

# **Comparative Trade Opening Among the G7: Middle Goods and the Integration of Developing Economies**

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## **Abstract**

The fragmentation of manufacturing in G7 economies has substantially altered the way in which developing countries participate in world trade and production. Commodity chains and intertwined production networks have become increasingly important as vectors for the diffusion of technology and integration of developing countries into the world economy.

We establish a set of simple and transparent benchmarks to compare and contrast the speed and extent to which production networks have integrated each of the G7 with developing economies through the importation of intermediate goods and examine these comparative indicators of G7 integration at both regional and global levels.

We examine both total and middle goods trade flows extracted from the UN's COMTRADE database and calculate the income-expenditure elasticity of developing-country sourced imports with respect to G7 incomes and also the elasticity of imported middle goods with respect to the value of manufactured output. Within the G7, we find three tiers of openness to developing middle goods, led by Germany and the US. Regional integration exhibits a clear pattern in which Central Europe appears to be integrating with developed Europe, Mexico with North America, and only East Asia is simultaneously integrating with North America, Europe and Japan.

JEL F15, O19, F23, L60

**Keywords:** Economic Integration, International Linkages to Development, Intermediate Goods, Vertical Specialization

#### I) Economic integration and vertical specialization

The precipitous decline in international trade during the 2008-2009 recession, with an anticipated 9 percent reduction in trade in 2009 (WTO, 2009), when world GDP is expected decline by 1 to 2 percent, has highlighted the international fragmentation of the value chain. The traditional trade model has countries specializing in, and exporting, products in which they have a comparative advantage, on the basis of factor endowment; the traded products are produced entirely within one country. A great deal of trade today, however, involves countries specializing in processes, or different stages in the production (Feenstra, 1998). A product, therefore, can cross borders several times before reaching its final user (Trefler, 1995), and the recorded value of such trade can be considerably greater than the value of the final product. Thus, world trade grew considerably faster than GDP in almost every year during the period 1990-2007, and fell faster in 2008-2009.

The rapid rise of international trade in the 1990's was accompanied by a wide-ranging resurgence of empirical work on trade's role in regional as well as global economic integration (Rogoff 2005). Both the volume and the variety of goods traded rose (both absolutely and relative to most national incomes) creating new export opportunities that appeared to be directly related to the fragmentation of manufacturing into an internationally dispersed network of activities.<sup>1</sup>

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<sup>1</sup> For recent surveys see Karras, G. and A. Submitter (2008). "Trade Openness and Economic Growth: Can We Estimate the Precise Effect?" Applied Econometrics and International Development, Vol. 3, No. 1, 2003, and Andersen, L. and R. Babula (2008). "The Link Between Openness and Long-Run Economic

The fragmentation of manufacturing allows firms and nations to specialize in specific manufacturing activities—the production, processing, or assembly of newly distinct components—which are potentially better suited to their factor endowments than the previously integrated product. This matters for development because activities can be selected so as to avoid a locality's previously inhibitory bottlenecks—which may have been either private or public in nature—e.g. the scarcity of particular skills or institutional competencies. While vertical specialization is not without its own set of factor and infrastructural requirements, and can certainly yield developmental dead ends, it has gained increasing theoretical as well as empirical attention as an important pathway for economic growth and technological development.

The empirical literature has explored several intertwined mechanisms through which international trade in intermediate goods might raise productivity and/or speed the growth of productivity. These level and rate of change effects may obtain at either the national or global level. Working with a variety of coauthors, Feenstra pioneered the application to international trade and intermediate goods of Romer's (1990) production function in which a greater variety of capital goods increases productivity and by doing so holds diminishing returns to the accumulation of capital in abeyance (Feenstra and Markusen 1992; Feenstra, Madani et al. 1997).

Vertical specialization may be an effective mechanism for the diffusion of best practice technologies between nations. For instance Kaminski and Ng (2005) find considerable technological diffusion in Central Europe where simple assembly led to the production and (net) export of components, as well as a progressive integration into

European Union networks of production and distribution.<sup>2</sup> Vertical specialization and the import and export of intermediate goods has been posited as a vector for the diffusion of existing best practice technique as well as a potent factor behind the development of innovative capacity (Connolly 1997; Santacreu 2008; Henry, Kneller et al. 2009).

While a large number of variations of these ‘new’ growth theory connections between trade, productivity and technical change could be mentioned, the rise of trade in intermediate goods between ‘north’ and ‘south’ also has clear implications for the traditional Singer-Prebisch concern regarding the ability of developing nations to successfully enter the world economy. By allowing newly industrializing economies to enter a far wider range of products the specter of deteriorating terms of trade and the attendant threat to export earnings is greatly attenuated, though for large entrants like China it can never be eliminated.<sup>3</sup>

## II) Analytics of Vertical Specialization

The analytics of specialization in processes as opposed to products has been clearly demonstrated by Arndt (1997)<sup>4</sup>. Figure 1 shows the standard 2-factor-2-product diagram for international trade, with the production of each good taking place entirely in its country of origin. Labor and capital are the two factors, and X and Y are the two products, whose expansion paths at a given ratio of the price of labor to the price of

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<sup>2</sup> Kasahara, H. and J. Rodrigue (2008). "Does the use of imported intermediates increase productivity? Plant-level evidence." *Journal of Development Economics* **87**(1): 106-118. finds that importing intermediate goods improves productivity in a panel study of Chilean manufacturing plants.

<sup>3</sup> There is a large literature related to Bhagwati's (1956) concept of "immiserizing growth". However, as Krueger (1997) noted more than a decade ago, developing countries integrating with the international economy through manufacturing have been able to grow rapidly.

<sup>4</sup> Arndt's objective was to show that unlike in the Heckscher-Ohlin model, where specialization in a product leads to a loss in income for the scarce factor, specialization in a process could lead to increases in income for labor in both the capital abundant and the capital scarce country.

capital (set by country A's factor endowments) are shown by the upward sloping dotted lines from the origin. The isoquants  $x$  and  $y$  represent outputs of  $X$  and  $Y$  at the same cost;  $X$  is clearly the capital-intensive product, and  $Y$  the labor-intensive one. If  $A$  is a capital-abundant country, it will specialize in and export  $X$ , and import  $Y$ .

Figure 2 shows the case of specializing in a process, or intra-product specialization. The left panel shows production of  $X$  is now fragmented into two stages,  $x_1$ , which is relatively capital-intensive, and  $x_2$ , which is relatively labor intensive<sup>5</sup>. The thin upward sloping lines from the origin,  $x_1$  and  $x_2$ , show the expansion paths of the two processes at the given factor price ratio. The heavier line  $OX$  is the expansion path of  $X$ . The capital-labor ratio for  $X$  is a weighted average of the ratios for  $x_1$  and  $x_2$ . Similarly, the right panel shows the production of  $Y$  fragmented into a capital intensive process  $y_1$ , and a labor intensive process  $y_2$ <sup>6</sup>. It is quite possible now that the capital abundant country  $A$  will specialize in the processes  $x_1$  and  $y_1$ , while a labor abundant country will specialize in processes  $x_2$  and  $y_2$ . Production fragmentation has led to the capital abundant as well as the labor abundant country being involved in the production of the capital intensive as well as the labor intensive good.

### III) Middle Goods in Regional Perspective

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<sup>5</sup> It may be helpful to think of  $X$  as a product like a tractor, with  $x_1$  representing assembly (capital intensive) and  $x_2$  components (labor intensive). In fact, many American tractor producers and exporters of tractors import camshafts from China.

<sup>6</sup>  $Y$  may be a shirt, with  $y_1$  representing capital intensive yarn and fabric production, and  $y_2$  labor intensive cutting and stitching.

A vigorous rise of regional trade arrangements accompanied the rise of trade as a share of national incomes. The NAFTA was negotiated and implemented in the early to mid 1990s, in Europe bilateral free trade and accession agreements with Eastern European partners presaged European Enlargement (Caporale, Rault et al. forthcoming as of 2009), while there was much concern about a regional bloc forming in East Asia (Frankel, 1993). Similar questions hovered over each region: would the rise of regional trade be complement or substitute for multilateral trade, and did regional arrangements bode well or ill for the integration and development of lower and middle income economies overall? Jacob Viner's famous distinction between 'trade creation' and 'trade diversion' was widely invoked: a regional free trade area will create trade to the extent that its members import previously domestically produced goods from member countries, but it will divert trade when members import goods from other members that had previously been produced outside of the free-trade region. Berdell and Ghoshal (2007) found that the US economy became considerably more open to non-Mexican imports from the developing world over the 1990s. Rather than diverting trade from other partners the NAFTA was associated with clear evidence of increased import penetration into the US economy by non-oil developing countries. Our objective here is to place the US experience of the 1990s in comparative perspective by examining changes in the openness of each of the G7 economies to imports from non oil developing countries in general, as well as from the different regions in which countries are newly industrializing. More importantly we give particular attention to the changes in G7 openness to intermediate goods flows because of the growing recognition that they indicate the

integration of industrializing economies into the productive structure of high income economies.

The regional structure and nature of inter industry trade has attracted attention for some time now. East Asia's pronounced orientation towards middle goods trade and vertical specialization is well established (Wakasugi 2007) and a considerable amount of comparative work has been done on the labor market impacts and implications of trade linkages between OECD economies and NIE's (Molnar, Pain et al. 2007). Our concern here is somewhat different. We view flows of intermediate goods as an important indicator of the economic integration of newly industrializing regions into the productive structure of the world economy, and are interested in establishing whether there is an emerging set of trans-regional relationships in which the G7 economies are only selectively integrating with different newly emerging regions.

#### IV) All Imports

Arora and Vamvakadis (2005) have made a strong case for the importance of export linkages in the growth process. They find that when developing countries trade more with wealthy countries they converge more quickly (or strongly) with the per capita income. As our objective is to examine the strength of linkages of each of the G-7 countries to developing countries, we start with a simple means of assessing these linkages: import penetration, or the value of exports from a country or group of countries to a G7 importer as a proportion of the importer's national income. An increasing share is a crude but fairly comprehensive indicator of economic integration as it indicates that export goods from the region are becoming more important in the importer's consumer basket or more prominent (as inputs) with its productive process.

Movements in a region's exports expressed as a share in the importer's GDP are directly related to what we refer to as the 'income elasticity of expenditure' on imports from that area. For example if the US income elasticity of expenditure on imports from East Asia is greater than one, then an increase in US income is accompanied by faster growth in the value of imports from East Asia and a rising East Asian import to US GDP ratio. Following upon the implementation of the NAFTA the US income elasticity of expenditure on Mexican imports increased substantially, but so did US income elasticity for imports from all non-oil developing countries excluding Mexico. This suggests that trade patterns indicated greater openness to developing country imports during the 1990's. Here we look at all G7 members and calculate the income elasticity for total imports from developing countries.

We first look at long term trends in imports of Canada, France, Germany, Italy, Japan, the UK, and the US from developing countries. We delineate the latter as those listed in the International Monetary Fund's classification as Group 201—non-oil developing countries.<sup>7</sup> Figure 3 shows quarterly values for the ratio of developing country imports to GDP for the period 1980-2005. Import figures are from the IMF's Direction of Trade Statistics, and GDP figures from International Financial Statistics. While there has been a good deal of variation among the G-7 economies in import penetration by developing countries, the overall trend has an increasing one for all seven.

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<sup>7</sup> The IMF has a broader Group 202—all developing countries, which includes a dozen countries listed as oil exporters, as well as the 201 countries.

It is useful to supplement the broad picture given by trends in import penetration with elasticity figures. As noted earlier, the income elasticity of expenditure on imports is a good measure of the degree to which an economy becomes more open to imports as its income rises. Using the same data, and OLS regression methods, we calculate elasticities for the entire period 1980-2005, as well as two sub-periods 1980-1992 and 1993-2005. The results are shown in Table 1. Most regressions generate highly significant figures for elasticity. With the exception of Japan, all the G-7 countries have elasticities greater than one, indicating that imports from developing countries grew faster than income. Moreover, the elasticity increased in the second period for all except Japan. These results indicate an increasing openness to imports from developing countries.

#### V) Imports of Middle Goods

Intermediate or middle goods are manufactured parts or components used in the production of other goods. While conceptually they are quite distinct from final goods, empirically it has not been easy to separate them in international trade statistics, until Revision 3 of the United Nations' Standard International Trade Classification. The UN's COMTRADE database now separates middle goods in the SITC 7 (machinery and transport equipment) and SITC 8 (miscellaneous goods) categories. This is what we focus on in this section. An illustration of the kinds of products included is shown in Table 2; a complete list is available from the authors.

It should be noted that we are able to identify only a segment of the range of middle goods traded internationally. As pointed out by Athukorala and Yamashita (2006), while

COMTRADE provides a fairly complete list of parts and components in the machinery and components sector, many items which should be recorded as parts in the miscellaneous goods sector are not. In addition, middle goods are not separated out in pharmaceutical and chemical products and metal products, two industries where there has been considerable international fragmentation of production. Data limitations, therefore, impose a downward bias in our figures for trade in middle goods.

To measure the strength of linkages of G-7 countries through imports of intermediate goods, we again start with import penetration. Since these imports of parts and components go into manufacturing, we are interested in examining the integration of manufacturing in G-7 countries with developing countries through such imports. As manufacturing has had an unstable and declining share of GDP in all the G-7 economies, as shown in Figure 4, it is more appropriate to compare middle goods imports to manufacturing output, obtained from the IMF's World Economic Outlook, than to GDP.

Figure 5 shows imports of middle goods as a share of manufacturing output for the period 1988-2005.<sup>8</sup> It is seen that the share rises for all seven countries, though there seem to be three groups among them. Germany and the US have the highest levels of openness, with import penetration reaching 6 percent by 2005. For Canada, the UK, and Japan the figure is about 4 percent, while Italy lags at 2 percent.

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<sup>8</sup> Unlike total trade, shown in figure 3, COMTRADE data are available only since 1988, and on an annual rather than a quarterly basis.

As in the previous section, we supplement import penetration trends with elasticity calculation, regressing imports of middle goods (in log form) on manufacturing output. The results are shown in Table 3. Here we go beyond Table 1 and calculate elasticities for imports from the world as a whole, from industrial and developing countries (as classified by the IMF), and from the five geographic groups among the developing countries. Each of the G-7 countries is seen to have an elasticity of greater than one for imports from developing countries, indicating a closer integration as income increases. In all cases, the elasticity figure is greater for developing countries than for industrial countries<sup>9</sup>. The US and the UK have higher elasticities than the other members of the G-7.

#### VI) A closer look at three areas of interest

Three areas have attracted a lot of attention in the discussion of outsourcing part of the production process to developing countries. East Asia, due to its favorable business climate and relatively low labor costs has for a long time been a favorite location for manufacturing affiliates of multinational corporations. Since 1989, Central Europe has attracted a great deal of manufacturing investment from firms based in Western Europe. With the implementation of NAFTA in 1994, removing trade barriers and providing investment security, American and Canadian firms have greatly expanded their presence in Mexico (as have Asian and European firms), to take advantage of an integrated North American market). We focus on these three areas, and their exports of intermediate goods to the G-7 countries.

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<sup>9</sup> This should be treated with some caution, since industrial countries account for most of component exports, though the share of developing countries has been increasing.

Figure 6 shows imports from Central Europe<sup>10</sup> as a share of the manufacturing output of the G-7. We see that import penetration into Germany has risen rapidly, followed by France, Italy and the UK; shares in Canada, the US and Japan have remained very low. Figure 7 shows similar figures for East Asia. Here we see a rising trend for all the G-7 countries, though considerably less for Italy than the others. In figure 8, we see sharply rising penetration of Mexican middle goods into the US and Canada, and with negligible shares for the other G-7 members.

We also calculate elasticities for intermediate imports from the three select areas of interest. These are seen in Table 4. In most cases, the elasticities are considerably greater than one, suggesting that the integration of the three regions with the G-7 through trade in middle goods will continue to increase with economic growth.

## VII) Conclusions

Our study shows unambiguous evidence of increasing integration and globalization. All seven of the G-7 economies saw greater opening to imports from developing countries, with rising trade shares and (with the exception of Japan), income elasticity of expenditure on imports greater than one for total imports. For middle goods, we have rising shares and high elasticities for all seven, as well as higher elasticity figures for imports from developing economies than from industrial countries.

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<sup>10</sup> We define Central Europe as the European parts of the former Soviet Union less Russia, other former Warsaw Pact countries, and the former Yugoslavia.

There are, however, some interesting variations within the overall trend of increasing integration. From the perspective of importing countries, the US and Germany are the most integrated with developing countries in their manufacturing production, while Italy is much less so. We also see clear regional patterns. Central Europe appears to be integrating successfully with Germany and other European members of the G-7, Mexico with the US and Canada, and East Asia with everyone.

## References

- Andersen, L. and R. Babula (2008). "The Link Between Openness and Long-Run Economic Growth." United States International Trade Commission Journal of International Commerce and Economics.
- Arora, V. and A. Vamvakidis (2005). "How Much Do Trading Partners Matter for Economic Growth?" IMF Staff Papers. Vol. 52.
- Athukorala, P.-c. and N. Yamashita (2006). "Production Fragmentation and Trade Integration: East Asia in a Global Context " North American Journal of Economics and Finance **17**(3): 233-256
- Arndt, S. W (1997). "Globalization and the Open Economy". North American Journal of Economics and Finance **8** (1), 71-79.
- Berdell, J. and A. Ghoshal (2007). "Gains and Losses from Preferential Trade Agreements: Some Evidence from NAFTA." The International Trade Journal **21**(2): 191-228.
- Bhagwati, J. (1956)"Immiserizing Growth: A Geometrical Note." Review of Economic Studies, 201-208.
- Caporale, G. M., C. Rault, et al. (forthcoming as of 2009). "On the bilateral trade effects of free trade agreements between the EU-15 and the CEEC-4 countries " Review of World Economics.
- Connolly, M. P. (1997). Technological Diffusion Through Trade and Imitation, SSRN.
- Feenstra, R. C., D. Madani, et al. (1997). Testing Endogenous Growth in South Korea and Taiwan, SSRN.
- Feenstra, R. C. (1998). "Integration of Trade and Disintegration of Production in the Global Economy". Journal of Economic Perspectives Fall 1998, 31-50.
- Feenstra, R. C. and J. R. Markusen (1992). Accounting for Growth With New Inputs, SSRN.
- Frankel, J. (1993). "Is Japan Creating a Yen Bloc in East Asia and the Pacific?" In Frankel. J. and M. Kahler, eds., Regionalism and Rivalry. Chicago:University of Chicago Press.
- Henry, M., R. Kneller, et al. (2009). "Trade, technology transfer and national efficiency in developing countries." European Economic Review **53**(2): 237-254.
- Kaminski, B. and F. Ng (2005). "Production disintegration and integration of Central Europe into global markets." International Review of Economics & Finance **14**(3): 377-390.
- Karras, G. and A. Submitter (2008). "Trade Openness and Economic Growth Can We Estimate the Precise Effect?" Applied Econometrics and International Development, Vol. 3, No. 1, 2003.

- Kasahara, H. and J. Rodrigue (2008). "Does the use of imported intermediates increase productivity? Plant-level evidence." Journal of Development Economics **87**(1): 106-118.
- Kimura, F., K. Hayakawa, et al. (2008). "Does International Fragmentation Occur in Sectors Other Than Machinery?" Asian Economic Journal **22**(4): 343-358.
- Krueger, A. (1997). "Trade Policy and Economic Development: How We Learn." American Economic Review **87**(1):1-22.
- Molnar, M., N. Pain, et al. (2007). "The internationalisation of production, international outsourcing and employment in the OECD." OECD Working Paper(2007)21: 1-73.
- Rogoff, K. (2005). Paul Samuelson's Contributions to International Economics. Samuelsonian economics in the twenty-first century. Szenberg, OUP.
- Romer, P. (1990). "Endogenous Technical Change." Journal of Political Economy **98**. S71-S102.
- Trefler, D. (1995). "The Case of Missing Trade and Other Mysteries". American Economic Review, **85**(5), 1029-1046.
- Santacreu, A.-M. (2008). Innovation, Diffusion and Trade: Theory and Measurement. Working Paper. New York, New York University.
- Wakasugi, R. (2007). "Vertical Intra-Industry Trade and Economic Integration in East Asia." Asian Economic Papers **6**(1).
- World Trade Organization. "World Trade 2008, Prospects 2009". Press Release, 23 March, 2009.

**Table 1. Income Elasticity of Imports from Non-Oil Developing Countries**

	1980-2005	1980-1992	1993-2005
USA	1.68 (0.02)	1.28 (0.03)	1.98 (0.05)
UK	1.34 (0.03)	0.85 (0.04)	1.56 (0.05)
FRANCE	1.19 (0.04)	0.84 (0.03)	1.82 (0.18)
Germany	1.26 (0.05)	0.93 (0.03)	1.53 (0.32)
Italy	0.99 (0.05)	0.54 (0.04)	1.86 (0.14)
Canada	2.09 (0.05)	1.49 (0.05)	1.94 (0.07)
Japan	1.04 (0.05)	0.69 (0.03)	0.42 (0.43)

**Table 2. Example of Middle Goods from SITC 7**

- SITC 7 Machinery and Transport Equipment
- 71191 Parts for steam generating or other vapour generating boilers
- 71192 Parts for auxiliary plants used with boilers; parts of condensers for steamers and other vapour power units; parts for steam turbines and other vapour turbines
- 71319 Parts, n.e.s., of spark-ignition reciprocating or rotary combustion piston engines for aircraft
- 71331 Outboard motors
- 71332 Spark-ignition reciprocating or rotary marine propulsion engines, n.e.s.
- 71391 Parts, n.e.s, suitable for use solely or principally with spark-ignition internal combustion piston engines
- .....
- We aggregate and examine by trade partner for each of the G7 using COMTRADE data.

**Table 3. Elasticities of Middle Goods Imports**

	Canada	France	Germany	Italy	Japan	UK	USA
World	1.037	1.2	1.086	1.477	1.502	1.905	2.407
Industrial	0.932	1.152	0.867	1.286	1.202	1.565	1.575
202 (Developing Countries)	2.416	1.982	1.536	2.821	2.291	4.349	3.7
Of Which							
Africa	4.981	2.728	1.104	3.44	0.907	4.124	6.918
Americas	2.418	1.519	1.495	1.636	0.219	6.419	3.795
Asia	2.377	1.79	1.471	2.542	2.323	4.008	3.646
Europe	3.431	2.351	1.71	3.497	1.155	6.862	5.736
Middle East	3.266	1.052	0.7	1.8	1.391	2.425	2.475

This is w/r/t manufacturing prod. 1988-2005

**Table 4. Elasticities of Middle Goods Imports from Selected Areas**

	Canada	France	Germany	Italy	Japan	UK	USA
201 Non-Oil Developing Countries	2.412	1.991	1.542	2.883	2.28	4.405	3.685
Central Europe	4.35	3.877	1.701	5.627	1.091	8.995	6.34
East Asia	2.364	1.772	1.459	2.477	2.319	3.989	3.631
Mexico	2.421	2.379	1.08	2.779	0.728	7.474	3.891

**Figure 1. Standard Diagram for Trade in Goods**

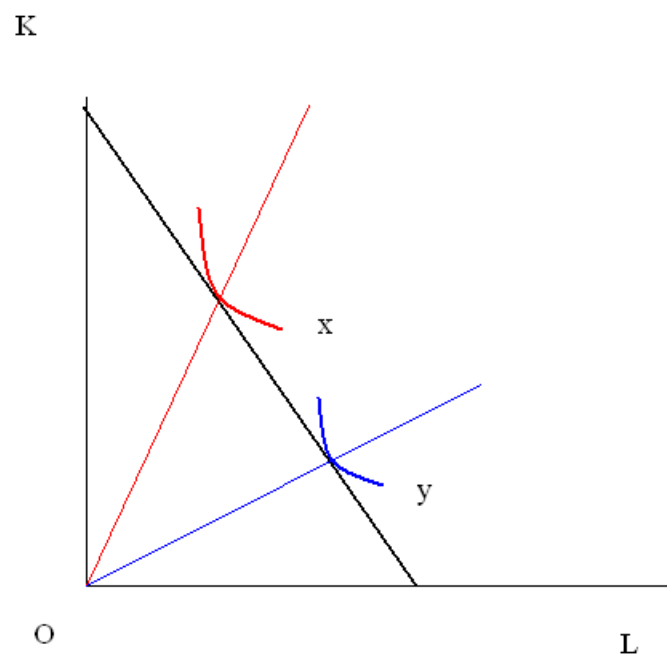
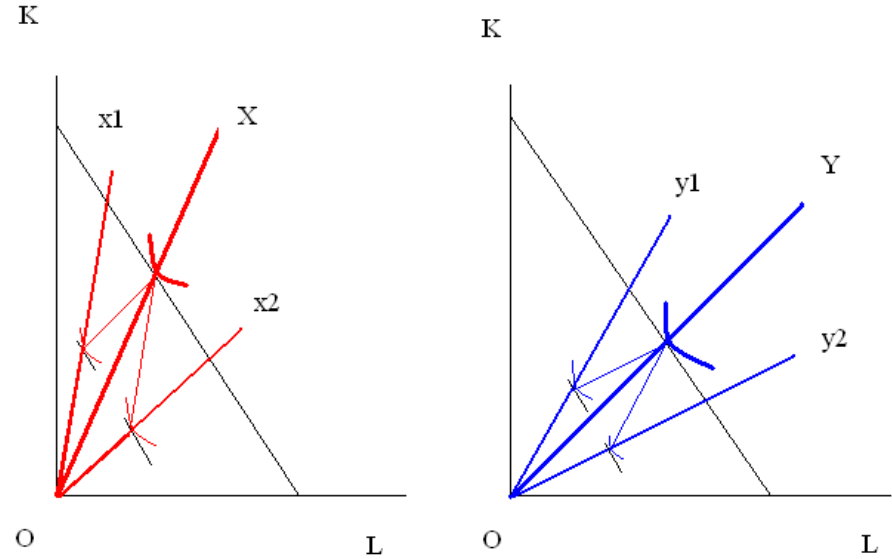
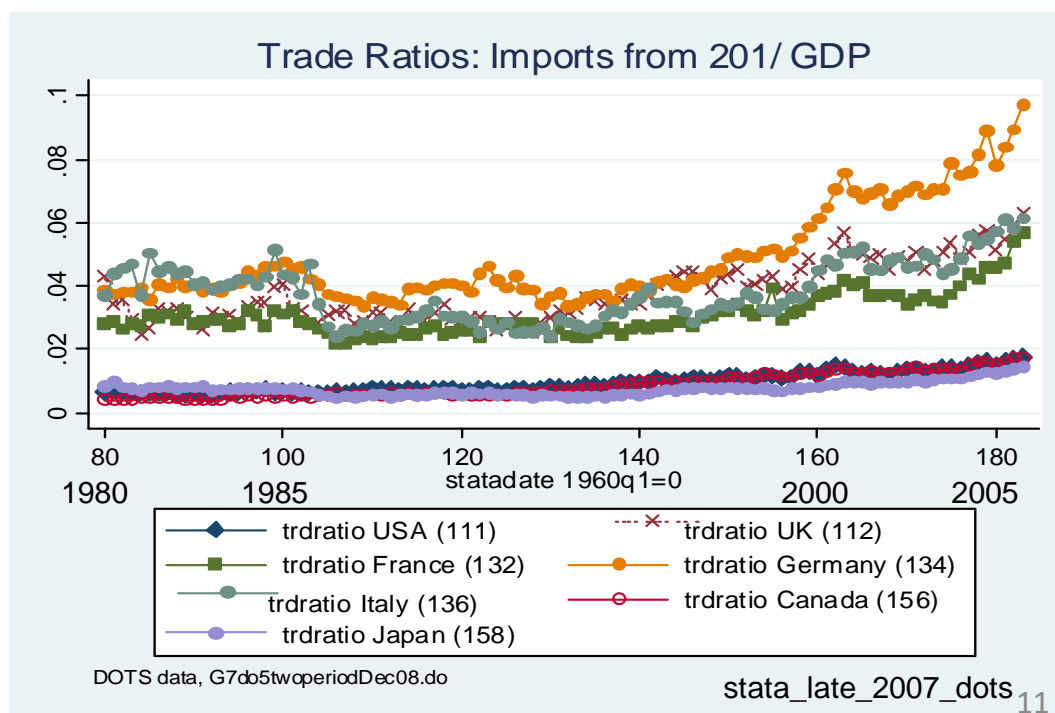


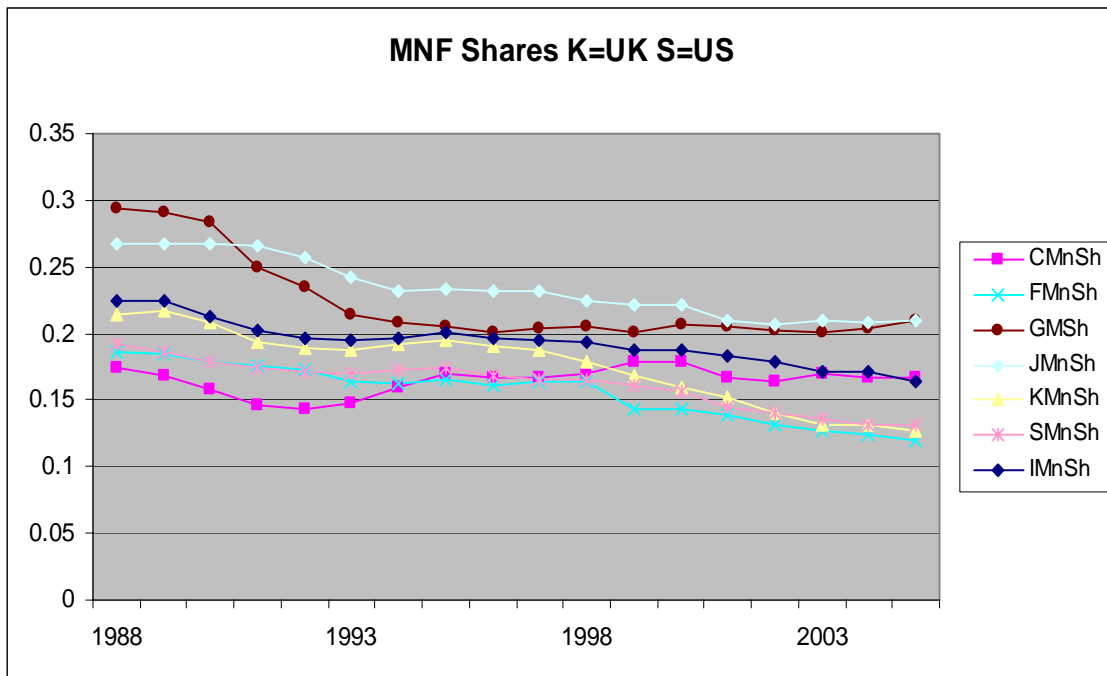
Figure 2. Two-stage production of X and Y



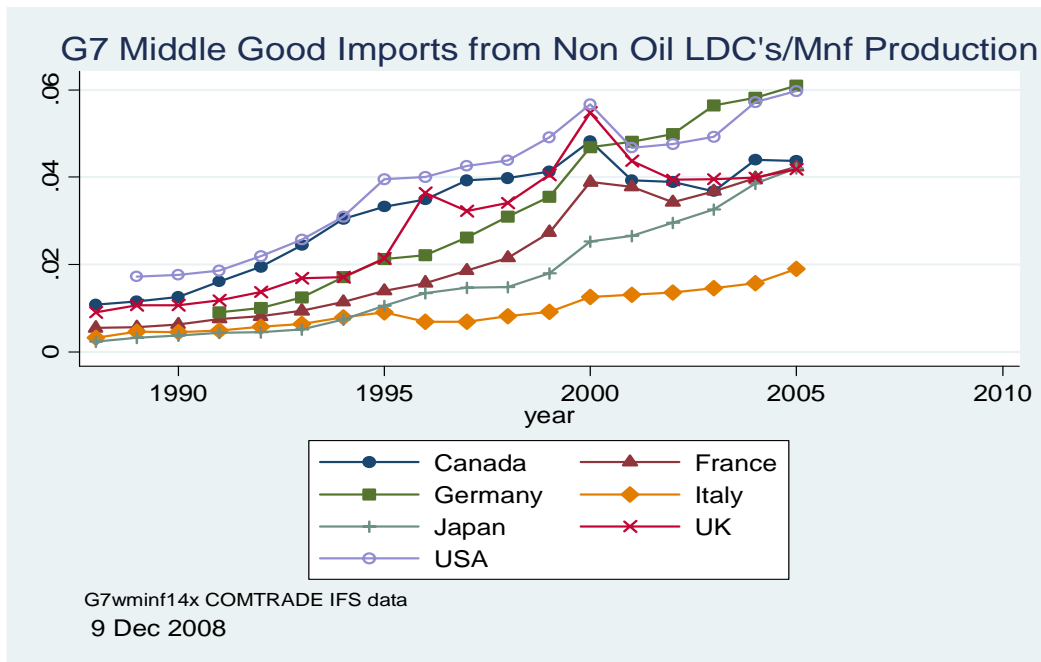
**Figure 3. Imports from Developing Countries as shares of GDP**



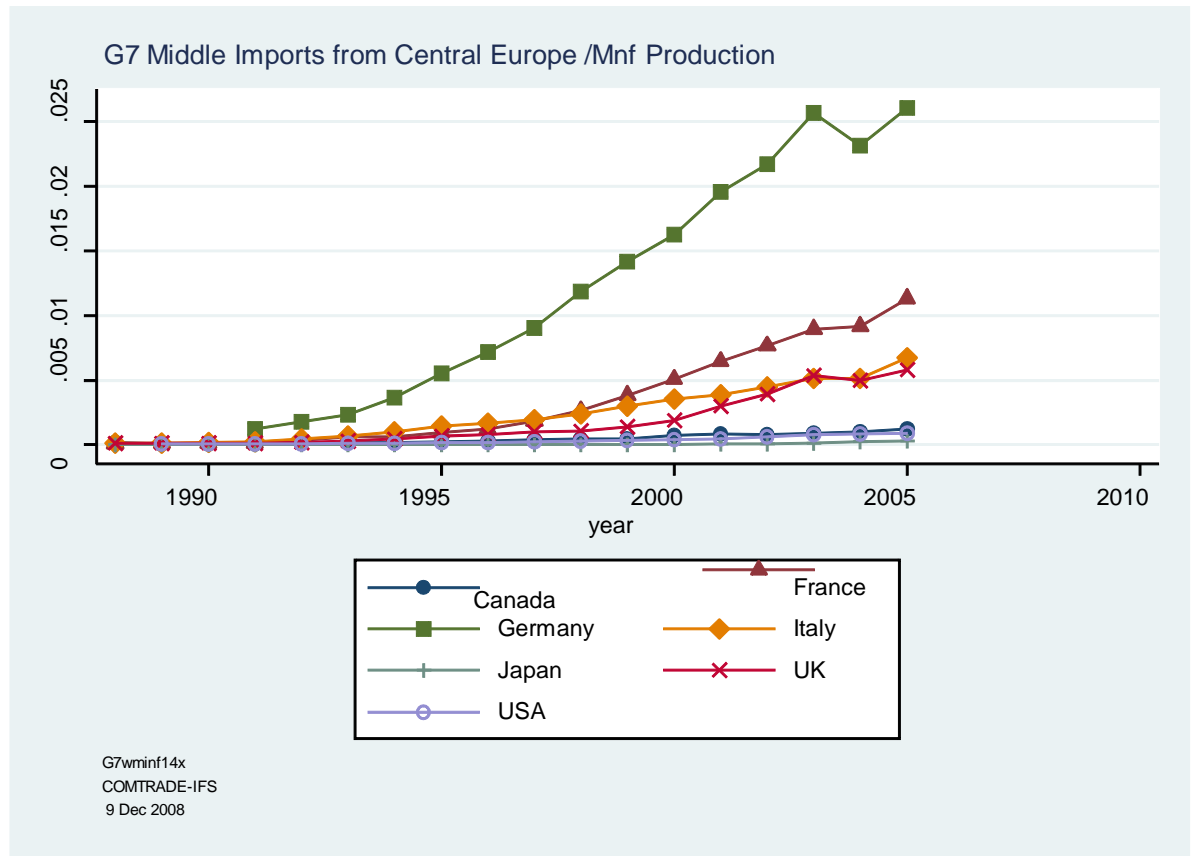
**Figure 4. Declining Share of Manufacturing in GDP of G-7**



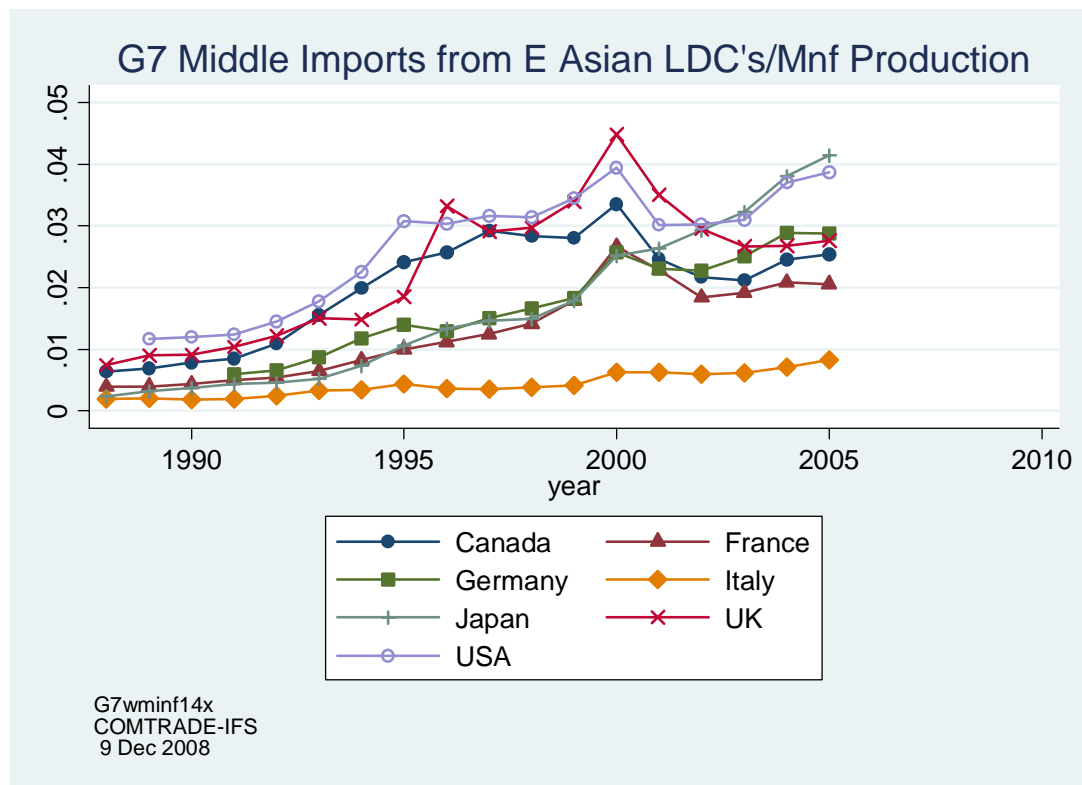
**Figure 5. Imports of Middle Goods as Share of Manufacturing Output**



**Figure 6. Central Europe: Exports of Middle Goods to G-7**

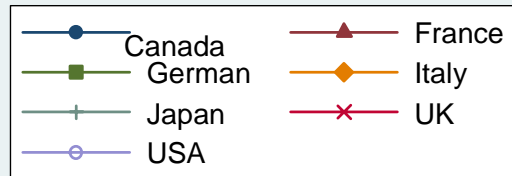
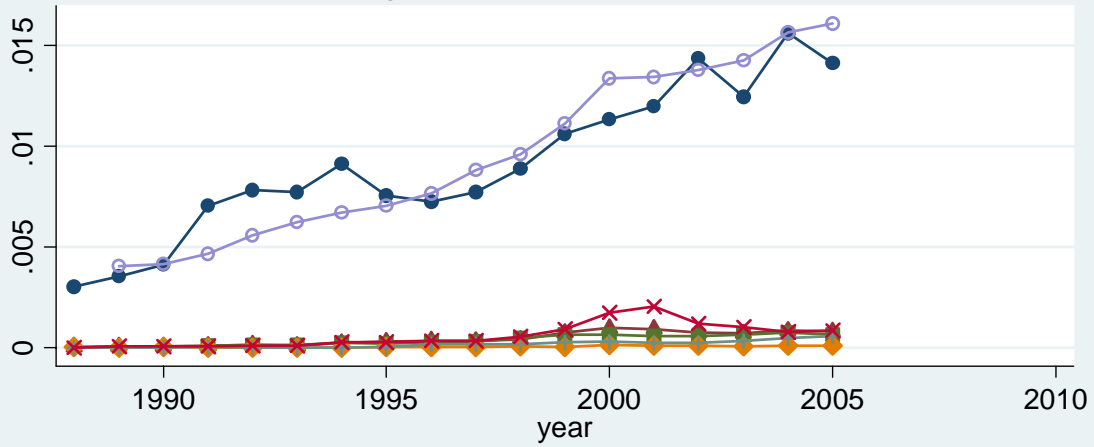


**Figure 7. East Asia: Exports of Middle Goods to G-7**



**Figure 8. . Mexico: Exports of Middle Goods to G-7**

## G7 Middle Imports from Mexico/Mnf Production



G7wminf14x  
COMTRADE-IFS  
9 Dec 2008