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TRADE INTENSITY, NET TRADE, AND REVEALED COMPARATIVE ADVANTAGE

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TRADE INTENSITY, NET TRADE, AND REVEALED COMPARATIVE ADVANTAGE[3]

More than a half a century ago, Bela Balassa proposed his famous revealed comparative advantage (RCA) index which represents the intensity of exports and can be represented as the ratio of actual-to-expected trade. Today, the index is still applied in the majority of empirical comparative advantage studies, though many alternative indices that account for the demand dimension by capturing imports have been proposed, and theoretical considerations indicate that a proper RCA index should be based on net trade. However, these alternatives cannot be represented as the ratio of actual-to-expected trade. We develop a new net trade RCA (*ntRCA*) index which estimates the comparative advantage from net trade and can be presented as the ratio of actual-to-expected net trade. The index is interpreted as the relative ability of a country to gain from trade in a certain product.

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1. Introduction

The surge of research on the role of comparative advantage in recent years makes it more and more important to choose an accurate indicator of comparative advantage from the large population of such indices (*Liu and Gao*, 2019), since the alternatives are far from being consistent (*Bebek*, 2011), and the choice of a particular indicator may strongly affect the results.

Guidance on how to choose the best comparative advantage index among the alternatives is limited. Revealed comparative advantage (RCA) indices, especially the well-known *Balassa* (1965) index, are used extensively in empirical research (for recent examples, see: *Bahar and Rapoport*, 2018; *Hanson et al.*, 2018). Though the literature has taken many steps forward from this starting point, the Balassa index is still the most widely used in comparative advantage studies. This index is defined as the ratio of the share of a product in a country's exports relative to the share of this product in world exports (a value of the index above one indicates a comparative disadvantage, while the value below one reveals a comparative disadvantage):

$$bi_{i,c} = \frac{x_{i,c}}{x_c}\frac{X_i}{X}, \quad \textbf{(1)}$$

where $x_{i,c}$ is the value of exports for product i from country c, X_i is value of world exports for product i, X_c is the value of total exports for country c, and X is value of total world exports.

We screened 131 papers published in 2013–2019 which dealt with RCA estimates[4] and found that two-thirds of them only used the Balassa index to guide their research. Less than 20% of papers used a modification of the Balassa index (most often, a symmetric one), and the same share of papers applied alternatives: *Lafay* (1992) or *Vollrath* (1991) indices accounting for both exports and imports, RCA based on value added, the TFP approach, etc. Only two papers (*Leromain and Orefice*, 2014; *French*, 2017) derived an RCA index econometrically from a Ricardian trade model. We also found that the frequency of the Balassa index's appearance in papers is declining along with journal impact factor growth but generally remains above 50% even for high-ranked journals.

The Balassa index is used in trade and development studies in order to reveal a country's export specialization. It is one of the crucial building blocks of economic complexity concept which is a powerful instrument to search for future exports at the product

[4] We have extensively searched the ScienceDirect web platform by the term "revealed comparative advantage" (https://www.sciencedirect.com/search/advanced?qs="revealed%20comparative%20advantage"&years=2018%2C2019%2C2017%2C2016%2C2015%2C2014%2C2013&show=100&offset=100&navigation=true) and screened 131 papers which dealt with RCA estimates using trade data (search result gives approximately 200 papers, but one third of them do not deal with trade data and refer to RCA for other purposes, e.g. analyzing patent data).

level, based on a country's productive structure reflecting its capabilities (*Hidalgo and Hausmann*, 2009). Recently, such studies have proliferated, but most of them assume that capabilities (factors of production in the broadest sense) are reflected in relative export shares (Balassa indices). This is a strong assumption. As follows from the Hecksher-Ohlin theorem, it is the positive *net trade*, not exports, that reflects excess factor supplies (*Leamer*, 1984, p. 8–10). As argued by *Deardorff* (1980), *Ballance et al.* (1987), *Balassa and Noland* (1989), and *de Ferranti et al.* (2002), a theoretically consistent RCA index should be based upon net trade. In other words, intra-industry trade should be eliminated from any RCA index which claims to be consistent with the theory.[5]

The Balassa index focuses on exports but neglects the demand dimension that can be captured by import data. The same relative share of a product in total exports may mean very different things for two countries that consume this product with different intensity. Countries with a high share of a product in their export bundle may have negative net trade for this product. A country may export a narrow range of varieties of a specific product and import a much wider range of varieties (due to the inability to produce *most of the varieties* that are demanded at home). The ability of such country to produce *some varieties* to meet external demand would not give us information about the extent or even the presence of a comparative advantage. The net trade approach also partially accounts for the international fragmentation of production, since net trade is a closer proxy for value added trade than gross trade.[6]

In this paper, we propose a net trade RCA (ntRCA) index that estimates comparative advantage from net trade. We rely on the ideas of *Kunimoto* (1977), *Bowen* (1983) and *Vollrath* (1991) on presenting an RCA index as the ratio of actual-to-expected trade (this is possible for the Balassa index but was a problem for net trade indices). We show that a ntRCA index is decomposable into the sign of the net trade and the expected net trade intensity, which can be presented as the ratio of the actual-to-expected absolute value of net trade. The new index can be interpreted as the relative ability of a country to gain from trade in a certain product.

This paper is structured as follows. In Section 2, we survey key papers that study RCA indices as the ratio of actual-to-expected trade and in capturing demand using imports.

[5] Intra-industry trade is defined empirically as a two-way trade in similar products (trade overlap), and conceptually – as trade between countries with identical factor abundance arising from increasing returns or other factors. There is a vast literature on the subject, based on *Grubel and Lloyd* (1975) and *Helpman and Krugman* (1985).

[6] Net trade helps to account for the re-exports, as well as for the imported inputs that are classified into the same commodity group as exports. Other imported inputs are not captured by this approach. The alternative is using indices based on trade in value added at the industry level (*Deb and Hauk*, 2017; *Brakman and van Marrewijk*, 2017). They account for intermediate imports from other industries but are limited in the number of sectors and cannot reveal comparative advantage at the product level.

In Section 3, we propose a new ntRCA index, present the rationale for it, and decompose it into four terms. In Section 4, we give a short empirical note that compares the outcomes of different RCA indices. Section 5 concludes.

2. Literature

The search for better RCA estimates has had a long history since Balassa introduced his index in 1965. The interested reader could refer to *Vollrath* (1991), which provides a good, brief review and *Liu and Gao* (2019), which compares the distributions of alternative RCA indices. There is a set of simple indices with different properties to choose from. Nevertheless, we would like to make several notes.

First, *Kunimoto* (1977) showed that the Balassa index can be reformulated as the ratio of the actual-to-expected exports of a product, if the expected exports are considered to be proportional to a country's share in total world exports:

$$bi_{i,c} = x_{i,c}/x_{i,c}^{(e)}, \quad \textbf{(2)}$$

$$x_{i,c}^{(e)} = X_i(X_c/\mathrm{X}), \quad \textbf{(3)}$$

where $x_{i,c}$ is the value of exports for product i from country c, X_i is the value of world exports for product i, X_c is the value of total exports from country c, and X is the value of total world exports.

This concept of representing an RCA index as the ratio of actual-to-expected trade is important, as expected trade reflects the neutral comparative advantage state of trade, or trade in a hypothetical world where there is no geographic specialization. Our search for a new RCA index is guided by this principle.

Second, it is interesting that *Balassa and Noland* (1989, p. 9–10) proposed to use both the Balassa index and the relative trade balance to account for RCA, as "the use of the net export index is superior to the export index of RCA on trade-theoretical grounds". However they did not developed this idea further. Some authors have developed such indices,[7] though they are not widely used due to their various shortcomings. The majority of these indices are not consistent with the sign of the net trade, as they consider exports and imports separately. For example, to embody demand dimension into an RCA index, *Vollrath* (1991) proposed a way to account for both export and import data:

$$vi_{i,c} = rxa_{i,c} - rma_{i,c}, \quad \textbf{(4)}$$

[7] See papers by *Donges and Riedel* (1977), *UNIDO* (1982), *Bowen* (1983), *Vollrath* (1991), *Lafay* (1992).

where $rxa_{i,c}$ ($rma_{i,c}$) is the export (import) intensity measure for product *i* from (into) country *c* calculated in the spirit of the Balassa index and slightly modified to avoid double counting.[8]

Bowen's (1983) index is among the few indices that are consistent with the sign of the net trade. It can be presented as the ratio of net trade to expected consumption:

$$b_{i,c} = \left(x_{i,c} - m_{i,c}\right) / c_{i,c}^{(e)}, \quad \textbf{(5)}$$

$$c_{i,c}^{(e)} = \frac{gnp_c}{GNP} C_i, \quad \textbf{(6)}$$

where $x_{i,c}$ and $m_{i,c}$ are the value of exports and imports for product *i* for country *c*, respectively, C_i is the value of world consumption for product *i*, gnp_c is gross national product for country *c*, and GNP is world gross national product.

Vollrath (1991, p. 274) claimed that expected consumption used as a scaling variable[9] in Bowen's index is not equivalent to expected trade as is needed according to Kunimoto's framework. Then—in a footnote—he suggested that Bowen's index could be made consistent with Kunimoto's framework if the net trade is *scaled by its expected value* (which can be presented as the difference between expected production and consumption):

$$b_{i,c}^{(consistent)} = \frac{\left(x_{i,c} - m_{i,c}\right)}{\left(x_{i,c} - m_{i,c}\right)^{(e)}} = \frac{q_{i,c} - c_{i,c}}{q_{i,c}^{(e)} - c_{i,c}^{(e)}}, \quad \textbf{(7)}$$

where $c_{i,c}$ ($q_{i,c}$) are consumption (production) for product *i* in country *c*, and $(x_{i,c}–m_{i,c})^{(e)}$ is the expected net trade for product *i* for country *c*, which equals the difference between expected production $q_{i,c}^{(e)}$ and expected consumption $c_{i,c}^{(e)}$.

Vollrath did not develop equation **(7)** further, probably considering that world net trade is equal to zero (by definition) and thus expected net trade cannot be defined using Kunimoto's framework. Instead, Vollrath proposed equation **(4)** as a proxy which is, however, inconsistent with the sign of the net trade. We developed the ideas presented above and propose a new index that is consistent with Kunimoto's framework and the sign of the net trade.

3. The new index

Our guess is that after Vollrath there was only one step left to use the expected *absolute value* of net trade instead of expected net trade as a scaling variable. In this case, the

[8] In the modified indices, Vollrath excluded exports of the country of interest from world exports (the rest of the world instead of all countries), and exports of product of interest from the country's total exports (all other products instead of all products).

[9] Scaling variables are necessary for revealed comparative advantage indices, because they eliminate the effects of country and product size.

presence of a comparative advantage is correctly indicated by the sign of the net trade, while scaling by the absolute value of net trade is used to estimate the extent of a comparative advantage.

We make this step and propose a *net trade RCA* index that is the product of the sign of net trade and absolute net trade relative to the expected absolute value of net trade:

$$ntRCA_{i,c} = \frac{x_{i,c}-m_{i,c}}{|x_{i,c}-m_{i,c}|} \cdot \frac{|x_{i,c}-m_{i,c}|}{nt_{i,c}^{(e)}}, \quad \textbf{(8)}$$

where $nt_{i,c}^{(e)}$ is the expected absolute value of net trade calculated in line with Kunimoto's framework:

$$nt_{i,c}^{(e)} = \sum_{\mathrm{c}} |x_{i,c} - m_{i,c}| \cdot \frac{gdp_c}{GDP}, \quad \textbf{(9)}$$

where gdp_c is the gross domestic product for country c, and GDP is the world gross domestic product. The rationale is simple. We utilize the fact that GDP is the sum of all factor incomes used in production at home.[10] In our framework, the neutral comparative advantage state of international trade with no geographical specialization implies that the gains from trade in a certain product relative to total factor incomes are equal among countries. Thus, the index can be interpreted as the relative ability of a country to gain from trade in a certain product.

By decomposing the numerator and the denominator, this index can also be rewritten as the product of the four terms: the sign of the net trade, the relative share of inter-industry trade, the relative trade intensity and the relative trade openness of a country:

$$ntRCA_{i,c} = \frac{x_{i,c}-m_{i,c}}{|x_{i,c}-m_{i,c}|} \cdot \frac{\frac{|x_{i,c}-m_{i,c}|}{x_{i,c}+m_{i,c}}}{\frac{\sum_{\mathrm{c}}|x_{i,c}-m_{i,c}|}{X_i+M_i}} \cdot \frac{\frac{x_{i,c}+m_{i,c}}{X_c+M_c}}{\frac{X_i+M_i}{\mathrm{X+M}}} \cdot \frac{\frac{X_c+M_c}{gdp_c}}{\frac{\mathrm{X+M}}{GDP}}, \quad \textbf{(10)}$$

where $x_{i,c}$ and $m_{i,c}$ are the value of exports and imports for product i for country c, respectively, X_c and M_c are the value of total exports and imports for country c, X_i and M_i are the value of world exports and imports of product i, X and M are the value of total world exports and imports, while gdp_c is the gross domestic product for country c, and GDP is world gross domestic product.

The proposed index is different from the net comparative advantage index previously presented in *Gnidchenko and Salnikov* (2015) in its treatment of intra-industry trade.[11] In the

[10] Like GDP, exports account for products produced by all factors (including foreign labor) at home. GNP for these purposes would be incomparable with trade data for countries that use foreign labor extensively or receive large remittances from abroad. Note that international labor migration may not match the flows of intermediate products.

[11] At that paper we introduced the first version of the index which used trade turnover instead of absolute value of net trade as scaling variable. Suggested index looked as follows (using notation introduced above):

new version, we use the expected absolute value of net trade instead of expected trade turnover as a scaling variable. This helps to move the ntRCA index closer to estimating the RCA in value added trade.[12] Technically, the difference is adding the world share of inter-industry trade, depicted as $\sum_c |x_{i,c} - m_{i,c}|/(X_i + M_i)$, to the whole story. In the previous version of the index, we accounted for the share of inter-industry trade for a country but did not compare this share with a benchmark. In the current version, we compare a country's share of inter-industry trade with a product-specific benchmark for the world as a whole. The country ranks for a certain product are equal for both indices (the values of the indices differ by a constant), while the product ranks for a certain country may change.

4. Empirical discussion

In our comparison of the outcomes of different RCA indicators and the discussion of the features of the proposed ntRCA index, we rely on UN COMTRADE data for 2013. The data contains both exports and imports for 137 countries and 1,222 commodity groups (by 4-digit HS classification). The data covers all traded commodity groups (agriculture and manufacturing) but not services. The total number of country-product pairs is 155,966.

We use direct trade data and do not follow the approach of using mirror import data to account for exports. We do not correct for the fact that export and import data are presented in different prices (CIF for imports, FOB for exports), and our results contain a small bias: the average CIF/FOB ratio for the world trade is around 1.06, and the mean CIF/FOB ratio estimated econometrically is around 1.03 (*Gaulier and Zignano*, 2010). On the other hand, we avoid the problem of discrepancies between direct and mirror data that may cause an even larger bias, especially at the most disaggregated level: as shown in *Carrere and Grigoriou* (2015), "while 77% of the lines are reported by both partners at the aggregate level, only 47% of the lines are (still) matching at the 6-digit level."

$$ntRCA(v1.0)_{i,c} = \frac{x_{i,c} - m_{i,c}}{(x_{i,c} + m_{i,c})^{(e)}} = \frac{x_{i,c} - m_{i,c}}{x_{i,c} + m_{i,c}} \cdot \frac{\frac{x_{i,c} + m_{i,c}}{\mathrm{GDP}_c}}{\frac{X_i + M_i}{GDP}}$$

[12] *Brakman and van Marrewijk* (2017, p. 79-80) state: "Although trade in value added data is a useful first step in identifying supply chains, their construction based on input–output tables imposes a strong limit on the number of sectors that can be identified (35 or so) compared to the many thousands of products that can be identified using gross export flows. Consequently, the authors argue that the best available indicator for supply chains to date is a detailed, trade-weighted average Grubel-Lloyd index". In the proposed net trade RCA index, we combine this insight with the traditional mechanics of calculating revealed comparative advantage indices.

Also, as noted by *Escaith* (2020), both Bowen's index and the net trade index previously presented in *Gnidchenko and Salnikov* (2015) do a good job at differentiating comparative advantages in final and in intermediate products. He shows that correlation between the RCA calculated for final and for intermediate products is close to zero for each of these indices.

We test if the outcomes of different RCA indices are close to each other. The difference between the previous and the new versions of the ntRCA index is discussed in the **Appendix**; further in the main text, we refer to the new version. In this paper, we use the term "outcome" to indicate whether an index reveals a comparative advantage. For each pair of indices (the ntRCA vs the Balassa index, and the ntRCA vs Vollrath's index), we calculate the proportion of the number of country-product pairs that corresponds to each of the four possible combinations of outcomes for all country-product pairs (**Table 1**).

Table 1
A comparison of the outcomes of ntRCA index with other RCA indices in terms of the proportion of the number of country-product pairs

Net trade RCA index	Balassa index		Vollrath index	
	comparative advantage	*comparative disadvantage*	*comparative advantage*	*comparative disadvantage*
comparative advantage	11.0	7.3	17.3	1.0
comparative disadvantage	4.1	77.6	2.7	79.0

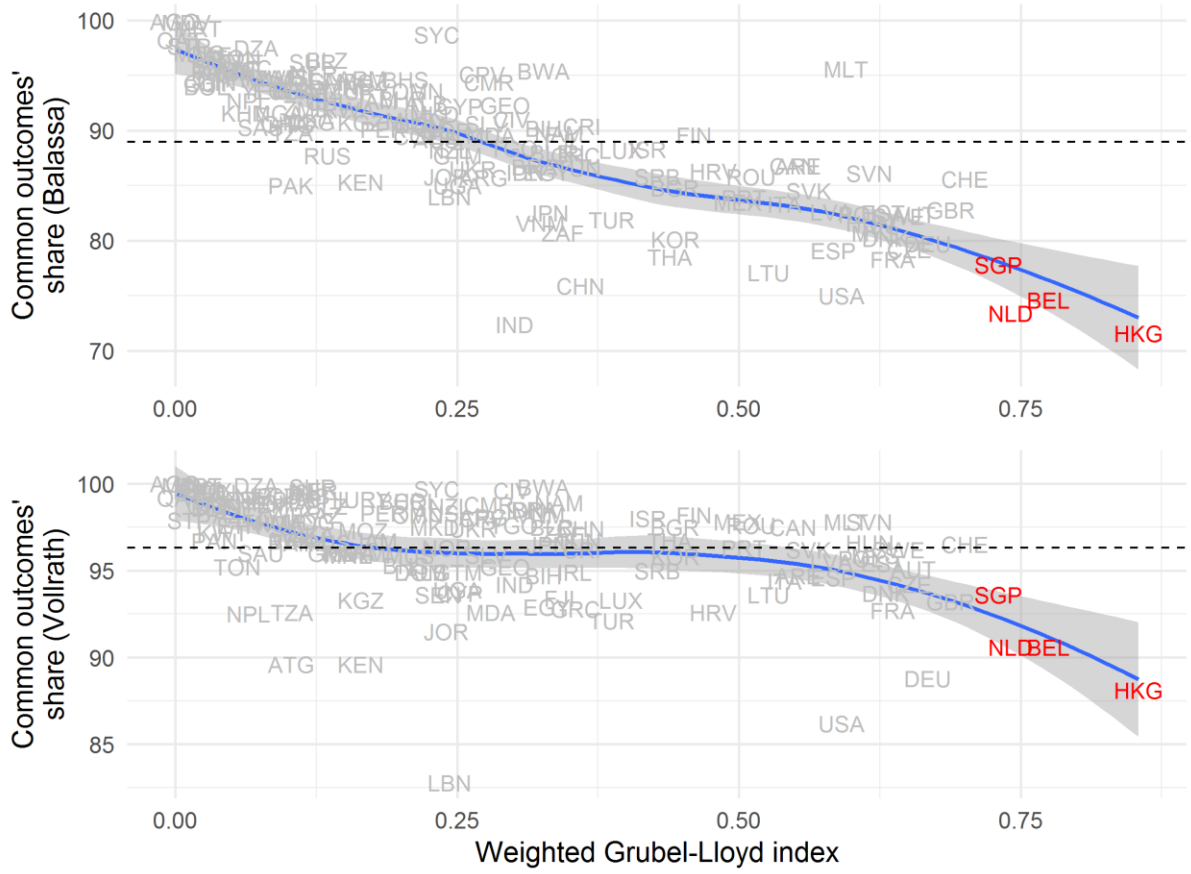
Source: Authors' calculations based on 2013 UN COMTRADE data.
Notes: Common outcomes are filled with pale green, and the diverging outcomes are filled in pale red.

In most cases, the new index matches the two other indices in indicating the presence or the lack of RCA. The average share of common outcomes is approximately 89% for the Balassa index and 96% for Vollrath's index. However, for our analysis, it is studying the diverging outcomes that is particularly important. We find that the share of intra-industry trade captured by the country-level Grubel-Lloyd index is strongly related to the discrepancies between the ntRCA index and other RCA indices, especially the Balassa index (**Figure 1**). The Grubel-Lloyd index at the country level is calculated by weighting the product-level intra-industry share indices by trade turnover:

$$wGL_c = \sum_{\mathrm{i}} \left(1 - \frac{|x_{i,c} - m_{i,c}|}{x_{i,c} + m_{i,c}}\right) \frac{x_{i,c} + m_{i,c}}{X_c + M_c} \ , \qquad \textbf{(11)}$$

where product *i* in this particular case is defined at the 4-digit HS level.

This is not surprising, since the main advantage of the proposed ntRCA index is the careful elimination of the intra-industry trade. Note that the four countries with the highest weighted share of intra-industry trade (Hong Kong, Singapore, Belgium and Netherlands) are widely known as international trade hubs. For some countries such as the US, high intra-industry trade reflects the diverse needs of consumers in the large home market.



Notes: The dashed line indicates the average share of common outcomes; the blue line reflects the smoothed trend; red labels marks countries that are large trade hubs; labels are 3-digit ISO country codes.

Figure 1. Share of common outcomes of ntRCA index with other RCA indices and weighted Grubel-Lloyd index

The Balassa index tends to overestimate the comparative advantage compared to the ntRCA index or Vollrath's index, since the Balassa index does not account for import trade flows. Let us consider several examples for three products united under HS 87 section – buses (HS 8702), trucks (HS 8704) and auto components (HS 8708). The Balassa RCA index indicates a comparative advantage for all countries presented at **Table 3**, but the outcomes of other indices in some cases diverge.

For "Georgian" buses and "Kyrgyz" trucks, the Balassa index is certainly biased due to the fact that nearly all exports of these products are explicitly marked in trade statistics as re-exports. However, re-exports rarely appear in trade data as is. More often, they are hidden under the broader formulation of exports. For instance, Jordan imports Chinese and Japanese buses and re-exports them to Iraq, and Namibia imports trucks from South Africa and the US and re-exports them to other African countries, but these trade flows are only partially

reflected in trade statistics as re-exports.[13] This means that re-exports cannot be eliminated from trade data on a systematic basis, and that is why there is a need for indices that correct RCA accounting for re-exports, such as the ntRCA index.

Table 3
The values and decomposition of different RCA indices for selected countries (HS 87 section: vehicles other than railway, tramway, 2013)

Country	Net trade RCA index*	SIGN	RTI	RO	RIIT	Vollrath's index	Balassa trade intensity		Trade value, USD mln	
							exp	*imp*	*exp*	*imp*
BUSES (HS 8702)										
Georgia	**-1.02**	-	2.00	1.43	0.36	**1.03**	**2.77**	1.74	7	12
Jordan	**-3.41**	-	5.30	1.85	0.35	**2.75**	**7.36**	4.61	52	82
Japan	**2.32**	+	2.42	0.64	1.51	**5.02**	**5.04**	2.32	3 187	14
TRUCKS (HS 8704)										
Kyrgyzstan	**-10.50**	-	3.46	2.24	1.36	**-1.71**	**2.15**	3.86	26	156
Namibia	**-9.52**	-	3.31	2.31	1.24	**-3.80**	**1.25**	5.05	54	259
Japan	**1.13**	+	0.99	0.64	1.80	**2.02**	**2.07**	0.05	10 105	282
AUTO COMPONENTS (HS 8708)										
Slovakia	**-15.36**	-	3.30	3.58	1.30	**-2.45**	**2.12**	4.57	3 597	7 306
Mexico	**-0.03**	-	2.73	1.28	0.01	**-0.04**	**2.71**	2.75	20 522	20 611
Japan	**2.23**	+	1.38	0.64	2.54	**2.04**	**2.47**	0.43	35 301	7 127

** SIGN - sign of the net trade; RTI - relative trade intensity; RO - relative openness; RIIT - relative inter-industry trade share (the components of ntRCA index).*
Source: Authors' calculations based on 2013 UN COMTRADE data.

For auto components, Slovakia, Mexico and Japan are indicated by the Balassa index as having strong comparative advantages, though they are located along the full scale of the ntRCA index. The latter results are much more intuitive: Japan is a world leader in the automobile industry, while Slovakia and Mexico are widely known for success in attracting investments in assembly from leading automobile companies. These facts are directly reflected in the trade data: Japan is a strong net exporter of auto components, Mexico has huge intra-industry trade and Slovakia is one of the primary importers.

In short, the Balassa index, indicating a local comparative advantage according to exports, may ignore such facts as re-exports and assembly. Vollrath's index partially accounts for these phenomena but operates with a difference of export and import shares which does not necessarily coincide with a trade surplus (i.e., gain from trade). The ntRCA index

[13] As a result according to the Balassa index Jordan appears to be more competitive than Japan. To clarify, Jordan's trucks imports from China and Japan are 40.5 million USD and 28.6 million USD, respectively, and its export to Iraq is 45.7 million USD. However, only 3.4 million USD that are attributed to the free zones are marked as re-exports in trade statistics. According to the presentation of the representative of Jordan Government's Department of Statistics, some re-exports in declarations are not recorded as they does not correspond with the Special Trade system which Jordan apply: https://unstats.un.org/unsd/trade/EG-IMTS/Web%20documents/Papers%20and%20presentations/Jordan%20-%20Item%2011%20-%20Re-exports.pdf

indicates the integral comparative advantage that accounts for a country's ability to gain from trade in certain products accounting for re-exports, assembly and the size of the local market (i.e., exports that are overlapped by imports do not add up to a comparative advantage; the ntRCA index allows us to calculate the degree of such an overlap precisely, and this is its main distinction from Vollrath's index).

5. Concluding remarks

In this paper, we propose a new ntRCA index which develops Bowen's and Vollrath's approaches to measuring RCA. The key idea of the index is combining the sign of the net trade and expected net trade intensity. The most important features of ntRCA are:

- the sign of the index always matches the sign of the net trade;
- the index accounts for relative trade shares, just as the Balassa index, but focuses on net trade instead of on exports alone (particularly, it accounts for such facts as re-exports, assembly and the size of the local market);
- the index is consistent with Kunimoto's framework (it can be presented as the ratio of actual-to-expected net trade which is problematic for other net trade indices);
- one can decompose the ntRCA index into four terms: the sign of the net trade, the relative share of inter-industry trade, the relative trade intensity, and the relative trade openness of a country (this makes it convenient for analysts and policy makers);
- the index has low data requirements (the data on exports, imports and GDP is enough to calculate the index), and therefore it can be provided for a wide range of countries and products on a regular basis.

Appendix. On the difference between the two versions of the net trade RCA index

Current version of the ntRCA index is the ratio of previous one and the world share of inter-industry trade for each product. So the current version is more sensitive to net trade values for product with low world share of inter-industry trade.

In this context it is interesting to look at the density distribution of the world share of inter-industry trade (**Figure 2**) and show that the new index is much higher than the old one for aggregated data. However, even for the most detailed 6-digit product groups, the median of the new version of the ntRCA is 1.6 times higher than the median of the previous version.

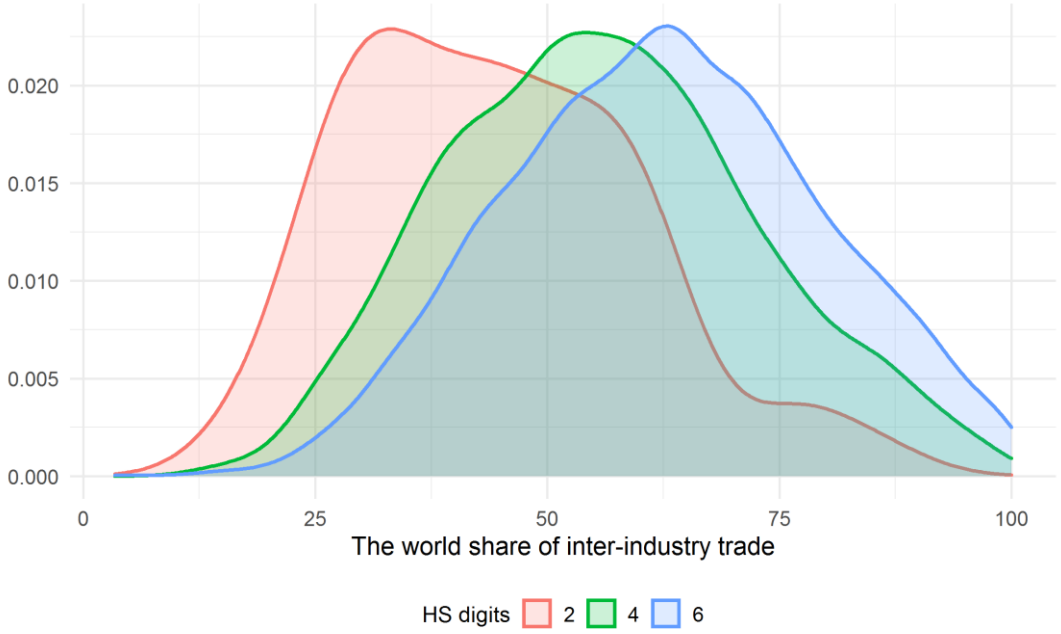


Figure 2. Density functions for the world share of inter-industry trade across all products at the 2-, 4- and 6-digit levels of HS

The products with the lowest world share of inter-industry trade are various works of art (HS 97), diodes, transistors and semi-conductor devices (HS 8541), printed circuits (HS 8534), diamonds (HS 7102), and clock or watch parts (HS 9114). For these products, the new version of the index is considerably higher than the previous version. The products with the world share of inter-industry trade close to 100% are various ores (HS 26), soya beans (HS 1201), asbestos (HS 2524), lignite (HS 2702), and unrefined copper (HS 7402). For these products, the new version of the index is practically undistinctable from the old one.

The old version of the ntRCA index has a certain shortcoming; it belittles some spheres of a country's specialization, specifically for products with low world share of inter-industry trade (high trade overlap). Let us consider the case of Germany (**Figure 3**). The old

version of the index does not distinguish the RCA ranks for wine lees (HS 2307) and springs (HS 7320). According to the new version, Germany has much higher RCA for springs than for wine lees, and this result is in line with the intuition. Springs are particularly used as an input for motor cars production. Germany is the world leader here and the value of its exports for this product is 2.4 times higher than the value of exports of the closest pursuer, the US. On the contrary, Germany is only the third largest exporter of wine lees after France and the US, and it is well-known that wine is not the top alcohol drink in Germany. So, strong comparative advantage of Germany in exporting springs is masked by the old version of the index but is correctly reflected by the new version. Apparatus based on the use of X-rays or of alpha, beta or gamma radiations (HS 9022) is another sphere of German specialization that is better caught by the new version of the index. According to the old one, this product ranks much lower as compared to railway or tramway passenger coaches (HS 8605), though passenger coaches are exported at the very close scale by Germany, China and Austria, while the apparatus is exported predominantly by Germany (25% of world exports) and the US (19% of world exports).

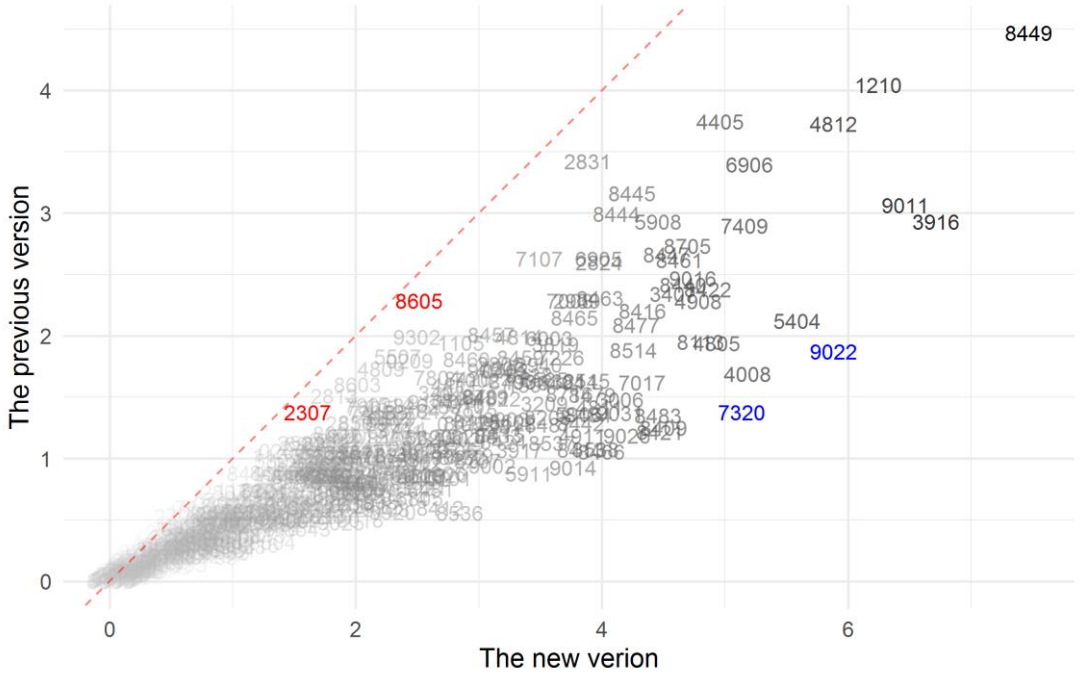


Figure 3. Net trade RCA index in its previous and current versions, for products with positive net exports (Germany, 4-digit HS)

References

Bahar D., Rapoport H. (2018). Migration, knowledge diffusion and the comparative advantage of nations. *The Economic Journal*, 128(612): F273–F305.

Balassa B. (1965). Trade liberalization and revealed comparative advantage. *Manchester School of Economic and Social Studies*, 33(2): 99–123.

Balassa B., Noland M. (1989). "Revealed" comparative advantage in Japan and the United States. *Journal of International Economic Integration*, 4(2): 8–22.

Ballance R., Forstner H., Murray T. (1987). Consistency tests of alternative measures of comparative advantage. *Review of Economics and Statistics*, 69(1): 157–161.

Bebek U. (2011). Consistency of the proposed additive measures of revealed comparative advantage. *Economics Bulletin*, 31(3): 2491–2499.

Bowen H. (1983). On the theoretical interpretation of indices of trade intensity and revealed comparative advantage. *Review of World Economics*, 119(3): 464–472.

Brakman S., van Marrewijk C. (2017). A closer look at revealed comparative advantage: Gross versus value-added trade flows. *Papers in Regional Science*, 96(1): 61–92.

Carrere C., Grigoriou C. (2015). Can mirror data help to capture informal international trade? FERDI Working Paper 123.

De Ferranti D., Perry G., Lederman D., Maloney W. (2002). *From natural resources to knowledge economy: Trade and job quality*. The World Bank, Washington DC.

Deardorff A. (1980). The general validity of the law of comparative advantage. *Journal of Political Economy*, 88(5): 941–957.

Deb K., Hauk W. (2017) RCA indices, multinational production and the Ricardian trade model. *International Economics and Economic Policy*, 14(1): 1–25.

Donges J., Riedel J. (1977). The expansion of manufactured exports in developing countries: An empirical assessment of supply and demand issues. *Review of World Economics*, 113(1): 58–87.

Escaith H. (2020). Contrasting revealed comparative advantages when trade is (also) in intermediate products. MPRA Paper 103666.

French S. (2017). Revealed comparative advantage: What is it good for? *Journal of International Economics*, 106: 83–103.

Gnidchenko A., Salnikov V. (2015). Net comparative advantage index: Overcoming the drawbacks of the existing indices. HSE Basic Research Program Working Paper WP BRP 119/EC/2015.

Grubel H., Lloyd P. (1975) *Intra-industry trade: The theory and measurement of intra-industry trade in differentiated products*. London: Macmillan.

Hakobyan S., Lederman D. (2016). Factor endowments, technology, capital mobility and the sources of comparative advantage in manufacturing. Policy Research Working Paper 7777, World Bank.

Hanson G., Lind N., Muendler M. (2018). The dynamics of comparative advantage. Unpublished Paper, March 18.

Helpman E., Krugman P. (1985) *Market structure and foreign trade: Increasing returns, imperfect competition and international economy*. Cambridge, Mass.: MIT Press.

Hidalgo C., Hausmann R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences*, 106(26): 10570–10575.

Kunimoto K. (1977). Typology of trade intensity indices. *Hitotsubashi Journal of Economics*, 17: 15–32.

Lafay G. (1992). The measurement of revealed comparative advantages. In: Dagenais MG, Muet PA (eds.) *International Trade Modeling*. Chapman & Hill, London.

Leamer E. (1984). *Sources of international comparative advantage: Theory and evidence*. Cambridge, Mass.: MIT Press.

Leromain E., Orefice G. (2014). New revealed comparative advantage index: Dataset and empirical distribution. *International Economics*, 139: 48–70.

Liu B., Gao J. (2019). Understanding the non-Gaussian distribution of revealed comparative advantage index and its alternatives. *International Economics*, 158: 1-11.

UNIDO (1982). *Changing patterns of trade in world industry: An empirical study on revealed comparative advantage*. New York: United Nations.

Vollrath T. (1991). A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Review of World Economics*, 127(2): 265–280.

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