Trade Liberalization, Growth, and Bi-polarization in Korean Manufacturing: Evidence from Microdata

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Chin Hee HAHN

Gachon University
Questions

1) Does globalization promote productivity improvement and growth?

2) Does globalization widen productivity differences across firms (plants)?

3) How does globalization affect wage inequality between skilled and unskilled workers?
This Study

- Discusses the effect of globalization on plant productivity and “bi-polarization”, based on available micro-evidence from Korean manufacturing sector since 1990s.

  - Bi-polarization in this paper means:
    - Increase in performance differences across firms: productivity, size, etc.
    - Increase in wage disparity between skilled and unskilled workers

  - The following aspects of globalization
    - Tariff reduction
    - Exporting
      - Trade cost reductions ⇒ increases the incentive to export

- Draws out broad policy implications
... against the literature

- Huge literature, theoretical and empirical, and macroeconomic and microeconomic, on the nexus bet’n trade and growth(productivity)
  - Macroeconomic literature somewhat inconclusive on the effect of openness on growth
  - Microeconomic studies tend to provide more clear cut answers, but inconclusive on the mechanisms.
    ✓ There is still no clear consensus on whether trade promotes firm-level productivity and what the mechanism is. => important issue for understanding the effect of globalization on growth and bi-polarization
- Also huge literature on the distributional effects of trade
  - However, does trade increase wage inequality between skilled and unskilled? => still an open question
Korea: growing concern about “bi-polarization”

- Korea’s past rapid growth relied on MFG sector which probably benefited from a larger and more integrated world market.

- However, since the early 1990s, there have been increasing concern that Korean economy is bi-polarized.
  - Large vs. small firms, exporting vs. domestically-oriented firms
  - Even bi-polarization in income, recently.

⇒ 1) Rapid growth of manufacturing sector and 2) bi-polarization. Do they have the same underlying cause—globalization?
Exporting, Productivity, and Divergence of Productivity among Plants
Fact 1: Increased productivity differential between top 1% most-productive plants and others

Fig. 1 Trends in Plant TFP (log) Distribution

=> Exceptional productivity performance of a very small set of high-productivity firms (e.g., top 1%)
Productivity of plants with the highest productivity is the most persistent.

Table 1. Five-year Transition Matrix of Relative Productivity Rankings

| 1990 | 1995 | Top 20% | 20-40 | 40-60 | 60-80 | 80-100 | Switch-out | death |
|------|------|--------|-------|-------|-------|-------|-----------|-------|
| Top 20% | 28.53 | 13.42  | 5.98  | 1.96  | 1.06  | 26.45 | 22.61     |       |
| 20-40% | 16.74 | 16.59  | 10.23 | 5.23  | 1.68  | 23.20 | 26.33     |       |
| 40-60% | 12.09 | 16.65  | 7.66  | 6.16  | 3.91  | 20.26 | 33.26     |       |
| 60-80% | 4.49  | 5.95   | 5.91  | 6.57  | 4.74  | 30.04 | 42.31     |       |
| 80-100%| 3.06  | 4.09   | 12.68 | 5.40  | 6.02  | 25.27 | 43.48     |       |
| Switch-in | 28.28 | 24.52  | 19.81 | 16.64 | 1074  | 0.00  | 0.00      |       |
| birth  | 25.63 | 22.09  | 18.90 | 16.91 | 16.47 | 0.00  | 0.00      |       |
Facts (continued)

Large cross-plant productivity differential and widening productivity advantage of the top 1% plants. => Related to export market participation behavior?

Fact 2: exporters are better than non-exporters

- Exporter premium: productivity, size, wages, etc..

| Performance Measures of Exporters and Non-exporters |
|-----------------------------------------------------|
| **1990** | 1994 | 1998 |
| | exporters | Non-exporters | Exporters | Non-exporters | exporters | Non-exporters |
| employment (person) | 153.6 | 24.5 | 119.4 | 20.0 | 95.1 | 17.8 |
| Shipments (million won) | 11,505.5 | 957.0 | 17,637.1 | 1,260.3 | 25,896.8 | 1,773.8 |
| Production per worker (million won) | 50.5 | 26.8 | 92.4 | 47.0 | 155.0 | 74.2 |
| Value added per worker (million won) | 16.5 | 11.3 | 31.0 | 20.4 | 51.3 | 29.6 |
| TFP (log) | 0.005 | -0.046 | 0.183 | 0.138 | 0.329 | 0.209 |
| Average wage (million won) | 5.7 | 5.1 | 10.3 | 9.2 | 13.7 | 11.5 |
Explaining Exporters' Productivity Premium: Theoretical Mechanisms

Exporting-Productivity Nexus

- **self-selection** or **learning-by-exporting** or **both**?
  - self-selection: only the productive firms can export
  - learning-by-exporting (LBE): exporters learn about new markets, new products, and advanced technology

- If LBE (post-exporting productivity gain) exists, trade liberalization widens initial productivity differences across firms.
  1) If self-selection only
     - Trade increases aggregate productivity but does not widen initial productivity differential (Melitz 2003)
  2) If both self-selection and LBE
     - Trade has a stronger effect on aggregate productivity but widens the initial productivity differences across firms.
Explaining Exporters’ Productivity Premium: Theoretical Mechanisms

**Exporting-Productivity Nexus**

- Even if there is no “learning” by exporting, trade can promote firm-level productivity through within-firm reallocation across products (“concentration on core competences”, Bernard, Redding and Schott 2006, 2010, Eckel and Neary 2010)
  - The effect is stronger for new exporters: New exporters not only drop low-expertise products but also expand output of newly exported products in response to reduced trade costs.

- Trade might promote Schumpeterian creative destruction.
  - exporting => Introduction of new products, dropping of old products?
Explaining Exporters’ Productivity Premium:
Theoretical Mechanisms

Exporting, Innovation, and Productivity

- 1) Exporting, Innovation => productivity
- 2) Interaction between exporting and innovation
  - exporting => innovation: larger market increases the incentive to innovate
  - innovation => exporting: New products or reduced cost increases the incentive to participate in export market.
※ Bi-directional causality implies a stronger impact of trade on widening initial productivity differential.

※ Costantini and Melitz (2008) and Aw, Roberts and Xu (2009)
Empirical Evidence on the Mechanisms
Econometric Methodology: PSM-DID

- Heckman, Ichimura, and Todd (1997)

- Probit model.

\[ P(X_i) \equiv \Pr(d_i = 1 \mid X_i) = E(d_i \mid X_i), \]

- \( X_i \): pre-exporting characteristics
- \( d_i \): dummy for export participation
Econometric Methodology: PSM-DID

- Matching: radius (reported)
  - common support restriction, within the same industry
  - radius: 0.001
  - qualitatively similar results for nearest neighbor matching

- PSM-DID estimator at s years after export market entry:

\[ \hat{\alpha}_{PSM-DID}^s = \frac{1}{N^T} \sum_{i \in T} \left( (y_{i,s}^T - y_{i,t_0}^T) - \sum_{j \in C(i)} w_{ij} (y_{j,s}^C - y_{j,t_0}^C) \right), \]

- Outcome variables: lnTFP and other plant performance variables
## Evidence on Self-selection

### Evidence: Self-selection? Yes!

**Probit Model of Export Participation**

| model             | (1)             | (2)             | (3)             |
|-------------------|-----------------|-----------------|-----------------|
| TFP (log)         | 0.138***        | 0.121***        | 0.085*          |
|                   | (0.041)         | (0.043)         | (0.048)         |
| TFPG              | 0.397***        | 0.391***        | 0.400***        |
|                   | (0.016)         | (0.016)         | (0.016)         |
| Plant size        | 0.002           | 0.002           | 0.002           |
|                   | (0.002)         | (0.002)         | (0.002)         |
| K/L ratio         | 0.141***        | 0.136***        | 0.133***        |
|                   | (0.012)         | (0.012)         | (0.013)         |
| Multi-product     | -0.065***       | -0.089***       | -0.093***       |
|                   | (0.031)         | (0.033)         | (0.034)         |
| R&D dummy         | 0.227***        | 0.227***        | 0.224***        |
|                   | (0.044)         | (0.045)         | (0.045)         |
| Product adding    | 0.073           | 0.073           | 0.073           |
|                   | (0.046)         | (0.046)         | (0.046)         |
| Product dropping  | 0.021           | 0.021           | 0.021           |
|                   | (0.044)         | (0.044)         | (0.044)         |
| Product creation  | 0.175**         | 0.183**         | 0.183**         |
|                   | (0.086)         | (0.086)         | (0.086)         |
| Product destruction | -0.190**       | -0.189**        | -0.189**        |
|                   | (0.087)         | (0.087)         | (0.087)         |
| Obs.              | 43,135          | 40,835          | 40,531          |
| Log likelihood    | -5918.40        | -5617.15        | -5543.76        |
Evidence on LBE

Evidence: LBE? Yes!

Estimated Learning-by-exporting Effects: PSM-DID

| Outcome variable | Probit | s=2  | s=1  | s=0  | s=1  | s=2  | s=3  |
|------------------|--------|------|------|------|------|------|------|
|                  | (1)    | 0.000| 0.015**| 0.035***| 0.038***| 0.035**| 0.058*|
| Plant TFP        | (2)    | 0.000| 0.021**| 0.031***| 0.041***| 0.071**| 0.103*|
|                  | (3)    | 0.000| 0.027***| 0.041***| 0.042**| 0.041**| 0.095*|

- Trade liberalization => increased incentive to export => LBE
  => initial productivity differential is widened
Figure 1: TFP Premium of New Exporters: simple regression approach

Note: Estimated from a simple dummy variable regressions with industry-year effects.
Source: Figure 1 from Hahn (2012)
Evidence on Exporting and Product Adding and Dropping

Evidence: Exporters more frequently add and drop products than non-exporters.

**Exporter Premium: Product Adding and Dropping**

|          | 1995                     | 1997                     |
|----------|--------------------------|--------------------------|
|          | No control               | Industry and region dummy controlled | Industry and region dummy, and size controlled |
| Product Adding | 0.95***                  | 0.95***                  | 0.14***                           |
| Product Dropping | 0.97***                  | 0.96***                  | 0.14***                           |
|          | 0.95***                  | 0.96***                  | 0.15***                           |
|          | 0.14***                  | 0.14***                  | 0.13***                           |
Evidence: As plants participate in exporting, they not only drop old products but also introduce new products!

### Exporter Premium: Product Adding and Dropping

| Outcome variable | Probit Model | s=-2 | s=-1 | s=0  | s=1  | s=2  | s=3  |
|------------------|--------------|------|------|------|------|------|------|
| Product adding   | (1)          | 0.000| 0.070***| 0.206***| 0.296***| 0.669***| 0.706* |
|                  | (2)          | 0.000| 0.078***| 0.216***| 0.343***| 0.580***| 0.492  |
|                  | (3)          | 0.000| 0.084***| 0.244***| 0.246** | 0.603** | 0.566  |
| Product dropping | (1)          | 0.000| 0.069***| 0.185***| 0.230** | 0.530** | 0.370  |
|                  | (2)          | 0.000| 0.071***| 0.201***| 0.167  | 0.394** | 0.262  |
|                  | (3)          | 0.000| 0.060** | 0.205***| 0.139  | 0.330** | 0.407  |
Figure 3: TFP Premium of New Exporters: simple regression approach

Note: Estimated from a simple dummy variable regressions with industry-year effects.
Source: Figure 1 from Hahn (2012)
### Evidence on Bi-directional Causality bet’n Exporting and R&D

**Evidence: Both directions? Yes!**

#### The Effect of Exporting (R&D) on R&D( Exporting): Intensive and Extensive Margins

| Treatment | Outcome variable | No. of treated | Estimated effect |
|-----------|------------------|----------------|-----------------|
|           |                  |                | s=-1 | s=0 | s=1 | s=2 | s=3 |
| Export     | R&D participation probability | 4,231 | -0.001 (0.003) | 0.003 (0.003) | 0.021*** (0.004) | 0.038*** (0.005) | 0.034*** (0.008) |
| Export     | R&D Intensity    | 460 | 0.918 (4.123) | 0.499 (0.674) | 0.747*** (0.333) | 0.277 (0.779) | 0.409 (0.614) |
| R&D        | Export participation Probability | 3,442 | 0.023*** (0.005) | 0.036*** (0.005) | 0.098*** (0.008) | 0.148*** (0.011) | 0.094*** (0.023) |
| R&D        | Export intensity | 746 | -1.570 (3.752) | -3.995 (4.097) | -3.910 (7.415) | 16.071 (11.600) | 47.332*** (16.122) |
Strong Evidence suggesting that ...

1) Trade (exporting) increased not only aggregate productivity but also plant (firm) productivity.

2) At the same time, however, the same forces as above also worked to widen initial productivity differences across firms.
   - self-selection, LBE, product portfolio change
   - interaction between exporting and R&D
In reality, only a small portion of plants are participating in global market or engaged in R&D! => Globalization produces Happy Few?

**Evidence: Plants doing both exporting and R&D are rare!**

### Share of Exporting and/or R&D-doing Plants

| Year | Plant group | R&D: No exporting: No | R&D only | exporting only | R&D: Yes exporting: Yes |
|------|-------------|-----------------------|----------|---------------|------------------------|
| 1991 |             | 53518 (81.0)          | 2161 (3.3)| 8656 (13.1)   | 1735 (2.6)             |
| 1995 |             | 74213 (84.2)          | 3516 (4.0)| 8323 (9.5)    | 2057 (2.3)             |
| 1998 |             | 58866 (80.1)          | 3590 (4.9)| 8370 (11.4)   | 2710 (3.7)             |
Evidence on Exporting and R&D and Productivity

Evidence:
1) Exporter plants or R&D-doing Plants have Better Performances!
2) Plants with both Exporting and R&D have exceptional performances!

Characteristics of Plant Groups Classified by Exporting and R&D

|                  | Non-exporters | Exporters |
|------------------|---------------|-----------|
|                  | R&D: No       | R&D: Yes  | R&D: No       | R&D: Yes |
| shipments (won)  | 1255          | 5797      | 10077         | 71902    |
| employees (person) | 18          | 52        | 71            | 328      |
| value added per worker (won) | 23   | 33        | 34            | 44       |
| plant TFP        | 2.7           | 2.9       | 3.0           | 3.3      |
| capital-labor ratio (won/person) | 23 | 34        | 37            | 55       |
| non-production worker/total employment (percent) | 17 | 30        | 26            | 33       |
| R&D/Production (percent) | 0.0  | 11.1      | 0.0           | 4.8      |
Trade Liberalization and Skilled-Unskilled Wage Inequality
Rising Relative Demand for the Skilled Workers since 1990s
Conventional Explanation: SBTC

- Increase in relative employment of skilled labor accompanied by the rise in wage skill premium is globally observed phenomenon since 1980s.

- Two possible explanations from demand side
  - Skill-biased technology change (SBTC)
    vs. international trade

- A consensus from the literature is that skill-biased technical progress is an important part of the story while the role of trade is less clear-cut.
Recent researches explore the interaction between Trade and SBTC

- Renewed interests on trade as a driver for rising wage skill premium: recent heterogeneous firm trade theories
  - Interactions bet’n trade and SBTC: Trade raises relative demand for skilled workers by inducing exporters to invest in new technologies that are skill-biased.
  - Trade and SBTC: complementary rather than competing explanations
Large, exporting, or R&D-doing plants are mostly responsible for the aggregate skill upgrading.

Evidence:
1) Large “within” effect (cf. large between effect in U.S., B&J 1997)
2) The within effect mostly due to exporting, R&D-doing, or large plants.

### Decomposition of Changes in Non-production Worker Share

|          | Relative skilled employment: | Relative skilled employment: |
|----------|-----------------------------|-----------------------------|
|          | 1991-1997                   | 1999-2003                   |
|          | between | within | total | between | within | total |
| All plants| 0.754   | 1.007  | 1.761 | -0.262  | 1.289  | 1.028 |
| Non-exporters| 0.779   | 0.197  | 0.976 | 1.119   | 0.015  | 1.134 |
| Exporters| -0.025  | 0.810  | 0.785 | -1.381  | 1.274  | -0.107 |
| All plants| 0.754   | 1.007  | 1.761 | n.a.    | n.a.   | n.a.  |
| Without R&D| -0.174  | 0.368  | 0.194 | n.a.    | n.a.   | n.a.  |
| With R&D | 0.928   | 0.639  | 1.567 | n.a.    | n.a.   | n.a.  |
Large, exporting, or R&D-doing plants upgraded their skill-mix faster! (multivariate analysis)

Determinants of Within-plant Skill Upgrading

|                          | Model I         | Model II        | Model III        |
|--------------------------|-----------------|-----------------|-----------------|
| Constant                 | -13.0927***     | -13.7887***     | -13.8176***     |
|                          | (2.8277)        | (2.9520)        | (2.9267)        |
| New exporter dummy       | 1.6061***       | 1.2664***       | 1.2147***       |
|                          | (0.4081)        | (0.4182)        | (0.4181)        |
| Export market exit dummy | -0.4571         | -0.9577**       | -0.9875**       |
|                          | (0.4334)        | (0.4449)        | (0.4448)        |
| Continuous exporter dummy| 1.4648***       | 0.4912          | 0.4514          |
|                          | (0.3230)        | (0.3836)        | (0.3839)        |
| size_{91}                |                 | 0.6819***       | 0.6621***       |
|                          |                 | (0.1248)        | (0.1253)        |
| age_{91}                 | 0.0096          | 0.0108          |                 |
|                          | (0.0165)        | (0.0165)        |                 |
| TFP_{91}                 |                 | 0.7273**        | 0.7611**        |
|                          |                 | (0.3650)        | (0.3656)        |
| K/L ratio_{91}           |                 | -0.3980***      | -0.4070***      |
|                          |                 | (0.1086)        | (0.1086)        |
| R&D dummy                |                 |                 | 0.1279**        |
|                          |                 |                 | (0.0600)        |
| Industry dummy           | Yes             | Yes             | Yes             |
| R²                       | 0.0055          | 0.0079          | 0.0082          |
| Obs.                     | 24,166          | 23,809          | 23,809          |
Tariff reductions increased skilled-unskilled wage inequality in plants engaged in R&D!

## The Effect of Tariff Reductions on Wage Skill Premium

|                              | Model I        | Model II       | Model III       |
|------------------------------|----------------|----------------|-----------------|
| Constant                     | -0.015***      | -0.007         | -0.394***       |
|                              | (0.006)        | (0.009)        | (0.128)         |
| Output tariff                | 0.138          | 0.035          | 0.011           |
|                              | (0.044)        | (0.048)        | (0.047)         |
| Output tariff * R&D dummy    | -0.119**       | -0.148**       | -0.172***       |
|                              | (0.058)        | (0.066)        | (0.066)         |
| R&D dummy                    | 0.024***       | 0.016          | 0.004           |
|                              | (0.005)        | (0.011)        | (0.011)         |
| Input tariff                 |                | -0.179         | -0.102          |
|                              |                | (0.154)        | (0.152)         |
| Input tariff * R&D dummy     | 0.242          | 0.279          |                 |
|                              | (0.266)        | (0.265)        |                 |
| Plant size                   |                |                | 0.139***        |
|                              |                |                | (0.003)         |
| Skill intensity              |                |                | -0.032***       |
|                              |                |                | (0.004)         |
| Industry dummies             | Yes            | Yes            | Yes             |
| Year dummies                 | Yes            | Yes            | Yes             |
| R²                           | 0.0048         | 0.0055         | 0.0678          |
| Obs.                         | 352,904        | 352,904        | 352,904         |
Broad Policy Implications?

- More liberalized trade and reductions in various trade costs are essential for Korea’s sustained growth.
- Policy coordination/governance might matter.
  - Trade policy should be pursued as part of a broader growth strategy, which requires a coordination among related policies, such as …
    - innovation, financial, competition, human capital, labor market, redistribution, infrastructure policies, among others.
  - Trade liberalization is not just about diplomatic deals.
- Strengthen, and improve the effectiveness of, active labor market policies.
Broad Policy Implications?

- Strengthen, and improve the effectiveness of, the general social protection scheme.
  - Trade adjustment assistance (TAA) program, which targets only at displaced workers by FTA-related increased import competition, discriminates against those who get unemployed due to other causes.

- Reduce various hurdles for SMEs, in particular, to participate in the global economy.
  - Various market imperfections are likely: lack of information on foreign market, credit constraints, not-fully-appropriable learning from global market, etc.
  - Further study on the exact nature of market failures!