II. Analysis using Updated Input-Output Tables

1. Impact of Japanese exports' structural change on domestic production

With increased economic globalization, the economic interdependence between Japan and other countries—especially China and the U.S.—has been growing through trade. How are these shifts and developments in the structure of exports impacting Japanese domestic production?

First, we use the Trade Statistics to gain an overview of the changes in the value of Japanese exports and shifts in its structure between 2000 and 2012. We then conduct a detailed analysis of these changes, using mainly the 2010 Updated Input-Output Table (at constant price) we created (hereafter referred to as the 2010 Updated Table) to understand their impact on domestic production.

Specifically, by capturing the structure of Japanese exports in terms of the composition of destinations (exports by destination) and the composition of commodity exports (exports by sector), we will conduct an analysis that includes the following steps:

(i) Use the composition of destinations and the composition of commodity exports in the Trade Statistics to understand the changes in the value of Japanese exports and the shifts in its structure.

(ii) In order to assess the impact of exports' structural change on domestic production, calculate export ratios, the value of domestic production induced by exports, the production inducement dependency on individual final demand items, and the production inducement coefficient for exports, using data from the 2010 Updated Table, the 2005 Input-Output Table (Basic Table) and the 1995-2000-2005 Linked Input-Output Table, and analyze factors contributing to variations in domestic production induced by exports and production inducement dependency on exports.

In an analysis by destination and by sector, however, a time-series comparison between three individual years is not possible because the 1995-2000-2005 Linked Input-Output Table' statistical concepts, including sector definitions and destination categories, are different from those of the 2005 Input-Output Table and the 2010 Updated Table. As such, we only analyze 2005 and 2010 data.

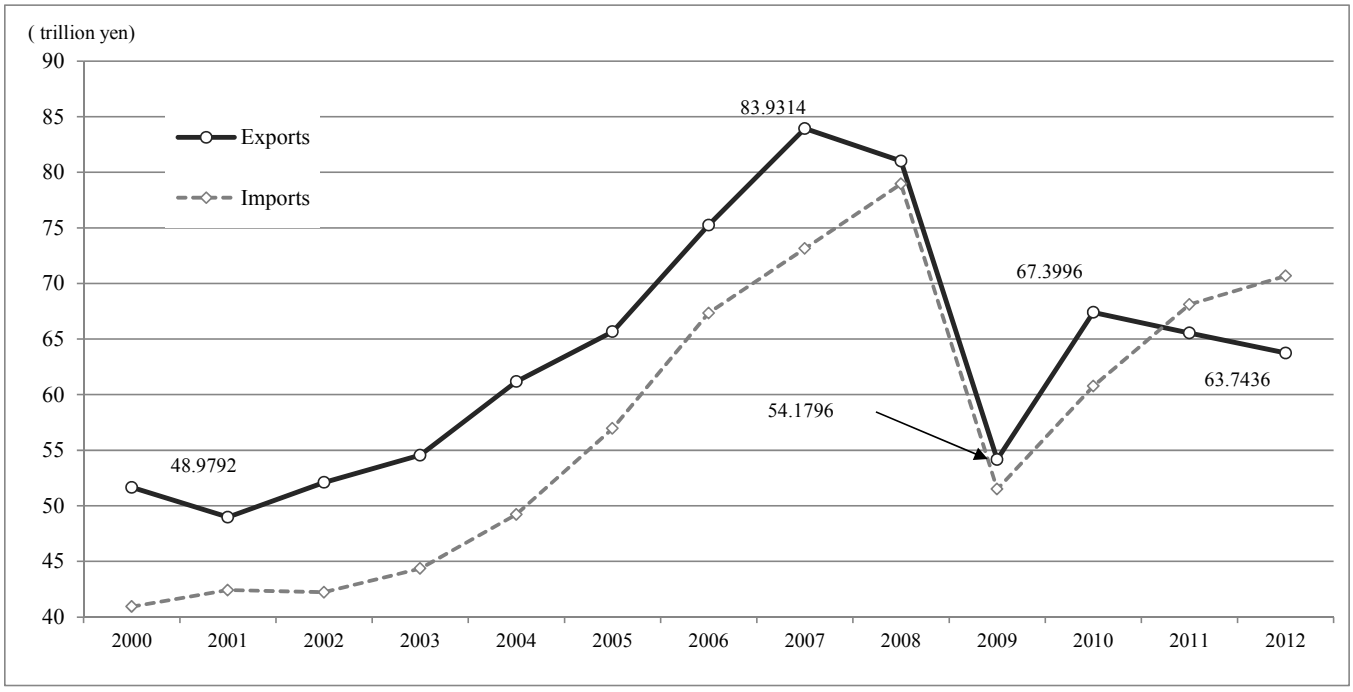
(1) Changes in the value of exports and shifts in its structure as seen in the Trade Statistics

The share of exports to China rises, while the share of exports to the U.S. falls

Looking at changes in the value of Japanese imports and exports between 2000 and 2012 using the Trade Statistics (Figure 1) shows that after hitting bottom at 48.9792 trillion yen in 2001, the value of exports[1] continued to rise until 2007 when it marked 83.9314 trillion yen (1.7 times increase from 2001 to 2007). Affected by the financial shock following the collapse of Lehman Brothers, the value of exports declined for two consecutive years in 2008 and 2009. It began to pick up in 2010 at 67.3996 trillion yen but took a downward turn again in 2011, recording 63.7436 trillion yen in 2012. This was a decrease for the second year in a row.

The value of imports, on the other hand, grew during the period from 2003 to 2008, marking an all-time high in 2008. Hit by the financial shock following the collapse of Lehman Brothers, the value of imports saw a significant drop in 2009—a year later than exports. But it began to rise again in 2010 and continued to grow in 2011 and 2012, marking an increase for the third year in a row.

Figure 1. Changes in imports and exports



Source: Trade Statistics (Ministry of Finance)

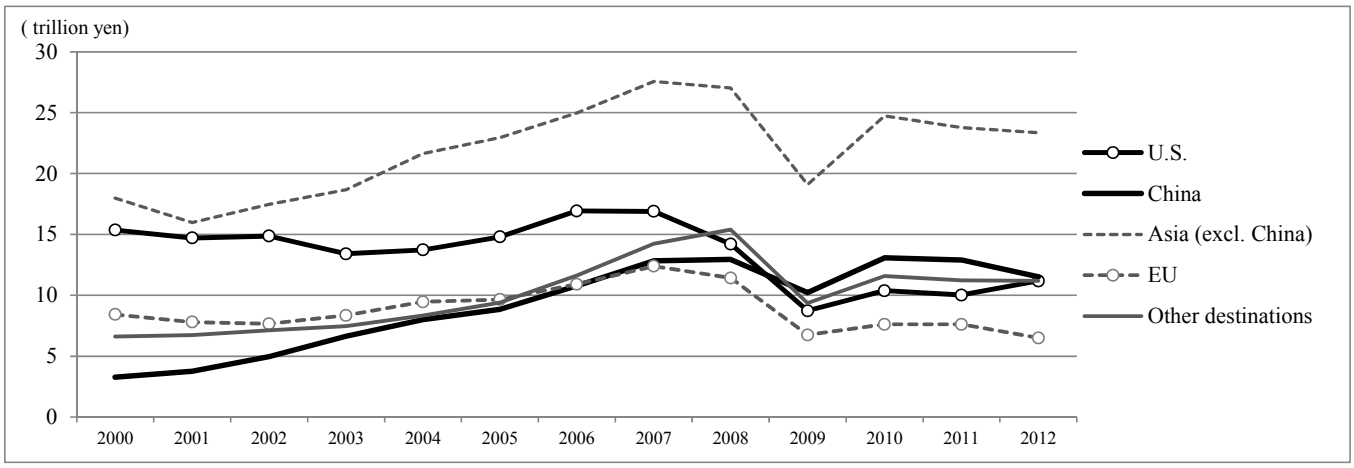
[1] The value of exports in the Trade Statistics corresponds roughly to "ordinary trade" under "exports" (see Note 3, Table 1-1 on Page 2 for the definition) in the Input-Output Tables.

Looking at the changes in the value of Japanese exports by destination between 2000 and 2012 (Figure 2), the value of US-bound exports was the highest in the early years. However, while growth in exports to China, Asia (excluding China), and other destinations was relatively strong between 2002 and 2007, US-bound exports saw slower growth during the same period.

In 2008, growth was only seen in exports to China and those to other destinations. In 2009, while a decline was seen in exports to all destinations, the pace of decline in China-bound exports was smaller than that in exports to other destinations. Helped by these, China-bound exports overtook US-bound exports, marking the highest levels since then.

After exports to all destinations began to pick up in 2010, exports to China, Asia (excluding China), and other destinations fell for two consecutive years in 2011 and 2012. US-bound exports declined in 2011 but rose in 2012. Exports to the EU increased in 2011 but contracted in 2012.

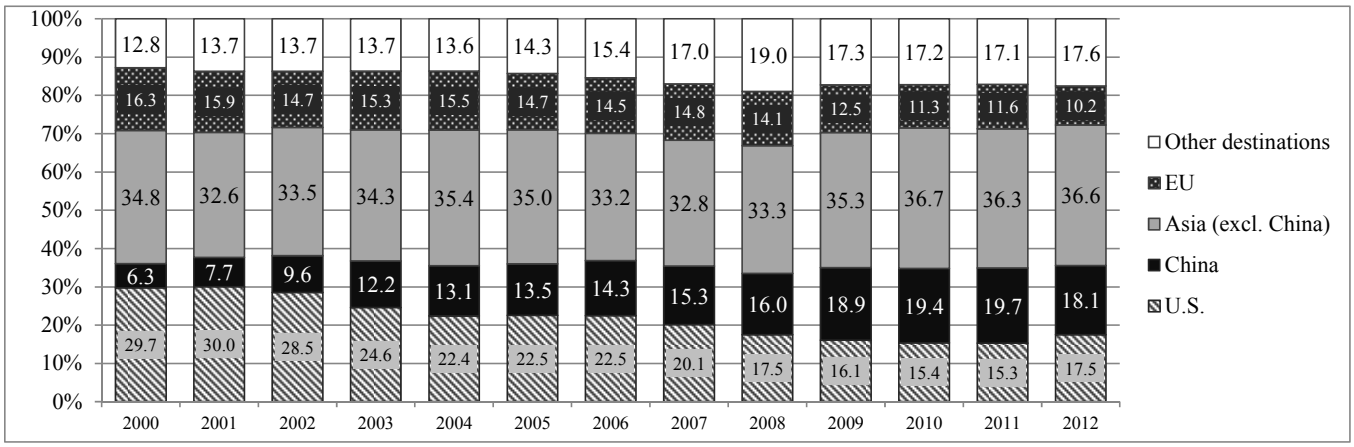
Figure 2. Changes in exports by destination



Source: Trade Statistics (Ministry of Finance)

The changes in the breakdown of exports by destination (Figure 3) shows that during the period from 2000 to 2012, the share of exports to China rose from 6.3% to 18.1%, up 11.9 percentage points, while the share of exports to the U.S. declined from 29.7% to 17.5%, down 12.2 percentage points. In 2009, the share of China-bound exports (18.9%) overtook that of US-bound exports (16.1%).

Figure 3. Changes in the breakdown of exports by destination



Source: Trade Statistics (Ministry of Finance)

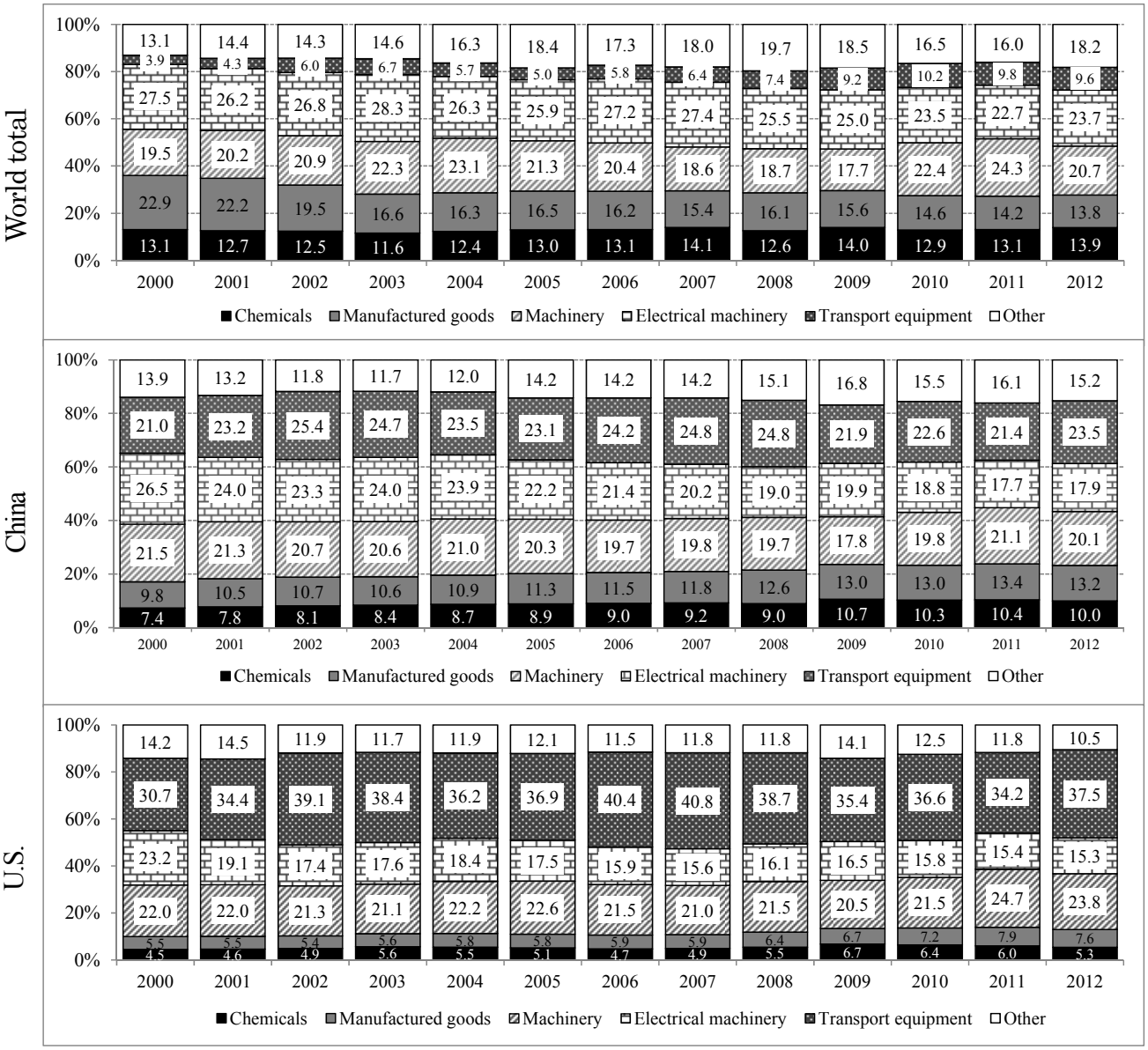
Here we look at the breakdown by commodity of Japanese exports to the world, China and the U.S. between 2000 and 2012 (Figure 4).

The percentage breakdown of the world total shows that over the 12 years, chemicals was up from 7.4% to 10.0%, manufactured goods was up from 9.8% to 13.2%, and transport equipment was up from 21.0% to 23.5%. In contrast, electrical machinery was down from 26.5% to 17.9%, and machinery was down from 21.5% to 20.1%. In 2012, transport equipment (23.5%) accounted for the largest share, followed by machinery (20.1%) and electrical machinery (17.9%).

The percentage breakdown of China-bound exports shows that while chemicals (13.1%) and electrical machinery (27.5%) accounted for large shares in 2000 compared to their respective shares in the world total, transport equipment rose significantly over the 12 years from 3.9% to 9.6%. In 2012, electrical machinery (23.7%) accounted for the largest share, followed by machinery (20.7%) and chemicals (13.9%).

The percentage breakdown of US-bound exports shows that transport equipment, which already accounted for a large share in 2000 at 30.7%, expanded its share to 40.8% in 2007. The breakdown by commodity did not change much over the years. In 2012, transport equipment (37.5%) accounted for the largest share, followed by machinery (23.8%) and electrical machinery (15.3%).

Figure 4. Breakdown by commodity of exports to the world, China and the U.S.



Source: Trade Statistics (Ministry of Finance)

(2) Analysis of the impact of Japanese exports' structural change on domestic production using Input-Output Tables

Here we present a detailed quantitative analysis of the shifts in the structure of Japanese exports observed in the Trade Statistics while taking into account the structural changes in domestic production, using mainly the 2010 Updated Table we created. Unless otherwise specified, "exports" mean "exports (ordinary trade)" below.

First, we look into Japanese exports' impact on domestic production using the 1995-2000-2005 Linked Input-Output Table, the 2005 Input-Output Table, and the 2010 Updated Table.

We then analyze Japanese exports by sector and destination, using the 2005 Input-Output Table (Basic Table)

and the export matrix by destination[2]—which was created by consistently reorganizing the 2010 Updated Table data and the Trade Statistics data in terms of sectors and destinations and putting them into Input-Output Tables. In the export matrix by destination, China-bound exports include those to Hong Kong. This is because the export matrix by destination used to have a destination category "China (including Hong Kong)."

Reorganizing the Trade Statistics data according to the sector classification used in the Updated Input-Output Tables allows for a comprehensive and quantitative analysis of the imports and exports' relationship with domestic production—specifically the impact of changes in Japanese imports and exports and in their structure on domestic production—using the Updated Input-Output Tables. A further breakdown of imports and exports by destination allows for a consistent and quantitative comparative analysis of the changes in imports and exports by destination and the shifts in their structure by destination, using the Updated Input-Output Tables.

Below we present charts that illustrate the changes in exports by destination (Figure 5), the breakdown of exports by destination (Figure 6), and the sector-by-sector breakdown of exports to the world, China and the U.S. (Figure 7), viewed in the export matrix by destination.

Figure 5. Changes in exports by destination

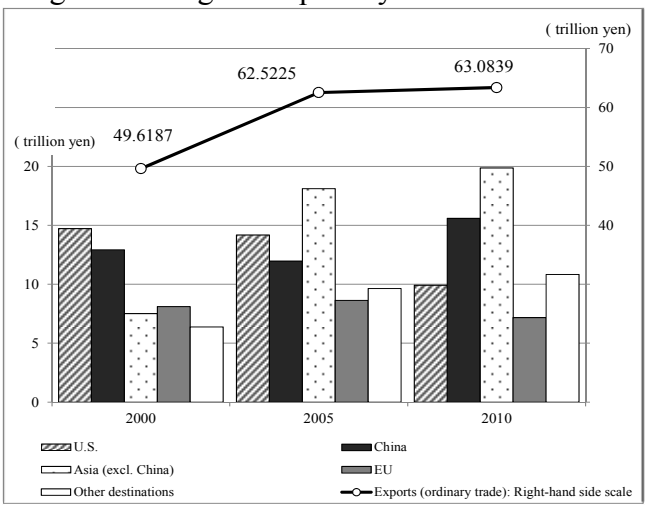
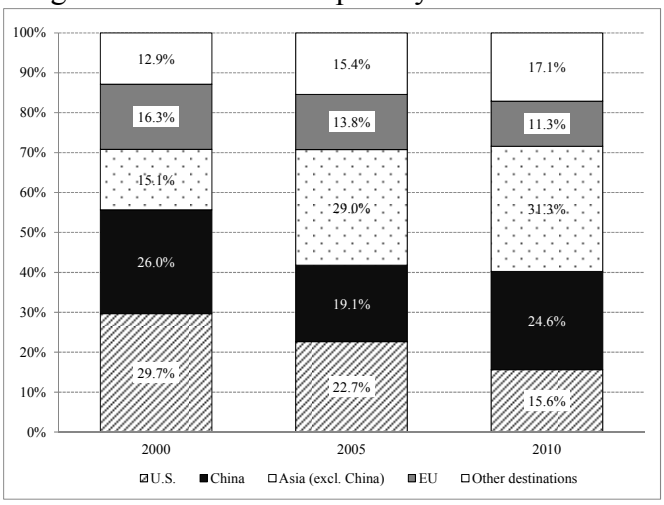


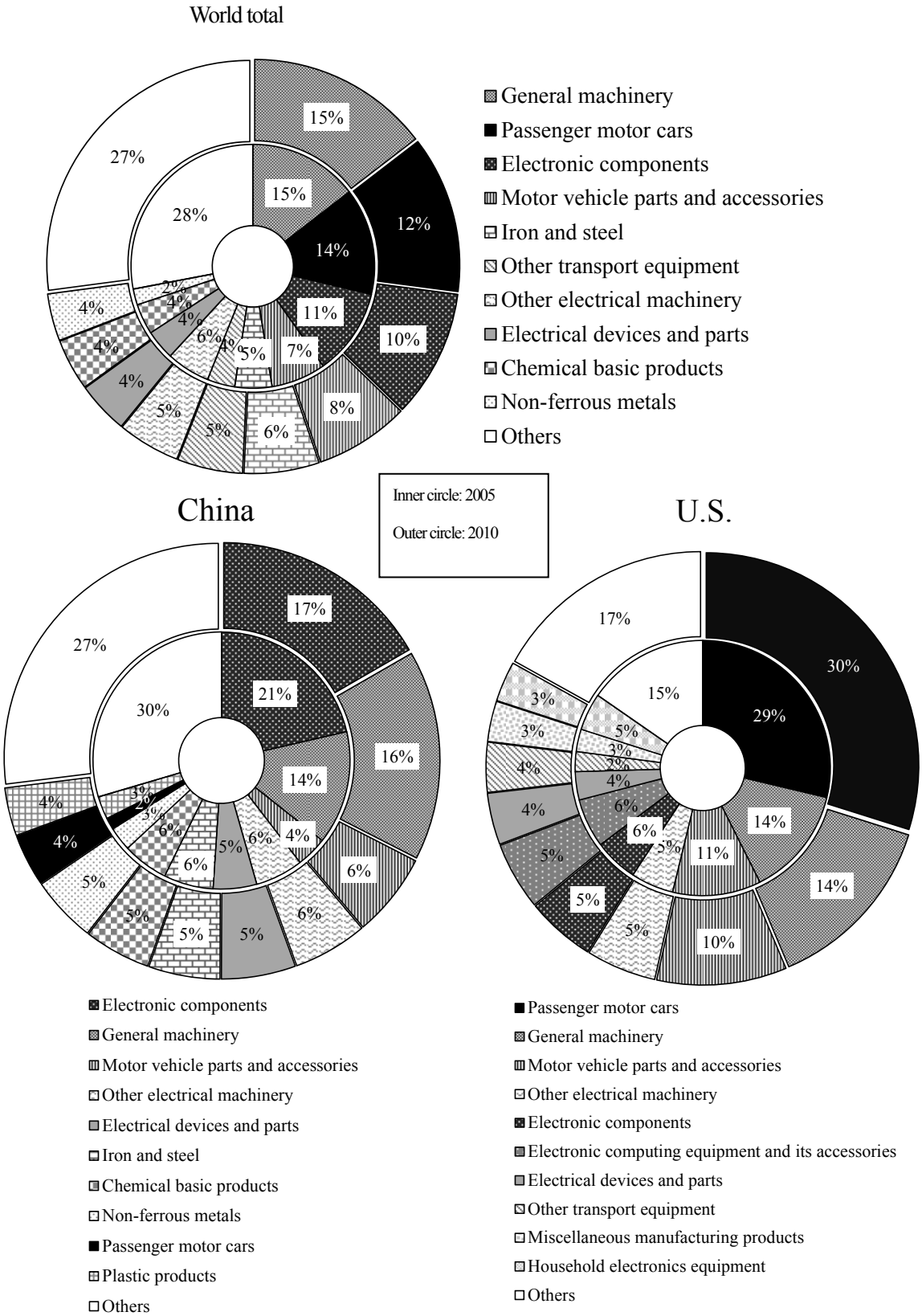
Figure 6. Breakdown of exports by destination



Note: "China" in 2000 data in Figure 5 and Figure 6 includes South Korea and Taiwan. Hong Kong is included in "other destinations."

[2] In creating the export (import) matrix by destination, in order to reorganize the Trade Statistics data according to the concept of the Updated Input-Output Tables, we (1) converted the Trade Statistics' commodity classification into the sector classification used in the Updated Input-Output Tables, (2) excluded used or recycled goods and (3) converted FOB prices into producer's prices, and treated these figures as imports or exports in the Updated Input-Output Tables.

Figure 7. Sector-by-sector breakdown of exports to the world, China and the U.S.



Below, we analyze the impact of exports' structural change on domestic production, using various analytical methodologies used in the Input-Output Tables. Specifically, our analysis involves the following steps:

(i) Calculate the export ratio for total exports and sector-by-sector exports, and analyze the changes in the share of exports in domestic production.

(ii) Calculate the value of domestic production induced by exports, for total exports, sector-by-sector exports and destination-by-destination exports, and analyze the changes in the value of domestic production induced by exports.

(iii) Calculate the production inducement dependency on individual final demand items, and analyze the changes in domestic production's dependence on exports.

(iv) Calculate the production inducement coefficient for exports, for total exports and destination-by-destination exports, and analyze the changes in the size of domestic production induced by an additional unit of exports.

(v) Analyze factors contributing to variations in domestic production induced by exports and break them down into the following categories: "changes in production technology structure," "changes in the scale of exports," "changes in export destination composition" and "changes in export commodity composition," and analyze their respective impact.

(vi) Break down the production inducement dependency on exports into the dependency on destination-by-destination exports and the dependency on sector-by-sector exports, and analyze the changes in them.

1) Export ratio

The share of exports in domestic production increases

The export ratio represents exports as a percentage of domestic production.

Looking at the export ratio for 2000, 2005 and 2010 (Table 1), it continued to rise, reaching 5.8% in 2000, 7.8% in 2005, and 9.1% in 2010. In particular, although domestic production decreased from 947.7022 trillion yen to 888.3810 trillion yen between 2005 and 2010, exports grew from 73.7687 trillion yen to 80.7277 trillion yen, with exports (ordinary trade) up from 62.4766 trillion yen to 69.6718 trillion yen. This shows that the shares of exports and exports (ordinary trade) in domestic production increased.

Table 1. Export ratios

	2000	2005	2010
Export ratio (%)	5.8	7.8	9.1
Exports (100 million yen)	537,912	737,687	807,277
Exports (ordinary trade) (100 million yen)	455,860	624,766	696,718
Domestic production (100 million yen)	9,219,356	9,477,022	8,883,810

Note: "Exports" in this table represent the total of "exports (ordinary trade)," "exports (non-ordinary trade)," "exports (direct purchase)" and "adjustment categories."
The 2000 data is derived from the 1995-2000-2005 Linked Input-Output Table and therefore not based on exactly the same statistical concept.
Export ratio = exports / domestic production

Sector-by-sector export ratios (Table 2) show that compared to 2005, the 2010 export ratio for precision instruments was up 8.1 percentage points, that for plastic products was up 7.9 percentage points, and that for non-ferrous metals was up 7.9 percentage points. In contrast, the 2010 export ratio for household electronics equipment was down 4.5 percentage points, that for machinery for office and service industry was down 2.6 percentage points, and that for reuse and recycling was down 1.9 percentage points.

Table 2. Sector-by-sector export ratios

	Sector	Export ratio (%)		
		2005	2010	2010-2005
Sectors with the largest increase	Precision instruments	37.5	45.7	8.1
	Plastic products	10.4	18.3	7.9
	Non-ferrous metals	16.7	24.7	7.9
	Other cars	35.5	43.3	7.8
	Ceramic, stone and clay products	10.5	18.3	7.8
Sectors with the largest decline	Household electronics equipment	26.0	21.5	-4.5
	Machinery for office and service industry	6.4	3.8	-2.6
	Reuse and recycling	25.5	23.6	-1.9
	Transport	13.9	13.2	-0.7
	Electronic computing equipment and its accessories	60.7	60.2	-0.5

2) Domestic production induced by exports

China-bound exports lead an increase in domestic production induced by exports

Induced domestic production[3] is the value of domestic production induced by final demand. Domestic production induced by exports is calculated by multiplying the inverse matrix coefficients $[I-(I-\hat{M})A]^{-1}$ by the export column vector.

Looking at domestic production induced by exports in 2000, 2005 and 2010 (Table 3), it is on the rise, marking 117.5791 trillion yen in 2000, 141.4317 trillion yen in 2005, and 146.7916 trillion yen in 2010. However, the pace of growth between 2005 and 2010 was 3.8%, a small increase compared to 11.5% growth in exports during the same period.

Table 3. Domestic production induced by exports

	2000	2005	2010	2010/2005 (%)
Induced domestic production (100 million yen)	**1,175,791**	**1,414,317**	**1,467,916**	**3.8**
Exports (100 million yen)	537,912	624,766	696,718	11.5

Note: The 2000 data is derived from the 1995-2000-2005 Linked Input-Output Table and therefore not based on exactly the same statistical concept.

Looking at sector-by-sector domestic production induced by exports (Table 4), sectors that made a positive contribution to growth in 2010 include: electronic components (up 19.3% compared to 2005), iron and steel (up 12.7%) and passenger motor cars (up 8.2%). On the other hand, sectors that made a negative contribution to growth include: motor vehicle parts and accessories (down 3.0%), goods rental and leasing services (down 23.3%) and finance and insurance (down 9.8%).

[3] Domestic production induced by exports was calculated by consolidating the basic sector classification in the 2010 Updated Table into 53 sectors and using the following equation output model that takes into account the self-sufficiency rate: $X=(I-(I-\hat{M})A)^{-1}(\Gamma Y+E)$.

I: Identity matrix, $(I-\hat{M})$: Self-sufficiency rate, $\hat{M}$: Import coefficient matrix, A: Input coefficient matrix,

Y: Domestic final demand, E: Exports, X: domestic production

Table 4. Sector-by-sector domestic production induced by exports

		Induced domestic production (100 million yen)			As a percentage of domestic production (%)		
		2005	2010	2010/2005 (%)	2005	2010	2010-2005
Sectors with the largest increase	Electronic components	105,366	125,665	19.3	65.0	69.4	4.4
	Iron and steel	112,354	126,644	12.7	44.4	52.8	8.5
	Passenger motor cars	75,093	81,278	8.2	51.4	56.5	5.1
	Other business services	40,639	45,358	11.6	9.5	10.3	0.7
	Plastic products	34,682	39,341	13.4	32.6	41.6	9.0
Sectors with the largest decline	Motor vehicle parts and accessories	156,775	152,037	-3.0	54.7	59.7	4.9
	Goods rental and leasing services	15,310	11,743	-23.3	12.7	12.0	-0.6
	Finance and insurance	32,735	29,533	-9.8	7.9	8.4	0.5
	Miscellaneous manufacturing products	19,129	17,263	-9.8	24.5	27.9	3.3
	Other cars	14,191	12,373	-12.8	34.6	42.1	7.4

Next, domestic production induced by exports by destination (Table 5) shows that domestic production induced by China-bound exports increased significantly by 39.7% from 24.9344 trillion yen in 2005 to 34.8219 trillion yen in 2010. In contrast, domestic production induced by US-bound exports decreased considerably by 26.4% from 34.2404 trillion yen in 2005 to 25.2017 trillion yen in 2010, pushing domestic production induced by China-bound exports ahead of domestic production induced by US-bound exports in 2010.

Table 5. Domestic production induced by exports by destination

		Exports (100 million yen)			Induced domestic production (100 million yen)		
		2005	2010	2010/2005 (%)	2005	2010	2010/2005 (%)
Exports		624,766	696,718	11.5	1,414,317	1,467,916	3.8
	China	117,243	173,043	47.6	249,344	348,219	39.7
	U.S.	143,781	114,244	-20.5	342,404	252,017	-26.4

3) Production inducement dependency by final demand item

Domestic production's dependence on exports rises

Production inducement dependency by final demand item is the value of domestic production induced by individual final demand items (consumption, investment and exports) expressed as a percentage of domestic production. It indicates how much of domestic production depends on individual final demand items.

Looking at the production inducement dependency on individual final demand items for 2005 and 2010 (Table 6), the production inducement dependency on domestic final demand—consisting of consumption and investment—declined from 83.0% in 2005 to 81.3% in 2010, down 1.7 percentage points. In contrast, the production inducement dependency on exports rose from 17.0% to 18.7%, up 1.7 percentage points. This indicates that domestic production's dependence on exports is on the rise.

Table 6. Production inducement dependency by final demand item

		Induced domestic production (100 million yen)		Production inducement dependency (%)		
		2005	2010	2005	2010	2010-2005
Domestic final demand		7,864,857	7,224,240	83.0	81.3	-1.7
	Consumption	5,757,460	5,583,640	60.8	62.9	2.1
	Investment	2,107,398	1,640,600	22.2	18.5	-3.8
Exports		1,612,165	1,659,570	17.0	18.7	1.7
	Exports (ordinary trade)	1,414,317	1,467,916	14.9	16.5	1.6
Total final demand		9,477,022	8,883,810	100.0	100.0	0.0

Note: "Exports" in this table represent the total of "exports (ordinary trade)," "exports (non-ordinary trade)," "exports (direct purchase)" and "adjustment categories."

4) Production inducement coefficients for exports

The capacity of exports to induce domestic production declines

Production inducement coefficient for exports is the value of domestic production induced by exports expressed as a percentage of exports. It indicates how much and which sector's domestic production is induced by an additional unit of exports.

The production inducement coefficient for exports (Table 7) marked 2.5793 in 2000, 2.2638 in 2005, and 2.1069 in 2010, with the 2010 figure recording a decrease of 0.1569 points from 2005. This shows that the capacity of exports to induce domestic production is on the decline.

Table 7. Production inducement coefficients for exports

	2000	2005	2010	2010-2005
Production inducement coefficient	**2.5793**	**2.2638**	**2.1069**	**-0.1569**
Induced domestic production (100 million yen)	1,175,791	1,414,317	1,467,916	53,599
Exports (100 million yen)	455,860	624,766	696,718	71,952

Note: The 2000 data is derived from the 1995-2000-2005 Linked Input-Output Table and therefore not based on exactly the same statistical concept.

Production inducement coefficients by final demand item (Table 8) show that although the coefficient for exports fell by 0.1297 points between 2005 and 2010, the coefficient for domestic final demand also declined during the same period, as seen in a decrease of 0.0327 points in the coefficient for consumption and a decrease of 0.1098 points in the coefficient for investment. In 2010, the production inducement coefficient for exports was 2.0558, still maintaining higher level than the coefficient for consumption at 1.5052 and the coefficient for investment at 1.7090.

Table 8. Production inducement coefficients by final demand item

		Production inducement coefficient		
		2005	2010	2010-2005
Consumption		1.5379	1.5052	-0.0327
Investment		1.8187	1.7090	-0.1098
Exports		2.1854	2.0558	-0.1297
	Exports (ordinary trade)	2.2638	2.1069	-0.1569

Note: "Exports" in this table represent the total of "exports (ordinary trade)," "exports (non-ordinary trade)," "exports (direct purchase)" and "adjustment categories."

The import ratio represents imports as a percentage of domestic demand.

Import ratios (Table 9) show that the import ratio for all industries rose from 7.7% in 2005 to 8.4% in 2010, up 0.7 percentage points. The import ratio for the manufacturing industry rose from 15.0% to 17.5%, up 2.5 percentage points.

Production spillover strength is the growth in production of the same or different sector induced directly or indirectly when final demand in one industry increases by one unit. Specifically, it is calculated as the column total of inverse matrix coefficients by sector.

The average production spillover strength for all industries declined by 0.0751 points from 1.9963 in 2005 to 1.9211 in 2010. The average production spillover strength for the manufacturing industry also declined from 2.2055 to 2.0915, marking a decrease of 0.1141 points.

A rise in the rate of import goods inputs—imported goods as a percentage of intermediate inputs by each industry—triggered by an increase in the import ratio pushes down production spillover strength. As such, the manufacturing industry, whose rate of import goods inputs is generally higher than that of other industries, sees a larger increase in the rate of import goods inputs and a bigger fall in the production spillover strength when the import ratio rises.

The major factor contributing to such decline in the production inducement coefficient for exports in 2010 compared to 2005 is thought to be the increase in imports.

Table 9. Changes in import ratios and average production spillover strength

		2005	2010	2010-2005
All industries	Average production spillover strength	1.9963	1.9211	-0.0751
	Import ratio (%)	7.7	8.4	0.7
Manufacturing industry	Average production spillover strength	2.2055	2.0915	-0.1141
	Import ratio (%)	15.0	17.5	2.5

Note: Import ratio = (imports (ordinary trade) + imports (non-ordinary trade) + imports (direct purchase) + customs duties + duty on imported goods) / total domestic demand
The manufacturing industry covers sectors from "04. Beverages and foods" to "34. Reuse and recycling" in the 53 sectors used in the Updated Input-Output Tables.

Production inducement coefficients for exports by destination (Table 10) shows that the coefficient for China-bound exports fell from 2.1267 in 2005 to 2.0123 in 2010. The coefficient for US-bound exports also declined from 2.3814 to 2.2060. The pace of decline in the coefficient for US-bound exports was 0.1755 points, whereas that for China-bound exports was 0.1144 points, a smaller decrease than US-bound exports. This shows that although the coefficient for US-bound exports is still higher than that for China-bound exports, the gap between the two is narrowing.

Table 10. Production inducement coefficients for exports by destination

		Production inducement coefficient		
		2005	2010	2010-2005
Exports		2.2638	2.1069	-0.1569
	China	2.1267	2.0123	-0.1144
	U.S.	2.3814	2.2060	-0.1755

5) Analysis of factors contributing to variations in domestic production induced by exports

Changes in the scale of exports and in export commodity composition pushes up domestic production induced by exports

Here we decompose the factors contributing to variations in domestic production induced by exports into "changes in production technology structure" and "changes in export structure." The changes in export structure consist of "changes in the scale of exports," "changes in export destination composition" and "changes in export commodity composition" (see Annotation 2 for the factor decomposition method). (Table 11)

Domestic production induced by exports in 2010 grew 3.8% from 2005. Each factor's degree of contribution to the growth from 2005 (referred to as "contribution" in Section II.1. below) shows that the changes in production technology structure made a negative contribution of 6.7% while the changes in export structure made a positive contribution of 11.4%. Of the changes in export structure, the changes in the scale of exports made a positive contribution of 11.5%, the changes in export commodity composition made a positive contribution of 0.6%, and the changes in export destination composition made a negative contribution of 0.7%.

These findings reveal that the biggest factor contributing to the growth in domestic production induced by exports between 2005 and 2010 was the changes in the scale of exports—an increase in exports. The second biggest factor was the changes in export commodity composition. In contrast, the changes in production technology structure and the changes in export destination composition made a negative contribution to the growth in domestic production induced by exports.

Table 11. Factors contributing to variations in domestic production induced by exports

	2010-2005 (100 million yen)	Contribution to growth from 2005 (%)
Induced domestic production	**53,599**	**3.8**
Changes in production technology structure	**-94,774**	**-6.7**
Changes in export structure	**160,613**	**11.4**
Changes in the scale of exports	**162,883**	**11.5**
Changes in export destination composition	**-10,070**	**-0.7**
Changes in export commodity composition	**7,800**	**0.6**
Confounding item	**-12,241**	**-0.9**

Looking at China-bound exports and US-bound exports as a component of the changes in export destination composition (Table 12), which made a negative 0.7% contribution to the growth in domestic production induced by exports, shows that China-bound exports made a positive contribution of 5.7% while US-bound exports made a negative contribution of 7.0%. This reflects the impact caused by the drop in US-bound exports that surpasses the impact generated by the increase in China-bound exports. As seen in these results, Japanese exports' shift from the U.S. to China not only changed their respective share in Japanese exports but also had an impact on the capacity of exports to induce domestic production.

Table 12. Impact of changes in export destination composition

	2010-2005 (100 million yen)	Contribution to growth from 2005 (%)
Induced domestic production	53,599	3.8
Changes in export destination composition	-10,070	-0.7
China	**80,665**	**5.7**
U.S.	**-98,436**	**-7.0**

Next, looking at China-bound exports and US-bound exports as a component of the changes in export commodity composition (Table 13), which made a positive 0.6% contribution to the 3.8% growth in domestic production induced by exports, shows that both China-bound exports and US-bound exports made a positive contribution of 0.3% and 0.1%, respectively.

Breaking down the changes in export commodity composition by sector reveals that China-bound exports saw a clear shift from raw material products to processed and assembled products. Sectors that made a negative contribution include: "chemical basic products," "textile products" and "iron and steel." Sectors that made a positive contribution were those with high production spillover strength, including "motor vehicle parts and accessories," "passenger motor cars" and "general machinery." In US-bound exports, on the other hand, the top position both in sectors that made the largest positive contribution to growth and that made the largest negative contribution to growth was held by the processed and assembled products sectors such as "passenger motor

cars" and "general machinery." Unlike China-bound exports, no shift from commodities with low production spillover strength to those with high strength was seen in US-bound exports. It is considered that the changes in export commodity composition therefore do not affect very much its impact on domestic production, making its contribution to growth smaller.

Table 13. Impact of changes in export commodity composition

				2010-2005 (100 million yen)	Contribution to growth from 2005 (%)	Production spillover strength 2010
Induced domestic production				53,599	3.8	–
Changes in export commodity composition				7,800	0.6	–
	China			**4,673**	**0.3**	**–**
		Up	Motor vehicle parts and accessories	**6,499**	**0.5**	**2.6680**
			Passenger motor cars	**2,726**	**0.2**	**2.8160**
			General machinery	**2,268**	**0.2**	**2.0340**
		Down	Chemical basic products	**-2,232**	**-0.2**	**2.1883**
			Textile products	**-1,854**	**-0.1**	**2.0467**
			Iron and steel	**-1,840**	**-0.1**	**2.5971**
	U.S.			**1,780**	**0.1**	**–**
		Up	Passenger motor cars	**3,410**	**0.2**	**2.8160**
			Electronic components	**2,509**	**0.2**	**1.8702**
			Electronic computing equipment and its accessories	**2,029**	**0.1**	**1.7588**
		Down	General machinery	**-3,695**	**-0.3**	**2.0340**
			Motor vehicle parts and accessories	**-2,841**	**-0.2**	**2.6680**
			Other cars	**-2,185**	**-0.2**	**2.8355**

6) Production inducement dependency on exports

Domestic production's dependence on China-bound exports rises

Production inducement dependency by final demand item revealed domestic production's growing dependence on exports. Here we look into how the production inducement dependency on exports changed over the years between 2005 and 2010 by breaking down the index by destination and sector.

Looking at production inducement dependency on exports by destination (Table 14), the production inducement dependency on China-bound exports rose by 1.3 percentage points from 2.6% in 2005 to 3.9% in 2010 while the production inducement dependency on US-bound exports declined by 0.8 percentage points from 3.6% to 2.8%. In 2010, the dependence on China-bound exports overtook the dependence on US-bound exports, implying domestic production's growing dependence on China-bound exports.

Table 14. Production inducement dependency on exports by destination

		Induced domestic production (100 million yen)		Production inducement dependency (%)		
		2005	2010	2005	2010	2010-2005
Exports		1,414,317	1,467,916	14.9	16.5	1.6
	China	**249,344**	**348,219**	**2.6**	**3.9**	**1.3**
	U.S.	**342,404**	**252,017**	**3.6**	**2.8**	**-0.8**

Looking at sector-by-sector production inducement dependency on exports in 2005 and 2010, the top five sectors with the highest production inducement dependency on exports are "electronic components," "synthetic resins," "motor vehicle parts and accessories," "electronic computing equipment and its accessories" and "chemical basic products" in both years (Table 15).

Sectors that saw a substantial change in their production inducement dependency on exports between 2005 and 2010 include "ceramic, stone and clay products," "mining," "plastic products," "synthetic resins" and "iron and steel" (Table 16).

Looking at these sectors in terms of their dependence on exports to China and the U.S., all the sectors saw a rise in their production inducement dependency on China-bound exports in 2010 compared to 2005, whereas all the sectors but "ceramic, stone and clay products" saw a decline in their production inducement dependency on US-bound exports.

One of the factors behind the rise in Japan's production inducement dependency on exports is rising production inducement dependency on China-bound exports in a wide range of sectors. This can be seen in the fact that 49 out of 53 sectors—including sectors that have particularly high production inducement dependency on exports such as "electronic components" and "synthetic resins" and sectors that saw a rise in their production inducement dependency on exports such as "ceramic, stone and clay products" and "mining"—saw a rise in their production inducement dependency on China-bound exports.

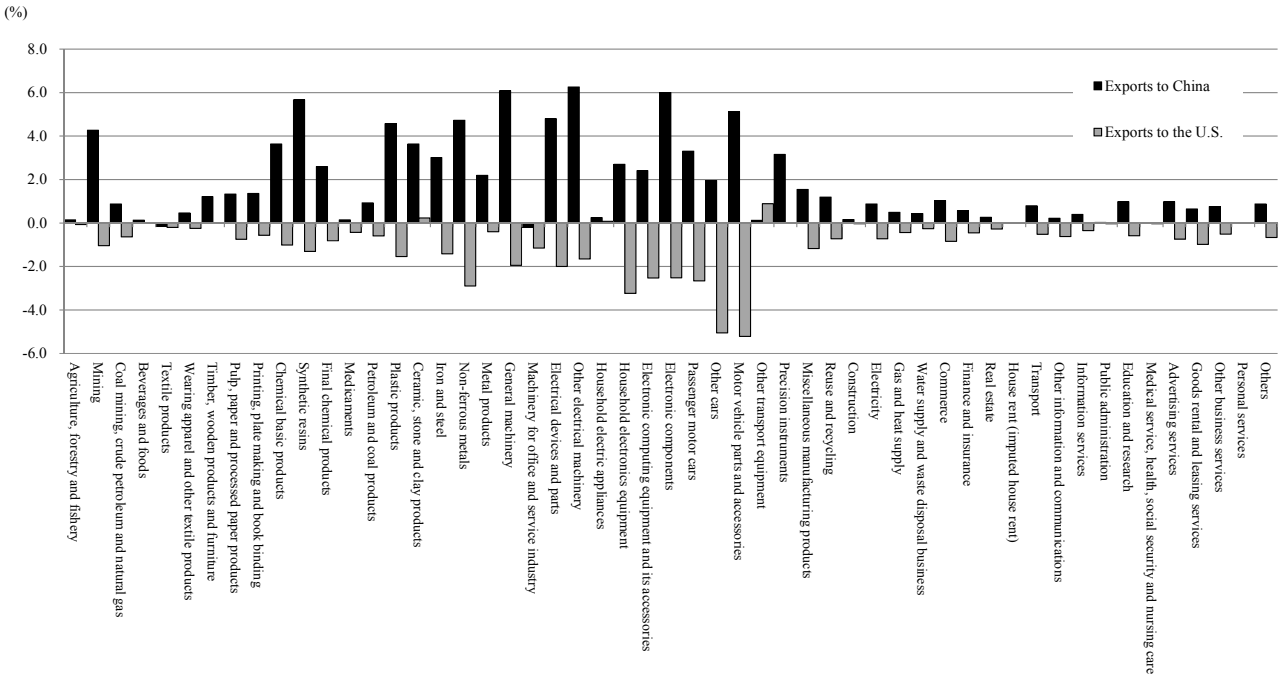
Table 15. Production inducement dependency on exports by sector and destination
(Top sectors in 2010)

Sector/Destination		Production inducement dependency (%)				
		Rank	2005	Rank	2010	2010-2005
Electronic components		1	65.0	1	69.4	4.4
	China		19.6		25.6	6.0
	U.S.		10.1		7.6	-2.5
Synthetic resins		3	51.6	2	60.5	8.9
	China		16.2		21.9	5.7
	U.S.		7.4		6.1	-1.3
Motor vehicle parts and accessories		5	54.7	3	59.7	4.9
	China		3.1		8.2	5.1
	U.S.		21.2		16.0	-5.2
Electronic computing equipment and its accessories		4	59.5	4	58.8	-0.8
	China		10.2		12.6	2.4
	U.S.		20.2		17.7	-2.5
Chemical basic products		2	50.8	5	56.5	5.7
	China		13.4		17.0	3.6
	U.S.		6.9		5.9	-1.0

Table 16. Production inducement dependency on exports by sector and destination
(Top sectors with the biggest difference between 2005 and 2010)

Sector/Destination		Production inducement dependency (%)		
		Rank	2010-2005	2010
Ceramic, stone and clay products		1	12.1	35.7
	China		3.6	—
	U.S.		0.2	—
Mining		2	10.7	47.0
	China		4.3	—
	U.S.		-1.0	—
Plastic products		3	9.0	41.6
	China		4.6	—
	U.S.		-1.5	—
Synthetic resins		4	8.9	60.5
	China		5.7	—
	U.S.		-1.3	—
Iron and steel		5	8.5	52.8
	China		3.0	—
	U.S.		-1.4	—

Figure 8. Production inducement dependency on exports by sector
(Difference between 2005 and 2010)



(3) Summary

According to the Trade Statistics, after seeing growth between 2002 and 2007, the value of Japanese exports, hurt by the financial shock following the collapse of Lehman Brothers, fell in 2008 and 2009. Although it began to rise again in 2010, it declined in 2011 and 2012. During this period, Japanese exports saw a structural change in which the share of exports to China increased while that of US-bound exports decreased. An analysis of its impact on domestic production, using data including the 2010 Updated Table, found out the following:

(i) As exports grew irrespective of the changes in the value of domestic production, the export ratio, which represents exports as a percentage of domestic production, continued to rise, marking 5.8% in 2000, 7.8% in 2005, and 9.1% in 2010.

(ii) In 2010, domestic production induced by exports—a value that shows how much domestic production was induced by exports—grew 3.8% from 2005. By sector, "electronic components," "iron and steel" and "passenger motor cars" recorded an increase. By destination, exports to the U.S. declined significantly while those to China saw a large increase. In 2010, domestic production induced by China-bound exports overtook that by US-bound exports. This shows China-bound exports' growing impact on Japan's domestic production.

(iii) Looking at production inducement dependency by final demand item, which indicates how much of domestic production depends on individual final demand items, shows that domestic production's dependence on exports in 2010 increased from 2005 but its dependence on consumption and investment—the components of domestic final demand—decreased.

(iv) The production inducement coefficient that indicates how much domestic production was induced by an additional unit of exports shows that although the coefficient for exports in 2010 declined from 2005, it still maintained higher level than the coefficients for consumption and investment—the components of domestic final demand. The decreases in the production inducement coefficients were largely due to domestic products' declining production spillover strength caused by rising import ratios.

(v) An analysis of factors contributing to the increase in domestic production induced by exports mentioned in (ii) above found out that the biggest factor was the changes in the scale of exports, caused by increased exports. The second biggest factor was the changes in export commodity composition, driven by China-bound exports' shift to commodities produced by sectors with high production spillover strength, including "motor vehicle parts and accessories" and "passenger motor cars." An analysis of factors contributing to the decrease in domestic production induced by exports, on the other hand, found out that the biggest factor was the changes in production technology structure, caused by rising import ratios. The second biggest factor was the changes in export destination composition, caused by an increase in China-bound exports and a decrease in US-bound exports.

(vi) A breakdown by sector and destination of factors contributing to the increase in production inducement dependency on exports mentioned in (iii) above revealed that many sectors, including those with high production inducement dependency on exports such as "electronic components" and "synthetic resins" and those that saw a rise in their production inducement dependency on exports such as "ceramic, stone and clay products" and "mining," increased their dependence on China-bound exports but cut their dependence on US-bound exports.

Annotation 2 Model Equation to Analyze Factors Contributing to Variations in Production (Exports)

1. Basic model to analyze factors contribution to variations

The basic model to analyze factors contribution to variations is as explained in Annotation 1. Annotation 2 will discuss a model that only involves exports among other final demand components.

Equation (1) is the basic equation of the equation output model (same as in Annotation 1).

Explanation of symbols

X : Domestic production, M : Imports, E : Exports, Y : Domestic final demand, A : Input coefficients, I : Identity matrix

$$X = [I - (I - \hat{M})A]^{-1}[(I - \hat{M})Y + E] \quad \text{.....(1)}$$

For the sake of convenience in explanation, we here call the inverse matrix coefficients in equation (1) $[I - (I - \hat{M})A]^{-1}$ "production technology structure" and express it as *(B)* and define final demand for domestic products as *(F)*. Induced domestic production *(X)* can be $[(I - \hat{M})Y + E]$ obtained by multiplying production technology structure *(B)* by final demand for domestic products *(F)* as shown in equation (2) below:

$$X = BF \quad \text{.....(2)}$$

Of equation (2), domestic production induced only by exports *(E)* can be obtained by equation (3) below:

$$X_E = BE \quad \text{.....(3)}$$

Thus, if we define the variations in domestic production induced by exports between Year *o* (base year: 2005 for example) and Year *t* (year to be compared: 2010 for example) as ΔX_E, the variations in exports as ΔE, the variations in the production technology structure of domestic products as ΔB, equation (3) can be resolved as follows and equation (4) can be obtained by simplifying it.

Explanation of symbols

X_E : Domestic production induced by exports, o : Base year, t : Year to be compared, Δ : Variations

Base year: $X_E^0 = B^o E^o$

Year to be compared: $X_E^t = B^t E^t = (B^o + \Delta B)(E^o + \Delta E)$

Variations in domestic production: $\Delta X_E = X_E^t - X_E^0$

$$= B^t E^t - B^o E^o$$

$$= (B^o + \Delta B)(E^o + \Delta E) - B^o E^o$$

$$\therefore \quad \Delta X_E = B^o \Delta E + \Delta B E^o + \Delta B \Delta E \quad \text{.....(4)}$$

The definitions in equation (4) are as follows:

The first term on the right-hand side $B^o \Delta E$:	variations caused by changes in exports
The second term on the right-hand side $\Delta B E^o$:	variations caused by changes in production technology structure
The third term on the right-hand side $\Delta B \Delta E$:	variations caused by simultaneous changes in the two factors above (confounding item)

2. Decomposition of factors contributing to the value of exports

Explanation of symbols

c : Distribution matrix (commodity composition of exports by destination)

e : Distribution coefficient row vector

(Composition ratio of the column total of exports by destination to the total value of exports)

$\hat{e}$: Diagonal matrix that has elements of e as the diagonal elements

ϕ : Total value of exports (scalar)

Using the three factors c, $\hat{e}$ and ϕ, exports of domestic products E can be expressed as follows in equation (5):

$$E = c\hat{e}\phi \quad \text{.....(5)}$$

Thus, variations (ΔE) in exports of domestic products E can be resolved as follows in equation (6):

Base year: $E^o = c^o \hat{e}^o \phi^o$

Year to be compared: $E^t = c^t \hat{e}^t \phi^t$

Variations:

$$\begin{aligned}\Delta E &= E^t - E^o \\ &= c^t \hat{e}^t \phi^t - c^o \hat{e}^o \phi^o \\ &= (c^o + \Delta c)(\hat{e}^o + \Delta \hat{e})(\phi^o + \Delta \phi) - c^o \hat{e}^o \phi^o \\ \therefore \quad \Delta E &= c^o \hat{e}^o \Delta \phi + c^o \Delta \hat{e} \phi^o + \Delta c \hat{e}^o \phi^o \\ &\quad + (c^o \Delta \hat{e} \Delta \phi + \Delta c \hat{e}^o \Delta \phi + \Delta c \Delta \hat{e} \phi^o + \Delta c \Delta \hat{e} \Delta \phi) \quad \text{.....(6)}\end{aligned}$$

Further details of the factors contributing to variations in domestic production can be obtained by substituting equation (5) into the first term on the right-hand side of equation (3) above.

(Same as (4) above) $\Delta X_E = B^o \Delta E + \Delta B E^o + \Delta B \Delta E$ .....(4)

$$\begin{aligned}\therefore \Delta X_E = {} & B^o c^o \hat{e}^o \Delta \phi + B^o c^o \Delta \hat{e} \phi^o + B^o \Delta c \hat{e}^o \phi^o + \Delta B E^o \\ & + \left\{ \begin{array}{l} (B^o c^o \Delta \hat{e} \Delta \phi + B^o \Delta c \hat{e}^o \Delta \phi + B^o \Delta c \Delta \hat{e} \phi^o + \Delta B c^o \hat{e}^o \Delta \phi + \Delta B c^o \Delta \hat{e} \phi^o \\ + \Delta B \Delta c \hat{e}^o \phi^o) + (B^o \Delta c \Delta \hat{e} \Delta \phi + \Delta B c^o \Delta \hat{e} \Delta \phi + \Delta B \Delta c \hat{e}^o \Delta \phi + \Delta B \Delta c \Delta \hat{e} \phi^o) \\ + (\Delta B \Delta c \Delta \hat{e} \Delta \phi) \end{array} \right\}\end{aligned}$$

.....(7)

The definitions in equation (7) are as follows:

The first term on the right-hand side $B^o c^o \hat{e}^o \Delta \phi$:	variations caused by changes in the scale of exports
The second term on the right-hand side $B^o c^o \Delta \hat{e} \phi^o$:	variations caused by changes in export destination composition
The third term on the right-hand side $B^o \Delta c \hat{e}^o \phi^o$:	variations caused by changes in export commodity composition
The fourth term on the right-hand side $\Delta B E^o$:	variations caused by changes in production technology structure
{ } in the fifth term on the right-hand side:	Variations caused by simultaneous changes in two or more of the four factors above (confounding item)