

## Methodological Annex – Chapter 6

### Technology balance of payments: a renewed perspective

The analysis of Brazil's international trade statistics presented in the chapter on the technology balance of payments follows the same framework as the corresponding chapters in previous editions of Indicators of Science, Technology & Innovation in São Paulo State (FAPESP, 2002, 2005), defining product categories by technology content or embodied technology.

Chapter 6 of this edition discusses data on trade flows in 2003-07, highlighting the first and last years of the period throughout the text but reserving significant space for statistics referring to the other years, which are presented in the Detailed Tables appended to this publication.

Data on Brazil's trade flows were furnished by the Foreign Trade Department (SECEX) of the Ministry of Development, Industry & Trade (MDIC). Trade data were tabulated for countries selected according to their importance in world technology flows. Statistics for less developed countries were also organized to provide a counterpoint to the analysis of the Brazilian

case and contribute to a discussion of the definition of technology content and the explanatory power of the respective classifications.

The chapter on the technology balance of payments in the first edition laid a foundation for the discussion of technology content embodied in the goods traded with other countries. For this purpose Brazilian trade statistics at the product level (eight-digit level of the Mercosur Common Nomenclature or NCM) needed to correspond to a product classification from the perspective of technology. This was achieved by using the commodity trade pattern (CTP) based on Pavitt's taxonomy (Pavitt, 1984).

The CTP classification comprises 11 product groups defined in accordance with a spectrum of embodied technology intensities. Table M6.1 presents these 11 product groups, as well as a residual group for products inadequately classified in other categories (e.g. jewelry, precious stones and art works, among others).

**Table M6.1**  
Commodity Trade Pattern (CTP) product categories and average export values in U.S. dollars – Brazil, 1999

	CTP product category	Average value (US\$ FOB/kg)	Group
RDII	R&D-intensive industry	7.47	High technology
SS	Specialist suppliers	5.65	
LII	Labor-intensive industry	2.67	Medium technology
MII	Mineral-intensive industry	0.82	
SII	Scale-intensive industry	0.59	
PAG	Primary agricultural goods	0.53	
AI	Agrifood industry	0.35	
IIOAR	Industry intensive in other agricultural resources	0.25	Low technology
EII	Energy-intensive industry	0.11	
PEG	Primary energy goods	0.08	
PMG	Primary mineral goods	0.02	
NC	Not classified	0.19	

The product categories in Table M6.1 are ordered from the highest to the lowest average value (or FOB price) of the respective trade flows, calculated by dividing value in current dollars by weight in kilograms. It was decided to obtain a proxy that would enable products or groups to be ordered in terms of embodied technology. Hence the option for calculating the average value of each product traded, which can be considered a way of ranking products with the most value added or embodied per unit of mass (kg) sold.

This was the option made to present the technology balance of payments in the previous editions (FAPESP, 2002, 2005). However, this type of classification is known to have flaws that can cause problems. Some products evidently weigh little while having very high values and nevertheless cannot be considered to embody technology in the strict sense. Precious stones are frequently cited as an example of this problem, but there are others, such as certain kinds of apparel, e.g. lingerie, with high average values but not necessarily high technology content.

Despite these reservations, ranking CTP categories according to average value in Brazilian exports in 1999 enabled the creation of product groups so as to obtain correspondences for three aggregations or groups by technology level (high, medium and low technology). As can be seen from Table M6.1, there were significant differences in value between each of these three groups.

The year chosen was 1999 because the data available for that year were the most complete when the first edition of this publication was produced (FAPESP, 2002). An important finding that resulted from the option to calculate average value as a proxy for the technology content of traded goods was the significant difference between the average value of exports and imports in 1999. In the case of exports, the average value found was US\$ 0.22 per kg, whereas for imports it was US\$ 0.55. In 2007 the respective values were US\$ 0.35 and US\$ 1.01 per kg. Thus the gap has widened considerably. In fact, the values for 2003 were similar to those for 1999, so most of the widening occurred more recently.

These numbers corroborate many of the arguments commonly found regarding the technology content of international trade using the traditional analytical approach, such as the perception that Brazilian exports remain less technology-intensive than imports. It should be stressed that this chapter rediscusses such concepts and puts forward a new perspective in order to stimulate thinking from a different angle and raise questions in favor of an enhanced methodology for the production of indicators that are more appropriate for less developed countries (LDCs) in this arena.

Classifying product groups on the basis of technol-

ogy content, as in this case, using the CTP and average values, supports the idea that technology-intensive goods are generally speaking those in which the developed countries (DCs) are leaders, e.g. electronics and information technology. In contrast, agricultural commodities, for example, are frequently considered low-tech or lacking in technology content altogether. On one hand, the recent boom in Brazil's commodity exports shows that an analysis based on the traditional classification according to economic sectors can surprisingly dilute the findings in terms of technology content. Thus although ranking exports and imports by average value is useful for present purposes, it also serves as a counterpoint in the debate proposed by this chapter. Counting tons of soybeans, for example, does not always permit a clear view of the technological trajectory that enabled advances of the agricultural frontier and rapid acceleration of yields from the crop acreages concerned. Moreover, average value always induces the perception that imported electronics and pharmaceuticals are high-tech, whereas many of these imports notoriously consist of standardized material for assembly processes. It can therefore be argued that many items in the product group classed as high-tech do not genuinely embody a high level of technology. Similarly, embodied technology is often ignored in the group classed as low-tech and in primary goods, because the country's capabilities are not taken into account, nor is their impact in terms of enhancing the competitiveness of goods traditionally classed in this way.

Table M6.2 presents average, maximum and minimum values of each CTP category for exports in the period 1999-2007.

Finally, trade flows were analyzed in terms of partner countries, origins and destinations in order to investigate the influence of the degree of development of these countries and identify significant differences between imports and exports. Countries were grouped in the same way as in the first edition (FAPESP, 2002, chap. 7). Thus, DCs comprised four groups: NAFTA, E.U., Japan and Hong Kong, and South Korea, Taiwan and Singapore, representing the Asian newly industrialized countries (NICs). The rest of the world comprised LDCs, with six more groups: Mercosur, Latin America and the Caribbean, Rest of Europe, Rest of Asia, Africa, and the Middle East. Although China was included in the Rest of Asia, it is shown separately in the tables in recognition of its increasing importance in international economic relations. Changes in the global economy and the growing process of productive integration evidently point to the need for a redefinition of this type of country aggregation or ranking so as to include or emphasize certain countries that are now more significant players in international trade than the traditional groupings or blocs.

**Table M6.2**  
Export product categories classified by CTP and average values in U.S. dollars – Brazil, 1999 & 2007

CTP product category		1999			2007		
		Minimum value (US\$ FOB/kg)	Maximum value (US\$ FOB/kg)	Average value (US\$ FOB/kg)	Minimum value (US\$ FOB/kg)	Maximum value (US\$ FOB/kg)	Average value (US\$ FOB/kg)
RDII	R&D-intensive industry	0.1	103,430	7.47	0.09	40,023	12.06
SS	Specialist suppliers	0.4	3,521	5.65	0.23	4,988	6.84
LII	Labor-intensive industry	0.03	13,156	2.67	0.02	32,590	2.44
MII	Mineral-intensive industry	0.06	27,392	0.82	0.05	57,092	1.27
SII	Scale-intensive industry	0.03	14,479	0.59	0.04	75,977	1.31
PAG	Primary agricultural goods	0.01	4,525	0.53	0.05	6,837	0.58
AI	Agrifood industry	0.05	185	0.35	0.07	326	0.60
IIOAR	Industry intensive in other agricultural resources	0.14	175	0.25	0.12	251	0.35
EII	Energy-intensive industry	0.06	5	0.11	0.13	46	0.45
PEG	Primary energy goods	0.02	2	0.08	0.25	14,025	0.41
PMG	Primary mineral goods	0.01	260	0.02	0.01	34	0.05
NC	Not classified	0.11	811,294	0.19	0.38	1,556,885	0.69

Source: MDIC. SECEX.