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# **Trade Policy and Plant-level Productivity : Micro Evidence from the Korean Manufacturing**

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Korea's Leading Think Tank 

# **C O N T E N T S**



**Motivation**

**Trade Liberalization and Channels of Productivity Growth**

**Productivity Dynamics of the Korean Manufacturing**

**Import Tariff and Plant-level Productivity**

**Concluding Remarks**

Part-01 | **Motivation**

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# Motivation

## Growing public concerns over the effects of trade liberalization

- A remarkable proliferation of bilateral and regional Free Trade Agreements around the world
- Accelerated pace of trade liberalization accompanied with growing public concerns over the effects of trade liberalization on the Korean economy
  - Korea experiencing deep and fast economic structural changes, including slowdown in growth potentials, an aging populations, etc
  - Will trade liberalization help to regain the growth momentum for the Korean economy?
- Micro-level empirical studies on the effects of trade liberalization for the Korean case are relatively rare.

# Motivation

## Two opposing views on the effects of trade liberalization

- The theoretical literature delivers some disparate predictions
  - A critical element for the sustainable economic growth versus Trade protection nurturing and developing internationally competitive firms.
- Empirical evidence on the characteristics and extents of trade liberalization effects is essential to inform the debate.

**Part-2** | **Trade Liberalization and  
Channels of Productivity Growth**

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# Channels of Productivity growth through FTA

Channel		Type of Transaction	Counterparts
Economies of Scale /Learning-by-Exporting		Exports	Advanced/ Developing Countries
Competition Enhancement	Reducing X-inefficiency	Imports/FDI	Advanced/ Developing Countries
	Incentives for Technological investment	Imports/FDI	Advanced/ Developing Countries
	Resource reallocation within- and between- industries	Imports/FDI	Advanced/ Developing Countries
R&D Spillovers	Knowledge Spillovers	Imports/FDI	Advanced Countries
	Rent Spillovers	Imports	Advanced Countries

## Recent empirical evidence

### **Are exports a main conduit for productivity growth?**

- Self-selection hypothesis vs learning-by-exporting hypothesis
- Little Evidence of learning-by-exporting
  - Bernard and Jensen, 1999; Hahn, 2003, etc

### **Importance of import competition**

- Recent empirical research shows that increased exposure to foreign competition generates gains in plant productivity in the domestic market.
- Lawrence & Weinstein(1999): Lower tariffs and higher import volumes would have been particularly beneficial for Japan and Korea (through competitive pressures and potentially learning from foreign rivals)
  - These channels are even more important as industries converge with the market leader.

# Motivation

## Stylized Facts: Openness, Mark-ups and Productivity

- High tariffs are associated with high margins and low productivity
- Price-cost margins fell with trade liberalization
- Import competition increases productivity
  - Gains emanating from reshuffling of resources and output from less to more efficient producers
    - : Pavcnik(2002, Chile), Muendler(2003, Brazil), etc.
  - Increased plant productivity through heightened competition pressure
    - : Fernandes(2006, Colombia), Baggs et al. (2002, Canada), etc.

**Part-3** | **Productivity Dynamics  
of the Korean Manufacturing**

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# Sources of TFP growth

## Resource allocation vs Within-plant productivity gains

- Decomposition of TFP growth: Griliches & Regev(1995) method

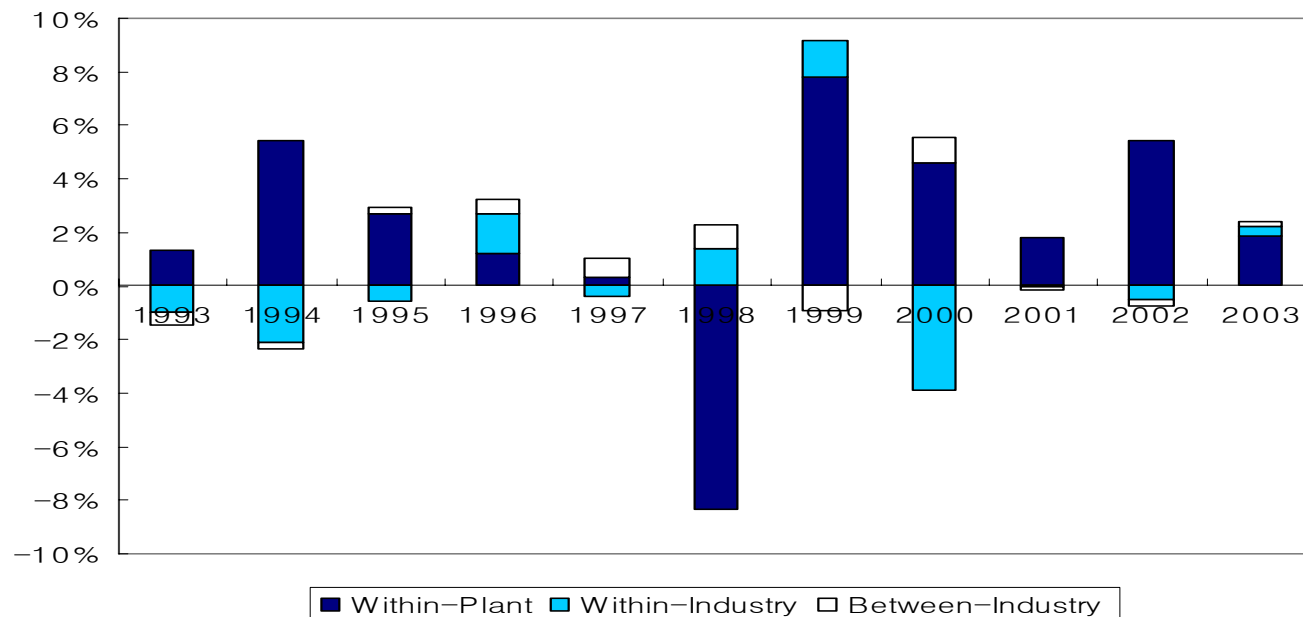
$$\Delta \ln A_t = \sum_j \sum_{i \in j} \overline{s_t^j} \overline{s_{it}^j} \Delta \ln A_{it}^j + \sum_j \sum_{i \in j} \overline{s_t^j} \overline{\ln A_{it}^j} \Delta s_{it}^j + \sum_j \overline{\ln A_t^j} \Delta s_t^j$$

- Between-industry resource allocation
  - Within-industry resource allocation
  - Plant-level productivity gains
- Constructing plant-, industry- and aggregate-level TFP indices for the Korean manufacturing for the periods of 1993~2003
    - Plant productivity constructed by the chained-multilateral index number approach
    - About 410,000 observations for more than 150,000 individual plants (Korea Census of Manufacturers)

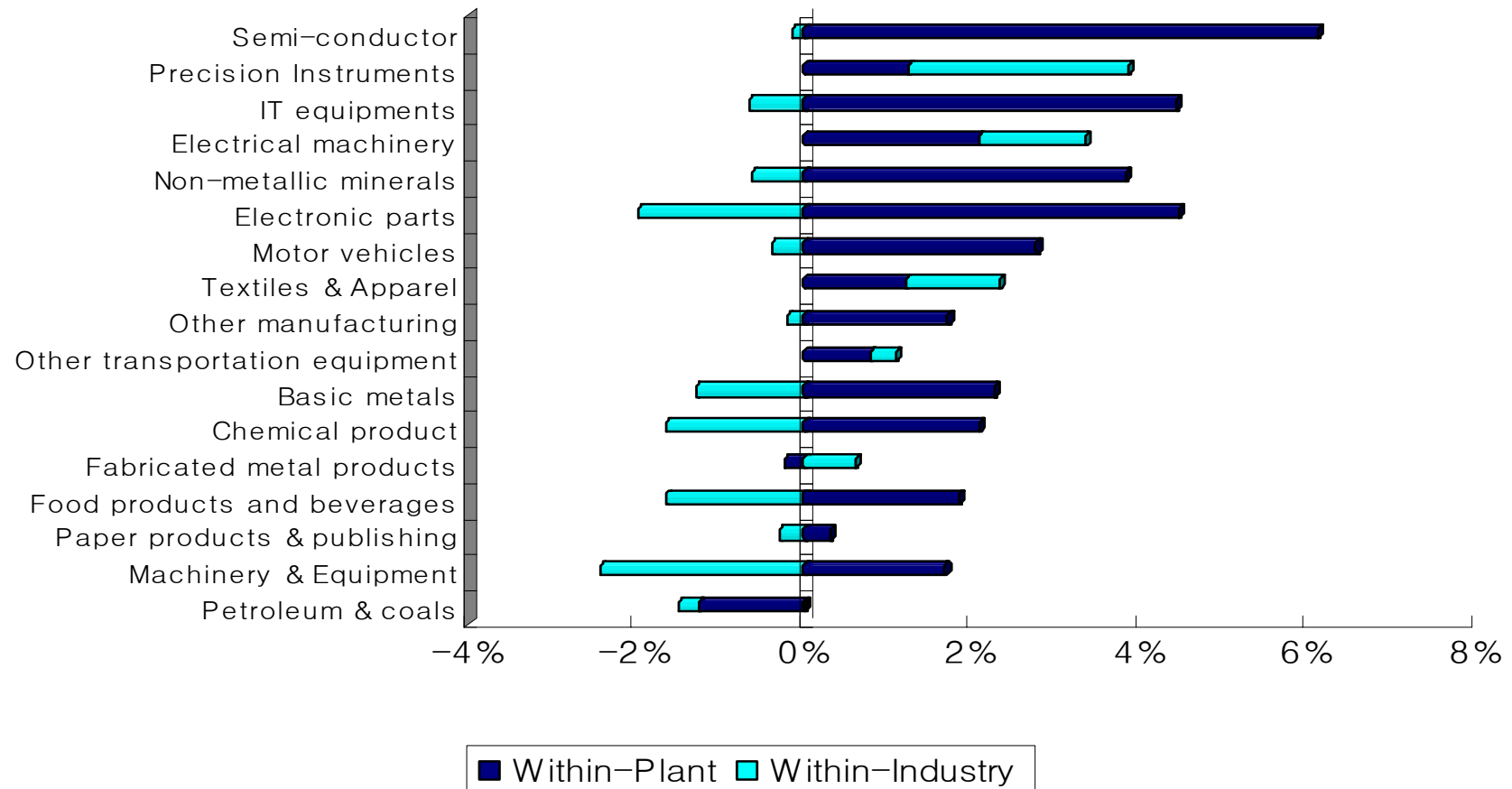
# Sources of TFP growth in Korean Manufacturing

## Aggregate TFP growth mostly induced by within-plant productivity gains

- For the period of analysis, the aggregate TFP growth rate is 2.0%
- The annual growth rate of within-plant productivity is 2.2%, while those emanating from within- and between-industry reallocation are -0.4% and 0.1%, respectively



# Decomposition of Within TFP Changes by Sector



Part-4

**Tariff Reduction and Plant-level**

**Productivity: the Korean Case**

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# Effects of Import Tariffs on TFP, Mark-ups, Employment

## Baseline Empirical Model

$$\ln A_{it}^j = \beta_{oi} + \beta_A \ln A_{it-1}^j + \Phi' \Omega_{it-1}^j + \beta_T TR_{t-1}^j + \lambda_t + (I^j) + v_{it}$$

$A_{it}^j$  : Total Factor Productivity for plant i in industry j at the year t

$\Omega$  : Vector of plant-specific variables such size and age, etc

$TR$  : Effective rate of import tariffs for an industry j

- Data : More than 150,000 individual plants (more than 5 workers) for the periods of 1993~2003 (Korea Census of Manufacturers)
- **Endogeneity of trade policy with respect to TFP**
  - One-year lagged tariff rates
  - Explicitly controlling for plant fixed effects in estimation
  - Robustness check by using Fernandes(2006)'s Approach

# Estimation Results I

## Lower import tariff barriers leads to higher plant TFP

- According to F-test and Hausman test results, the most appropriate model specification is a Fixed Effect model with year dummies.
- **If the tariff rate decreases by 1% p, then average plant-level productivity increases by 1.52%**
  - Generally consistent with results from recent empirical studies : Mexico(Iscan, 1998; Tybout and Westbrook, 1995), Brazil(Muendler, 2003; Hay, 2001), India(Krishna and Mitra, 1998), Ivory Coast (Harisson, 1994 and 1996), Chile(Tybout, de Melo and Corbo, 1991; Pavcnik, 2002), Canada(Baggs et al., 2002), etc

# Impacts of Import Tariff : Fixed Effect Estimation

	<b>TFP</b>	<b>Mark-Ups</b>	<b>Employment</b>
<b>TR<sub>t-1</sub></b>	<b>-1.516</b>	<b>.247</b>	<b>- .506</b>
	<b>(.094)</b>	<b>(.037)</b>	<b>(.104)</b>
<b>A<sub>t-1</sub></b>	<b>.019</b>	<b>-.008</b>	<b>.327</b>
	<b>(.003)</b>	<b>(.009)</b>	<b>(.004)</b>
<b>AGE</b>	<b>-.165</b>	<b>.017</b>	<b>.268</b>
	<b>(.033)</b>	<b>(.015)</b>	<b>(.038)</b>
<b>AGE<sup>2</sup></b>	<b>.292</b>	<b>-.023</b>	<b>-.632</b>
	<b>(.069)</b>	<b>(.030)</b>	<b>(.081)</b>
<b>SIZE</b>	<b>.032</b>	<b>-.008</b>	<b>-</b>
	<b>(.002)</b>	<b>(.001)</b>	<b>-</b>
R-Squared	.0558	.0216	.8718
(within)	(.0454)	(.0138)	(.1359)
(between)	(.0580)	(.0299)	(.8829)
No. of observations	411,136		

\* Year dummies included

## Estimation Results I (cont.)

### High tariffs associated with high margins and low employment

- Mark-ups negatively affected by lowering tariff barriers
  - If the tariff rate is lower by 1% p, then plant margins decrease by .25%
- Lowering tariff barriers contributes positively to plant employment.
  - If the tariff rate is lower by 1% p, plant employment is higher by .51%

### Interpretations

- Lowering tariff barriers heightens competitive pressure, which in turn creates incentives for firms to reduce the slack in plant management and to invest more on innovative activities.
- The linkage between tariff barriers and employment is a little bit puzzling !

## Estimation Results II

### Similar results revealed by further analyses based on plant size

- Most of the plants, other than those of less than 10 employees, revealed a statistically significant positive impacts on productivity growth
  - Plants of 50~100 employees experienced the biggest TFP improvement (2.2% ).
- If the tariff rate is lower by 1% p, employment sizes for plants of 10~50 employees and of 100~300 employees becomes bigger by 0.7% and 0.8%, respectively
  - Interestingly, little evidence of employment creation in plants of 50~100 employees.
- Low tariffs associated with low margins, especially for those of 50 employees and of more than 300 employees

## Effects of Import Tariff: by plant size

<b>Firm Size (No. of Observations)</b>	<b>TFP</b>	<b>Employment</b>	<b>Mark-ups</b>
5 ≤ N < 10 (164,160)	-.231 (.193)	<b>-.301</b> (.155)*	<b>.582</b> (.071)***
10 ≤ N < 50 (199,886)	<b>-1.536</b> (.136)***	<b>-.741</b> (.151)***	<b>.172</b> (.055)***
50 ≤ N < 100 (26,378)	<b>-2.183</b> (.320)***	.217 (.340)	-.108 (.129)
100 ≤ N < 300 (15,827)	<b>-1.574</b> (.319)***	<b>-.760</b> (.410)*	.125 (.141)
300 ≤ N (4,885)	<b>-1.110</b> (.500)***	.113 (.553)	<b>.715</b> (.196)***

## Estimation Results II (cont.)

### Import penetration rates vs Import tariff rates

- Import Penetration rates often employed as a measure of openness
  - Their effects may differ from those of trade policy variables , because the extent of import penetration is also affected by some factors other than trade policy, such as changes in macro-economic condition and industrial characteristics, etc.
- Higher import penetration raise TFP only for relatively larger plants.
  - Employment negatively affected by higher import penetration, especially for relatively smaller plants
- Tariff rates are preferable when the research focus is the effect of trade policy changes

## Effects of Import Penetration: by plant size

Firm Size (No. of Observations)	TFP	Employment	Mark-ups
5 ≤ N < 10 (164,160)	-.024 (.044)	<b>-.119</b> <b>(.039)***</b>	<b>.108</b> <b>(.018)***</b>
10 ≤ N < 50 (199,886)	.002 (.031)	<b>-.191</b> <b>(.037)***</b>	<b>.027</b> <b>(.016)*</b>
50 ≤ N < 100 (26,378)	.052 (.081)	<b>-.141</b> <b>(.083)*</b>	.000 (.031)
100 ≤ N < 300 (15,827)	<b>.180</b> <b>(.081)**</b>	-.035 (.108)	.043 (.036)
300 ≤ N (4,885)	<b>.520</b> <b>(.086)***</b>	-.036 (.088)	.012 (.056)

## Estimation Results III

Plant productivity quickly adjusted to the import tariff changes, while the employment effect proceeds relatively slowly.

- Growth Equation

$$\Delta \ln A_{it}^j = \beta_{oi} + \beta_A \ln A_{it-\tau}^j + \Phi' \Omega_{it-\tau}^j + \beta_{\Delta} \Delta TR_{t-\tau}^j + \beta_T TR_{t-\tau-1}^j + \lambda_t + v_{it}$$

- Plant TFP growth conspicuous within one-year after tariff changes
  - If the import tariff decrease by 1% p, then plant productivity increase by a total of 2.2% within 3-year span after the changes
- The estimated coefficients on employment creation become statistically significant only in case of 3-year changes

# Dynamics of TFP and Employment Adjustment

	TFP			Employment		
	One-year Change	2-year Change	3-year Change	One-year Change	2-year Change	3-year Change
	-1.835 (.183)***	-1.213 (.210)***	-2.222 (.208)***	.019 (.201)	-.060 (.250)	-.732 (.251)***
	-1.986 (.197)***	-1.947 (.207)***	-.8.09 (.221)***	-.681 (.214)***	-1.219 (.254)***	-1.304 (.279)***
No. of Observations	125,809					
R-Squared (within)	.2415 (.5144)	.3088 (.5515)	.3941 (.5822)	.0176 (.3765)	.0267 (.4509)	.0392 (.4919)
(Between)	(.1718)	(.2590)	(.3828)	(.0092)	(.0172)	(.0295)

\* Continuing Plants for at least 4 consecutive years

# Robustness Check

## Fernandes (2006) estimation

- Drawbacks of fixed effect estimation
  - Control only for time-invariant plant-specific attributes
  - A substantial part of information left unused, especially for the cross section variation
- Fernandes (2006) estimation
  - A variant of Levinsohn & Petrin (2003)
  - Avoiding simultaneity problem by using the plant's intermediate inputs to proxy unobserved productivity shocks
- The estimated sizes of productivity gains are turned out to be much greater than those from the fixed effect estimation with high statistical significance.

## Estimation Results: Fernandes(2006) model

	Non-Energy intermediates		Energy intermediates	
	(i)	(ii)	(iii)	(iv)
TR	- 3.006 (.041)	- 3.004 (.041)	- 4.623 (.050)	- 4.690 (.054)
AGE	- .331 (.012)	- .290 (.013)	- .532 (.017)	- .465 (.017)
AGE <sup>2</sup>	.386 (.033)	.342 (.033)	.836 (.043)	.765 (.043)
SIZE	.064 (.001)		.107 (.002)	
K	.089 (.001)	.090 (.001)	.080 (.001)	.083 (.001)
L	.347 (.001)	.400 (.001)	.447 (.002)	.536 (.001)
M	.297 (.001)	.294 (.001)	.367 (.000)	.368 (.001)
E	.067 (.000)	.068 (.000)	.048 (.001)	.046 (.001)
No. of observations	443,053 (265,360)			
R-Squared	.9687 (.9064)	.9585 (.9079)	.9314 (.3778)	.9304 (.3924)

**Part-5** | **Concluding Remarks**

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## Implications for the KORUS FTA

According to our results, within-plant productivity gains through the KORUS FTA are expected to be at least 0.9~1.4%.

- The KORUS FTA will lead to the reduction of the effective import rates by 0.6~0.9% p and hence the expected TFP gains are a 0.9~1.4% increase.
  - The current effective rate of import tariffs is currently 4~6%
  - The import share of U.S. in total manufacturing imports is around 15%
- The overall impacts of the KORUS FTA on productivity will be much higher than our estimates.
  - Our analysis focuses only on one of the channels through which free trade contributes to domestic productivity growth.
  - There exists other channels for TFP growth uncovered, such as resource

reallocations, R&D spillovers, scale economies, etc.

## Concluding Remarks

### **Trade liberalization as a short-cut vehicle for enhancing Productivity and for upgrading economic system**

- However, the current empirical literature also suggest that the extent of productivity gains from trade liberalization depends on how far countries are willing to go in removing not just tariffs, but also a wide range of other barriers to economic integration
- The importance of domestic reforms complementing trade liberalization
  - Labor market reform/ building up stable institutional and legal environments
  - Investments in human capital and infrastructure
  - Effective compensation scheme, etc

**Thank You!**

