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by

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Abstract

This paper extends the analysis of the product space in two dimensions. It considers net trade flows instead of single-trade flows as the basis for the measurement of comparative advantage, and incorporates vertical specialization into the analysis. The representation of the product space appears very different according to a net-trade flow indicator compared to a single-trade flow indicator, with much fewer links to connect low and medium-low productivity sectors to medium-high and high sectors. Vertical specialization is analysed through the distribution of unit values within sectors. The pattern of trade specialization is radically different for low and for high unit values, thus justifying a separate analysis along different segments of the unit value distribution.

1. Introduction

The possibility that a country's production capabilities can be inferred from the pattern of its trade flows has attracted significant interest in the recent literature. The issue is particularly important in development economics, because the existence of capabilities is seen as essential for the long-term growth prospects of a country. Ever since the pioneering work by Hirschman (1958), production capabilities are related to the existence of backward and forward linkages across sectors. These linkages should not be interpreted as simply resulting from input-output relationships, but should instead be seen as reflecting complex interactions between economies of scale and market size. In a recent influential contribution, Sutton (2001) has forcefully argued that the success of modern industrialised economies ultimately rests on the existence of a network of firms that enjoy the benefits of scarce capabilities. Sutton's (2001) contribution is directly related to the modern literature on market structure and on the key role that even a small number of leading firms can play in the global market.

It is very difficult to measure capabilities directly, because of their complex nature. The recent analysis of capabilities and trade rests on the notion that the observed profile of trade specialization of a country provides *indirect* information about its productive capacity. In their seminal contribution, Hausmann and Klinger (2006) use sectoral trade flow data to obtain a representation of the product space that is consistent with the global pattern of revealed comparative advantage. The location of a country in the product space is related to its underlying production capabilities. Hidalgo, Klinger, Barabási and Hausmann (2007) make use of advanced methods from network analysis to describe the structure of interactions between production sectors on the basis of their export specialization. In turn, export specialization is able to explain cross-section differences in growth performance (Hausmann, Hwang and Rodrik, 2007).

The key idea behind the research programme initiated by Hausmann *et al.* is that, whilst it would prove problematic directly to measure capabilities, the actual trade flows can convey important information on countries' latent capabilities. In particular, export specialization is seen as the most reliable indicator of a country's underlying capabilities. Their approach is fully consistent with traditional theories of trade, in which trade specialization is directly related to resource endowments and to the available technology. Their analysis of the product space identifies the location of a country within that space and can help predict the directions in which its sectoral specialization could expand, given its existing capabilities. The current position of a country in the product space is thus a critical factor influencing its development prospects (Hidalgo, Klingmann, Barabási and Hausmann, 2007).

The use of export specialization in the analysis of the product space is based on the implicit assumption that exports can be regarded as a sufficient statistics for the purposes of inferring the underlying latent capabilities. Theoretical and empirical research in international trade, however, has emphasised the importance of intra-industry trade (IIT) (Greenaway and Torstensson, 1997; Greenaway and Milner, 2003). The large observed flows of imports and exports that take place within production sectors can partly be explained in terms of horizontal product differentiation. Even at a high level of disaggregation, however, intra-industry trade remains a significant component of total trade[1], with vertical differentiation being a very significant component of intra-trade flows (Fontagné, Freudenberg and Gaulier, 2006).

Vertical product differentiation is a powerful motivation for intra-industry trade (Shaked and Sutton, 1984; Sutton, 1986). Vertical differentiation is in turn closely related to the distribution of unit values (*UV*s) within each sector. Schott (2004) provides empirical evidence on within-product specialization and discusses its importance for understanding some of the most relevant consequences of globalization on firms and workers.

For the purposes of our analysis, intra-industry trade is crucial because a country may import and export products that incorporate different production capabilities. It would thus be useful to consider both export and import flows, since exports and imports could incorporate different and complementary information about capabilities. In accordance with this view, a measure of comparative advantage that is relevant for estimating capabilities should look at net trade flows, because they can be more directly related to the actual production capabilities of a country. The analysis of net trade flows is also useful in the light of the increasing relevance of trade networks and global production sharing, where vertically separated production processes are carried out in different countries (Athukorala and Menon, 2010).

[1] Brülhart (2008) estimates that, in 2006, 44 percent of global trade was intra-industry at the 3-digit level of disaggregation, and 27 percent was intra-industry at the 5-digit level of disaggregation.

The present paper extends the analysis of the product space in two directions. First, the measure of comparative advantage that is used for the analysis of the underlying capabilities is based on net trade flows. Specifically, the examination of the product space makes use of the indicator proposed by Lafay (1992), which is directly related to the Grubel-Lloyd index of intra-industry trade. This is in contrast to extant analysis that is based on Balassa's export-based index of revealed comparative advantage. We compare and contrast the results obtained by using the Balassa and the Lafay index, and show that they generate a radically different representation of the product space.

Second, we refine the notion of proximity between sectors by considering not just the *horizontal distance* between products, but also their *vertical distance*. We compute sectoral Unit Values (*UV*s) and distinguish between high *UV*s and low *UV*s within each sector. This makes it possible to have two dimensions of the ability of an economy to expand and adapt its production structure: a "horizontal" dimension, which involves sectors that are close in the product space; and a "vertical" dimension, which involves low- and high-*UV* activities within the same sector.

The structure of the paper is as follows. Section 2 discusses the measures of proximity between sectors that define the product space. Section 3 introduces and motivates our choice of indicator for trade flows. Section 4 presents our evidence on the product space according to the Balassa and the Lafay indicator and discusses the role of unit values. The case of China is studied in section 5, where we consider both its pattern of trade specialization and its location in the product space in relation to alternative definitions of revealed comparative advantage. Section 6 concludes.

2. Capabilities and trade networks

Trade specialization is linked to the analysis of a country's capabilities and of its potential productive capacity. In a series of contributions, Hausmann and Klinger (2006, 2007), Hausmann, Hwang and Rodrik (2007), Hidalgo, Klinger, Barabási and Hausmann (2007), Hidalgo and Hausmann (2009) and Hidalgo (2009) set out a methodology for modelling trade flow networks and for identifying the position of each country in the global product space. The metric that is employed for measuring trade specialization is based on Balassa's (1986) index of Revealed Comparative Advantage (RCA). If one denotes by $x(c,i)$ the value of exports of product *i* by country *c*, then Balassa's Revealed Comparative Advantage of country *c* in good *i* is given by:

$$RCA(c,i) = \frac{\frac{x(c,i)}{\sum_i x(c,i)}}{\sum_c \frac{x(c,i)}{\sum_{i,c} x(c,i)}} \quad (1)$$

where $\sum_i x(c,i)$ are total exports of country *c*. Each product *i* is associated to an index of productivity, which is obtained by adding up the product of the index of comparative advantage *RCA*(*c*,*i*) by the average income level of each country. The resulting productivity index, or *PRODY*(*i*), is thus computed as:

$$PRODY(i) = \sum_c RCA(c,i) \bullet Y_c \quad (2)$$

The notion of capabilities is related to the possibility to move from the production of a commodity to the production of other commodities that are "close" to the first commodity in terms of production requirements. A measure of how close two sectors are in the product space is obtained from the pattern of revealed comparative advantages. More specifically, two products are regarded as "close" when comparative advantage in one of the commodities tends to be associated with comparative advantage in the other commodity and *vice versa*. One can thus distinguish depending on whether $RCA(c,l) \geq 1$ or $RCA(c,l) < 1$, $l = i,j$ to construct an index of proximity between goods *i* and *j*. The indicator function for trade specialization is defined as:

$$w(c,i) = \mathbb{I}(RCA(c,i) \geq 1) \equiv \begin{cases} 1 & \text{if } RCA(c,i) \geq 1 \\ 0 & \text{if } RCA(c,i) < 1 \end{cases} \quad (3)$$

An index of proximity between goods *i* and *j* can be obtained from the conditional probability that countries which specialize in the production of one commodity also specialize in the production of the other commodity, or $\mathbf{P}(w(c,i) = 1 | w(c,j) = 1)$. Specifically, the index of proximity is defined as [2]:

[2] See Hausmann and Klinger (2006) for a discussion of the use of this measure of proximity between sectors.

$$\varphi(i,j) = min\{\mathbf{P}(w(c,i) = 1|w(c,j) = 1), \mathbf{P}(w(c,j) = 1|w(c,i) = 1)\} \quad (4)$$

The index of proximity between commodities *i* and *j*, $\varphi(i,j)$, captures how close the commodities are in the product space in terms of their profile of joint revealed comparative advantage. The proximity between products is a measure of the "closeness" between sectors in the product space, and can be seen as related to the ability to adapt to the production of new products.

In each country *c*, the mass of products that are close to a given product *i* can be measured by the proportion of all paths leading to that product in which country *c* is present (Hausmann and Klinger, 2006). This can be interpreted as the average proximity of a new potential product to a country's current productive structure. The higher is the density mass around a given product, the easier it would be for the country to adapt to the production of new products. Formally, the index of density of product *i* for country *c* is defined as:

$$\omega(c,i) = \frac{\sum_j \varphi(i,j) w(c,j)}{\sum_j \varphi(i,j)} \quad (5)$$

A graphical description of the density of sectors according to their relative proximity is given by the *product space*. The product space can be interpreted as a forest, where trees represent different sectors. Proximity is a measure of how close trees are to each other in the forest. The capacity to adapt to the production of a new commodity is akin to the ability of forest monkeys to jump from tree to tree. The closer the trees, the easier it is to move to a new production. There is therefore a clear advantage for a country from being located in a relatively "dense" region of the product space.

A summary measure of a country's location in the product space is the *Open Forest*, which captures a country's unexploited opportunities (Hausmann and Klinger, 2006). The index of Open Forest for country *c* is computed as:

$$OF(c) = \sum_i \sum_j \left\{ \frac{\varphi(i,j)}{\sum_i \varphi(i,j)} [1 - x(c,j)] x(c,i) PRODY(j) \right\} \quad (6)$$

The Open Forest index is an average of the value of products that are not yet produced, measured by their productivity index *PRODY*, weighted by their relative proximity. It therefore gives an indication of the potential to expand into new production sectors.

The description of the product space that is thus obtained critically depends on the indicator of comparative advantage that is used. An indicator that is exclusively based on export flows may not fully consider that a country's underlying capabilities could be more closely related to the net contribution of the country to global trade. This is better achieved by controlling for intra-industry trade. Furthermore, in the context of vertical product differentiation, it may be important to distinguish whether a country is present in the low-value or in the high value segment of sector. The set of capabilities present in a country could be such that it is easier to move from a low-segment of a sector to the corresponding value segment in a neighbouring sector, rather than to move up the value ladder within the same sector. Following the tree analogy, a monkey located at the base of a tree could find it easier to jump to the base of an adjacent tree, rather than to climb up to the top of the same tree. It can therefore be important to consider both net trade flows and unit values in the construction of the product space.

3. Measuring trade specialization

The definition of the product space discussed in the previous section uses export trade flows to estimate the revealed comparative advantage profile. For the purpose of analysing the underlying capabilities of a country, however, in the presence of intra-industry trade single-flow trade indicators may not be the most accurate measure of a country's production capabilities. A more satisfactory measure of comparative advantage could be related to the net contribution of a country to global trade. Hence, net trade indicators may constitute a more appropriate foundation for a definition of the product space that seeks to map the latent production capabilities.

A suitable starting point for the definition of an indicator of net trade specialisation is the normalised trade balance. This is defined as the ratio between the sectoral trade balance and total sectoral trade (see *e.g.* the extensive discussion in Iapadre, 2001):

$$z(c,i) = \frac{x(c,i) - m(c,i)}{x(c,i) + m(c,i)} \tag{7}$$

where c denotes the country, i the commodity, x exports and m imports. It is useful to note that the normalised trade balance can also be written as:

$$z(c,i) = \frac{x(c,i)/_{m(c,i)} - 1}{x(c,i)/_{m(c,i)} + 1} \qquad (8)$$

from which it is apparent that $-1 \leq z(c,i) \leq 1$. The normalised trade balance (8) or (9) is inversely related to the Grubel-Lloyd indicator of intra-industry trade, *GL*(*c*,*i*):

$$GL(c,i) = 1 - |z(c,i)| \qquad (9)$$

A trade specialisation index, *TS*(*c*,*i*), can be constructed from the normalised trade balance by considering the distribution of normalised trade balances of a country amongst its products:

$$TS(c,i) = z(c,i) - Z(c) \qquad (10)$$

where $Z(c) \equiv \sum_i z(c,i)$.

For the purposes of constructing a proxy for capabilities, a pure trade specialisation index may not be appropriate because no allowance is made for the different size of the sectors in terms of their trade. It is useful to weigh the index by the sectoral contribution to the trade balance:

$$LF(c,i) = \frac{TS(c,i)\big(x(c,i) + m(c,i)\big)}{X(c) + M(c)} \qquad (11)$$

where $X(c) = \sum_i x(c,i)$ and $M(c) = \sum_i m(c,i)$ are total exports and imports of country *c* respectively. The indicator *LF* in (11) is similar to the index proposed by Lafay (1992). In the form given above, it coincides with the indicator used by Bugamelli (2001) [3].

The indicator function for trade specialization can now be defined with respect to the Lafay index *LF*:

$$q(c,i) = \mathbb{I}(LF(c,i) \geq 0) \equiv \begin{cases} 1 & \text{if } LF(c,i) \geq 0 \\ 0 & \text{if } LF(c,i) < 0 \end{cases} \qquad (12)$$

[3] See also Zaghini (2005) and Alessandrini, Fattouh, Ferrarini and Scaramozzino (2009) for examples of applications of the indicator defined in (11).

The index of proximity (4) must be accordingly modified as:

$$\theta(i,j) - min\{\mathbf{P}(q(c,i) = 1|q(c,j) = 1), \mathbf{P}(q(c,j) = 1|q(c,i) = 1)\} \quad (13)$$

The proximity index $\theta(i,j)$ defined in (13) can be used for the analysis of the product space in terms of net trade flows. The formula for density (5) and for Open Forest (6) are accordingly redefined to be consistent with Lafay's indicator.

4. Net flows and the product space

The empirical analysis of trade flows is carried out on the BACI [4] dataset, collected and managed by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (see Gaulier and Zignago, 2010, for a detailed description of the data base). BACI covers over 5,000 products. The analysis in this paper makes use of data from the year 2007 for 144 countries at different levels of aggregation (HS4 and HS6). Revealed comparative advantage is measured both in terms of the Balassa (1986) and of the Lafay (1992) indices, and unit values (*UV*s) were estimated to gain further insights on the pattern of trade specialization. For each category the median *UV* was computed, and individual products were classified as either high-UV or low-UV according as to whether their UV was higher of lower than the median.

Table 1 breaks down the Balassa's RCA index by unit value and by quartiles of the *PRODY* distribution for the whole sample and for five selected countries: China, Germany, India, Japan and the USA. *PRODY* is computed using the Hausmann-Hwang-Rodrik (2007) methodology. We use GDP per capita, PPP, at constant 2005 USD for all products, computed across all trading nations, with trade flows taken as 2006/2007 average. For the whole set of countries in the sample, RCA is a decreasing function of both *UV*s and of *PRODY*. If one looks at individual countries, however, the pattern is more complex. In terms of *UV*s, China enjoys greater comparative advantage for low *UV*s than for high *UV*s, whilst the opposite holds true for Germany. These results conform to what one would expect from the production structure of these two countries. However, some of the other results are somewhat surprising. India apparently enjoys greater comparative advantage for high *UV*s, and Japan for lower *UV*s. The USA receive the same score for both. When we look at the distribution of the *PRODY* indicator, the results however always conform to prior expectations, given each

[4] *Base pour l'Analyse du Commerce International.*

country's degree of technological development. The RCA index increases along the *PRODY* distribution for Germany, Japan and the USA, and decreases for China and India.

The previous findings cast doubt on the use of the Balassa index for measuring trade specialization over different segments of the *UV* range, and motivate the use of alternative measures of specialization. We thus computed the Lafay index for all countries and all products, according to equation (11). The Lafay index is weakly correlated with the Balassa index. Table 2a shows that the Pearson correlation coefficient across all countries and products is only 0.1399. The correlation coefficient is even lower for high-*UV*s products (0.0834). The Spearman's rank correlation coefficient is higher, but it is still only 0.5257. The rank correlations are however higher within countries, as shown in Table 2b (HS–4 digits) and in Table 2c (HS–6 digits). The analysis of net trade flows, therefore, can yield a very different measure of specialization than single-flow trade.

A detailed exploration of the Lafay index for selected countries is offered in the set of Figures 1 and 2. Figures 1a-1e display the cumulated Lafay index for China, Germany, India, Japan and the USA (HS4). Products are ordered on the horizontal axis by increasing values of the productivity index *PRODY*. Increasing values of the cumulated Lafay graph denote trade specialization over the range of products, whereas decreasing values of the cumulated graph denote trade despecialization. China is shown to be specialized in low- and intermediate-*PRODY* items and despecialized in high-*PRODY* items. India is specialized in low-*PRODY* items and despecialized in high-*PRODY* items, whereas the opposite is true for Germany, Japan and the USA.

The set of Figures 2a(i)-2e(ii) break down the cumulative Lafay index separately for low unit values and for high unit values, in order to gain insight on the detailed specialization profile of the different countries. Unit values are available for all products. For each country and product code, the latter are divided into high- and low-*UV*, according to whether a product's *UV* falls above or below the median of the *UV* distribution of that specific product. The specialization pattern for China is quite striking: along the *PRODY* distribution, China presents trade specialization for low *UV*s, but despecialization for high *UV*s (Figures 2a(i) and 2a(ii) respectively). India exhibits a similar pattern, although less clear-cut, with specialization in some low-*PRODY*, high-*UV*s products (Figures 2c(i) and 2c(ii)). By contrast, both Germany and Japan present despecialization for low *UV*s but also for high *UV*s - low *PRODY* items (Figures 2b(i) and 2b(ii), and 2d(i) and 2d(ii)). The USA are despecialised for low *UV*s and specialised for high *UV*s (Figures 2e(i) and (2e(ii)). The pattern of trade specialization appears therefore to be radically different for low and for high unit values, thus justifying a separate analysis along different segments of the unit value distribution.

The "closeness" of different products in the product space is measured by their proximity (equation (14)). Tables 3a show average proximities according to the first 4 digit of HS96 and Tables 3b according to the first 6 digits. The values of proximities appear to be very similar at 6 and 4 digit levels of disaggregation. Tables 4a and 4b combine proximities with *UV*s and with the productivity index *PRODY*. Products are first split along the four quartiles of the *PRODY* distribution. The inter-quartile absolute difference between pairs of products is then computed in absolute terms. For instance, if product 1 belongs to the third quartile and product 2 to the first quartile, the absolute difference is 2. This absolute difference is then tabulated against communality or not of *UV* categories: HH denotes that both products are high *UV* relative to the median, LL that both products are low *UV*, and HL that one of the products is high *UV* and the other is low *UV*. The values in the tables reveal that average proximity between products relates to the absolute distance between the *PRODY* quartile to which they relate. This is true across *UV*s, but strongest for the case of the HL category, where distance among products is greatest (lower proximities). In short, both *PRODY* and HL categories come out as one would have expected *a priori*, which is a relevant finding.

Pairwise proximities across all products form the basis for the analysis of the product space. The methodology developed by Hidalgo and Hausmann (2007) makes use of network analysis to illustrate the interactions between production sectors. To visualize the product space, these proximities are read into Cytoscape (Shannon *et al.*, 2003), an open source platform for complex-network analysis and visualization, which applies a greedy algorithm (spring-embedded) to cluster nodes along the intensity of the edges (proximities). To facilitate visualization, we drop proximities smaller than 0.60. To categorize products, we divide the distribution of *PRODY* into 4 classes, taking quartiles as delimiters (percentiles no. 25, 50, and 75). Graphically, categories 1 to 4 are associated to a different colour of the node (products). Category 1 are low-GDPpc products (green), category 4 are highest-GDPpc products (in red). Category 2 takes colour light-blue, category 3 is in dark blue. The size of the nodes is determined by the share of products in total world trade.

The Balassa graphs (Figures 3a-3e) and Lafay graphs (Figures 4a-4e) look remarkably different. The Balassa product space looks much more connected, whereas the Lafay product space is almost dichotomized into two halves, with only one link between them with a proximity index greater than 0.6 (the link is between sector 7309 - Tanks etc., over 300 Liter Capacity, Iron or Steel, and sector 9406 - Prefabricated Buildings). In the Balassa product space, products are ordered according to increasing values of *PRODY* in a clockwise fashion starting from the top-left corner of the graph. In the Lafay space, low and middle-low *PRODY* products are located in the lower half of the graph (from the right to the left), and middle-high and high *PRODY* sectors in the top half (again right to left). If one considers net trade flows as measures of capabilities as opposite to single-trade export flows only, thus, it can be much more difficult to adapt and move to far away regions of the product space. In particular, it can prove problematic to move from the two bottom quartiles of the *PRODY* distribution to the two top quartiles.

According to the Balassa representation of the product space, China is over-represented in the lowest quartiles of the *PRODY* distribution (Figure 3a). According to both the Balassa and the Lafay graphs, however, China is also present in the third quartile of the *PRODY* distribution. In particular, according to the Lafay index China has successfully crossed the bridge to the upper half of the product space (Figure 4a). The potential development prospects for China therefore look even brighter if we measure its specialization in terms of net trade flows instead of single-trade flows.

According to both the Balassa and the Lafay metric, Germany is mostly represented in the upper quartiles of the product space (Figures 3b and 4b). The same is true for Japan (Figures 3d and 4d) and for the USA (Figures 3e and 4e).

The interpretation of the product space for India is quite complex. According to the Balassa index, India is mostly present in the first and in the third quartiles of the *PRODY* distribution, although it is also located in a number of products in the highest quartile (Figure 3c). According to the Lafay index, however, India is still over-represented in the lowest quartile of the *PRODY* distribution, but it also has a strong presence in all the upper quartiles of the productivity distribution, and has already established a specialization profile in the top half of the product space (Figure 4c).

5. Trade specialization in China

China is as interesting case study for the purposes of the comparison between the Balassa and the Lafay measures of comparative advantage, because the differences between total exports and net exports can be quite significant in a number of sectors. From the discussion of the product space in section 4, China occupies a somewhat higher productivity region of the space according to the Lafay index compared to the Balassa index. Hence, its growth prospects look even more encouraging if one looks at net trade flows.

Tables 5a and 5b list the top 25 and the bottom 25 ranking products for China at 6 digits according to the Balassa index, and Tables 6a and 6b list the corresponding products according to the Lafay index. From Table 5a, it is apparent that some products that enjoy a very high ranking according to the export specialization perform very poorly once we control for net trade. In particular, product 282738 (Chlorides, Chloride Oxides And Hydroxide) is ranked second according to Balassa, but only 3,053rd according to Lafay. Similarly, item 293729 (Adrenal Cortical Hormones And Derivatives) is ranked 15th according to Balassa but only 2,954th according to Lafay, item 1839 (Camphor) is ranked 16th according to Balassa and 1,839th according to Lafay, and item 050210 (Pigs', hogs' or boars' bristles and hair and waste thereof) is ranked 24th and 1,074 respectively. By contrast, the lowest-ranking items with the Balassa index also tend to have a low ranking according to Lafay (Figure 5b).

A similar pattern emerges if one looks at the top products according to the Lafay index (Figure 6a). Item 852812 (TV Receivers, Color, Incl Video Monitors) is ranked 8th and 1,540 according to Lafay and Balassa, item 847150 (Digital Processing Units) is ranked 16th and 1,243rd, item 844390 (Parts, of Printing Machinery, of Machines for Uses Ancillary to Printing) is ranked 22nd and 1,297th, and item 890190 (Other vessels for the transport of goods and other vessels for the transport of both persons and goods) is ranked 25th and 1,759th respectively. Again, no big surprises emerge from the products at the bottom of the Lafay ranking.

In the case of China, therefore, one can reach quite different conclusions about the pattern of product specialization if one uses net export flows rather than data on total exports.

The divergence between the two measures is also evident from Table 7, where the values of the Open Forest indicator (equation (6)) are given. Open Forest is the average *PRODY* of those products China is not present yet but are attainable (*i.e.* the distance-weighted *PRODY* of all products that China is currently not producing but which it has the potential to produce). This measure is much higher for the Balassa-based product space than for that of Lafay. This may be reflective of China being already in a higher segment of the product space according to Lafay, in line with the graphs in Figures 3a and 4a. The choice of Lafay over Balassa is thus shown to have a strong bearing on the definition of product space.

6. Conclusions

This paper extends the analysis of the product space in two dimensions. It considers net trade flows instead of single-trade flows as the basis for the measurement of comparative advantage, and incorporates vertical specialization into the analysis. Both these extensions are seen to be important in order to capture some aspects of the global pattern of trade specialisation. The representation of the product space appears very different according to a net-trade flow indicator compared to a single-trade flow indicator, with much fewer links to connect low and medium-low productivity sectors to medium-high and high sectors.

Vertical specialization is analysed through the distribution of unit values within sectors. When the proximity between sectors are combined with unit values and with the Hausmann-Hwang-Rodrik index of productivity the pattern of trade specialization is radically different for low and for high unit values, thus justifying a separate analysis along different segments of the unit value distribution.

Ongoing research efforts expand the analysis on the basis of methods that better capture the extent of production sharing and network trade. Revealed comparative indicators reliant on net trade flows capture only in part the phenomenon of production fragmentation, to the extent that such activities take place within the product categories and the degree of aggregation chosen as the relevant level of analysis. By contrast, the explicit distinction of trade in parts and components from trade in final goods, as reflected in the international trade data, will provide a more reliable basis for the assessment of countries' net capabilities.

Data Appendix

Trade data are drawn from the BACI dataset by the *Centre d'Etudes Prospectives et d'Informations Internationales*(CEPII).[5] Constructed on the basis of raw data from UN Comtrade, the BACI dataset offers the advantage of broad coverage of trade flows measured in volume, obtained through mirroring techniques of trade flow data available from UN Comtrade partner countries' records. Therefore, the BACI dataset is particularly suitable for the analysis of unit value data, which is one purpose of this paper's expansion of the unit values concept. The data are disaggregated to six digits of the Harmonized System. For the analysis, we use data alternatively at 6 and 4 digits of aggregation.

Population and GDP per capita series in purchasing power parity are obtained from the World Bank's World Development Indicators (WDI), accessed online in August 2010. Data for Taipei, China, where added from official country statistics, since missing in World Bank statistics. To reduce possible noise deriving from the inclusion of very small, countries with populations totaling less than 1 million were dropped from the database prior to computations.

Data availability in the BACI HS1996 database spans from 1998 to 2007.[6] For this analysis, we used the datasheet for the year 2007 only, leaving the analysis of the historical evolution of the product space for future analysis.

[5] For a description of the dataset, see **http://www.cepii.fr/anglaisgraph/workpap/pdf/2010/wp2010-23.pdf**

[6] There is another version of BACI, HS1992, available for analysis, according to a previous nomenclature of HS and spanning from 1995 to 2009.

Table 1. Trade specialization indicators: Balassa index (HS4).

Country	Unit Values		*PRODY*				Whole
	Low	High	Q1	Q2	Q3	Q4	sample
China	2.74	1.79	2.60	3.02	2.47	1.62	2.56
Germany	1.82	1.88	1.13	1.59	2.02	2.21	1.86
India	3.74	3.99	6.69	3.07	2.67	1.54	3.81
Japan	1.65	1.40	0.59	1.02	1.73	1.89	1.46
USA	1.80	1.80	1.45	1.79	1.77	2.02	1.80
All Countries	6.61	5.11	17.31	3.10	1.90	1.26	5.89

Note: *PRODY* is computed as in equation (2); Q1-Q4 denote the quartiles of the *PRODY* distribution.

Table 2a. **Balassa *vs*. Lafay: Pearson and Spearman correlation coefficients (HS 4 digits).**

	Unit Values		*PRODY*				Whole
	Low	**High**	**Q1**	**Q2**	**Q3**	**Q4**	**sample**
Pearson	0.1879	0.0834	0.2242	0.0754	0.1401	0.2349	0.1399
Spearman	0.5696	0.4810	0.6406	0.5522	0.4753	0.4165	0.5257

Table 2b. **Spearman's rank correlation coefficients (HS 4 digits).**

Country	**Spearman's ρ**
China	0.7028
Germany	0.6518
India	0.6315
Japan	0.6907
USA	0.7207

Table 2c. **Spearman's rank correlation coefficients (HS 6 digits).**

Country	**Spearman's ρ**
China	0.6947
Germany	0.6175
India	0.6239
Japan	0.7037
USA	0.7073

Table 3a. Average proximities according to first digit of HS96 (4 digits).

	First-digit product code									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	0.22	0.21	0.20	0.20	0.24	0.20	0.26	0.23	0.23	0.22
1		0.20	0.20	0.20	0.24	0.21	0.26	0.24	0.23	0.23
2			0.20	0.20	0.25	0.22	0.26	0.26	0.25	0.24
3				0.20	0.25	0.22	0.26	0.25	0.24	0.24
4					0.23	0.20	0.23	0.22	0.23	0.24
5						0.19	0.20	0.19	0.23	0.25
6							0.23	0.21	0.23	0.23
7								0.20	0.23	0.24
8									0.22	0.22
9										0.20

Table 3b. Average proximities according to first digit of HS96 (6 digits).

	First-digit product code									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	0.19	0.19	0.19	0.22	0.23	0.20	0.26	0.22	0.22	0.21
1		0.21	0.19	0.23	0.24	0.21	0.26	0.23	0.23	0.22
2			0.18	0.23	0.26	0.24	0.27	0.26	0.26	0.25
3				0.21	0.22	0.22	0.27	0.24	0.25	0.23
4					0.21	0.20	0.26	0.23	0.24	0.22
5						0.22	0.27	0.26	0.26	0.25
6							0.24	0.21	0.23	0.22
7								0.22	0.25	0.24
8									0.23	0.22
9										0.19

Table 4a. Average proximity according to Unit Values and to the absolute difference between *PRODY* quartiles (4 digits).

Absolute difference between *PRODY* quartiles	Unit Values		
	HH	**HL**	**LL**
0	0.26	0.22	0.25
1	0.25	0.22	0.24
2	0.24	0.21	0.22
3	0.23	0.19	0.19

Table 4b. Average proximity according to Unit Values and to the absolute difference between *PRODY* quartiles (6 digits).

Absolute difference between *PRODY* quartiles	Unit Values		
	HH	**HL**	**LL**
0	0.26	0.23	0.27
1	0.26	0.22	0.26
2	0.25	0.21	0.24
3	0.22	0.19	0.21

Table 5a. China: Top ranking products according to the Balassa index.

Balassa ranking	Lafay ranking	Product code (HS6)	Product name	Balassa	*PRODY*
1	760	580134	Woven Pile Fabrics Of Manmade Fibers, Un..	8.90	7982
2	3053	282738	Chlorides, Chloride Oxides And Hydroxide..	8.73	6316
3	190	940530	Magnetic Tapes For Sound Recording Or Si..	8.60	13304
4	274	360410	Fireworks	8.32	15127
5	290	851672	Electrothermic Domestic Appliances, N.E.S.	8.26	18879
6	509	610323	Ensembles, Of Knitted Or Crocheted Texti..	8.01	7295
7	285	670420	Wigs, False Beards, Eyebrows, Eyelashes,..	7.93	9561
8	480	500200	Raw Silk (Not Thrown)	7.86	2509
9	266	660199	Umbrellas And Sun Umbrellas (Including W..	7.81	14245
10	39	950510	Articles, N.E.S. For Christmas Festivities	7.80	12085
11	463	660191	Umbrellas And Sun Umbrellas (Including W..	7.70	24452
12	336	670210	Artificial Flowers, Foliage Or Fruit And..	7.70	18579
13	150	847010	Electronic Calculators Capable Of Operat..	7.68	17268
14	605	280530	Calcium, Strontium And Barium; Rare Eart..	7.64	24107
15	2954	293729	Adrenal Cortical Hormones And Derivatives	7.63	13442
16	1839	291421	Camphor	7.46	10684
17	793	720280	Ferroalloys, N.E.S	7.43	15189
18	896	580123	Cotton Pile And Chenille Woven Fabrics, ..	7.42	13873
19	462	940430	Sleeping Bags	7.42	8460
20	635	442110	Manufactured Articles Of Wood, N.E.S.	7.32	17253
21	637	460120	Mats, Matting And Screens Of Vegetable M..	7.32	3415
22	37	420212	Trunks, Suitcases, Vanity Cases, Executi..	7.25	8230
23	118	392640	Articles Of Plastics, N.E.S.	7.20	13160
24	1074	050210	Pigs', hogs' or boars' bristles and hair	7.19	17049
25	72	841451	Fans, Table, Floor, Wall, Window, Ceilin..	7.19	12480

Table 5b. China: Bottom ranking products according to the Balassa index.

Balassa ranking	Lafay ranking	Product code (HS6)	Product name	Balassa	*PRODY*
5015	3881	040620	Grated Or Powdered Cheese, Of All Kinds	0.00	25960
5016	3040	310280	Fertilizers, Urea And Ammonium Nitrate M..	0.00	13489
5017	3111	030222	Flat Fish, Fresh Or Chilled (Excluding L..	0.00	32649
5018	4768	261690	Ores And Concentrates Of Precious Metals..	0.00	3049
5019	4240	151211	Sunflower Seed Oil Or Safflower Oil, Crude	0.00	6381
5020	3482	051110	Bovine Semen	0.00	11833
5021	5040	290250	Styrene	0.00	31747
5022	3106	030231	Tunas, Skipjack Or Stripe	0.00	6103
5023	3731	120911	Sugar Beet Seed	0.00	20542
5024	4843	120500	Rape Or Colza Seeds	0.00	14023
5025	4997	260400	Nickel Ores And Concentrates	0.00	4432
5026	3358	030219	Salmonidae, Fresh Or Chilled (Excluding ..	0.00	5446
5027	4936	711031	Platinum Group (Except Platinum) Metals ..	0.00	12205
5028	3616	120924	Seeds Of Forage Plants, Other Than Beet ..	0.00	33161
5029	3282	010111	Horses, Live	0.00	32267
5030	3423	410320	Hides And Skins, N.E.S., Raw (Fresh, Sal..	0.00	2502
5031	3469	080121	Brazil Nuts, Fresh Or Dried, Whether Or ..	0.00	5126
5032	5010	260800	Zinc Ores And Concentrates	0.00	6618
5033	4012	040690	Cheese, N.E.S.	0.00	18295
5034	3168	040640	Blue	0.00	32035
5035	5027	260112	Iron Ore Agglomerates (Sinters, Pellets,..	0.00	10960
5036	4663	284410	Natural Uranium And Its Compounds; Urani..	0.00	1211
5037	4468	180100	Cocoa Beans, Whole Or Broken, Raw Or Roa..	0.00	1701
5038	4591	261210	Uranium Ores And Concentrates	0.00	1822
5039	3122	020726	Poultry Cuts (Of Chickens, Ducks, Geese,..	0.00	20806

Table 6a. China: Top ranking products according to the Lafay index.

Lafay ranking	Balassa ranking	Product code (HS6)	Product name	Lafay	*PRODY*
1	125	847130	Digital Processing Units Whether Or Not P..	1.69	20399
2	651	852520	Transmission Apparatus For Radiotelephon..	1.46	20532
3	665	847330	Parts Of Automatic Data Processing Machi..	0.87	18665
4	242	847160	Input Or Output Units Whether Or Not Pre..	0.56	19004
5	403	844359	Printing Machinery, N.E.S	0.50	17950
6	777	851780	Telephonic Or Telegraphic Apparatus, N.E..	0.46	22439
7	49	950410	Video Games Of A Kind Used With A Televi..	0.41	19870
8	1540	852812	TV Receivers, Color, Incl Video Monitors..	0.40	16609
9	573	852540	Video Recording Or Reproducing Apparatus..	0.36	17717
10	491	640399	Footwear, N.E.S., With Outer Soles Of Le..	0.33	7810
11	200	950390	Toys, N.E.S.	0.33	19460
12	35	640299	Footwear, N.E.S., With Outer Soles And U..	0.31	6640
13	141	852190	Video Recording Or Reproducing Apparatus..	0.30	15970
14	517	850440	Static Converters (E.G., Rectifiers)	0.29	18566
15	161	950490	Articles For Funfair, Table And Parlor G..	0.26	20261
16	1243	847150	Digital Processing Units Whether Or Not P..	0.25	26930
17	598	611020	Jerseys, Pullovers, Cardigans, Waistcoat..	0.24	3778
18	959	852990	Parts Of Television Receivers, Radiobroa..	0.22	19955
19	608	620462	Trousers, Bib And Brace Overalls, Breech..	0.22	4874
20	333	852821	TV Receivers, Color, Incl Video Monitors..	0.21	19297
21	371	611030	Jerseys, Pullovers, Cardigans, Waistcoat..	0.21	4713
22	1297	844390	Parts For Printing Machinery And Parts O..	0.19	22582
23	505	853400	Printed Circuits	0.19	20836
24	145	851999	Sound Reproducing Apparatus, N.E.S.	0.18	22157
25	1759	890190	Vessels For The Transport Of Goods (Incl..	0.18	7447

Table 6b. China: Bottom ranking products according to the Lafay index.

Lafay ranking	Balassa ranking	Product code (HS6)	Product name	Lafay	*PRODY*
5030	4650	390120	Polyethylene, Having A Specific Gravity ..	-0.15	21817
5031	4393	870840	Gear Boxes	-0.16	23737
5032	4227	750210	Nickel, Unwrought (Not Alloyed)	-0.17	16513
5033	4144	390330	Acrylonitrile	-0.18	24144
5034	4950	854250	Electronic Integrated Circuits And Micro..	-0.18	3246
5035	4581	390210	Polypropylene, In Primary Forms	-0.19	19265
5036	4951	151190	Palm Oil, Refined, And Its Fractions	-0.19	6990
5037	3714	290243	Xylenes, Pure	-0.19	21017
5038	4739	520100	Cotton (Other Than Linters), Not Carded ..	-0.21	1681
5039	4655	870323	Motor Vehicles For The Transport Of Pers..	-0.22	19257
5040	5021	290250	Styrene	-0.25	31747
5041	4826	290531	Ethylene Glycol (Ethanediol)	-0.27	27530
5042	5013	291736	Polycarboxylic Acids, N.E.S. And Their A..	-0.35	18297
5043	5000	870324	Motor Vehicles For The Transport Of Pers..	-0.37	28396
5044	4185	740400	3936er Waste And Scrap	-0.41	7785
5045	3783	847989	Machinery Having Individual Functions, N..	-0.51	26716
5046	4943	260300	Copper Ores And Concentrates	-0.51	5146
5047	4340	120100	Soybeans	-0.60	6793
5048	4263	740311	Refined Copper	-0.60	4897
5049	4119	271000	line Including Aviation (Except Jet) Fuel	-0.66	14760
5050	4651	880240	Airplanes And Other Aircraft, Mechanical..	-0.67	23639
5051	4884	260111	Iron Ore And Concentrates, Not Agglomera..	-1.16	7501
5052	1592	901380	Liquid Crystal Devices, N.E.S. And Optic..	-1.20	26519
5053	2716	854230	Nondigital Monolithic Integrated Units	-3.27	23293
5054	4815	270900	Petroleum Oils And Oils From Bituminous ..	-4.31	12115

Table 7. China: Density and Open Forest indices.

	Density		Open forest	
	Balassa	**Lafay**	**Balassa**	**Lafay**
mean	**0.53**	**0.67**	**7.90e+06**	**2.06e+06**
median	0.51	0.66	7.90e+06	2.06e+06
SD	0.12	0.08	0.00	0.00
min	0.13	0.45	7.90e+06	2.06e+06
max	0.96	1.00	7.90e+06	2.06e+06

Figure 1a. ***PRODY* and Cumulated Lafay Index, HS 4 digits – China.**

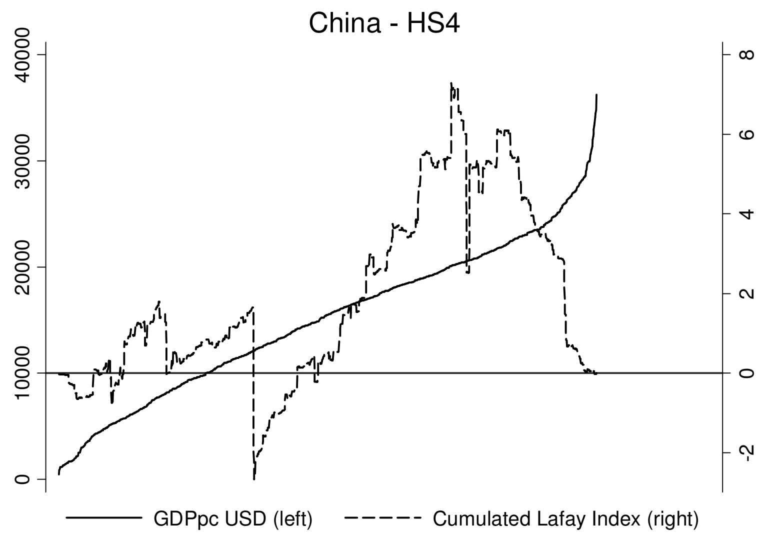


Figure 1b. ***PRODY* and Cumulated Lafay Index, HS 4 digits – Germany.**

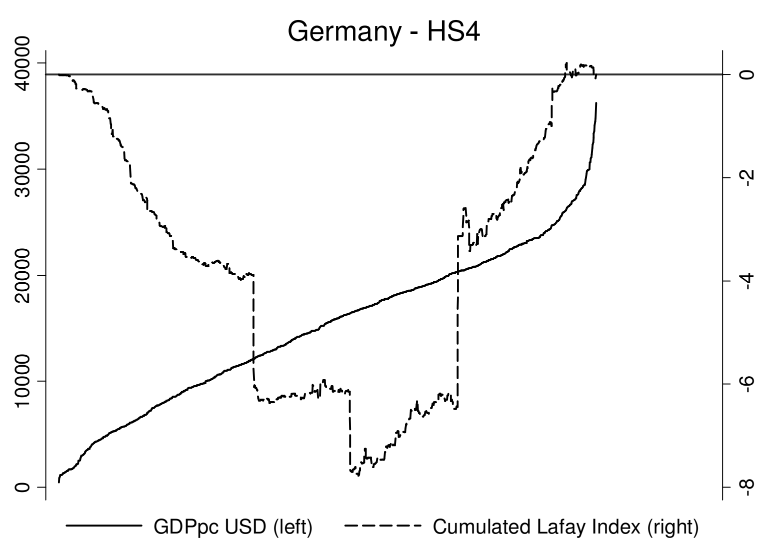


Figure 1c. ***PRODY* and Cumulated Lafay Index, HS 4 digits – India.**

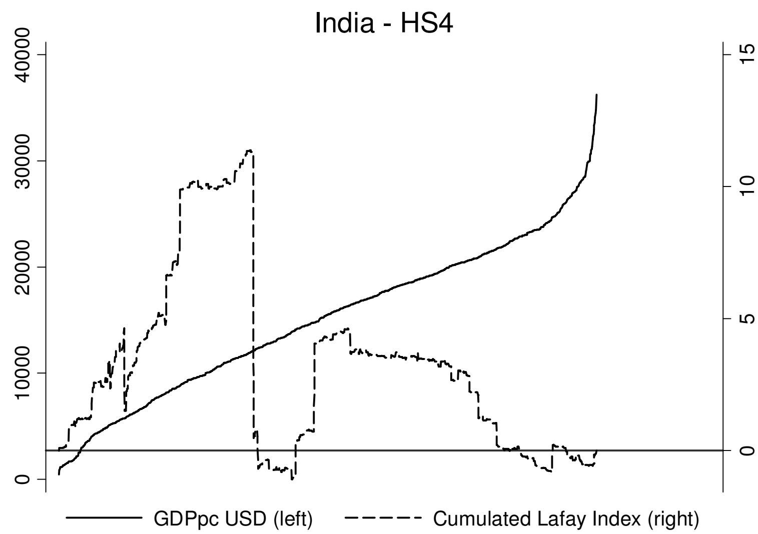


Figure 1d. ***PRODY* and Cumulated Lafay Index, HS 4 digits – Japan.**

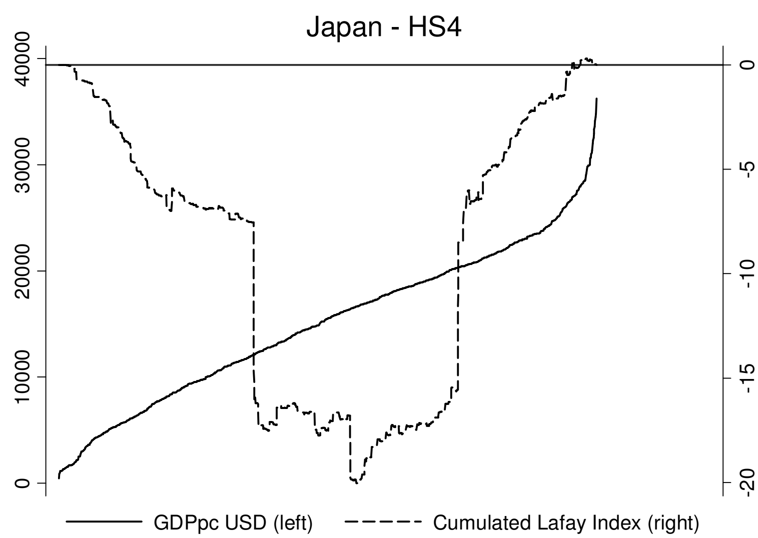


Figure 1e. ***PRODY* and Cumulated Lafay Index, HS 4 digits – USA.**

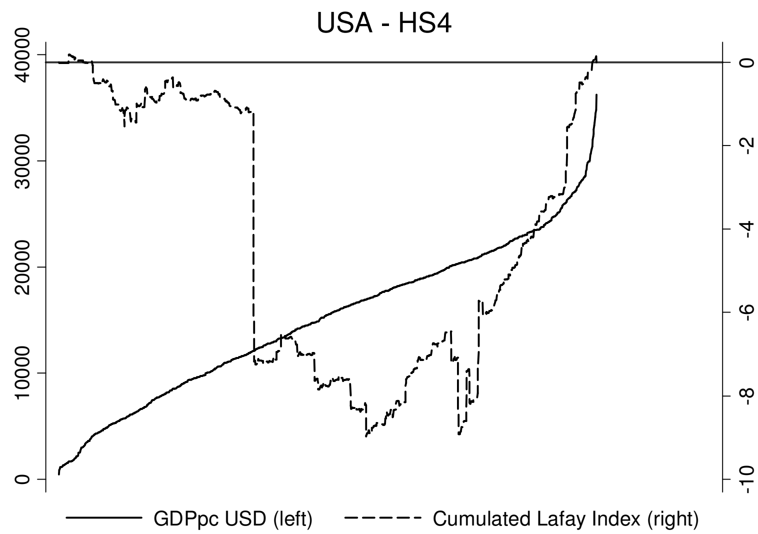


Figure 2a(i). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, Low Unit Values – China.**

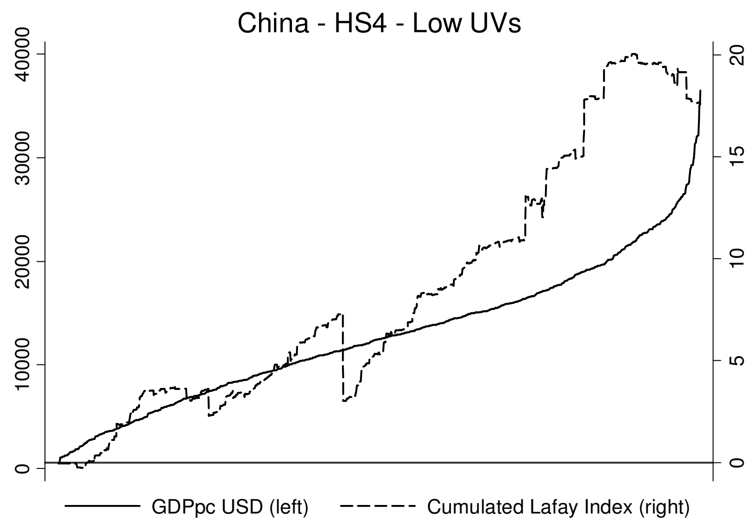


Figure 2a(ii). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, High Unit Values – China.**

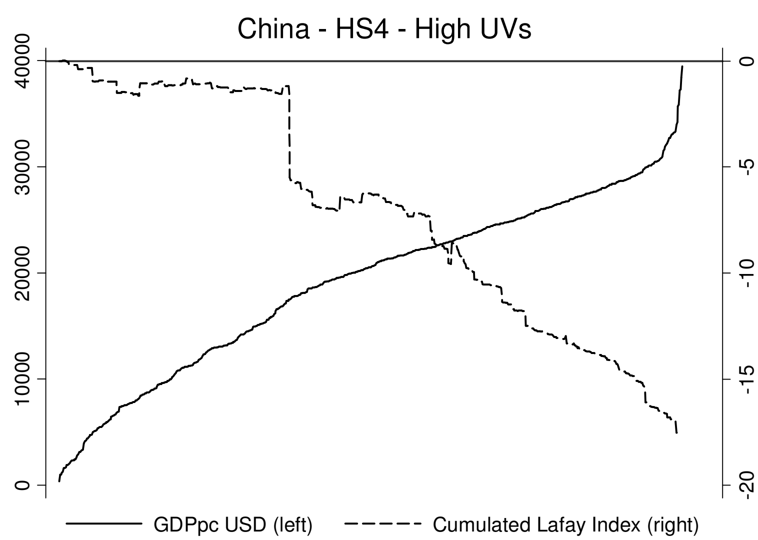


Figure 2b(i). *PRODY* and Cumulated Lafay Index, HS 4 digits, Low Unit Values – Germany.

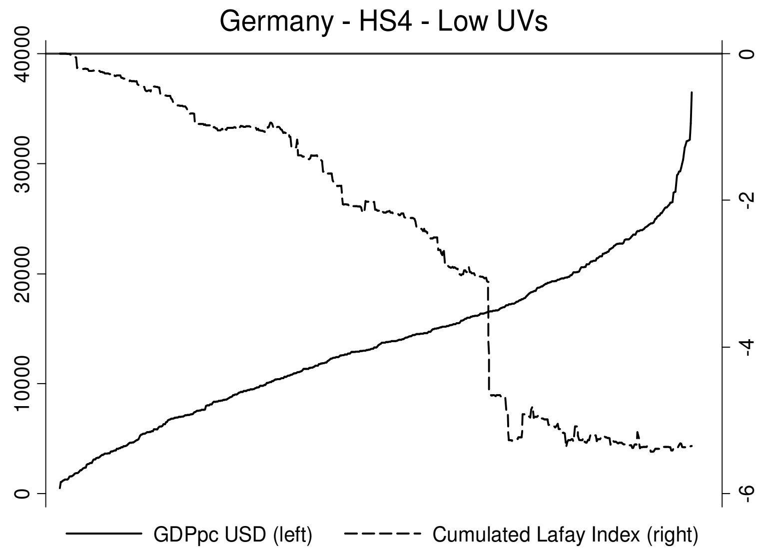


Figure 2b(ii). *PRODY* and Cumulated Lafay Index, HS 4 digits, High Unit Values – Germany.

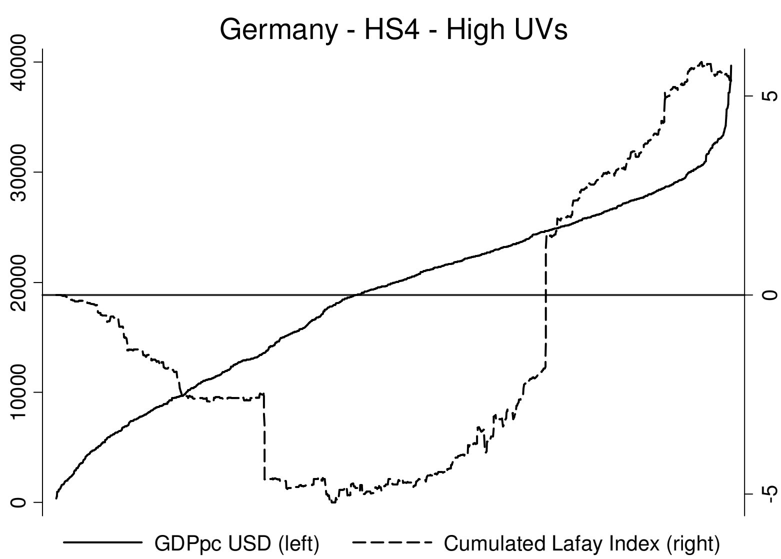


Figure 2c(i). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, Low Unit Values – India.**

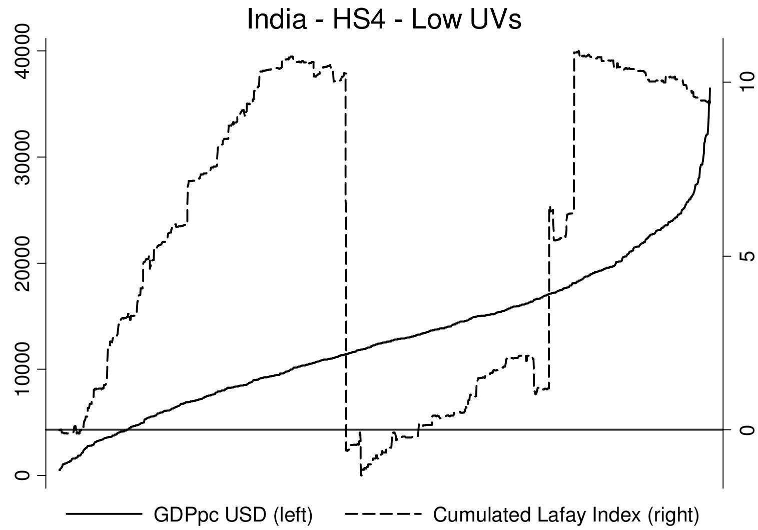


Figure 2c(ii). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, High Unit Values – India.**

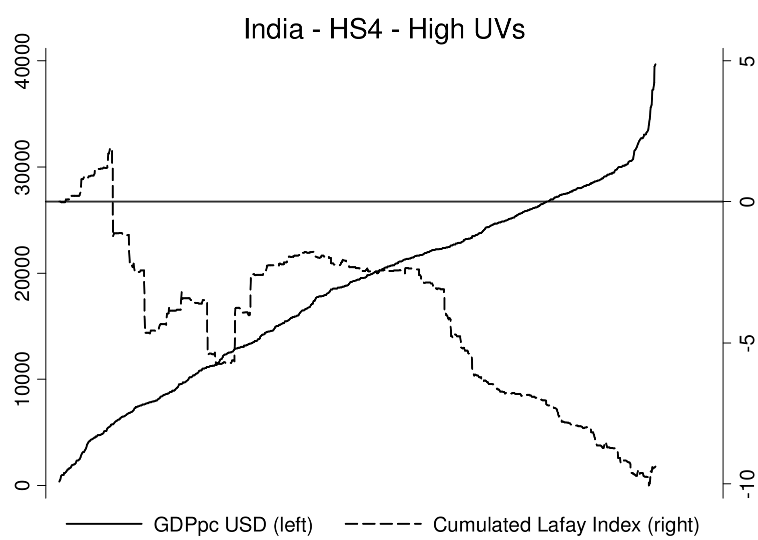


Figure 2d(i). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, Low Unit Values – Japan.**

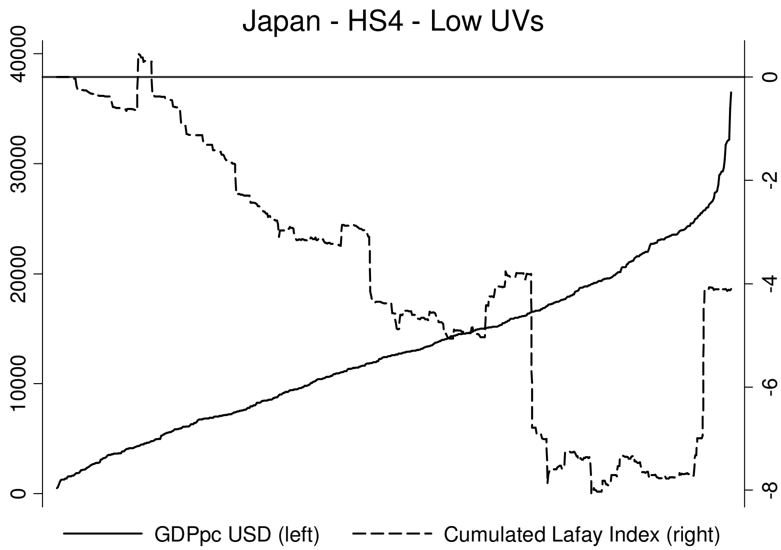


Figure 2d(ii). ***PRODY*** **and Cumulated Lafay Index, HS 4 digits, High Unit Values – Japan.**

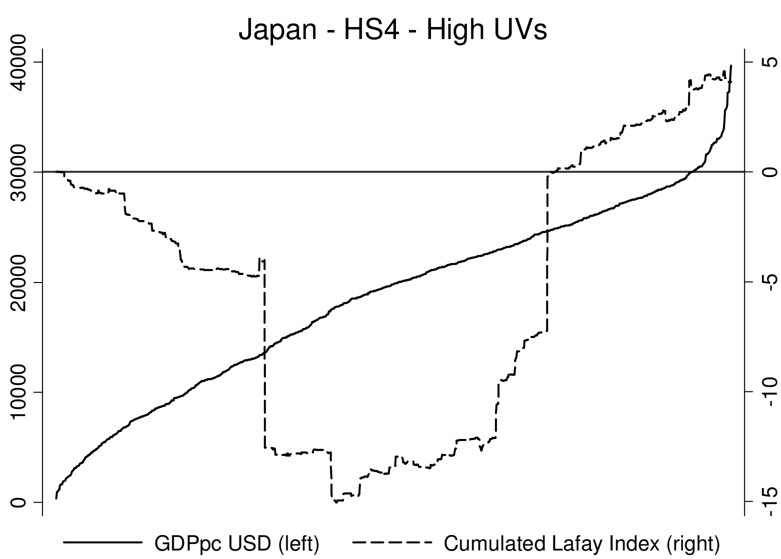


Figure 2e(i). *PRODY* and Cumulated Lafay Index, HS 4 digits, Low Unit Values – USA.

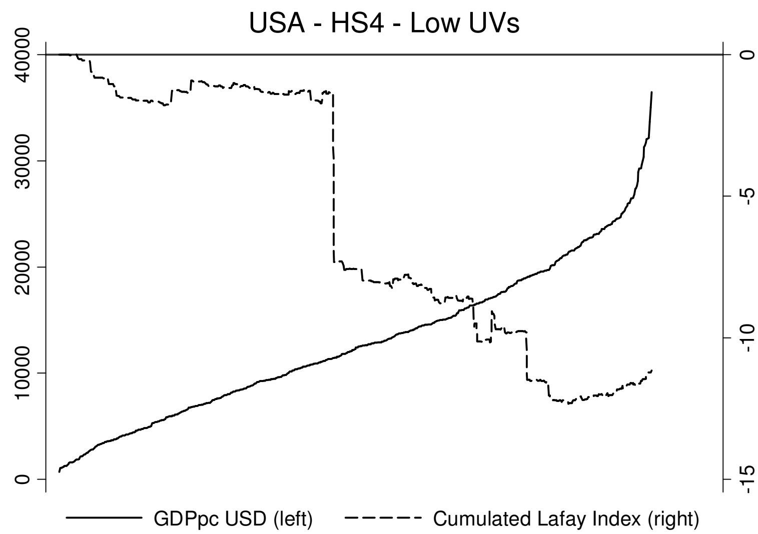


Figure 2e(ii). *PRODY* and Cumulated Lafay Index, HS 4 digits, High Unit Values – USA.

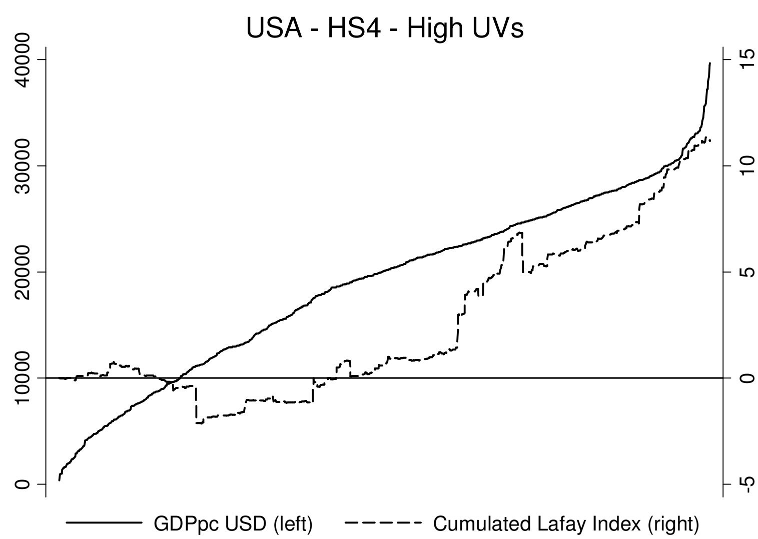


Figure 3a. The Product Space: Balassa index - China.

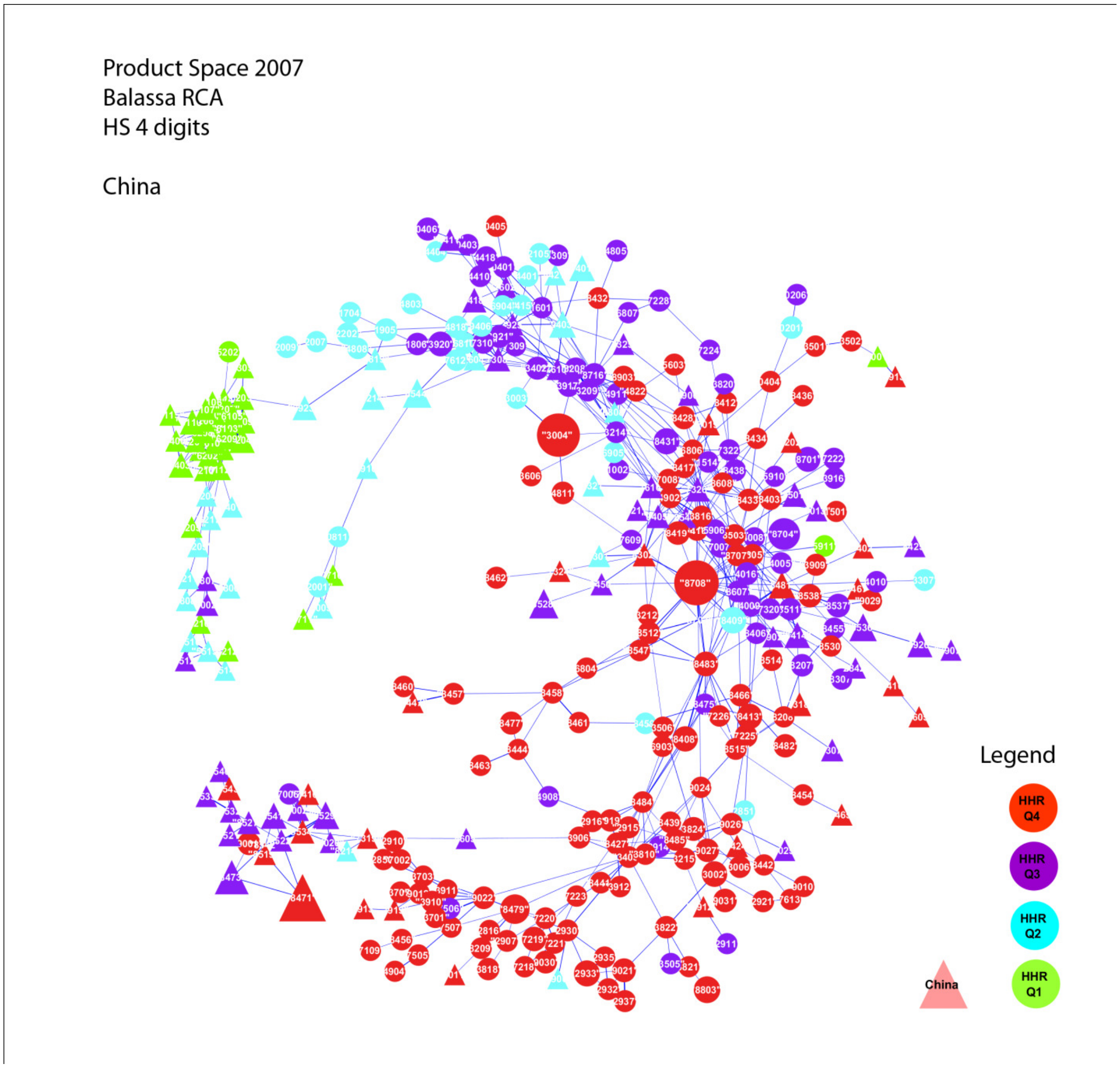


Figure 3b. The Product Space: Balassa index - Germany.

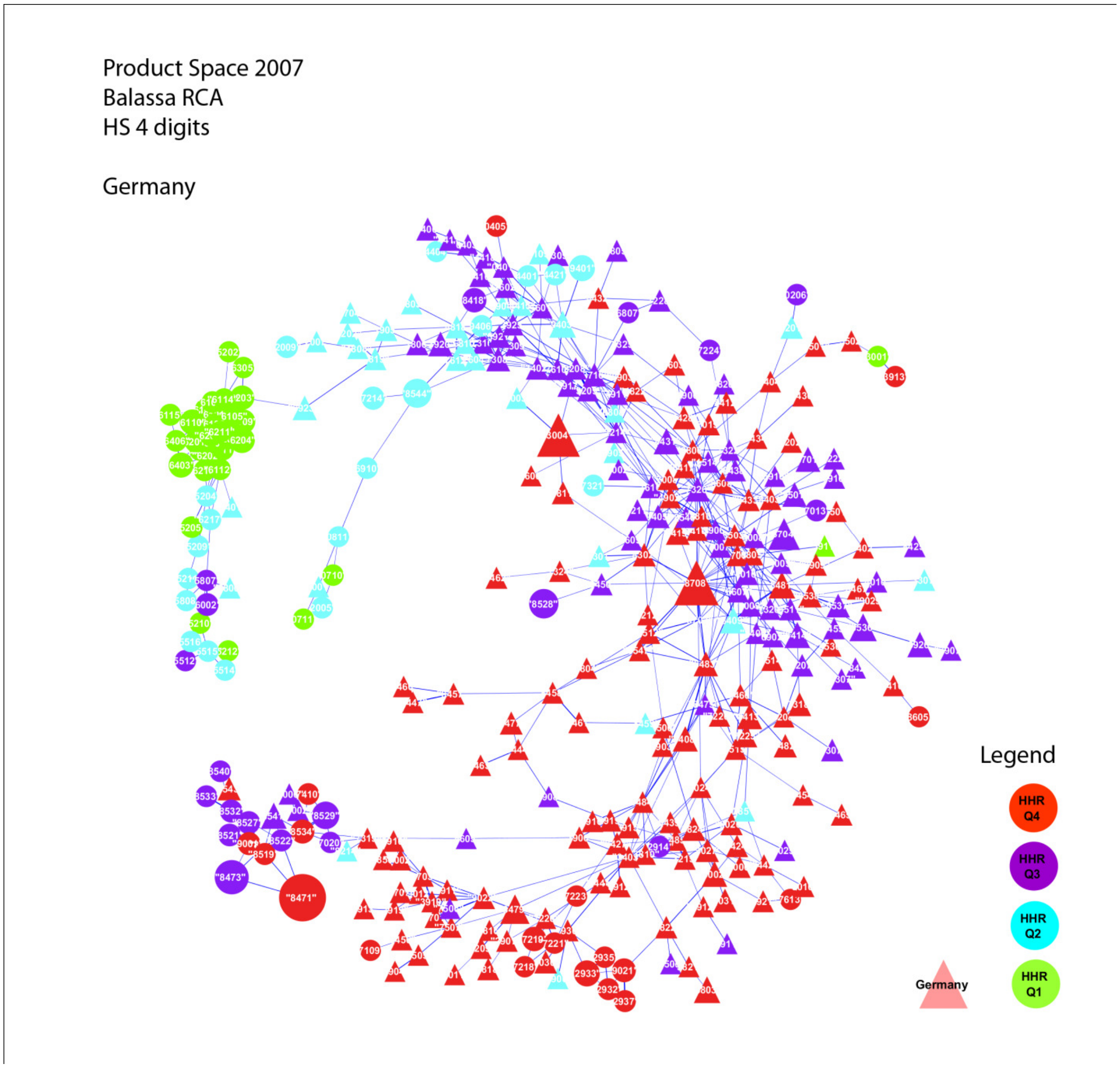


Figure 3c. The Product Space: Balassa index - India.

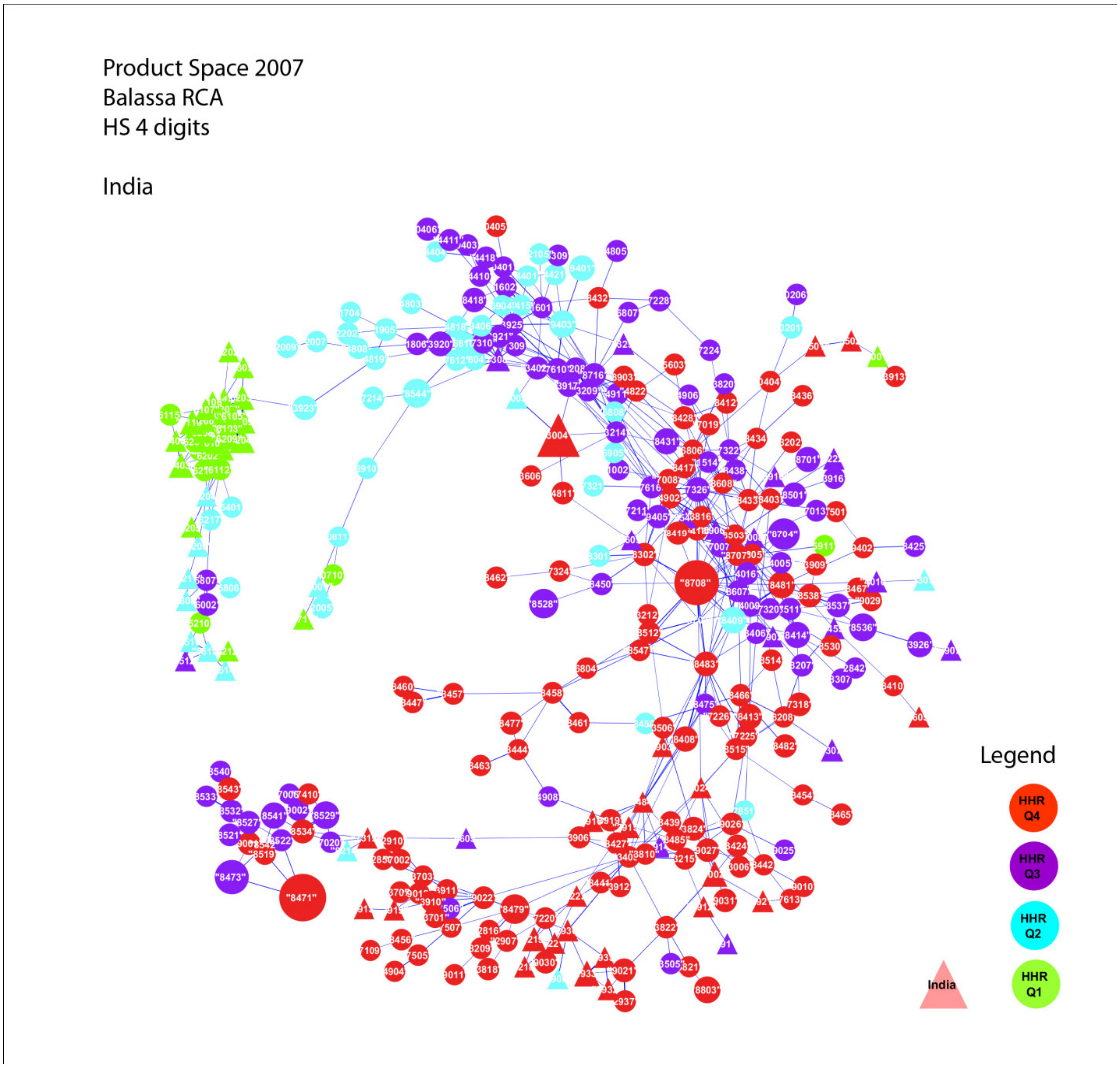


Figure 3d. The Product Space: Balassa index - Japan.

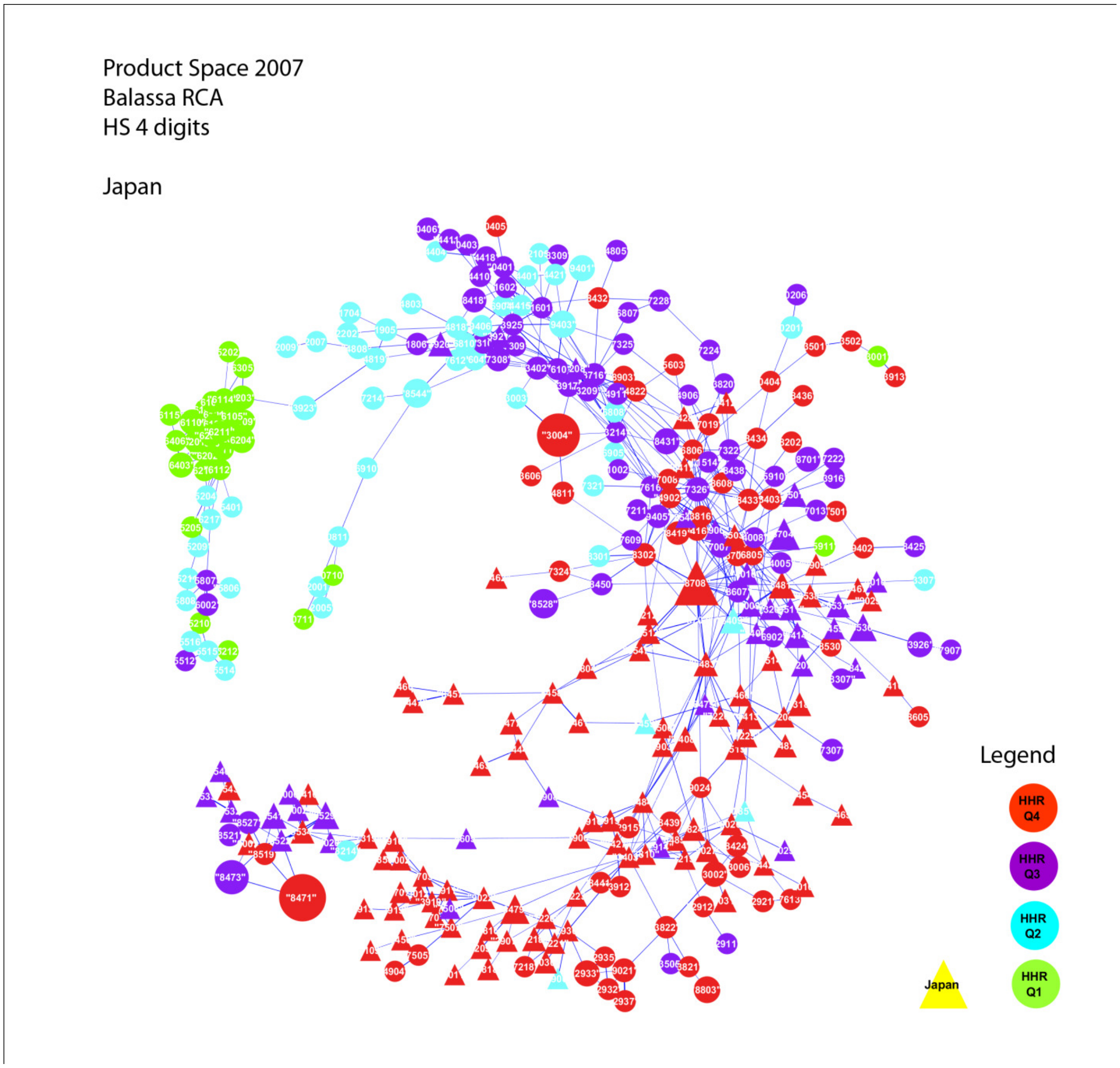


Figure 3e. The Product Space: Balassa index - USA.

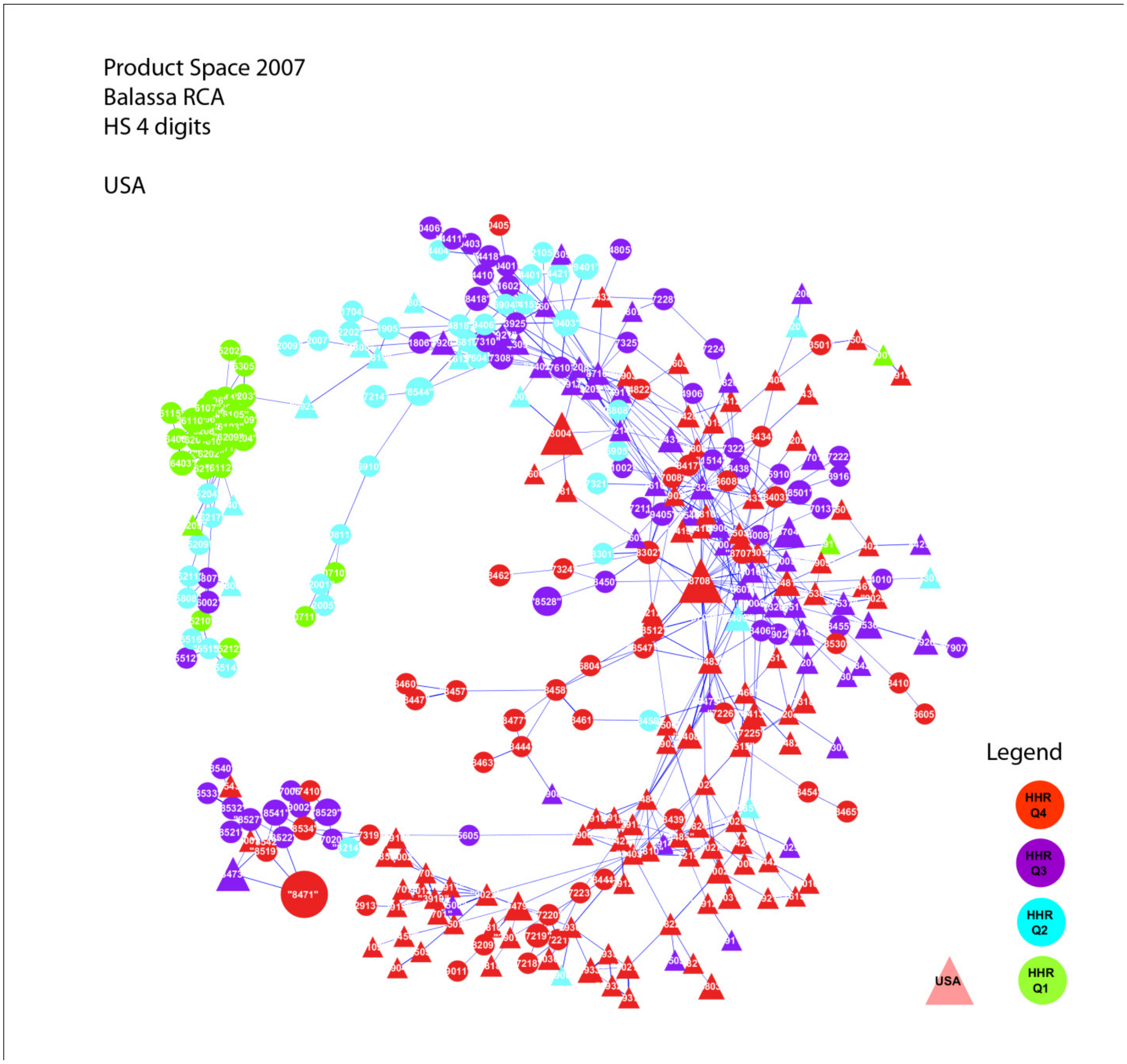


Figure 4a. The Product Space: Lafay index - China.

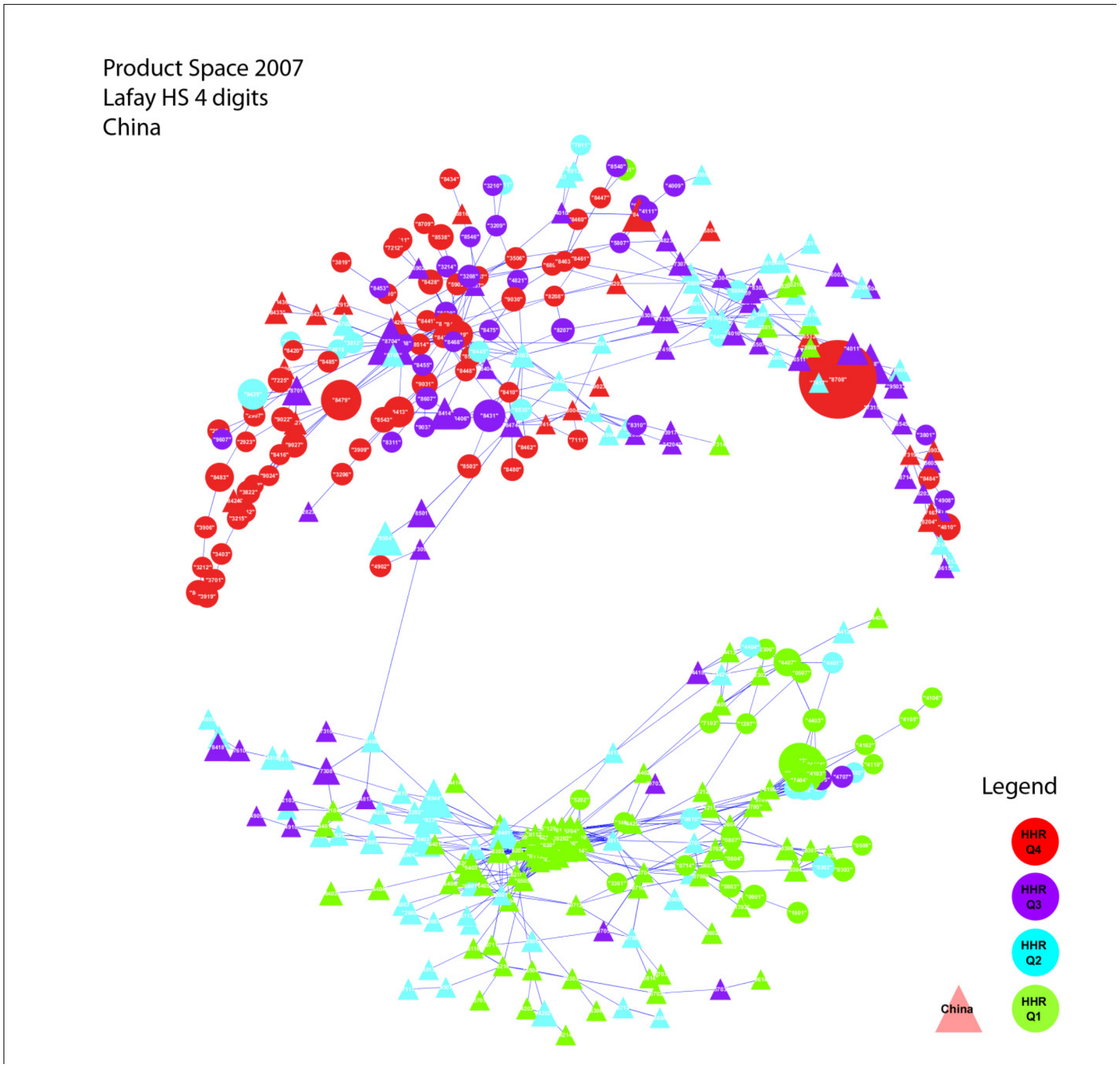


Figure 4b. The Product Space: Lafay index - Germany.

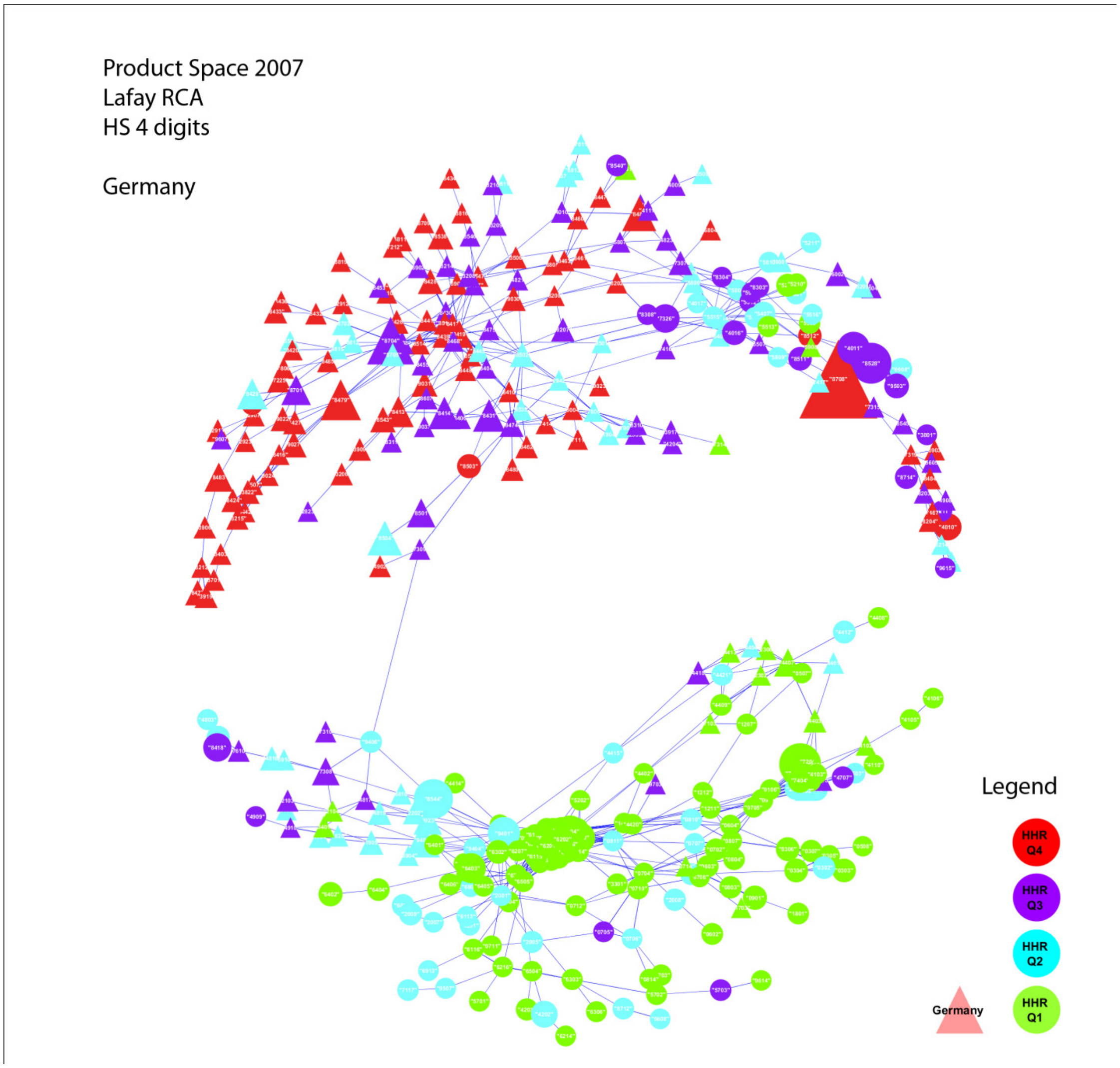


Figure 4c. The Product Space: Lafay index - India.

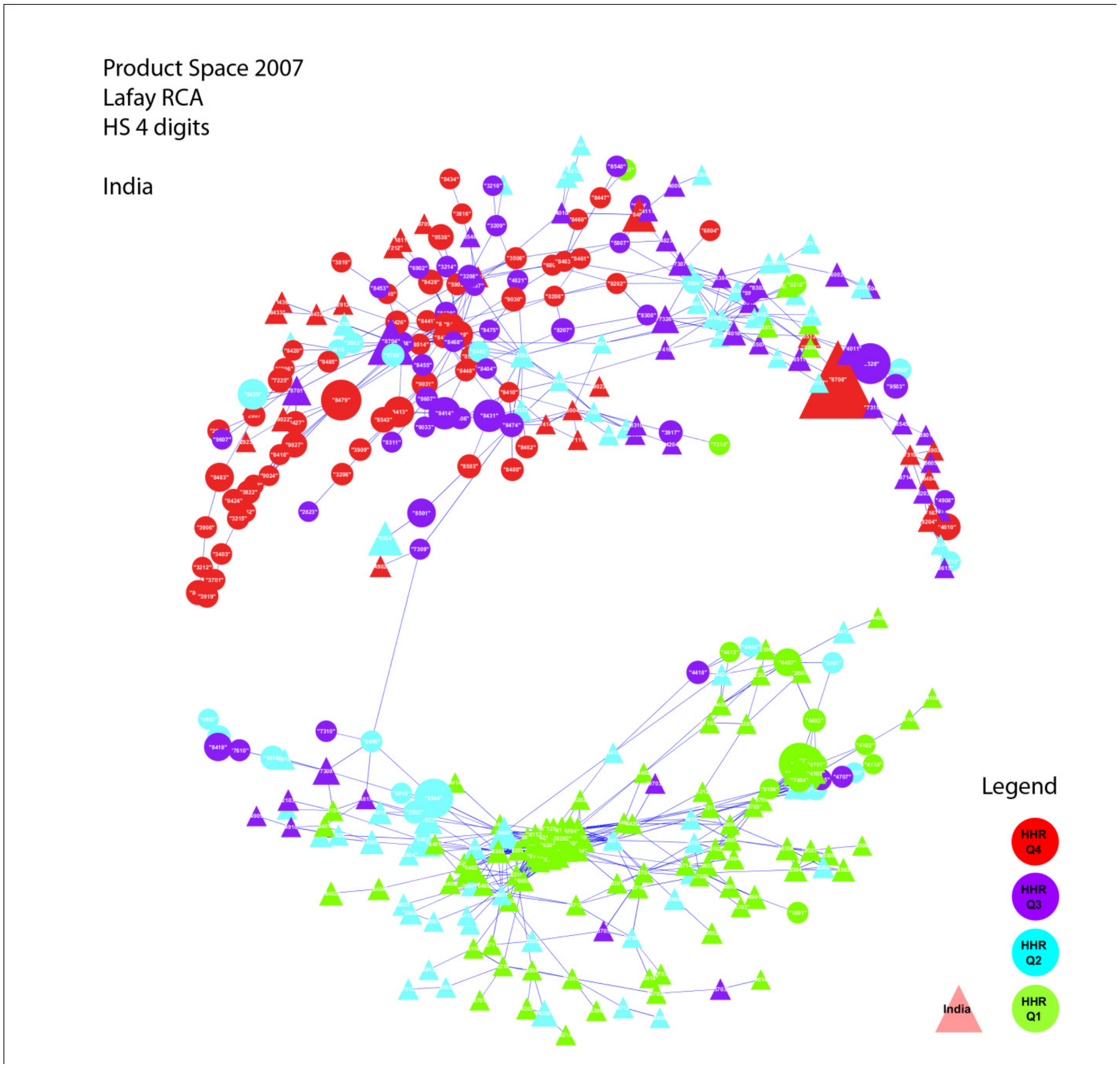


Figure 4d. The Product Space: Lafay index - Japan.

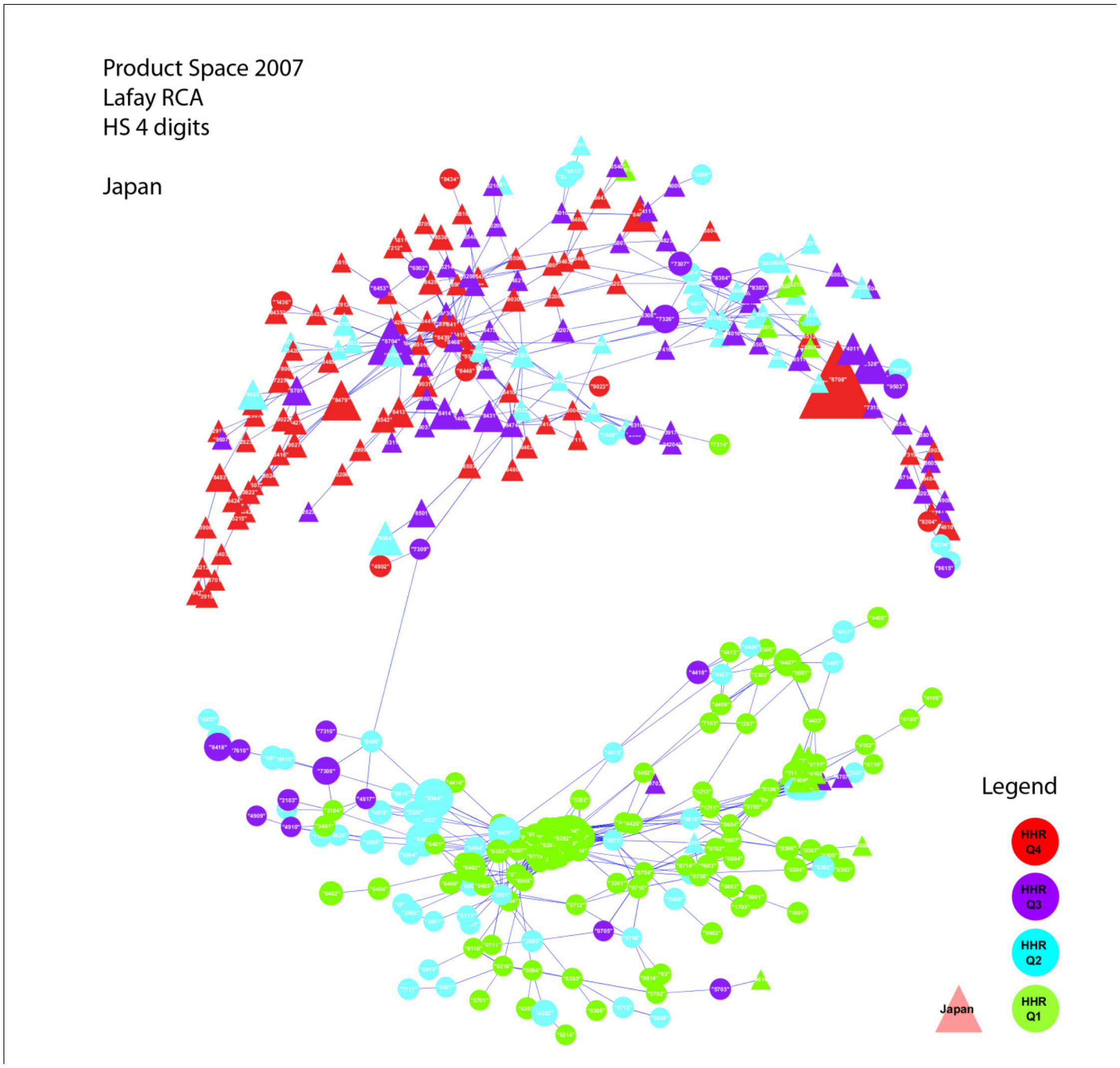
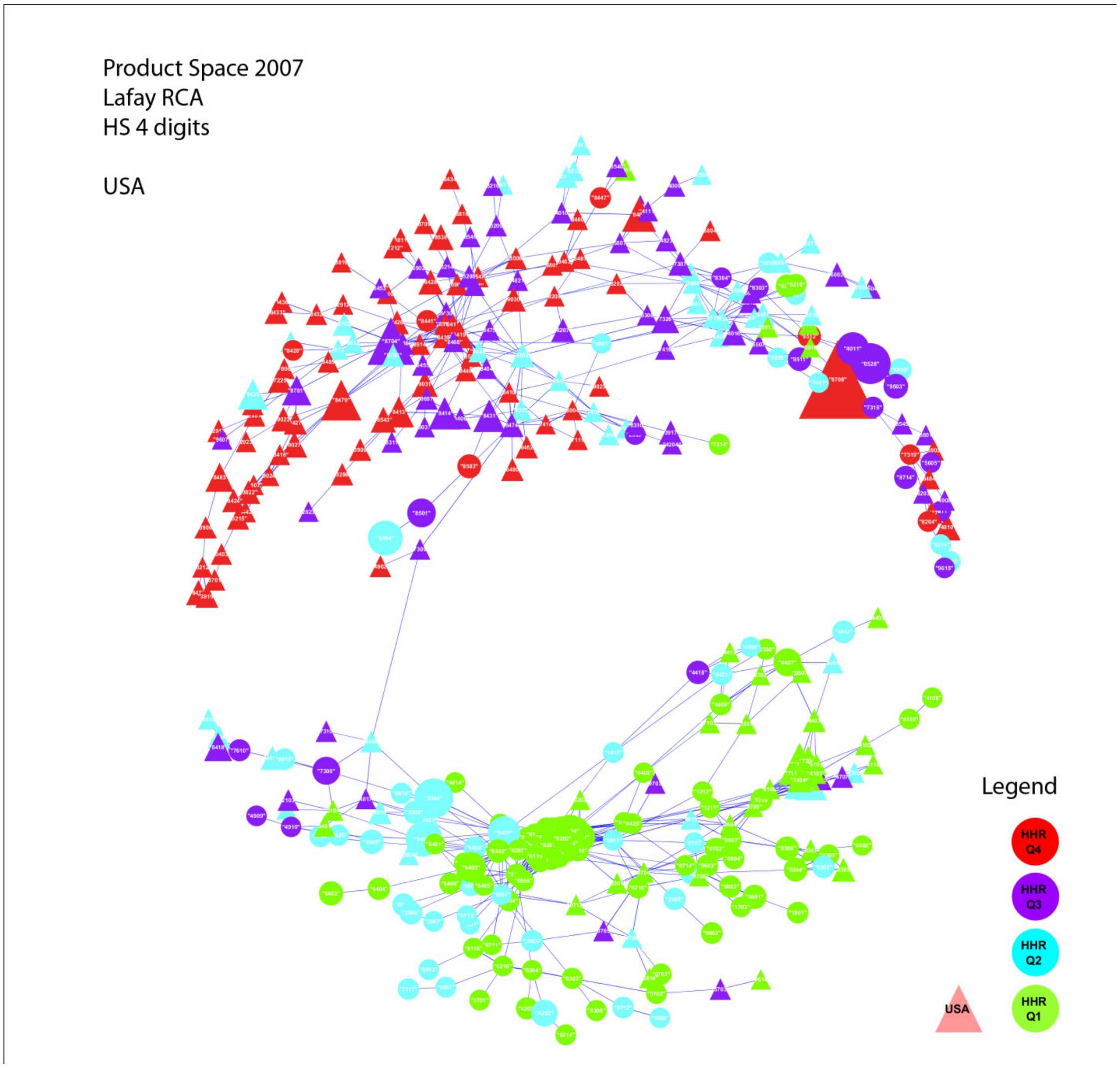


Figure 4e. The Product Space: Lafay index - USA.



References

Alessandrini, M., B. Fattouh, B. Ferrarini and P. Scaramozzino (2009), "Tariff Liberalization and Trade Specialization in India", Asian Development Bank, ADB Economics, Working Paper No. 177, November.

Athukorala, P.-C., and J. Menon (2010), "Global Production Sharing, Trade Patterns, and Determinants of Trade Flows in East Asia", Asian Development Bank, ADB Working Paper Series on Regional Economic Integration No. 41, January.

Balassa, B. (1986), "Comparative Advantage in Manufactured Goods: A Reappraisal", *Review of Economics and Statistics*, Vol. 68, No. 2, May, pp. 315-319.

Brülhart, M. (2008), "An Account of Global Intra-industry Trade, 1962-2006", GEP Leverhulme Centre, University of Nottingham, Research Paper 2008/08.

Bugamelli, M. (2001), "Il Modello di Specializzazione Internazionale dell'Area dell'Euro e dei Principali Paesi Europei: Omogeneità e Convergenza", Temi di Discussione 402, Banca d'Italia, Rome.

Fontagné, L., M. Freudenberg and G. Gaulier (2006), "A Systematic Decomposition of World Trade into Horizontal and Vertical IIT", *Review of World Economics*, Vol. 142, No. 3, pp. 459-475.

Gaulier, G., and S. Zignago (2010), "BACI: International Trade Database at the Product-level. The 1994-2007 Version", CEPII, Centre d'Etudes Prospectives et d'Informations Internationales", Working Paper No. 2010-23, October.

Greenaway, D., and C. R. Milner (2003), "What Have We Learned from a Generation's Research on Intra-Industry Trade?", GEP Leverhulme Centre, University of Nottingham, Research Paper 2003/44.

Greenaway, D., and J. Torstensson (1997), "Back to the Future: Taking Stock on Intra-Industry Trade", *Weltwirtschaftiches Archiv*, Vol. 133, No. 2, pp. 249-269.

Hausmann, R., J. Hwang and D. Rodrik (2007), "What You Export Matters", *Journal of Economic Growth*, Vol. 12, pp. 1-25.

Hausmann, R., and B. Klinger (2006), "Structural Transformation and Patterns of Comparative Advantage in the Product Space", Centre for International Development, Harvard University, Working Paper No. 128.

Hausmann, R., and B. Klinger (2007), "The Structure of the Product Space and the Evolution of Comparative Advantage", Centre for International Development, Harvard University, Working Paper No. 146.

Hidalgo, C. A. (2009), "The Dynamics of Economic Complexity and the Product Space over a 42 Year Period", Centre for International Development, Harvard University, Working Paper No. 189.

Hidalgo, C. A., and R. Hausmann (2009), “The Building Blocks of Economic Complexity”, *Proceedings of the National Academy of Sciences*, Vol. 106, No. 26, June 30, pp. 10570-10575.

Hidalgo, C. A., B. Klinger, A.-L. Barabási, and R. Hausmann (2007), “The Product Space Conditions the Development of Nations”, *Science*, Vol. 317, 27 July, pp. 482-487.

Hirschman, A. (1958), *The Strategy of Economic Development*, New Haven, Conn., Yale University Press.

Iapadre, P. L. (2001), “Measuring International Specialization”, *International Advances in Economic Research*, Vol. 7, No. 2, May.

Lafay, G. (1992), “The Measurement of Revealed Comparative Advantage”, in M. G. Dagenais and P. A. Muet (eds), *International Trade Modelling*, London, Chapman & Hall.

Schott, P. K. (2004), “Across-Product versus Within-Product Specialization in International Trade”, *Quarterly Journal of Economics*, Vol. 119, No. 2, May, pp. 647-678.

Shaked, A., and J. Sutton (1984), “Natural Oligopolies and International Trade”, in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford, Oxford University Press.

Shannon P., A. Markiel, O. Ozier, N.S. Baliga, J.T. Wang, D. Ramage, N. Amin, B. Schwikowski and T. Ideker (2003), “Cytoscape: A Software Environment for Integrated Models of Biomolecular Interaction Networks”, *Genome Research*, Vol. 13, No. 11, November, pp. 2498-2504.

Sutton, J. (1986), “Vertical Product Differentiation: Some Basic Themes”, *American Economic Review*, Vol. 76, No. 2, Papers and Proceedings, May, pp. 393-398.

Sutton, J. (2001), “Rich Trades, Scarce Capabilities: Industrial Development Re-visited”, Keynes Lecture, British Academy, 2000, Proceedings of the British Academy 2001.

Zaghini, A. (2005), “Evolution of Trade Patterns in the New EU Member States”, *Economics of Transition*, 13(4), 629-658.