IESE Business School
University of Navarra

Innovation and Markups

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Introduction

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What do we know?

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What do we know?

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What do we do?

- *Estimate*
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Innovation & Markups

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Estimating Markups Using Production Data

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$$\frac{P_{it}^X X_{it}}{c_{it} Q_{it}} = \frac{\partial Q_{it}}{\partial X_{it}} \frac{X_{it}}{Q_{it}}$$

$$\mu_{it} \frac{P_{it}^X X_{it}}{P_{it} Q_{it}} = \varepsilon_{it}^X$$

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Estimating Production Functions

- $$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + \omega_{it} + \eta_{it}$$
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Markup Calculation

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- $$\varepsilon_{it}^{L} = \beta_{l} + 2\beta_{ll} l_{it} + \beta_{lk} k_{it}$$
- [redacted]

Data Set

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Summary Statistics

Table 1: Summary Statistics

	All	Small	Large
Nr. of Firms	4,567	3,366	1,277
Nr. of Observations	33,570	22,574	10,996
Value Added (X1000 €)	20,810	2,649	58,091
Employment	256	46	687
Capital Stock (X1000 €)	12,222	1,542	34,992
Labor Productivity (X1000 €)	57.3	45.9	80.8
Labor Cost Share	.54	.56	.50
Product Innovation	.24	.18	.38
Process Innovation	.33	.25	.48
Exporter	.60	.45	.90
Importer	.61	.45	.92
Nr. of Competitors			
10 or less	57%	49%	73%
Between 11 and 25	15%	16%	14%
Over 25	10%	12%	6%
Atomistic Market	18%	23%	8%

Production Function Estimates

- $$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + \omega_{it} + \eta_{it}$$
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Output Elasticities

Table 2: Output Elasticities

			Labor			Capital			Obs.
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.419	894	Meat Products	.873	.794	.645	.655	.239	.287	.413
.451	2,998	Food and Tobacco	.687	.783	.565	.562	.402	.297	.451
.283	563	Beverages	1.13	.725	1.151	1.08	.148	.358	.130
.375	3,014	Textiles and Clothing	.737	.837	.560	.568	.295	.244	.374
.229	959	Leather Products	.668	.864	.426	.490	.276	.213	.309
.361	895	Wood Products	.779	.795	.525	.511	.261	.280	.336
.494	837	Paper Products	.791	.734	.500	.532	.306	.345	.513
.301	1,652	Printing and Publishing	1.056	.785	.814	.806	.146	.201	.324
.328	2,051	Chemicals	.871	.759	.703	.713	.265	.324	.345
.409	1,644	Plastic and Rubber	.813	.777	.598	.612	.269	.302	.402
.463	2,247	Mineral Products	.756	.777	.577	.562	.314	.308	.463
.476	959	Basic Metals	.677	.747	.512	.509	.376	.339	.487
.313	3,191	Metal Products	.853	.810	.653	.659	.213	.268	.314
.298	2,316	Machinery and Equipment	.914	.816	.648	.650	.146	.267	.306
.272	464	Office Machinery	.957	.833	.536	.545	.163	.253	.429
.351	1,832	Electrical Machinery	.895	.815	.647	.644	.196	.272	.347
.361	1,447	Motor Vehicles	.810	.784	.631	.609	.247	.307	.352
.241	628	Other Transport	.853	.829	.718	.721	.153	.260	.222
.231	1,558	Furniture	1.049	.843	.750	.762	.120	.235	.236
.280	663	Miscellaneous	.792	.810	.585	.658	.285	.267	.388
.384	30,812	Total	.832	.796	.625	.627	.241	.286	.382

ach. For the translog production
ually lower (26,357) because

Results from estimating Cobb-Douglas (CD) and Translog (TL) production functions by ordinary least squares or control function
function, the average elasticity over all firms is reported. Note that the number of observations for the control function estimation
we need to observe lagged capital as well. The resulting paramer estimates are used to compute output elasticities for all observati

Heterogeneity in Output Elasticities

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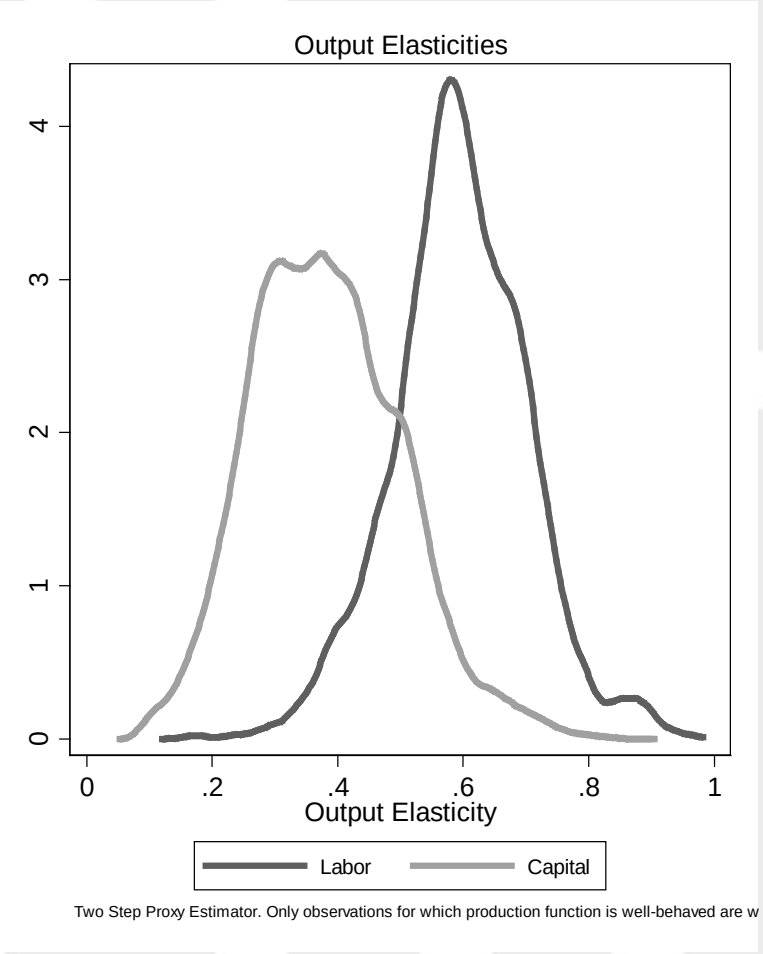

Firm Level Markups

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	Median	S.D.
Cobb Douglas, OLS	1.64	.853
Cobb Douglas, Control	1.19	.760
Translog, OLS	1.48	.654
Translog, Control	1.16	.581

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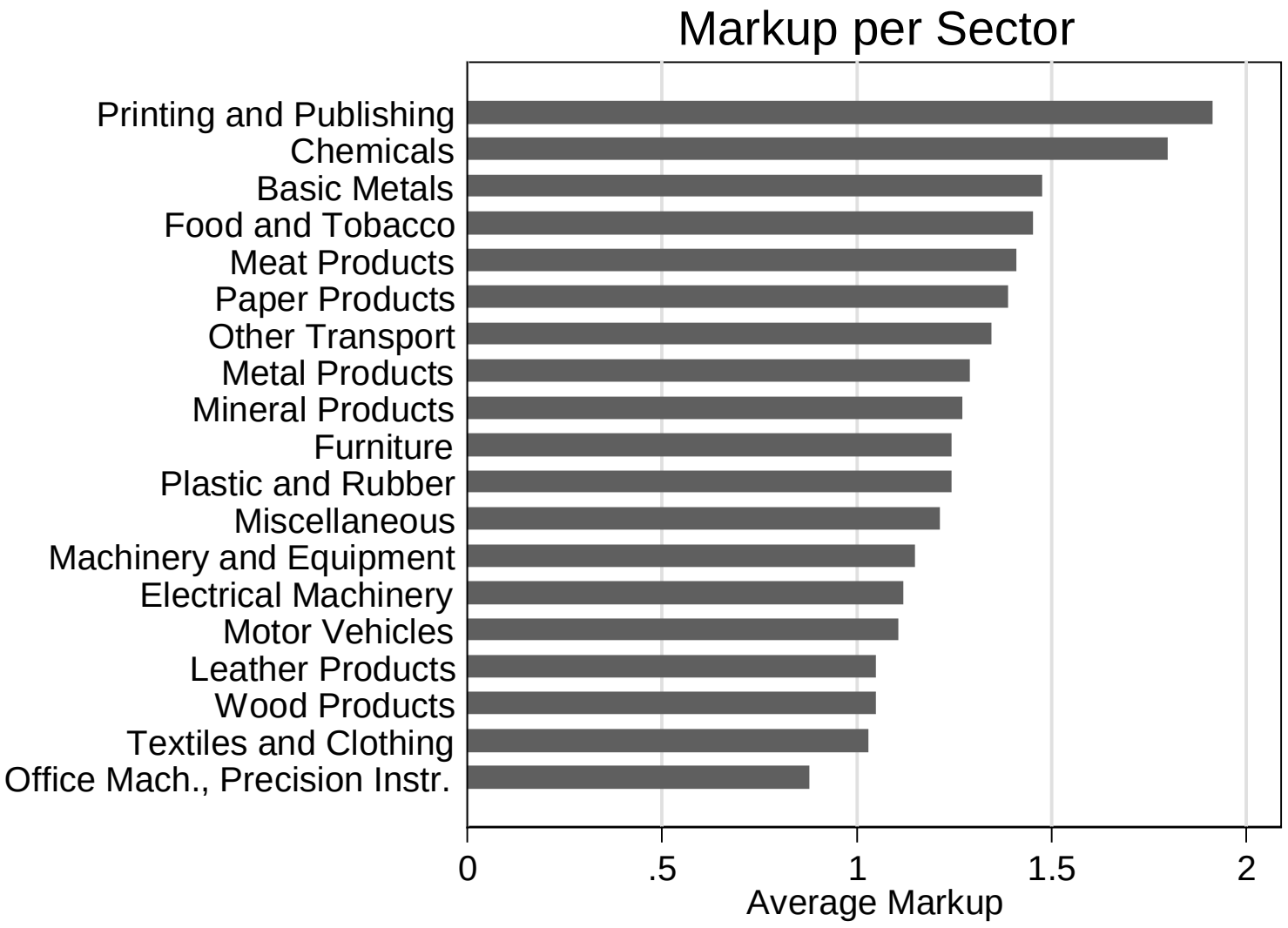
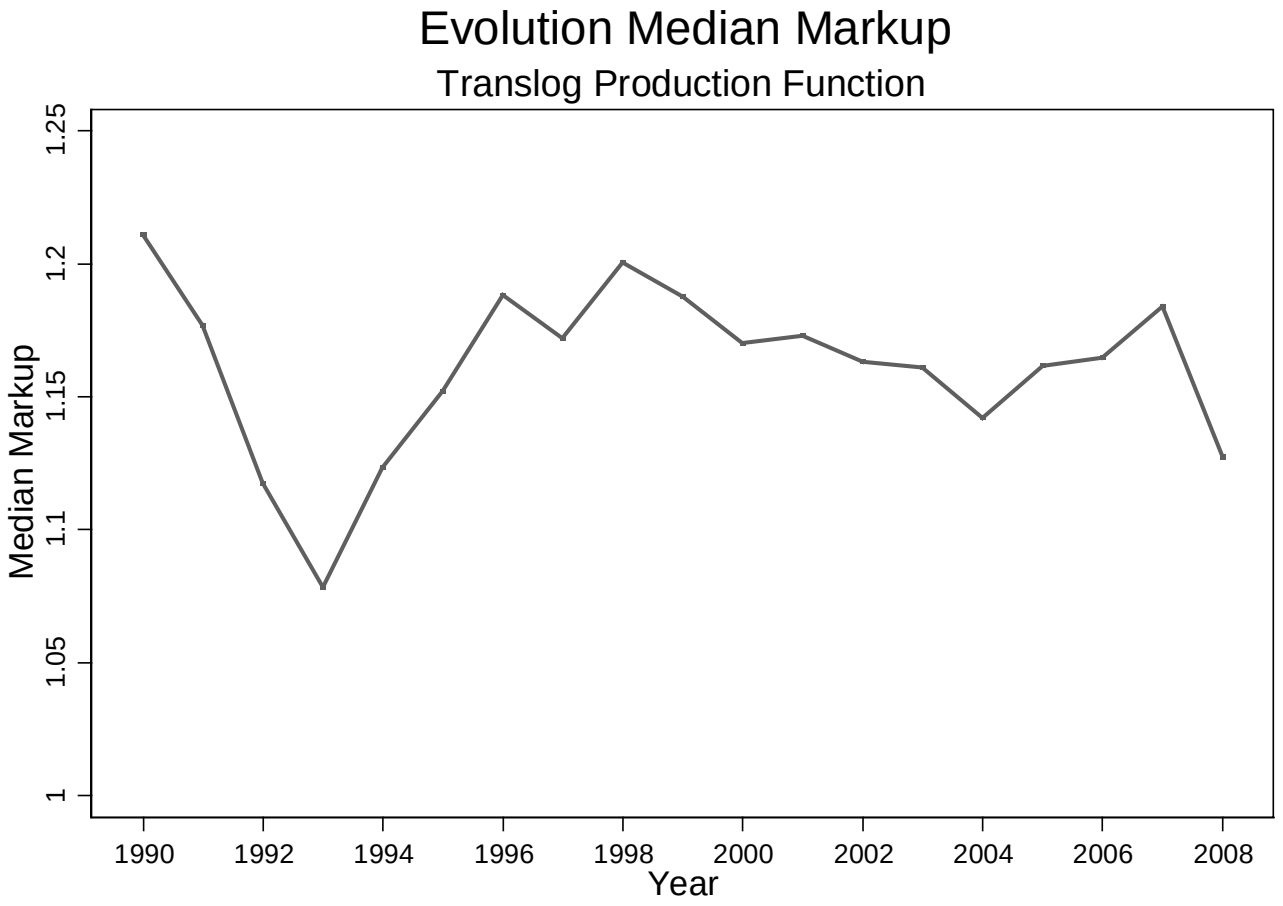
$$\mu_{it} = \frac{P_{it}}{c_{it}} = \frac{\varepsilon^{L}_{it}}{\alpha^{L}_{it}}$$

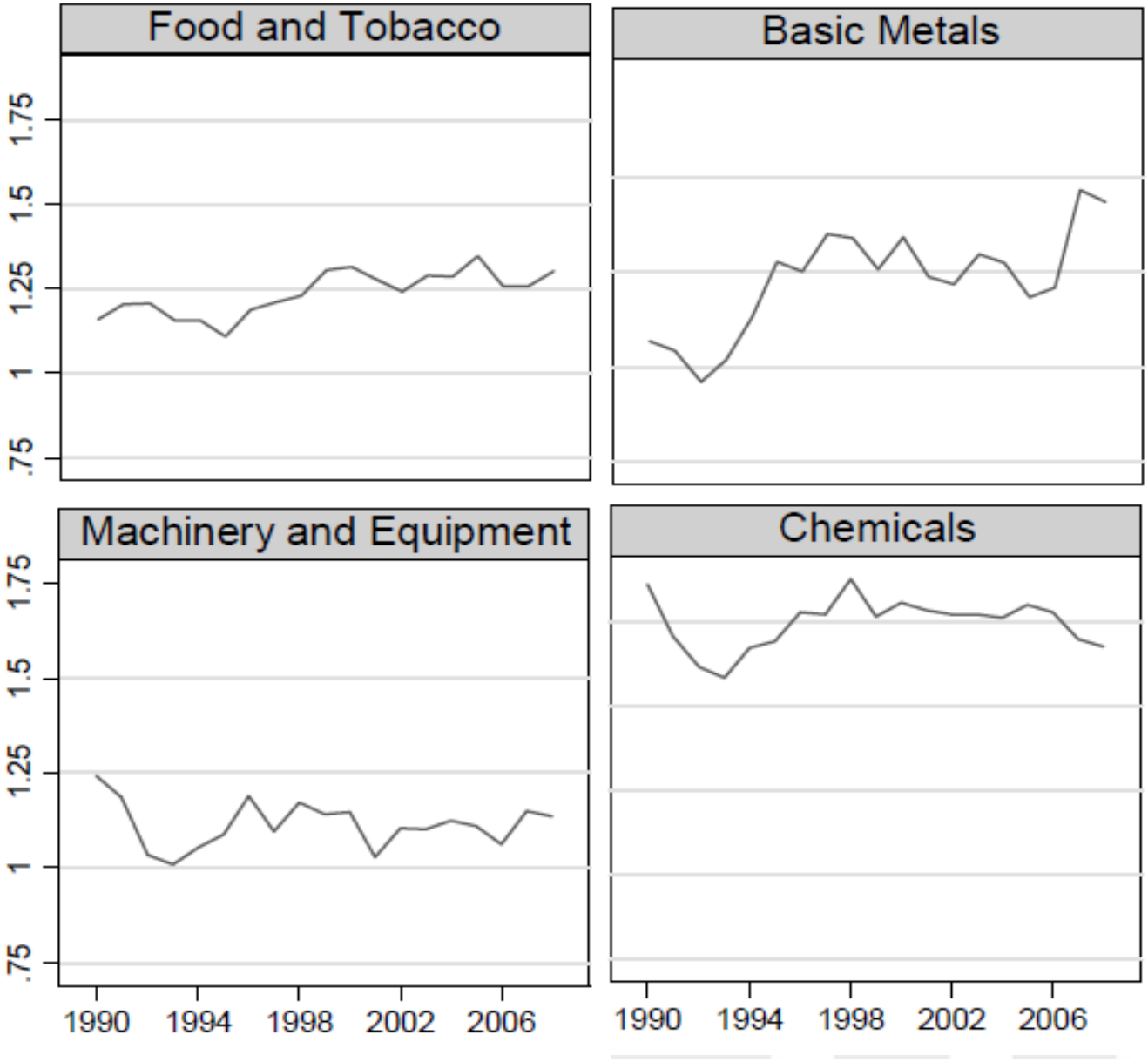
Markup per Sector



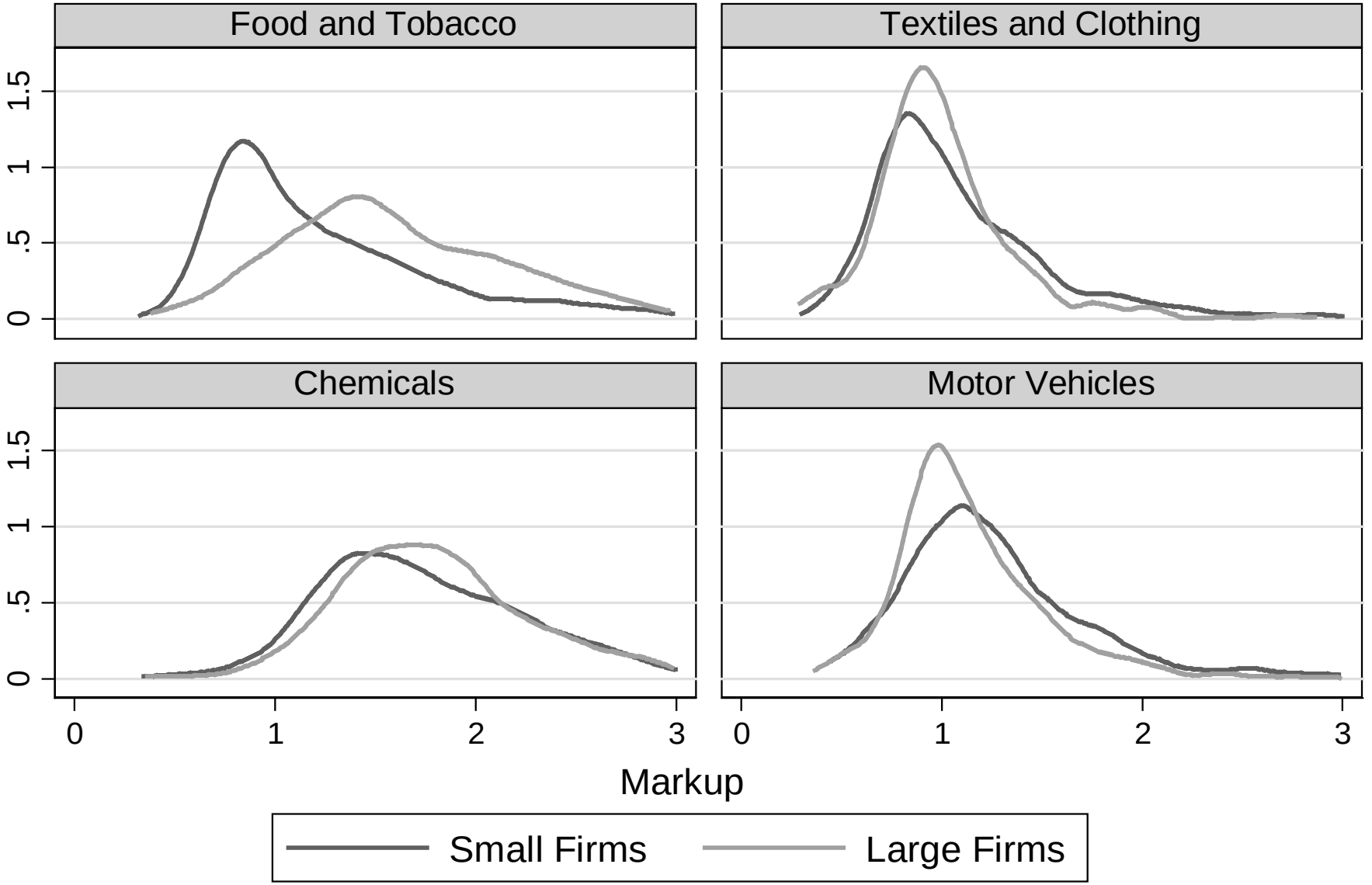
Evolution Markups



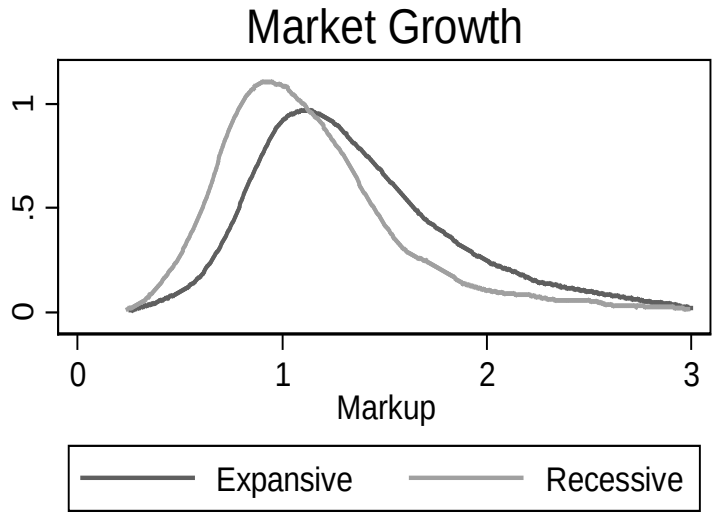
Evolution Median Markup Selected Industries

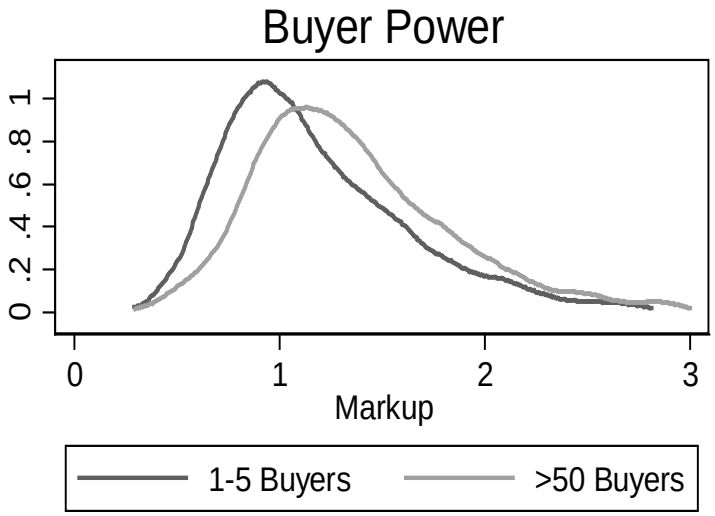


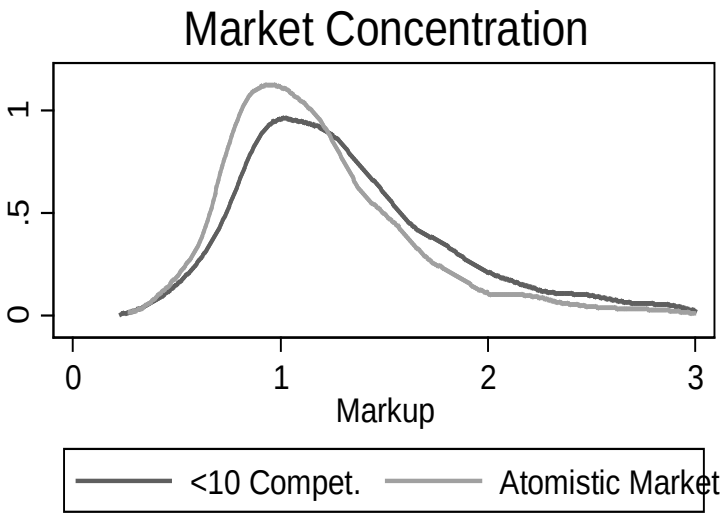
Distribution Markups Small versus Large Firms

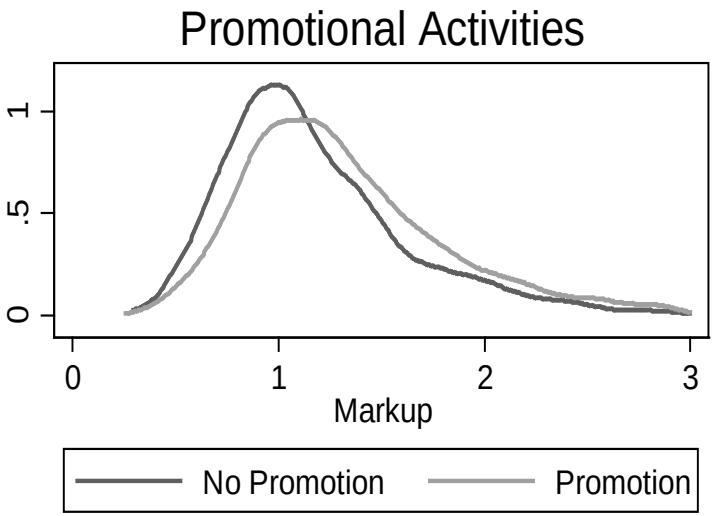


Drivers of Markup Differences









Markups & Firm Decisions

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$$\ln \mu_{it} = \beta_0 + \beta_1 prodinn_{it} + \beta_2 procinn_{it} + X_{it}\gamma + \gamma_t + \gamma_i + \varepsilon_{it}$$

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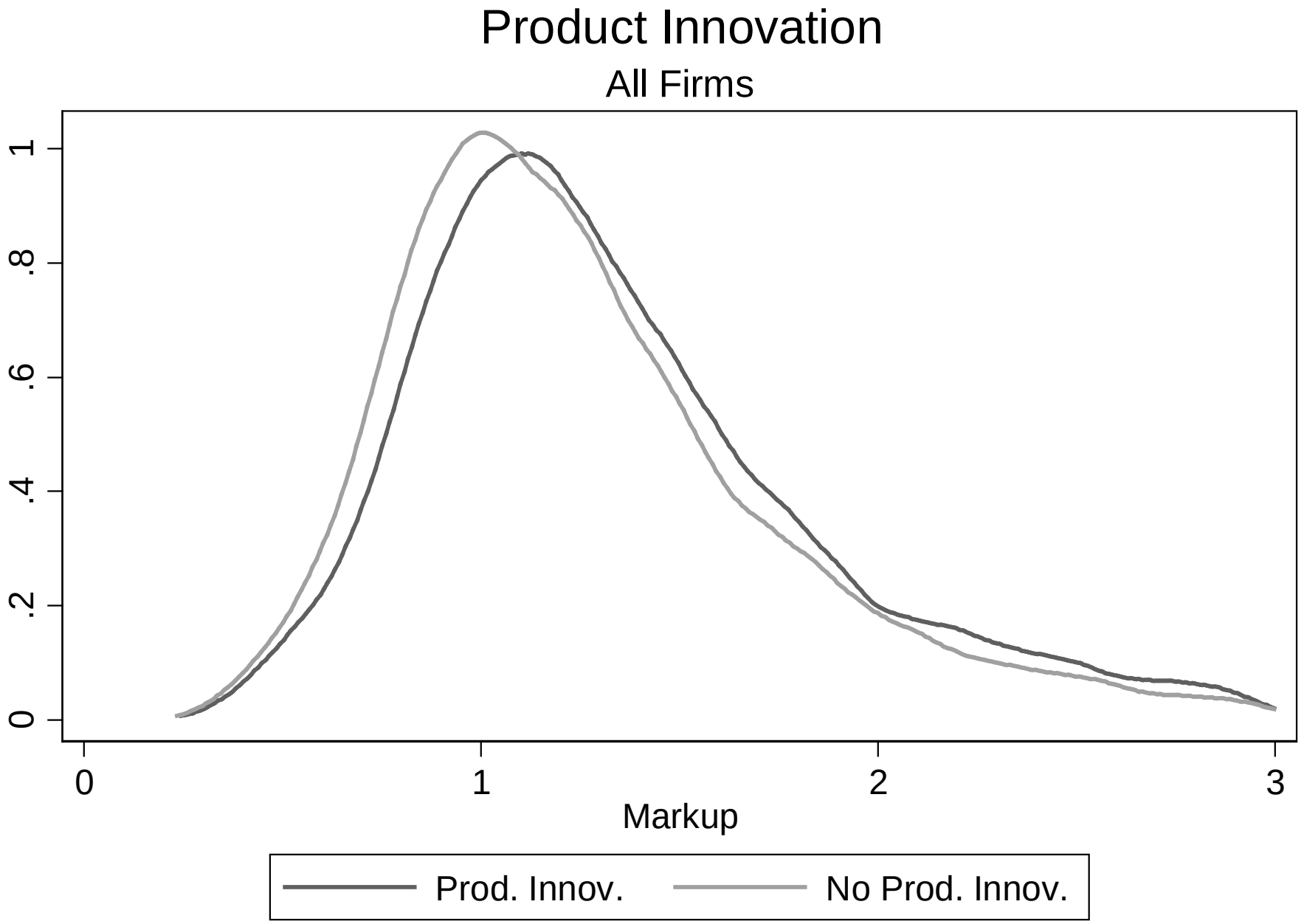
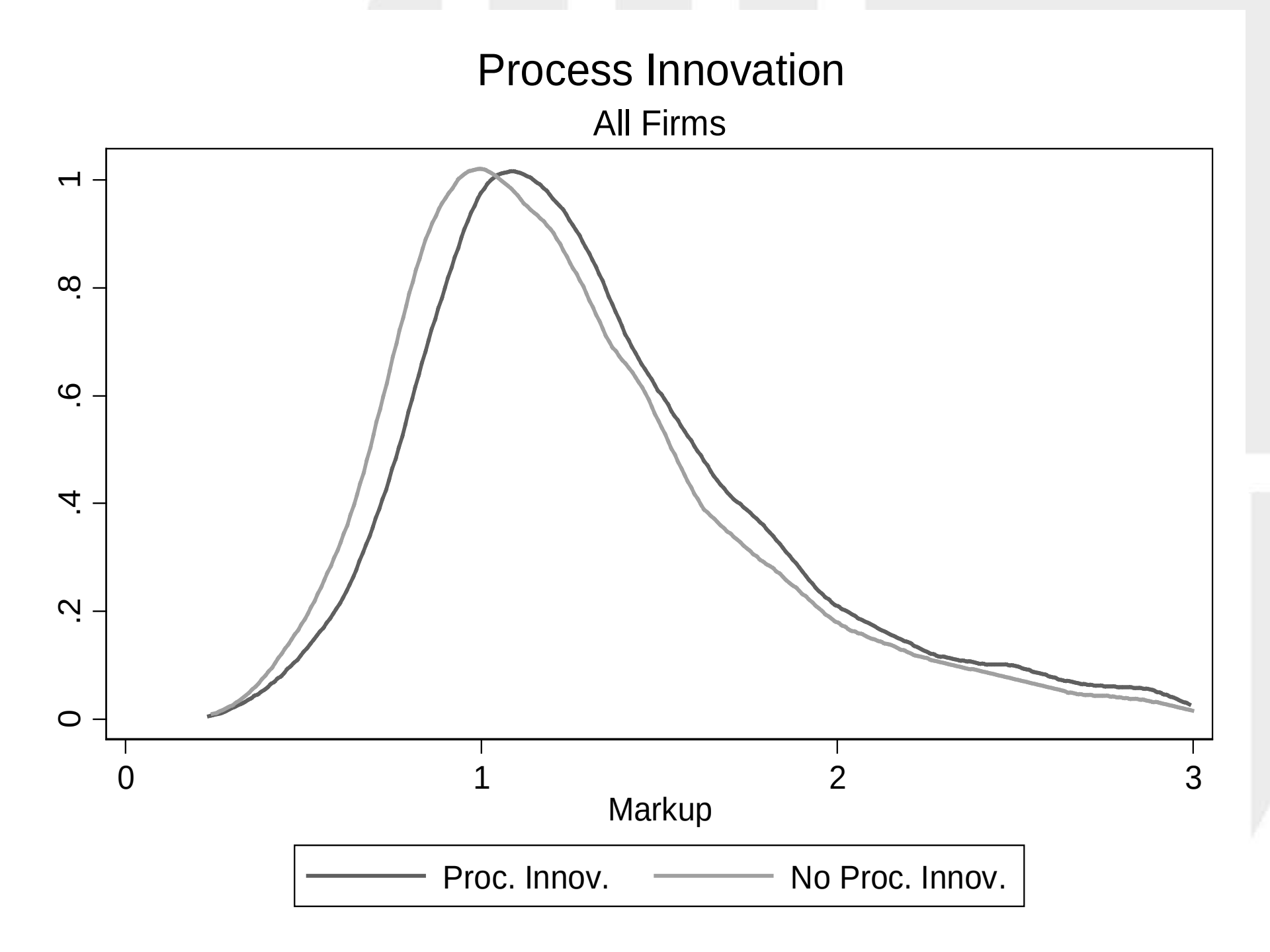
Product & Process Innovation

			All	Small	Large
75	Product Innovation		.243	.178	.3
)2		New Materials	.125	.087	.2(
12		New Components	.125	.083	.2
)2		New Function	.117	.076	.2(
)4		New Design	.198	.145	.3(
77	Process Innovation		.325	.251	.4
.159		Machinery		.139	.129
.062		Methods		.047	.040
.266		Machinery and Methods		.146	.087


Product Innovation
All Firms
0
.2
.4
.6
.8
1
0
1
2
3
Markup
Prod. Innov.
No Prod. Innov.


Process Innovation
All Firms
0
.2
.4
.6
.8
1
0
1
2
3
Markup
Proc. Innov.
No Proc. Innov.

Markups and Innovation

	All Firms		Small Firms		Large Firms	
	Cobb-Doug	Translog	Cobb-Doug	Translog	Cobb-Doug	Translog
Process Innov.	0.0305**	0.0290**	0.0351**	0.0278**	0.0243*	0.0168
	(0.00704)	(0.00761)	(0.00857)	(0.00899)	(0.0113)	(0.0120)
Product Innov.	0.0309**	0.0386**	0.0424**	0.0486**	0.00835	0.0115
	(0.00868)	(0.00943)	(0.0117)	(0.0128)	(0.0121)	(0.0128)
10<Compet.<25	-0.0302**	-0.0319**	-0.0270*	-0.0263*	-0.0383*	-0.0388*
	(0.00981)	(0.0106)	(0.0117)	(0.0128)	(0.0166)	(0.0169)
Compet > 25	-0.0405**	-0.0391**	-0.0317*	-0.0293*	-0.0727**	-0.0766**
	(0.0122)	(0.0128)	(0.0138)	(0.0144)	(0.0242)	(0.0250)
Atom. Market	-0.0425**	-0.0430**	-0.0425**	-0.0441**	-0.0304	-0.0254
	(0.00979)	(0.0107)	(0.0105)	(0.0114)	(0.0239)	(0.0248)
Exporter	0.0659**	0.0551**	0.0767**	0.0753**	0.0146	-0.0388
	(0.0113)	(0.0120)	(0.0118)	(0.0128)	(0.0278)	(0.0286)
Importer	0.0884**	0.104**	0.0932**	0.0998**	0.0725**	0.0878**
	(0.0107)	(0.0115)	(0.0114)	(0.0122)	(0.0271)	(0.0264)
N	29153	25983	19930	17376	9223	8607
R^2	0.395	0.231	0.359	0.215	0.471	0.372
Nr. Firms	4025	3690	2920	2641	1168	1110

Standard errors in parentheses. + $p < .10$, * $p < .05$, ** $p < .01$

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Results

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Fixed Effects

	(1) CobbDoug. All	(2) Translog All	(3) Translog Small	(4) Translog Large
Process Innov.	0.00813*	0.00859*	0.0114*	0.00476
	(0.00401)	(0.00421)	(0.00534)	(0.00678)
Product Innov.	0.0103*	0.00934+	0.00579	0.00912
	(0.00470)	(0.00499)	(0.00671)	(0.00736)
10 < Compet.< 25	-0.0130*	-0.0106+	-0.00751	-0.0128
	(0.00551)	(0.00580)	(0.00703)	(0.0102)
Compet.>25	-0.0140*	-0.00888	-0.00446	-0.00968
	(0.00694)	(0.00740)	(0.00859)	(0.0147)
Atom. Market	-0.00977+	-0.0120+	-0.0141*	-0.00696
	(0.00594)	(0.00638)	(0.00715)	(0.0146)
Exporter	0.00846	0.00698	0.0158*	-0.0127
	(0.00656)	(0.00699)	(0.00780)	(0.0164)
Importer	0.0199**	0.0232**	0.0196**	0.0506**
	(0.00615)	(0.00656)	(0.00731)	(0.0153)
N	29153	26828	18172	8656

Standard errors in parentheses

+ $p < .10$, * $p < .05$, ** $p < .01$

Different Types of Innovation

	(1) OLS	(2) FE
New Components	-0.00263	-0.00449
	(0.0134)	(0.00791)
New Materials	0.00467	-0.00585
	(0.0134)	(0.00768)
New Design	0.0501**	0.0159*
	(0.0114)	(0.00663)
New Function	0.00324	0.0168*
	(0.0124)	(0.00728)
New Machinery	0.0419**	0.0153**
	(0.00982)	(0.00562)
New Methods	0.00369	-0.00752
	(0.0148)	(0.00873)
New Mach & Method	0.0155	0.00312
	(0.0109)	(0.00618)
N	23359	23359

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Further Controls

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$$\ln \mu_{it} = \alpha_0 + \alpha_1 \ln \mu_{it-1} + \alpha_2 prod_{it} + \alpha_3 proc_{it} + X_{it}\gamma + \gamma_t + \gamma_i + \varepsilon_{it}$$

Dynamic Specification

Table 10: Lagged Markups Included as Control

	(1) FE	(2) GMM	(3) GMM SYS	(4) GMM SYS
Lagged Markup	0.270**	0.307**	0.441**	0.313**
	(0.00712)	(0.0182)	(0.0159)	(0.0205)
Prod New Materials	-0.00816	-0.00643	0.00271	0.00450
	(0.00767)	(0.0127)	(0.0123)	(0.0130)
Prod New Components	-0.000767	-0.00505	-0.0111	-0.0127
	(0.00795)	(0.0133)	(0.0127)	(0.0137)
Prod New Function	0.0144*	0.0195	0.0238*	0.0266*
	(0.00727)	(0.0119)	(0.0117)	(0.0126)
Prod New Design	0.0134*	0.0123	0.0186+	0.0260*
	(0.00663)	(0.0117)	(0.0105)	(0.0117)
Proc New Machinery	0.0103+	0.0181+	0.0142+	0.00501
	(0.00562)	(0.00965)	(0.00855)	(0.00954)
Proc New Mach & Method	0.00107	0.0176	0.00202	0.00516
	(0.00625)	(0.0107)	(0.0102)	(0.0113)
Proc New Methods	-0.00486	0.00431	-0.00672	-0.0214
	(0.00866)	(0.0157)	(0.0126)	(0.0141)
N	20877	17601	20877	20877
$P-$ value AR			0.00498	0.659
Hansen $P-$ Value			0.112	0.0672

Standard errors robust against heteroskedasticity and within-group correlation.

$+ p < .10$, $* p < .05$, $** p < .01$

Appropriation & Markups

Table 5: Patents and R&D

	Patents		R&D	
Proc. Innov	.0268**	.0264**	.0265**	
	[0.0075]	[.0075]	[.0075]	
Prod. Innov.	.0334**	.0350**	.0335**	
	[.0093]	[.0093]	[.0093]	
Patent (Y/N)	.0473**			
	[.0149]			
Nr. Patents		.0105**		
		[.0032]		
Log(R&D)			.0014	.0028**
			[.0010]	[.0010]
N	26787	26647	26828	26828
R^2	0.207	0.206	0.206	0.204
Nr. Firms	3775	3775	3777	3777

Standard errors in brackets

$+ \ p < .10$, $^* \ p < .05$, $^{**} \ p < .01$

Each time the usual control variables as well as market characteristics and import/export dummies are included.

In regression with nr. patents, observations with over 15 patents excluded.

Prices, marginal costs and innovation

- Percentage changes in output prices can be used to disentangle markup changes in price and marginal costs changes: $\Delta \ln c_{it} = \Delta \ln p_{it} - \Delta \ln \mu_{it}$
- Product innovation leads to higher prices, no impact on marginal costs
- Process innovation puts downward pressure on both prices and marginal costs, but impact on prices is smaller, leading to an increase in markups.

$$\Delta \ln p_{it} = \underset{(.0007)}{.0014} * prodinnov_{it} - \underset{(.0005)}{.0025} * procinnovdum_{it} + year_t$$

$$\Delta \ln c_{it} = \underset{(.0027)}{.0014} * prodinnov_{it} - \underset{(.0025)}{.0048} * procinnovdum_{it} + year_t$$

Conclusions

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