



International Workshop “Integração Produtiva – Lições da
Ásia e Europa para o MERCOSUL”

The World Fragmentation of Production and Trade:
Concepts and Basic Issues

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(October, 2008)

Working Document
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[A paper prepared for CEPAL/Brasil]

Keywords: China, Fragmentation, Latin America (Mercosul), Semi-manufactured, Sharing production, Trade in parts & components.

^{*} I'm indebted to many people and institutions with whom or where I've been discussing these issues and presenting my ideas. German Calfat and Maria Paula Fontoura, in particular, have created opportunities to further develop my views.

Executive Summary

Sharing production has become a key feature of the world economy. If it raises important implications for those who can participate in it, it also decreases the opportunities available for those outside the process. Many policy implications are thus raised, ranging from the pattern of the world division of labour to the sustainability of each individual country trade flows. This document discusses basic concepts and features of this process.

Eleven key points or questions raised deserve mention:

[I] *A sharper and finer division of procedures, together with the splintering of the whole productive process to different locations in the world, with even different ownerships, may be considered a modern phenomenon. This is the basic understanding of fragmentation in this text.*

[II] *Absolute advantages regain importance, as Ricardo- (or Heckscher-Ohlin) type comparative advantages considerations are less relevant when choosing a location for the particular sub-unit, in a fragmentation process.*

[III] *Key governance issues take place in a value chain, as – at the different levels – producers struggle for the ideal (from their viewpoint) market structure, alongside ways to absorb or move to higher stages,*

[IV] *For purchasers one step above, it is more interesting to procure their inputs in perfect competition markets, what will secure them lower prices. This means, for instance, that keeping design and manufacturing secrets goes against their interest. On the other hand, the lower level suppliers have an interest in working under imperfect competition, to secure advantageous mark-ups. In broad lines, as the upper level “dominates”, or creates the demand, it is expected that their optimal structure will prevail.*

[V] *Who or what drives fragmentation ? The final producer, shedding abroad low-tech, labour intensive or very repetitive tasks ? A competitive emerging economy, grabbing opportunities suddenly open ? Technological progress ? What is the role of tariff jumping ? Given a specific good, what are the limits to fragmenting its productive process ? What role plays R&D in designing the process ? If an essential one – as it seems -, does it mean that fragmentation will always be triggered by an advanced economy (like the US) and/or a cleverly controlled one (like China) ?*

What is the interaction between factor mobility, including migration, and fragmentation ? Does it diminish its scope ?

[VI] *Fragmentation usually requires a minimum level of production-related as well as transportation and logistic services, which create conditions for the smooth performing and connections required by the fragmented operations.*

[VII] *For those goods which, internationally, are already produced in a fragmented way, if one is a producer outside the fragmented chain, unless owning or mastering a top technology, the likelihood that the product will become non-competitive (if not being so already) is high. Thus, unless one has a captive market – for geographical or preferential reasons –, one will be ruled out of the market.*

[VIII] *The logic of fragmentation is a global one, with its roots in the US, and may encompass, in principle, any sector.*

[IX] *In the moment that trade negotiations have become so tight, concessions being so hard to extract in some areas, given the political-economic thresholds expressed by the tariffs, deeper knowledge of how each emerging or developed economy is placed within the fragmentation context seems mandatory.*

[X] *The majority of present-day statistical systems fail in compiling trade data under a value-chain perspective. In particular, with the exception of the US (and, to some extent, the EU), data on inward and outward flows of goods related by a fragmentation operation are not available.*

[XI] *Fragmentation is a very dynamic process and, specially for LA countries, continuous time analyses are required to correctly gauge the development and success of the international insertion.*

Within this context, it is important to identify “sources and destinations”, i.e., markets/countries that will act as partners in a fragmentation process. The regional market seems crucial for LA economies, but the US stands out as another major option. While the EU raises doubts, Asian economies must be seriously considered. Among them, China, of course, may both be a rival and an ally.

The question of financing also comes up. How can producers switch activities in order to engage in or profit from value chains: with their own funds? by way of state resources? The issue is not negligible and, within a policy framework, should receive attention. Small and medium enterprises can be an interesting component of the fragmented industries, and investment lines from private commercial or investment banks could be encouraged.

Related to the above is the institutional setting. The Chinese experience, briefly discussed in Section 4 of the document, showed how the combination of

trade and foreign direct investment policies in the outward-processing sectors were crucial for the fast catching-up of the country, alongside the value chains. It seems that a few governmental measures are unavoidable; whether at a federal or regional level is a question to be further considered.

Nowadays somewhat better times for LA economies seem to be *the* moment to address a courageous rethinking of the present productive structure. This should contemplate a dual objective. Improve the insertion into global chains, while creating more employment opportunities inside each country and strengthening the links among the different economies in the region. Reconciling both is far from obvious, though not impossible.

1. Introduction: fragmentation – concepts, ideas and consequences

The division of production into separate processes and units is not necessarily new. Multiple production from a single unit, or the combination of different processes until obtaining one or several final goods has long been part of the logic and practice of manufacturing. However,

[1] *a sharper and finer division of procedures, together with the splintering of the whole process to different locations in the world, with even different ownerships, may be considered a modern phenomenon. This will be our basic understanding of fragmentation in this text.*

Indeed, in spite of its nowadays importance and recognition, fragmentation – or production complementarity - still bears different meanings and connotations. At its origin lies a radical change from classical conceptions of manufacturing, for which a ‘good’ is the result of the combination of a given set of inputs according to a specified technology, *all making a productive process that takes place at one plant*, eventually supplying the ‘good’. Essential to the splitting of the process, the set of different operations needs to be efficiently detailed and codified so that they can be performed “anywhere”, their several parts or outputs being eventually combined to make up the (final) good(s), in one or several countries.

Notwithstanding, from the above (basic) definition, fragmentation, though modern, appears as something not exactly brand new. In the theoretical field, works like Rosenberg (1963) and Young (1928), and more recently Kogut (1985), may be considered as insightful analyses of a then incipient phenomenon.

As regards the ‘real world’, the car industry is a major example at least 20 years old. Textile and apparel industries in advanced economies, which have shifted their unskilled labour processes towards developing countries, keeping design and distribution at headquarters, or high-technology sectors such as electronics are other important examples. The latter, however, may present some particularities. Broadly, when the activity is very intensive in Research & Development, like pharmaceuticals, fragmentation is less frequent¹. Anyhow, this logic has spread to many other products and the way fragmentation is performed has acquired drastic and sophisticated instances. In particular, in most cases, each specific production module moves to the place where it can be more efficiently made, actual manufacturing being split all over the planet. This brings about the first major theoretical change due to fragmentation:

¹ See also the end of Section 3.

[II] *Absolute advantages regain importance, as Ricardo- (or Heckscher-Ohlin) type comparative advantages considerations are less relevant when choosing a location for the particular sub-unit.*

A strongly related idea is the concept of production chains. In this case, the different phases are clearly identified and ways to move through the chain receive greater attention. Ownership is clearly spread, with (usually) many producers at each stage. The change of value-added along the chain becomes a key element in its analysis, as well as the varied profile of the labour force. In fact, looking at fragmentation from the production chain perspective raises interesting questions on how to distribute the different shares of value-added. Also,

[III] *key governance issues take place, as – at the different levels – producers struggle for the ideal (from their viewpoint) market structure, alongside ways to, in principle, absorb or move to higher stages²,*

raising several novel questions. An ironic one concerns the conflict of interest in keeping strict intellectual property rights, what amounts in fact to a third consequence:

[IV] *For the purchasers one step above, it is more interesting to procure their inputs in perfect competition markets, what will secure them lower prices. This means, for instance, that keeping design and manufacturing secrets goes against their interest. On the other hand, the lower level suppliers want to work under imperfect competition, to secure advantageous mark-ups. In broad lines, as the upper level “dominates”, or creates the demand, it is expected that their preferred structure will prevail.*

Fragmentation, as said, does not apply to all kinds of manufactures, and is no panacea. When it does apply, it changes the way the final good must be considered, either in terms of industrial policy or of international trade. It also brings forth challenging and (usually) unsolved theoretical questions related to

[V] *Who or what drives it ? The final producer, shedding abroad low-tech, labour intensive or very repetitive tasks ? A competitive emerging economy, grabbing opportunities suddenly open ? Technological progress ?*

What is the role of tariff jumping ?

Given a specific good, what are the limits to fragmenting its productive process ?

² See, for instance, Gereffi et al. (2005).

What role plays R&D in designing the process ? If an essential one – as it seems -, does it mean that fragmentation will always be triggered by an advanced economy (like the US) and/or a cleverly controlled one (like China) ?

What is the interaction between factor mobility, including migration, and fragmentation ? Does it diminish its scope ?

Moreover, fragmentation

[VI] *usually requires a minimum level of production-related as well as transportation and logistic services, which create conditions for the smooth performing and connections required by the fragmented operations.*

Though being no “universal solution” to the problem of better and more competitively inserting a given economy into world trade flows, it is becoming ever more a necessary condition for this. Entering or having access to an international production chain often is a key development strategy.

Why is fragmentation so important for a Southern bloc, like Mercosul, or South America globally ? The answer expands the previous lines:

[VII] *For those goods which, internationally, are already produced in a fragmented way, if one is a producer outside the fragmented chain, unless owning or mastering a top technology³, the likelihood that the product will become non-competitive (if not being so already) is high. Thus, unless one has a captive market – for geographical or preferential reasons –, one will be ruled out of the market.*

Moreover, insertion in fragmented chains is, many times, an efficient way of acquiring technology and upgrading the manufacturing sector.

The recent boost of fragmentation took place in Asia, notably through the dynamics among Southeast Asia, Japan and China. The last one strongly used it as a way of progressively (and very fast) gaining several markets in manufacturing flows. Be it through the regional context, or through a careful insertion in fragmented processes triggered by the US and, to a lesser extent, the European Union (EU), China and the Southeast Asian economies have gone up the manufacturing processes ladder.

This overall positive phenomenon is not without qualification. Many say that a lot of copying – often by not strictly fair ways – lies at its heart, and that no true industrial innovation, or at least in a rather reduced scale, has taken place in

³ What, in the case at stake, though not impossible isn't much realistic.

these centres⁴. Moreover, R&D levels, in many of them, are still far behind those in an advanced economy. Many official organisms, in the EU countries, notably in France, Germany and the Southern members, refuse to fully accept the phenomenon⁵.

Indeed, many people do think that the concept, and related strategies, applies only to the specific Eastern economies mentioned above, making no sense for other ones, like those of Mercosul and, particularly, strong agricultural exporters like Argentina, Australia or Brazil. Nothing more wrong in our view:

[VIII] *the logic of fragmentation is a global one, with its roots in the US, and may encompass, in principle, any sector.*

Evidence points towards the fact that it will prevail, nearly universally, for any good whose production can or has already been fragmented. Outsiders, unless possessing a differential technology, are simply doomed.

In the context of the agricultural exporters, as often happens, the unquestionable success of the agribusiness sector contributes to support the blind vision above, voiced by a few groups of both analysts and entrepreneurs. They fail to see that even part of the very agribusiness activities are leaning towards fragmented practices⁶.

[IX] *In the moment that trade negotiations have become so tight, concessions being so hard to extract in some areas, given the political-economic thresholds expressed by the tariffs, deeper knowledge of how each emerging or developed economy is placed within the fragmentation context seems mandatory.*

Among other things, it can help in better identifying which sectors/goods should be immediately liberalised to facilitate insertion in global production chains, either from the side of exports or imports. The same applies in the negotiations of a free trade agreement, where fragmentation can alter substantially the logic of a set of concessions.

⁴ See, for instance, the views expressed by Mr. Martin Richenhagen, chairman and chief executive of the US multinational Agco (the world's third biggest manufacturer of tractors), in the *Financial Times*, February 26, 2008, page 17.

⁵ Indeed, these countries have, at the end of 2007/beginning 2008, blocked Trade Commissioner Peter Mandelson's plans of adapting EU trade rules to the (new) global supply chains reality

⁶ The childish argument that a chicken or a pig cannot be produced in a fragmented way forgets that selling the whole chicken or pig as such is a very low value-added activity. When cleaning, freezing, cutting – here included special and gourmet slices, packaging, sophisticated processing and placing, as well as other activities enter the value-chain, the door to fragmentation is open. Moreover, even flows like one-day chicks or piglets are, to some extent, a counter-example to it.

Moreover, as insertion is not a gift from heaven, countries becoming part of the process either if they trigger it or if they gather qualities and absolute advantages that make them attractive, this knowledge may also help to gain a better view of missed and potential opportunities. Actually, to get involved in a world fragmented production chain represents a great challenge for any country, and even more for developing economies whose opportunities are limited. The lack of insertion in shared production processes *reduces their growth and industrialisation opportunities*, whilst their inclusion provides more sustainable growth paths.

This text is an attempt to address all these issues from a broad perspective. To the extent of our knowledge it is the first time that a work tries to highlight and discuss all the aspects of the problem, from the conceptual to the empirical ones. Studies have been conducted with different data and geographic coverage, shedding light on some issues. Pervasive analyses are few and, in fact, lacking. We do hope it can open the way to several refinements, extensions and linkages with other related topics.

The structure of the text is as follows. Section 2 tackles the question of fragmentation and the world division of labour, also called outsourcing and a contentious point in the developed economies. Section 3 discusses the methodologies adopted for measuring fragmentation, and the related technical literature; to a certain extent it is the core of the document. It is complemented by Section 4, presenting two concrete examples. The former shows empirical results for Argentina and Brazil⁷, at the geographic and product levels, and the latter sheds some light on the Chinese experience. Section 5 complements the previous one, by introducing the dynamics inherent to any position in an internationally fragmented chain.

Finally, Section 6 summarises the main conclusions, setting a few policy recommendations and suggestions of further developments.

2. Fragmentation (outsourcing) and the world division of labour.

One doesn't need to be a great economist to understand that, once a productive process is fragmented, and one of its phases goes abroad (or is sourced from abroad), the key reason underlying this action is that, transport and other distance-related costs notwithstanding, the intermediate good at stake will arrive at a cost

⁷ Under a "Mercosul perspective".

lower than if locally produced. That's why absolute advantages come back to the fore, as such a judgement will be based on a blunt cost comparison.

Given that, especially during fragmentation's modern beginning, less skilled activities were shed away, it is only natural that labour costs played a major role in such decisions. India, Pakistan, Malaysia, Turkey and notably China, are economies that profited intelligently from their labour abundance and secured a steady growth of semi-manufacturing activity. The displacement, mainly due to much more advantageous labour costs, of this kind of activities – globally named, since the early eighties, outsourcing – raised concern and protests in the main advanced economies. The debate was particularly heated in the US, Mankiw et al. (2004), where, between 1979 and 1995, the real wages of full-time workers with less than 12 years of education fell by 20.2%. During the same period, the real wages of those with 16 or more years of education rose by 3.4%, testifying a dramatic wage gap between less- and more-skilled workers.

It must be pointed out that, though we presented the idea of outsourcing in the context of manufacturing, it is as important in the realm of services, where huge amounts of operations have been transferred to countries like India and Ireland that benefited immensely, beyond specific skills of their labour force⁸, from using the English language. The massive relocation of call centres to them is perhaps the best example of such linguistic asset.

The debate, beyond involving politicians and policy makers, has naturally engaged the academic community. Samuelson (2004), backing his arguments on Ricardo-Mill's *comparative advantage*, develops in a carefully constructed paper two scenarios for the problem. In the former, closer to the situation described above, both regions/countries benefit, as consumers' gains in the advanced economy outdo the job losses. In the latter, however, if the emerging economy raises its productivity, and starts to competitively produce goods in which, up to then, the advanced one had a supremacy⁹, the latter will lose.

Bhagwati et al. (2004) took the argument up again, though concentrating on the services case; more specifically, Mode I of the GATS/WTO classification (arm's length supply of services, with both provider and user remaining in their respective locations). They developed three different models and, in general, though in many cases welfare increases for all nations involved, job and wages losses take place for unskilled workers in the advanced economy (and, depending

⁸ And competitive tax regimes, as in Ireland. A well-educated, though cheaper, labour force was also a key factor, in the case of both countries mentioned.

⁹ And, consequently, gain some market share of this good.

on the amount of technological innovation in the emerging economy, skilled as well).

Blinder (2006) re-addresses the subject from the viewpoint of intra-firm trade, presenting a model that explains intra-firm exports of intermediate or semi-finished goods. It does not explain the symmetrically important case of intra-firm *imports of semi-finished*, or of intra-firm trade of finished goods which, though less interesting for this study, makes nowadays for a sizeable bulk of international trade in manufacturing.

In a more technical vein, Feenstra and Hanson (2001) develop a simple formal model for analysing the impact of outsourcing. They consider a good resulting from three operations: two – one unskilled-labour, and another skilled-labour intensive – producing intermediates, and a third one in which the good is assembled (or finally manufactured). Disregarding the cases of total domestic and total foreign production, the six remaining combinations of domestic (d) and foreign (f) sourcing help in composing an idea of the fragmentation phenomenon. Calling U, S and M, respectively, the unskilled and skilled-labour inputs, and the final manufacturing/assembly phase, we can have:

a) an (internationally) inserted country: three patterns,

| U | S | M |
|-------|---|---|
| ----- | | |
| d | d | f |
| d | f | f |
| f | d | f |

more akin to a developing economy . Though the final good is never manufactured locally, in the first and third cases the skilled-labour input is, as is becoming the case with China (and with whichever country goes up the value-added ladder).

b) common outsourcing: two cases,

| U | S | M |
|-------|---|---|
| ----- | | |
| d | f | d |
| f | d | d |

one (the first) more akin to a developing and another to a developed economy.

c) totally fragmented advanced economy:

$$\begin{array}{ccc} U & S & M \\ \hline f & f & d \end{array}$$

Assuming that both inputs can be either imported or exported, beyond being produced domestically, Feenstra and Hanson derive several results. For instance, if the share of capital in total cost is the same for both inputs, a decrease in the price of the (imported) unskilled-labour intensive input leads to a *decrease* in the domestic relative wage of unskilled labour. The (domestic) price of the final good also falls, though less than that of the (unskilled) imports. This amounts to a *rise* in the final price *relative to imported inputs*, a fact confirmed empirically in the US and other industrial countries, during 1980-1990.

When the unskilled-labour intensive input is also more capital intensive than the other, conclusions are not so straight.

The brief summary above shows that the controversy whether outsourcing is good or bad hasn't, at least, a globally accepted answer. Economists involved in actual negotiations and policy making are aware that arguments based on global welfare are not very convincing for special interests groups. For this reason, the question of outsourcing is also of importance for Latin American countries, particularly for an economy with the manufacturing potential of Brazil. As fragmentation is a two-way process which, to be fully rewarding, has at its back a belief in free trade, many people fear that engaging in such world process will eventually mean loss of jobs in countries where job creation still is a main objective.

The answer depends upon many conditioning points. First, the sectors to engage into fragmentation must be identified; then an analysis must be performed on how this will take place, and, finally, an overall evaluation must be made on the several interrelationships and related gains/losses that this will entail. To our knowledge, no prospective study in this line has been conducted for any LA economy.

3. Methodology.

The expansion of international fragmentation of production along with globalisation has attracted substantial (theoretical as well as empirical) attention since the last decade. It has led to a body of research aimed at finding its causes, content and effects. A main attempt is the comprehensive volume edited by Arndt (2001); many different papers having followed since then.

A standard denomination in the literature for the phenomenon of fragmentation is lacking. [Sanyal & Jones \(1982\)](#) called *middle products* the pair of inputs entailed for the production of final goods - those available in the domestic market and those obtained abroad. [Yeats \(2001\)](#) and [Kimura & Ando \(2005\)](#) used *production sharing* to refer to the internationalisation of a manufacturing process of a specific good, in which several countries participate at different stages of the process. Likewise, terms such as super-specialisation, vertical integration and outsourcing constitute other examples by which it has been denominated ([Arndt \(1998\)](#), [Hummels et al. \(2001\)](#), [Feenstra et al. \(1998\)](#)).

By investigating the forces that might have underpinned its expansion, [Athukorala & Yamashita \(2006\)](#) pointed out that

1. advances in production technology,
 2. innovations in transport and communications, as well as
 3. liberalisation and trade reforms undertaken by many countries,
- can be considered as the three main facts which have lowered service-linked costs and created new opportunities for extending production fragmentation across national frontiers. They analysed the nature, trends and patterns of fragmentation trade with special attention to East Asian economies, using recent and detailed UN data. Apart from evidencing a substantial expansion of such trade, they found that the degree of dependence on sharing production is proportionately larger in East Asia than in either North America or Europe.

[Jones & Kierzkowski \(2005\)](#) took into account the geographical dimension, emphasising the role of transport costs and service linkages and their contribution to international outsourcing, as compared to production within the borders of a single economy. [Van Long et al. \(2005\)](#) also explored the key role services may play in limiting fragmentation. To produce components and connect them to other production blocs, an economy needs both manufacturing labour and services. The greater the range of services a country has, the more efficient is its components output, and more flexibility it shows in engaging in different, several chains. Nonetheless, in an economy with a greater range of services – usually bigger and more developed -, they may be more expensive, perhaps due to higher labour costs. Therefore, the trade off between scope in the supply of services and their related cost determines what types of components will be produced in which country.

Our purpose here is, however, to focus more on the empirical approaches that can be used in the Latin American case. In this vein, [Feenstra \(1998\)](#) is the first paper trying to draw a quantitative assessment of the fragmentation flows - with special attention to the US case -, using the standard source for trade analysis: COMTRADE data.

He provides evidence that differences in factor prices across national borders is one of the main forces on a firm's outsourcing decision. As firms in developed countries tend to shift their unskilled-labour stages of production towards unskilled-labour abundant developing countries, fragmentation may drive changes in the pattern of trade, by enhancing developing countries integration into the world economy. He also addressed the effects of fragmentation on the wages of unskilled workers in developed countries, pointing out that domestic employment is affected when firms decide to source their production overseas. This, however, impacts differently unskilled and skilled workers' wages. As unskilled labour in a developed country is relatively more expensive than abroad, the outsourced activities will be those that use a large amount of it and, consequently, the demand for unskilled- relative to skilled-labour within an industry will shift downwards¹⁰. Yet, trade (through international fragmentation) and technology are complementary rather than competing explanations for the change in employment and wages.

In his comprehensive paper, [Feenstra \(1998\)](#) used three methods to measure the relative importance of fragmentation:

- i) a first one, based on a reclassification of trade data using the "end-use" categories of the Broad Economic Activities (BEA). As these categories *assign goods according to their use by purchase rather than by their production process*, this reclassification enables to identify which categories the pull of trade is concentrated in, as well as to analyse their evolution through time;
- ii) through imports of intermediate inputs by each industry. Input purchases data can be used to estimate imported intermediate inputs by industry¹¹. The estimated values can then be expressed relative to total intermediate inputs purchases;
- iii) the vertical specialization index proposed by [Hummels et al. \(1997\)](#), which is equal to the fraction of the total trade accounted by inputs that are both imported and then embodied in exports.

By using all these measures, Feenstra found that OECD countries had witnessed an increasing use of imported inputs as well as a reduction of domestic production activities.

In the context of the Asian economies, [Lemoine & Unal-Kesenci \(2004\)](#) analysed developments in assembly trade for China, reclassifying trade data by

¹⁰ Compare with the brief outline of Feenstra and Hanson (2001)'s formal model results in Section 2.

¹¹ It can be computed by multiplying the purchases of each type of input and its respective share in the economy. The obtained values are then aggregated by industry.

stage of production. As a country's exports may have high/low imports content, they considered the sectoral trade balances, measured by the Contribution Trade Balance index by [Lafay \(1994\)](#). The authors found that China's booming trade is crucially linked to world fragmented production processes. Specialization in assembly trade has enhanced the growth of its competitive manufacturing sector, being the main channel for technology transfers.

[Most studies till now have](#) addressed mainly developed countries or East-Asian developing economies, giving little or no attention whatsoever to Latin America. This might be explained by the fact that

[X] the majority of present-day statistical systems fail in compiling trade data under a value-chain perspective. In particular, with the exception of the US (and, to some extent, the EU), data on inward and outward flows of goods related by a fragmentation operation are not available.

Precise measurement of fragmentation entails finer trade data, and the best empirical studies have used not only standard international trade statistics but also complementary information not generally available for developing countries.

The possibility of identifying how the product 'travels around', being for instance shipped as semi-finished and returning nearly made, is a key factor to provide deeper insights. Such information, as stated above, is available only for the US flows and, in a more limited way, the EU ones. That's why [Görg \(2000\)](#) could use data from the Outward Processing Trade in the EU and [Feenstra et al. \(1998\)](#) used the US Offshore Assembly Programme (OAP) data to capture trade under customs arrangements in which complete/partial tariff exceptions or levy reductions are granted in accordance to the domestic input content of imported goods. Unfortunately, though focussing on Central America, this study has a somewhat limited policy implication, due to the special characteristics of the US programme.

[Yeats \(2001\)](#) used both international trade statistics – SITC (Standard Industrial Trade Classification), category 7, revision 3 - and the OAP data to assess the size and nature of global production sharing. The latter helped in the comparison of trade in parts and components with that in final products, gauging the magnitude of production sharing.

This methodology can be roughly adapted to trade data available for many Latin American countries. In the absence of OAP-like information, one must focus not only on parts & components comprised under the SITC-7 rev.3 group, but extend the analysis to those SITC product groups that, without being classified as

parts & components, are considered semi-finished goods used as inputs in the (fragmented) production of manufactures.

There are three reasons for the above inclusion. First, a country may be part of a production process at a stage which uses more intensively semi-finished rather than parts & components. Second, the SITC-7 category includes mostly parts & components for machinery and transport; nevertheless, industries such as chemicals, apparel and textiles, or footwear and even electronics, require also semi-finished products not comprised under it. Notwithstanding, the bulk of most studies is concentrated on parts & components.

The last reason is a crucial point in any study trying to assess fragmentation with imperfect data. The import flows of both parts & components and semi-finished *must* always be contrasted with the export flows in the same categories *and* those of final products. A country may present impressive exports of final and semi-finished¹² goods giving, at first, a suggestion of a positive insertion in fragmented chains. Inspection of its import flows may signal, however, that it only slightly processed significant inflows of related goods, re-exporting them to more advanced centres. In this case, we merely have a setting similar to the old *maquiladoras* phenomenon – a classical characteristic, for decades, of the Mexican economy -, with no valuable competitive insertion in the world economy. Striking examples of this are provided, mainly for the electronics industry, by Philippines and Malaysia, which show a portfolio of more than 45% of exports in the high-tech sectors, while domestic spending on R&D is well below 1% of GDP!¹³

Using a revised version of the Broad Economic Categories (BEC), one can reclassify SITC products into categories corresponding to their intermediate or final use. In order to identify the stage of production that any SITC product is related to, one approach is to follow the [Lemoine & Unal-Kesenci \(2004\)](#) classification. They identify three stages of production:

- (a) primary goods (I);
- (b) intermediate goods, split up into two categories: semi-finished products (II) and parts & components (III);
- (c) final goods, which also split into two categories: capital goods (IV) and consumption goods (V).

¹² Even geographically diversified.

¹³ In a few, interesting papers, Martin Srholec discusses these and other cases (see, for instance, Srholec (2006)),

Being based on the BEC, use of this classification implies matching SITC-rev.3 items to the BEC ones, in order to then compute, from COMTRADE data, the trade profiles by stages of production. Of great help is the file on this available from the UN Statistical Office ([//unstats.un.org/unsd/cr/registry](http://unstats.un.org/unsd/cr/registry)).

The correspondence between stages and BEC codes is shown below:

| Stages of production | | BEC code | Bec description |
|----------------------|------------------------------------|---|---|
| Primary goods | | 111 | Food and beverages mainly for industry |
| | | 21 | Industrial supplies, n.e.c, primary |
| | | 31 | Fuels and Lubrucants, primary |
| Intermediate goods | Semi-finished goods | 121 | Food and beverages, processed, mainly for industry |
| | | 22 | Industrial supplies, n.e.c, processed |
| | | 321 | Motor spirit |
| | Parts and Components | 322 | Other processed fuels and lubricants |
| 42 | | Parts and components of capital goods, except for transport equipment | |
| Final goods | Capital goods | 53 | Parts and components of transport equipment |
| | | 41 | Capital goods except transport equipment |
| | Consumption goods | 521 | Other industrial transport equipment |
| | | 112 | Food and beverages, primary, mainly for household consumption |
| | | 122 | Food and beverages, primary, processed, for house consumption |
| | | 51 | Passanger motor cars |
| | | 522 | Other non-industrial transport equipment |
| 61 | Durable consumer goods n.e.c | | |
| 62 | Semi-durable consumer goods n.e.c. | | |
| 63 | Non-durable consumer goods n.e.c. | | |

For the matching job, COMTRADE statistics available up to either five or seven-digits of the SITC rev.3 are in general used. Focus is basically on the parts & components flows - category 7 in the SITC -, the main (and classical) locus of fragmentation relations. However, as said, semi-finished (group II) also play an important role.

In any case, further work is needed for accurately measuring the degree of fragmented inputs in final goods exports¹⁴, a point deserving a more detailed answer.

4. Fragmentation: a few empirical examples.

The Calfat and Flôres (2008) study for Mercosul

¹⁴ Though – from the partial evidences collected so far - we fear it to be negligible in the South American case. (See the next section)

Table 1¹⁵ shows, according to the stages-of-production classification, how Mercosul's trade flows distribute themselves. A first striking point is the negligible to small participation of parts & components exports in all four economies. In 2004, they ranged from 0.3 %, for Paraguay, to the modest 11.0 %, for Brazil. Semi-finished flows present sizeable contributions, both in the exports and imports side, what might signal a positive insertion. Unfortunately, as discussed in the paper, this is not the case. Moreover, the amount of imports in this category is far superior, in gross value, than the exports of capital goods, and quite many times even the combined exports of final goods, showing that, very likely, rather than "travelling semi-finished", those entering the main economies are internalised in production for domestic consumption.

The above pattern is clearly noticeable for Brazil – where, in 2004, \$18.5bn of imports, outdid \$14.1bn of consumption goods exports – and Argentina – where, even in 2004¹⁶, \$6.6bn must be contrasted to \$5.8bn of (total) final goods exports. It is only slightly reversed in Uruguay – \$0.96bn against \$1.18bn of consumption goods, in 2004 –, but not in Paraguay, in spite of the special character of these two economies. Truly, exports of semi-finished are, but for Uruguay, always higher (in per cent) than imports, but they refer to mostly different goods.

Insert Table 1 by here

These patterns may look somewhat unexpected, specially for the two biggest economies. In fact, Brazilian trade policy, though lacking a more consistent and sustainable focus, has tried, from time to time, to strengthen the expansion of trade in manufactures. Automobiles, aircrafts and shipbuilding have benefited from specific support programmes. Moreover, the country has become a world-class manufacturer of a few selected products, like motor vehicles, aircraft, and certain (basic) electronic products, machines and equipment.

The economic troubles of Argentina, specially during 2001 and 2002, may help in explaining why, except for 2004, intermediate products constitute by far the foremost category in both exports and imports (70% of total exports and 64%

¹⁵ All tables and figures are to be found at the end of the text.

¹⁶ Some could argue that 2003, rather than 2004, displays a more representative profile for the Argentine flows. However, the choice is debatable and, for the sake of comparisons, we used 2004.

of total imports, in 2003), with semi-finished products being the most representative sub-group. The parts & components share oscillates around 6% of total exports, whilst its relative participation in global imports has decreased. Final consumption goods (sub-group V) have fairly increased their relative participation in exports, while within total imports it has greatly decreased. The substantial significance of both intermediate and final goods in the Argentine trade structure might, as said, suggest that its manufacturing sector is strongly linked to fragmented chains of production, what turns out not to be the case.

Intermediates also represent the most important category in the Brazilian trade structure. Although exports in parts & components make around 12% of total exports, during the period under analysis, semi-finished products again appear as the most important sub-group within this category. Consumption goods are the most representative subgroup within exports of final goods.

Comparing the exports shares in Argentina and Brazil, we observe that capital goods (sub-group IV) hold a relatively greater participation in the latter, suggesting that the Brazilian manufacturing sector would be more connected to high-tech production chains than Argentina. The modest percentage, in both countries, of exports of primary goods is an indirect evidence of the effort both are making to upgrade their raw materials and commodities exports. Indeed, it is this what explains the high values for semi-finished which, unfortunately, rather than being related to fragmented flows, are made up of roughly processed commodities and natural resources goods. In other words, mainly commodities barely out of stage I.

As for the direction of trade in parts & components by regions and countries, a *South-South pattern emerges*, thanks to the large amount of trade with Mercosul, by far Argentina's leading partner in either imports or exports in parts & components. The share of Mercosul in the Argentine imports increased persistently from 22% in 2000 to 27% in 2004 (see Figure 1). By contrast, the share in total parts & components exports decreased from 56% in 2000 to 44% in 2003, recovering in 2004 to 50%. Inside this bloc, Table 2 shows that Brazil constitutes the leading partner, which is not surprising since both countries maintain intra-industry linkages, especially in the automotive sector.

Insert Tables 2 and 3 by here

Though the share of the European Union (EU) is declining, it still represents another important destination. It accounted for 24% of total imports in parts & components in 2004, down from 31% in 2000. Exports to the EU slightly increased from 14% in 2000 to 16% in 2004. Inside this bloc, Germany and Spain display the most representative shares in both imports and exports, in 2004 (see [Table 2](#)).

NAFTA represents the third supplier of parts & components, with 17% of total respective imports in 2004 (decreasing from 23 % in 2000). This lower figure is mainly explained by the fall of the US share, which recorded only 13.8% of total Argentine imports in parts & components in 2004, in sharp contrast with the 18.5% recorded in 2000. Likewise, Mexico shrank slightly its share from 2.2% in 2000 to 1.9% in 2004. On the export side, NAFTA kept a steady share of over 20% during the whole period, though Mexico decreased from 9.4% in 2000 to 6.8% in 2004.

The share of the “other East Asian bloc” in total imports also decreased from 8% in 2000 to 6% in 2004. The huge increase in imports from China (a two-fold increase in import value, from \$10.1m to \$19.5m, resulting in a rise in market share from 2.8% in 2000 to 6.3% in 2004) is particularly noteworthy. Japan instead showed a tiny increase from 6.6% in 2000 to 7.2% in 2004. Moreover, “other East Asian bloc” shares in total Argentine exports in parts and components fell from 1.3% in 2000 to 0.13% in 2004.

Two additional features are relevant. First, the combined Asian bloc is supplying 17% of total imports in category 7, being already at the same level of NAFTA. However, no such goods ‘flow back’ to Asia, showing the total decoupling of Argentina as a supplier to this part of the world. Second, a significant ‘leakage’ of 8% of exports to South America is noticeable. This growing importance of a regional trade of more sophisticated character is becoming an important component of Mercosul flows in general.

While the Argentine pattern in parts & components depicted a pro-South-South pattern, the Brazilian trade followed a more North-South pattern (Figure 2). The EU has progressively become Brazil’s leading supplier, holding around 30% of the total imports in parts and components by the end of 2004. In decreasing order, Germany, Spain, France and Italy are the main sources within this bloc. However, Germany, Spain and Italy decreased slightly their shares from 10%, 3.4%, 4.5% in 2000 to 9%, 2.8% and 4.5% in 2004, respectively. France instead increased its share from 3.5% in 2000 to 5.5% in 2004 (see [Table 3](#)).

NAFTA, the second supplier, decreased substantially its share from 36% in 2000 to 25% in 2004 (see [Table 3](#)). Inside this bloc, only the US ranks among the

top ten major sources of Brazilian imports. Though it held a quite significant share into the Brazilian market, it declined from 33.4% in 2000 to 22.5% in 2004. This can be explained by the expansion of China, whose penetration in the Brazilian market has rapidly increased.

Imports from Asia are also noteworthy. The “other East Asian bloc” increased from 13% in 2000 to 19% in 2004. Imports from Korea and Taiwan were the most representative within this bloc. Both economies held increasing shares from 4.3% and 2.5% in 2000, to 7.4% and 3.4% in 2004, respectively. China has substantially raised its share from 3% in 2000 to 8% in 2004.

Brazil has truly diversified its export markets in parts & components. While in terms of value, exports to NAFTA slightly increased from \$2.0m in 2000 to \$2.7m in 2004, the relative importance of NAFTA declined from 45% in 2000 to 41% in 2004. This fall is mainly explained by the declining importance of the US, whose share shrank from 35% in 2000 to 31% in 2004.

In contrast, the relative importance of exports to the EU rose significantly from 17% in 2000 to 23% in 2004. Three of the four main EU-partners of Brazil increased substantially their share (Germany, France and United Kingdom, from 5.8%; 1.4%; 1.9% in 2000, to 7.5%, 2%; 5% in 2004, respectively).

The share of Mercosul fell down from 20% in 2000, to 14% in 2004, due to the fall of Argentina’s share in Brazilian exports, from 18% in 2000 to 13% in 2004. This helped to re-orient the direction of the Brazilian trade in parts & components towards a more North-South pattern

As regards the Asian blocs, the increase of China in the Brazilian exports, from 0.6% in 2000 to 3.6% in 2004, is noteworthy. Contrariwise, those of Japan and “other East Asian bloc” are really small and decreasing. This is not unexpected, since Brazil represents one of the main locations in which Japanese manufacturing firms develop their activities in Latin America, particularly in the machinery sectors.

The analysis then moves to goods, investigation being performed at the five-digits level. In the case of Argentina (tables not shown), in 2004, the twenty main products constituted jointly 56.9% or about \$1.77bn of total imports in parts & components and 84.4% or about \$1.02bn of total exports in these goods. Five of the twenty major imports are linked to the automotive industry, accounting for over 29% of total imports in category 7, with parts and accessories for road vehicles (SITC 78439) alone accounting for \$399.0m, or about 13% of the total exchange in these goods. Gearboxes (78434) is the only item in the automotive industry to show a positive trade balance during the whole period. Though this is

explained by the fact that, during the last years, the sector has attracted investments from leading multinational carmakers, induced by the lower production costs and the growing domestic market¹⁷, the country continues to be a net importer of the four other parts.

Products linked to machinery and equipment are fairly significant. Compression-ignition engines (71323) raised their share from 2.9% in 2000 to 5.7% in 2004, and 5.2 in 2005, whereas they have reduced their exports shares from 10% in 2000 to 4% in 2005. Products related to the electrical machinery industry, as boards (77261), parts of electrical ignition (77833), electrical equipment (77834), are also noteworthy: they jointly accounted for 5% of total exports. Office machines products are ranked also as major items, parts and accessories for calculating machines (75997) being the most representative group, with 7% of total imports in parts & components.

Though the relative importance of the selected products in the Argentine trade in parts & components has risen, the one in the total trade shows another picture. On the export side, stagnation prevails, representing either in 2000 or 2005 only 5% of total exports, whilst on the imports side their relative importance has slightly increased from 81% in 2000 to 83% in 2005.

In the case of Brazil, the major twenty groups represent around 46% of total imports in parts & components and about 74% of all exports of this kind in 2005. Half of them record a positive trade balance, since Brazilian manufacturing not only develops assembly activities but also produces some high technology components. Six of the twenty major groups are related to the automotive industry, accounting for 14% of total imports in parts & components and about 32% of total exports. Parts and accessories for motor vehicles (78439) is the most representative, having improved its trade balance through time. However, the whole group 78 of car parts (six goods, in the Brazilian case) is much less relevant than in Argentina, highlighting the more diversified Brazilian patterns. Moreover, the country is consistently a net importer in only two of them, gearboxes (78434) being one¹⁸.

Besides the automotive industry, machinery and equipment is also representative. Four of the twenty major groups are related to this sector; in 2004, they accounted jointly for over 6% of imports and about 29% of exports, having raised their relative participation from that showed in 2000 (23%) only on the export side. Among these four groups, piston engines (71322) greatly raised from over 4% in 2000 to about 8% in 2004. In decreasing importance, parts and

¹⁷ The case of gearboxes is somewhat special, as Argentina is an important international supplier of this component.

¹⁸ See the previous footnote.

components related to the electronics and telecommunications industries are also included among the major groups. Noteworthy are goods 71441 and 79295, related to the aircraft industry, with somewhat decreasing percentages as regards imports, though the country remains a net importer of both. As expected, EMBRAER output has a fragmented side.

Although, in terms of value added, trade in parts & components has greatly increased, the relative importance of the major groups (now) in total Brazilian exports has not. On the imports side, these twenty groups participation in total Brazilian imports oscillated around 12.75%, with a slightly increasing trend, reaching 13.80% in 2004. On the exports side, they have slightly decreased their share from 9.22% in 2000 to about 8.67% in 2004.

Tables 4 and 5 move to semi-finished, showing the top exports for Argentina and Brazil. The nature of the goods is telling, giving a disturbing picture of the situation. Things look worse for Argentina, where the top four - oil cake of soybeans, crude soybean oil, prepared equine/bovine leather and crude oil of sunflower seed – represent 53.6% of total exports in semi-finished, many other roughly processed commodities figuring in the remaining items. Moving to Brazil, while the top three are similar to the previous four, they account for only 22.0% of the exports. Brazil's profile is more spread and diversified, with a greater presence of – though roughly processed – items from the steel, paper and chemical industries. Nevertheless, these results confirm points previously raised.

Insert Tables 4 and 5 by here

Summing up, the study made a first attempt to assess the importance of world production sharing in Mercosul, with special emphasis on Argentina and Brazil. Two conclusions are worth mentioning:

i) Mercosul's insertion in world fragmentation processes is still modest, led by a promising though incipient diversification by Brazil. NAFTA and the EU are the main partners in this process, though the Asian group, with notably China and Japan, is becoming a serious supplier. A starting penetration in the South American market is also taking place, suggesting that Mercosul might, in a smaller scale, be reproducing there features of a Northern behaviour;

ii) the significant semi-finished flows are mostly deceiving, as, in terms of exports, they mainly relate to crude elaborations of raw materials, commodities or natural

resources; though the picture is better for Brazil, mainly due to a greater diversification of such exports.

An immediate policy line stands out. Upgrading the semi-finished flows seems mandatory, as most are leaving the bloc as very low value-added goods that can then enter different value chains. Some Brazilian firms are already pursuing this line - even by opening further processing plants elsewhere to transform the corresponding semi-finished¹⁹ -, that should receive priority in both economies. Further improvement and liberalisation of the whole group of associated producer services would also greatly help in this effort, being services nearly a pre-condition for engaging in fragmented processes.

The Lemoine and Unal-Kesenci (2004) study on China

This paper, using data up to 1999/2001, examines how China's trade policy in favour of fragmented trade has enhanced production sharing with Asian partners, allowing for a rapid diversification of its exports. As the former example, it presents an analysis of China's trade by stages of production *and by technology content*. Its key conclusion is that intermediates, or semi-finished, have played a crucial role in the technological upgrade of the country's trade flows.

Since the mid-1980s, the Chinese authorities have practised an active trade policy, with duty exemptions to imports to be processed and re-exported. Two broad regimes are distinguished: i) processing trade, encompassing imports to be processed for export and the corresponding exports; ii) ordinary trade, encompassing exports mainly based on local inputs, and imports for the domestic market and subject to normal tariff rates. Table 6 shows the dramatic importance of processed trade along the nineties. While processed exports went mainly to the US, the New Industrialised Economies²⁰ (NIEs), Japan and the EU, imports for processing came basically from the NIEs and Japan. Indeed, the NIEs and, to a lesser extent, Japan, more than a supply chain relationship, enjoy a close productive integration with Greater China.

The rapid expansion of China's processing trade was associated with far-reaching changes in its commodity composition. The traditional sectors (apparel, leather and shoes) accounted for more than 40% of processed exports in 1993, but only 26% in 1999. A shift towards machinery and electrical machinery took place, as shown in Table 7. In many sectors or sub-sectors, China does not master the entire production processes, but has established its specialisation in the final,

¹⁹ Though some are also motivated by tariff jumping or bypassing of trade policy instruments, like anti-dumping.

²⁰ Hong Kong, Singapore, South Korea and Taiwan.

labour-intensive stages of production. This amounted to a high concentration of both intermediates in *imports*. In the case of exports, though semi-finished have a strong (though much smaller) presence, parts & components show values close to those for Brazil, in the previous example (Table 7).

Insert Tables 6 and 7 by here

Foreign affiliates were responsible for most of the expansion of processing activities, and held a dominant share – more than 70% - in them in 2001. They also played an outstanding role in China's processing trade with other Asian countries (see Table 8). Most firms from these countries have chosen to establish affiliates in China, instead of contractual relationships with Chinese firms for out-processing. Indeed, they have tended to establish wholly foreign affiliates, rather than equity joint-ventures. *A large portion of China's trade thus corresponds to intra-firm trade between parent firms in Asian countries and their plants in the Mainland.*

The Chinese trade pattern is concentrated in final goods, as relates to exports, and intermediates, in the case of imports (Table 9). The country is a net importer of high-tech goods: they represented 145 of its imports and 8% of its exports, on average, in 1997-99.

Parts & components constitute the main channel of high-tech imports, accounting for 57% of them, in 1997-99. Capital goods accounted only for one-third. On average, imported parts & components embody more high-technology than other categories of imports. This suggests that export-oriented, internationalised industries have a higher capacity to import and absorb high-technology than traditional, domestic-based ones.

Insert Tables 8 and 9 by here

Since imported parts & components are used, at least partially, in export processing industries, China's exports are more technologically advanced than

would be expected, given its level of development²¹. In a coherent fashion, with the exception of chemicals, China's high-tech exports and imports take place in the same sectors.

After the Asian countries, Western Europe is the most important source of high-tech products (almost ¼ of total high-tech imports). In contrast with Asia, the West-European products are mostly capital goods. European transfers of technology to China follow a more traditional pattern, as they are aimed at modernising investment capacity and not at re-exports. Imports from the US are evenly distributed between capital goods and parts & components, but the US ranks second as *a market for Chinese high-tech exports* (about ¼ of them), far ahead Western Europe (14%).

It is worth stressing that although Europe and the US stand far behind Asia as suppliers of high-tech products, their total exports to China are, on average, more technologically intensive than those from Asia.

As known, the share of high-tech goods in China's exports may be misleading, since it does not reflect the innovative capacity of its manufacturing industry, but rather the technology produced in the advanced economies embodied in them. The outward-oriented sector has obviously provided substantial gains to the economy, but its impact on the technological upgrading of the domestic industry is less easy to assess. Broadly, it can be said that a positive impact has taken place, due not only to such industries but also to spillovers from foreign affiliates, which have raised the local content of processed exports.

Finally, the analysis of exports by trade regime, type of firms and sector shows that Chinese firms and foreign affiliates tend to be positioned in different product markets, which correspond to their respective resilience on local *versus* imported inputs (see Table 10). Chinese firms' exports rely mainly on ordinary exports (like garment, textiles and chemicals) integrated in domestic chains. Foreign affiliates' exports are concentrated in processed goods (mainly machinery and electrical machinery) resulting from international production sharing. This – returning to the question in the previous paragraph – signals to relatively weak linkages between the outward-oriented sectors and the domestic-based exports.

Insert Table 10 by here

²¹ Compare with the drastic case of electronics exports in Philippines and Malaysia, mentioned at the end of Section 3 (and discussed in the papers mentioned in footnote 13).

5. A simple complementary methodology: assessing the international positioning of a good in a fragmented production process.

Industrial and trade policy require detailed knowledge of exporting and importing markets at a disaggregate product level. Accordingly, in the competitive environment of fragmented production, it is not enough to show a given insertion. The way this insertion evolves in time is crucial, as new partners and actors occupy apparently secure positions, elbowing out previous suppliers, and destroying their hopes of upgrading their status along the production chain.

Any given insertion must be contrasted with the positions held by the main rivals through time. In order to illustrate a simple way to perform this important analysis, we present a few examples of how the Argentine and Brazilian exports of parts & components are spread among different countries, and how robust is this spread.

For the top five exports of each of these countries, we found the five main destinations (markets; in volume). Inside each of these markets, the evolution of the position of the exporter, *together with those of its main competitors*, is ascertained. According to it, positioning can be (informally) classified as ‘stable’ or ‘menaced’.

Tables 11 and 12 show some results for Argentina, while tables 13 and 14 do analogously for Brazil. In the case of Argentina, the notorious gearboxes (78434) are perhaps the best illustration²². Even their dominant position in Brazil, which answered for 37.5 and then 51.9%, in 2000 and 2005, respectively, of the product exports, is under threat. Table 12 explains why. In 2000, Argentina held a comfortable market share of 41.4%, other main suppliers, the US and Germany, coming far below, with 18.0 and 13.7%, respectively. The situation begins to change in 2002, when Japan enters the market, capturing, in that year, 18.4% already. In 2005, though Argentina’s position recovers somewhat to 30.7%, it has a close-by Japan with 26.2%. Moreover, the US and Germany have at least held their absolute positions, while a new player, Switzerland, appears (replacing France (2002) and Chile (2000) in a volatile fifth rank). The market has become bigger, but Argentina is surely under threat.

Insert Tables 11 and 12 by here

²² See the previous Section.

Similar analyses can be performed for Brazil. Again, in only 2 of the 15 markets analysed the Brazilian situation can be taken as stable. Product 71391, of the important power-generating engines sector, is a good example (Table 13). Taking the US market, Brazil enjoyed, in 2000, a 3% share, together with Germany (2.9%), in a market dominated by Japan, Canada and Mexico, in this order. In 2002, the very competitive US environment shows a slight decrease in the fraction held by the top 3 – now 82%, instead of 86%, before – and Germany overtakes Brazil, that however sticks to a 3.1% share. In 2005, Mexico changes position with Canada in the top 3, whose combined share continues to decline (now 78.9%), *and a new player, China, elbows Brazil out, which, with 2.6%, goes down to the sixth rank* (not shown). The market has experienced some growth; though Brazil, in absolute terms, has kept its flow, it is definitely under threat.

Insert Tables 13 and 14 by here

The main message clearly is that

[XI] *fragmentation is a very dynamic process and, specially for LA countries, continuous time analyses are required to correctly gauge the development and success of the international insertion.*

6. Conclusions and policy guidelines.

Sharing production has become a key feature of the world economy. If it raises important implications for those who can participate in it, it also decreases the opportunities available for those outside the process.

Many policy implications are raised by it, ranging from the pattern of the world division of labour to the sustainability of each individual country trade flows. Without making a detailed list of all relevant issues, it is worth highlighting a few points considered strategic.

First, it is important to identify “sources and destinations”, i.e., markets/countries that will act as partners in a fragmentation process. The regional market seems crucial for economies like Argentina and Brazil, but the US stands

out as another major option. While the EU raises doubts, Asian economies must be seriously considered. Among them, China, of course, may both be a rival and an ally.

Secondly, the question of financing comes up. How can producers switch activities in order to engage in or profit from value chains? With their own funds? By way of state resources? The issue is not negligible and, within a policy framework, should receive attention. Small and medium enterprises can be an interesting component of the fragmented industries, and investment lines from private commercial or investment banks could be encouraged. The Chinese example has also called attention to the importance of carefully planned foreign direct investment (FDI) in the outward-processing sectors.

Thirdly, and related to the above, is the institutional setting. As just mentioned, and briefly discussed in Section 4, China showed how the combination of trade and FDI policies were crucial for the fast catching-up of the country, alongside the value chains. A few governmental measures seem unavoidable; whether at a federal or regional level is a question to be further considered.

Then, it is worth reminding that a sound analysis goes beyond the economics of the facts. Sectoral studies, taking into account the technical characteristics of each production process and its feasible alternatives in the domestic context, must be coupled to the evidence emerging from the trade flows and productive structures.

Finally, we highlighted throughout the text eleven key points on fragmentation²³. Needless to say, we think they should be kept in mind whenever this subject is treated.

Nowadays somewhat better times for LA economies seem to be *the* moment to address a courageous rethinking of the present situation. This should contemplate a dual objective. Improve the insertion into global chains, while creating more employment opportunities inside each member country and strengthening the links among the different economies in the region. Reconciling both is far from obvious, though not impossible.

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²³ Written in *italics* and marked with Roman numerals ([I], [II], etc).

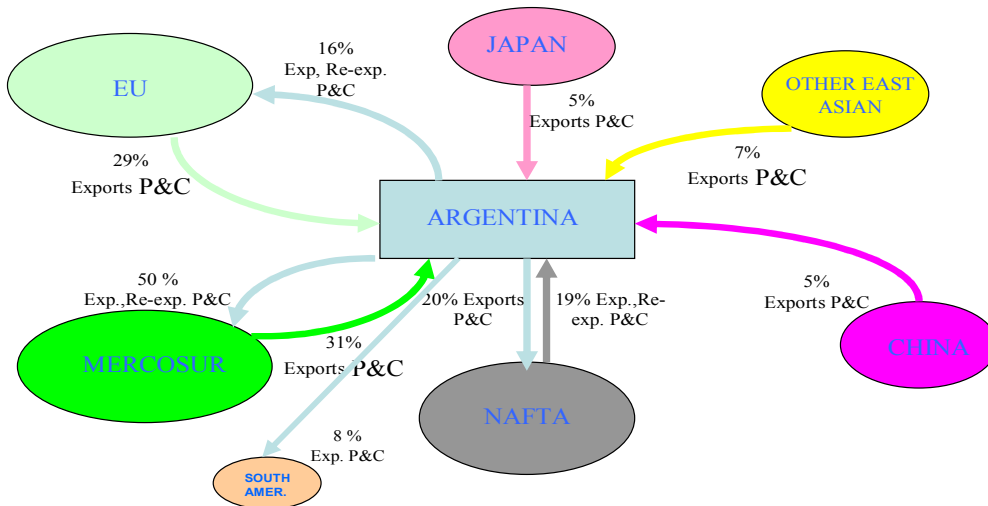
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ANNEX: Selected Figures and Tables

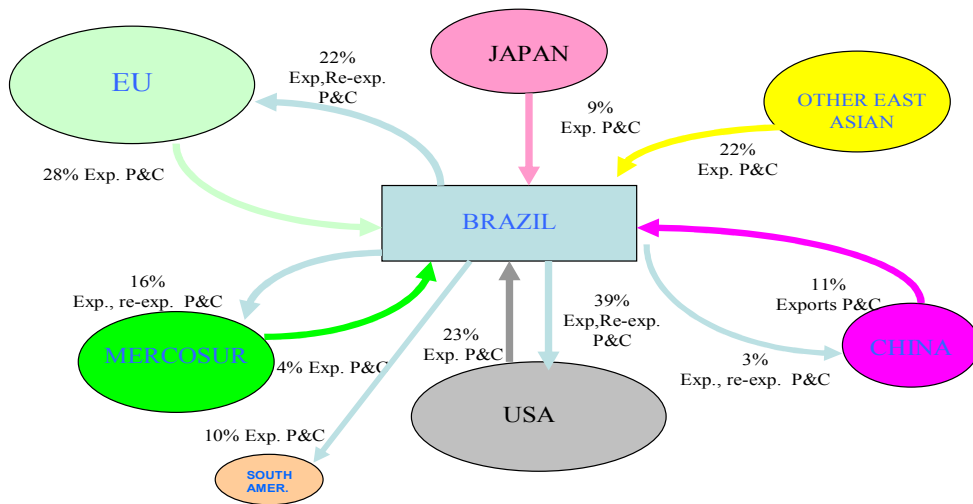
(Figures 1 and 2, and tables 1-5, 11-14 are adapted from Calfat and Flôres (2008), tables 6-10 are adapted from Lemoine and Unal-Kesenci (2004))

Figure 1: Argentina – Fragmentation : parts & components flows, 2005.



Source: COMTRADE –SITC rev 3. Statistics for 2005

Figure 2: Brazil – Fragmentation : parts & components flows, 2005.



Source: Authors' calculations based on COMTRADE –SITC rev 3. data, 2005

Table 1: Mercosul members - Trade by stage of production; 2000-2004.

| Country | Stage of Prod ^{a/} | | Exports (in percentage) | | | | | Imports (in percentage) | | | | |
|-------------------------|-----------------------------|-----|-------------------------|--------------------|------|------|------|-------------------------|--------------------|------|------|------|
| | | | 2000 ^{7/} | 2001 ^{7/} | 2002 | 2003 | 2004 | 2000 ^{7/} | 2001 ^{7/} | 2002 | 2003 | 2004 |
| Argentina | Primary | I | 2.5 | 2.1 | 1.8 | 1.6 | 1.4 | 1.4 | 1.4 | 2.6 | 2.1 | 1.2 |
| | | II | 58.6 | 61.1 | 62.5 | 64.6 | 61.9 | 34.5 | 37.5 | 49.9 | 46.4 | 25.0 |
| | Intermediates | III | 6.5 | 5.8 | 5.9 | 5.4 | 6.1 | 19.9 | 18.9 | 19.3 | 17.8 | 11.7 |
| | | IV | 7.7 | 7.6 | 6.9 | 5.0 | 5.7 | 24.4 | 21.0 | 14.1 | 19.2 | 53.7 |
| | | V | 23.9 | 22.5 | 22.1 | 22.7 | 24.1 | 19.0 | 20.3 | 13.3 | 13.6 | 7.4 |
| All above (billions \$) | | | 15.7 | 15.3 | 14.4 | 16.5 | 19.7 | 18.3 | 15.6 | 6.7 | 10.4 | 26.3 |
| Brazil | Primary | I | 5.9 | 4.8 | 4.9 | 4.6 | 4.5 | 2.3 | 2.4 | 3.1 | 3.3 | 3.9 |
| | | II | 48.4 | 47.0 | 47.7 | 48.5 | 46.7 | 37.9 | 38.2 | 37.0 | 39.4 | 40.7 |
| | Intermediates | III | 12.5 | 12.2 | 11.8 | 11.6 | 11.0 | 26.8 | 26.8 | 27.1 | 28.6 | 29.6 |
| | | IV | 12.2 | 11.9 | 11.6 | 11.6 | 14.0 | 19.2 | 23.1 | 22.1 | 18.6 | 16.2 |
| | | V | 20.1 | 23.3 | 23.1 | 22.8 | 23.2 | 13.0 | 8.5 | 9.7 | 9.1 | 8.8 |
| All above (billions \$) | | | 36.1 | 37.0 | 37.8 | 45.8 | 60.6 | 45.5 | 43.9 | 35.9 | 36.0 | 45.6 |
| Uruguay | Primary | I | 6.3 | 6.4 | 6.7 | 7.3 | 8.4 | 1.8 | 2.5 | 3.8 | 5.3 | 4.3 |
| | | II | 40.7 | 46.3 | 45.0 | 42.3 | 36.6 | 39.1 | 39.9 | 44.8 | 49.9 | 48.2 |
| | Intermediates | III | 1.8 | 1.5 | 1.6 | 1.7 | 2.0 | 12.3 | 11.0 | 10.0 | 9.4 | 9.8 |
| | | IV | 3.5 | 2.7 | 1.7 | 1.8 | 1.7 | 18.0 | 16.8 | 13.6 | 11.3 | 15.7 |
| | | V | 47.7 | 43.0 | 45.0 | 46.9 | 51.3 | 28.8 | 29.8 | 27.8 | 24.1 | 22.0 |
| All above (billions \$) | | | 1.9 | 1.7 | 1.5 | 1.7 | 2.3 | 2.4 | 2.2 | 1.3 | 1.4 | 2.0 |
| Paraguay | Primary | I | 5.8 | 4.8 | 6.0 | 3.8 | 4.0 | 0.6 | 0.6 | 0.9 | 1.1 | 0.7 |
| | | II | 62.1 | 55.8 | 69.1 | 72.0 | 67.1 | 37.7 | 42.9 | 32.9 | 34.7 | 32.6 |
| | Intermediates | III | 0.7 | 0.4 | 0.3 | 0.3 | 0.3 | 9.3 | 9.1 | 11.7 | 10.8 | 9.5 |
| | | IV | 0.8 | 1.2 | 0.6 | 0.9 | 0.6 | 17.3 | 16.1 | 22.7 | 24.3 | 25.6 |
| | | V | 30.6 | 37.8 | 24.1 | 23.0 | 28.0 | 35.1 | 31.3 | 31.8 | 29.1 | 31.5 |
| All above (billions \$) | | | 0.3 | 0.3 | 0.4 | 0.4 | 0.7 | 1.5 | 1.6 | 1.0 | 1.4 | 1.9 |

a/ I : Primary goods; Intermediate goods: II: semi-finished products, III: Parts and Components; Final Goods: IV: Capital goods, V: consumption goods

Source : Authors' calculations based on COMTRADE and the Bank of Guatemala databases

Table 2: Argentine imports and exports in parts & components, by main partners.

| Partner | Imports (value in thousands \$) | | | | | Share(%) ^{*/} | | | | |
|----------------|---------------------------------|--------|--------|--------|--------|------------------------|------|------|------|------|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2000 | 2001 | 2002 | 2003 | 2004 |
| Brazil | 78082 | 67338 | 31441 | 47333 | 80777 | 21,4 | 22,8 | 24,3 | 25,7 | 26,0 |
| China | 10174 | 12512 | 3134 | 10514 | 19526 | 2,8 | 4,2 | 2,4 | 5,7 | 6,3 |
| Germany | 27150 | 17932 | 13099 | 16201 | 24405 | 7,4 | 6,1 | 10,1 | 8,8 | 7,8 |
| Spain | 15419 | 11192 | 7612 | 8712 | 12687 | 4,2 | 3,8 | 5,9 | 4,7 | 4,1 |
| France | 31996 | 18800 | 4521 | 6954 | 11365 | 8,8 | 6,4 | 3,5 | 3,8 | 3,7 |
| United Kingdom | 7450 | 7452 | 4953 | 3783 | 5163 | 2,0 | 2,5 | 3,8 | 2,1 | 1,7 |
| Italy | 12536 | 10386 | 3637 | 5211 | 10019 | 3,4 | 3,5 | 2,8 | 2,8 | 3,2 |
| Japan | 23985 | 27598 | 10362 | 14243 | 22350 | 6,6 | 9,3 | 8,0 | 7,7 | 7,2 |
| Areas Nes. | 20182 | 15634 | 7997 | 11624 | 27872 | 5,5 | 5,3 | 6,2 | 6,3 | 9,0 |
| USA | 67352 | 57794 | 23384 | 30192 | 42995 | 18,5 | 19,5 | 18,1 | 16,4 | 13,8 |
| | Exports (value in thousands \$) | | | | | Share(%) ^{*/} | | | | |
| Brazil | 529704 | 420704 | 372343 | 380179 | 575864 | 51,0 | 46,6 | 43,4 | 42,1 | 47,8 |
| Chile | 28850 | 27629 | 30149 | 33122 | 39286 | 2,8 | 3,1 | 3,5 | 3,7 | 3,3 |
| Germany | 59981 | 75148 | 60369 | 84248 | 58392 | 5,8 | 8,3 | 7,0 | 9,3 | 4,9 |
| Spain | 35141 | 28709 | 37057 | 25062 | 67568 | 3,4 | 3,2 | 4,3 | 2,8 | 5,6 |
| France | 23407 | 17454 | 20109 | 22426 | 19569 | 2,3 | 1,9 | 2,3 | 2,5 | 1,6 |
| Mexico | 97649 | 73279 | 74247 | 91627 | 81799 | 9,4 | 8,1 | 8,7 | 10,2 | 6,8 |
| Sweden | 10105 | 5205 | 21699 | 20468 | 8503 | 1,0 | 0,6 | 2,5 | 2,3 | 0,7 |
| Uruguay | 42574 | 20402 | 12922 | 10622 | 15652 | 4,1 | 2,3 | 1,5 | 1,2 | 1,3 |
| USA | 109231 | 102790 | 123304 | 127864 | 166906 | 10,5 | 11,4 | 14,4 | 14,2 | 13,9 |
| Venezuela | 10856 | 15316 | 7516 | 6530 | 21922 | 1,0 | 1,7 | 0,9 | 0,7 | 1,8 |

Data source: Authors' calculations based on COMTRADE database

*/ Share of total country's imports/exports in parts and components

Table 3: Brazilian imports and exports in parts & components, by main partners.

| Partner | Imports (value in thousands \$) | | | | | Share(%) ^{*/} | | | | |
|----------------|---------------------------------|---------|---------|---------|---------|------------------------|------|------|------|------|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2000 | 2001 | 2002 | 2003 | 2004 |
| Argentina | 51888 | 40813 | 35676 | 35514 | 56192 | 4,3 | 3,5 | 3,7 | 3,4 | 4,2 |
| China | 32228 | 33927 | 40807 | 60156 | 110992 | 2,6 | 2,9 | 4,2 | 5,8 | 8,2 |
| Germany | 117451 | 123778 | 109949 | 113541 | 118689 | 9,6 | 10,5 | 11,3 | 11,0 | 8,8 |
| Spain | 41857 | 46995 | 36528 | 33156 | 37537 | 3,4 | 4,0 | 3,7 | 3,2 | 2,8 |
| France | 42849 | 50998 | 44267 | 49448 | 74760 | 3,5 | 4,3 | 4,5 | 4,8 | 5,5 |
| Italy | 54645 | 57656 | 46781 | 39863 | 53849 | 4,5 | 4,9 | 4,8 | 3,9 | 4,0 |
| Japan | 128767 | 117729 | 92645 | 109010 | 128166 | 10,6 | 10,0 | 9,5 | 10,6 | 9,5 |
| Korea Rep. | 52912 | 53988 | 50045 | 60038 | 99716 | 4,3 | 4,6 | 5,1 | 5,8 | 7,4 |
| Taiwan | 30931 | 26017 | 29927 | 26381 | 47505 | 2,5 | 2,2 | 3,1 | 2,6 | 3,5 |
| USA | 407271 | 378542 | 258299 | 248299 | 303559 | 33,4 | 32,1 | 26,5 | 24,0 | 22,5 |
| | Exports (value in thousands \$) | | | | | Share(%) ^{*/} | | | | |
| Argentina | 816417 | 663169 | 322199 | 467898 | 848106 | 18,0 | 14,6 | 7,2 | 9,7 | 12,6 |
| Chile | 102727 | 105144 | 125915 | 114646 | 180818 | 2,3 | 2,3 | 2,8 | 2,4 | 2,7 |
| China | 26465 | 101748 | 152824 | 341224 | 240873 | 0,6 | 2,2 | 3,4 | 7,1 | 3,6 |
| Germany | 262881 | 295552 | 331632 | 357262 | 506125 | 5,8 | 6,5 | 7,4 | 7,4 | 7,5 |
| France | 63287 | 92630 | 84740 | 94349 | 146989 | 1,4 | 2,0 | 1,9 | 2,0 | 2,2 |
| United Kingdom | 87000 | 186830 | 261086 | 284468 | 344557 | 1,9 | 4,1 | 5,8 | 5,9 | 5,1 |
| Italy | 142110 | 135833 | 129953 | 150235 | 180936 | 3,1 | 3,0 | 2,9 | 3,1 | 2,7 |
| Mexico | 374769 | 410502 | 436436 | 401541 | 589704 | 8,2 | 9,0 | 9,7 | 8,3 | 8,8 |
| USA | 1610701 | 1475147 | 1644796 | 1775110 | 2064826 | 35,4 | 32,4 | 36,5 | 36,7 | 30,7 |
| Venezuela | 99919 | 165109 | 100827 | 85883 | 235117 | 2,2 | 3,6 | 2,2 | 1,8 | 3,5 |

Data source: Authors' calculations based on COMTRADE database

*/ Share of total country's imports/exports in parts and components

Table 4: Argentina, the top exports in semi-finished; 2000-2005.

| SITC | Product description | Exports (Value in millions \$) | | | | | | Share (%) | | | | | |
|-----------|--|---------------------------------|------|------|------|------|------|------------|------|------|------|------|------|
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| 08131 | Oilcake and other solid residues (except dregs), whether or | 2170 | 2401 | 2568 | 3260 | 3598 | 3798 | 23.5 | 25.5 | 28.4 | 30.3 | 29.4 | 27.9 |
| 42111 | Crude oil, whether or not degummed | 907 | 1000 | 1283 | 2002 | 2229 | 2120 | 9.8 | 10.6 | 14.2 | 18.6 | 18.2 | 15.6 |
| 61142 | Other bovine leather and equine leather, without hair on ... | 713 | 690 | 593 | 617 | 705 | 706 | 7.7 | 7.3 | 6.6 | 5.7 | 5.8 | 5.2 |
| 42151 | Crude oil of Sunflower seed | 479 | 341 | 474 | 496 | 494 | 669 | 5.2 | 3.6 | 5.2 | 4.6 | 4.0 | 4.9 |
| 67913 | Casing, tubing and drill pipe of a kind used in drilling for oil | 218 | 268 | 222 | 220 | 258 | 545 | 2.4 | 2.9 | 2.5 | 2.0 | 2.1 | 4.0 |
| 68412 | Aluminium alloys | 241 | 179 | 198 | 242 | 215 | 280 | 2.6 | 1.9 | 2.2 | 2.2 | 1.8 | 2.1 |
| 25151 | Chemical wood pulp, soda or sulphate, other than dissolving | 149 | 101 | 101 | 113 | 137 | 101 | 1.6 | 1.1 | 1.1 | 1.1 | 1.1 | 0.7 |
| 97101 | Gold (including gold plated with platinum), non-monetary, u | 96 | 99 | 111 | 111 | 139 | 142 | 1.0 | 1.1 | 1.2 | 1.0 | 1.1 | 1.0 |
| 67912 | Line pipe of a kind used for oil or gas pipelines, of iron (othe | 86 | 94 | 102 | 96 | 117 | 167 | 0.9 | 1.0 | 1.1 | 0.9 | 1.0 | 1.2 |
| 26873 | Wool tops and other combed wool | 63 | 79 | 87 | 101 | 108 | 104 | 0.7 | 0.8 | 1.0 | 0.9 | 0.9 | 0.8 |
| 61141 | Other bovine leather and equine leather, without hair on ...t | 83 | 88 | 77 | 84 | 99 | 96 | 0.9 | 0.9 | 0.9 | 0.8 | 0.8 | 0.7 |
| 57112 | Polyethylene...having a specific gravity of 0.94 or more | 25 | 79 | 76 | 79 | 112 | 142 | 0.3 | 0.8 | 0.8 | 0.7 | 0.9 | 1.0 |
| 57433 | Polyethylene terephthalate | 67 | 74 | 82 | 78 | 106 | 102 | 0.7 | 0.8 | 0.9 | 0.7 | 0.9 | 0.7 |
| 67413 | Flat-rolled products...otherwise plated or coated, of a width o | 73 | 60 | 79 | 67 | 113 | 98 | 0.8 | 0.6 | 0.9 | 0.6 | 0.9 | 0.7 |
| 56216 | Urea, whether or not in aqueous solution | 0 | 32 | 53 | 81 | 84 | 121 | 0.0 | 0.3 | 0.6 | 0.8 | 0.7 | 0.9 |
| 67916 | Other, of circular cross-section, of other alloy steel | 38 | 39 | 44 | 55 | 85 | 108 | 0.4 | 0.4 | 0.5 | 0.5 | 0.7 | 0.8 |
| 55131 | Essential oils of citrus fruit | 50 | 56 | 65 | 47 | 54 | 95 | 0.5 | 0.6 | 0.7 | 0.4 | 0.4 | 0.7 |
| 57311 | Polyvinyl chloride....not mixed with any other substances | 47 | 42 | 46 | 47 | 62 | 78 | 0.5 | 0.4 | 0.5 | 0.4 | 0.5 | 0.6 |
| 89319 | Articles for the conveyance or packing of goods, n.e.s.; sto | 38 | 42 | 35 | 41 | 64 | 89 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.7 |
| 64126 | Other paper and paperboard, weighing 40 g/m2 or more bu | 8 | 8 | 24 | 37 | 69 | 79 | 0.1 | 0.1 | 0.3 | 0.3 | 0.6 | 0.6 |
| All above | | 5553 | 5773 | 6322 | 7874 | 8849 | 9640 | 60.1 | 61.3 | 69.9 | 73.3 | 72.2 | 70.9 |

Source: Author's Calculations based on COMTRADE databases

*/ Share in total country's exports in semi-finished

Table 5: Brazil, the top exports in semi-finished; 2000-2005.

| SITC | Product description | Exports (Value in millions \$) | | | | | | Share (%) | | | | | |
|------------------------------|---|---------------------------------|-------|-------|-------|-------|-------|------------|------|------|------|------|------|
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| 08131 | Oilcake and other solid residues (except dregs), whether or r | 1653 | 2065 | 2199 | 2602 | 3271 | 2865 | 9.4 | 11.8 | 12.1 | 11.6 | 11.5 | 8.7 |
| 25152 | Chemical wood pulp, soda or sulphate, other than dissolving | 1526 | 1195 | 1109 | 1686 | 1667 | 1976 | 8.7 | 6.8 | 6.1 | 7.5 | 5.9 | 6.0 |
| 06111 | Cane sugar, raw | 762 | 1401 | 1111 | 1350 | 1511 | 2382 | 4.3 | 8.0 | 6.1 | 6.0 | 5.3 | 7.3 |
| 67262 | Semi-finished products of iron or non-alloy steel, ...other, of r | 808 | 617 | 926 | 919 | 1216 | 1077 | 4.6 | 3.5 | 5.1 | 4.1 | 4.3 | 3.3 |
| 68411 | Aluminium, not alloyed | 947 | 676 | 813 | 903 | 952 | 1020 | 5.4 | 3.9 | 4.5 | 4.0 | 3.3 | 3.1 |
| 67121 | Non-alloy pig-iron containing by weight 0.5% or less of phosph | 446 | 428 | 472 | 573 | 1179 | 1810 | 2.5 | 2.4 | 2.6 | 2.6 | 4.1 | 5.5 |
| 42111 | Crude oil, whether or not degummed | 300 | 415 | 675 | 1042 | 1156 | 1022 | 1.7 | 2.4 | 3.7 | 4.7 | 4.1 | 3.1 |
| 61142 | Other bovine leather and equine leather, without hair onpa | 314 | 455 | 545 | 646 | 804 | 917 | 1.8 | 2.6 | 3.0 | 2.9 | 2.8 | 2.8 |
| 61141 | Other bovine leather and equine leather, without hair on ...ta | 425 | 398 | 399 | 395 | 470 | 455 | 2.4 | 2.3 | 2.2 | 1.8 | 1.7 | 1.4 |
| 97101 | Gold (including gold plated with platinum), non-monetary, un | 375 | 336 | 349 | 327 | 413 | 459 | 2.1 | 1.9 | 1.9 | 1.5 | 1.5 | 1.4 |
| 64126 | Other paper and paperboard, weighing 40 g/m2 or more but | 166 | 174 | 339 | 433 | 427 | 536 | 0.9 | 1.0 | 1.9 | 1.9 | 1.5 | 1.6 |
| 67159 | Ferro-alloys, n.e.s. | 269 | 276 | 290 | 314 | 342 | 468 | 1.5 | 1.6 | 1.6 | 1.4 | 1.2 | 1.4 |
| 63439 |other Plywood consisting solely of sheets of wood, | 156 | 156 | 211 | 344 | 521 | 510 | 0.9 | 0.9 | 1.2 | 1.5 | 1.8 | 1.6 |
| 68412 | Aluminium alloys | 238 | 191 | 197 | 219 | 421 | 379 | 1.4 | 1.1 | 1.1 | 1.0 | 1.5 | 1.2 |
| 51215 | Undenatured ethyl alcohol of an alcoholic strength by volume | 35 | 92 | 166 | 147 | 461 | 743 | 0.2 | 0.5 | 0.9 | 0.7 | 1.6 | 2.3 |
| 67261 | Semi-finished products of iron or non-alloy steel...of rectangu | 167 | 137 | 153 | 326 | 400 | 376 | 0.9 | 0.8 | 0.8 | 1.5 | 1.4 | 1.1 |
| 67282 | Semi-finished products of alloy steel..of other alloy steel | 317 | 245 | 218 | 187 | 200 | 389 | 1.8 | 1.4 | 1.2 | 0.8 | 0.7 | 1.2 |
| 66245 | Glazed ceramic flags and paving, hearth or wall tiles; glazed | 181 | 173 | 200 | 242 | 328 | 357 | 1.0 | 1.0 | 1.1 | 1.1 | 1.2 | 1.1 |
| 57111 | Polyethylene...having a specific gravity of less than 0.94 | 170 | 111 | 115 | 199 | 260 | 401 | 1.0 | 0.6 | 0.6 | 0.9 | 0.9 | 1.2 |
| 66139 | Other monumental or building stone and articles thereof (oth | 70 | 69 | 67 | 12 | 41 | 409 | 0.4 | 0.4 | 0.4 | 0.1 | 0.1 | 1.2 |
| Total export in semifinished | | 17638 | 17516 | 18205 | 22382 | 28448 | 32836 | 52.9 | 54.9 | 58.0 | 57.5 | 56.4 | 56.5 |

Source: Author's Calculations based on COMTRADE databases

*/ Share in total country's exports in semi-finished

Table 6: China's foreign trade by customs regimes (in percentage).

| | 1992 | 1995 | 1998 | 2001 |
|------------------|------|------|------|------|
| EXPORTS | | | | |
| ordinary | 51.4 | 47.9 | 40.4 | 42.0 |
| after processing | 46.6 | 49.5 | 56.9 | 52.1 |
| other | 2.0 | 2.6 | 2.7 | 5.9 |
| | | | | |
| IMPORTS | | | | |
| ordinary | 41.7 | 32.8 | 31.1 | 46.6 |
| for processing | 39.1 | 44.2 | 48.9 | 38.6 |
| other | 19.2 | 23.0 | 19.9 | 14.8 |

Table 7: China's processed exports (in percentage).

| SECTORS | Share in all processed | | Share in the sector exports | |
|-------------------------------------|------------------------|------|-----------------------------|------|
| | 1993 | 1999 | 1993 | 1999 |
| Electrical machinery | 18 | 25 | 84 | 84 |
| Machinery | 6 | 14 | 57 | 79 |
| Apparel | 20 | 13 | 49 | 46 |
| Leather and shoes | 15 | 9 | 78 | 66 |
| Toys and various manufactured goods | 12 | 9 | 79 | 69 |
| Others | 29 | 30 | 29 | 42 |
| Total processed exports | 100 | 100 | 48 | 57 |

Table 8: Foreign affiliates (FA) in China's foreign trade with major partners, 1999*.

| | World | EU-15 | US | Japan | Singapore |
|---------------------------|-------|-------|-----|-------|-----------|
| ALL EXPORTS | 100 | 100 | 100 | 100 | 100 |
| FA exports | 45 | 42 | 54 | 55 | 55 |
| FA processed exports | 38 | 36 | 48 | 43 | 50 |
| | | | | | |
| ALL IMPORTS | 100 | 100 | 100 | 100 | 100 |
| FA imports | 52 | 49 | 43 | 63 | 64 |
| FA imports for processing | 32 | 12 | 21 | 43 | 41 |

* all figures in percentage

Table 9: China's trade pattern by stage of production (in percentage).

| | IMPORTS | | EXPORTS | |
|----------------|---------|------|---------|------|
| | 1997 | 1999 | 1997 | 1999 |
| Primary goods | 11 | 9 | 5 | 3 |
| Intermediates | 62 | 65 | 32 | 33 |
| Parts & Comp. | 18 | 23 | 8 | 11 |
| Semi-finished | 44 | 42 | 24 | 22 |
| Final goods | 23 | 24 | 61 | 63 |
| Consumption | 4 | 5 | 49 | 47 |
| Capital goods | 19 | 19 | 13 | 15 |
| Not classified | 4 | 3 | 1 | 1 |
| TOTAL | 100 | 100 | 100 | 100 |

Table 10: China's exports by custom regime and type of firm, 1999 (in percentage of total exports). Main exporting sectors.

| SECTORS | ALL EXPORTS | Processed exports | | Ordinary exports | |
|-------------------------------------|-------------|-------------------|---------------|------------------|---------------|
| | | Foreign firms | Chinese firms | Foreign firms | Chinese firms |
| Total | 100 | 38 | 19 | 6 | 34 |
| Electrical machinery | 17 | 11 | 3 | 0 | 2 |
| Garments | 15 | 4 | 3 | 1 | 7 |
| Machinery | 10 | 6 | 2 | 0 | 2 |
| Chemical products | 8 | 2 | 1 | 1 | 4 |
| Leather and shoes | 7 | 3 | 1 | 0 | 2 |
| Toys and various manufactured goods | 7 | 3 | 2 | 0 | 2 |
| Fiber, thread and cloth materials | 6 | 2 | 1 | 0 | 3 |

Table 11: Argentina: evolution of the international position of product 71323 (diesel engines) exports; 2000, 2002 and 2005.

| Market | Sitcr3 | 2000 | | | | 2002 | | | | 2005 | | | |
|----------------|-------------|----------------|-----------------|-------|------|----------------|-----------------|-------|------|----------------|-----------------|-------|------|
| | | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank |
| Brazil | 71323 | Argentina | 97.87 | 58.1 | 1 | Italy | 29.53 | 28.5 | 1 | Argentina | 52.16 | 21.7 | 1 |
| | | United Kingdom | 17.65 | 10.5 | 2 | United Kingdom | 28.99 | 28.0 | 2 | Germany | 39.44 | 16.4 | 2 |
| | | Italy | 14.54 | 8.6 | 3 | Argentina | 20.77 | 20.1 | 3 | Italy | 36.40 | 15.1 | 3 |
| | | Japan | 9.46 | 5.6 | 4 | Germany | 12.82 | 12.4 | 4 | France | 34.99 | 14.6 | 4 |
| | | United States | 8.86 | 5.3 | 5 | Sweden | 2.90 | 2.8 | 5 | Thailand | 21.84 | 9.1 | 5 |
| | 71323 Total | | 148.38 | 88.0 | | | 95.01 | 91.8 | | | 184.83 | 76.9 | |
| Mexico | 71323 | United States | 947.53 | 85.1 | 1 | United States | 925.17 | 87.8 | 1 | United States | 1673.76 | 85.6 | 1 |
| | | Brazil | 105.02 | 9.4 | 2 | Germany | 59.04 | 5.6 | 2 | Germany | 148.50 | 7.6 | 2 |
| | | Germany | 35.07 | 3.2 | 3 | Brazil | 37.59 | 3.6 | 3 | Brazil | 90.74 | 4.6 | 3 |
| | | United Kingdom | 16.37 | 1.5 | 4 | United Kingdom | 23.76 | 2.3 | 4 | Venezuela | 18.61 | 1.0 | 4 |
| | | Italy | 3.80 | 0.3 | 5 | Italy | 3.54 | 0.3 | 5 | United Kingdom | 15.92 | 0.8 | 5 |
| 71323 Total | | 1107.79 | 99.5 | | | 1049.09 | 99.5 | | | 1947.54 | 99.6 | | |
| United Kingdom | 71323 | Japan | 80.28 | 19.3 | 1 | Austria | 186.79 | 21.6 | 1 | France | 392.54 | 28.1 | 1 |
| | | United States | 69.52 | 16.7 | 2 | France | 157.08 | 18.2 | 2 | Poland | 285.15 | 20.4 | 2 |
| | | Poland | 64.48 | 15.5 | 3 | Germany | 134.19 | 15.5 | 3 | Austria | 141.69 | 10.1 | 3 |
| | | Germany | 62.68 | 15.1 | 4 | Spain | 103.11 | 11.9 | 4 | Netherlands | 124.38 | 8.9 | 4 |
| | | Spain | 62.05 | 14.9 | 5 | Poland | 99.78 | 11.5 | 5 | Japan | 116.72 | 8.3 | 5 |
| 71323 Total | | 339.01 | 81.5 | | | 680.94 | 78.8 | | | 1060.48 | 75.8 | | |
| India | 71323 | France | 2.45 | 29.5 | 1 | Thailand | 23.46 | 70.1 | 1 | Thailand | 59.68 | 47.0 | 1 |
| | | United Kingdom | 2.38 | 28.6 | 2 | Korea, Rep. | 3.05 | 9.1 | 2 | Korea, Rep. | 22.25 | 17.5 | 2 |
| | | Japan | 1.86 | 22.4 | 3 | United Kingdom | 2.06 | 6.2 | 3 | Germany | 17.50 | 13.8 | 3 |
| | | Poland | 0.35 | 4.2 | 4 | France | 1.65 | 4.9 | 4 | Czech Republic | 10.79 | 8.5 | 4 |
| | | Singapore | 0.32 | 3.9 | 5 | Mexico | 1.13 | 3.4 | 5 | Sweden | 7.34 | 5.8 | 5 |
| 71323 Total | | 7.36 | 88.7 | | | 31.35 | 93.6 | | | 117.55 | 92.6 | | |
| Uruguay | 71323 | Japan | 4.63 | 38.7 | 1 | Japan | 0.15 | 25.2 | 1 | United States | 0.22 | 27.7 | 1 |
| | | Argentina | 2.97 | 24.8 | 2 | Spain | 0.10 | 16.5 | 2 | United Kingdom | 0.20 | 25.2 | 2 |
| | | Netherlands | 1.10 | 9.2 | 3 | United Kingdom | 0.07 | 11.6 | 3 | Brazil | 0.10 | 12.9 | 3 |
| | | Italy | 0.86 | 7.2 | 4 | Brazil | 0.06 | 10.9 | 4 | Japan | 0.08 | 10.6 | 4 |
| | | Germany | 0.61 | 5.1 | 5 | Argentina | 0.05 | 8.7 | 5 | Argentina | 0.06 | 8.0 | 5 |
| 71323 Total | | 10.18 | 85.2 | | | 0.43 | 72.9 | | | 0.67 | 84.3 | | |

Source : Authors' calculations based on COMTRADE databases
Code 71323: Diesel etc engines

Table 12: Argentina: evolution of the international position of product 78434 (gearboxes) exports; 2000, 2002 and 2005.

| Market | Sitcr3 | 2000 | | | | 2002 | | | | 2005 | | | |
|-------------|-------------|---------------|-----------------|-------|-----------|---------------|-----------------|-------|---------------|---------------|-----------------|-------|------|
| | | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank |
| Brazil | 78434 | Argentina | 99.97 | 41.4 | 1 | Argentina | 53.34 | 25.7 | 1 | Argentina | 157.64 | 30.7 | 1 |
| | | United States | 43.51 | 18.0 | 2 | Japan | 38.15 | 18.4 | 2 | Japan | 134.75 | 26.2 | 2 |
| | | Germany | 33.00 | 13.7 | 3 | Germany | 35.09 | 16.9 | 3 | United States | 57.37 | 11.2 | 3 |
| | | Italy | 16.94 | 7.0 | 4 | United States | 27.00 | 13.0 | 4 | Germany | 43.77 | 8.5 | 4 |
| | | Chile | 14.87 | 6.2 | 5 | France | 16.21 | 7.8 | 5 | Switzerland | 30.49 | 5.9 | 5 |
| | 78434 Total | | 208.29 | 86.3 | | | 169.79 | 81.7 | | | 424.02 | 82.6 | |
| Germany | 78434 | France | 298.52 | 32.0 | 1 | France | 388.20 | 39.4 | 1 | Japan | 377.02 | 25.4 | 1 |
| | | Austria | 143.74 | 15.4 | 2 | UK | 117.27 | 11.9 | 2 | France | 313.34 | 21.1 | 2 |
| | | Slovak Rep | 114.12 | 12.3 | 3 | Japan | 111.26 | 11.3 | 3 | Slovak Rep | 243.69 | 16.4 | 3 |
| | | Japan | 100.48 | 10.8 | 4 | Slovak Repub | 105.83 | 10.7 | 4 | UK | 208.08 | 14.0 | 4 |
| | UK | 76.51 | 8.2 | 5 | Spain | 53.95 | 5.5 | 5 | United States | 63.45 | 4.3 | 5 | |
| 78434 Total | | 733.37 | 78.7 | | | 776.51 | 78.8 | | | 1205.59 | 81.3 | | |
| Mexico | 78434 | United States | 700.42 | 91.8 | 1 | United States | 873.86 | 70.9 | 1 | United States | 796.54 | 63.3 | 1 |
| | | Canada | 39.63 | 5.2 | 2 | Germany | 266.60 | 21.6 | 2 | Germany | 326.44 | 25.9 | 2 |
| | | Brazil | 8.50 | 1.1 | 3 | Canada | 56.86 | 4.6 | 3 | Japan | 72.98 | 5.8 | 3 |
| | | Japan | 7.77 | 1.0 | 4 | Brazil | 17.18 | 1.4 | 4 | Brazil | 23.08 | 1.8 | 4 |
| | Sweden | 3.52 | 0.5 | 5 | Japan | 10.48 | 0.9 | 5 | Korea, Rep. | 18.46 | 1.5 | 5 | |
| 78434 Total | | 759.83 | 99.6 | | | 1224.96 | 99.4 | | | 1237.50 | 98.3 | | |
| Spain | 78434 | Germany | 210.93 | 34.0 | 1 | Germany | 244.48 | 37.9 | 1 | Germany | 232.37 | 30.5 | 1 |
| | | France | 149.99 | 24.2 | 2 | France | 139.08 | 21.6 | 2 | France | 129.77 | 17.0 | 2 |
| | | Austria | 87.29 | 14.1 | 3 | Austria | 89.40 | 13.9 | 3 | Japan | 94.91 | 12.5 | 3 |
| | | Japan | 62.33 | 10.0 | 4 | Japan | 34.19 | 5.3 | 4 | Portugal | 84.54 | 11.1 | 4 |
| | Argentina | 26.76 | 4.3 | 5 | Argentina | 33.78 | 5.2 | 5 | Argentina | 71.81 | 9.4 | 5 | |
| 78434 Total | | 537.29 | 86.5 | | | 540.93 | 83.9 | | | 613.39 | 80.5 | | |

Source : Authors' calculations based on COMTRADE databases
Code 78434: Motor Vehicle gearboxes

Table 13: Brazil: evolution of the international position of product 71391 (parts, not elsewhere specified, of sparking engines) exports; 2000, 2002 and 2005.

| Market | Sitcr3 | 2000 | | | | 2002 | | | | 2005 | | | |
|---------------|-------------|----------------|-----------------|-------|------|----------------|-----------------|-------|---------|----------------|-----------------|-------|------|
| | | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank |
| Argentina | 71391 | Brazil | 21.81 | 41.5 | 1 | Brazil | 12.26 | 56.1 | 1 | Italy | 27.80 | 38.3 | 1 |
| | | United States | 5.76 | 11.0 | 2 | United States | 4.33 | 19.8 | 2 | Brazil | 27.59 | 38.0 | 2 |
| | | Unspecified* | 5.53 | 10.5 | 3 | Unspecified* | 1.35 | 6.2 | 3 | United States | 5.64 | 7.8 | 3 |
| | | France | 4.78 | 9.1 | 4 | Germany | 0.59 | 2.7 | 4 | France | 3.55 | 4.9 | 4 |
| | | Italy | 4.47 | 8.5 | 5 | Japan | 0.55 | 2.5 | 5 | Japan | 1.52 | 2.1 | 5 |
| | 71391 Total | | 42.35 | 80.6 | | 19.09 | 87.3 | | 66.10 | 90.9 | | | |
| Germany | 71391 | Austria | 248.31 | 20.8 | 1 | Austria | 280.34 | 19.2 | 1 | Austria | 366.47 | 19.9 | 1 |
| | | Italy | 167.52 | 14.0 | 2 | Italy | 228.85 | 15.7 | 2 | Italy | 325.49 | 17.6 | 2 |
| | | United States | 119.55 | 10.0 | 3 | United Kingdom | 133.13 | 9.1 | 3 | United Kingdom | 196.67 | 10.7 | 3 |
| | | United Kingdom | 104.39 | 8.7 | 4 | United States | 120.42 | 8.3 | 4 | France | 144.41 | 7.8 | 4 |
| | | Hungary | 95.81 | 8.0 | 5 | Czech Republic | 105.97 | 7.3 | 5 | Spain | 103.69 | 5.6 | 5 |
| | 71391 Total | | 735.57 | 61.5 | | 868.71 | 59.6 | | 1136.74 | 61.6 | | | |
| Italy | 71391 | Germany | 137.29 | 34.3 | 1 | Germany | 179.72 | 43.5 | 1 | Germany | 244.53 | 45.8 | 1 |
| | | Japan | 66.93 | 16.7 | 2 | Japan | 43.60 | 10.6 | 2 | Japan | 61.43 | 11.5 | 2 |
| | | France | 39.99 | 10.0 | 3 | France | 39.98 | 9.7 | 3 | France | 47.85 | 9.0 | 3 |
| | | Brazil | 39.44 | 9.9 | 4 | Brazil | 17.71 | 4.3 | 4 | Austria | 24.19 | 4.5 | 4 |
| | | Poland | 16.42 | 4.1 | 5 | Poland | 17.41 | 4.2 | 5 | United States | 19.76 | 3.7 | 5 |
| | 71391 Total | | 300.07 | 75.0 | | 298.42 | 72.3 | | 397.75 | 74.5 | | | |
| Mexico | 71391 | United States | 722.33 | 73.0 | 1 | United States | 833.60 | 72.4 | 1 | United States | 856.70 | 68.5 | 1 |
| | | Germany | 130.52 | 13.2 | 2 | Germany | 140.48 | 12.2 | 2 | Japan | 129.54 | 10.4 | 2 |
| | | Japan | 76.51 | 7.7 | 3 | Japan | 67.56 | 5.9 | 3 | Germany | 124.30 | 9.9 | 3 |
| | | Canada | 24.90 | 2.5 | 4 | United Kingdom | 33.91 | 2.9 | 4 | Brazil | 34.51 | 2.8 | 4 |
| | | France | 18.24 | 1.8 | 5 | Brazil | 23.99 | 2.1 | 5 | Unspecified* | 21.49 | 1.7 | 5 |
| | 71391 Total | | 972.49 | 98.3 | | 1099.54 | 95.6 | | 1166.54 | 93.2 | | | |
| United States | 71391 | Japan | 1514.14 | 39.6 | 1 | Japan | 1242.45 | 34.0 | 1 | Japan | 1450.18 | 30.0 | 1 |
| | | Canada | 1022.83 | 26.8 | 2 | Canada | 922.69 | 25.3 | 2 | Mexico | 1296.64 | 26.8 | 2 |
| | | Mexico | 748.44 | 19.6 | 3 | Mexico | 828.85 | 22.7 | 3 | Canada | 1068.14 | 22.1 | 3 |
| | | Brazil | 113.26 | 3.0 | 4 | Germany | 166.99 | 4.6 | 4 | Germany | 235.25 | 4.9 | 4 |
| | | Germany | 112.61 | 2.9 | 5 | Brazil | 114.77 | 3.1 | 5 | China | 159.97 | 3.3 | 5 |
| | 71391 Total | | 3511.29 | 91.9 | | 3275.75 | 89.7 | | 4210.19 | 87.2 | | | |

Source : Authors' calculations based on COMTRADE databases

/ Unspecified refers to imports in which the code partner has not been recorded

Code 71391: Parts n.e.s sparking engines

Table 14: Brazil: evolution of the international position of product 71392 (parts, not elsewhere specified, of diesel engines) exports; 2000, 2002 and 2005.

| Market | Sitcr3 | 2000 | | | | 2002 | | | | 2005 | | | |
|----------------|-------------|----------------|-----------------|-------|------|----------------|-----------------|-------|------|---------------|-----------------|-------|------|
| | | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank | Supplier | M (millions \$) | Share | Rank |
| Argentina | 71392 | Brazil | 46.58 | 45.9 | 1 | Brazil | 13.91 | 37.1 | 1 | Thailand | 48.51 | 38.4 | 1 |
| | | France | 11.72 | 11.6 | 2 | United States | 7.51 | 20.0 | 2 | Brazil | 27.06 | 21.4 | 2 |
| | | Japan | 7.80 | 7.7 | 3 | Unspecified | 4.23 | 11.3 | 3 | Japan | 11.80 | 9.4 | 3 |
| | | United States | 7.24 | 7.1 | 4 | Japan | 2.38 | 6.4 | 4 | United States | 10.65 | 8.4 | 4 |
| | | United Kingdom | 6.51 | 6.4 | 5 | Spain | 2.19 | 5.8 | 5 | France | 8.07 | 6.4 | 5 |
| | 71392 Total | | 79.85 | 78.7 | | | 30.22 | 80.5 | | | 106.10 | 84.1 | |
| Germany | 71392 | France | 126.33 | 15.6 | 1 | Turkey | 186.46 | 17.4 | 1 | Poland | 265.45 | 13.3 | 1 |
| | | Turkey | 124.97 | 15.4 | 2 | France | 144.70 | 13.5 | 2 | Turkey | 229.85 | 11.5 | 2 |
| | | Brazil | 72.50 | 8.9 | 3 | Poland | 103.87 | 9.7 | 3 | France | 220.16 | 11.0 | 3 |
| | | Italy | 56.42 | 7.0 | 4 | Brazil | 84.09 | 7.8 | 4 | Hungary | 158.19 | 7.9 | 4 |
| | | United States | 48.93 | 6.0 | 5 | Italy | 64.52 | 6.0 | 5 | Austria | 141.29 | 7.1 | 5 |
| 71392 Total | | 429.15 | 52.9 | | | 583.63 | 54.3 | | | 1014.94 | 50.7 | | |
| Mexico | 71392 | United States | 261.39 | 80.2 | 1 | United States | 254.76 | 78.5 | 1 | United States | 330.78 | 71.4 | 1 |
| | | Brazil | 13.20 | 4.1 | 2 | United Kingdom | 22.10 | 6.8 | 2 | Brazil | 35.12 | 7.6 | 2 |
| | | France | 12.27 | 3.8 | 3 | Germany | 12.81 | 3.9 | 3 | Germany | 28.66 | 6.2 | 3 |
| | | Germany | 11.05 | 3.4 | 4 | Brazil | 9.48 | 2.9 | 4 | Japan | 11.71 | 2.5 | 4 |
| | | Japan | 11.02 | 3.4 | 5 | Japan | 8.05 | 2.5 | 5 | Canada | 10.40 | 2.2 | 5 |
| 71392 Total | | 308.94 | 94.8 | | | 307.21 | 94.6 | | | 416.66 | 89.9 | | |
| United Kingdom | 71392 | United States | 165.44 | 26.8 | 1 | Germany | 115.66 | 20.9 | 1 | Germany | 225.94 | 22.5 | 1 |
| | | Germany | 125.50 | 20.3 | 2 | United States | 110.40 | 19.9 | 2 | Japan | 131.64 | 13.1 | 2 |
| | | France | 41.51 | 6.7 | 3 | Italy | 46.10 | 8.3 | 3 | United States | 123.20 | 12.3 | 3 |
| | | Japan | 36.75 | 6.0 | 4 | France | 38.69 | 7.0 | 4 | France | 67.38 | 6.7 | 4 |
| | | Brazil | 35.85 | 5.8 | 5 | Japan | 37.68 | 6.8 | 5 | Belgium | 63.62 | 6.3 | 5 |
| 71392 Total | | 405.05 | 65.6 | | | 348.53 | 63.0 | | | 611.79 | 60.9 | | |
| United States | 71392 | Mexico | 207 | 16.7 | 1 | Japan | 213 | 18.3 | 1 | Mexico | 347 | 15.3 | 1 |
| | | Brazil | 203 | 16.4 | 2 | Germany | 191 | 16.4 | 2 | Brazil | 329 | 14.5 | 2 |
| | | Germany | 200 | 16.1 | 3 | Brazil | 182 | 15.6 | 3 | Germany | 318 | 14.0 | 3 |
| | | Japan | 188 | 15.1 | 4 | Mexico | 157 | 13.5 | 4 | Canada | 318 | 14.0 | 4 |
| | | Canada | 152 | 12.3 | 5 | Canada | 109 | 9.4 | 5 | Japan | 296 | 13.1 | 5 |
| 71392 Total | | 950 | 76.6 | | | 853 | 73.2 | | | 1609 | 71.0 | | |

Source : Authors' calculations based on COMTRADE databases

*/ Unspecified refers to imports in which the code partner has not been recorded

Code 71392: Parts n.e.s diesel engines