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Evolving Patterns of Trade between Brazil and the European Union 1994-2005

Abstract

The evolution of trade patterns is of major importance for trade negotiations, since changes in trade patterns have important implications for the formulation of trade policies. The goal of this paper is to provide a dynamic test to evaluate the evolution of trade patterns between Brazil and the European Union following Proudman and Redding (2000) in calculating transition probabilities to measure mobility across export sectors. In addition, a structural change test in the sense of Mancini-Griffoli and Pauwels (2006) is used to verify if the patterns of trade are constant in the 1994-2005 period. The results of this analysis reveal a typical North-South trade pattern between the EU and Brazil. Trade specialization is primarily based on factor endowment although some evidence of increasing intra-industry trade and trade diversification appears.

1. Introduction

Models of North-South trade are only one of the issues of the trade literature. However, due to the growing share of developing countries in world trade, this relatively neglected area becomes more and more important.[1] A main interest of North-South trade research is evolvement of trade patterns.[2] It is a thriving area of research, since many of the results have direct impact on policy formulation.

Although conceptualized for the specific situation of developing countries, models of North-South trade follow regular trade models. Since developing countries are experiencing a late industrialization

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1 For a survey of North-South trade models see Chui et al. (2002).

2 See for example Bastos and Cabral (2007), Kaplinsky et al. (2006), Zaghini (2005), Uchida and Cook (2005), Stehrer and Wörz (2003), Curtis and Shenjie (2003), Proudman and Redding (2000), Brasili et al. (2000), Labson (1997), Zhang (1994), James (1994).

processes, North-South models usually analyze issues like technological diffusion, productivity links, oligopolistic dynamics etc.

Textbook trade models predict that evolving patterns of trade include not only growing specialization depending on factor endowments (inter-industry trade), but also increasing intra-industry trade and trade diversity. Moreover, since trade expansion is linked to the industrialization process, linkages between technology and trade dynamics are fundamental to explain this evolution. The intention of this is to build upon current research in formalizing a test for evolving patterns of trade between Brazil and the European Union. Although econometrically simple, the test can be viewed as a way to test if the evolution of trade between two regions follows a locked-in factor endowment-based trade pattern or if technology and intra-industry play a larger role.

There are three main considerations motivating this investigation: First, Brazilian exports show an impressive growth, with an annual growth rate of 15 per cent in 2001-2006. This is the result of a massive currency depreciation in 2002 and a production towards a more export-led growth than experienced by the country previously. Second, considering trade negotiations between Brazil and the EU, formal tests of trade patterns are an important tool to formulate trade policies. Finally, the present trade literature does not yet provide an analysis of the stylized facts that characterize the bilateral trade between the EU and Brazil and its dynamics considering technological content, comparative advantages on a HS06 product level, evolving patterns of trade and so on.

This scenario presents an interesting background on which to present some characteristics of the trade pattern between the regions to study the dynamics of patterns of trade. Focusing on bilateral trade also has the advantage of using the stylized facts as an important tool for analysis of the results. Analyzing trade patterns of either Brazil or European Union with the rest of the world would make the results less clear since many different effects would impact the trade flows, such as cross-country trade barriers, changes in tariff structure, FDI, etc.

The paper is organized as follows. The second section presents a review on the relevant literature and the models to be tested and analyzed. The third section presents stylized facts and analysis of the trade flows between Brazil and the EU, as well as data

construction procedures and the mains results. The final section brings some final comments.

II. Theoretical arguments and modeling of the evolution of trade patterns

That the world trade grows at a briskly pace is hardly news, but is still surprising, since economic theory cannot explain why world trade is growing so fast. A good example can be found in Bergoeing and Kehoe (2001). The authors develop a model that allows changes in relative prices to have large effects, assumes differences in income distribution among industrialized countries, and postulates nonhomothetic preferences to affect trade directions and volumes. Analyzing the 1950-1990 period, Bergoeing and Kehoe's model backwardly predicts positive and large world trade growth, but does not predict the extreme growth of the ratio of trade to world income, from 7.9 per cent in 1950 to 15.4 per cent in 1990. From 1990 on this pattern does not change, with trade in 2006 accounting for almost 25 per cent of global GDP (World Economic Outlook, 2007), a fact that no trade model can explain.

Partial explanations include the decrease in average tariff, intra-industry trade, high elasticity of substitution and financial links, among others. The most common explanation is tariff reduction, but tariffs are decreasing at a slower pace than in previous decades, and world trade is still consistently growing more than world income. Yi (2003) develops a model with vertical specialization to try to explain the growth conundrum. The model generates a non-linear response - which may be the best way to explain world trade growth - of trade to tariff reductions, but the model still explains only slightly more than 50 per cent of the world trade growth. Alternative developments look into reduction of non-tariff barriers as a source for the extreme trade growth (Hummels, 1999; Wacziarg and Welch, 2003).

Irwin (2002) observes that there is increasing sensitivity of trade to income, and even though trade is growing consistently, its growth pattern is becoming increasingly linked to income growth, with trade following cycles much like income cycles. Also, until the early 1990's trade growth was skewed towards developed countries, with trade growing more through intra-industry trade between developed countries than through North-South inter-industry trade. This scenario began to change with emerging markets like China, India and Brazil presenting double-digit annual trade growth. In the

period 1989-1998, trade growth in developed countries averaged 6.6 per cent, while 7.4 per cent in emerging markets. This difference is growing, with a 5.6 per cent average annual trade flows growth in developed markets compared to 9.5 per cent in emerging markets in the 1999-2007 period (World Economic Outlook, 2007).

As observed by Bergoeing and Kehoe (2001), the new trade theory was developed to account for three major stylized facts: the ratio of trade to income has increased; trade has become more concentrated among industrialized countries; and trade among industrialized countries has been largely intra-industry trade. While the first stylized fact is still true, the others are relatively less important since most of the world trade growth is being carried out by inter-industry trade too, and from, emerging markets. Moreover, intra-industry trade is also increasing between advanced and emerging markets. In Brazil, for instance, a sizable part of the trade with the United States is manufactured goods - 20 per cent of the trade flow is concentrated in the HS02 chapter 84 – Machinery and mechanical appliances.

Another key interest of the recent trade literature is the link between technology transfer and trade.[3] Technology transfer through trade is usually considered to take place via the technological component of imports. In this way, developing countries would adopt technological advance by importing more technology-intensive products and learning by imitation. As Connolly (1997) observes, the process of imitation can lead to dynamic gains of trade to the South since "free trade generally results in a positive feedback effect between Southern imitation and Northern innovation yielding a higher common steady-state growth rate". Keller (2002) corroborates that those gains are relevant, and develops a framework where "technology in the form of product designs is transmitted to other industries, both domestically as well as internationally, through trade in differentiated intermediate goods".

Lumenga-Neso *et al.* (2001) makes the interesting case that 'indirect' trade-related technology transfer also matters. This 'indirect' transfer is defined as one associated with available rather than with produced levels of R&D. The authors conclude that

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[3] See for example Cameron et al. (2005), Connolly (1997), Hoppe (2005), Lumenga-Neso et al. (2001), Keller (2002).

"these 'indirect' trade-related spillovers are at least as important as the 'direct' ones, and strengthen the view that trade does matter for the international transmission of R&D".

Recent developments in econometrics allow for many diverse analyses of trade patterns, with some based on the aforementioned link between factor productivity and trade pattern. Curtis and Shenjie (2003) focus on the impact of trade costs of trade patterns. Sachs *et al.* (2002, p. 22) develop a model to "provide a unified framework for the analysis of trade patterns and economic development of monopolistic competition." Trade pattern studies are so diverse that even the role of inequality in trade patterns has been analyzed (Requena-Silvente and Walker, 2007).

The present work follows the line of James (1994), Proudman and Redding (2000), Brasili *et al*. (2000), Bastos and Cabral (2007) and many others, which focus on the dynamics and the evolution of trade patterns. The range of these works goes from mainly descriptive analysis (James, 1994) to a throughout econometric estimation (Bastos and Cabral, 2007), with many intermediate steps. Usually no structural models are used, since it is difficult to derive testable equations that can be analyzed with trade data, especially if a researcher considers changes in factor productivity. The main drive is that factor productivity changes are revealed in the evolution and dynamics of trade patterns, hence, in trade data.

We wish to develop a comprehensive analysis of the evolution of patterns of trade between the European Union (EU) and Brazil in the 1994-2005 period and to verify if this evolution is mainly due to inter-industry or intra-industry trade. This comprehensive approach consists of three main lines of research: a descriptive analysis using trade data and indexes; a statistical analysis following Proudman and Redding (2000) and Brasili *et al*. (2000); and an econometric dynamical test that builds upon Bastos and Cabral (2007), Mancini-Griffoli and Pauwels (2006) and other works.

The descriptive analysis follows in the next section. The statistical analysis is based on a model of Proudman and Redding (2000), which considers the evolution of patterns of trade based on changes in productivity due to technological changes, with complementary analysis done by Brasili *et al*. (2000).

Proudman and Redding (2000) present a way to analyze the extent to which trade patterns persist over time (what the authors call intra-distribution dynamics). The argument is that the trade literature neither presents a clear argument for mobility nor for the

persistence of Revealed Comparative Advantages (RCA) over time. Evolution of trade can be experienced by constant RCA of trading partners or shifting exports and imports across export sections. Trade models predict that the two happen over time, and the authors try to investigate the degree of persistence versus mobility in patterns of international specialization. The rationale is pretty clear and is summarized by the authors: "much of the existing empirical trade literature is concerned with patterns of international trade at a point in time. This (...) stands in marked contrast with the theoretical literature on growth and trade, which emphasizes that comparative advantage is dynamic and evolves endogenously over time" (Proudman and Redding, 2000, p. 373).

The model employed has the purpose of deriving changes in the dynamics of patterns of trade. The static equilibrium is based on a simple Ricardian model with continuous goods. The equilibrium condition is such that a country produces goods following the condition that the country's relative wage is higher than the country's productivity relative to the foreign country´s productivity. Two more conditions have to be met: a country's income equals world expenditure on the country's goods, and instantaneous utility is a symmetric Cobb-Douglas function.

The main result of the static model (specification and notation can be found in Proudman and Redding, 2000) is that the evolution of patterns of international trade over time is determined by rates of technological progress in each section of the two economies (Proudman and Redding, 2000, p. 376). To develop a dynamic framework the authors consider three sources of technological change: learning-by doing (γ); knowledge spillovers (ψ); and a constant function based on unobserved variables (λ). With A_{ij} as productivity in section j of economy i, L_j as the amount of labor (the only production factor), and A_{xj} as productivity in section j in whichever of the two economies is the technological leader, the rate of productivity growth is a linear additive function of these three sources given by:

$$\ln\left(\frac{A_{ij}(t)}{A_{ij}(t-1)}\right) = \gamma_{ij} + \psi_j \ln(1 + L_{ij}(t-1)) + \lambda_j \ln\left(\frac{A_{xj}(t-1)}{A_{ij}(t-1)}\right), \quad (1)$$

$$\gamma_{ij}, \psi_{ij}, \lambda_{ij} \geq 0 \quad \forall i, j$$

The evolution of the productivity of each section of each economy relative to the world technological leader is then given by:

$$\Delta \ln\left(\frac{A_{ij}(t)}{A_{xj}(t)}\right) = (\gamma_{ij} - \gamma_{xj}) + \psi_j \ln\left(\frac{1+L_{ij}(t-1)}{1+L_{xj}(t-1)}\right) - \lambda_j \ln\left(\frac{A_{ij}(t-1)}{A_{xj}(t-1)}\right) \quad (2)$$

The result of the model is that the patterns of trade are initially determined by factor productivity but its evolution over time depends on the dynamics of equations (1) and (2). Equation (2) is not strictly additive so technological patterns don't follow a discernible pattern. As Proudman and Redding (2000, p. 377) observe, "on the one hand, the presence of section specific learning-by-doing means that initial patterns of international specialization will tend to be reinforced over time. On the other hand, technological transfer and differences in the exogenous rates of productivity growth across sections may both be responsible for reversing initial patterns of international specialization – depending upon the correlation between initial levels of relative productivity and the steady state levels".

To model it empirically the authors consider the evolution of RCA across sections. The empirical model is straightforward and very efficient. The authors assume that the distribution of RCA over time follows a stochastic difference equation (Proudman and Redding, 2000, p. 378). If the space of possible RCA values is divided into *m* discrete cells, the operator *P** (Proudman and Redding, 2000, p. 387) on the stochastic equation becomes a *m* x *m* matrix of transition probabilities:

$$\lambda_t = P^* . \lambda_{t-1} \quad (3)$$

Where *P** contains elements p_{kl}, each of which denotes the probability that an industry moves from cell *k* to cell *l* (where $k,l \in \{1,\ldots,m\}$) and which may be estimated by counting the number of transitions out of and into each cell. This estimation already yield interesting results, but the authors go further by estimating formal indices of mobility. For our purpose the transition probabilities present enough information on the patterns of trade between Brazil and the EU. For comparison the benchmark used is that of Proudman and Redding (2000), who provide a pooled estimation of five countries. The pooled estimation gives the transition probabilities of a section moving from a lower state of RCA to a higher one. Moving up has the effect that an economy is gaining RCA on that section, while moving down has the opposite effect. It should be noted that the results of the analysis are an average probability of the entire trade pattern, i.e., the average probability that a section is going to gain or lose RCA. Following Brasili *et al.*

(2000), the statistical distribution of the results is analyzed, using its marginal density and scatter diagrams to verify the robustness of the results.

The econometric analysis complements the statistical analysis in developing a test for the marginal intra-industry trade index (MIIT) (Brülhart, 1994). Bastos and Cabral (2007) analyze the MIIT to describe the dynamics of trade patterns in 20 OECD countries. The MIIT is also used as the dependent variable in econometric analysis (Bastos and Cabral, 2007). We propose an alternative way of using the MIIT to consider the dynamics of trade patterns, by looking at the evolution of the MIIT over time, estimated econometrically, in the same vein as research on terms of trade advanced by Cuddington and Urzua (1989) and Zanias (2005).

When applied to terms of trade analysis the idea is to test for an improvement or deterioration of the terms of trade by laying an exponential trend line through the data (Cuddington and Urzua, 1989) or by looking for structural breaks (Zanias, 2005). We apply this test in the context of panel data, and focus on the MIIT. In this way a deterioration or improvement would indicate the deterioration of trade specialization or gains of trade specialization in a sector. Cuddington and Urzua (1989) estimate:

$$ly(t) = a + bTIME_{it} + e_{it} \quad (4)$$

If $b>0$ there is an improvement of the terms of trade or trade patterns, and if b<0 a deterioration. The null hypothesis is that $b = 0$, i.e. that the pattern of trade is invariant over the period considered, while the alternative is that there is a trend over time. We introduce panel dynamics to incorporate the effect of the evolution of trade patterns in each HS chapter. In this way, accepting the null is stronger in the sense that it would mean that the patterns of trade are invariant over time and over export sectors. Introducing fixed-effects equation (4) then becomes:

$$ly(t) = a + bTIME + e(t) \quad (5)$$

Zanias (2005) observes structural breaks in terms of trade series. In this sense, it is relevant to consider the possibility of structural breaks in patterns of trade. A break would indicate that patterns of trade are evolving over time, either due to a shock or to internal dynamics. However, instead of considering *ad hoc* possible structural break points, our investigation follows the work of Andrews (2003), who presents a test for structural break in panel data which is robust to non-normal, heteroskedastic and serially

correlated errors, and allows for the number of post break observations to be small (Chan *et al.*, 2006). The test has already been used with trade data (Mancini-Griffoli and Pauwels, 2006), although in a different context. Our idea is to test if there are structural breaks at all. Since the transposition of Andrews (2003) theoretical work to real world data is not direct, we follow Mancini-Griffoli and Pauwels (2006). The regression that is the basis for the test is (Mancini-Griffoli and Pauwels, 2006, p. 4):

$$Y_{it} = \begin{cases} X_{it}^{'}\beta_0 + U_{it} & t = 1,...,T \\ X_{it}^{'}\beta_{1t} + U_{it} & t = T+1,...,T+m \end{cases} \quad (6)$$

for individuals i = 1, . . . , n, and where T is the postulated break date. The test naturally hinges on the following hypotheses: $H_0 : \beta_{1t} = \beta_0$ against $H_A : \beta_{1t} \neq \beta_0$ The coefficients are homogeneous across *i* under both the null and the alternative hypothesis. The alternative hypothesis requires all individuals to exhibit an end-of-sample break.

The test statistics and the critical values are calculated in the same form as in Mancini-Griffoli and Pauwels (2006), where one can also find the translation of the test to panel data.

III. Brazil and the EU – Some Trade Facts

A. Data Sources and Data Construction

The first best data on international trade are those of national government agencies. However, most often than not, the micro data necessary for whole merchandise trade analysis is either unavailable due to bureaucracy or incompatible with other data sets. The second best alternative is to rely on global data from multilateral agencies, like the WTO, World Bank, UNCTAD etc. Using data from these sources (now integrated at the WITS project) yields the benefit of a single compatible data source, which we prefer in this paper.

Another issue is which European Union to consider. Since the EU is a free trade zone, it is better to consider the whole EU instead of the Euro-Zone. Also, since the present analysis uses data from 1994 to 2005, it encompasses changes in the EU structure. Those changes refer to the accession of ten countries in 2004, which the trade data should reflect that. However, for consistency, the data will be backtracked and the European Union will be considered as having 25 countries for the entire data period. Romania and Bulgaria are not considered, but the choice between 15, 25 or 27

countries would not likely affect trade patterns, since most of the trade between Brazil and the European Union is with the large European countries – France, UK, Germany, and the accession of ten countries in 2004 only enlarged trade between Brazil and the EU by four per cent.

Data is annual for the 1994-2005 period, both for the European Union and Brazil. The data comprises the whole trade flow disaggregated by 06-digit on the Harmonized System (HS06). A typology of goods divided by technological content and input specialization is also used, sourced from OECD.

The result data is then a panel with bilateral flow for each sector for each year and each HS02 chapter, comprising a panel with 97 chapters and twelve years.

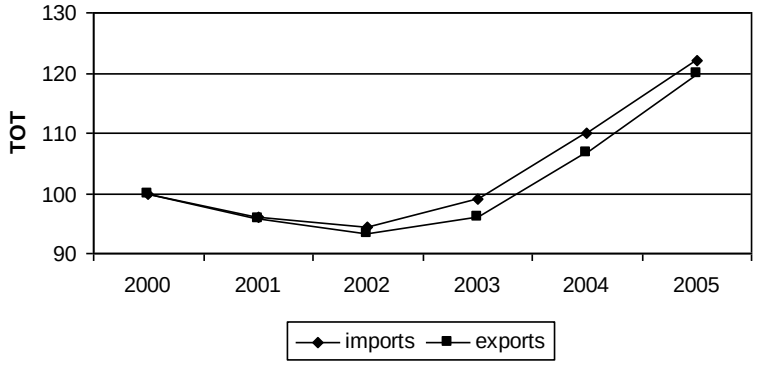
B. Brazil - EU trade – aggregated data analysis

In 1994 Plano Real was implemented in Brazil and inflation was finally curbed down from an average of 2000 per cent in previous years. The early years of Plano Real were marked by an adjustment process to reach low inflation, with significant GDP growth. This soon changed and Brazil experienced a recession period from 1997 to 1999, with a negative impact on Brazil's trade flows with the world, worsened by an appreciated pegged currency. In the 1994-1999 period, exports grew by only 1,97 per cent annually, while imports grew by 8,3 per cent per year. Unlike in 1994, for the entire period following Brazil's trade balance was negative.

In contrast to the 1994-1999 period, Brazilian trade flows experienced an impressive growth in the 2000-2005 period, with exports increasing by more than 100 per cent - from U$55 billion in 2000 to U$118 billion in 2005 –, and a cumulative imports growth of 56 per cent (from U$47 billion in 2000 to U$73 billion in 2005). In the same period, the cumulative growth of world trade amounted to 60 per cent. This impressive performance of Brazilian exports is usually attributed to two devaluations of the Real, one in January 1999 - when the government was unable to maintain the pegged exchange rate (the Brazilian Real jumped from U$1-R$1,22 to U$1-R$2), the other in 2002, an election year when the exchange rate went up to almost R$4 for a dollar. Complementary to these devaluations, there are further explanations for the high Brazilian trade growth: a higher linkage to world trade growth, a rise in commodities prices, and a change in industrial patterns – a kind of export effort by firms to meet a growing world demand for

Brazilian goods. The argument of price changes – the terms of trade explanation - is commonly favored, although Puga (2006) shows that, in fact, Brazilian terms of trade actually worsened in 2005 compared to 2000, even though exports prices are higher, as can be seen on Figure 1, which presents the export and import price index in the 2000-05 period.

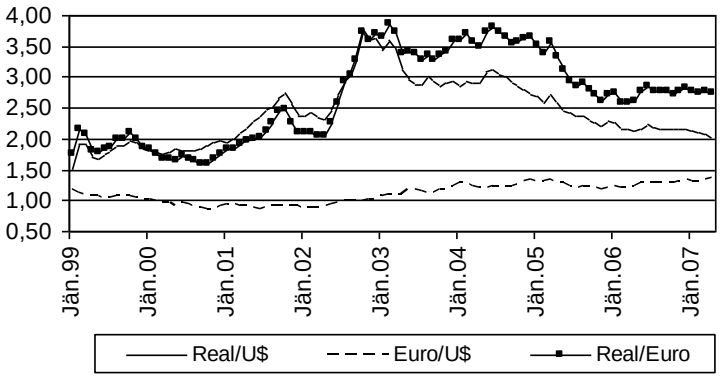
Figure 1: Brazilian Terms of Trade – Relative Prices of Exports and Imports 2000-05



Source: Puga (2006).

Puga (2006) also decomposes the trade flows growth in the period and concludes that only U$11 billion of exports growth can be explained by rising international prices, while the other U$52 billion in growth is not derived from price fluctuations, but from firms' export efforts to meet an international growing demand. Moreover, at the same time that export prices were growing (in the figure, from the lowest value in 2002 onwards), the exchange rate started to appreciate sharply. Figure 2 shows that the Brazilian currency peaked in October 2002, reaching above 3.8 for both the dollar and the euro.

Figure 2: Nominal Exchange Rate – Real, Euro and Dollar 2000-05

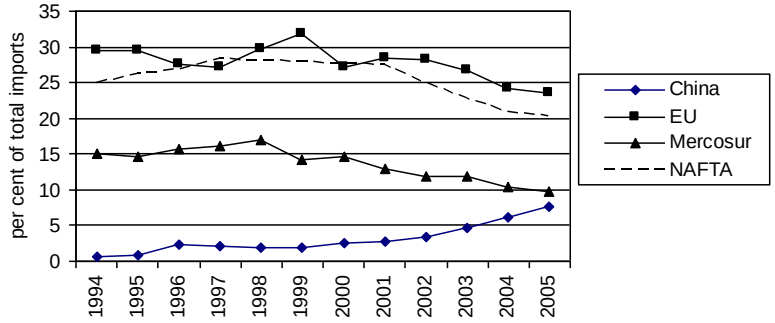


Source: Central Bank of Brazil (2007).

Since then the real has sharply appreciated, while, for the period of July 2002 to early 2005, the real was fluctuating between R$3,3 and R$3,8 per euro. In the same period European trade also experienced growth, but in line with world trade growth, at a pace of 8-10 per cent per year. The EU accounts for 13 per cent of world trade. It shows a diversified export and import structure (in some product areas where the EU has no comparative advantages, such as agricultural products for example, it becomes competitive through export subsidies), and is one of the most important trading partner of Brazil, alongside with NAFTA and MERCOSUR.

EU exports to Brazil grew at 4,9 per cent annually during 1994-2005, which was lower than the total Brazilian imports, 6,9 per cent per year. Although this would imply that the EU has become a less important trading partner, this difference can be explained by the high growth of Chinese exports to Brazil, which went up by 25 per cent per year in the same period. Imports from other trading partners of Brazil showed similar growth as the EU, NAFTA five per cent per year, MERCOSUR 3,2 per cent, and Japan four per cent. Figure 3 shows that the European Union is still the largest exporter to Brazil, even if China is an increasingly relevant partner. The decline of the EU share in Brazilian imports cannot be ascribed simply to exchange rate fluctuations, since NAFTA, whose currency depreciated more against the real, shows a larger decline of its share in the Brazilian market. The fact is that while Brazilian imports are growing, the relative share of EU exports is declining, even if absolute trade flows were growing.

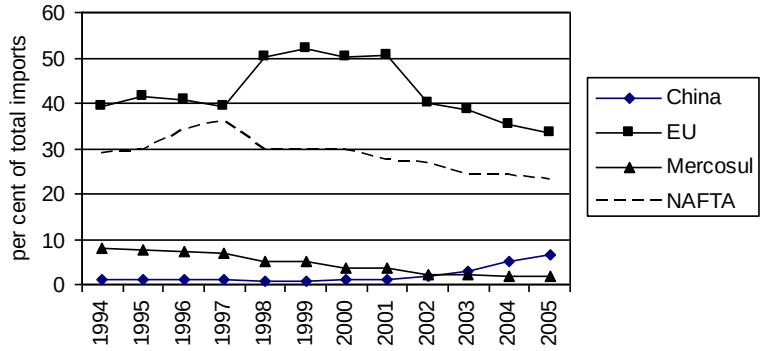
Figure 3: Brazilian Import Structure by Country and Regions 1994-2005



Source: WITS (2007), elaborated by the author.

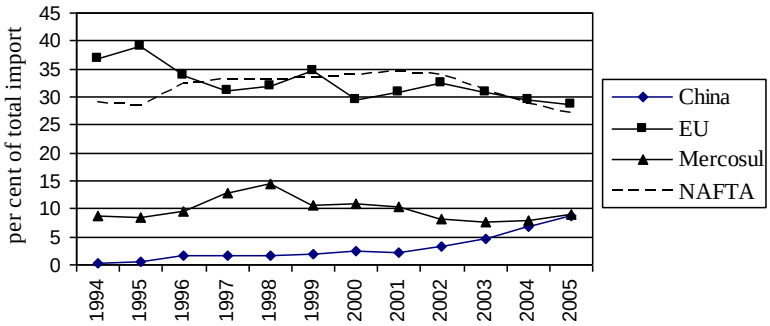
Gains in trade are not only a result of efficiency, but also are, as previously observed, a consequence of technology transfer to recipient countries. To analyze possible gains in trade one has to decompose EU exports to Brazil in terms of their technological content. This decomposition is achieved by using the OECD classification of HS04 products by technological content, and export data from WITS. High and medium-high technological content exports are presented in Figures 4 and 5 below.

Figure 4: Brazilian Imports of High-Technology Goods 1994-2005, by origin



Source: WITS (2007), elaborated by the author.

Figure 5: Brazilian Imports of Medium-High Technology Goods 1994-2005, by origin



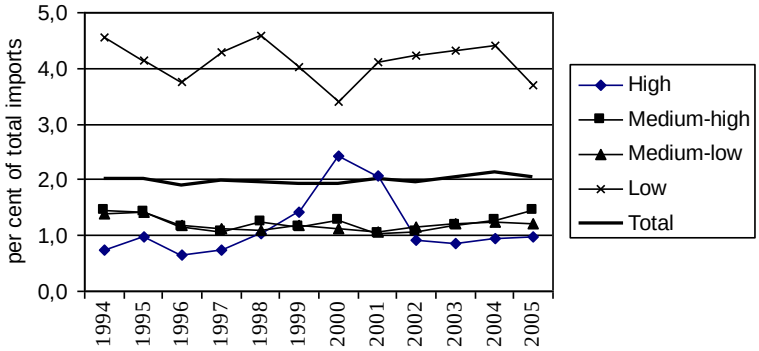
Source: WITS (2007), elaborated by the author.

Figures 4 and 5 show the importance of EU exports in high and medium-high technology goods in the Brazilian market. For both kinds of goods the EU is the leading exporter, although losing market-share. This is, unsurprisingly, a result of Chinese competition. In the case of high-technology goods, the Chinese competition is very recent, growing only in the last three years of the 1994-2005 period. In contrast, Chinese exports of medium-high technology goods have been growing since the end of the 1990's. Chinese exports are usually not associated with high-technological content. However, their growth to the Brazilian market shows the

diversity of China's trade expansion. Nevertheless the EU´s relative share of exports of high and medium-high technology goods should stabilize, since the EU is a traditional trade partner and, as will be seen, has comparative advantages in high-tech industries.

The EU exports to Brazil are concentrated in medium and high-technology goods. Brazilian exports to the EU are mostly concentrated in low technology goods, as can be seen in Figure 6.

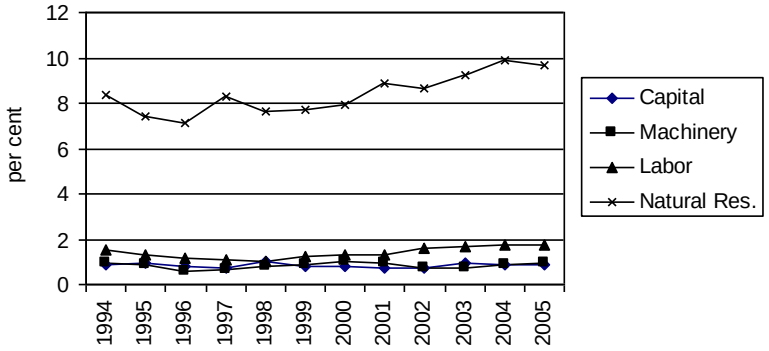
Figure 6: Share of imports from Brazil in EU´s total imports 1994-2005, by technological content



Source: WITS (2007), elaborated by the author.

Two main observations can be derived from the figure above. First, the share of Brazil in the EU market is constant over time, comprising two per cent of EU imports. This is surprising, since Brazilian exports performance was much worse in the 1994-1999 than in later years. The other important point is that Brazilian exports are concentrated in low-technology goods, with the share of these products averaging four per cent of EU imports, in contrast to 1,3 per cent with higher-technology goods. This pattern can be clearly seen in Figure 7, which presents Brazilian exports to the EU decomposed by production factor.

Figure 7: Share of imports from Brazil in total EU imports– 1994-2005, by main production factor



Source: WITS (2007), elaborated by the author.

Figure 7 reveals a structure that one would expect in North-South trade. The South exports, i.e. Brazil´s exports, are heavily concentrated on natural resources goods, followed by labor-intensive goods.

While the EU´s total import share from Brazil is constant, the share of natural resources intensive goods is increasing, reaching almost 10 per cent of EU imports in 2005. This is surprising, because although Brazil is an important exporter of natural resources goods, it is not the main European trading partner, and furthermore Brazil´s exports to the rest of the world are not only growing in natural resources, but in other areas as well. We can conclude that the Brazil – EU trade pattern represents the common textbook story of North-South trade. But is that the whole story? Looking into different sectors should bring more information regarding trade patterns.

C. Brazil - EU trade – disaggregated data analysis by product sector

To examine the development of trade patterns, a look on sectoral trade data is important since trade patterns partly reflect product specialization in the Ricardian tradition, and the rest intra-industry trade. While intra-industry trade is most relevant in North-North trade, it is almost disregarded in North-South analysis. However, the industrialization process experienced by developing countries has brought also an advance in intra-industry trade between

developing and developed countries. Nevertheless specialization in natural resources and labor intensive goods is still the main characteristic of North-South trade.

There is no specific theory on North-South trade, but many works deal with the causes and consequences of trade between developed and developing countries. The main finding is that factor endowments still drive North-South trade, but intra-industry trade is increasingly important due to the fact that the technological ladder hypothesis (where countries improve technologically with ongoing industrialization) leads developing countries into increased production of manufactured goods, which makes technology a determinant of the dynamics of trade. Also, there is trade diversification at the sectoral level, with differentiated products leading to more diversity in trade flows.

Before looking at the data, one has to make a choice regarding the level of disaggregation. There are roughly 5200 products at 06 digits and 1200 at 04 digits. At the chapter-level, data at 02 digits yields 97 chapter, which can be further clustered in 21 chapters. Calculations can be done by looking first at 06 or 04 digits level and then averaging to show the results in the more suitable form of 97 or 21 chapters. We shall follow this approach and presenting the main findings using 21 chapters. When regarding Revealed Comparative Advantages, the results will be presented for all 97 chapters.

For our analysis we use the marginal intra-industry index of trade (MIIT), the Herfindahl-Hirschman Index (HHI), and the Revealed Comparative Advantage index (RCA), first described by Balassa (1965). The present version of the RCA index was modified by Proudman and Redding (2000), and has the advantage of normalizing Balassa's RCA to maintain a constant mean, equal to one over time.

Since the analysis covers a twelve-year period it is necessary to divide it to visualize the results better. The choice is to divide 1994-2005 in three intervals according to structural changes in the Brazilian and European economies. Our first period is from 1994 to 1998, since 1999 marks the start of the euro and the first currency depreciation in Brazil. The second period is 1999 to 2001, since the end of 2001 marks the beginning of a mild world recession and 2002 presents another sharp currency depreciation in Brazil. The third period goes from 2002 to 2005, the last year with available data.

First we calculate the MIIT for these three periods. For averaging the index by trade chapters, a simple procedure is used. Total trade flows of the entire period are summed up (import plus exports plus each year) for of each of the 1200 HS04 goods, and the relative share of product *i* in total bilateral trade is determined. This share is then used for averaging of the MIIT index to find the chapter average MIIT index. The resulting index is in the (0,1) interval. Values close to zero indicate inter-industry trade, while for intra-industry trade results are close to the unity. Since HS04 disaggregation is used, values close to one rarely happen, since specialization in differentiated goods would make it difficult for industry exports and imports in the exactly same amount for the entire chapter.

The marginal intra-industry trade index is defined as (Bastos and Cabral, 2007):

$$MIIT_{ijt} = 1 - \frac{|\Delta_t X_{ijt} - \Delta_t M_{ijt}|}{|\Delta_t X_{ijt}| + |\Delta_t M_{ijt}|} \quad (7)$$

where $\Delta_t X_{ijt} = X_{ijt\,f} - X_{ijt\,0}$ and $\Delta_t M_{ijt} = M_{ijt\,f} - M_{ijt\,0.}$ $X_{ijt\,0}$ and $M_{ijt\,0}$ are, respectively, the exports and imports of section *I* from country *j* at the beginning of period *t*, while X_{ijtf} and $M_{ijt\,f}$ are the respective exports and imports at time *f*.

The results of the *MIIT* for Brazil - EU trade for the 1994-2005 period are presented in Table 1.

Table 1: Marginal Intra-industry Trade Index for Brazil - EU trade and share of total trade, 1995-2005

		MIIT			share in total trade*
Chap.	Description	1995-98	1999-01	2002-05	per cent
1	Meat, Animal Products and Live Animals	0.094	0.073	0.050	2.7
2	Vegetable Products	0.027	0.024	0.019	10.5
3	Animal or Vegetable Fats And Oils	0.146	0.197	0.156	0.4
4	Prepared Foodstuffs; Beverages,Spirits, Tobacco	0.032	0.021	0.023	11.8
5	Mineral Products	0.020	0.016	0.046	8.0
6	Products of the Chemical or Allied Industries	0.159	0.142	0.180	10.8
7	Plastics, Rubber And Articles Thereof	0.316	0.354	0.405	3.3
8	Raw Hides And Skins, Leather,	0.044	0.043	0.131	0.6
9	Wood, Charcoal, Cork And Articles	0.041	0.048	0.020	2.2
10	Pulp, Paper And Printed Material	0.088	0.093	0.135	3.2
11	Textile And Textile Articles	0.203	0.179	0.199	1.5
12	Footwear, Headgear, Etc	0.066	0.058	0.041	0.9
13	Stone, Plaster, Cement, Glass and Articles	0.378	0.404	0.389	1.0
14	Precious Stones And Metals	0.074	0.082	0.050	0.7
15	Base Metals And Articles	0.191	0.230	0.242	6.9
16	Machinery; Electrical Equipment	0.283	0.316	0.383	22.8
17	Vehicles, Aircraft, Associated Equipment	0.410	0.420	0.311	9.1
18	Electronics	0.170	0.173	0.215	2.3
19	Arms And Ammunition; Parts	0.372	0.581	0.426	0.0
20	Miscellaneous Manufactured Articles	0.284	0.229	0.241	1.2
21	Works Of Art, Collectors' Pieces	0.273	0.504	0.258	0.0

* period average – exp plus imp of each chapter on total trade – 95-05.

Table 1 also indicates the average share of each product chapter in the trade of the entire period. The results corroborate the expected evolution of the trade pattern. Agricultural goods are the main source of inter-industry trade, with chapters 1 (meat), 2 (vegetables), and 4 (food preparations) showing absolute values close to zero that decrease. The relevant industrial chapters all show increasing values, with the exception of the automotive industry (chapter 17). In chapters 16 (machinery), 7 (plastics), and 15 (base metals), an increasing specialization in intra-industry trade becomes evident.

With respect to diversification of trade, the issue arises whether there is concentration inside exports and imports chapters. The industrialization process should bring more diversification in industrial products. Also with agricultural products, more diversification is expected since product diversification is a clear sign of a healthy agricultural country that does not rely on a single product. Trade diversification happens if there is a decreasing share of leading products in a chapter's exports. This can be examined with the Herfindahl-Hirschman Index (HHI). It is defined as:

$$H_j = \sum_{i=1}^{n} s_i^2 \tag{8}$$

where s_i is the share of product *i* in chapter *j*. The HHI ranges from *1/n* to 1, with values close to *1/n* indicating an export chapter that is truly diverse, with each product having the same share as the others, whereas values close to one indicate that only one product is responsible for the exports of the entire chapter.[4] Although the *HHI* for international trade is rarely done, it is quite useful to examine trade diversification, especially if a time series is available and if changing patterns are expected. The *HHI* is presented for each chapter for the three periods, based on the share of HS04 products in a chapter's exports. A decreasing *HHI* indicates increasing trade diversification, and an increasing HHI that trade becomes more concentrated in a few products. The values of the HHI for Brazilian exports to the EU are presented in Table 2.

[4] There is a normalized version of the HHI that gives an interval of (0,1), but since the interest is in the evolution of the index instead of its absolute value, we use the simple version. Low values indicate a truly diversified trade.

Table 2: Diversification of Brazil´s exports to the EU: HHI of product chapters, 1995 - 2005

		HHI			exports to EU*
Chap	Description	'95-98	'99-01	'02-05	%
1	Meat, Animal Products And Live Animals	0,242	0,206	0,173	4,4
2	Vegetable Products	0,431	0,408	0,403	18,7
3	Animal Or Vegetable Fats And Oils	0,251	0,220	0,174	0,3
4	Prepared Foodstuffs; Beverages, Spirits, Tobacco	0,322	0,324	0,332	20,5
5	Mineral Products	0,426	0,359	0,326	13,5
6	Products Of The Chemical Or Allied Industries	0,031	0,039	0,036	3,1
7	Plastics, Rubber And Articles Thereof	0,075	0,072	0,060	1,4
8	Raw Hides And Skins, Leather,	0,159	0,198	0,272	1,1
9	Wood, Charcoal, Cork And Articles	0,119	0,124	0,128	4,0
10	Pulp, Paper And Printed Material	0,476	0,685	0,484	4,6
11	Textile And Textile Articles	0,078	0,082	0,065	1,5
12	Footwear, Headgear, Etc	0,368	0,308	0,250	1,6
13	Stone, Plaster, Cement, Glass, Articles	0,094	0,063	0,064	0,7
14	Precious Stones And Metals	0,260	0,176	0,230	1,0
15	Base Metals And Articles	0,125	0,111	0,056	7,5
16	Machinery; Electrical Equipment	0,046	0,043	0,046	8,2
17	Vehicles, Aircraft, Associated Equipment	0,174	0,277	0,153	5,8
18	Electronics	0,043	0,043	0,052	0,5
19	Arms And Ammunition; Parts	0,215	0,285	0,413	0,0
20	Miscellaneous Manufactured Articles	0,270	0,295	0,293	1,5
21	Works Of Art, Collectors' Pieces	0,522	0,227	0,492	0,0

* period average – exp of each chapter on BR to EU trade – 95-05.

The HHI indicates that most exports are concentrated in primary products, with chapters 2 (Vegetables), 4 (Food preparations), and 5 (Mineral products) accounting for a little over 50 per cent of Brazilian exports to the EU in 1994-2005. In the most important product chapters no trade diversification takes place, but the pattern is not quite clear, since for some chapters the *HHI* is either constant (16 –Machinery), or increasing (4 – Food preparations). For most chapters the absolute value of the index is close to zero, indicating an already diversified trade pattern. With respect to EU exports to Brazil, the HHI is given in Table 3 below.

Table 3: Diversification of EU´s exports to Brazil: HHI of product chapters, 1995 - 2005

		HHI			exports to Brazil*
Ch.	Description	'95-98	'99-01	'02-05	%
1	Meat, Live Animals- and Products	0,148	0,123	0,137	0,8
2	Vegetable Products	0,221	0,131	0,170	1,2
3	Animal Or Vegetable Fats And Oils	0,564	0,443	0,333	0,5
4	Prepared Foodstuffs; Beverages, Spirits, Tobacco	0,085	0,092	0,102	2,0
5	Mineral Products	0,115	0,119	0,322	1,8
6	Products Of The Chemical Or Allied Industries	0,012	0,017	0,019	19,5
7	Plastics, Rubber And Articles Thereof	0,051	0,022	0,024	5,6
8	Raw Hides And Skins, Leather,	0,156	0,121	0,106	0,1
9	Wood, Charcoal, Cork And Articles	0,075	0,070	0,098	0,1
10	Pulp, Paper And Printed Material	0,106	0,108	0,057	1,6
11	Textile And Textile Articles	0,030	0,017	0,019	1,6
12	Footwear, Headgear, Etc	0,113	0,111	0,095	0,1
13	Stone, Plaster, Cement, Glass, Articles	0,030	0,029	0,033	1,3
14	Precious Stones And Metals	0,211	0,234	0,155	0,3
15	Base Metals And Articles of Base Metal	0,020	0,016	0,014	6,2
16	Machinery; Electrical Equipment	0,012	0,009	0,008	39,3
17	Vehicles, Aircraft, Associated Equipment	0,221	0,121	0,135	12,8
18	Electronics	0,039	0,047	0,057	4,4
19	Arms And Ammunition; Parts	0,334	0,303	0,219	0,0
20	Miscellaneous Manufactured Articles	0,077	0,183	0,250	0,8
21	Works Of Art, Collectors' Pieces	0,667	0,489	0,649	0,0

* period average – exp of each chapter on EU to BR trade – 95-05.

European exports to Brazil are concentrated in industrial products accounting for more than 90 per cent of total EU exports to Brazil. In four industrial product chapters we find high diversification, but in two chapters, 18 (Eletronics) and 06 (Chemicals), high concentration. There is no clear pattern, but for the two most relevant chapters (06 – Chemicals and 16 – Machinery) the absolute value of the HHI is very close to zero, revealing diversified industrial exports to Brazil.

Finally, we analyze the Brazil – EU trade pattern by looking at Balassa's Revealed Comparative Advantage index as modified by Proudman and Redding (2000). For every country exports i of chapter j Balassa defines RCA_{ij} as:

$$\overline{RCA_{ij}} = \frac{Z_{ij} / \sum_i Z_{ij}}{\sum_j Z_{ij} / \sum_i \sum_j Z_{ij}} \quad (9)$$

Proudman and Redding (2000) normalize the RCA_{ij} so that the average equals one: $RCA_{ij} = \overline{RCA}_{ij} / \frac{1}{N} \sum_j \overline{RCA}_{ij}$ (10)

Taking Brazil as the exporter, the RCA index of a specific export chapter is calculated by comparing the exports of the chapter to the EU with all exports to the European market, and comparing it to Brazilian exports of this chapter to the world with total exports to the world. It is a measure of relative competitiveness of a country´s exports. Instead of showing the data with only 21 chapters, we present the RCA for the whole HS02 since the data relates export chapters to total exports, information would be lost with only 21 chapters. In fact, a thourough analysis of the evolution of patterns of trade should be done by analyzing the 5200 HS06 products, but that is beyond the scope of the present paper. The results are presented in Table 4.

Table 4: RCA – EU exports to Brazil and share of product group in total trade, 1995 – 2005 (to be continued)

HS 02	Description	Exports EU to BR			%	Exports BR to EU			%
		95/98	99/01	01/05		95/98	99/01	01/05	
1	Live animals	0.67	1.03	0.42	0.0	0.00	0.00	0.45	0.0
2	Meat	0.05	0.05	0.02	0.0	1.88	1.92	1.34	3.4
3	Fish and crustaceans	0.39	0.40	0.77	0.1	0.44	1.11	2.02	0.5
4	Dairy produce; eggs; honey; other products	1.84	0.63	0.22	0.4	0.08	0.25	1.23	0.0
5	Products of animal origin	2.48	4.05	4.42	0.2	1.68	1.76	1.79	0.4
6	Live trees and plants; cut flowers and ornamental	0.10	0.17	0.23	0.0	2.73	3.24	2.79	0.1
7	Edible vegetables and certain roots and tubers	0.87	1.08	0.40	0.1	1.13	0.42	1.60	0.0
8	Edible fruit and nuts; peel of citrus fruit or melons	0.98	1.09	0.98	0.2	1.85	2.24	2.60	1.6
9	Coffee, tea, mate and spices	0.21	0.37	0.34	0.0	1.93	2.44	2.39	6.7
1	Cereals	0.31	0.10	0.91	0.1	0.01	0.66	1.15	0.3
1	Products of the milling industry; malt; starches	4.46	3.15	3.47	0.6	0.25	0.56	0.81	0.0
1	Oil seeds and oleaginous fruits; misc grains	0.50	0.93	1.16	0.1	2.58	2.86	1.96	10.0
1	Lac; gums, resins and other saps and extracts	1.74	1.97	2.34	0.1	1.86	1.98	1.25	0.1
1	Vegetable plaiting materials; other products	0.16	0.24	0.33	0.0	0.80	0.38	0.63	0.0
1	Animal or vegetable fats and oils	2.10	2.15	2.54	0.5	0.42	0.40	0.35	0.3
1	Preparations of meat, of fish etc	0.39	0.26	0.10	0.0	2.22	2.59	2.81	1.9
1	Sugars and sugar confectionery	0.48	0.39	0.25	0.1	0.15	0.11	0.14	0.2
1	Cocoa and cocoa preparations	0.71	0.29	0.24	0.2	0.64	0.57	0.41	0.2
1	Preparations of cereals, flour, starch or milk	0.75	0.63	0.33	0.1	0.04	0.05	0.16	0.0
2	Preparations of vegetables, fruit, nuts or others	1.51	1.18	0.68	0.2	2.06	2.53	2.23	4.5
2	Miscellaneous edible preparations	0.83	0.84	0.56	0.2	0.44	0.54	0.83	0.3
2	Beverages, spirits and vinegar	0.95	0.57	0.48	0.9	0.68	0.70	0.59	0.2
23	Soy beans, Prepared animal feed, residues	0.56	0.74	1.68	0.1	2.41	3.57	3.34	11.0
24	Tobacco and manufactured tobacco substitutes	0.11	0.18	0.15	0.1	1.44	1.81	1.18	2.4
25	Salt; sulfur; stone; plastering materials, cement	0.69	0.65	0.82	0.2	2.28	2.64	2.02	1.7

Table 4 (cont.): RCA – EU exports to Brazil and share of product group in total trade, 1995 – 2005

HS 02	Description	Exports EU to BR			%	Exports BR to EU			%
		95/98	99/01	01/05		95/98	99/01	01/05	
26	Ores, slag and ash	2.42	1.53	1.56	0.1	1.50	1.77	1.33	10.5
27	Oil, Mineral fuels, and distillation	1.07	0.93	0.85	1.5	1.15	0.87	0.63	1.3
28	Inorganic chemicals	1.41	1.74	2.27	1.2	0.56	1.00	0.92	0.7
29	Organic chemicals	2.45	2.07	1.68	7.1	0.80	0.78	0.79	1.2
30	Pharmaceutical products	1.12	1.33	0.97	4.2	0.62	0.24	0.65	0.2
31	Fertilizers	4.59	9.18	13.6	1.6	0.04	0.04	0.03	0.0
32	Tanning or dyeing extracts; dyes, pigments, paints	1.77	1.94	1.81	1.3	1.03	1.02	0.44	0.2
33	Essential oils and resinoids; perfumery, cosmetic	0.65	0.76	0.57	0.6	0.77	0.89	0.82	0.2
34	Soap, organic surface-active agents,	1.84	1.60	1.61	0.5	0.43	0.21	0.32	0.0
35	Albuminoidal; modified starches; glues; enzymes	1.09	1.11	1.22	0.3	1.08	1.26	1.32	0.2
36	Explosives; pyrotechnic products; matches	0.40	0.51	0.50	0.0	0.54	0.45	0.18	0.0
37	Photographic or cinematographic goods	1.10	1.65	1.75	0.4	0.25	0.23	0.21	0.1
38	Miscellaneous chemical products	1.51	1.93	2.83	2.3	0.45	0.69	0.84	0.3
39	Plastics and articles thereof	1.45	1.54	1.69	3.9	0.35	0.48	0.61	0.7
40	Rubber and articles thereof	2.15	2.04	2.56	1.6	0.64	0.68	0.72	0.7
41	Raw hides and skins (not furskins) and leather	0.78	0.87	0.62	0.1	1.33	1.66	1.61	1.0
42	Articles of leather	0.08	0.12	0.10	0.0	1.74	1.73	1.25	0.1
43	Furskins and artificial fur; manufactures thereof	0.01	0.01	0.01	0.0	2.17	1.64	2.16	0.0
44	Wood and articles of wood; wood charcoal	0.09	0.17	0.06	0.1	1.70	1.70	1.26	4.0
45	Cork and articles of cork	0.84	0.61	0.50	0.0	0.15	0.22	0.45	0.0
46	Manufactures of straw, of esparto, other	0.74	1.16	0.45	0.0	2.77	1.30	1.76	0.0
47	Pulp of wood or of other fibrous cellulosic material	0.05	0.20	0.34	0.0	1.35	1.68	1.83	3.8
48	Paper and paperboard; articles of paper pulp	0.95	0.65	1.05	1.0	0.83	0.36	0.95	0.7
49	Printed books, newspapers, etc	1.23	0.82	0.54	0.6	1.49	1.74	1.61	0.1
50	Silk	0.10	0.16	0.19	0.0	0.59	0.59	0.63	0.1

Table 4 (cont.): RCA – EU exports to Brazil and share of product group in total trade, 1995 – 2005

HS 02	Description	Exports EU to BR			%	Exports BR to EU			%
		95/98	99/01	01/05		95/98	99/01	01/05	
51	Wool, fine or coarse animal hair	0.08	0.13	0.07	0.0	1.50	2.41	2.02	0.1
52	Cotton	0.64	0.45	0.15	0.1	0.48	0.68	0.73	0.3
53	Other vegetable textile fibers	0.48	0.89	0.26	0.1	2.10	2.33	1.24	0.1
54	Man-made filaments	1.28	1.37	1.37	0.4	0.73	0.30	0.30	0.0
55	Man-made staple fibers	0.40	0.88	0.90	0.2	0.42	0.19	0.20	0.0
56	Wadding, felt and nonwovens; special yarns	1.35	1.08	0.87	0.2	0.34	0.32	0.23	0.0
57	Carpets and other textile floor coverings	0.61	0.50	0.24	0.1	1.12	1.47	0.97	0.0
58	Special woven fabrics; tapestries	0.54	0.53	0.38	0.1	1.03	0.89	0.29	0.0
59	Impregnated, coated, or laminated textile fabrics	1.87	1.57	1.42	0.3	0.47	0.34	0.16	0.0
60	Knitted or crocheted fabrics	0.62	0.40	0.14	0.0	0.01	0.05	0.26	0.0
61	Articles and clothing access, knitted or crochet	0.10	0.22	0.11	0.1	1.27	0.61	1.17	0.2
62	Articles and clothing access, not knitted or crochet	0.06	0.18	0.15	0.1	0.65	0.34	0.86	0.1
63	Other made up textile articles	0.18	0.17	0.16	0.0	1.43	0.92	0.65	0.4
64	Footwear, gaiters and the like; parts	0.08	0.09	0.09	0.0	0.76	0.58	0.78	1.6
65	Headgear and parts thereof	0.28	0.26	0.29	0.0	0.98	0.60	0.75	0.0
66	Umbrellas, walking sticks, seatsticks, whips	0.37	0.45	0.16	0.0	0.48	0.13	0.56	0.0
68	Articles of stone, plaster, cement, asbestos	1.13	1.15	1.22	0.5	0.66	0.66	0.57	0.3
69	Ceramic products	0.55	0.45	0.50	0.3	0.72	0.43	0.39	0.2
70	Glass and glassware	0.89	1.05	1.15	0.5	0.67	0.89	0.99	0.2
71	Precious or semi-precious stones,precious metals	0.12	0.21	0.18	0.3	1.13	0.81	1.06	1.0
72	Iron and steel	0.73	0.80	0.87	1.4	0.63	0.79	0.65	3.7
73	Articles of iron or steel	0.93	1.24	1.40	1.9	0.40	0.36	0.41	0.3
74	Copper and articles thereof	0.55	0.63	0.73	0.3	0.91	0.76	0.35	0.2
75	Nickel and articles thereof	0.98	1.13	2.36	0.1	0.40	1.91	1.55	0.2
76	Aluminum and articles thereof	1.01	1.76	1.81	1.0	1.06	1.48	1.15	2.6

Table 4 (cont.): RCA – EU exports to Brazil and share of product group in total trade, 1995 – 2005

HS 02	Description	Exports EU to BR			%	Exports BR to EU			%
		95/98	99/01	01/05		95/98	99/01	01/05	
78	Lead and articles thereof	0.75	0.60	0.68	0.0	0.51	0.85	1.03	0.0
79	Zinc and articles thereof	0.64	0.27	0.47	0.0	0.51	0.24	0.42	0.0
80	Tin and articles thereof	0.46	0.26	0.40	0.0	0.77	0.14	0.84	0.1
81	Other base metals; cermets; articles thereof	2.12	2.41	2.18	0.1	1.35	1.03	1.83	0.0
82	Tools, implements, cutlery, spoons and forks	2.04	1.58	1.19	0.7	0.59	0.72	0.73	0.2
83	Miscellaneous articles of base metal	1.74	1.37	1.63	0.6	0.53	0.49	0.53	0.1
84	Machinery and mechanical appliances	1.89	1.73	1.48	27.1	0.79	1.00	0.96	6.2
85	Electrical machinery and equipment and parts	1.51	1.74	1.27	12.3	0.64	0.50	0.69	2.0
86	Railway or tramway locomotives, and parts	0.51	0.68	0.32	0.3	0.46	0.24	0.23	0.0
87	Vehicles and parts and accessories thereof	1.64	0.98	0.79	9.9	0.61	0.65	0.29	3.1
88	Aircraft, spacecraft, and parts thereof	0.70	1.83	1.59	2.6	1.41	1.49	0.64	2.7
89	Ships, boats and floating structures	0.07	0.20	0.08	0.0	1.20	0.27	0.45	0.0
90	Electronics	1.46	1.20	1.18	4.3	0.92	0.84	1.16	0.4
91	Clocks and watches and parts thereof	0.51	0.38	0.42	0.0	1.48	1.85	1.36	0.0
92	Musical instruments; parts and accessories	0.50	0.22	0.23	0.0	1.69	1.16	1.35	0.0
93	Arms and ammunition; parts and accessories	0.14	0.45	0.11	0.0	0.42	0.35	0.25	0.0
94	Furniture; bedding, mattresses, mattress supports	0.31	0.57	0.49	0.6	1.98	1.94	1.52	1.4
95	Toys, games and sports requisites	0.26	0.23	0.11	0.1	0.34	0.12	0.54	0.0
96	Miscellaneous manufactured articles	0.94	0.95	0.72	0.2	0.40	0.27	0.47	0.1
97	Works of art, collectors' pieces and antiques	0.07	0.02	0.03	0.0	1.71	0.98	1.79	0.0

The RCA reveals important information. First, it provides further corroboration that Brazil-EU trade is mostly inter-industry trade, since most Brazilian exports with high RCA are concentrated in agricultural products, whereas industrial goods show a high RCA in EU exports. Moreover, the RCA values are fairly constant over the three periods considered. It does not seem that there is increasing specialization, but that specialization is constant. We shall more formally test this later, following Proudman and Redding (2000).

However, the rapid growth of the bilateral trade in the period analyzed, especially in 2000-2005, should have brought changes in the pattern of trade. Since Brazilian trade with the world underwent an increase of almost 100 per cent in 2002-2005, one would expect that this had been caused by an introduction of new products and trade diversification. While, as shown, trade diversification has indeed taken place in the last period, trade specialization still dominated, and Brazilian exports maintained its RCA pattern in the European market. Considering EU exports to Brazil, in all product chapters with high RCA, this remains over one for the entire period, with the exception of chapter 30 (pharmaceutical products), which presents a RCA of 0.97 in the last period. However, in all those chapters the RCA has decreased, which can be interpreted as a loss in competitiveness of EU exports in the Brazilian market, probably due to increased competition form China, as previously observed, or other unobserved factors.

In a Heckscher–Ohlin thinking, the conclusion is that trade between countries with similar factor endowments would not occur due to specialization in the same industries. But including product differentiation and economies of scale the implication is that specialization in different products inside an industry is viable and thus intra-industry trade emerges. That means that one of the main conditions for intra-industry trade is that both countries' industries present RCA above average. Regarding the Brazil - EU trade, this only appears in six of the 97 HS02 chapters. These six chapters account for less than seven per cent of the bilateral trade. Although intra-industry trade between EU and Brazil is growing, the fact that the trade is highly specialized, and that there is no congruence for RCA over one in most industries limits the possibility of intra-industry growth. The growth of Brazilian exports, then, cannot be explained by a rapid industrial development, and the export effort (Puga, 2006) by Brazilian firms seems to be a consequence of

growth in the same chapters that already present above average RCA, with specialization based on labor and natural resources abundance.

Thus it seems that technology transfer is not playing a major role in the dynamics of Brazil-EU trade. If so, RCA would have changed over time, and intra-industry trade would have grown at a higher rate. Also, RCA index for Brazilian exports would have grown across the board for industrial products, not only for chapters 90 (Electronics), 72 (Lead), 82 (Tools), and 35 (Albuminoids).

IV. Econometric results

The results of the analysis of the mobility or persistence of trade patterns investigating transition probabilities are presented in Table 5. The interpretation of the table is as follows. RCAs are divided into four sets, numbered 1 to 4, from lower RCAs levels to higher RCAs levels. Upper endpoints are determined at which point transition from one set to another happens. A transition to a higher RCA means a jump from a lower state to a higher state. It can also happen that an export section loses RCA and jumps back to a lower state.

The first column gives the upper endpoint in parentheses for each sample, i.e., the cutting point at which RCA transition happens. The numbers on the diagonal are the probabilities that the RCA is constant. Numbers to the left of the diagonal are probabilities that a section is moving up the RCA ladder and numbers to the right indicate a downward movement. The results are iterated to present a five-year average.

Table 5: Five-year transition probabilities for Brazil and EU trade

	Upper endpoint		1	2	3	4
Brazil exports to the EU	(0.45)	1	0.7813	0.1712	0.0311	0.0005
	(0.86)	2	0.2103	0.5826	0.1879	0.0155
	(1.12)	3	0.0428	0.2032	0.6643	0.1077
	∞	4	0.0001	0.0255	0.2566	0.7322
EU exports to Brazil	(0.53)	1	0.7936	0.1830	0.0377	0.0092
	(0.91)	2	0.2756	0.5109	0.2094	0.0221
	(1.24)	3	0.0218	0.1208	0.7767	0.0875
	∞	4	0.0041	0.0243	0.1398	0.8188

Concerning Brazil's export to the EU one notes that chapters with very high or very low RCAs have a higher probability of staying in such states, while mobility is higher in chapters with average RCAs indexes. In the case of European exports to Brazil results are ever more pronounced, with a 80 per cent probability that a chapter with a RCA of under 0.53 or over 1.24 stays in the same RCA state in a five-year period. In chapters with intermediate levels of RCA the probability of moving upwards or downwards the RCA ladder is low. This is surprising since the impressive growth of the trade flow between Brazil and the EU might have brought changes in specialization patterns. Our analysis provides no evidence for this and confirms the preliminary conclusions drawn in the last section.

The last test is a simplified one based on Mancini-Griffoli and Pauwels (2006), since the idea is not to look deeply into structural breaks but to find one. For that purpose, the test is applied to the last year and then backtracked to explore the possibility of a structural break. The "break date" is defined as the first period when the null of stability occurs with at least 90 per cent confidence, for a post-break sample of six quarters. The break criterion is a year. A dynamic OLS is run, trying to find a structural break. Not even at the 10 per cent probability level one is found (see Table 6). This was expected after the strong evidence already found that the trade pattern between Brazil and the EU has been constant over the period analyzed.

Table 6: Structural Break test

Year	α=1%	α =5%	α =10%
1994	0.027	0.033	0.044
1995	0.037	0.047	0.007
1996	0.065	0.024	0.009
1997	0.041	0.027	0.000
1998	0.077	0.035	0.003
1999	0.071	0.024	0.032
2000	0.030	0.066	0.037
2001	0.071	0.010	0.026
2002	0.088	0.008	0.024
2003	0.078	0.029	0.022
2004	0.080	0.064	0.045

IV. Final Comments

The goal of this paper was to discuss current issues in North-South international trade in the context of the trade between Brazil and the European Union. First, a comprehensive exploratory data analysis of the patterns of trade was presented, using tools such as the marginal intra-industry index, the Herfindahl-Hirschman index, and the Revealed Comparative Advantage index. The results of this investigation revealed a typical North-South trade pattern between the EU and Brazil, with specialized trade based on factor endowments, and some first weak signs of increasing intra-industry trade and trade diversification.

For verifying these preliminary results two econometric analyses were implemented, one investigating the mobility of trade patterns following Proudman and Redding (2000) and another searching for structural breaks in trade patterns following Chan *et al.* (2006) and Mancini-Griffoli and Pauwels (2006). The second econometric estimation focused on a new use on the tools developed by the authors, based on the marginal intra-industry index. The results confirmed the initial analysis of patterns of trade between Brazil and EU and corroborated that the trade between them is still based on factor endowments and inter-industry trade, with low probability that export sectors either gain or lose RCA over the years. The period analyzed, 1994-2005, is a relatively long period, during which trade between Brazil and the EU experienced expressive growth. One would expect that in such a long period many changes in trade patterns had happened. However, this conjecture had to be rejected. It can be affirmed that the trade pattern between Brazil and the European Union is almost the quintessential textbook description of North-South trade. This pattern will probably be extended by further trade negotiations, especially if the EU cuts subsidies on agriculture. If this happens, Brazilian exports to the EU should soar, since even with many non-tariff barriers Brazil is already responsible for 10 per cent of EU imports of natural resources based goods.

In absence of technological knowledge spillovers and endogenous technological progress trade theory predicts that initial specialization patterns will be locked-in over time (Proudman and Redding, 2000) since factor endowments will be the only source of trade. As uninteresting as it is, the present main conclusion is that this seems to be happening in trade between Brazil and the

European Union. Despite all interesting models showing the relevance of technological spillovers and the technological ladder hypothesis, the North-South pattern of trade between Brazil and the EU seems indeed locked-in.

There are a number of further trade issues remaining to be investigated. An interesting issue arises in the context of the accession of new EU members which may have resulted in trade diversion. Another question relates to trade creation which may result from reduced agricultural export subsidizes of the EU, or a reduction of trade tariffs and non-tariff barriers by Brazil. The present analysis did not focus on tariff effects since after the first trade liberalization of the Brazilian economy in the early 1990s no further movements to open up to trade occurred in Brazil. The EU is more open, but has still a closed agricultural sector which has yet to experience significant international competition.

To summarize, this paper strived to advance the literature by showing that, in the case of Brazil and EU trade, patterns of trade are not evolving over time, a result which can be classified as unexpected, and which invites a formal test of a Heckscher-Ohlin model to explain it.

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