

The Regional Integration Manual

Quantitative and qualitative methods

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5 Statistical measures of regional trade integration

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Introduction: the regionalization of world trade

The process of international economic integration is fuelled by a complex set of factors, ranging from technical progress to the learning of foreign languages, and including the economic forces leading to a higher degree of interdependence among national markets, as well as policies aimed at removing obstacles to international transactions.

This process is normally represented as a world-scale phenomenon (globalisation), and measured with indicators based on the notion of a country's international openness, such as the trade-to-GDP ratio. According to this perspective, each country is considered in light of its economic relationships with the rest of the world, seen as a unique partner, regardless of the geographic distribution of bilateral trade and investment flows.

In the real world, however, the actual network of international transactions does not correspond to this simplification (De Lombaerde and Iapadre 2008). In the case of trade, for example, as predicted by gravity models, the intensity of bilateral flows exhibits a high degree of cross-country variability, depending on the relative size of partner countries and on their distance, as well as on a set of additional factors segmenting national markets (tariffs, quantitative restrictions, different currencies, regulations, and so on) or creating preferential linkages, such as the use of a common language, migration flows and free-trade agreements (FTAs).

As a result, it is often argued that trade and production integration has been increasing at not so much the multilateral but rather the regional level, spurred by the development of an increasing number of integration agreements (regionalism), as well as by the tendency of firms to develop their activities more intensely within the borders of a given continental region than on a global scale (market-driven regionalisation).¹

As of July 2010, the number of preferential trade agreements notified to the General Agreement on Tariffs and Trade/World Trade Organisation (GATT/WTO) and in force came to 283 – mostly in the form of FTAs. Each of the 153 WTO members is involved in at least one of them. The rise of preferential agreements is due to a variety of political and economic factors, including the problems encountered by multilateral trade negotiations at

the WTO and the attempts to obtain more easily reductions in market-access barriers via a more limited number of partners. Increasingly, preferential agreements involve countries belonging to different regions (cross-regional trade agreements), which could be seen as a sign of weakening in the process of (geographic) regional integration.

Regionalism is at the core of an intense debate in academic and policy circles. On the one hand, regional integration, particularly if it goes beyond the simple removal of trade barriers, has the potential to augment the production of transnational public goods and solve many difficult problems in the governance of cross-border relations. More specifically, the integration level that can be achieved on a regional scale is normally deeper than what could be feasible at the multilateral level. On the other hand, the development of often overlapping preferential integration schemes can have detrimental effects, by fragmenting the set of market regulations, diverting trade flows, and making the progress of multilateral negotiations more difficult.

It is, therefore, of paramount importance to measure correctly the intensity of regional market integration, in order to improve the understanding of economic globalisation, feed the public debate on its effects on the progress of societies, and support decision-making at all levels.

Indicators of trade regionalisation are manifold and can be used for different purposes. For example, the intensity of intra-regional trade flows is relevant both for assessing ex-ante a region's integration potential, and for evaluating to what extent integration policies have actually increased trade interdependence in the region.

After going over the main international statistical sources for the analysis of regional trade (first section), this chapter presents an overview of the most important statistical indicators used to measure the process of trade regionalisation, starting from those aimed at assessing the global importance of regionalism at the policy level (second section). It then turns to indicators of the actual degree of trade regionalisation (third section), and illustrates some measures of the relative importance of intra- versus extra-regional trade flows. It starts from the simplest indicators (intra-regional trade shares and intensity indices), underlining their shortcomings, and includes a more sophisticated measure (the regional trade introversion index), which is proposed as a better alternative to measure the regionalisation of international trade. It also presents a couple of indicators based on the trade-to-GDP ratio, aimed at capturing at the regional level the internal and external trade-creating effects of international integration.

All these indicators have been computed for four regions, representing the largest areas – in terms of total trade – involved in preferential integration agreements, namely the European Union (EU) (EU-15 or EU-27), the North American Free Trade Agreement (NAFTA), the Association of South East Asian Nations (ASEAN) and the Common Market of the South (MERCOSUR). Member countries of these agreements are listed in the Annex.

Fourth section is devoted to recently developed statistical indicators, based

on network analysis, which are aimed at representing the topological features of the world trade web, including its possible tendency to concentrate in regional groupings.

Fifth section concludes and points to some promising directions of future research.

Statistics on regional trade

Data on international trade is widely and easily available from several sources, including national statistical offices, international institutions, research centres and private firms. In particular, data on the value of merchandise trade is published regularly in most countries on a monthly basis at very detailed levels of disaggregation by product and partner country, following international standards that make the data easily comparable across countries. International institutions collect trade statistics from national sources and manage information systems that allow users to retrieve the data from different reporting countries on a consistent basis.

The most comprehensive trade database, administered by the United Nations, is the Commodity Trade Statistics Database (COMTRADE)², which includes data for many countries, disaggregated according to different classifications. COMTRADE data is used as input by research centres and private firms in order to build databases addressing specific user needs. One notable example is the Base pour l'Analyse du Commerce International (BACI) database, developed by the Centre d'Études Prospectives et d'Informations Internationales (CEPII), which addresses some problems of the COMTRADE system, building a consistent set of data for virtually every country at a very detailed level of product disaggregation.³ Another important information source is the WTO statistical portal, which combines a set of trade data at a fairly aggregate level with quantitative and qualitative information on trade policies.⁴ A specific section of the WTO website is devoted to regional and other preferential trade agreements.⁵

Research on trade regionalisation does not necessarily require product disaggregation, but depends crucially on the availability of data by partner country. The most comprehensive and current database on bilateral trade flows at the aggregate level is the International Monetary Fund (IMF) Direction of Trade Statistics, which contains monthly data and/or estimates for most member countries of the IMF.⁶ Annual bilateral trade data at the aggregate level are also available on a recently developed database, included in the United Nations University Institute for Comparative Regional Integration Studies (UNU-CRIS) Regional Integration Knowledge System (RIKS)⁷, which offers a comprehensive set of quantitative and qualitative information on several aspects of regional integration. One specific feature of the RIKS database is the prompt availability of several statistical indicators for the analysis of regional integration, including some of the indicators presented in this chapter.

Notwithstanding some recent progress, the available data on international trade in services is still less comprehensive and detailed than data on merchandise trade. This is partly the result of the immaterial nature of services, which makes the collection of custom statistics impossible. More importantly, only a minor part of international transactions in services takes the form of cross-border trade (mode 1 in the language of the GATS), which is typical of merchandise trade and implies that producers and consumers deal without leaving their own country. In many cases the international supply of services requires the mobility of either consumers (mode 2) or producers, in the form of commercial presence (mode 3), which normally implies foreign direct investment (FDI) or the movement of workers (mode 4).

As a result, a complete analysis of trade in services entails access to different kinds of databases. The most important source is still the balance-of-payments statistics produced by central banks and other national statistical institutions, but an increasingly relevant role is played by recently developed surveys on the activities of foreign affiliates of multinational enterprises (Foreign Affiliates Trade Statistics (FATS)).

International institutions provide standards for the harmonisation of national statistical activities and build databases including comparable data for different countries. In particular, the already mentioned WTO statistical portal includes also aggregate data on trade in commercial services and some information on related policies, whereas the IMF Balance of Payments Statistics database⁸ contains extensive information on trade by type of service for many reporting countries, but without any disaggregation by partner country. The growing information on the activities of multinational enterprises is collected by the Organisation for Economic Cooperation and Development (OECD 2007).

Harmonised data on bilateral trade in services, which is necessary for the analysis of trade regionalisation, is available in the OECD Statistics on International Trade in Services, but only for a limited number of countries.⁹ However, reporting countries represented about 75 per cent of world export services in 2003, and the country coverage can be increased by using bilateral mirror imports as a proxy for the exports of non-reporting countries.

Indicators of trade regionalism

Many indicators can be used to measure the empirical relevance of regional integration processes, considering either the number of agreements, or the value of trade among their member countries. The former can be seen as measures of the intensity of regionalism at the policy level, whereas the latter refer to the actual degree of trade regionalisation.

The WTO Secretariat keeps the count of bilateral, plurilateral and regional preferential trade agreements in force, that have been notified by GATT/WTO member countries, in compliance with their obligations under GATT article XXIV, the 'Enabling Clause' and GATS article V (Fiorentino,

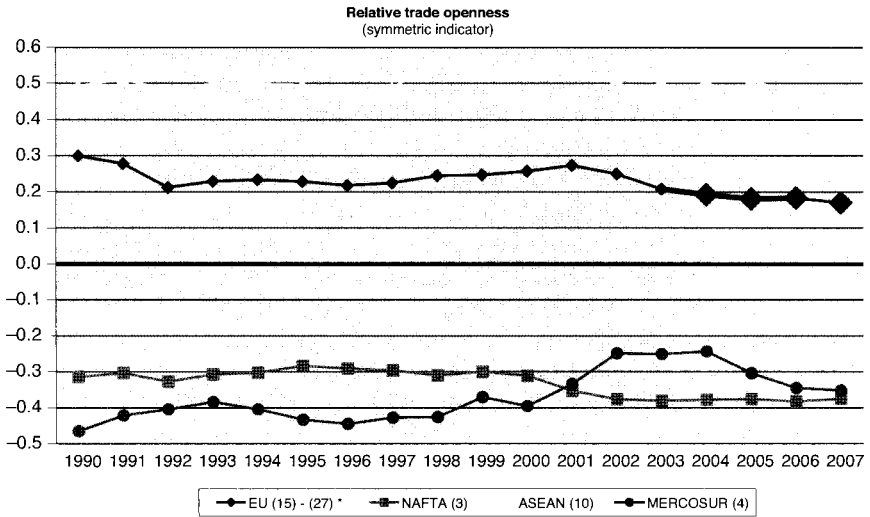


Figure 5.1 Preferential trade agreements notified to the GATT/WTO and in force, by date of entry into force.

Source: WTO website, accessed on September 22, 2009.

Verdeja and Toqueboeuf 2007). This count does not include agreements in force that are still to be notified, signed agreements that have not entered into force yet, agreements under negotiation or simply at the stage of proposal, and agreements among countries that are not members of the WTO.

The number of preferential trade agreements notified to the GATT/WTO has been growing steadily in the 1990s and early 2000s (Figure 5.1). One of the main contributing factors was the political disintegration of the Soviet Union and other Central and Eastern European Countries (CEECs), as well as of the Council of Mutual Economic Assistance (CMEA), the arrangement regulating their international trade relations. This process prompted the conclusion of a large number of preferential agreements, aimed at replacing previous trade routes or at creating new linkages, particularly with Western European countries.

Other factors include the activism of the EU and, more recently, of the United States (US) in pursuing a series of bilateral preferential agreements, mostly with developing countries, in the view to deepen reciprocal integration beyond the levels reached in the WTO system. This tendency has been followed by several other countries, particularly in East and South Asia (Heydon and Woolcock 2009).

The significance of the number of agreements as a measure of trade regionalism is questioned by Pomfret (2007), who argues that this indicator gives the same weight to each preferential agreement, regardless of its nature and depth, as well as of the number and size of partner countries.

So, bilateral and cross-regional agreements are not distinguished from truly regional processes.

Indicators of trade regionalisation

Several indicators based on the value of intra-regional trade have been proposed in the literature, to measure the trade effects of regional integration. Much caution must be used in their interpretation, because the growth in intra-regional trade is not necessarily the result of preferential trade agreements among the region's members, but may reflect higher growth rates of their GDP and market-driven processes of regionalisation.

Intra-regional trade shares

The simplest statistical indicator used to assess the relative importance of intra-regional trade is its share of the region's total trade (*intra-regional trade share, S_i*):

$$S_i = t_{ii}/t_i \quad (5.1)$$

$$0 \leq S_i \leq 1$$

where:

t_{ii} = region i 's intra-regional trade (exports plus imports);

t_i = region i 's total trade.

Given its intuitive appeal, this indicator is often used in the empirical analysis of RIAs.¹⁰ However, it incurs at least two problems, impairing its usability for cross-region and time-series analyses (Anderson and Norheim 1993: 80–81; Frankel 1997: 21–25). Regardless of the level of trade integration, a region's intra-regional trade share is positively affected by

- the number of its member countries, for any given value of its total trade;
- its size in terms of total trade, for any given number of member countries.

The latter problem is particularly insidious, because it gives the intra-regional trade share a pro-cyclical bias, so that dynamic regions, whose trade grows more rapidly than the world average, tend to show rising intra-regional trade shares regardless of their degree of trade integration, that is even assuming that the weight of every partner in the region's trade is equal to its weight in world trade ('geographic neutrality').¹¹

These problems are clearly visible in Figure 5.2, where the EU and NAFTA show higher intra-regional trade shares.

The intra-regional trade share of the EU (15) fell from around 64 per cent

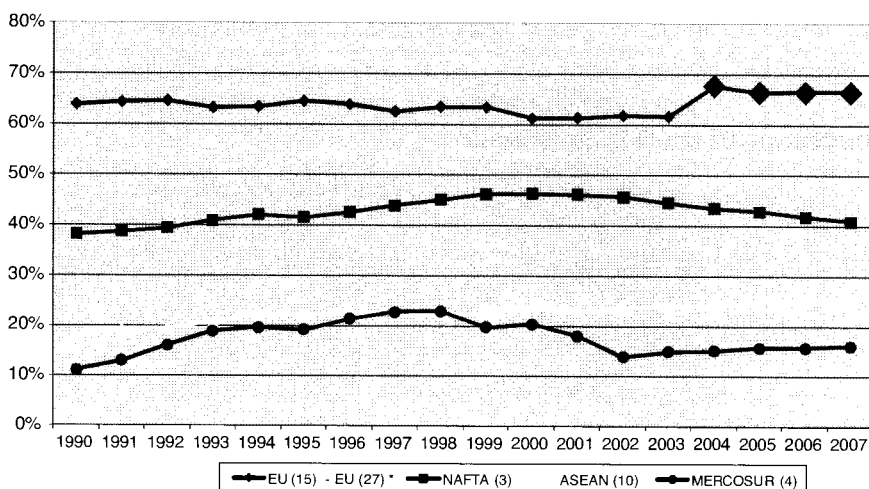


Figure 5.2 Intra-regional trade shares.

Source: based on WTO, International Trade Statistics, various years, appendix tables. * Data for the European Union refer to EU (27) in 2004–07.

in the early nineties to less than 62 per cent in 2000–03. The 2004 enlargement translated into an upward adjustment of this indicator, which has remained quite stable around 66 per cent in the following two years.

The other three regions' intra-regional trade shares show a more or less pronounced upward trend in the nineties, which only in the case of ASEAN has continued in the current decade. NAFTA's intra-regional trade share has fallen back to its level of the early nineties, due to the relatively slow growth of its total trade and to the nominal impact of the dollar depreciation. In the case of MERCOSUR, the financial crises in Brazil and Argentina brought about a sharp fall in the intra-regional trade share. Its upward trend has resumed since 2003.

At the country level, the intra-regional trade share is defined as $S_k = t_{ki}/t_{k.}$, where subscript k refers to region i 's member countries.

Figure 5.3 shows its distribution among the 27 members of the EU in 2007, which is characterised by remarkable variability. Other things being equal, smaller and more central countries tend to show higher intra-regional trade shares.

Intra-regional trade intensity indices

An alternative indicator, which has been proposed as a possible solution for the problems of intra-regional trade shares, is the *intra-regional trade intensity index* (I_i).¹² In its simplest form, it is equal to the ratio between region i 's intra-regional trade share (S_i) and its share of world trade (W_i):¹³

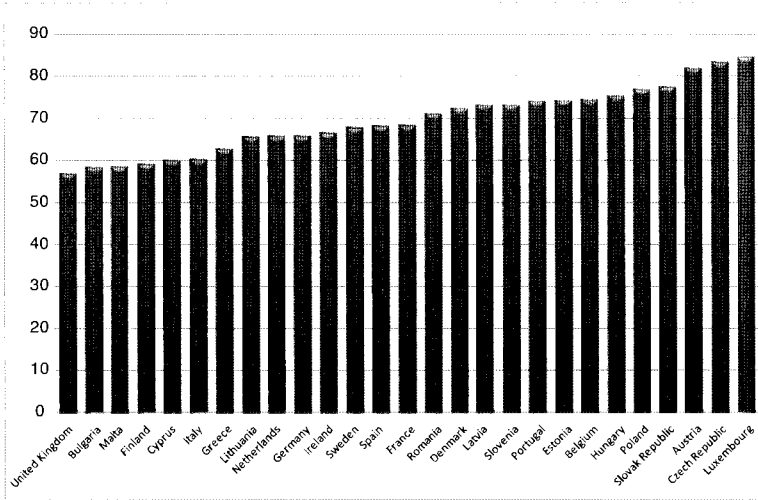


Figure 5.3 European Union (27) – Intra-regional trade shares, 2007.

Source: based on IMF, Direction of Trade Statistics.

$$I_i = S_i/W_i = (t_{ii}/t_i)/(t_i./T) \tag{5.2}$$

$$0 \leq I_i \leq (T/t_i)$$

where:

t_{ii} = region i 's intra-regional trade;

t_i = region i 's total trade;

T = world trade.

This index is equal to one if the region's weight in its own trade is equal to its weight in world trade (geographic neutrality). On the contrary, if intra-regional trade is relatively more important than trade flows with the rest of the world, the intra-regional trade intensity index is higher than one.

Correspondingly, an *extra-regional trade intensity index* (E_i) can be defined as:

$$E_i = (1 - S_i) / (1 - W_i) \tag{5.3}$$

$$0 \leq E_i \leq [T/(T - t_i)]$$

The importance of intra-regional trade for each region is generally larger than the region's weight in world trade. This is shown by the fact that intra-regional trade intensity indices are higher than one for every region, reflecting integration policies and other proximity factors.

Figure 5.4 is dominated by MERCOSUR, whose intra-regional trade share is, on average, 13 times larger than the region's weight in world trade.

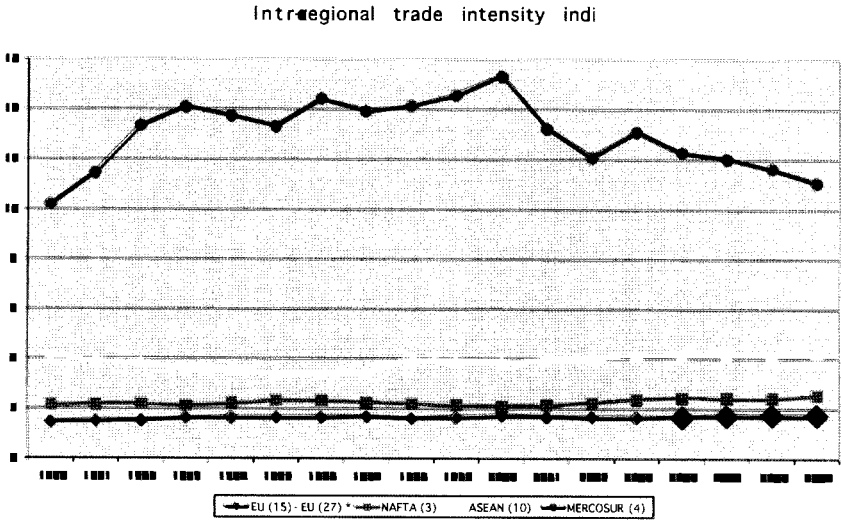


Figure 5.4 Intra-regional trade intensity indices.

Source: based on WTO, International Trade Statistics, various years, appendix tables. * Data for the European Union refer to EU (27) in 2004–07.

This is a common feature of many regional groupings of developing countries, whose weight in world trade remains relatively low due to a variety of factors, including trade barriers in their domestic markets and abroad. MERCOSUR’s intra-regional intensity index shows an upward trend in the nineties, which has reversed in the current decade, in the aftermath of the financial crises in Brazil and Argentina.

Intra-regional trade intensity indices are much lower in the other regions and tend to show increasing trends. The main exception is the EU-15, where the indicator remained stable between 1993 and 2003.

At the country level, $I_k = S_k/W_i = (t_{ki}/t_k)/(t_i/T)$ and $E_k = (1 - S_k)/(1 - W_i)$, where subscript k refers to region i ’s member countries.

Figure 5.5 shows intra-regional trade intensity indices in the three member countries of NAFTA in 2007, and the US appears to be less oriented towards intra-regional trade than Canada and Mexico.

Although being immune from the specific problems afflicting trade shares, the intra-regional trade intensity index is also characterised by at least three uncomfortable features, which limit its interpretability and usefulness:

- *Range variability*: the maximum value of the index is a decreasing function of the region’s total trade, so that indices computed for different regions and/or periods are not perfectly comparable among each other;
- *Range asymmetry*: its range below the threshold value of 1 is much smaller than above, which may give rise to biased assessments of the index changes, and create problems in econometric estimates involving the index;

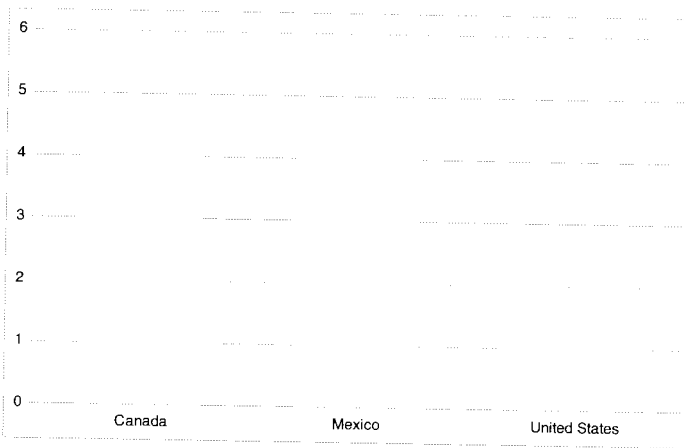


Figure 5.5 NAFTA – Intra-regional trade intensity indices, 2007.

Source: based on IMF, Direction of Trade Statistics.

- *Dynamic ambiguity*: intra- and extra-regional trade intensity indicators can move in the same direction, if certain conditions hold, creating problems in their interpretation. More precisely, it can be shown that, if the regional direction of trade is not neutral ($I_i \neq E_i$) and the ratio between the changes of S_i and W_i lies in the interval between I_i and E_i , the two complementary indices show a simultaneous increase or fall, depending on whether the region's total trade grows less or more rapidly than world trade (condition of sign concordance).

Given these problems, trade intensity indices should not be used to compare the degree of regional integration across different countries or areas, nor to draw inferences about its changes across time.

However, these problems have been addressed in the literature (Iapadre 2006: 67–71) and specific solutions are available for each of them, based on adjustments to expression (5.2). The indicator discussed below offers a comprehensive solution to all of them.

The 'regional trade introversion' index

The *regional trade introversion index* (SJ_i) is based on a modified version of intra- and extra-regional intensity indices (HI_i, HE_i), where the intra-regional trade share is compared to the region's share of other regions' trade (and not of world trade), so that their range is independent of the region's size (Iapadre 2006). The regional introversion index rises (falls) only if the intensity of intra-regional trade grows more (less) rapidly than that of extra-regional trade. Its range is symmetric because it is divided into two equal parts by the threshold value of geographic neutrality ($SJ_i = 0$).¹⁴

Its formula is the following:

$$Sf_i = (HI_i - HE_i)/(HI_i + HE_i) \quad (5.4)$$

$$-1 \leq Sf_i \leq 1$$

where:

$$HI_i = S_i/V_i = (t_{ii}/t_i)/(t_{ni}/t_r)$$

$$HE_i = (1 - S_i)/(1 - V_i)$$

t_{ni} = region i 's extra-regional trade;

t_r = total trade of the rest of the world.

The corresponding *regional trade extroversion index* (SF_i) can be defined as:

$$SF_i = (HE_i - HI_i)/(HE_i + HI_i) = -Sf_i \quad (5.5)$$

$$-1 \leq SF_i \leq 1$$

The dynamic ambiguity problem is absent in this case, since any change in the regional introversion index necessarily implies an opposite and equal change in the complementary extroversion index.

An interesting property of the regional introversion index is that it simultaneously measures the relative intensity of intra-regional trade in the target region i and in the rest of the world, taken as a single 'complementary region'. Stated differently, if the world is divided into two regions, since, by definition, $S_2 = (1 - V_1)$; $V_2 = (1 - S_1)$, and vice versa, it is easy to show that $Sf_2 = Sf_1$, independently of the regions' size.

Intuitively, it is reasonable that, if the world is divided into only two regions, any level of trade introversion in one of them implies the same result in the other, with the limiting case where both regions are completely isolated from each other.

The symmetric trade introversion index can therefore be proposed as the most satisfactory measure of intra-regional trade intensity. It must be stressed, however, that Sf_i can give only an *ex-post* evaluation of the level of trade integration within the region, which is not enough to draw any conclusion about the strength of the underlying causal links. In other words, trade introversion indices simply measure *revealed trade preferences* among the region's members, in analogy to what can be said about the Balassa specialisation index, which measures revealed comparative advantages, without pretending to give any *ex-ante* assessment of their intensity.

The relative intensity of intra- and extra-regional trade is affected by a series of factors, including geographic and cultural proximity, integration policies and the international fragmentation of production. These forces shape the direction of trade flows, so that members of regional integration

agreements tend to reveal a more or less intense degree of intra-regional trade preference.

The regional trade introversion index is strongly positive for all the four regions shown in Figure 5.6, confirming the great importance of intra-regional trade flows.

MERCOSUR appears as the area with the highest level of regional trade introversion, with an upward trend that was particularly strong in the first nineties, but was reversed by the Argentine crisis. The high level of MERCOSUR's trade introversion can be interpreted as not so much the result of regional integration, as of the relatively high geographic and political barriers hindering the region's trade with the rest of the world. MERCOSUR's countries are relatively distant from many important markets and their agricultural exports face significant trade barriers. Moreover, their average degree of protection against imports is relatively high.

The other regions show similar levels of trade introversion. NAFTA is the area where this indicator increased more, starting from relatively low levels in 1990. In the ASEAN region a fall of the index until 1995 was followed by an upsurge, particularly in the aftermath of the Asian crisis. Opposite trends appear in the European Union, where trade introversion has been slowly declining since 1995, after rising markedly in the previous years.

At the country level, $SJ_k = (HI_k - HE_k)/(HI_k + HE_k)$ and $SF_k = -SJ_k$, where $HI_k = S_k/V_i = (t_{ni}/t_k)/(t_{ri}/t_r)$, $HE_k = (1 - S_k)/(1 - V_i)$, and subscript k refers to region i 's member countries.

Figure 5.7 shows regional trade introversion indices for the ten member

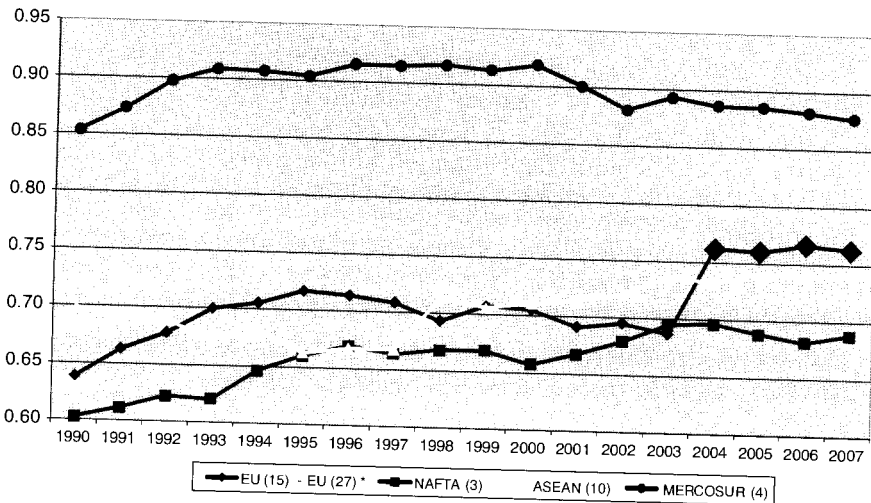


Figure 5.6 Regional trade introversion.

Source: based on WTO, International Trade Statistics, various years, appendix tables. * Data for the European Union refer to EU (27) in 2004–07.

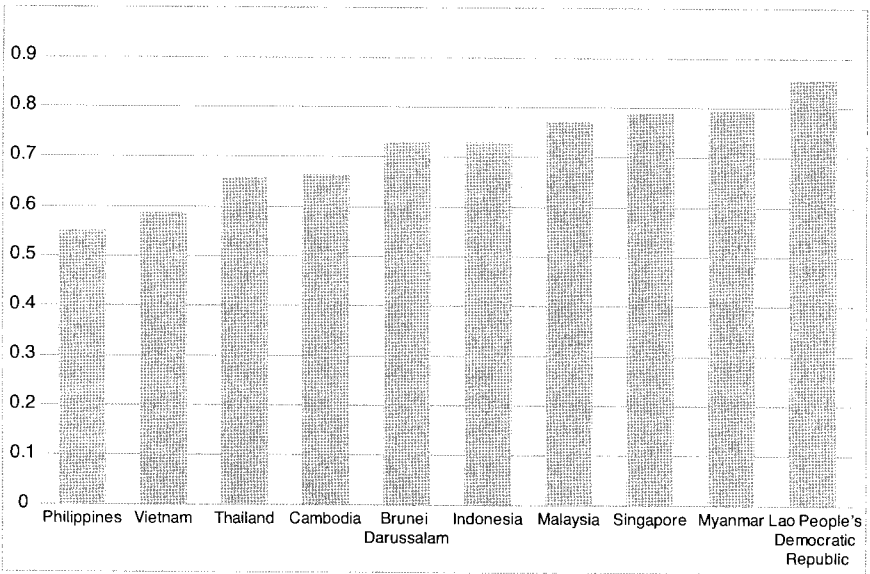


Figure 5.7 ASEAN – Regional trade introversion indices, 2007.

Source: based on IMF, Direction of Trade Statistics. Data for the European Union refer to EU (27) in 2004–07.

countries of ASEAN in 2007. These indices are understood to measure to what extent each country's trade is concentrated with other regional partners more than what implied by the geographic neutrality criterion (*revealed intra-regional trade preferences*). Their levels are quite high for most countries, although some of the more peripheral ones, such as Philippines and Vietnam, appear to be relatively less oriented towards the region. On the other hand, smaller and less developed countries, such as Laos and Myanmar, tend to be more dependent on intra-regional trade, given their limited capabilities to participate in international economic integration on a wider scale.

Relative trade openness and intra-regional trade propensity indices

A region's relative degree of openness (O_i) can be measured by its trade-to-GDP ratio relative to the world average trade-to-GDP ratio:

$$O_i = (t_i/y_i)/(T/Y)$$

where:

- t_i = region i 's total trade;
- T = world trade;

y_i = region i 's gross domestic product (GDP);
 Y = world GDP.

However, this indicator is affected by several problems, similar to those already discussed for trade intensity indices. A possible solution is a *symmetric indicator of relative trade openness* (SO_i), which is equal to zero if the region's degree of openness is equal to the world average:

$$SO_i = \frac{\{(t_i/y_i) - [(T - t_i)/(Y - y_i)]\}}{\{(t_i/y_i) + [(T - t_i)/(Y - y_i)]\}} \quad (5.6)$$

$$-1 \leq SO_i \leq 1$$

The trade-to-GDP ratio is an imperfect measure of trade openness for a variety of reasons. First of all, it should be reminded that trade flows are measured in terms of gross output (including the value of intermediate goods), while GDP is expressed in terms of value added. This problem cannot be easily solved because data on the value of gross domestic production is not readily available. Second, since GDP includes the services sector, trade in goods and services should be used in the numerator. Third, independently of these statistical problems, the trade-to-GDP ratio should be used very cautiously in cross-country comparisons, because it is inversely related with country size (see Anderson and Norheim 1993: 80, endnote 1). Other things being equal, larger countries tend to show lower trade-to-GDP ratios, only because they face a smaller ratio between the size of foreign and domestic markets.

In addition to country size, a region's relative degree of trade openness can be the result of many factors, including economic structure, distance from the main markets and trade policies (in the region and abroad). The speed of multilateral integration processes may be different across the regions of the world, resulting in variations in their relative degree of openness. Moreover, changes in a region's relative trade openness are influenced by the internal and external trade creation effects of regional integration.

In the case of regional indicators, it must also be stressed that all the variables are inevitably measured at current prices, given the non-availability of regional trade data at constant prices. As a consequence of this, all the indicators are also affected by inflation differentials and exchange rate fluctuations. The latter tend to influence trade prices more than domestic prices, which can create problems in the interpretation of the indices, particularly after currency crises.

There are huge differences in relative trade openness among the four areas shown in Figure 5.8, with the two American regions much less open than the rest of the world. Given the GDP size of the US, it is not particularly surprising that the relative trade openness of NAFTA is so low. More striking is the position of MERCOSUR, which is probably due also to the relatively inward-looking orientation of its member countries' trade policies, as well

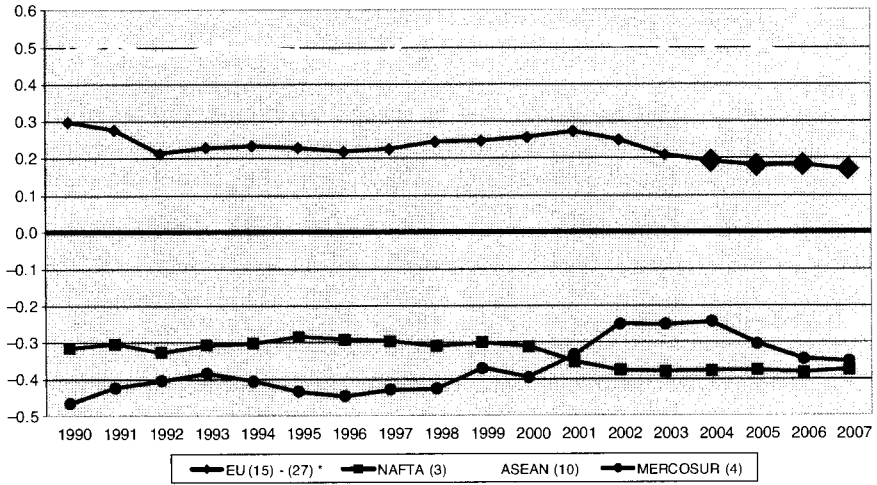


Figure 5.8 Relative trade openness.

Source: based on WTO, International Trade Statistics, various years, appendix tables, and IMF World Economic Outlook database. * Data for the European Union refer to EU (27) in 2004–07.

as to the market access barriers faced by their exports, particularly in the agricultural sector.

Most curves in Figure 5.8 show a downward trend, particularly in the current decade, which seems to reveal that the trade-creating effects of regional integration were weak, or at least weaker than the other technological and economic factors leading to a global increase of the trade-to-GDP ratio.

At the country level, $SO_k = \{(t_k/y_k) - [(T - t_k)/(Y - y_k)]\} / \{(t_k/y_k) + [(T - t_k)/(Y - y_k)]\}$, where subscript k refers to region i 's member countries.

Figure 5.9 shows large differences in trade openness among the four members of MERCOSUR in 2007, with the largest countries characterised, as expected, by indices well below the world average.

It can be useful to combine the measurement of intra-regional trade intensity and relative openness in terms of GDP, in order to generate a comprehensive measure of the trade effects of regional integration. This can be done through an index of *propensity to intra-regional trade* (PI_i) defined as the intra-regional trade share (S_i) divided by the region's weight in world GDP (G_i):¹⁵

$$PI_i = S_i/G_i \equiv (t_{ii}/t_i)/(y_i/Y) \tag{5.7}$$

$$0 \leq PI_i \leq (Y/y_i)$$

It is easy to see that PI_i is also equal to the product between the intra-regional trade intensity index (I_i) and the region's relative degree of openness (O_i):

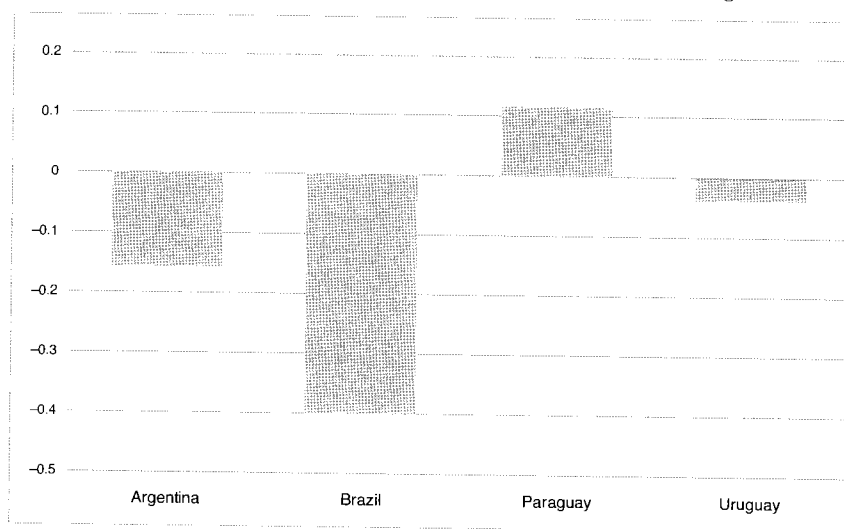


Figure 5.9 MERCOSUR – Relative trade openness symmetric indicators, 2007.

Source: based on IMF, Direction of Trade Statistics and IMF, World Economic Outlook database.

$$PI_i = I_i O_i \quad (5.8)$$

where:

$$O_i = (t_i/y_i)/(T/Y)$$

If PI_i is higher than one, the intra-regional trade share is larger than the region's share of world output, which can be the effect of a high relative degree of openness (global trade creation) and/or of a high intra-regional trade intensity (revealed trade preferences).

Adapting to this indicator the approach used by Kunimoto (1977) to interpret trade intensity indices, it can be shown that the propensity to intra-regional trade is equal to the ratio between the *actual* value of intra-regional trade and its *expected* value, $E'(t_{ii})$, which is here proportional to the region's weight in world GDP:

$$PI_i = t_{ii}/E'(t_{ii}) \quad (5.9)$$

where:

$$E'(t_{ii}) = G_i t_i = [(y_i)^2/Y] (t_i/y_i)$$

There is a clear analogy between the underlying structure of this descriptive indicator and the logic of gravity models of international trade, where

the intensity of bilateral flows depends positively on the GDP of partner countries, and negatively on their 'distance'.¹⁶ A PI_i higher than one can be interpreted as a sign of a situation where, after controlling for the region's GDP and its trade-to-GDP ratio, intra-regional trade is higher than expected due to the operation of 'proximity' factors, such as common borders and preferential trade agreements. The two elements determining the expected value of intra-regional trade capture the effects of the region's size and of its overall degree of trade openness, which can be related, among other things, to geographic distance and other barriers limiting the region's international trade. Given such influences, the propensity to intra-regional trade can be directly explained by the linkages among the region's members, although the relative importance of the various proximity factors can only be estimated with a gravity model.¹⁷

The index of intra-regional trade propensity is affected by all the problems already discussed with reference to the traditional specification of the trade intensity index. The maximum value of PI_i is inversely related to the size of the region; its range is not symmetric around its neutrality threshold of one; and its changes may have the same sign as those of the complementary indicator of propensity to extra-regional trade (PE_i), given by the ratio between the extra-regional trade share and the rest of the world's weight in world GDP:

$$PE_i = (1 - S_i) / (1 - G_i) \quad (5.10)$$

$$0 \leq PE_i \leq [Y / (Y - y_i)]$$

These problems can be solved in a way similar, but not identical, to that followed to build the regional introversion index (Iapadre 2006). The result is a *symmetric index of relative intra-regional trade propensity* (SPJ_i):

$$SPJ_i = (PI_i - PE_i) / (PI_i + PE_i) \quad (5.11)$$

$$-1 \leq SPJ_i \leq 1$$

Similarly to what seen for the regional introversion index, SPJ_i is less ambiguous than its underlying complementary indicators because, even if their changes happen to have the same sign, it increases if a region's propensity to intra-regional trade rises more rapidly than that to extra-regional trade, and vice versa. It is easy to see, furthermore, that the range of SPJ_i is independent of the region's size and symmetric around zero (its neutrality threshold).

Figure 5.10 shows the propensity to intra-regional trade of the four regional groupings considered in this section. ASEAN ranks first because it combines relatively high levels of trade openness and intra-regional trade intensity. On the other hand, in the case of NAFTA, the importance of intra-regional trade is only marginally larger than the region's weight in world GDP.

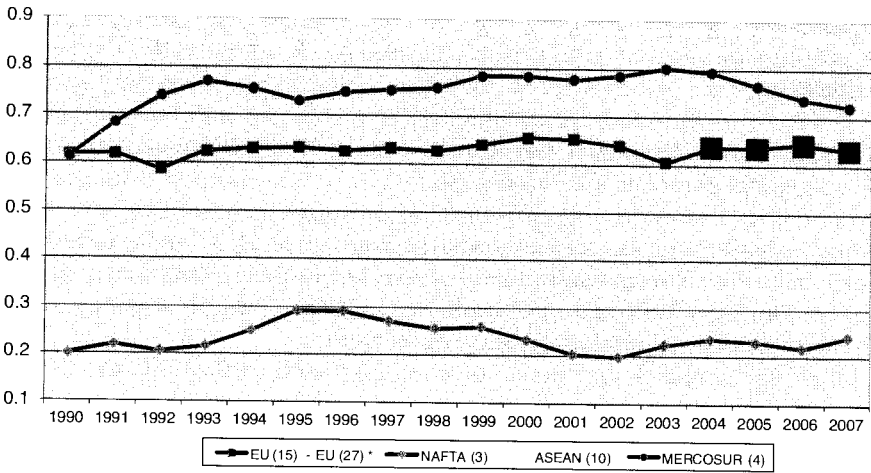


Figure 5.10 Intra-regional trade propensity.

Source: based on WTO, International Trade Statistics, various years, appendix tables, and IMF, World Economic Outlook database. * Data for the European Union refer to EU (27) in 2004–07.

Indicators based on network analysis of regional trade

A relatively recent strand of literature has tried to assess international trade using the wide range of statistical tools developed in the context of social network analysis.¹⁸ According to this approach, international trade can be represented as a system of links (trade flows) among nodes (countries), whose relevant topological properties are not limited to country features and the intensity of their trade, but refer to the entire system. This approach has two main variants: binary network analysis (BNA) is based on the number of trade linkages among countries, regardless of their intensity, whereas weighted network analysis (WNA) takes the value of bilateral trade into account. Both BNA and WNA aim at measuring concepts such as the density of the network, its degree of centralisation, clustering, core-periphery patterns and selective mixing (the tendency of countries to trade more intensely with partners sharing similar features).

Network analysis has mainly been used to study the topology of the entire world trade web, but can easily be adapted to regional networks.¹⁹ A complete list of the indicators developed under this approach would go well beyond the limits of this chapter. Some of them can however be mentioned, in order to offer some insights about the relevance of network analysis in comparison with more traditional measurement strategies.

The simplest indicator developed under BNA that can be adapted to the study of regional trade networks is the *intra-regional density index (IDI_i)*, which is the ratio between the actual and the maximum number of trade linkages among the n member countries of region i :²⁰

$$IDI_i = \sum_k IND_k / [n(n-1)] \quad (5.12)$$

where:

IND_k : country k 's intra-regional node degree (the number of country k 's regional partners, with $k = 1, \dots, n$).

When working with aggregate data at the regional level, IDI tends to be very high and often at its maximum level of one, because the eventuality that two neighbouring countries do not trade between each other is very rare, even in absence of a regional integration agreement.

The same remark applies to another BNA indicator, the *intra-regional centralisation index* (ICI_i), which measures to what extent the topology of regional trade resembles a 'star network', the benchmark of maximum centralisation. In a 'star region' there is only one hub country trading with all its regional partners (spokes), which, however, do not trade between each other.

The *intra-regional centralisation index* (ICI_i) can be defined as:

$$ICI_i = \sum_k (\max[IND_k] - IND_k) / [(n-1)(n-2)] \quad (5.13)$$

This indicator measures the region's actual centralisation as a proportion of its theoretical maximum, defined by the number of missing linkages in the corresponding star network, which is equal to $(n-1)(n-2)$.²¹

Since regional trade networks are normally very dense, their centralisation indices tend to be very low, particularly if the analysis is conducted at the aggregate level. As for other binary indicators, more interesting results can be obtained at the level of single products or industries, where core-periphery patterns can easily be identified in intra-regional trade networks.

The limitations of BNA can partly be overcome by WNA, where, as already mentioned, the value of bilateral trade, and not only the existence of a trade linkage, is taken into account. Most weighted network indicators are similar to the corresponding binary measures, but a crucial problem concerns the choice of the normalisation criterion used to build relative indicators. The common practice of expressing the value of each bilateral flow as a proportion of the largest flow is questionable, because it is based on the implicit assumption that any country pair, regardless of its economic size, could in principle achieve the same maximum level of bilateral trade.

A useful alternative normalisation method can be based on the same geographic neutrality criterion used to build trade intensity indices, that is on a comparison between the intra-regional trade share and the region's weight for the rest of the world. As a result, the role played in BNA by the *intra-regional density index* (5.12) can be assigned in WNA to the *regional trade introversion index* (5.4). This change implies, however, a different perspective: instead of trying to measure the density of regional trade networks – in a

range between zero and one – the regional trade introversion index aims at assessing to what extent the geographic distribution of regional trade flows reflects the region’s importance for the rest of the world, in a range between minus one and one, where zero is the geographic neutrality threshold.

WNA can be used also to measure the degree of regionalisation displayed by the global network of international trade flows. This can be done in several ways, including an index of assortative mixing proposed by Newman (2003) in a binary context. Newman’s proposal can be easily adapted to a weighted matrix of trade flows. The resulting *intra-regional assortativity coefficient* (*IAC*) is:

$$IAC = (Tr(\mathbf{R}) - ||\mathbf{R}^2||)/(I - ||\mathbf{R}^2||) \quad (5.14)$$

where \mathbf{R} is the matrix of intra- and inter-regional trade flows, divided by their total, Tr is the trace operator, and $||\mathbf{R}^2||$ is the sum of all the elements of matrix \mathbf{R}^2 .

IAC is equal to zero in the case of geographic neutrality, that is when regions trade among each other in proportion to their total trade values, and reaches a maximum value of one in the limiting case of no inter-regional trade. On the other hand, in the limiting case of no intra-regional trade, the minimum (negative) value of *IAC* is equal to:

$$- ||\mathbf{R}^2||/(I - ||\mathbf{R}^2||).^{22}$$

As mentioned, network analysis is generating a series of interesting contributions to the study of international trade at the global level. However, in the analysis of regional trade networks, its value-added with respect to more traditional measures is still to be proven convincingly. Figure 5.11 compares the *intra-regional assortativity coefficient* (5.14) with a simple measure of the world trade share of intra-regional trade, showing that the two indicators convey similar information.

Conclusion

This chapter has presented an overview of the main descriptive statistical indicators used to measure the degree of regionalisation exhibited by international trade flows. It has shown that the simplest indicators, such as the intra-regional trade share of a region’s total trade, can be misleading, particularly when used to build rankings across different regions. It has advocated the use of a recently proposed indicator, the *regional trade introversion index*, as a possible solution of the main problems of traditional measures. It has shown how to combine the measurement of intra-regional trade intensity and relative openness, in order to gauge the internal and external trade creating effects of regional integration, through a simple indicator that is consistent with the logic of the gravity model of international trade. It has

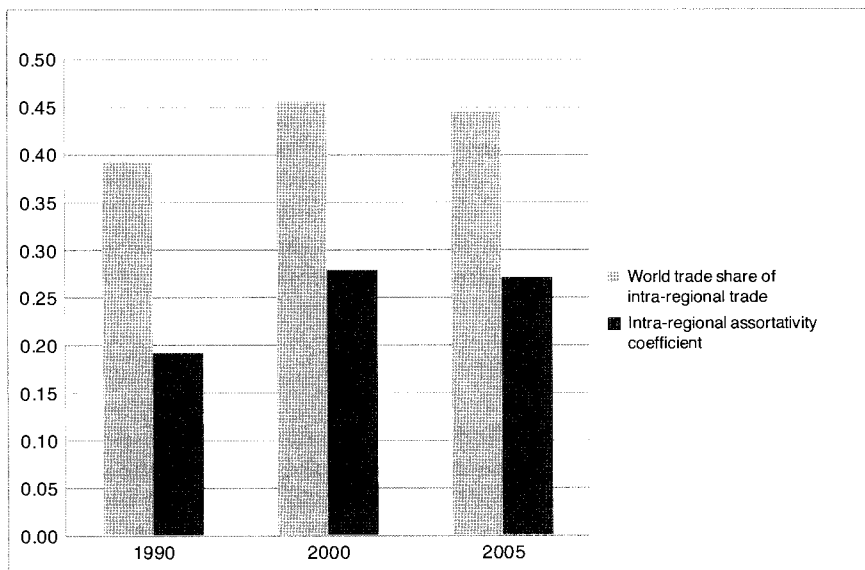


Figure 5.11 Two measures of world trade regionalisation.

Source: based on IMF, Direction of Trade Statistics.

discussed a new approach to the study of regional trade, based on network analysis.

Much work has not been covered by this survey or remains to be done. Almost all the indicators considered here do not take the number of trading partners duly into account. The region or the rest of the world are treated as single partners, regardless of the degree of geographic diversification of bilateral trade flows. Moreover, distance does not play any role in the measurement of trade intensity, so that trade linkages among neighbouring countries are treated in the same way as those with very remote partners. Some work has already been done to overcome these problems, but has not been considered here.²³

The possibility to use intensity indices or similar measures of trade regionalisation in order to improve the specification of gravity models has still to be fully explored. More sophisticated applications of network analysis to regional trade have the potential to give results that are even more interesting than those mentioned in section four.²⁴

For the purposes of this book, however, we believe that our survey has covered the most useful indicators, which can easily be applied in academic research and policy-related analysis.

As usual, an important constraint is given by the quality of statistical sources. For merchandise trade, the necessary data is promptly available at different levels of product aggregation, but only at current prices, since unit

values of exports and imports are seldom disaggregated by partner country. Data availability problems are still serious for trade in services, given the limited coverage and reliability of the information about the geographic distribution of these flows. However, national statistical institutes, central banks and international organisations are working to improve the coverage and comparability of existing data on trade in services.

Data problems are even more severe in the field of international production. However, provided that the recent progress in statistical sources will improve the situation, the indicators presented in this chapter can easily be adapted to other forms of international transactions that are important to understand to what extent the spatial organisation of global production tends to follow regional patterns. So, they can be used also to measure regional integration in terms of FDI flows, as well as regional production networks based on cooperation agreements among firms, such as non-equity joint-ventures and outsourcing contracts.

Appendix 5.1

Composition of regions

ASEAN (Association of Southeast Asian Nations)

Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.

EU-15 (European Union at 15 member states)

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

EU-27 (European Union at 27 member states)

Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

MERCOSUR (Southern Common Market)

Argentina, Brazil, Paraguay, Uruguay.

NAFTA (North American Free Trade Agreement)

Canada, Mexico, United States.

Notes

1 See, among others, Rugman (2008).

2 See <http://comtrade.un.org>.

3 BACI (Base pour l'Analyse du Commerce International) is the world trade database developed by CEPII at the HS 6-digit product disaggregation. BACI is developed using an original procedure that reconciles the declarations of the exporter and the importer. The harmonisation procedure enables to extend considerably the number of countries for which trade data are available, as compared to the original COMTRADE dataset. BACI provides bilateral values and

- quantities of exports at the HS 6-digit product disaggregation, for more than 200 countries over the period 1995–2007. For further information, see www.cepii.fr/anglaisgraph/bdd/baci.htm and Gaulier and Zignago (2009).
- 4 See www.wto.org/english/res_e/status_e/status_e.htm.
 - 5 See <http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx>.
 - 6 See <http://www2.imfstatistics.org/DOT>.
 - 7 See www.cris.unu.edu/riks/web/.
 - 8 See <http://www2.imfstatistics.org/BOP>.
 - 9 See <http://stats.oecd.org/Index.aspx?DatasetCode=TISP>.
 - 10 Intra-regional trade shares are regularly published in official reports by international organisations. See, for example, WTO (2008: 2–3).
 - 11 Similar problems affect another trade share indicator that is sometimes used, namely the ratio between a region's intra-regional trade and total world trade. This indicator rises if intra-regional trade grows more rapidly than the world average, but is clearly biased by the number of member countries and the trade size of the region. It can only be useful at the aggregate level, i.e. after dividing the world into a given number of regions and summing up their intra-regional trade flows. The resulting *intra-regional share of world trade* can be used to measure the actual degree of regionalisation of global commerce. This implies a previous selection of the regions to be included in the computation, which can create some problems in areas, such as Africa and Asia, where several countries belong simultaneously to different but partially overlapping preferential agreements.
 - 12 Intensity indices for bilateral trade flows were proposed by Brown (1949) and elaborated by Kojima (1964), Kunimoto (1977) and Drysdale and Garnaut (1982). They can be seen as the geographical version of the Balassa (1965) sectoral index of trade specialisation. Their properties at the regional level have been studied by Anderson and Norheim (1993), as well as by Frankel (1997) who calls them 'concentration ratios'. Another name which has sometimes been given to the intensity index is 'double-relative' measure (Petri 1993) or 'double-density' index (Kreinin and Plummer 2000). Recent applications of the index include WTO (2003: 55–57) and UNCTAD (2007: 93–96). We will not use the word 'concentration' in this context, because it could be confused with its usual definition, which refers to the entire distribution of a region's trade, rather than to the importance of a single element, such as intra-regional trade.
 - 13 When the intra-regional trade intensity index is computed at the regional level, it should be reminded that, since no country can trade with itself, the denominator of the index should be corrected by subtracting from the region's total trade, as well as from world trade, one n th of the region's total trade (where n is the number of countries in the region), as shown by Anderson and Norheim (1993: 82, footnote 6). This correction ensures that the index is approximately equal to unity, if the geographic orientation of the region's trade is not inward biased. The more similar are the trade values of member countries, the lower is the approximation error. See also Frankel (1997: 25–29). The Anderson and Norheim correction is important for comparing trade intensity levels of different regions, but may be neglected if the interest is focused on the time path of intra-regional trade intensity in a single region. On the other hand, this correction does not solve other problems raised by the fact that no country can trade with itself, which were highlighted by Savage and Deutsch (1960). A more rigorous correction procedure has been proposed by Freudenberg, Gaulier and Ünal-Kesenci (1998).
 - 14 A similar solution was proposed by Dalum, Laursen and Villumsen (1998) for the Balassa (1965) index of revealed comparative advantages.
 - 15 Similar indicators were discussed by Anderson and Norheim (1993: 84) as well as by Frankel (1997: 27).

- 16 The relationship between trade intensity indices and gravity models of international trade was analysed by Leamer and Stern (1970), Drysdale and Garnaut (1982) and Frankel (1997). Gaulier (2003) shows how trade intensity indices can be related to the gravity model proposed by Deardorff (1998).
- 17 A recent survey of the empirical evidence on the trade and investment effects or regional integration, based on gravity models, can be found in Adams *et al.* (2003). Traditional trade intensity indices have been recently used in the context of a gravity model by Gaulier and Ünal-Kesenci (2004) and by Zhang and van Witteloostuijn (2004).
- 18 See Smith and White (1992), Li, Jin and Chen (2003), Serrano and Boguña (2003), Garlaschelli and Loffredo (2004, 2005), Fagiolo, Reyes and Schiavo (2007, 2008), Kali and Reyes (2007), Serrano, Boguña and Vespignani (2007), De Benedictis and Tajoli (2008).
- 19 See Iapadre and Tironi (2009). An application of network analysis to trade in continental groupings is offered by De Benedictis and Tajoli (2008). An earlier attempt to use network analysis at the regional level, in order to identify the most attractive regional member countries for FDI, is due to Roth and Dakhli (2000). A different question underlies a paper by Reyes, Schiavo and Fagiolo (2008), who study the relative degree of integration into the world economy of two different regions (East Asia and Latin America).
- 20 For the sake of simplicity, we assume here that trade linkages are 'undirected', meaning that we consider that there is one trade linkage between country *a* and *b* regardless of its direction (only exports from *a* to *b*, only export from *b* to *a*, or a bidirectional flow).
- 20 See Kali and Reyes (2007).
- 21 The minimum IAC of -1 (perfect disassortativity) is reached when $Tr(R) = 0$ (no intra-regional trade) and $\|R^2\| = 0.5$. The latter parameter depends on the distribution of extra-regional flows and on the number of regions. It can be shown that $\|R^2\|$ is equal to 0.5 only for a two-region world with no intra-regional trade. For a symmetric matrix with a number of regions larger than 2, the minimum IAC is higher than -1 and grows with the number of regions.
- 22 See, among others, Arribas, Pérez and Tortosa-Ausina (2008), De Lombaerde and Iapadre (2008), Edwards (2007), Iapadre and Tironi (2009).
- 23 See Reyes, Wooster and Shirrell (2009).

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