

Foreign acquisition and internal organization

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UM, NIPE and World Bank

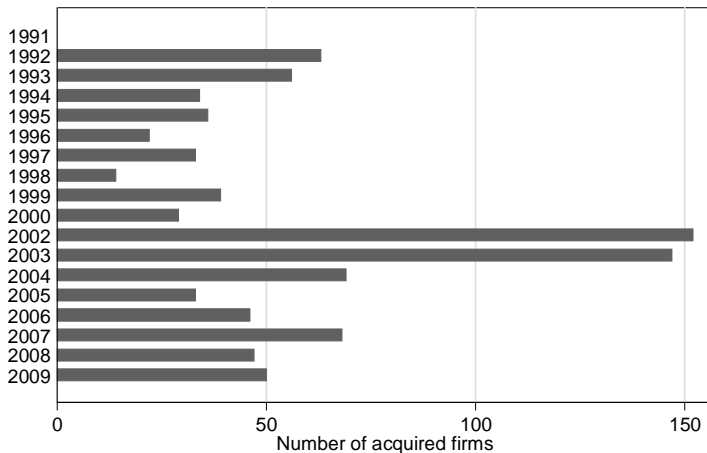
Budapest, 26/27 June 2017

- What are the effects of foreign takeovers on firm organization and pay structure?
- We address these questions empirically using data from Quadros de Pessoaal for the period 1991-2009;
- Portugal received sizable inflows of FDI from higher-income nations, where firms tend to have better management practices and make extensive use of information technologies.

- The effects of foreign acquisition on **productivity, employment, wages, innovation and management practices**. [Griffith (1999), Canyon at al. (2002), Girma and Gorg(2007), Almeida (2007), Arnold and Javorcik (2009) Guadalupe, Kuzmina and Thomas (2012), Bloom Sadun and Van Reenen (2012) Hijzen at al. (2013)];
- Literature on labor market consequences **of new information technologies** [Autor, Katz and Krueger (1998); Bresnahan, Brynjolfsson and Hitt (2002), Acemoglu and Autor (2011), Beaudry, Doms and Lewis (2010) and Autor, Dorn and Hanson (2015)];
- We establish a casual link between **foreign acquisition, the organization and pay structure of the firm**.

- Our main dataset: Quadros de Pessoal, 1991-2009;
- Foreign ownership: if more than 50% of capital is owned by foreign investors;
- Four hierarchical layers were built using detailed information on occupations: CEO and directors, top managers, supervisors and operators, following Caliendo, Monte and Rossi-Hansberg (2015);
- We compute firm-year and firm-layer-year averages of earnings, education levels and other observable variables;
- We exclude firms with less than 10 employees and those without the lowest layer (operators);
- Final sample: domestic firms (73,728) and domestically-owned in the first year of observation that were acquired later by foreign investors (938).

Figure 1: Distribution of acquired firms over time



Foreign acquisition (FO)

Figure 2: Distribution of acquired firms across industries

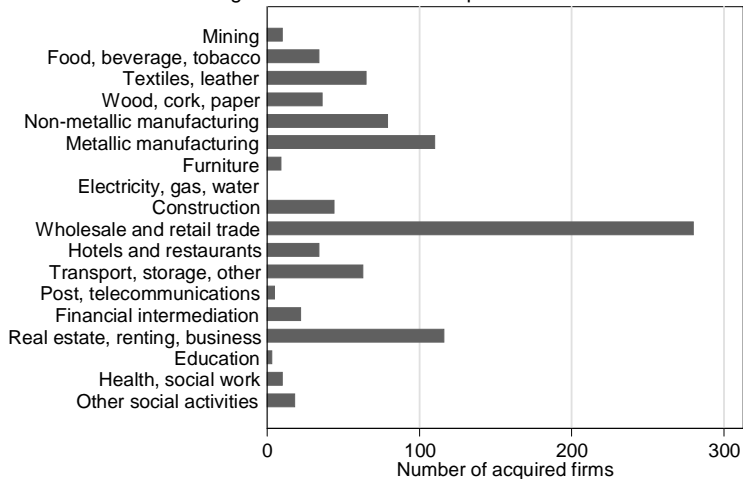


Table 1: Summary statistics, full sample, 1991-2009

	All firms	Always domestic	Acquired by foreign investors
	(1)	(2)	(3)
Log sales	14.0677 (1.3365)	14.0411 (1.3169)	15.5926 (1.5529)
Employment	42.1986 (143.0868)	40.4140 (128.6462)	144.7823 (485.1442)
Log labor productivity	10.8681 (1.0532)	10.8561 (1.0453)	11.5595 (1.2592)
Number of layers	2.0508 (0.7620)	2.0411 (0.7572)	2.6098 (0.8227)
Log hourly wage	1.4504 (0.4146)	1.4419 (0.4073)	1.9366 (0.5263)
Education (years of schooling)	6.2147 (2.1079)	6.1780 (2.0792)	8.3235 (2.6149)
Tenure (years)	7.4826 (5.2359)	7.4883 (5.2356)	7.1516 (5.2389)
Potential experience (years)	25.8508 (6.5251)	25.9121 (6.5114)	22.3306 (6.3436)
N (obs.)	432,955	425,552	7,403
N (firms)	74,666	73,728	938

The acquisition decision

$$foreign_{it} = \beta \mathbf{X}_{it-1} + \delta_s + \phi_t + \mu_{it}$$

- \mathbf{X}_{it-1} lagged sales or labor productivity demeaned relative to the industry;
- δ_s industries indicators;
- ϕ_t years indicators;
- add industry-specific time trends.

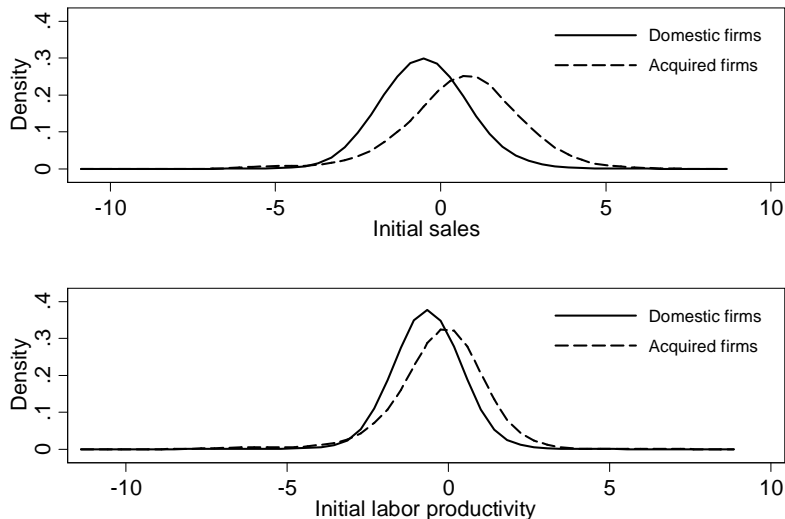
The acquisition decision

Table 2: The acquisition decision

	Dependent variable: foreign ownership			
	(1)	(2)	(3)	(4)
Log sales	0.0029*** (0.0004)	0.0031*** (0.0004)		
2nd quartile			0.0004 (0.0004)	0.0006 (0.0004)
3rd quartile			0.0017*** (0.0007)	0.0021** (0.0007)
4th quartile			0.0061*** (0.0011)	0.0064*** (0.0011)
Industry trends	N	Y	N	Y
R ²	0.772	0.773	0.772	0.773
F-stat	11.480	7.762	10.718	7.429
N (obs.)	432,955	432,955	432,955	432,955
N (firms)	74,666	74,666	74,666	74,666

The acquisition decision

Figure 3: Distribution of firms according to size and productivity



- Difference-in-differences (DD) approach:

$$y_{it} = \beta \text{foreign}_{it-1} + \gamma_i + \phi_t + \mu_{it}$$

- DD-PSM: we match treated firms (624) by year and industry, using one-to-one nearest neighbor without replacement and imposing common support;
- Add industry-specific time trends.
- Concept: "initial" differs for domestic and acquired firms, but not in the matched sample.

Table 6: Effects of foreign acquisition on sales

Dependent variable: log sales				
	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Pooled				
Foreign ownership	0.3752*** (0.0452)	0.3771*** (0.0452)	0.2951*** (0.0549)	0.2916*** (0.0549)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,966	11,966
N (firms)	74,666	74,666	1,224	1,224
B. Conditional on initial number of layers				
Firms with initially 1 layer				
Foreign ownership	0.1009 (0.0994)	0.0976 (0.0987)	0.1044 (0.1245)	0.0788 (0.1231)
Industry trends	N	Y	N	Y
N (obs.)	167,301	167,301	1,573	1,573
N (firms)	26,969	26,969	184	184

Effects on sales (cont.)

Firms with initially 2 layers

Foreign ownership	0.3527*** (0.0765)	0.3568*** (0.0766)	0.3348*** (0.0903)	0.3235*** (0.0889)
Industry trends	N	Y	N	Y
N (obs.)	189,655	189,655	4,110	4,110
N (firms)	34,685	34,685	431	431

Firms with initially 3 layers

Foreign ownership	0.3878*** (0.0680)	0.3860*** (0.0680)	0.2832*** (0.0861)	0.2800*** (0.0874)
Industry trends	N	Y	N	Y
N (obs.)	72,429	72,429	5,355	5,355
N (firms)	12,363	12,363	521	521

Firms with initially 4 layers

Foreign ownership	0.6194*** (0.1572)	0.5859*** (0.1584)	0.3410** (0.1709)	0.3518** (0.1720)
Industry trends	N	Y	N	Y
N (obs.)	3,570	3,570	1,033	1,033
N (firms)	649	649	96	96

Effects on labor productivity

Table 7: Effects of foreign acquisition on labor productivity

Dependent variable: log labor productivity				
	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Pooled				
Foreign ownership	0.2406*** (0.0380)	0.2440*** (0.0380)	0.1541*** (0.0467)	0.1529*** (0.0468)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,966	11,966
N (firms)	74,666	74,666	1,224	1,224
B. Conditional on initial number of layers				
Firms with initially 1 layer				
Foreign ownership	0.0486 (0.0959)	0.0525 (0.0946)	0.0327 (0.1172)	0.0042 (0.1142)
Industry trends	N	Y	N	Y
N (obs.)	167,301	167,301	1,573	1,573
N (firms)	26,969	26,969	184	184

Effects on labor productivity (cont.)

Firms with initially 2 layers

Foreign ownership	0.1901***	0.1935***	0.1552**	0.1506**
	(0.0603)	(0.0603)	(0.0692)	(0.0696)
Industry trends	N	Y	N	Y
N (obs.)	189,655	189,655	4,110	4,110
N (firms)	34,685	34,685	431	431

Firms with initially 3 layers

Foreign ownership	0.2537***	0.2555***	0.1405*	0.1414*
	(0.0580)	(0.0581)	(0.0771)	(0.0785)
Industry trends	N	Y	N	Y
N (obs.)	72,429	72,429	5,355	5,355
N (firms)	12,363	12,363	521	521

Firms with initially 4 layers

Foreign ownership	0.4409***	0.3884***	0.2736**	0.2727**
	(0.1435)	(0.1451)	(0.1320)	(0.1321)
Industry trends	N	Y	N	Y
N (obs.)	3,570	3,570	1,033	1,033
N (firms)	649	649	96	96

Table 8: Effects of foreign acquisition on hourly wage

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Pooled				
Foreign ownership	0.0800*** (0.0116)	0.0808*** (0.0116)	0.0674*** (0.0133)	0.0660*** (0.0133)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,966	11,966
N (firms)	74,666	74,666	1,224	1,224
B. Conditional on initial number of layers				
Firms with initially 1 layer				
Foreign ownership	0.0717*** (0.0265)	0.0709*** (0.0264)	0.0679** (0.0309)	0.0610** (0.0304)
Industry trends	N	Y	N	Y
N (obs.)	167,301	167,301	1,573	1,573
N (firms)	26,969	26,969	184	184

Effects on hourly wage (cont.)

Firms with initially 2 layers

Foreign ownership	0.0793*** (0.0221)	0.0709*** (0.0220)	0.0487** (0.0232)	0.0475** (0.0230)
Industry trends	N	Y	N	Y
N (obs.)	189,655	189,655	4,110	4,110
N (firms)	34,685	34,685	431	431

Firms with initially 3 layers

Foreign ownership	0.0833*** (0.0166)	0.0839*** (0.0429)	0.0677*** (0.0196)	0.0650*** (0.0195)
Industry trends	N	Y	N	Y
N (obs.)	72,429	72,429	5,355	5,355
N (firms)	12,363	12,363	521	521

Firms with initially 4 layers

Foreign ownership	0.1655*** (0.0454)	0.1420*** (0.0429)	0.1195** (0.0508)	0.1096** (0.0490)
Industry trends	N	Y	N	Y
N (obs.)	3,570	3,570	1,033	1,033
N (firms)	649	649	96	96

Effects on number of layers

Table 9: Effects of foreign acquisition on the number of layers

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Pooled				
Foreign ownership	0.0981*** (0.0275)	0.1000*** (0.0274)	0.1312*** (0.0309)	0.1276*** (0.0304)
Industry trends	N	Y	N	Y
N (obs.)	432,955	432,955	11,966	11,966
N (firms)	74,666	74,666	1,224	1,224
B. Conditional on initial number of layers				
Firms with initially 1 layer				
Foreign ownership	0.1120 (0.0762)	0.1034 (0.0745)	0.2889*** (0.0840)	0.2923*** (0.0810)
Industry trends	N	Y	N	Y
N (obs.)	167,301	167,301	1,573	1,573
N (firms)	26,969	26,969	184	184

Effects on number of layers (cont.)

Firms with initially 2 layers

Foreign ownership	0.2306*** (0.0506)	0.2310*** (0.0504)	0.2338*** (0.0588)	0.2314*** (0.0576)
Industry trends	N	Y	N	Y
N (obs.)	189,655	189,655	4,110	4,110
N (firms)	34,685	34,685	431	431

Firms with initially 3 layers

Foreign ownership	0.2343*** (0.0370)	0.2325*** (0.0369)	0.0250 (0.0391)	0.0297 (0.0387)
Industry trends	N	Y	N	Y
N (obs.)	72,429	72,429	5,355	5,355
N (firms)	12,363	12,363	521	521

Firms with initially 4 layers

Foreign ownership	0.4435*** (0.1557)	0.4680*** (0.1137)	-0.0207 (0.1176)	-0.0695 (0.1223)
Industry trends	N	Y	N	Y
N (obs.)	3,570	3,570	1,033	1,033
N (firms)	649	649	96	96

Conditional layer-level analysis - effects on hourly wages

Dependent variable: log hourly wages of		Firms initially with			
		1 Layer	2 Layers	3 Layers	4 Layers
log hourly wages of	Firms currently with	(1)	(2)	(3)	(4)
Layer 0	1 Layer	0.0687*	0.0763	-0.1943	
		(0.0385)	(0.0856)	(0.2152)	
Layer 0	2 Layers	-0.0205	-0.0101	0.0112	0.6732
		(0.0548)	(0.0356)	(0.0537)	(0.6240)
Layer 1		-0.1358	0.0136	0.0869	0.6187
		(0.1377)	(0.0457)	(0.1096)	(0.5605)
Layer 0	3 Layers	0.0115	0.0485	0.0241	0.1099
		(0.1482)	(0.0422)	(0.0237)	(0.0864)
Layer 1		0.0540	-0.0126	0.0073	-0.0772
		(0.1973)	(0.0639)	(0.0312)	(0.0918)
Layer 2		0.3383	0.1435	0.1018**	0.0417
		(0.4201)	(0.1011)	(0.0403)	(0.2102)
Layer 0	4 Layers		-0.0712	-0.0146	0.1328*
			(0.0670)	(0.0367)	(0.0782)
Layer 1			0.0893	0.0216	0.1884***
			(0.1236)	(0.0648)	(0.0625)
Layer 2			0.4226***	0.0101	0.1157
			(0.1131)	(0.1734)	(0.1058)
Layer 3			0.3377	0.3724*	0.1368
			(0.3349)	(0.2207)	(0.2680)

Effects on hourly wage of top and bottom layers

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Pooled				
Dependent variable: log hourly wage of top layer				
Foreign ownership	0.1528*** █ (0.0296)	0.1534*** █ (0.0296)	0.1220*** █ (0.0325)	0.1183*** █ (0.0326)
Industry trends	N	Y	N	Y
N (obs.)	179,974	179,974	8,690	8,690
N (firms)	42,456	42,456	1,115	1,115
Dependent variable: log hourly wage of bottom layer				
Foreign ownership	0.0190* █ (0.0113)	0.0200* █ (0.0113)	0.0251* █ (0.0132)	0.0245* █ (0.0132)
Industry trends	N	Y	N	Y
N (obs.)	432,954	432,954	11,966	11,966
N (firms)	74,665	74,665	1,224	1,224

Effects on hourly wage of top and bottom layers (cont.)

B. Conditional on initial number of layers

Firms with initially 1 layer

Dependent variable: log hourly wage of top layer

Foreign ownership	0.1828*	0.1849*	0.1715	0.1373
	(0.1061)	(0.1071)	(0.1338)	(0.1570)
Industry trends	N	Y	N	Y
N (obs.)	33,809	33,809	460	460
N (firms)	9,240	9,240	108	108

Dependent variable: log hourly wage of bottom layer

Foreign ownership	0.0437*	0.0461*	0.0523*	0.0486
	(0.0452)	(0.0452)	(0.0309)	(0.0304)
Industry trends	N	Y	N	Y
N (obs.)	167,300	167,300	1,573	1,573
N (firms)	26,968	26,968	184	184

Effects on hourly wage of top and bottom layers (cont.)

Firms with initially 2 layers

Dependent variable: log hourly wage of top layer

Foreign ownership	0.1440*** (0.0474)	0.1447*** (0.0473)	0.1377*** (0.0504)	0.1280** (0.0518)
Industry trends	N	Y	N	Y
N (obs.)	95,541	95,541	2,965	2,965
N (firms)	23,367	23,367	409	409

Dependent variable: log hourly wage bottom layer

Foreign ownership	0.0191 (0.0213)	0.0200 (0.0213)	-0.0010 (0.0229)	-0.0005 (0.0229)
Industry trends	N	Y	N	Y
N (obs.)	189,655	189,655	4,110	4,110
N (firms)	34,685	34,685	431	431

Effects on hourly wage of top and bottom layers (cont.)

Firms with initially 3 layers

Dependent variable: log hourly wage of top layer

Foreign ownership	0.1480*** (0.0382)	0.1477*** (0.0382)	0.1129*** (0.0428)	0.1114*** (0.0426)
Industry trends	N	Y	N	Y
N (obs.)	47,687	47,687	4,458	4,458
N (firms)	9,258	9,258	510	510

Dependent variable: log hourly wage of bottom layer

Foreign ownership	0.0139 (0.0160)	0.0145 (0.0160)	0.0156 (0.0194)	0.0123 (0.0195)
Industry trends	N	Y	N	Y
N (obs.)	72,429	72,429	5,355	5,355
N (firms)	12,363	12,363	521	521

Effects on hourly wage of top and bottom layers (cont.)

Firms with initially 4 layers

Dependent variable: log hourly wage of top layer

Foreign ownership	0.2806** (0.1284)	0.2867** (0.1266)	0.0811 (0.1387)	0.0558 (0.1415)
Industry trends	N	Y	N	Y
N (obs.)	2,937	2,937	899	899
N (firms)	591	591	96	96

Dependent variable: log hourly wage of bottom layer

Foreign ownership	0.0807* (0.0425)	0.0802* (0.0423)	0.1346*** (0.0487)	0.1340*** (0.0489)
Industry trends	N	Y	N	Y
N (obs.)	3,570	3,570	1,033	1,033
N (firms)	649	649	96	96

Effects on worker attributes of top and bottom layers

- The effects of education, potential experience and tenure at the firm
- FO tends to **lower** the average number of schooling years of the bottom layer among firms that have initially 2 or 3 layers;
- FO **increases** the levels of experience and tenure of workers at the top layer among firms that initially had 3 layers.
- Increased wage inequality is partly explained by changes in worker attributes.
- Effects of FO on wages averaged across all "managerial layers" (i.e., Layers 1-3).
- The pooled FO effect is somewhat larger for average "managerial wages" than for average wages in the bottom layer; but it vanishes in the sub-sample analysis;
- This finding re-inforces that the increased wage inequality observed is largely driven by the top layer of the organization.

Foreign versus domestic acquisitions (cont.)

- 349 firms had foreign ownership in the first year of observation and which were subsequently acquired by domestic investors;
- Use 2 alternative control groups -foreign and domestic firms- and use the same econometric approach;
- Hardly no significant effects on sales, employment, labor productivity, wages and number of hierarchical layers;
- Our main results are related to the *type of ownership* than to *acquisition per se* and are *persistent*.

How can our empirical results be rationalized?

The theory of firms as *knowledge hierarchies* has been developed by Garicano (2000) and Garicano and Rossi-Hansberg (2004, 2006);

- The realization of output requires labor and knowledge - successful problem solving;
- An agent who encounters a problem asks for help from a more knowledgeable agent, but with a communication cost;
- The optimal pyramidal organization structure consists of production workers and one or more successive layers of managers who specialize in problem solving;
- Agents are rewarded according to their knowledge;
- The optimal number of layers, all else equal, is determined by the trade-off between economizing on costs of acquiring knowledge and on the size of communication costs within the firm.

How can FO affect the optimal re-organization in the context of the knowledge hierarchies theory?

- FO might directly lead to an expansion in the scale of production because of **improved productivity** (investments in machinery and new technology) or because of **higher demand** (product quality upgrading or better access to export markets).
- FO might also lead to **changes in the optimal hierarchical structure** for a **given scale** of production. FO often implies the transfer of new management practices to the acquired firm, namely to secure efficient communication and information flows within the organization. A **reduction** of the communication costs leads to a **decline** of the marginal cost of production and to higher productivity/larger scale of production. Even if the number of layers remains unchanged, the wage inequality within the firm still increases.
- We examine FO effects on the use of information technologies, using data from *Inquérito à Utilização de Tecnologias de Informação e da Comunicação nas Empresas*, which was merged with Quadros de

Effects on the use of information technologies

	Full sample			Matched sample		
	All firms	Always domestic	Acquired by foreign investors	All firms	Always domestic	Acquired by foreign investors
	(1)	(2)	(3)	(4)	(5)	(6)
Use of intranet (yes=1)	0.6987 (0.4588)	0.6734 (0.4690)	0.8750 (0.3310)	0.8017 (0.3996)	0.7750 (0.4195)	0.8279 (0.3791)
Use of e-mail (yes=1)	0.9941 (0.0763)	0.9933 (0.0816)	1.0000 (0.0000)	1.0000 (0.0000)	1.0000 (0.0000)	1.0000 (0.0000)
Use of extranet (yes=1)	0.4412 (0.4966)	0.4244 (0.4943)	0.5578 (0.4971)	0.5331 (0.4999)	0.5333 (0.5011)	0.5328 (0.5009)
Use of internal networks (yes=1)	0.8946 (0.3071)	0.8826 (0.3219)	0.9776 (0.1481)	0.9876 (0.1109)	0.9750 (0.1568)	1.0000 (0.0000)
N (obs.)	4,268	3,732	536	233	111	122
N (firms)	1,624	1,452	172	65	32	33

Effects on the use of information technologies

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
A. Dependent variable: use of intranet				
Foreign ownership	0.1989*** (0.0617)	0.2041*** (0.0622)	0.1960** (0.0867)	0.1965** (0.0911)
Industry trends	N	Y	N	Y
Matched sample	N	N	Y	Y
N (obs.)	4,268	4,268	233	233
N (firms)	1,624	1,624	65	65

Effects on the use of information technologies (concl.)

C. Dependent variable: use of extranet

Foreign ownership	0.0218 █ (0.1054)	0.0156 █ (0.1053)	0.0462 █ (0.1241)	0.0596 █ (0.1337)
Industry trends	N	Y	N	Y
Matched sample	N	N	Y	Y
N (obs.)	4,268	4,268	233	233
N (firms)	1,624	1,624	65	65

D. Dependent variable: use of internal networks

Foreign ownership	-0.0292*** █ (0.0097)	-0.0291*** █ (0.0100)	0.0206 █ (0.0335)	0.0206 █ (0.0347)
Industry trends	N	Y	N	Y
Matched sample	N	N	Y	Y
N (obs.)	4,268	4,268	233	233
N (firms)	1,624	1,624	65	65

Concluding Remarks

- We exploit comprehensive data on Portuguese firms and workers 1991-2009 to study the effect of foreign takeovers on the internal organization and pay structure.
- We find that foreign acquisition leads to:
 - an expansion in the scale of operations;
 - a higher number of hierarchical layers;
 - increased wage inequality between the top and bottom layers in firms that reorganize and add layers:
- These results accord with a theory of knowledge-based hierarchies in which foreign takeovers lead to improved productivity, higher demand, or reduced communication costs within the acquired firms;
- We find that FO has a positive and significant effect on the use of the intranet, supporting the mechanisms emphasized by the theory of knowledge-based hierarchies played some role.