Impacts of firm's GVC participation on productivity: A case of Japanese firms

March 28, 2025

Shujiro URATA
RIETI

1. Background and Objective

①Background

- Expansion of GVCs（global value chains）
  - Decline in the cost of conducting trade and foreign direct investment (FDI)
    - Liberalization of trade and FDI policies
    - Technological progress in transportation and communication services
- Japanese firms and GVCs
  - Sharp yen appreciation in the mid-1980s ➔ outward FDI ➔ GVCs
  - Increase in the share of overseas affiliates' sales in parent firms' sales
    - 8.7%（1985）➔ 37.2%（2019）
- Benefits from GVC participation
  - Improvement of performance
    - Specialization based on comparative advantage
    - Efficient use of resources (human, financial, technical resources)
    - Technology transfer from parent firms to affiliates
    - Use of intermediate and capital goods embodied with advanced technology
    - Exposed to competition abroad

② Objective

- Investigate the impact of GVC participation on productivity for Japanese firms

2. Previous Literature

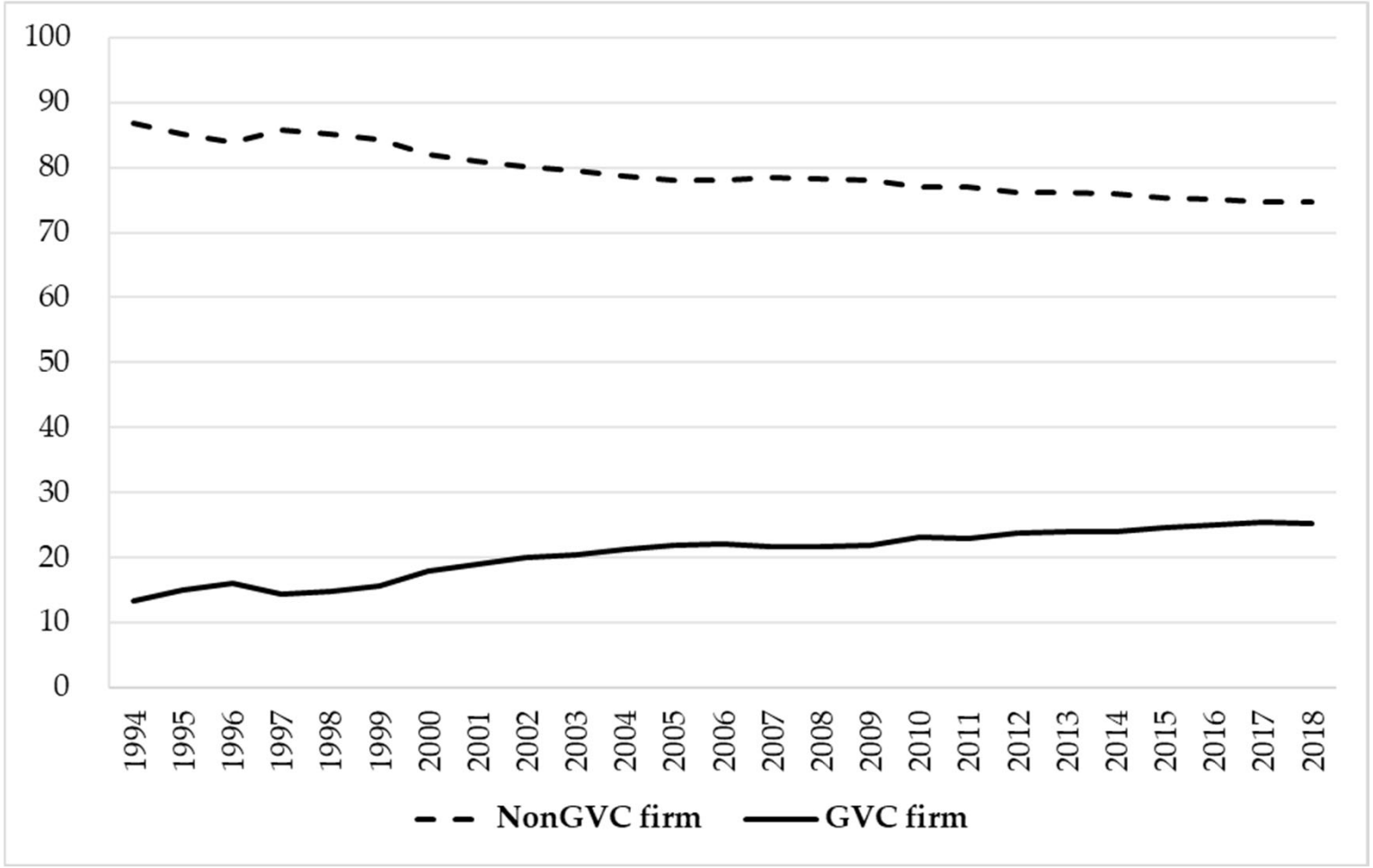
- **Baldwin and Yan (2014)**
  - **Canada's Annual Survey of Manufactures data, 2002-2006**
  - **GVC participation：simultaneous exporting and importing**
  - **GVC participation improves firm's labor productivity**
  - **GVC firms with high-income countries experience higher productivity increase**
- **Del Prete et al. (2017)**
  - **World Bank's Enterprise Surveys data, Egypt and Morocco, 2004 and 2007**
  - **GVC participation: simultaneous exporting and importing, hold internationally recognized quality certificate**
  - **Observes both selection effect (high TFP firms participate in GVC) and learning effect (GVC participation improves TFP)**

2. Previous literature (continued)

- **Lu et al. (2016)**
  - **Chinese Industrial Firm Database and China Customs Import and Export Database from 2000 to 2006**
  - **GVC participation：Foreign value added / Exports (FVAR)**
  - **Inverse-U shape relationship between GVC participation and TFP**
- **Ge et al. (2018)**
  - **Chinese industrial firms Data from the National Bureau of Statistics (NBS) of China and Chinese customs transaction-level trade data from 2000 to 2007**
  - **GVC participation：Foreign value added / Exports (FVAR)**
  - **GVC participation improves TFP**
- **Benkovskis et al. (2019)**
  - **International trade of Latvian firms over the 2006-2014 period and Estonian firms for the 1995-2014 period**
  - **GVC participation: exporting related to GVC such as exporting intermediate goods, re-exporting, exporting services**
  - **GVC participation improves TFP**

3. GVC Participation

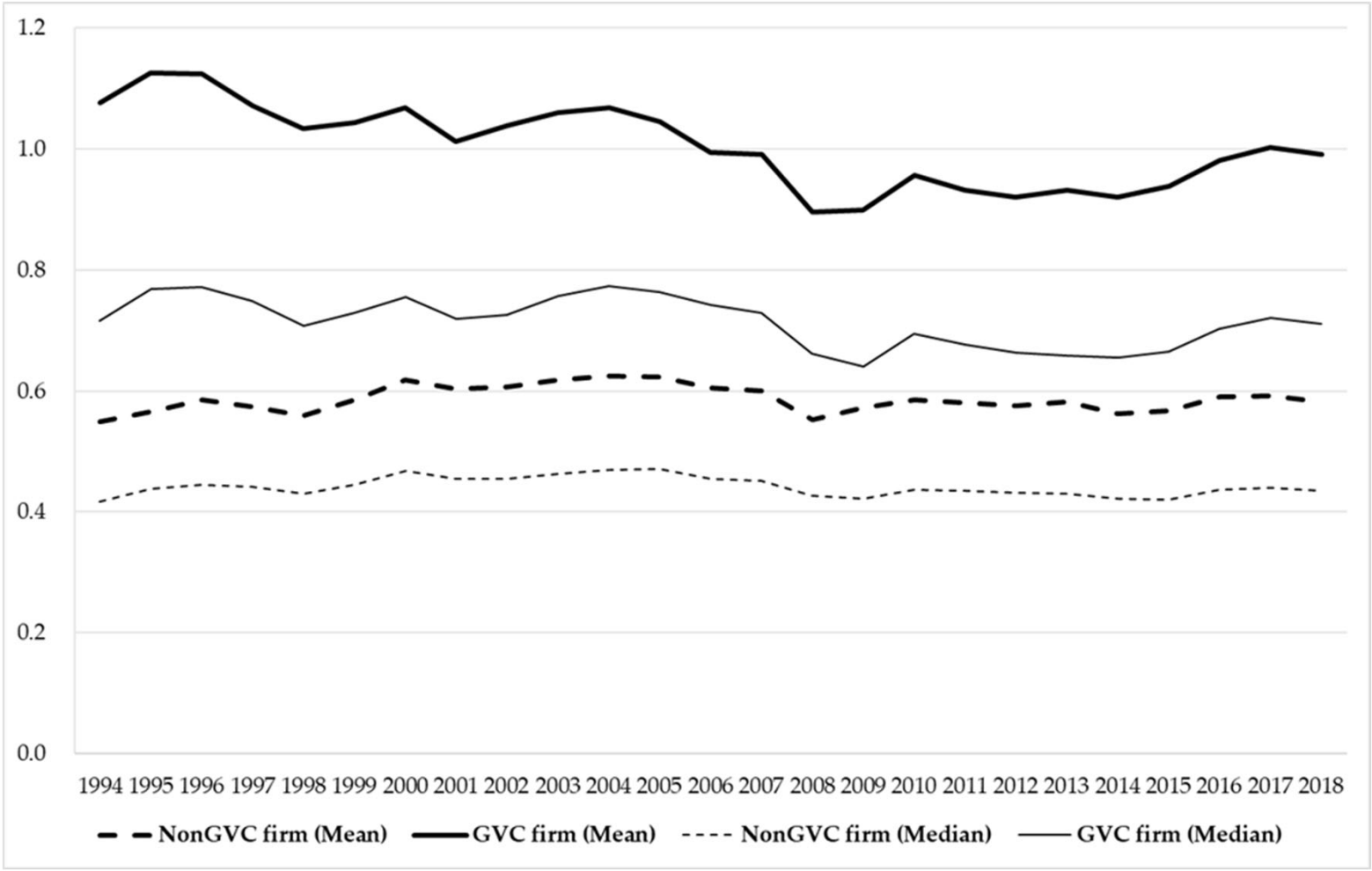
Shares of GVC Firms and Non-GVC Firms in Total Number of Firms(%)



3. GVC Participation by Industry

Code	Japan Standard Industrial Classifica	1994 Number of Firms			Share of GVC Firms (%)	2018 Number of Firms			Share of GVC Firms (%)
		GVC	Non-GVC	Total		GVC	Non-GVC	Total	
9	food	55	1,267	1,322	4.2	112	1,393	1,505	7.4
10	beverages,tobacco and feed	17	205	222	7.7	29	162	191	15.2
11	textile products	66	987	1,053	6.3	84	338	422	19.9
12	lumber and wood products	6	164	170	3.5	16	135	151	10.6
13	furniture and fixtures	19	187	206	9.2	24	92	116	20.7
14	pulp, paper and paper products	30	422	452	6.6	44	334	378	11.6
15	printing and allied industries	6	522	528	1.1	27	486	513	5.3
16	chemical and allied products	256	664	920	27.8	372	528	900	41.3
17	petroleum and coal products	18	41	59	30.5	17	34	51	33.3
18	plastic products	62	576	638	9.7	181	582	763	23.7
19	rubber products	30	120	150	20.0	54	98	152	35.5
20	leather products	8	44	52	15.4	6	12	18	33.3
21	ceramic, stone and clay products	51	594	645	7.9	84	356	440	19.1
22	iron and steel	31	390	421	7.4	56	391	447	12.5
23	non-ferrous metals and products	57	279	336	17.0	100	246	346	28.9
24	fabricated metal products	71	908	979	7.3	198	851	1,049	18.9
25	general-purpose machinery	167	578	745	22.4	210	311	521	40.3
26	production machinery	139	518	657	21.2	423	610	1,033	40.9
27	business oriented machinery	134	341	475	28.2	177	202	379	46.7
28	electronic parts and devices	134	512	646	20.7	209	397	606	34.5
29	electrical machinery	130	691	821	15.8	236	496	732	32.2
30	information and communication electronics equipment	106	410	516	20.5	70	139	209	33.5
31	transportation equipment	154	999	1,153	13.4	346	934	1,280	27.0

3. GVC Firms and TFP



4. Methodology

DID-PSM

- **Compute probability of a firm participating in GVC by using Probit model (compute propensity score)**
  - $Pr(GVC_{it} = 1) = \Phi(\alpha + \beta X_{i,t-1} + \gamma_s)$
    - $X_{i,t-1}$：TFP、Size、Age、Foreign ownership
  - Caliper Matching、Kernel Matching
  - Balancing test
- **DID estimation using matched sample**
  - $Y_i = \alpha + \beta_1 GVC_i * Post_i + \beta_2 GVC_i + \beta_3 Post_i + \gamma_s + \varepsilon_i$
    - Y_i：lnTFP
    - GVC_i：GVC dummy
      - 1：treated group（GVC firm）
      - 0：control group（Non-GVC firm)
    - $Post_i$
      - 1：year t
      - 0：year t-1
    - β_1：impact of GVC participation on TFP

4. Methodology: Variables and Data

- **Productivity (TFP)**
  - **Levinsohn and Petrin (2003)**
  - **Value added = sales – intermediate inputs**
  - **Intermediate inputs = cost of sales ~ (wages + rent + depreciation)**
  - **Tangible fixed assets**
  - **Labor = Number of workers x average working hour（JIP Database 2018）**
  - **Deflators: Output and intermediate deflators (JIP Database 2018) , deflator for capital stock from system of national accounts (SNA).**
- **GVC**
  - **Importing intermediates and exporting (GVC Dummy)**
- **Data**
  - **Basic Survey of Japanese Business Structure and Activities [Kigyo Katsudo Kihon Chosa], Ministry of Economy, Trade and Industry, covering manufacturing firms for 1994–2018**

4. Variables and Data

Industry Classification: 23 Industries

Code	Japan Standard Industrial Classification
9	manufacture of food
10	manufacture of beverages,tobacco and feed
11	manufacture of textile products
12	manufacture of lumber and wood products, except fourniture
13	manufacture of furniture and fixtures
14	manufacture of pulp, paper and paper products
15	printing and allied industries
16	manufacture of chemical and allied products
17	manufacture of petroleum and coal products
18	manufacture of plastic products, except otherwise classified
19	manufacture of rubber products
20	manufacture of leather tanning, leather products and fur skins
21	manufacture of ceramic, stone and clay products
22	manufacture of iron and steel
23	manufacture of non-ferrous metals and products
24	manufacture of fabricated metal products
25	manufacture of general-purpose machinery
26	manufacture of production machinery
27	manufacture of business oriented machinery
28	electronic parts, devices and electronic circuits
29	manufacture of electrical machinery, equipment and supplies
30	manufacture of information and communication electronics equipment
31	manufacture of transportation equipment

Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnTFP	314,713	-0.6712013	0.683	-5.931	3.253
GVC	314,713	0.2044148	0.403	0	1
lnSize	314,713	5.182503	0.980	3.912	11.321
Foreign Firm	314,713	0.0435985	0.204	0	1
Age	314,082	56.03318	18.217	1	176

Correlation Coefficients

	lnTFP	GVC	lnSize	Foreign Firm	age
lnTFP	1				
GVC	0.286	1			
lnSize	0.600	0.287	1		
Foreign Firm	0.309	0.219	0.292	1	
Age	0.160	0.116	0.173	0.046	1

5. Results: Determinants of GVC Participation (Probit)

① Determinants of GVC Participation（Probit estimation）

	base year: 2000				
	1 year	**2 years**	**3 years**	**4 years**	**5 years**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
lnTFP_2000	0.252***	0.291***	0.378***	0.325***	0.297***
	[0.0707]	[0.0843]	[0.0994]	[0.1102]	[0.1158]
Foreign_Firm	0.003	0.134	0.074	0.139	0.205
	[0.1811]	[0.2013]	[0.2326]	[0.2432]	[0.2487]
Age	0.0010	-0.001	0.00002	0.001	-0.00006
	[0.0019]	[0.0022]	[0.0026]	[0.0029]	[0.0031]
lnSize	0.152***	0.153***	0.108*	0.150**	0.158**
	[0.0420]	[0.0492]	[0.0576]	[0.0636]	[0.0674]
Observations	8,523	7,205	4,742	4,178	3,783
Pseudo R-squared	0.0926	0.1106	0.0850	0.0942	0.0923
	base year: 2012				
	1 year	**2 years**	**3 years**	**4 years**	**5 years**
	(6)	**(7)**	**(8)**	**(9)**	**(10)**
lnTFP_2012	0.278***	0.356***	0.362***	0.312***	0.342***
	[0.0624]	[0.0744]	[0.0813]	[0.0862]	[0.0911]
Foreign_Firm	0.00006	0.003	-0.034	0.038	-0.05
	[0.1512]	[0.1703]	[0.1865]	[0.1915]	[0.2044]
Age	0.0020	0.003	0.003	0.004*	0.004*
	[0.0015]	[0.0018]	[0.0019]	[0.0021]	[0.0022]
lnSize	0.001	-0.021	-0.02	-0.002	0.002
	[0.041]	[0.0475]	[0.0516]	[0.0546]	[0.058]
Observations	8,250	7,370	6,737	6,241	5,592
Pseudo R-squared	0.0557	0.0666	0.0721	0.0744	0.0735

5. Results

②GVC Participation and TFP, Baseline Estimations

	base year: 2000					base year: 2012				
	1 year	2 years	3 years	4 years	5 years	1 year	2 years	3 years	4 years	5 years
DID with Original data	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
GVC × Post	-0.000146	0.0131	0.0711**	0.115***	0.132***	0.0309	0.0329*	0.0453***	0.0656***	0.0778**
	[0.0238]	[0.0271]	[0.0332]	[0.0261]	[0.0341]	[0.0180]	[0.0174]	[0.0141]	[0.0191]	[0.0325]
GVC	0.311***	0.342***	0.364***	0.372***	0.357***	0.239***	0.287***	0.296***	0.271***	0.297***
	[0.0384]	[0.0370]	[0.0463]	[0.0435]	[0.0468]	[0.0398]	[0.0456]	[0.0396]	[0.0387]	[0.0445]
Post	-0.0292***	-0.0224**	-0.0147	-0.00991	-0.0120	-0.00202	-0.00935	-0.00676	0.0372**	0.0374*
	[0.0083]	[0.0101]	[0.0123]	[0.0171]	[0.0213]	[0.0059]	[0.0097]	[0.0146]	[0.0155]	[0.0181]
Observations	17298	14920	12898	11728	10616	17030	15218	13944	12906	12064
Adjusted R-squared	0.260	0.248	0.224	0.211	0.197	0.103	0.105	0.109	0.122	0.115
DID with Caliper Matching	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**
GVC × Post	0.0297	0.0322	0.0897***	0.0996***	0.122***	0.0458**	0.0359*	0.0339*	0.0619**	0.0806**
	[0.0176]	[0.0277]	[0.0301]	[0.0325]	[0.0392]	[0.0195]	[0.0201]	[0.0185]	[0.0273]	[0.0323]
GVC	0.0650	0.0273	0.0435	0.0663	0.0300	0.0241	0.0597	0.0701*	0.0617	0.0707
	[0.0415]	[0.0428]	[0.0455]	[0.0548]	[0.0613]	[0.0403]	[0.0375]	[0.0377]	[0.0471]	[0.0550]
Post	-0.0542***	-0.0450*	-0.0283	-0.00794	-0.00346	-0.0177*	-0.0139	0.00191	0.0332	0.0379
	[0.0168]	[0.0240]	[0.0211]	[0.0387]	[0.0434]	[0.0085]	[0.0131]	[0.0180]	[0.0239]	[0.0257]
Observations	2504	1792	1325	1075	1013	2360	1706	1376	1240	1107
Adjusted R-squared	0.334	0.275	0.273	0.228	0.215	0.144	0.151	0.167	0.169	0.219
DID with Kernel Matching	**(21)**	**(22)**	**(23)**	**(24)**	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**
GVC × Post	0.0243	0.0298	0.0888***	0.101***	0.104***	0.0454**	0.0420**	0.0433***	0.0668**	0.0975***
	[0.0186]	[0.0269]	[0.0266]	[0.0315]	[0.0338]	[0.0182]	[0.0187]	[0.0144]	[0.0241]	[0.0334]
GVC	-0.00288	0.0107	0.0279	-0.00887	-0.0151	0.0163	0.0176	0.0229	0.0220	0.0104
	[0.0469]	[0.0393]	[0.0378]	[0.0528]	[0.0446]	[0.0346]	[0.0360]	[0.0464]	[0.0400]	[0.0474]
Post	-0.0550***	-0.0402**	-0.0246	-0.00478	0.0121	-0.0167**	-0.0163	-0.00512	0.0384*	0.0206
	[0.0125]	[0.0156]	[0.0269]	[0.0347]	[0.0396]	[0.0069]	[0.0129]	[0.0151]	[0.0187]	[0.0229]
Observations	15756	12111	8314	7320	6481	16179	13738	12566	11819	10752
Adjusted R-squared	0.328	0.327	0.257	0.256	0.211	0.135	0.183	0.192	0.210	0.232

5. Results

③Summary of DID Results

# of estimations	1 year 24	2 years 23	3 years 22	4 years 21	5 years 20
DID with Original data					
# of positive coefficients	22	22	19	18	18
average	0.023	0.033	0.042	0.050	0.056
maximum	0.060	0.094	0.088	0.122	0.137
minimum	-0.006	-0.003	-0.017	-0.062	-0.017
# of coefficinets with significance	5	6	8	10	8
average	0.040	0.055	0.069	0.083	0.100
maximum	0.060	0.094	0.088	0.122	0.137
minimum	0.021	0.033	0.045	0.051	0.076
DID with Caliper Matching					
# of positive coefficients	23	23	21	19	18
average	0.030	0.039	0.044	0.052	0.058
maximum	0.062	0.102	0.090	0.109	0.131
minimum	-0.003	0.006	-0.010	-0.043	-0.037
# of coefficinets with significance	9	8	7	9	6
average	0.044	0.051	0.063	0.081	0.106
maximum	0.062	0.102	0.090	0.109	0.131
minimum	0.025	0.024	0.034	0.059	0.079
DID with Kernel Matching					
# of positive coefficients	24	23	22	20	20
average	0.031	0.043	0.046	0.055	0.055
maximum	0.062	0.101	0.089	0.136	0.111
minimum	0.002	0.011	0.003	-0.036	0.012
# of coefficinets with significance	9	10	8	8	5
average	0.044	0.053	0.068	0.087	0.099
maximum	0.062	0.101	0.089	0.136	0.111
minimum	0.022	0.039	0.043	0.067	0.080

5. Results

④Robustness Check（GVC Firms for 5 consecutive years）

	base year: 2000					base year: 2012				
	1 year	2 years	3 years	4 years	5 years	1 year	2 years	3 years	4 years	5 years
DID with Original data	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
GVC × Post	-0.0202	0.0148	0.0855**	0.120***	0.132***	0.0443**	0.0412*	0.0550***	0.0656**	0.0778**
	[0.0315]	[0.0285]	[0.0338]	[0.0224]	[0.0341]	[0.0166]	[0.0214]	[0.0194]	[0.0254]	[0.0325]
GVC	0.391***	0.384***	0.373***	0.362***	0.357***	0.305***	0.302***	0.302***	0.299***	0.297***
	[0.0472]	[0.0451]	[0.0456]	[0.0460]	[0.0468]	[0.0452]	[0.0453]	[0.0454]	[0.0450]	[0.0445]
Post	-0.0275***	-0.0203*	-0.0114	-0.00855	-0.0120	-0.000275	-0.00920	-0.00676	0.0383**	0.0374*
	[0.0091]	[0.0102]	[0.0132]	[0.0174]	[0.0213]	[0.0073]	[0.0104]	[0.0152]	[0.0161]	[0.0181]
Observations	10616	10616	10616	10616	10616	12064	12064	12064	12064	12064
Adjusted R-squared	0.257	0.247	0.225	0.211	0.197	0.108	0.109	0.114	0.124	0.115
DID with Caliper Matching	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**
GVC × Post	0.0153	0.0228	0.0956**	0.100***	0.122***	0.0457*	0.0355	0.0431*	0.0560**	0.0806**
	[0.0293]	[0.0306]	[0.0361]	[0.0275]	[0.0392]	[0.0251]	[0.0256]	[0.0246]	[0.0251]	[0.0323]
GVC	0.0346	0.0335	0.0321	0.0325	0.0300	0.0686	0.0701	0.0706	0.0709	0.0707
	[0.0603]	[0.0605]	[0.0610]	[0.0612]	[0.0613]	[0.0553]	[0.0553]	[0.0552]	[0.0553]	[0.0550]
Post	-0.0568***	-0.0261	-0.0190	0.00711	-0.00346	-0.00332	-0.00237	0.00338	0.0407	0.0379
	[0.0118]	[0.0187]	[0.0242]	[0.0375]	[0.0434]	[0.0153]	[0.0191]	[0.0208]	[0.0261]	[0.0257]
Observations	1013	1013	1013	1013	1013	1107	1106	1107	1107	1107
Adjusted R-squared	0.298	0.271	0.241	0.228	0.215	0.208	0.210	0.215	0.229	0.219
DID with Kernel Matching	**(21)**	**(22)**	**(23)**	**(24)**	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**
GVC × Post	0.0114	0.0403	0.0972**	0.0908***	0.104***	0.0576**	0.0501*	0.0596**	0.0735**	0.0975***
	[0.0265]	[0.0300]	[0.0338]	[0.0285]	[0.0338]	[0.0229]	[0.0266]	[0.0252]	[0.0298]	[0.0334]
GVC	-0.0188	-0.0165	-0.0166	-0.0166	-0.0151	0.00881	0.00995	0.0100	0.0102	0.0104
	[0.0456]	[0.0452]	[0.0451]	[0.0450]	[0.0446]	[0.0479]	[0.0477]	[0.0477]	[0.0475]	[0.0474]
Post	-0.0476***	-0.0335*	-0.0192	0.0139	0.0121	-0.0126	-0.0136	-0.00989	0.0331	0.0206
	[0.0106]	[0.0178]	[0.0189]	[0.0335]	[0.0396]	[0.0121]	[0.0154]	[0.0219]	[0.0231]	[0.0229]
Observations	6480	6481	6482	6481	6481	10751	10752	10752	10751	10752
Adjusted R-squared	0.284	0.274	0.251	0.231	0.211	0.214	0.217	0.224	0.239	0.232

6. Conclusions

Summary of results

- High productivity firms have high probability to participate in GVC（Self-Selection）
- Impact of GVC participation on TFP: Out of 110 estimation, most estimated results are positive
  - Approximately 40 % are statistically significant (for the unusual period such as the Global Financial Crisis period, estimates are not significant)
  - GVC participation is likely to improve TFP (learning-by-GVC participation effect）
- GVC learning effect gets magnified over time

Policy implications

- Provide technical assistance
- Facilitate firms to participate in internation trade by
  - providing information on overseas markets
  - establishing FTAs
  - simplifying export procedure

Thank you

Based on the following article.

Shujiro Urata and Youngmin Baek

“Impacts of firm’s GVC participation on productivity: A case of Japanese firms”

Journal of the Japanese and International Economies

Vol. 66, December 2022

https://doi.org/10.1016/j.jjie.2022.101232