On the measurement of comparative advantage

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ON THE MEASUREMENT OF COMPARATIVE ADVANTAGE

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SOM-theme C: Coordination and growth in economies

Abstract

This article shows that the distribution of the standard measure of revealed comparative advantage (RCA), which runs from 0 to ∞, has problematic properties. Due to its multiplicative specification, it has a moving mean without a useful interpretation, while its distribution depends on the number of countries and industries. This article proposes an alternative, additive RCA, running from –1 to +1, with a bell-shaped distribution that centres on a mean equal to zero, independent of the classifications used. Statistical tests show the additive index to be more stable empirically too. Furthermore, the article proposes an aggregate RCA that runs from 0, when pure intra-industry trade prevails, to 1 in the case of pure inter-industry trade. Comparable conclusions hold for the location quotient (LQ), which is used as a measure for the revealed locational attractiveness of certain regions or countries for certain types of industry.

Keywords

Export specialisation, Balassa Index, Location Quotient, Intra-Industry Trade Index

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1 INTRODUCTION

Both in trade theory and in location theory comparative advantage is defined in simplified theoretical worlds. Thus, depending on the model of the economy used, different answers will be given to questions such as 'which regions and countries have what type of comparative advantages' (see Ten Raa & Mohnen, 2001, for a recent account), and different answers will be given to the question about the most desirable policy response.

In trade theory this problem is most paramount since there comparative advantage is mostly defined as the difference in relative prices in a non-existing pre-trade world. Balassa (1965, p. 116) summarised the problem as follows: "Comparative advantages appear to be the outcome of a number of factors, some measurable, others not, some easily pinned down, others less so. One wonders, therefore, whether more could not be gained if, instead of enunciating general principles and trying to apply these to explain actual trade flows, one took the observed pattern of trade as a point of departure". Hence, he advanced to measure the 'revealed' comparative advantage of certain countries for certain exporting commodities by means of what has become known as the Balassa Index or the index of Revealed Comparative Advantage (*RCA*).

Exactly the same mathematical measure, known there as the Location Quotient (*LQ*), is used in spatial economics to measure the 'revealed' locational advantages of certain regions to attract and develop certain industries (Isard, 1960). Not only mathematically, but also from an economic point of view, both concepts are closely related. The regional or national specialisation of production, measured by the *LQ*, will inevitably lead to export specialisation, measured by the *RCA*, and vice versa.[2]

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[2] In fact, if domestic demand specialisation and import specialisation are added to export and domestic output specialisation, a handy choice of formula applied to the appropriate accounting identity results in a precise relation between the *RCA* and the *LQ* (see Van der Linden & Oosterhaven, 2001, for an empirical account). Bowen (1983, 1985, 1986) uses this relation to derive his alternative, net trade definition of the *RCA*, which combined with the assumption of identical homothetic preferences leads to an *RCA* that equals the production *LQ* minus one. However, Ballance (et al. 1985, 1986) and Volrath (1991) challenged Bowen's *RCA* on several grounds.

As opposed to location research, however, the measurement of revealed comparative advantage in international trade research led to a considerable debate, concentrating on the issue of 'which index has the best theoretical properties' (see Vollrath, 1991, for an overview). Using a probabilistic framework Kunimoto (1977) provided a cornerstone to that debate by proposing to use only indices that could be interpreted as measures of 'actual-to-expected' trade, where 'expected' of course needs to be defined in the absence of the type of comparative advantage being studied. Quoting difficulties in interpreting and comparing *RCA's* from different studies, Hinloopen & Van Marrewijk (2001) attempt to derive its distribution and properties empirically. They hardly succeed, among other things, because "the distribution of the *RCA* differs considerably over countries" (op. cit. p. 3).

In this article, we argue that deriving the distribution of the *RCA* and mutatis mutandis that of the *LQ* is a difficult, if not an impossible task. The distribution is shown to depend on the number and size of countries or regions and industries used in the analysis. Furthermore, we argue that the mean of the *RCA* is not a meaningful concept, which makes attempts to derive the distribution not very useful either. To get an index with more attractive theoretical and numerical properties, we suggest an alternative, additive *RCA*, which is much better suited for further analyses and for which a well interpretable bell-shaped distribution exists. Furthermore, the distribution of the additive index appears to be more stable empirically than the distribution of the standard, multiplicative index.

In section 2 we will discuss the properties of the multiplicative *RCA* and *LQ*. In section 3 we present the alternative, *additive RCA* and *LQ*, and an aggregate export specialisation coefficient, the *aggregate RCA*, which may be derived from it and may serve as an alternative measure of intra-industry trade. Section 4 contains the conclusion and a suggestion to use the related aggregate spatial concentration coefficient when inter-sectoral comparisons of export or production specialisation are at issue.

2 ON THE PROPERTIES OF THE MULTIPLICATIVE RCA

The index of revealed comparative advantage most generally used is:

$$RCA_j^A = \left(X_j^A / X^A\right) / \left(X_j^{REF} / X^{REF}\right) \tag{1}$$

In which RCA_j^A stands for the *RCA* of country *A* in sector *j*. X_j^A refers to the export of sector *j* of country *A*. X^A stands for the total exports of country *A*, and *REF* refers to a group of reference countries. An *RCA* larger than one is interpreted as a 'revealed comparative advantage' or the 'export specialisation' of country *A* in sector *j*, whereas an *RCA* smaller than one is interpreted as a 'revealed comparative disadvantage'. The *RCA*, thus, compares for each sector *j* its actual export share with a measure of its expected export share, based on the assumption that sector *j* in *REF* does not have a comparative (dis)advantage.

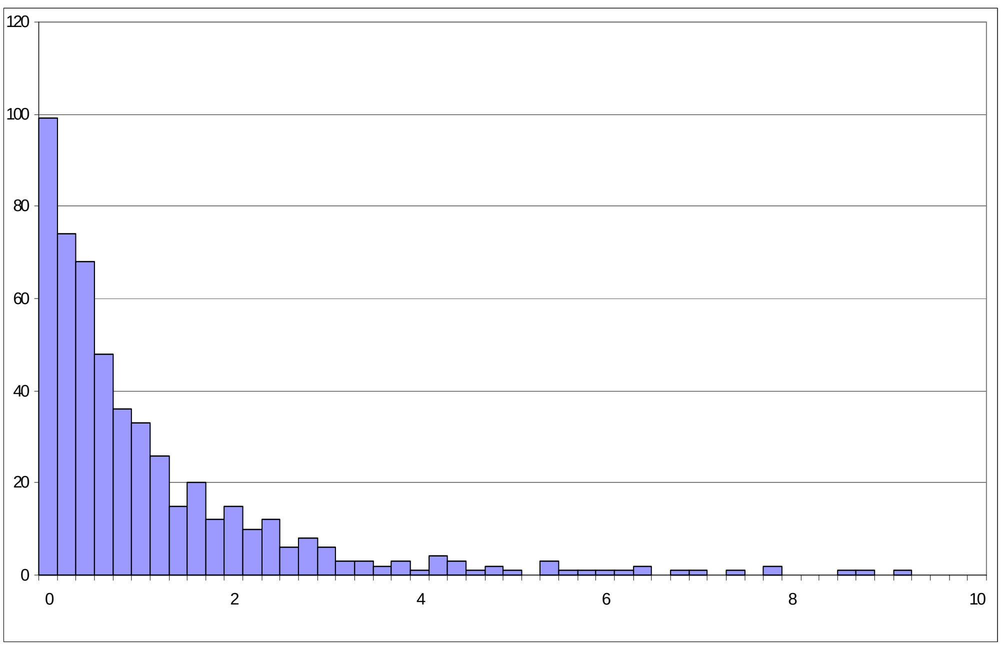
The distribution of multiplicative RCA's

Hinloopen & Van Marrewijk (2001) observe that the mean of the distribution of the *RCA's* is well above one. This seems strange as it suggests that each country has a comparative advantage in its 'average sector', whereas one would expect the 'average sector' to be neutral in terms of its *RCA*. This empirical result, however, is a direct consequence of choosing specification (1).

Suppose, to get a direct relation with standard trade theory (Vollrath, 1991), that there are only two countries, *A* and *B*. If the export share of sector *j* in country *A* is *x* times as large as its export share in *B*, the *RCA* of *A* equals *x* when *B* is taken as the reference country. Contrary, when A is taken as the reference country for *B* the *RCA* of country *B* will equal *1/x*. This means that the counterpart of an *RCA* of *x* is an *RCA* of *1/x*. Of course, the distribution of the *x's*, and hence that of the *1/x's*, is not known a priori. However, the average of *x* and the corresponding *1/x* is always larger than one and that explains the result for the mean, which is the average total of all actual combinations of *x* and *1/x*.

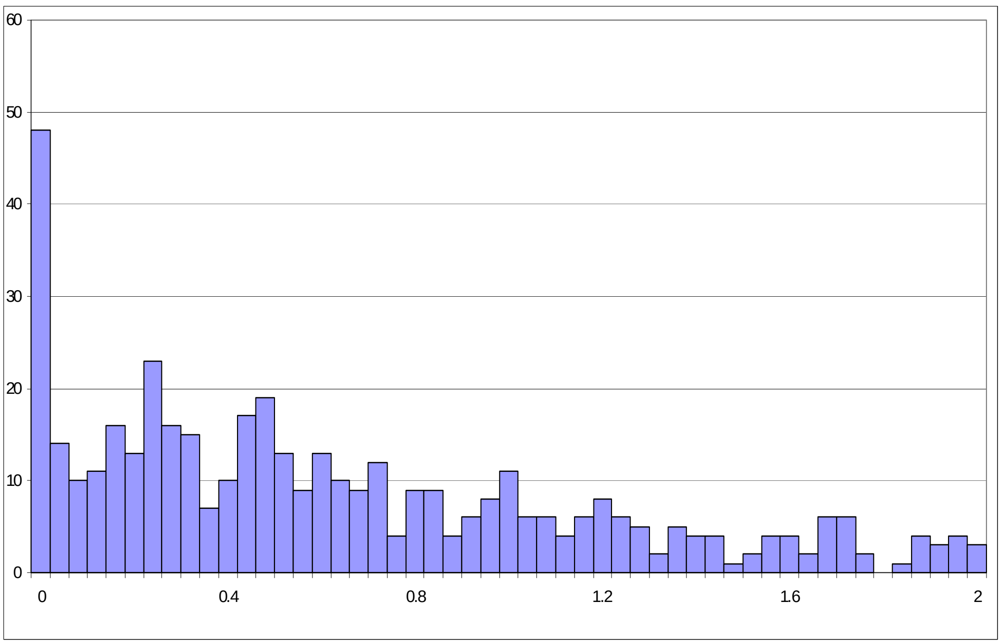
Empirically, the distribution of the multiplicative *RCA's* turns out to be asymmetric around the mean (Hinloopen & Van Marrewijk, 2001). This shape can also be explained theoretically. To begin with, note that in a pure interindustry trade world one expects only zero and infinitely large *RCA's*. In a pure intra-industry world one expects only values very close to one. In reality, if only because sector classifications are not perfect, a smooth continuous distribution is more probable. In the 2-country case, its shape equals the expected distribution of *x's* and *1/x's*. Using equal class sizes, this implies that the distribution of the *RCA's* will partly be determined by the distribution of *1/x*, starting with high frequencies and slowly but continuously declining. This is indeed the empirical density found in Figure 4 in Hinloopen and Van Marrewijk (2001).

Figure 1: Frequency of standard RCA's for Poland and the Netherlands, class size 0.2.



When SITC-3 data from a study into the consequences of the EU-enlargement for the trade between the Netherlands and Poland are used, a similar distribution is found (see Figure 1).[3]

Figure 2: Frequency of standard RCA's for Poland and the Netherlands, class size 0.04.



However, the smooth *1/x*-alike distribution is only found if the size of the classes is chosen carefully. With the Dutch-Polish data, this shape only appears if the size of the classes is large enough. For smaller sizes, the first column remains large, which indicates a relatively large number of *RCA's* close to and equal to zero. The other columns, however, are more evenly distributed and have several local extremes. As an illustration, Figure 2 displays the same *RCA's* as those of Figure 1, but with a class

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[3] The data used are derived from Hoen & De Mooij (2001). The reference group consists of the EU-countries Austria, Belgium/Luxembourg, Denmark, Germany, Spain, Finland, France,

size of 0.04 instead of 0.2.[4] This shows that the distribution of the *RCA's* is not as regular or as smooth as expected or hoped for.

The number of countries

Deriving the distribution of the standard *RCA* is complicated by its dependence on the number of countries in the analysis. To start, again suppose that there are only two countries, *A* and *B*. If country *B* is taken as the reference country, the *RCA* of sector *j* in country *A* is larger than one, if and only if:

$$\left[X_j^A / X^A\right] > \left[X_j^B / X^B\right] \qquad (2)$$

If instead both countries are taken as reference countries, the *RCA* of sector *j* in country A is larger than one, if and only if:

$$\left[X_j^A / X^A\right] > \left[\left(X_j^A + X_j^B\right) / \left(X^A + X^B\right)\right] \qquad (3)$$

which is equivalent to (2). Hence, in the 2-country case, if one country has an *RCA* larger than one in a certain sector, the second country has an *RCA* smaller than one in the same sector. If both countries are pooled, the number of sectors with an *RCA* smaller than one must be 50%.

This expectation, however, does not become true when more than two countries are considered. Hinloopen & Van Marrewijk (2001) compare *RCA's* for 12 EU-countries. They find that only about one third of all *RCA's* is larger than one, which implies that the median of the *RCA's* is well below one. This clearly differs from 50%, which shows that the distribution of the *RCA* depends on the number of countries in the analysis.

United Kingdom, Greece, Ireland, Italy, Portugal, and Sweden. The reference group thus excludes the Netherlands and Poland for reasons given in the next section.

[4] Figures 1 and 2 only display the first 50 classes. The last classes have *RCA's* that are all larger than, respectively, 10.0 and 2.0. The omitted classes contain, respectively, 10 and 107 indices. The total number of *RCA's* in this study is 528.

The number of sectors

The number of sectors also influences the size and the distribution of the *RCA's*. Suppose that an arbitrary sector *j* is divided into two subsectors, *i* and *k*. Then only by pure coincidence one gets precisely: $RCA_i = RCA_j = RCA_k$. In all other cases either $RCA_i > RCA_j > RCA_k$ or $RCA_k > RCA_j > RCA_i$. Hence, with a more detailed sector classification, the unbounded maximum of the *RCA's* will remain the same or become larger, and the minimum will remain the same or become smaller. This minimum, however, is bounded from below, that is, as soon as one single sector has zero exports the minimum *RCA* will not decrease further.

More generally, if export data are used at higher levels of detail, the export shares of each sector become smaller and smaller. In that case, the denominator in (1) becomes smaller, which works as a multiplier on the numerator. Hence, the *RCA's* from a more detailed sector classification will contain more extreme values than those from an aggregated sector classification. As mentioned before, the larger the *x*, the larger the average of *x* and *1/x*. Thus, a more detailed sector classification is likely to lead to a larger mean and a higher maximum.

The dependence of the *RCA's* on the number of sectors may be illustrated empirically by *RCA's* for The Netherlands and Poland. When the classification goes from SITC-1 to SITC-3, the results in Table 1 conform the above theoretical predictions. Beyond SITC-3 the mean and the maximum do not increase further. This deviation, however, is a statistical artefact, since with SITC-4 3.5% of all exports, and with SITC-5 25.0% of all exports, are missing. These exports are simply not included in the available data, which leads to missing export categories and to a lower total amount of exports. Since the exports excluded relate to small categories with on the average extreme *RCA's*, the average of the *RCA's*, and for the Netherlands even the maximum *RCA*, decreases from SITC-3 to SITC-4 and SITC-5.

The sensitivity of the standard *RCA* for the classification used also follows from excluding the single largest *RCA* and from the values for the standard deviation, as is shown in the last two rows for both countries.[5]

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[5] Hinloopen & Van Marrewijk (2001), who compute the average of 814 *RCA's* with and without the largest observation, observe that including the largest observation increases the

Table 1: Statistics for standard RCA's for different sector classifications for 1997.

	SITC-1	SITC-2	SITC-3	SITC-4	SITC-5
The Netherlands					
Minimum *RCA*	0.1	0.0	0.0	0.0	0.0
Median *RCA*	1.5	0.9	0.7	0.6	0.5
Average *RCA*	1.4	1.5	3.1	2.2	2.1
Maximum *RCA*	2.8	11.9	314.6	309.4	180.8
Average, except max.	-10.4%	-10.5%	-38.0%	-13.1%	-3.0%
Standard deviation	0.8	1.9	21.2	12.8	7.8
Poland					
Minimum *RCA*	0.0	0.0	0.0	0.0	0.0
Median *RCA*	1.0	0.9	0.6	0.4	0.2
Average *RCA*	1.0	2.7	2.5	2.0	1.7
Maximum *RCA*	2.3	99.1	200.4	241.1	327.8
Average, except max.	-13.0%	-54.0%	-29.9%	-11.8%	-6.8%
Standard deviation	0.8	12.0	13.4	8.9	9.5

Summing up

It is difficult, if not impossible, to theoretically derive the distribution of the standard *RCA's*. The dependence of the distribution on the number of countries and sectors further complicates the interpretation of the results. In fact, its unstable mean is much larger than the 'expected' value of 1, which indicates that it does not have a useful interpretation. The root cause of the problems lies in the multiplicative character of the standard *RCA*. Since computing an average implies adding *RCA's*, the mean and the distribution around it do not give meaningful information either. Hence, it is worthwhile to develop an index that has less or none of these problems.

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average by 20%. Table 1 shows that this specific result is strongly dependent on the sector classification.

3 PROPOSAL FOR AN ALTERNATIVE, ADDITIVE RCA

Instead of the normally used multiplicative *RCA* and *LQ*, an additive specification can be used, which may be aggregated into an index of export or output specialisation. This section analyses this additive index, and it proposes to use the additive index with the country or region at hand excluded from the group of reference countries or regions.

Sectoral and aggregate alternatives

Instead of taking the quotient, it is possible to take the difference between the export shares. This leads to the following *additive RCA* of country *A* in sector *j*:

$$ARCA_j^A = \left(X_j^A / X^A \right) - \left(X_j^{REF} / X^{REF} \right) \qquad (4)$$

This index is zero if the export share of sector *j* in country *A* is equal to that of the reference countries. It is larger than zero if country *A* has a 'revealed comparative advantage' in sector *j*, and it is smaller than zero if country *A* has a 'revealed comparative *dis*advantage'. Since (4) is additive in the export shares, the mean of the additive *RCA's* has a value of zero, independent of the number and classification of the sectors or countries. Simply summing (4) over *j* shows this.

However, in several cases it will be more interesting to know whether a country as a whole, compared to the reference countries, has a relatively specialised export package or not. This may be measured by using the *regional specialisation coefficient* (see Oosterhaven, 1995). In the context of international trade research this coefficient may best be labelled as the *aggregate RCA* of country *A*, since it takes the sum of the absolute values of (4):[6]

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[6] An alternative measure of aggregate export specialisation might be to use the standard deviation of (4). But by taking the squared differences instead of the absolute differences, this measure weighs the extreme differences more heavily. We prefer (5) that gives equal weights to all differences, be they small or large.

$$ARCA^{A} = \frac{1}{2}\sum_{j}\left|\left(X_{j}^{A} / X^{A}\right) - \left(X_{j}^{REF} / X^{REF}\right)\right| \quad (5)$$

The division by ½ secures that the aggregate *RCA* results in an index that ranges from 0 to 1. The aggregate *RCA* will be 0 if a country has an export package that is precisely equal to that of the reference countries, that is when all trade is of the intra-industry type and there is no export specialisation at all. The aggregate *RCA* will be 1 if the country at hand has a unique export package only consisting of commodities that are absent in the package of the reference countries. Thus, (5) also offers an alternative for the Intra-Industry Trade indices.[7]

Choice of reference countries

The second issue refers to choosing the set of reference countries. There are several considerations to be taken into account, all related to the purpose of the analysis (see Hinloopen & Van Marrewijk, 2001, for a discussion). There is, however, one technical choice that is not discussed in the literature. It relates to the question whether to exclude the country at hand from the group of reference countries or not. When more countries are compared it seems most handy to include all countries being compared into the reference group. Thus, each country individually can be compared with the same reference group instead of with a changing set of countries. This suggests that including country *A* in the reference group is to be preferred for comparison reasons.

However, in that case the index becomes biased. This is easily seen if we consider the situation in which country *A* is fully specialised. Suppose that country *A* is the only exporter of, for example, the last product *n*. Since country *A* is fully specialised, it does not export any other good, and no other country exports product *n*.

[7] See Husted & Melvin (2000, p.137) who aggregate the absolute differences between export and import shares, much like (5), or Krugman & Obstfeld (2000, p. 138) who use the difference between exports and imports divided by the sum of both, per sector. Our specification has the advantage of only using export data, which are mutually more comparable (see Van der Linden, 1998, p. 82-89). Disregarding import data, on the other hand, may be considered a disadvantage of (5) as an I-IT index.

If we assume there are m countries and country A is the m^{th} country, the total export of the reference countries equals:

$$X^{REF} = \sum_{r=1}^{m} \sum_{i=1}^{n} X_j^r = \sum_{r=1}^{m-1} \sum_{i=1}^{n-1} X_j^r + X_n^A \qquad (6)$$

Then, the aggregate *RCA* for country *A* equals:

$$ARCA^A = \frac{1}{2} \sum_{i=1}^{n} \left| \left(X_i^A / X^A \right) - \left(X_i^{REF} / X^{REF} \right) \right| = 1 - \left(X_n^A / X^{REF} \right) \qquad (7)$$

This index is smaller than 1, whereas it should be equal to 1 since country *A* is fully specialised. If we use all countries excluding country *A* as reference countries, the index does become one (see Hoen, 2002, pp. 196-198). Hence, the index that includes the country at hand in the group of reference countries is biased, whereas the index that excludes the country at hand leads to the correct result.

The distribution of the additive RCA

The additive sectoral *RCA*, with country *A* excluded from the group of reference countries, can run from exactly –1 to exactly +1. If there is no specialisation, (4) equals zero. In the theoretical 2-country case each *RCA* value of +*x*, no longer has *1/x* as its counter part but –*x*. Moreover, the absolute sum of the negative values equals the sum of the positive values, irrespective of the number of countries and sectors, as can be easily verified. Hence, we expect the distribution of the additive *RCA* to be centred evenly on zero.

The empirical distribution of the additive *RCA's* for the STIC-3 classification for The Netherlands and Poland (see Hoen & de Mooij, 2001, for details) is shown for two different class sizes in Figure 3 and 4.[8] They show that the additive *RCA's* are

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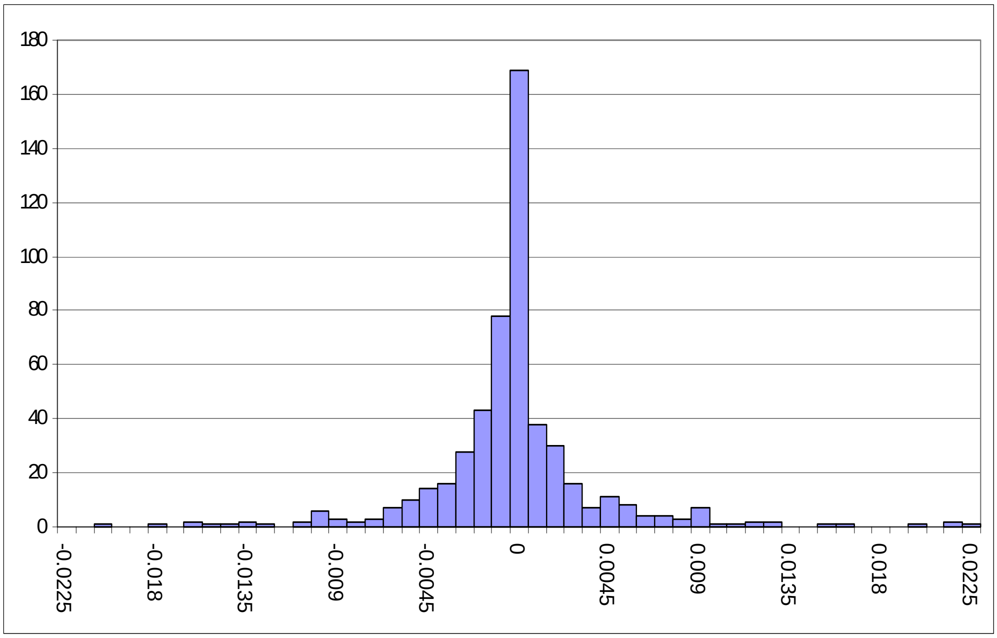
[8] In order to be comparable with the Figures 1 and 2, the Figures 3 and 4 display the (central) 50 classes around zero. Figure 3 omits the 10 most extreme values, and Figure 4 omits the 108 most extreme values from a total of 528 additive RCA's.

indeed centred on zero and that the distribution resembles a bell shape irrespective of the class size chosen. In spite of the bell shape, however, the data do not fit into a normal distribution, as its kurtosis is far too high.[9]

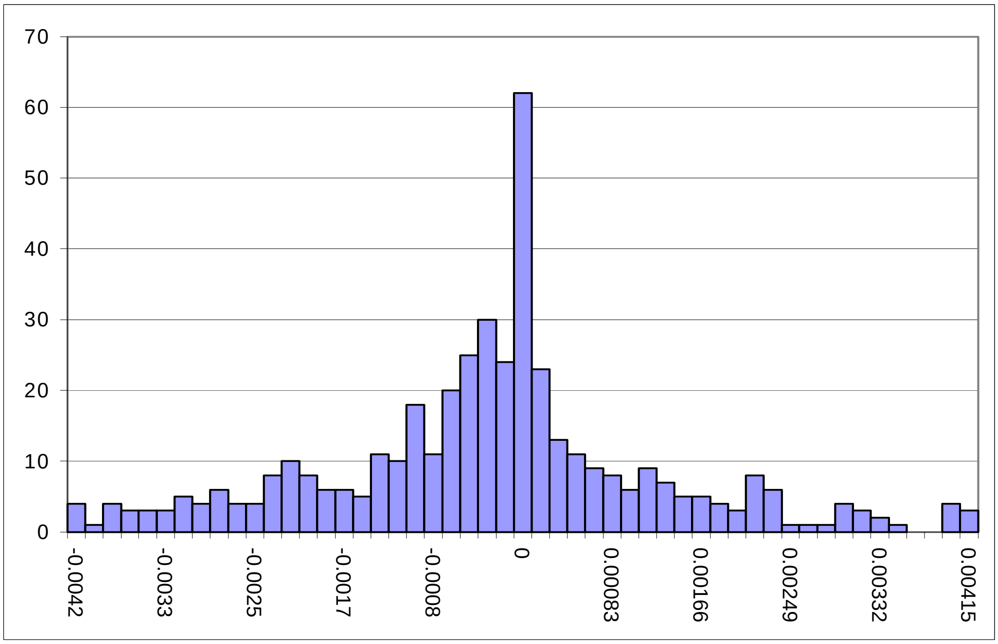
Figure 3: Frequency of additive RCA's for The Netherlands and Poland, class size 0.0009.



This means that the distribution of the additive *RCA's* is more peaked than that of a normal distribution, indicating a dominance of intra-industry exports and only a few Dutch and Polish sectors with a strong comparative advantage or *dis*advantage compared with the exports of the reference EU-countries.

[9] The kurtosis of the distribution behind Figure 3 and 4 is about 27 instead of 3, as with the normal distribution.

Figure 4: Frequency of additive RCA's for The Netherlands and Poland, class size 0.000166.



The number of sectors and the additive RCA

The findings above do not imply that the additive *RCA* is independent of the size and the number of sectors analysed, as follows from Table 2. As opposed to the standard *RCA*, however, the minimum and maximum of the additive *RCA* do not by definition decrease and increase with a finer sector classification. Nevertheless, Table 2 shows that a finer sector classification empirically leads to a gradually more peaked distribution, as follows from especially the standard deviation that does continuously decrease with the increasing number of sectors from SITC-1 to SITC-5. The statistics for the additive *RCA*, however, do not appear to be as sensitive to the lacking export categories, in especially the SITC-5 classification, as the statistics of the standard *RCA* in Table 1. Furthermore, the median empirically soon becomes equal to the mean.[10] In all, these features give the additive *RCA* a more stable and a more regular distribution than the standard *RCA*.

Finally, the last rows of Table 2 show the empirical results of the *aggregate RCA* for the Netherlands and Poland for different sector classifications. Obviously, a finer sector classification captures a larger degree of export specialisation, which makes this measure dependent on the sector classification. However, the order difference in export specialisation between the Netherlands (smaller) and Poland (larger) does appear to be independent of the sector classification chosen.

Table 2: Statistics for additive RCA's for different sector classifications for 1997.

	SITC-1	SITC-2	SITC-3	SITC-4	SITC-5
The Netherlands					
Minimum *RCA*	-0.097	-0.074	-0.051	-0.053	-0.016
Median *RCA*	0.007	0.000	0.000	0.000	0.000
Maximum *RCA*	0.061	0.066	0.040	0.023	0.026
Standard deviation	0.049	0.017	0.007	0.003	0.001
Aggregate RCA	0.182	0.333	0.399	0.453	0.464
Poland					
Minimum *RCA*	-0.197	-0.056	-0.037	-0.038	-0.015
Median *RCA*	0.003	0.000	0.000	0.000	0.000
Maximum *RCA*	0.096	0.060	0.057	0.044	0.035
Standard deviation	0.084	0.018	0.007	0.003	0.002
Aggregate RCA	0.284	0.356	0.452	0.526	0.585

Stability of the entire distribution

The current section further tests whether the distribution of the additive *RCA* is more stable than that of the standard *RCA*. It uses export data of Poland and the Netherlands to derive the empirical distributions of the additive and multiplicative

[10] Note that the SITC-1 classification only contains 10 very aggregate commodity groups, which in general is too aggregate for a meaningful empirical analysis of comparative advantage.

RCA's, after which a χ^2-test is used to test whether the distributions are significantly different from each other. The distributions are based on the bilateral and total export data of the Netherlands for the years 1988, 1992 and 1997, and those of Poland for the years 1992 and 1997, according to the SITC-3 classification. Hence, we test the stability of the entire distribution of *RCA's* with regards to time, space, and type of export data for both types of *RCA's*. The results of the additive *RCA* are displayed in Table 3 and those of the multiplicative *RCA* in Table 4.

Because of the 101 frequency classes used, the outcomes are tested against a χ^2 distribution with 100 degrees of freedom. For the significance levels of 1% and 5% the critical values are 136 and 124, respectively (Kanji, 1999, p.75). Outcomes above these values indicate that the tested distributions are significantly different. The results in Table 3 show that there are no significant differences between the distributions of the additive *RCA*. Thus, the distribution of the additive *RCA* seems to be stable with regards to time, space and type of export data used.

A comparison of Tables 3 and 4 shows that 40 of the 45 χ^2 values for the multiplicative *RCA* are larger than the comparable values for the additive *RCA*, indicating a lesser general degree of stability of the standard multiplicative *RCA*. In more detail, the separate results in Table 4 show that most of the distributions of the standard *RCA* are unstable with regards to the type of data used, as 18 out of the 25 χ^2 values comparing bilateral exports with total exports are above the critical value of 124.

Although the data in Table 3 do not show significant differences between the distributions of the additive *RCA's*, this does not mean that the distributions are the same; different tests may lead to different outcomes. If the median test is used with a significance level of 5% (Kanji, 1999, p.83), the results show that the additive distributions do differ according to type of export data used in 15 out of 25 cases, and in 3 out of 20 cases the distributions based on the same export data differ significantly in time and space.[11]

[11] Tables with the results for the median test are available on request by email: a.r.hoen@cpb.nl. The same holds for the basic data and other empirical results.

Table 3: Outcomes of the Chi-test for the additive RCA.

		Total export data				
		The Netherlands			Poland	
		1988	1992	1997	1992	1997
Total export data						
The Netherlands	1988	-	-	-	-	-
	1992	52	-	-	-	-
	1997	59	57	-	-	-
Poland	1992	82	83	83	-	-
	1997	62	76	64	74	-
Bilateral export data						
The Netherlands	1988	95	100	98	82	84
	1992	76	79	74	72	73
	1997	74	75	76	88	76
Poland	1992	103	94	98	75	88
	1997	88	106	100	93	92
		Bilateral export data				
		The Netherlands			Poland	
		1988	1992	1997	1992	1997
Bilateral export data						
The Netherlands	1988	-	-	-	-	-
	1992	71	-	-	-	-
	1997	73	79	-	-	-
Poland	1992	74	69	83	-	-
	1997	74	78	76	73	-

Table 4: Outcomes of the Chi-test for the multiplicative RCA..

		Total export data				
		The Netherlands			Poland	
		1988	1992	1997	1992	1997
Total export data						
The Netherlands	1988	-	-	-	-	-
	1992	72	-	-	-	-
	1997	78	76	-	-	-
Poland	1992	113	112	83	-	-
	1997	100	88	101	96	-
Bilateral export data						
The Netherlands	1988	185	174	171	128	126
	1992	119	127	110	73	84
	1997	132	125	120	83	100
Poland	1992	205	205	189	128	137
	1997	185	178	173	130	141

		Bilateral export data				
		The Netherlands			Poland	
		1988	1992	1997	1992	1997
Bilateral export data						
The Netherlands	1988	-	-	-	-	-
	1992	67	-	-	-	-
	1997	111	81	-	-	-
Poland	1992	66	98	113	-	-
	1997	91	87	113	60	-

When applied to the multiplicative *RCA's*, the median test shows larger differences than those on the additive *RCA* in 42 out of 45 comparisons. Looking at the multiplicative *RCA* separately, 21 out of 25 comparisons of distributions with different export data show significant differences. Furthermore, with the same export data, significant differences exist with regards to space and time in 9 out of 20 cases. Thus, also with the median test, the distribution of the additive *RCA* is significantly more stable than the distribution of the multiplicative *RCA*.

Relevance of multiplicative and additive RCA's for policy makers

A final difference between the standard and the additive *RCA* concerns the type of sectors focussed on by the indexes. This difference is important for policy makers, since the choice of which sectors to promote is influenced by the choice of the index used. As mentioned before, the multiplicative *RCA* is likely to have the most extreme values for the smaller sectors, due to the denominator effect. The additive *RCA* will generally have larger values for the larger sectors, since these sectors tend to have larger exports shares and thus potentially larger differences in export shares. Hence, the multiplicative *RCA* emphasises the comparative advantage of the smaller sectors, whereas the additive *RCA* emphasises the (percentage wise smaller) comparative advantage of the larger sectors. A policy maker that wants to identify and promote sectors that have a large impact on the economic system is therefore likely to prefer the additive *RCA*, whereas a policy maker that wants to identify comparative advantage sectors without caring about their economic impact will prefer the multiplicative *RCA*.

4 CONCLUSION

This article shows that the well-known index of revealed comparative advantage (*RCA*) suggests that the 'average sector' has a (net) comparative advantage. Moreover, the mean of the standard *RCA* becomes larger when a more detailed sector classification is used. Furthermore, the distribution around the moving mean of the standard *RCA* is dependent on the number of countries and sectors distinguished. The same conclusions hold for the location quotient (*LQ*), which is used in spatial analysis to measure the 'revealed attractiveness' of a certain region or country for the location and production of a certain industry. Most of these problems stem from the multiplicative specification of the *RCA*.

This article, therefore, proposes an *additive RCA* and an *additive LQ*, which have even, bell-shaped distributions between –1 and +1 with a mean of zero that by definition is independent of the number and classification of the countries and sectors distinguished. Moreover, it proposes an *aggregate RCA* for a country as a whole that runs from 0, indicating pure intra-industry trade, to 1, indicating pure inter-industry trade. Thus, it also provides an alternative for the intra-industry trade index. Finally, it shows that to obtain a non-biased *RCA* or *LQ* the country at hand should be excluded from the group of reference countries.

An empirical evaluation of the multiplicative and the additive *RCA* shows that the theoretically expected greater stability of the additive index also shows up empirically. The distribution of the multiplicative index depends on the type of export data used (total or bilateral), and on space and time. Although the distribution of the additive index also depends on these factors, according to some tests, the magnitude of the dependence is significantly less than that for the multiplicative index.

For policy makers the standard index will still be of importance if they want to identify comparative advantage sectors without caring about their economic impact, as the standard index emphasises the comparative advantage of the smaller sectors, whereas the additive index emphasises that of the larger sectors.

Finally, although this article concentrates on an inter-country perspective, comparable suggestions may be made when, for inter-sectoral comparisons, one has to choose an aggregate ‘spatial concentration index’ (see Oosterhaven, 1995). Such an index would, for example, compare world export patterns or world production patterns between industries, and would also run from zero (no spatial concentration at all) to one (complete spatial concentration in one single country).

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