Innovation Investment and Productivity Dynamics: Evidence from Chile

10th Conference on Model-based Evidence on Innovation and Development

(MEIDE)

Montevideo, Uruguay

November 16-17, 2017

Roberto Álvarez

robalvar@fen.uchile.cl

University Chile

Motivation

- Abundant empirical evidence looking at the relationship among R&D investment, innovation, and productivity
  - CDM Model
  - LATAM: Alvarez et al. (2011); Alvarez et al. (2015); Benavente, 2006; Crespi and Zuniga; 2012, De Fuentes et al., 2015; Gallego et al., 2015; and Aboal and Garda, 2016

Motivation

- Most of these papers show that innovation is positively associated with productivity.
- Cross-sectional (static)
- Labor productivity
- Identification concerns

Motivation

- Doraszelski and Jaumandreu (2013) and De Loecker (2013)
  - Endogenous TFP
  - Impact of R&D investment (exports) on productivity
  - DL: Learning by exporting
  - DJ: Heterogeneity and uncertainty of private R&D returns.

Questions

- How innovation investment affects TFP?
- How heterogeneous is the impact?
  - Industries and productivity
- How is the joint impact of innovation and exports?
  - Across productivity levels

Data

- Annual survey of manufacturing industry (ENIA)
- 1996-2005
- Industry and firm-specific deflators
- Innovation investment: purchases foreign licenses (+ marketing = intangible)

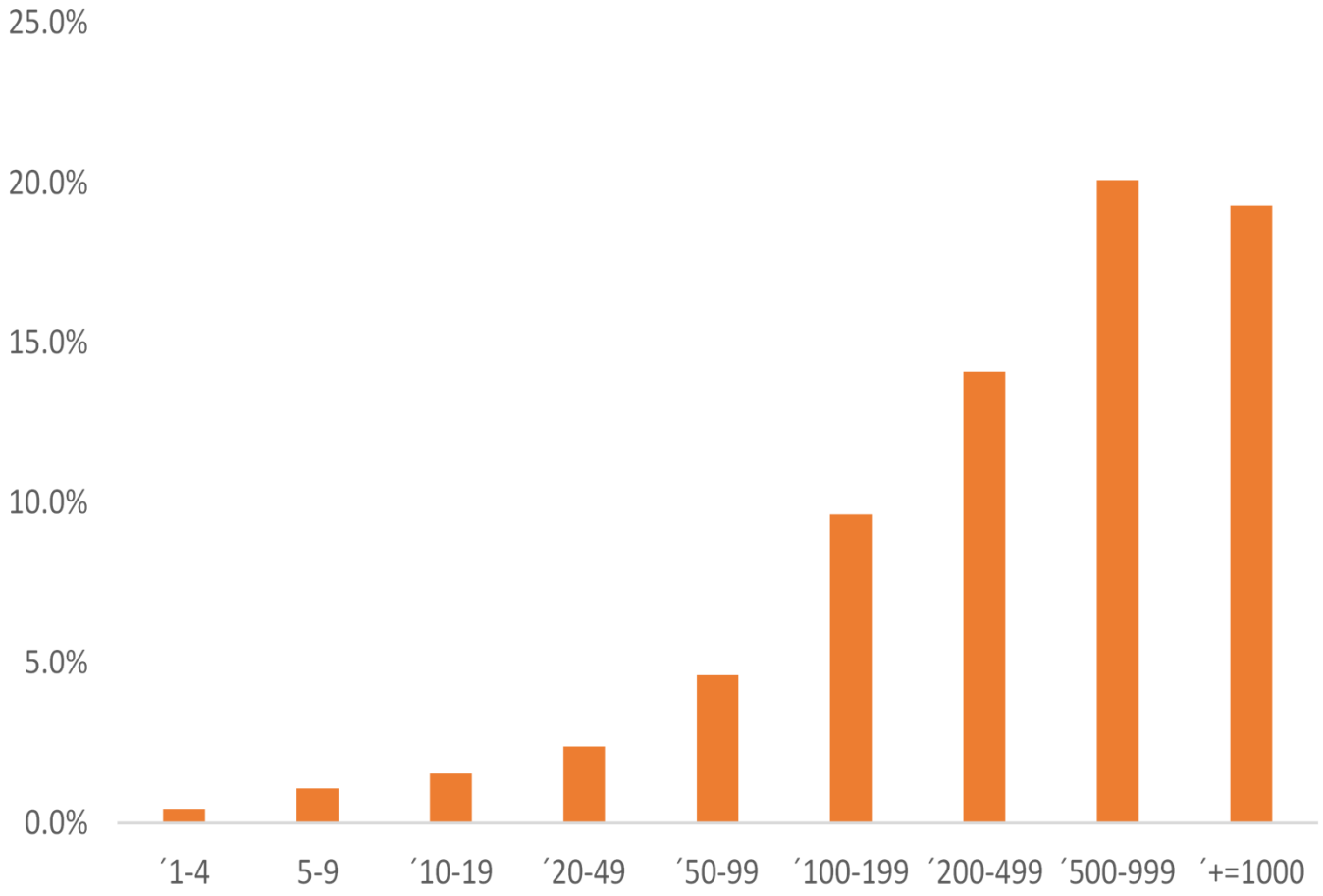
Data

Year	Plants
1996	5762
1997	5549
1998	5351
1999	5222
2000	5082
2001	5015
2002	5331
2003	5294
2004	5508
2005	5444

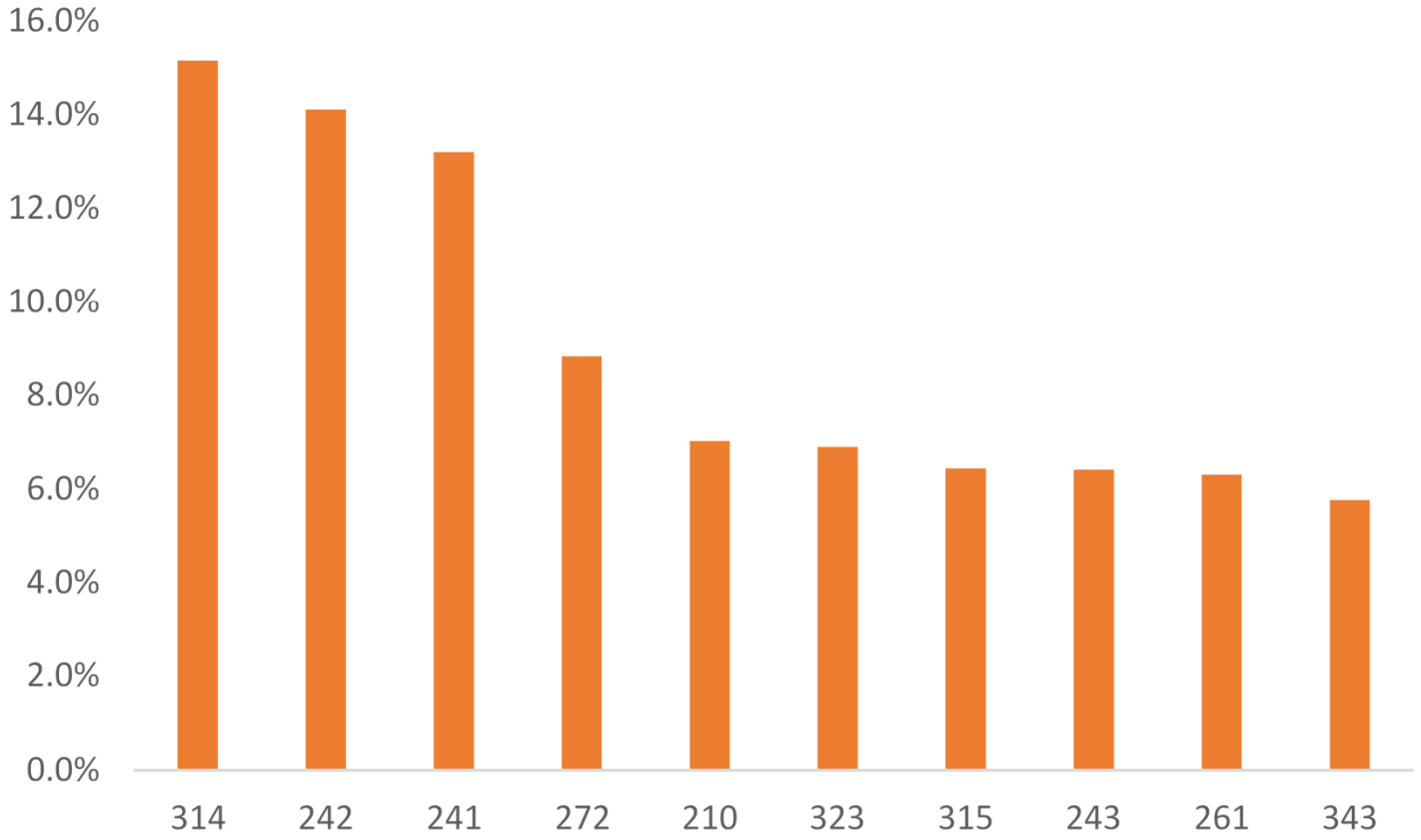
Innovation Investment

Year	Licenses	Licenses/Sales
1996	5.48%	0.08%
1997	5.02%	0.07%
1998	5.44%	0.11%
1999	7.08%	0.10%
2000	5.74%	0.09%
2001	4.40%	0.07%
2002	4.21%	0.10%
2003	5.19%	0.09%
2004	5.11%	0.08%
2005	5.20%	0.06%

Innovation Investment by Size



Innovation Investment by Industries (top ten)



Data

- 314 - Manufacture of accumulators, primary cells and primary batteries
- 242 - Manufacture of other chemical products
- 241 - Manufacture of basic chemicals

Data

		Innovation	
2013		NO	YES
Licenses	NO	93.2	6.8
	SI	58.9	41.1
2014		NO	YES
Licenses	NO	92.0	8.0
	SI	28.0	72.0

Innovation Survey 2015

Methodology

$$q_t = f(l_t, k, m_t) + \omega_t + \varepsilon_t$$

$$\omega_t = g(\omega_{t-1}, Z_{t-1}) + \xi_t$$

Following De Loecker, 2013, dummy for purchases of foreign licenses

$$\omega_t = g(\omega_{t-1}, F_{t-1}) + \xi_t$$

Identifying assumption

$$E\left\{\xi_{it}(\beta_l, \beta_k)\begin{pmatrix} l_{it-1} \\ k_{it} \end{pmatrix}\right\} = 0$$

Methodology

Linear model

$$\omega_t = \alpha_1 \omega_{t-1} + \alpha_2 F_{t-1} + \xi_t$$

General model

$$\omega_t = \alpha_1 \omega_{t-1} + \alpha_2 F_{t-1} + \alpha_3 F_{t-1} \omega_{t-1} + \xi_t$$

Basic Results
(firm-level deflator)

	Linear Model		General Model	
Parameter	Estimate	SE	Moment	Estimate
Licenses				
Average Effect	-0.017	0.011	25th pct	-0.009
Persistence	0.839	0.005	50th pct	0.008
			75th pct	0.012
Licenses and Marketing				
Average Effect	0.018	0.007	25th pct	0.006
Persistence	0.572	0.007	50th pct	0.009
			75th pct	0.027

Basic Results
(industry-level deflator)

	Linear Model		General Model	
Licenses	Parameter	SE	Moment	Estimate
Average Effect	-0.040	0.007	25th pct	-0.0396
Persistence	0.902	0.003	50th pct	-0.0391
			75th pct	-0.0321

Impact across Industries

Industry	Licenses		Licenses and Marketing	
	Average	Median	Average	Median
Metals and Metals products	0.077	0.052	0.034	0.013
Non-Metallic minerals	0.060	0.037	-0.000	0.012
Chemical Products	0.099	0.082	0.096	0.068
Industry Machinery	-0.078	0.085	0.126	0.099
Electrical goods	0.028	-0.178	0.026	-0.032
Transport Equipment	-0.088	-0.018	-0.113	-0.029
Food, drink and tobacco	-0.008	0.020	0.023	0.003
Textile, leather and shoes	0.022	-0.005	0.041	0.053
Timber and Furniture	-0.071	0.067	0.074	0.077
Paper and printing products	0.015	0.029	-0.024	-0.041

Complementarities between innovation and exports

$$\omega_t = g(\omega_{t-1}, Z_{t-1}) + \xi_t$$

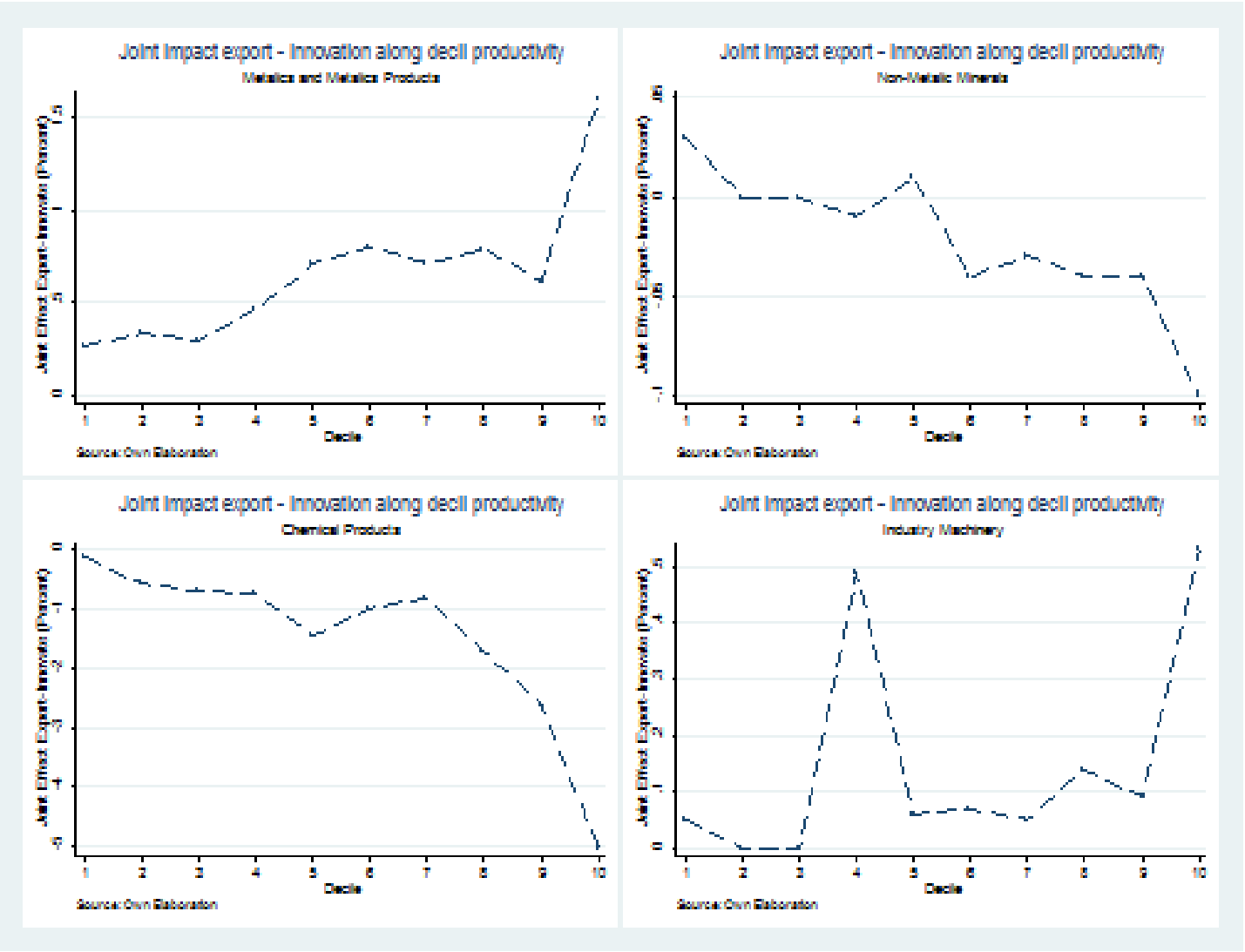
De Loecker, 2013 & Doraszelski and Jaumandreu (2013)

$$\omega_t = g(\omega_{t-1}, F_{t-1}, E_{t-1}) + \xi_t$$

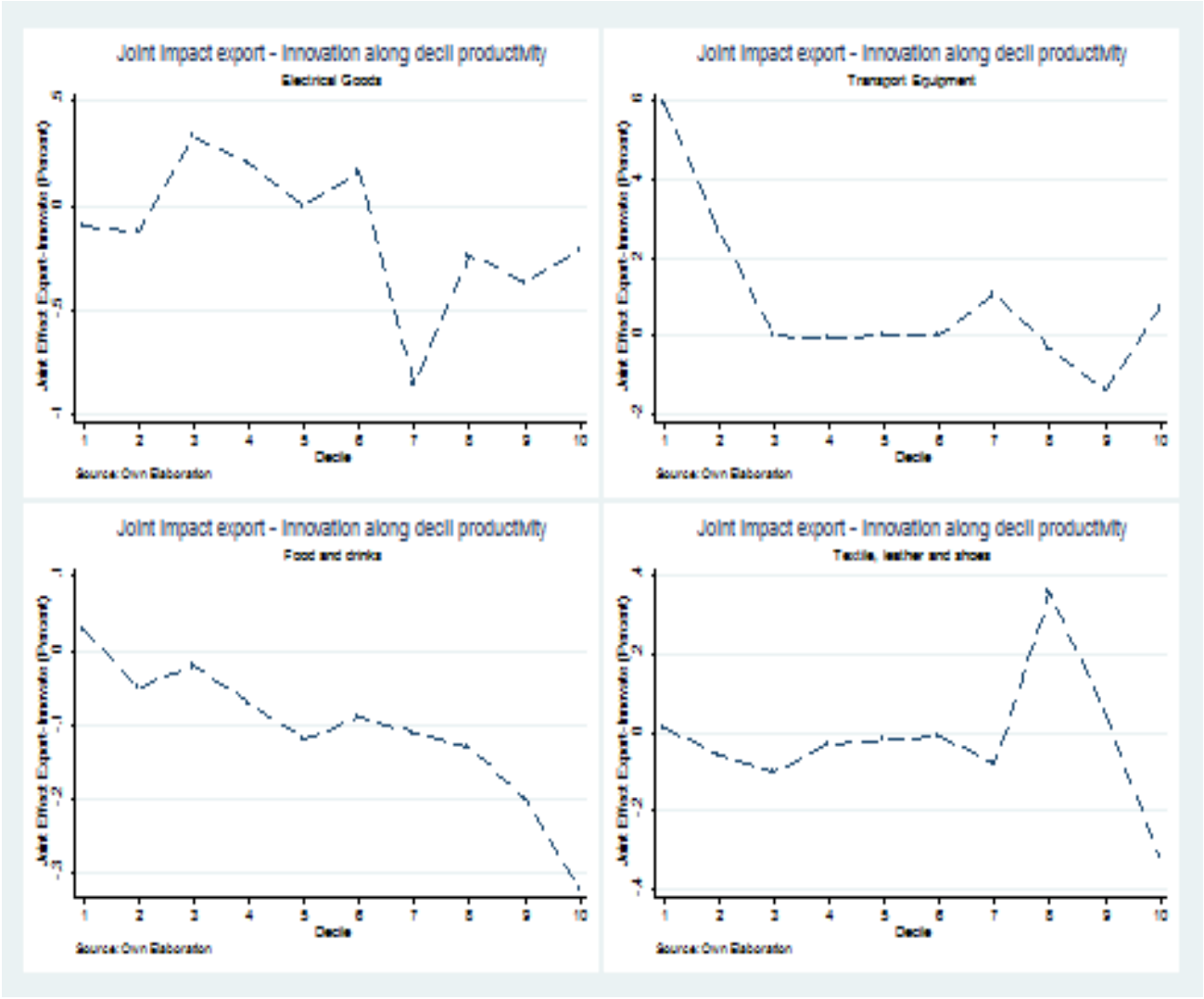
Impact across Industries

Variables	Parameter	Estimate	Standard Error
Productivity	θ_1	0.492***	(0.006)
RD	θ_2	-0.018**	(0.006)
Exports	θ_3	-0.045	(0.023)
RD x Exports	θ_4	0.010	(0.007)
RD x Productivity	θ_5	0.011***	(0.003)
Export x Productivity	θ_6	0.060***	(0.013)
Export x RD x Productivity	θ_7	-0.005	(0.004)
Observations	26.514	F-test	F(6,26.506)=31.30

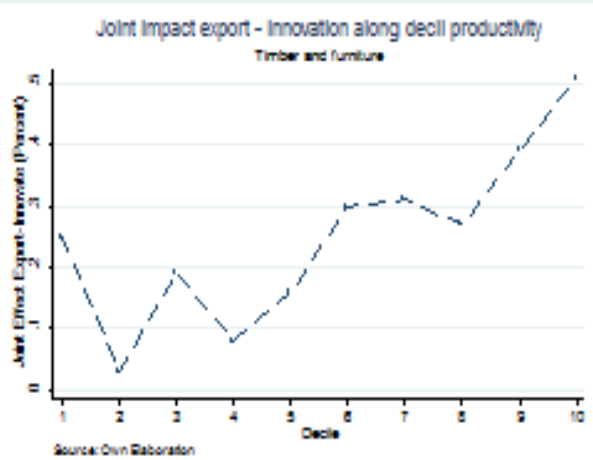
Impact across industries and productivity

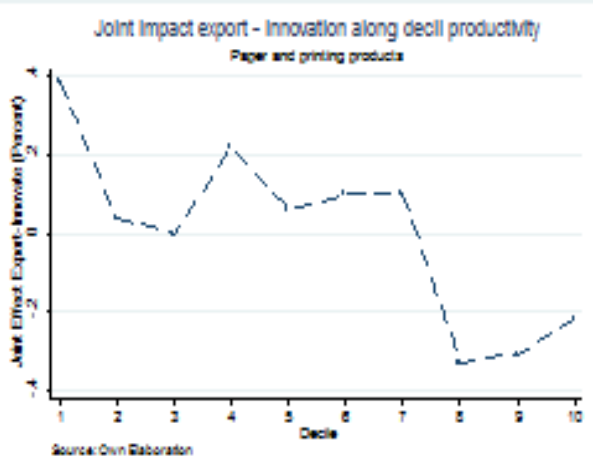


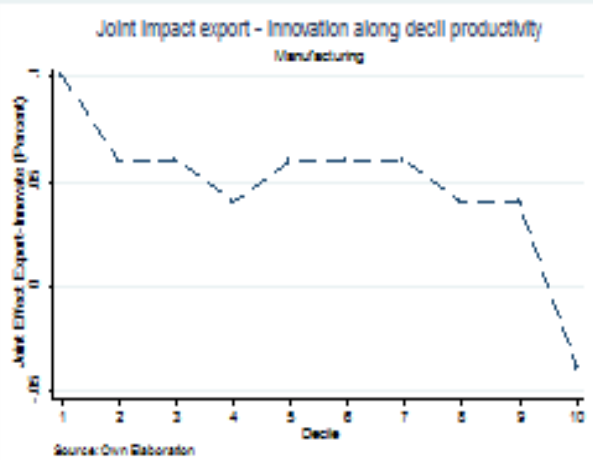
Impact across Industries



Impact across Industries







Conclusions

- Positive….but heterogeneous and uncertain impact of innovation investment (D&J)
- Deflators matters for uncovering the positive impact
- Joint effect of exports and innovation is, in general, positive

Conclusions

- Highly heterogeneous across industries and firm productivity
- Why? – theory?
- Policy implications?