Wage inequality and trade reform: productivity channel

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Outline

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Inequality

"...it tells you something about the breadth of global concerns about inequality that China's president, Britain's prime minister, America's second-richest man and the head of the International Monetary Fund have all worried...about the dangers of a rising gap between the rich and the rest."

Economist, Jan 20th 2011

Inequality, trade, and wages

"It's no longer safe to assert that trade's impact on the income distribution in wealthy countries is fairly minor"

Krugman, 15th of June, 2007, VOX EU

"Increases in household income inequality have been largely driven by changes in the distribution of wages and salaries... With very few exceptions (France, Japan, and Spain), the wages of the 10% best-paid workers have risen relative to those of the 10% lowest paid."

Divided we stand, OECD report, 2012

Failure of traditional approach

- Hekscher-Ohline (1941)
  - trade liberalization $\Longrightarrow \nearrow$ inequality between low and high skilled workers in developed countries and $\searrow$ inequality in developing countries
  - no variation in factor income within industry
- 90's – $\nearrow$ inequality in low- and high-income countries (OECD, 2012)
- Increase in inequality comes together with trade reforms
  - Mexico, Colombia, Argentina, Brazil, Chile, India, and China (Goldberg and Pavcnik, 2007, Topalova, 2007, Harrison and Hanson, 1999)
- Increase in wage dispersion in US mostly comes from within industry (Dunne et al, 2004)

New approaches to inequality

- Skilled-based technical change (Dunne et al, 2004)
  - changes in technologies increasingly reward skills
- Offshoring and fragmentation of tasks (Feenstra and Hanson, 1996)
  - moving borderline b/w skill-intensive and labor-intensive tasks

Splintering

Production of CPU
1. printing of circuits on silicon disks (developed countries)
2. cutting silicon disks, assembly, and testing (China, Malaysia, and the Philippines)

Firm heterogeneity and wages

- Firm heterogeneity within industry – Melitz model combined with
  - Search and matching frictions (Diamond-Mortensen-Pissaridies) Helpman, Itskhoki, and Redding (HIR, 2010)
  - Fair wage (Akerlof and Yellen, 1990) Egger and Kreickemeier, 2009; Amiti and Davis, 2012
  - Efficiency wage (Shapiro and Stiglitz) Davis and Harrigan, 2007

Outline

Features of the HIR model

- Extends Melitz model by adding search and matching frictions (Diamond-Mortensen-Pissaridies)
- Introduce ex-post match-specific heterogeneity of workers
- Production function includes worker's complementarity (Alchian and Demsetz, 1972)
  - "productivity" consist of exogenous draw of φ and endogenous "human" capital component $\bar{a}$

Wage and productivity in HIR

- More productive firms
  - screen workers more intensively $\Rightarrow$ have workforce of higher ability
  - have larger market share and higher profits
  - pay higher wages
- Exporting firms
  - are more productive than domestic
  - given productivity θ, pay higher wage relative to autarky firm

Effects of trade liberalization in HIR

- Dramatic trade liberalization (from autarky to free trade)
  - increase dispersion of firm's revenues and profits
  - increase wage inequality within an industry
- Partial trade liberalization
  - $\nearrow$ wage inequality when share of exporters is low
  - $\searrow$wage inequality when share of exporters is high

Outline

Regulations and distribution of firms

- Productivity distribution depends on the regulatory environment R

$$G_\theta(\theta) = 1 - \left(\frac{\theta_{min}(R)}{\theta}\right)^z$$

- $\frac{\partial \theta_{min}}{\partial R} > 0$
- $\nearrow$ R $\Rightarrow$ $\nearrow$ productivity and dispersion
  - $E(\theta) = \frac{z\theta_{min}}{z-1}, \frac{\partial E(\theta)}{\partial R} = \frac{z}{z-1}\frac{\partial \theta_{min}}{\partial R} > 0,\ z > 1$
  - $var(\theta) = \frac{z\theta_{min}^2}{(z-1)^2(z-2)}, \frac{\partial var(\theta)}{\partial R} = \frac{2z\theta_{min}}{(z-1)^2(z-2)}\frac{\partial \theta_{min}}{\partial R} > 0,\ z > 2.$

Regulations and Cut-offs

- Cut-offs are determined as

$$\left[\Upsilon_x^{\frac{\delta}{k}\mu} - 1\right]\left(\frac{\theta_x}{\theta_d}\right)^{\frac{\delta}{k}\eta} = \frac{f_x}{f_d}$$

- and

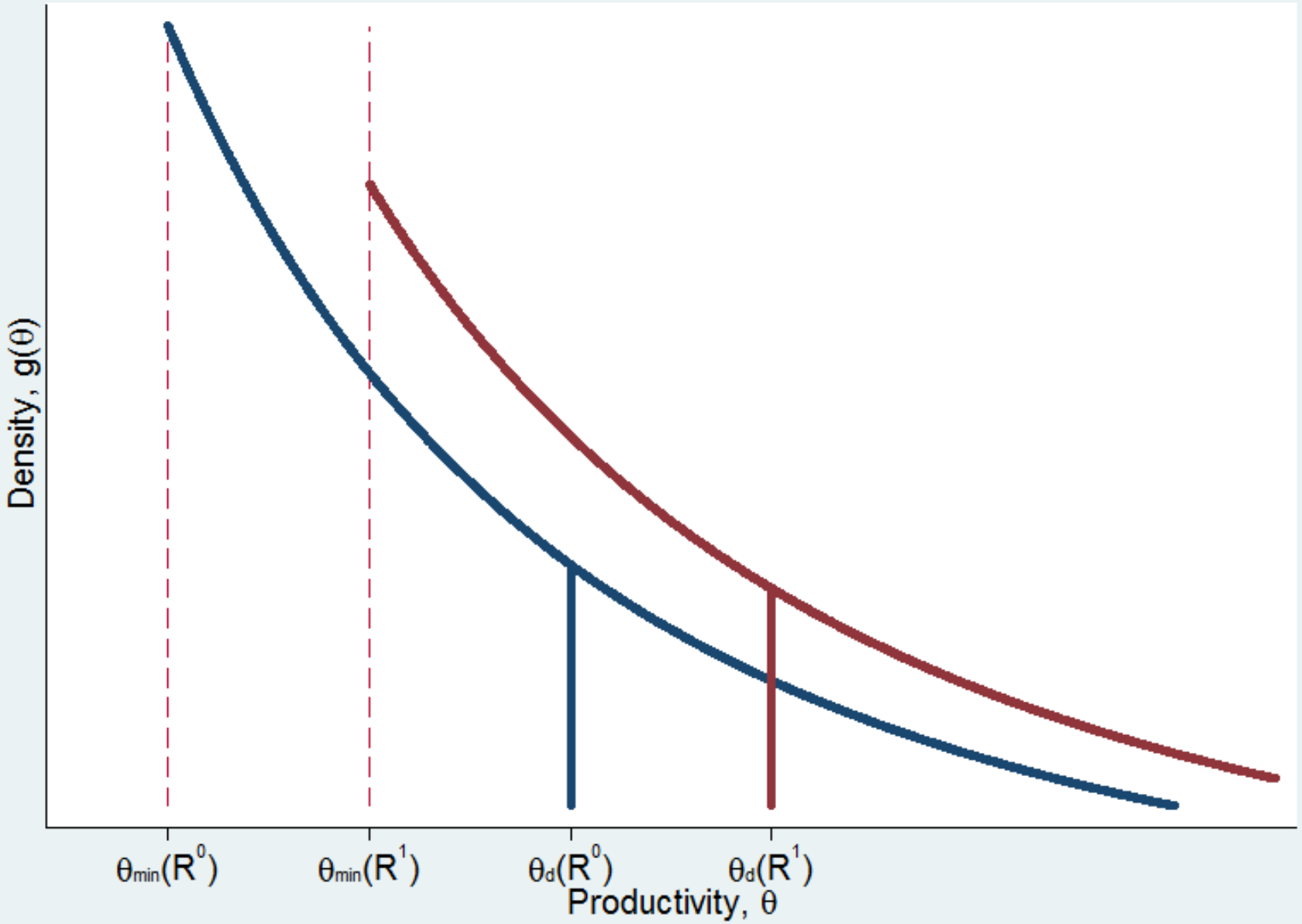
$$\int_{\theta_d}^{\infty} \pi(\theta) dG(\theta) = f_e$$

  - f_d, f_x, and f_e are fixed costs of producing, exporting, and entry;
  - $k > 1$ determines the shape of distribution of worker's ability;
  - $\delta > 0$ is a parameter of the screening technology;

- ↗R

  - θ_d and $\theta_x$shift to the right, resulting in the higher mean and variance of the distribution of firms operating in the industry

Improvement in R



Productivity and wages

$$\omega = \Upsilon(\theta)^{\mu} \omega_d \left(\frac{\theta}{\theta_d} \right)^{\eta} \tag{1}$$

where

$$\Upsilon(\theta) = \begin{cases} 1 & \theta < \theta_x \\ \Upsilon_x & \theta \geqq \theta_x \end{cases}$$

and $\Upsilon_x^{\mu} = 1 + a > 1$. θ_d is a zero profit productivity cut-off and ω_d is a wage set by the least productive firm.

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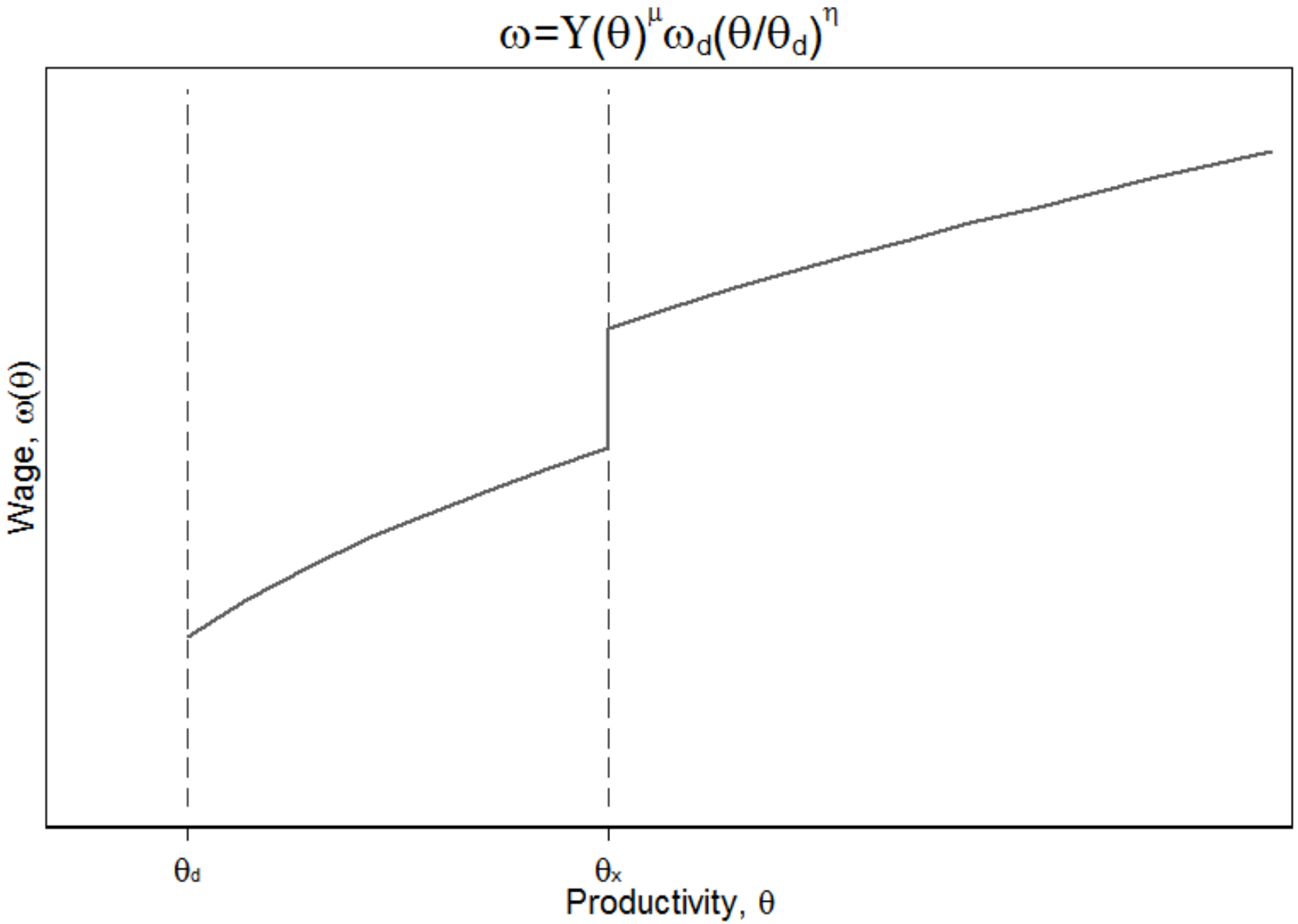
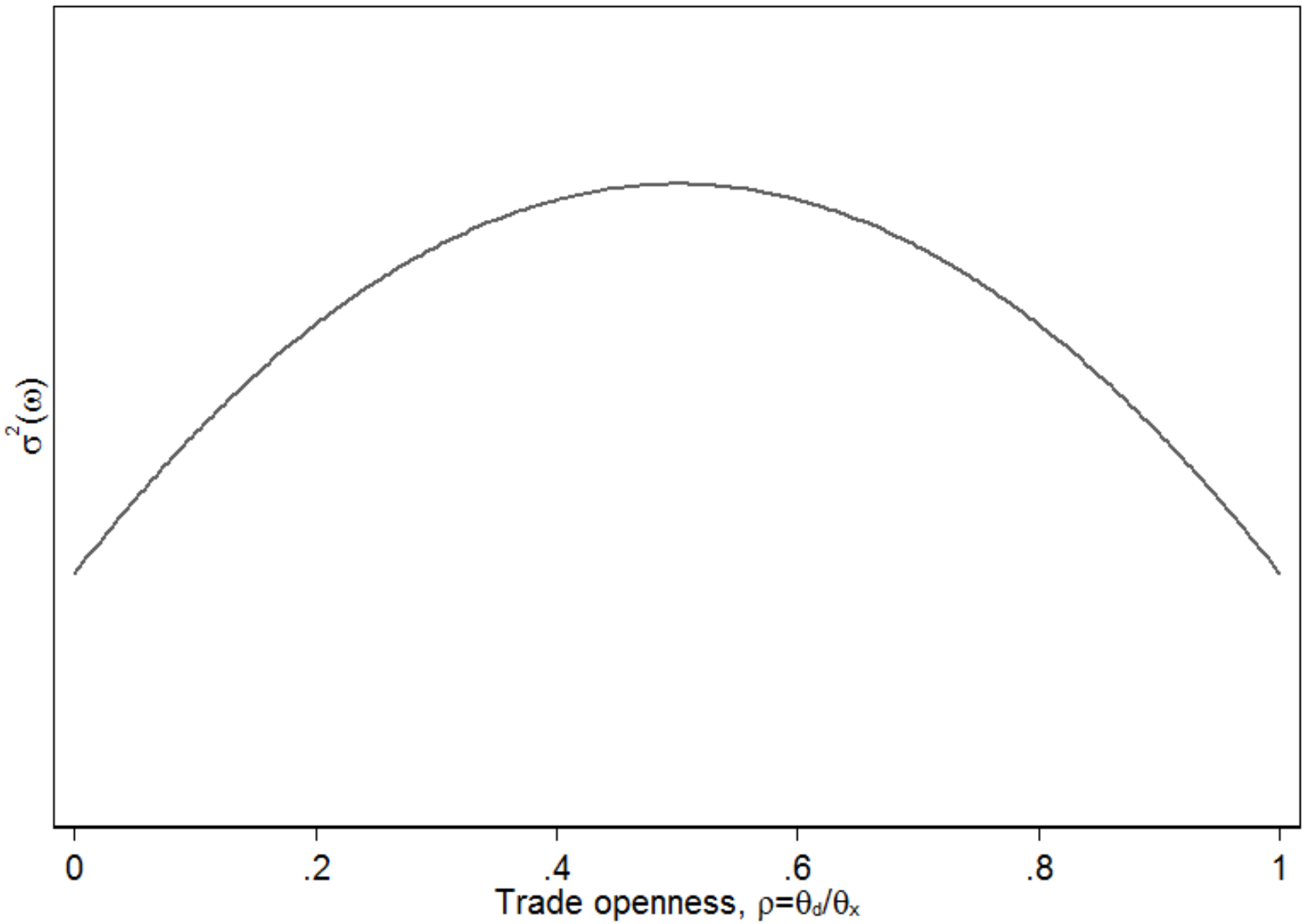
Wage, productivity, and export



Industry level result



Empirical equation

$$\ln \omega_{it} = \alpha + \eta \ln \tilde{\theta}_{it} + \mu exporter_{it} + X_{it}\gamma + D_{st}\mu + D_r r + \varepsilon_{it}$$

Empirical challenges

- Endogeneity
  - wage has effect on effort, hence on productivity (Lazear and Rosen, 1981; Shapiro and Stiglitz, 1984; Akerlof and Yellen, 1990)
  - upward bias due to $corr(\theta, \varepsilon) > 0$
- Measurement error
  - $\tilde{\theta}_{it} = \theta_{it} + (p_{it} - P_t) + q_{it}$

Instruments

- Trade liberalization:
  - Deregulation increase *within* firm productivity in import-competing sectors by 3-10 percent more than in non-traded good sectors (Pavcnik, 2002)
  - Reduction in import tariffs on inputs used in production by 10 p.p. increase TFP of manufacturing firms by 12 % (Amiti and Koenings, 2007)
- Services liberalization:
  - A standard deviation increase in the foreign presence in services is associated with 7.7 % increase in TFP in downstream manufacturing firms (Arnold et al., 2011)
  - forward linkages from foreign direct investment in services to downstream manufacturing industries account for almost 7 % increase in the Chilean manufacturing productivity growth (Fernandes and Paunov, 2011)

Markups to control for prices and quality

- Markups (De Loecker and Warzynsky, 2012)

$$\frac{p_{it}}{c(\theta_{it})} = \frac{\beta_l}{\omega_{it} L_{it} / p_{it} Y_{it}} \tag{2}$$

- $corr(\frac{p_{it}}{\theta_{it}}, \varepsilon_{it}) < 0 \Rightarrow$ downward bias in the estimation of the markup coefficient
- Markups are instrumented same as productivity
  - De Loecker et al. (2012) – after trade liberalization firms do not fully adjust prices to reduction in the marginal costs

Outline

Why Ukraine?

- Rapid liberalization of services in 2001-2007
  - More competition, FDI, and trade in services
  - Labor productivity of services increased by more than 40 percent
  - Services sectors accounts for 48 percent of GDP in 2007 and growing
- Push for services liberalization was mostly imposed externally
  - WTO accession requirements
  - Exogenous shock for Ukraine

Outline

Data

- 2001-2007 statistical statements 50,000 firms per year
  - 12,000 firms per year have information on use of services and material inputs
- EBRD index of reforms and FDI share for each services sub-sector
- Ownership: private domestic, private foreign, state
- Export and import status

Variable	Observations	Mean	Std. deviation
ω_{it}, thsd. UAH 2001	46515	4.885	3.94
Y_{it}, thsd. UAH 2001	46530	23521	180168
L_{it}, workers	46530	297.1	1360
K_{it}, thsd. UAH 2001	45923	8138	49820
M_{it}, thsd. UAH 2001	45924	15265	147687
I_{it}, thsd. UAH 2001	34321	2368	21711
$\ln(TFP_{i,t})$	44243	1.139	1.027
$\text{Importer}_{i,t}$	46530	0.3131	0.4637
$\text{Exporter}_{i,t}$	46530	0.3647	0.4813
$\text{Foreign}_{i,t}$	46530	0.08764	0.2828
$\text{Exit}_{i,t}$	46530	0.04008	0.1962
$\text{Entry}_{i,t}$	46530	0.09654	0.2953
Urban_{i}	46530	0.678	0.4673
Serv. Lib_{it} (EBRD)	46530	0.3966	0.6553
Serv. Lib_{it} (FDI)	46530	0.3784	0.7961
$\text{Private}_{i,t}$	46530	0.893	0.3092
Single plant_{it}	46530	0.9356	0.2454
Input tariff_{it}	46530	5.693	3.2
$\text{Markup}_{i,t}$	46515	5.468	153.8

Outline

OLS results

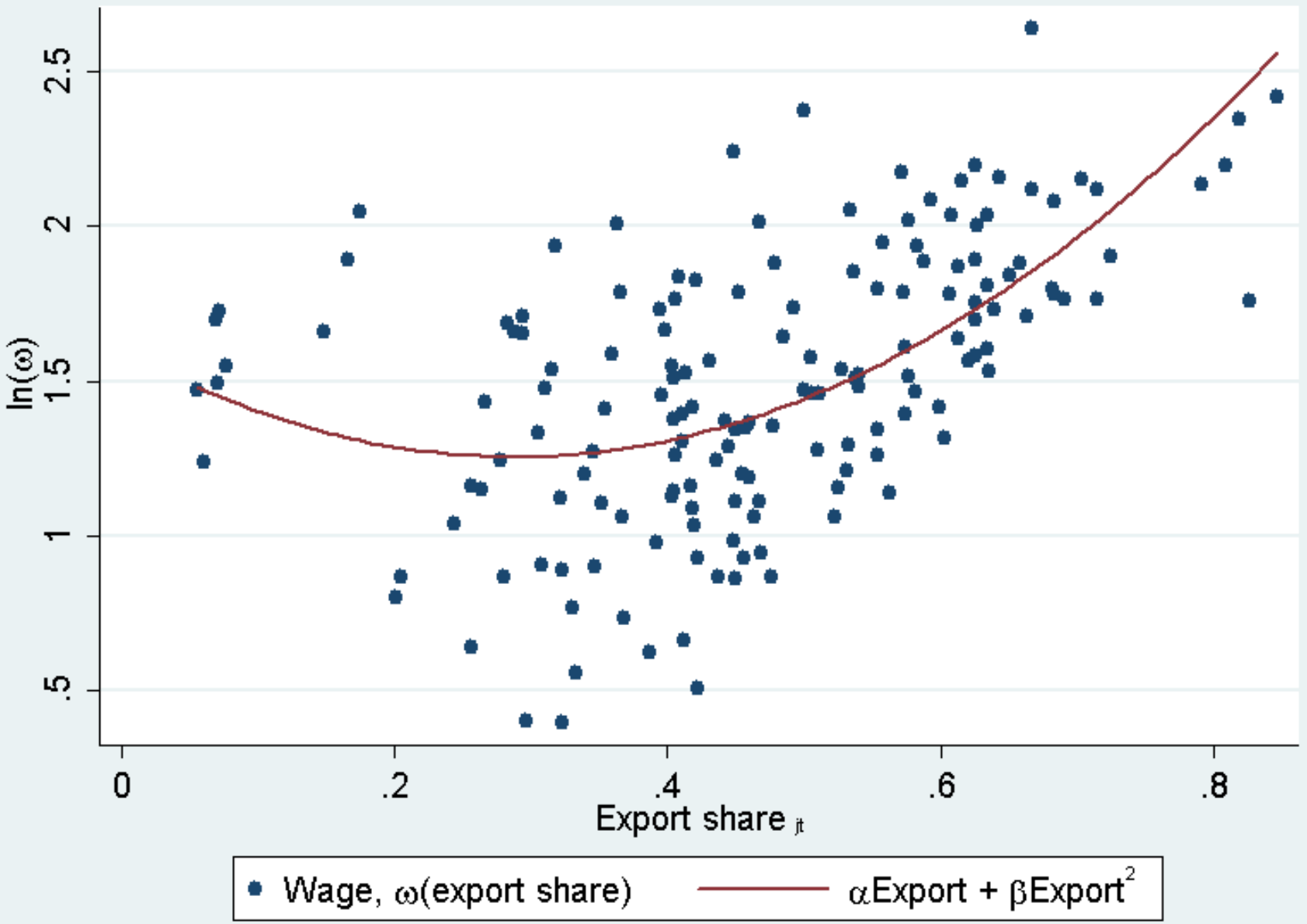
Dependent variable: $\ln(wage_{i,t})$	$\ln(va_{i,t}/L_{i,t})$				$\ln(TFP_{i,t})$			
	OLS	Markups	FE	Exp × prod.	OLS	Markups	FE	Exp × prod.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Productivity	0.240***	0.457***	0.247***	0.252***	0.264***	0.351***	0.223***	0.229***
	(0.008)	(0.022)	(0.024)	(0.029)	(0.009)	(0.011)	(0.011)	(0.012)
Markup		-0.384***	-0.323***	-0.323***		-0.119***	-0.175***	-0.175***
		(0.017)	(0.021)	(0.022)		(0.006)	(0.009)	(0.009)
$\text{Exporter}_{i,t}$	0.025**	0.036***	0.034***	0.080*	0.061***	0.073***	0.048***	0.071***
	(0.009)	(0.007)	(0.006)	(0.035)	(0.010)	(0.009)	(0.006)	(0.012)
$\text{Exporter}_{i,t} \times$				-0.017				-0.020*
$\text{productivity}_{i,t}$				(0.013)				(0.008)
$\text{Importer}_{i,t}$	0.020*	0.080***	0.048***	0.048***	0.114***	0.155***	0.060***	0.061***
	(0.010)	(0.008)	(0.005)	(0.005)	(0.010)	(0.010)	(0.006)	(0.006)
$\text{Foreign}_{i,t}$	0.156***	0.128***	0.037**	0.038**	0.219***	0.226***	0.051***	0.051***
	(0.017)	(0.014)	(0.013)	(0.013)	(0.019)	(0.018)	(0.015)	(0.015)
$\ln(L_{i,t})$	0.115***	0.072***	-0.006	-0.006	0.106***	0.091***	-0.024**	-0.025**
	(0.004)	(0.003)	(0.007)	(0.007)	(0.004)	(0.004)	(0.008)	(0.008)
$\text{Exit}_{i,t}$	-0.063***	-0.121***	-0.096***	-0.095***	-0.143***	-0.193***	-0.128***	-0.128***
	(0.019)	(0.016)	(0.015)	(0.015)	(0.021)	(0.021)	(0.018)	(0.018)
Urban_i	0.094***	0.064***	0.015	0.014	0.132***	0.132***	0.025	0.024
	(0.009)	(0.008)	(0.020)	(0.020)	(0.011)	(0.011)	(0.025)	(0.026)
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	43985	43985	43985	43985	44236	44236	44236	44236
R^2	0.583	0.715	0.601	0.602	0.509	0.529	0.522	0.522

Standard errors clustered by firms in parentheses. * p<0.05, ** p<0.01, *** p<0.001

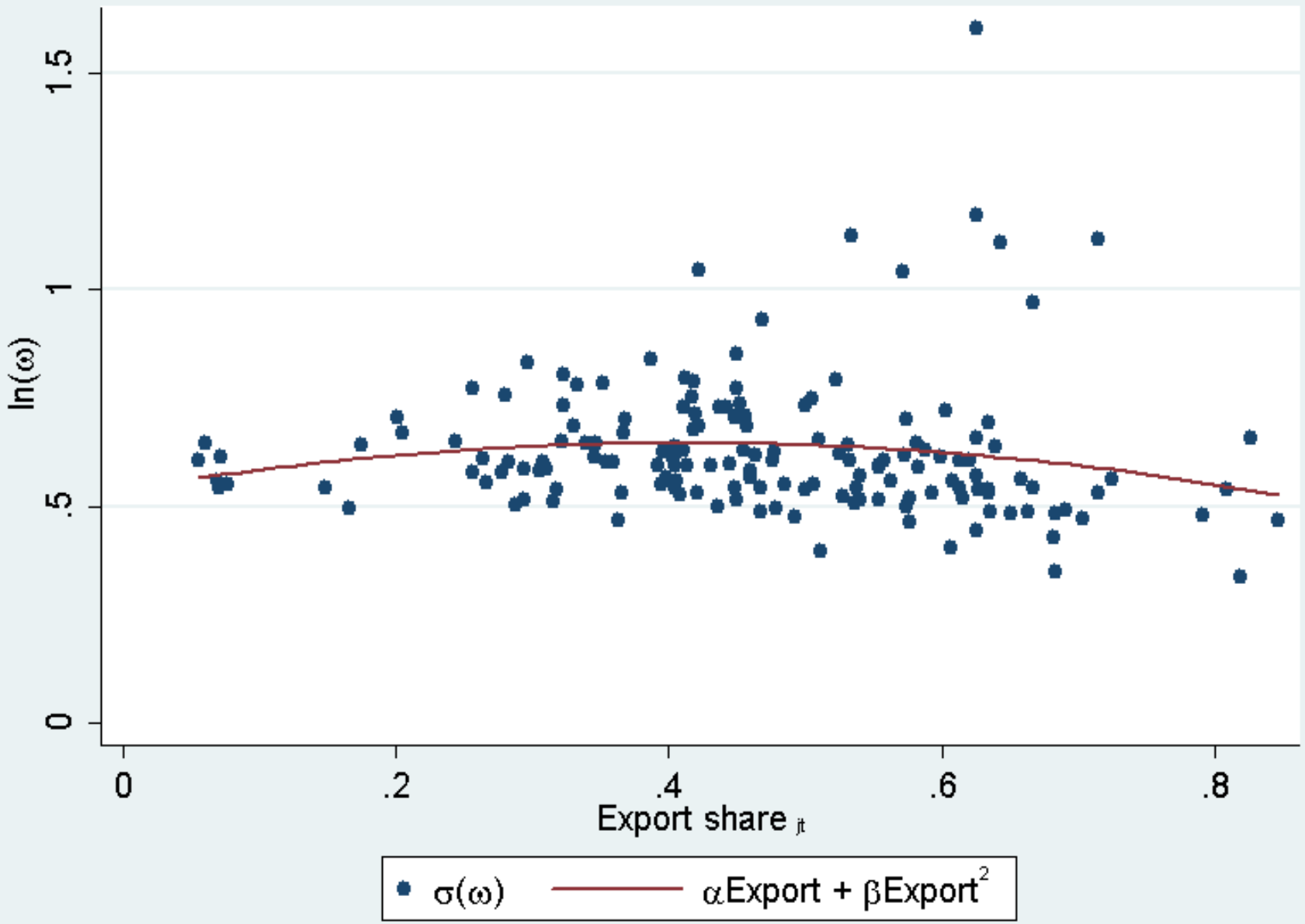
Standard errors in parentheses

Dependent variable: $\ln(wage_{it})$	(1) Base	(2) Lagged	(3) Inter-action	(4) Private	(5) Single plant	(6) Entry	(7) Input tariff	(8) All
$\ln(TFP_{i,t})$	0.153***	0.155***	0.142***	0.165***	0.156***	0.157***	0.145***	0.167***
	(0.033)	(0.037)	(0.041)	(0.033)	(0.033)	(0.033)	(0.034)	(0.044)
$\text{Markup}_{i,t}$	0.083***	0.074***	0.083***	0.089***	0.083***	0.085***	0.140***	0.137***
	(0.014)	(0.016)	(0.014)	(0.014)	(0.014)	(0.014)	(0.024)	(0.024)
$\text{Exporter}_{i,t}$	0.061***	0.050***	0.032	0.056***	0.060***	0.060***	0.047***	0.042
	(0.012)	(0.013)	(0.022)	(0.012)	(0.012)	(0.012)	(0.013)	(0.023)
$\text{Importer}_{i,t}$	0.096***	0.089***	0.094***	0.102***	0.096***	0.097***	0.073***	0.085***
	(0.016)	(0.017)	(0.015)	(0.016)	(0.016)	(0.016)	(0.018)	(0.016)
$\text{Foreign}_{i,t}$	0.220***	0.220***	0.220***	0.232***	0.221***	0.221***	0.211***	0.228***
	(0.020)	(0.022)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)	(0.020)
$\ln(L_{i,t})$	0.115***	0.119***	0.115***	0.111***	0.118***	0.110***	0.122***	0.115***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
$\text{Exit}_{i,t}$	-0.117***		-0.119***	-0.115***	-0.115***	-0.119***	-0.096***	-0.099***
	(0.024)		(0.025)	(0.024)	(0.024)	(0.024)	(0.026)	(0.026)
Urban_{i}	0.138***	0.138***	0.138***	0.141***	0.138***	0.140***	0.137***	0.142***
	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
$\text{Exporter}_{i,t} \times$			0.026					0.001
$\ln(TFP_{i,t})$			(0.023)					(0.025)
$\text{Private}_{i,t}$				-0.164***				-0.176***
				(0.017)				(0.017)
$\text{Single plant}_{i,t}$					0.073***			0.091***
					(0.018)			(0.019)
$\text{Entry}_{i,t}$						-0.085***		-0.096***
						(0.013)		(0.016)
$\text{Input tariff}_{j,t}$							-0.009**	-0.007*
							(0.003)	(0.003)
Observations	44236	33222	44236	44236	44236	44236	44236	44236
Hansen J statistic	0.055	1.263	0.047	0.000	0.044	0.058	0.049	0.001
$\chi^2(1)$ p-value	0.815	0.261	0.829	0.999	0.834	0.810	0.824	0.978
R^2	0.470	0.440	0.469	0.472	0.471	0.471	0.436	0.447

Exploratory analysis. Mean wage



Exploratory analysis. Variance



Industry results

Dependent variable	Average wage$_{j,t}$		St. Dev. Wage$_{j,t}$	
	(1)	(2)	(3)	(4)
	OLS	FE	OLS	FE
$\ln(TFP_{j,t})$	-0.094***	0.155*		
	(0.026)	(0.062)		
$\sigma(\ln(TFP)_{j,t})$			0.189***	0.111**
			(0.045)	(0.042)
Share of exporters$_{j,t}$	-1.813**	0.250	0.236	0.319
	(0.590)	(0.482)	(0.148)	(0.297)
Share of exporters$^2_{j,t}$	1.490*	-0.740	-0.589**	-0.002
	(0.634)	(0.439)	(0.185)	(0.270)
Sub-Industry FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	161	161	161	161
R^2	0.840	0.973	0.713	0.871

Standard errors clustered by industries in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Outline

Conclusions

- Productivity channel is important determinant of wage inequality
- Share of exporters within industry has a non-linear effect on inequlaity
- OLS estimation and labor productivity measure overestimate the effect of productivity on wages

Thank you!