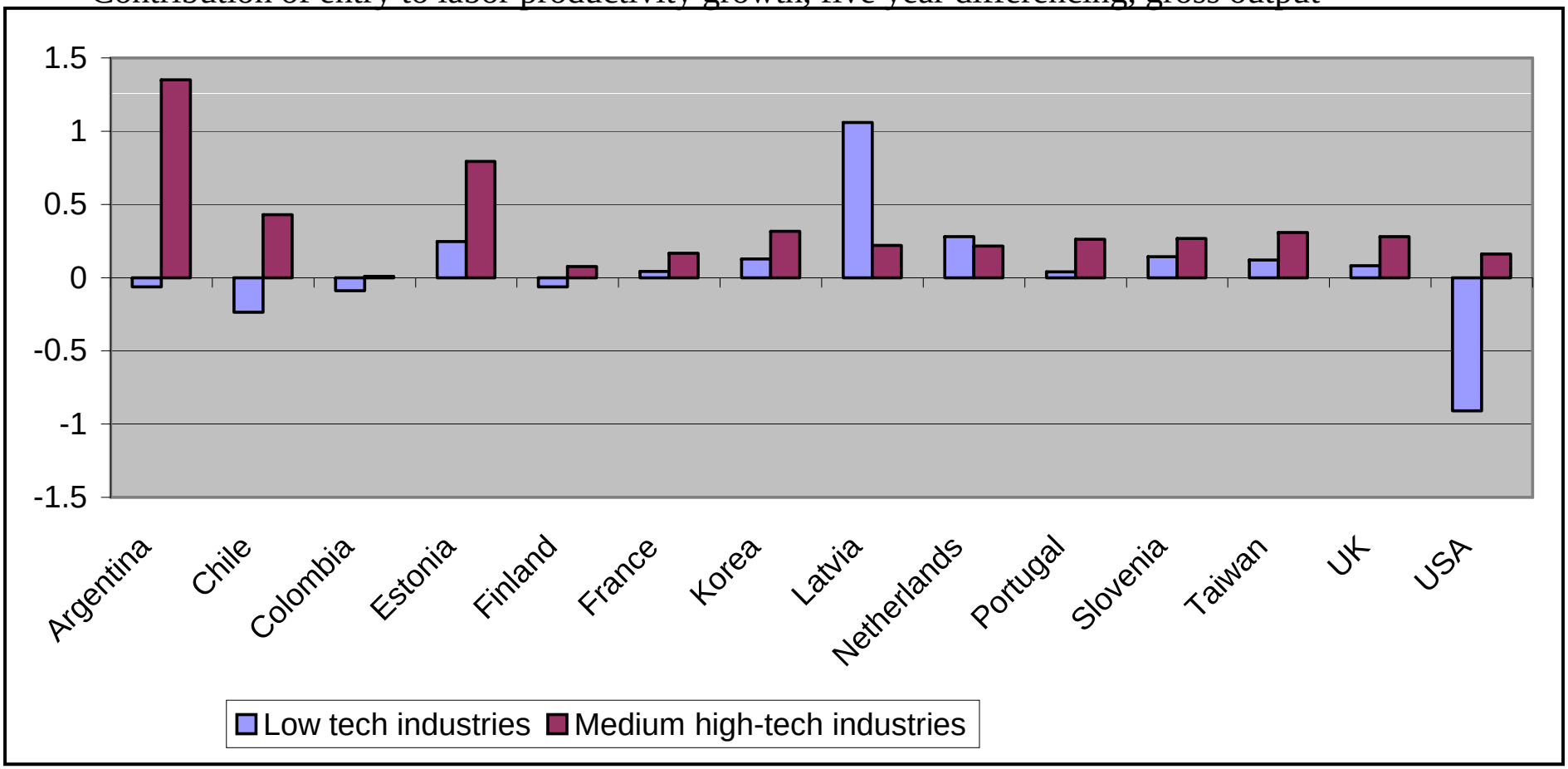
Argentina: 1995-2001. Chile: 1985-1999. Colombia: 1987-1998. Estonia: 2000-2001.
Finland: 2000-2002. France: 1990-1995. West Germany: 2000-2002. Korea: 1988 & 1993.
Latvia: 2001-2002. Netherlands: 1992-2001. Portugal: 1991-1994. Slovenia: 1997-2001.
Taiwan: 1986, 1991 & 1996. UK: 2000-2001. USA: 1992 & 1997.
Excluding Brazil and Venezuela.

Dynamic allocative efficiency: the importance of “technology factors”

We decompose our data for manufacturing into a low technology group and a medium high tech group

→ Stronger contribution of entry to productivity growth in medium high tech industries

Contribution of entry to labor productivity growth, five year differencing, gross output



Labor Productivity Dispersion

	ICT-producing		ICT-using	
Quartile	US	EU	US	EU
Top	123	118	74	58
3	88	87	51	48
2	61	72	40	46
Bottom	38	68	26	41

Units: Thousand US$ per worker

Producer Heterogeneity: What are we measuring?

- Limitation of most studies of productivity and reallocation:
  - Plant-level output measured as deflated revenue using industry deflator
  - More than just a measurement problem
  - Differences in measured productivity may be capturing differences in market power so results on productivity and reallocation may be capturing demand factors
  - Market selection should be on profitability but positive/normative aspects of selection depend critically on whether selection is on efficiency or market power

Measurement of Plant-level Productivity

$$tfp_i = y_i - \alpha_l l_i - \alpha_k k_i - \alpha_m m_i - \alpha_e e_t$$

All variables in logs, difficult measurement Issues on outputs and inputs and factor elasticities

Measurement and Conceptual Issues Interact with Policy Implications

- Many reforms in transition/emerging economies aimed at making markets more competitive
  - And obviously plays role in all countries (e.g., antitrust, deregulation, etc. in U.S.)
- Which and how much do product, credit, labor market distortions matter?
- Focus in this lecture – market power

Price/Demand Factors

- Theory: Differentiated product model
  - Prices depend upon both cost/efficiency (-) and demand factors (+)
  - Selection on efficiency (costs/productivity) and demand factors
  - Raises some questions regarding welfare (why demand elasticities vary across producers)
- Empirical analysis:
  - Rich data on businesses with measures of physical quantities and prices (Direct approach as opposed to indirect approach of Melitz, Tybout, etc.)
  - Productivity, prices and reallocation with “corrected” measure of productivity

$$U = y + \alpha \int_{i \in I} q_i di - \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)\left(\int_{i \in I} q_i di\right)^2 + \int_{i \in I} \delta_i q_i di - \frac{1}{2}\gamma \int_{i \in I} \left(q_i - \bar{q}\right)^2 di$$

$$q_i = \frac{\alpha}{\eta N + \gamma} + \frac{\eta N}{\eta N + \gamma}\frac{1}{\gamma}\bar{p} + \frac{1}{\gamma}\delta_i - \frac{1}{\gamma}p_i$$

$$q_i = \omega_i x_i$$

$$\pi_i = \left(\frac{\alpha}{\eta N + \gamma} + \frac{\eta N}{\eta N + \gamma}\frac{1}{\gamma}\bar{p} + \frac{1}{\gamma}\delta_i - \frac{1}{\gamma}p_i\right)\left(p_i - \frac{w_i}{\omega_i}\right)$$

$$p_i = \frac{1}{2}\frac{\gamma\alpha}{\eta N+\gamma} + \frac{1}{2}\frac{\eta N}{\eta N+\gamma}\bar{p} + \frac{1}{2}\delta_i + \frac{1}{2}\frac{w_i}{\omega_i}$$

$$\phi_i \equiv \delta_i - \frac{w_i}{\omega_i} \qquad \phi^* = -\frac{\gamma\alpha}{\eta N+\gamma} - \frac{\eta N}{\eta N+\gamma}\bar{p}$$

$\phi_i < \phi^*$ will not find operations profitable

$$V^e = \int_0^{w_u}\int_{\omega_l}^{\omega_u}\int_{\phi^*+\frac{w}{\omega}}^{\delta_e} \frac{1}{4\gamma}\left(\phi_i - \phi^*\right)^2 f\left(\delta,\omega,w\right)d\delta d\omega dw - s = 0$$

$$\frac{d\phi^*}{d\gamma} = \frac{-\partial V^e / \partial \gamma}{\partial V^e / \partial \phi^*}$$

$$\frac{\partial V^e}{\partial \gamma} = \int_0^{c_u} \int_{\omega_l}^{\omega_u} \int_{\phi^* + \frac{w}{\omega}}^{\delta_e} -\frac{1}{4\gamma^2}\left(\delta - \frac{w}{\omega} - \phi^*\right)^2 f(\delta, \omega, w)\, d\delta\, d\omega\, dw < 0$$

$$\frac{\partial V^e}{\partial \gamma} = \int_0^{c_u} \int_{\omega_l}^{\omega_u} \frac{1}{4\gamma}\left(\phi^* + \frac{w}{\omega} - \frac{w}{\omega} - \phi^*\right)^2 f\left(\phi^* + \frac{w}{\omega}, \omega, w\right) d\omega\, dw$$

$$- \int_0^{c_u} \int_{\omega_l}^{\omega_u} \int_{\phi^* + \frac{w}{\omega}}^{\delta_e} \frac{1}{2\gamma}\left(\delta - \frac{w}{\omega} - \phi^*\right) f(\delta, \omega, w)\, d\delta\, d\omega\, dw < 0$$

Key predictions:

$d\phi^*/d\gamma < 0$

$d\phi^*/ds < 0$

Data and Measurement

- Census of Manufactures for 1982, 1987, 1992, 1997
- Physical quantity/price data available for selected sectors:
  - 11 very detailed sectors
- TFPQ (physical) and TFPR (revenue) measured using std. index number approach (output less cost-share weighted inputs)
- Materials measured as cost of materials with industry materials deflator
  - Implications for interpretation of TFPQ:

Estimation and Conceptual Issues

- TFP measured using cost shares
- Demand equations estimated using TFP as an instrument
  - Elasticities vary by product but not within product
- All exercises control for complete set of product/year interactions

Basic Facts

- Heterogeneity and persistence in prices, TFPQ, TFPR
- Prices and TFPQ inversely related
  - Makes sense – more efficient/low cost producers have lower prices
- Var(TFPQ)>Var(TFPR)
- High rates of entry/exit

Correlations							
Variables	Traditional Output	Revenue Output	Physical Output	Price	Traditional TFP	Revenue TFP	Physical TFP
Traditional Output	1.00						
Revenue Output	0.99	1.00					
Physical Output	0.98	0.99	1.00				
Price	-0.03	-0.03	-0.19	1.00			
Traditional TFP	0.19	0.18	0.15	0.13	1.00		
Revenue TFP	0.17	0.21	0.18	0.16	0.86	1.00	
Physical TFP	0.17	0.20	0.28	-0.54	0.64	0.75	1.00
Standard Deviations							
Standard Deviations	1.03	1.03	1.05	0.18	0.21	0.22	0.26

Three main exercises

- Selection equation:
  - Exit = f(TFPQ, prices)
    - TFPQ is, in principle, a good index of cost/efficiency
    - Controlling for TFPQ implies controlling for cost/efficiency so can isolate demand factors
- Evolution of TFPR, TFPQ, prices (continuers, entry, exit)
- Productivity and reallocation decompositions using TFPQ and TFPR

Differences Between Continuing, Entering and Exiting

	Unweighted Regression		Weighted Regression	
	Exit Dummy	Entry Dummy	Exit Dummy	Entry Dummy
Variable				
Traditional TFP	-0.0202	0.0014	-0.0285	0.0414
	0.0045	*0.0043*	*0.0048*	*0.0053*
Revenue TFP	-0.0224	0.0124	-0.0340	0.0448
	0.0048	*0.0046*	*0.0049*	*0.0055*
Physical TFP	-0.0207	0.0166	-0.0305	0.0999
	0.0054	*0.0052*	*0.0058*	*0.0064*
Price	-0.0018	-0.0042	-0.0035	-0.0551
	0.0036	*0.0035*	*0.0040*	*0.0045*
Demand Shock	-0.3540	-0.3656	-0.6364	-0.0927
	0.0251	*0.0243*	*0.0293*	*0.0326*

Specification:	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Unweighted Regressions							
Traditional TFP	-0.073						
	0.014						
Revenue TFP		-0.063					
		0.013					
Physical TFP			-0.040			-0.062	-0.034
			0.012			*0.014*	*0.012*
Prices				-0.021		-0.069	
				0.018		*0.021*	
Demand Shock					-0.047		-0.047
					0.003		*0.003*
Weighted Regressions							
Traditional TFP	-0.055						
	0.012						
Revenue TFP		-0.062					
		0.011					
Physical TFP			-0.031			-0.059	-0.028
			0.010			*0.012*	*0.009*
Prices				-0.034		-0.078	
				0.014		*0.017*	
Demand Shock					-0.038		-0.038
					0.002		*0.002*

Exit Probits

Productivity Decompositions

Productivity Measure	Total Growth	Components of Decomposition					
		Within	Between	Cross	Entry	Exit	Net Entry
Traditional							
	2.31	39.35	-16.62	47.72	23.22	6.34	29.55
Revenue							
	5.09	66.43	-10.08	25.95	13.99	3.71	17.70
Physical							
	5.09	67.78	-7.91	13.81	23.97	2.35	26.32

Main Findings

- Exiting businesses have lower prices and lower productivity (either TFPQ or TFPR) than incumbents or entrants.
- Entering businesses have lower prices than incumbents.
- Entering businesses have higher TFPQ but not higher TFPR than incumbents
- Decompositions of aggregate TFPQ vs. TFPR suggests that the results in the existing literature may have understated the contribution of entry (entrants have low prices).

Demand vs. Efficiency in Selection?

- Lower productivity establishments and lower price establishments are more likely to exit.
- Controlling for both price and productivity effects simultaneously shows that both factors are important for survival as implied by the theory.

Where do we go from here?

- Theory:
  - Nature of product differentiation/market structure:
    - Welfare consequences?
- Evidence:
  - More sectors and countries
  - How to estimate differences in elasticities across businesses producing same product?
- The World?
  - Distortions in product, credit, labor markets all are relevant for productivity and reallocation.
  - See Eslava et. al. (2005)