Convergence or divergence from Comparative Advantage

A Comparison of China and the European Union

Bushra Riaz¹

Abstract:

We examine the comparative advantage convergence and divergence pattern between China and the European Union (EU) over the last two decades for a variety of sectors. Using seven measures of revealed comparative advantage for China and the EU we assess their validity in order to understand how China's rapid growth has changed its pattern of trade as well as that of the EU. Applying OLS Galtonian, Quantile and Robust regressions we check the convergence or divergence pattern. We find that China is gaining a lot by its comparative advantage in high technology sectors as well and there was a rapid change in its traditional comparative advantage. Furthermore, China is diverging towards high tech sectors. In contrast, there is no convergence or divergence in the trade specialization pattern of the EU and remains more or less stable.

Key words: Comparative advantage, Convergence

JEL Classification: F1, F10

1 Introduction

China's rapid growth and rise as the world's largest supplier of goods is one of the most notable changes to the global economy in the last three decades. There is a 500 percent increase in China's real exports over the last 2 decades. As a consequence, in 2013, China became the world's leading exporter of goods. In 2014, China export goods valued at total of 2,342,3 billion USD in the year. This essay decomposes the current pattern of its comparative advantage in comparison with the EU. China established its trade relations with European Union (EU) in 1975 and is currently the EU's top supplier of goods and its third largest export market (Deutsche bank research, 2014). Although China is a single fast growing developing country while the EU is a highly developed region that includes 28 individual countries, China has the largest gain in world market share. It is a country that is relatively scarce in capital, skill and land but still gaining significantly from its exports and comparative advantage. The main aim of this study is to compare the EU and China in terms of their revealed comparative advantage in order to get a clear picture of trade specialization and their tendencies towards

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their current comparative advantage. The motivation behind this study is to understand and to evaluate how China’s world market share is rapidly increasing and how it is affecting the EU’s export market and its current comparative advantage in different sectors. Most recently China has also shown a comparative advantage in capital intensive sector such as office machines and tele-communications versus its main trading partners. This technological upgrading has led to highly internationalized and competitive industries (including the electrical machinery domain) being capable to sell their exports to the developed economies. In this paper, we shall investigate the evolution of trade flows between China’s international trade partners, which has grown steadily since the utilization of the opening-up policy, both exports and imports rising greatly. China relies heavily on export-led increase; in particular, there has been a shift from resource-and labour-intensive to capital- and technology-intensive exports. We shall try to answer the following questions: Are China and the EU converging towards a more homogeneous international trade pattern? Is the EU losing its existing comparative advantage? To analyse the changes in comparative advantage, we will compare and analyse various indices of revealed comparative advantage for both regions. Moreover, we will apply beta convergence method to look at EU and China's convergence and divergence pattern.

As China becomes the world's largest export country, one would expect that EU will lose grounds in their traditional sectors and that it will converge to the revealed comparative advantage neutral point i.e. no revealed comparative advantage/disadvantage. It has been claimed that developed countries like the EU should be more despecialized relative to developing countries like China. This is an argument made by De Benedictis et al. (2009) who made an empirical analysis for 39 different countries over a period of 17 years and showed that on average, countries diversify and do not specialize. In our case, more diversification means that the EU loses its comparative advantage in a few sectors after a long experience of comparative advantage in traditional sectors, but it improves its trade position in other sectors like Pharmaceuticals, chemicals and automotive sectors. Some authors use the term despecialization instead of diversification (e.g. Worz (2005) and Ferto and Soos (2008)). In order to check for convergence or divergence, we use Galtonian regressions to compare the changes in the past and current comparative advantage. Hinloopen and Marrewijk (2004) and Sanidas and Shin (2011) also use Galtonian regression for comparative advantage analysis.

Since China is still the developing country in relation to the EU, we can ask whether China is trying to imitate the EU in terms of the goods it exports? The idea developed in this paper clarifies that what matters for China's long term sustainability is not only the volume of exports and its relation to its GDP, but its long term hold in its real comparative advantage, as the productivity level is much higher as compared to other similar countries. It is for this reason that China’s trade is regarded as challenging advanced countries (Rodrik, 2006). Schott (2008) also views China as special in its level of sophistication in exports.

In this essay we use various indices and choose the best among them, i.e. normalised revealed comparative advantage index, which is used in the most recent research papers like Yu et.al. (2009) and Sandias and Shin (2011). The previous literature has revealed that this rigorous comparison has not been considered so far. Still, there are some similar studies about
EU-China trade\(^2\) and China's exports enhancement and comparative advantage in labour and capital intensive goods\(^3\). Therefore, this study makes an effort to fill this gap in the literature by focusing on convergence and divergence pattern of comparative advantage. We will check and compare China and the EU's comparative advantage patterns more recently and how and where (in which sectors) they are similar or dissimilar with each other. 

Debate on China's export market share in the EU and other developed and developing countries has been rising in the recent decade. Some economists believe that the end of manufacturing has come in developed countries like those of the EU while others think this will only hold for low and middle-income countries (Schott, 2008). Therefore, this study is timely to check the structure of comparative advantage of China in comparison with the EU, and the magnitude with which these two economies compete with each other in the world export market for labour-intensive and capital-intensive goods. We use WTO trade data covering 11 different sectors in order to create various indices of RCA and analyse some quantitative methods, using Galtonian regressions, to make a comparative evaluation of China and the EU in terms of their trade patterns and export performance from 1990-2013 and 2000-2013 for China and EU, respectively.

The theory of comparative advantage is old but still relevant to compare a country's factor endowment structures and their trade patterns. However, the analytical approaches that measure the comparative advantage of countries over other countries engaged in the production and sale of commodities have changed, expanded and improved over time. The Ricardian theory finds that trade takes place where countries face differences in labour productivity while the Heckscher-Ohlin (H-O) theory is about the differences in factor endowments and intensities. In the new trade theory, the intra industry trade takes into account two main assumptions of imperfect competition and increasing returns to scale. As Krugman (1979) developed “a simple general equilibrium model of non-comparative advantage trade”, nevertheless he used that term in its traditional sense, which can be taken as a broader notion of comparative advantage (Sanidas, 2011). This notion can be found in the existing literature as 'internal returns to scale as a source of comparative advantage'(Tybout, 1993) and also as a 'Product differentiation as a source of comparative advantage' (Hummels and Levinsohn, 1993). Palley (2008) has also considered these conceptual differences.

The passage from comprehensive trade theories to measuring comparative advantage has always been difficult. The major breakthrough was made by Balassa's (1965) Revealed Comparative Advantage Index (BRCAI), which is still the most widely used index to analyse trade performance, although it has been criticised for its ordinal ranking and non-comparability across countries or sectors. Therefore, like Sanidas and Shin (2011), I calculated alternative indices to overcome the shortcomings of the Balassa Index. Similar to Ballance et al. (1987), Seyoum (2007) and Yeats (1985), Sanidas and Shin (2011) have systematically compared alternative indices and formulated a strategy to accurately use various indices which


\(^3\) Li et.al. (2006), Freytag (2008), Li (2009), He and Mu (2012),
will be applied in this paper as to make an analysis of comparative advantage between China and the EU.

The remainder of this paper is structured as follows: Section 2 provides a theoretical background of revealed comparative advantage and explains the various indices of revealed comparative advantage. Section 3 gives a brief review of the studies that have made comparisons of China and the EU. Section 4 provides information about nature and sources of data. Section 5 explains the methodology of our analysis. Major findings of the regression techniques are provided in Section 6. Section 7 concludes and discusses about future extensions.

2 Revealed Comparative advantage

The concept of comparative advantage is one of the few concepts in economics that is more than common sense. The beauty of this theory is that it illustrates how even a country having no absolute cost advantage in any sector can benefit from trade by specializing in industries at which it is 'least bad' (Lin and Chang, 2009).

Even having a strong theoretical concept of comparative advantage, problems arise when this concept is analysed empirically. Empirical researchers have been looking for measuring comparative advantage by using existing post-trade volume data, exports and imports, and is known as revealed comparative advantage. Balassa (1965) proposed an index which has been widely used to determine the revealed comparative advantage of a country's exports to the rest of the world or a reference country. The Balassa index suffers, though, from a weak theoretical foundation and empirical distribution. Due to its inconsistency and poor ordinal ranking property, numerous attempts have been made to overcome the deficiencies of the Balassa index; The Lafay index (1992), the symmetric revealed comparative advantage index (1998), the weighted revealed comparative advantage index (1998), the additive revealed comparative advantage index (2006) and the normalized revealed comparative advantage index (2009).

Changes in comparative advantage should reflect changes in factor endowment. Changes in comparative advantage can also be brought about in cases where the state played a key role in determining the social and economic conditions. Admitting that the RCA is not a perfect measure, as it fails to distinguish between a region's factor endowment and changes in trade policy, economists still believe that the RCA measure are still acceptable as the impact of changes in trade policies can be seen from movement of the RCA index. (Bender and Li, 2002)

In theory, comparative advantage depends on pre-trade relative prices of commodities which are unobservable in the real world. Analysts only have access to post-trade data. Although Liesner (1958) was the first to utilize an index of revealed comparative advantage, the most frequently used measure in this respect is the Balassa Index, after the refinement and popularization by Balassa (1965, 1989). It is broadly applied to establish a country's
efficient sectors and to explore the competency of the strong sectors of the economy. Therefore, the Revealed Comparative Advantage is measured by the relative value of a product in total exports of a country divided by the product’s relative value in total exports of the world.

In order to estimate revealed comparative advantage using indicators derived from real post-trade observations (see for example Kojima 1970; Yamazawa 1970; and a number of studies have employed the theory of comparative advantage. Given a group of reference countries the Balassa Index measures normalized export shares, where the normalization is with respect to the export share in the same industry in the group of reference countries, which can be written as:

\[ BRCAI_{c,j} = \frac{\frac{x_{cj}}{x_{ct}}}{\frac{x_{wj}}{x_{wt}}} \]  

(1)

here \( BRCAI_{c,j} \) is the Balassa revealed comparative advantage index for country \( c \) (China or EU) in sector \( j \), \( x_{cj} \) is the exports of country \( c \) in sector \( j \), and \( x_{ct} \) is the total exports of country \( c \) (China or EU), \( x_{wj} \) is the total world exports in sector \( j \) and \( x_{wt} \) is the total world exports.

If the \( BRCAI \) takes a value greater than 1, it indicates that the country has a comparative advantage in that sector. In contrast, if the index is less than one then it indicates that the country has a comparative disadvantage in that sector. Michael Porter (1990) defined Balassa Index above 1, in some cases strengthened to a Balassa Index exceeding 2, to identify a country’s strong sectors. Some other empirical examples which make use of the Balassa index are Ariovich (1979), Reza (1983), Yeats (1985), Peterson (1988), Crafts (1989), and Amiti (1999) and Fertö, Imre& Hubbard, L. J. (2003).

2.1 Proposed Alternative indices for Revealed Comparative Advantage

Due to some shortcomings like the variable mean of the Balassa index, some alternative methods were proposed to control the original index around a stable mean which have some symmetric distributions. Some authors took the logarithm value, while others computed the index in a different way. The first indicator of a sector’s contribution to the trade balance, proposed by Lafay (1992) to check the comparative advantage, is presented:

\[ LRCAI_{c,j} = 100 \left[ \frac{X_j - M_j}{X_j + M_j} - \frac{\sum_{j=1}^{N} N \left( X_j - M_j \right)}{\sum_{j=1}^{N} N \left( X_j + M_j \right)} \right] \frac{X_j + M_j}{\sum_{j=1}^{N} N \left( X_j + M_j \right)} \]  

(2)

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where again c represents the country and j the sector. X and M are exports and imports towards and from the rest of the world, respectively N is the total number of sectors. According to the Lafay index, positive values indicate the existence of comparative advantage in a specific sector; higher values point to a higher degree of specialisation. On the contrary, negative values indicate comparative disadvantage.

Fagerberg (1995) proposed the symmetry revealed comparative advantage index (SRCAI) by using a small number to modify the BRCAI.

$$SRCAI_{c,j} = \frac{RCA_{cj} - 1}{RCA_{cj} + 1}$$ (3)

This is an estimation of a log transformation of the Balassa revealed comparative advantage index (Benedictis and Tamberi 2001) which ranges from -1 to +1 where 0 appears when a country is at comparative advantage neutral point.

Proudman and Redding (1998) calculated the sectoral average share of a country with world exports taking as denominator, which is known as weighted revealed comparative advantage index (WRCAI).

$$WRCAI_{c,j} = \frac{BRCAI_{cj}}{\frac{1}{N} \sum_{j=1}^{N} BI_{cj}}$$ (4)

where N is the number of sectors or commodities. This does not correct the uneven distribution of the BRCAI index and is still not suitable for dynamic analysis. Furthermore, this transformation makes the comparative advantage neutral point sensitive to the classification of sectors (Benedictis and Tamberi 2001).

Hoen and Oosterhaven (2006) proposed an additive form of Balassa revealed comparative advantage index, indicating the problem in the multiplicative form of BRCAI and suggested a formula to overcome the previous problem, which is Additive revealed comparative advantage or Additive index (AI).

$$ARCAI_{c,j} = \frac{X_{cj}}{X_c} - \frac{X_{wj}}{X_w}$$ (5)

In this index, the values fall between -1 and +1 and zero stands as the comparative advantage neutral point. This index has many advantages in cross-sector analysis but not in the case of cross country comparison. Moreover, there is no stable cardinal value for a country where it has no specialization in a sector or not fully specialised in that sector, which should technically be at the lower and upper bounds of the index, respectively.
With regard to the instability of additive index (AI), Yu et al. (2009) developed a similar index and normalised the term with total world exports. That is;

\[
NRCAI_{c,j} = \frac{\Delta X_{c,j}}{X_w} = \frac{X_{c,j}}{X_w} - \frac{X_{c}X_{w,j}}{X_wX_w}
\]

(6)

The above index ranges from -0.25 to 0.25, zero being the comparative advantage neutral point. The NRCAI is symmetrical and also follows a normal distribution. Though the above indices overcome the shortcomings of Balassa revealed comparative advantage index however only the NRCAI gives the correct results, hence we will use the NRCAI in our further analysis.

### 2.2 Revealed Comparative Advantage: The normalised verses Balassa Index

As stated earlier, the revealed comparative advantage indices have some pros and cons; however, the statistical properties are checked to develop a strong representation of positive features as a revealed comparative advantage index. Firstly, we check the corresponding residuals by some normality assumption by applying Shapiro-Wilk, Anderson-Darling and Kolmogorov-Smirnov tests. The following table present the properties of Balassa and Normalised index:

<table>
<thead>
<tr>
<th></th>
<th>Comparative Advantage Neutral Point</th>
<th>Sum Over Sectors</th>
<th>Sum Over Countries</th>
<th>Symmetry</th>
<th>Normality</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRCAI</td>
<td>1</td>
<td>Not constant</td>
<td>Not constant</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>NRCAI</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

### 3. Background

Export share and trade performance of China is highly argued in the literature, because the China's export performance is better than the rest of the world after the financial crisis and especially from 2008-2010. In 2009, China became the leading global exporter and in 2010 passed Japan as the second largest economy in the world. In China, labour intensive industries benefited from its accession to WTO. Capital intensive industries particularly, iron and steel benefitted from government subsidies (Berger and Martin 2013).

The success of China’s transformation from low to middle income country will be of crucial importance for China to avoid the middle-income trap and sustain its long term economic growth (Wu, 2013.) To cope with world challenges as well to maintain country's stable growth China also needs to strengthen its technology market (Fu and

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MU, 2014). The country is being forced towards a more skill intensive and technology intensive growth path, with the amount of surplus unskilled labour in China falling. They further argued that China should continue to increase its investment in R&D and in education.

The main concern in this essay is to check where China compete with highly developed zone i.e. EU and where do EU stands, as the developed economies like EU compete with China by raising the quality of their exports (Schott, 2008). Emerging countries have been endearing huge market shares over the last twenty years and China stands out with the most astonishing performance: it has almost tripled its market share since 1995 (Zignago, 2014). After 1999, the imports of China have substituted imports from other emerging countries (Freytag, 2008), and recently China became the world's biggest merchandise trader in 2013, with total exports and imports of US$ 4,159 billion and a trade surplus of US$ 259 billion, 2.8 per cent of its GDP. However, most EU countries faced declines in their merchandise exports in 2012 due to structural glitches in the euro zone. (WTO, trade statistics 2013)

China is popular as a labour abundant country but gaining a lot of competition from its medium and high technology goods as well. High technology products play a vital role while comparing international competition among different economies. This theory was pioneered by Leamer (1987) who defined that what countries export does matter. This idea was further developed by Hausmann et al. (2007) who explained income level of a country's exports as another determinant of economic growth. (Zignago, 2014). The economic relations between China and the EU grew close and both gained benefits from the stable relations (Huaqun, 2004). However, the EU has lost -0.27 p.p. of market share in high technology goods, whiles, China has gained massively in high technology market (18.9 p.p.), due to a huge transfer of the assembly of these goods to China.

Hinloopen and Marrewijk (2004) analyzed the dynamics of revealed comparative advantage for Hong Kong, Taiwan and China. They also used Galtonian regression in their analysis and concluded that Hong Kong and Taiwan are more specialized in their exports as compared to China. Lall and Albaladejo (2004), argue that Chinese exports has upgraded in the technological content from 1990 to 2000, and due to its increasing share in high-tech good’s exports it is moving rapidly towards high technology goods. Batra and Khan (2005) made an attempt to check the pattern of revealed comparative advantage of China and India. They further checked the trade similarities and differences of these two economies by calculating at the sector and commodity level of the Harmonised System of classification. The results showed that India and China both enjoy comparative advantage in labour and resource intensive goods in the world market.

Harrigan and Deng (2008) made an argument about China’s local comparative advantage which is influenced by labour intensive commodities and by geography as well. They concluded that China has Comparative advantage in heavy goods but only in nearby markets and for distant markets it has comparative advantage in lighter goods. Amiti and Freund (2008) analyse that between 1992 and 2005 the export growth of China showed a
transition from low tech goods (agricultural products) into medium tech good (machinery and transport equipment). This shift is mainly associated with increasing skill which is driven by processing exports making up a large share in exports of manufacturing sector. According to Dettmer et.al. (2009), China is specialising in technology intensive goods and focuses on mobile type technology goods while EU's comparative advantage sustains in immobile technology intensive goods. Tuan et.al (2016) argue that after China’s trade openness (1978-1988) most of its exports growth occurred in the extensive margin (new variety products), whereas, after 1989 it switched towards the intensive margin (existing variety products). They find significant evidence and confirmed that from 1978 to 2008 the intensive margin is the vital factor in the growth of China’s exports.

Additionally, in order to compare the comparative advantage convergence and divergence pattern between China and the EU, our analysis will be deepened by applying the Galtonian regression and the error correction techniques in eight different sectors.

4 Data

We use annual data comprising ten major sectors for China and EU from 2000-2012. The 260 observations are derived from the WTO statistics. The sectors are Manufacturing, Chemicals. Although, it is obvious that China has comparative advantage in Clothing and Textiles, but to check the trend this sector is considered as well. Furthermore, Clothing and Textiles is among one of the most dynamic exports in the world. If we classify the sectors considered in this paper by technological intensity, we will get the following categorization.

Table 1: Sector ordering by Technological Intensity

<table>
<thead>
<tr>
<th>High-technology sectors</th>
<th>Pharmaceuticals, Office, accounting and computing machinery, Electronics and communications equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium-high-technology Sectors</td>
<td>Electrical machinery, Auto-motive, Chemicals excluding pharmaceuticals, Machinery and equipment</td>
</tr>
<tr>
<td>Low-technology industries</td>
<td>Textiles, textile products,</td>
</tr>
</tbody>
</table>

Source: Based on the World Bank Database

7 Pharmaceuticals, office and telecom equipment, machinery and transport equipment, electronic data and office equipment, integrated circuits and electronic components, automotive products, clothing and textiles.
Table 2: Share in World Trade in Goods and Services (%)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
| China   | 8.1  | 8.7  | 9.3  | 9.4  | 10.2 | 11.1 | 11.4 | 11.9 | 12.6
| USA     | 16.9 | 16.4 | 15.5 | 14.4 | 14.6 | 14.1 | 13.5 | 13.6 | 13.5
| EU-28   | 19.0 | 18.7 | 19.0 | 18.7 | 18.7 | 17.3 | 17.1 | 16.3 | 16.4

Source: Eurostat, WTO Taken from European Commission Directorate General for trade

(e) Estimated, (p) Preliminary data (for services)

In Table 2, one can easily distinguish the fact that China's world trade share growing rapidly at an increasing rate from 8.1% to 12.6% for the time period 2004 to 2013, whereas, For EU and the United states it is declining from 19.0% to 16.4% and from 16.9% to 13.5% respectively. Moreover, if one compare the global exports of goods with China and the EU it shows that China is trying to be the world's largest exporter and its exports of goods increasing rapidly whereas, EU exports in goods increasing almost at a constant rate.

After accession to the WTO (11 December, 2001), china’s pattern of trade improving and export volume index rapidly increasing and reaches at world’s highest level i.e. 643.178 in 2013. Interestingly, the pattern of exports and the comparative advantage changing overtime in all cases especially in integrated circuits. Although, China has comparative disadvantage in automotive sector but still its exports are increasing over the time from 2000 to 2012. According to the EU-China trade data, another interesting fact is China’s increasing volume of exports in all sectors except Pharmaceuticals. Meanwhile, European Union follows different trend, with a slight decreasing trend in all sectors except chemicals. In the automotive sector, the percentage remains approximately constant (from 11.7% in 2000 to 10.6% in 2012).

According to the normalised index, the highest degree of comparative advantage is listed in manufactures which also has great contribution in China's overall economic growth, in addition it has the highest percentage in the total exports (88% in 2000 and 93% in 2012). More interestingly, the EU's comparative advantage at highest degree is also in manufactures and its percentage is highest in terms of total exports percentage (82% in 2000 and 75% in 2012). The only difference is the rate of change; the China's manufacturing exports are increasing whiles the EU's manufacturing exports are declining. China's exports are increasing in all sectors except pharmaceuticals. Whereas, the EU's exports are declining except in the sectors of chemicals and pharmaceuticals. In order to reach a clear conclusion, it is essential

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8 Export Volume index (2000= 100) is derived from UNCTAD’s volume index series and is the ratio of the export value index to the corresponding unit value index, World Bank, statistics.
to make a clear comparison of comparative advantage between China and EU on each type of sectors. In order to show the comparison, we will discuss the results of normalized revealed comparative advantage index only.

5 Methodology

Investigating structural changes in Comparative advantage

Hart and Praise (1956) pioneered the idea of using revealed comparative advantage indices in econometric analysis by introducing the Galtonian regression. This method created by Galton (1889), has been applied in different areas of research like Cantwell (1989) used it to examine technological specialization patterns. We employ the following Galtonian regression:

\[ \text{RCAI}_{c,j}^{t_2} = \alpha_c + \beta_c \text{RCAI}_{c,j}^{t_1} + \epsilon_{c,j} \] (7)

In the above equation, first two time periods are selected as an i.e. \( t_2 \) and \( t_1 \) which is for 2000-2002 and 2010-2012 respectively; \( \alpha_c \) and \( \beta_c \) are standard regression coefficients and \( \epsilon_{c,j} \) is the error term. At first, we will check the corresponding residuals by some normality assumption by applying Shapiro-Wilk, Anderson-Darling and Kolmogorov-Smirnov tests. It is noteworthy that in this case, the normalised index calculation follows a normal distribution also it is assumed that the corresponding regression is linear, and the error term is normally distributed and is independent of \( t_2 \) and \( t_1 \).

The basic idea of Galtonian regression is to check the similarity and dissimilarity in the distribution of revealed comparative advantage at different points of time are relative to each other. Furthermore, it also looks at the patterns of stability, convergence or divergence in its trade specialization. Hart (1995) applied the ratios of variances in two different point of time to calculate the convergence in labour productivity i.e.

\[ \frac{\sigma_{c,t_2}^2}{\sigma_{c,t_1}^2} = \frac{\beta^2}{R^2} \] (8)

Where \( \beta^2 \) and \( R^2 \) are the coefficients of regression and coefficients of determination correspondingly.

\( \beta > 1 \), shows the trade specialization divergence given that the \( R^2 \) does not go above 1.

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9 See the graphs in Appendix 2.
10 He examined the heights of fathers and sons to analyse the size-wise business concentration.
12 For the results see Appendix 3A.
which means the pattern of trade specialization is becoming strong since the sectors with traditional comparative advantage will become more advantaged in the future and vice versa for the sectors having comparative disadvantage (which is known as $\beta$-specialization (Dalum et al. 1998). Moreover, $\beta < 1$ does not certainly suggest convergence. The convergence occurs when $\beta < R^2 < 1$, here the trade specialization pattern can be reflected to be declining, which states that the products with initial comparative disadvantage make their position better, whereas those with initial comparative advantage lose their position. In the condition where $\beta = R^2$, it could be the case where there is no divergence or convergence, so the pattern of trade specialization remains stable. First we carry out the Galtonian regression analysis. Then we apply some normality tests on the corresponding residuals such as Shapiro Anderson-Darling and Kolmogorov-Smirnov tests.

6 Econometric Analysis of Revealed Comparative Advantage:

6.1 OLS Galtonian Regression

In this section, we try to prove the arguments made in the paper about China and EU comparative advantage empirically. The Galtonian regression indicates the convergence and divergence pattern of a country. However, this is an ordinary regression with respect to two cross sections and two time periods.

$$RCAI_{c,j}^{t2} = \alpha_c + \beta_cRCAI_{c,j}^{t1} + \epsilon_{c,j}$$  \hspace{1cm} (9)

where error terms are normally distributed.

To check the authenticity of the indices we first examine whether the normality assumption is met or not\(^{13}\). We use the average data over 2000-2003 for $t^1$ and the average over 2010-2012 for $t^2$. We also plot the influence statistics, histograms and scatter plots for the normalised index and Balassa Index and find that the distribution of the Balassa index is extremely rightly skewed hence far from symmetrical distribution. In case of normalised index, the distribution is normal and histogram is bell shaped and the influence statistics gives us good results (without the outliers) for normalised index. We consider the R Student, Hat matrix, DFFITS and COVRATIO results for the influence statistics.

The following table gives us the Galtonian regression results.

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\(^{13}\) As our sample size is less than 30, so is necessary to check the normality assumption. we will state the results of normality issue only for the normalized revealed comparative advantage index.
Table 3 Results of Regressions for China and the EU

<table>
<thead>
<tr>
<th></th>
<th>China, EU</th>
<th>R²</th>
<th>/R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS Galtonian</td>
<td>2,03</td>
<td>0,86</td>
</tr>
<tr>
<td>China</td>
<td>Robust</td>
<td>1,87</td>
<td>0,63</td>
</tr>
<tr>
<td></td>
<td>Quantile</td>
<td>1,86</td>
<td>0,64</td>
</tr>
<tr>
<td></td>
<td>OLS Galtonian</td>
<td>1,02</td>
<td>0,99</td>
</tr>
<tr>
<td>EU</td>
<td>Robust</td>
<td>1,06</td>
<td>0,91</td>
</tr>
<tr>
<td></td>
<td>Quantile</td>
<td>1,07</td>
<td>0,89</td>
</tr>
</tbody>
</table>

Note: we combine all the sectors in this analysis.

To check the robustness, we apply different regression models. The first one is the robust regression which deals with the outliers and the non-normality and the second one is the Quantile regression, which deals with the median or other quantiles. According to De Benedictis and Tamberi (2004), the median is more useful instead of mean in the case of Balassa index. The results of OLS, Quantile and the robust regression are also given in Table 3. Our results suggest that there are noticeable differences between the results of China and the EU. In case of China the OLS Galtonian regression indicates there is more divergence as the value of \( \beta \) is much greater than 1. It also interprets that the pattern of trade specialization in China is more strengthened as the sectors with initial comparative advantage become more advantaged. Whereas, in the EU, the value of \( \beta \) is close to one and also close to \( R^2 \) and according to Sanidas and Shin (2011), it means that there is no convergence or divergence, therefore the trade specialization pattern in the EU remains more or less stable.

7 Conclusions and Policy Implications

China is the main challenge for the EU's trade strategy, as China re-appeared as the World's leading economy and the pinnacle exporter in the global economy for 2015. EU-China trade increased dramatically in recent years. This paper challenged the view that China has comparative advantage in labour intensive goods only, since China is gaining comparative advantage in low-medium and medium-high technology sectors. Using the well-known Galtonian model, data on the EU and China, our work estimated and analysed the revealed comparative advantage from calculating different indices in various sectors. We found that China is gaining a lot by its comparative advantage in high technology sectors as well and there was a rapid change in its traditional comparative advantage. The results of Galtonian
regression reveal that China is diverging towards high tech sectors or diverging from its traditional comparative advantage whereas, there is no convergence or divergence in the trade specialization pattern of the EU and remains more or less stable.

The current essay documented the extent to which EU is exposed to China in terms of their Comparative advantage and trade competitiveness. According to our findings EU and China overlap in some sectors like manufacturing, machinery and transports equipment. We found that China is not only gaining comparative advantage in labour intensive sectors but also in capital intensive sectors. Moreover, China is gaining more from its comparative advantage in terms of its strong sectors which is revealed from higher values of Balassa Index and positive values for other indices like in case of textiles, clothing, Office and telecom equipment (O&T), machinery and transport equipment (M&T), electronic data processing and office equipment (EDP & OE), Telecommunications equipment (T). Furthermore, the EU has comparative advantage in high-tech goods like pharmaceuticals, chemicals and automotive products (AP) but not in telecommunications and integrated circuits products, which are also from high-tech goods.

The comparative advantage indices presented in this paper were based on actual export data. Hence the results show that the EU seems to be losing its comparative advantage. There are some measures that can be taken by the EU to overcome the problem highlighted in the paper above. The following are some recommendations for EU: Though China has comparative advantage in labour intensive and medium to high-tech sectors and EU cannot compete China in cost efficiency, because at first, China has more cheap labour as well as cheap factors of production, secondly there is huge labour force which is available in China not in the EU, thirdly wages are not very high in China as compared to the wages in the EU. So the only solution to compete with China in terms of these sectors is that;

As, it is a famous saying, "never put your all eggs in one basket", the EU should invest equally in different developing countries like India, Pakistan Brazil etc., not only in china, so in the future they will not be solely dependent on China’s products.

1. Policy to protect EU’s clothing and textile industry;

Though China has comparative advantage in clothing and textile industry because of cheap factors of production and cost deficiency but still EU has comparative advantage in the field of fashion and designs. Fashion launched in EU because sense of fashion and design is still with EU. China make copy of that new more fashioned product which was initiated by EU and send it on cheaper amount, so EU should work on patent laws and copyrights rules to restrict China from making copies of their products, this will bound china to make copies and it will give more protection to EU’s own industry and EU can still survive with comparative advantage in clothing and textile industry.

This paper has focused on the exports and goods of China and the EU, using different tools to check their respective comparative advantages. Further research related to digital trade comparison between China and EU would be very useful in this research scenario.
References


Laursen, K., 1998. Revealed comparative advantage and the alternatives as measures of international specialisation (No. 98-30). DRUID, Copenhagen Business School, Department of Industrial Economics and Strategy/Aalborg University, Department of Business Studies.


Sanidas, E. and Shin, Y., 2011. Convergence towards the revealed comparative advantage neutral point for East Asia: similarities and differences between the three countries.


Appendix 1

China:

The Balassa index of RCA is greater than one in all sectors excluding Pharmaceuticals (PH), Chemicals (CH) and automotive products (AP), indicating that China holds comparative advantage in these sectors in the global market. Results show that China has revealed comparative advantage in Manufacturing (Manf), Office and telecom equipment (O&T), machinery and transport equipment (M&T), electronic data processing and office equipment (EDP & OE), Telecommunications equipment (T) integrated circuits and electronic components (IC&EC) from 2000-2012. China has revealed comparative disadvantage in Pharmaceuticals (PH), Chemicals (CH) and automotive products (AP). Interesting issue is that China had comparative disadvantage in machinery and transport equipment from 2000-2003 and in integrated circuits and electronic components but after 2003 and 2008 it gains
comparative advantage in these sectors respectively. To analyse the changing trend of comparative advantage, if we check China’s comparative advantage from 1980, it is surprising that China does not have any comparative advantage in the respective sectors. China gained comparative advantage in manufacturing sector from 1989, in office and telecom equipment from 1998, in machinery and transport equipment from 2003 and in integrated circuits and electronic components from 2008. Our analysis suggests that China intend to gain comparative advantage in most dynamic sectors of the world trade, more interestingly the high technology sectors.

**European Union:**

The Balassa index of RCA is greater than one in all sectors indicating that EU holds comparative advantage in these sectors in the global market. Results indicate that EU has revealed comparative advantage in Manufacturing (Manf), Pharmaceuticals (PH), Chemicals (CH), machinery and transport equipment (M&T), automotive products (AP) from 2000-2012. EU has revealed comparative disadvantage in Office and telecom equipment (O&T), Telecommunications equipment (T), electronic data processing and office equipment (EDP & OE) and integrated circuits and electronic components (IC&EC) from 2000-2012. In total, EU gain comparative advantage in five out of nine sectors and has comparative disadvantage in four sectors. One thing is strange here that EU had comparative advantage in Telecommunications equipment (T) in the year 2000 but after 2000 EU lost his comparative advantage in this sector.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>6,214.1</td>
<td>7,144.7</td>
<td>7,550.3</td>
<td>8,247.0</td>
<td>6,786.5</td>
<td>8,983.9</td>
<td>10,344.2</td>
<td>11,484.2</td>
<td>11,330.1</td>
</tr>
<tr>
<td>China</td>
<td>612.5</td>
<td>771.7</td>
<td>890.5</td>
<td>972.7</td>
<td>861.5</td>
<td>1,190.1</td>
<td>1,363.8</td>
<td>1,594.6</td>
<td>1,663.3</td>
</tr>
<tr>
<td>USA</td>
<td>724.3</td>
<td>817.1</td>
<td>837.8</td>
<td>875.3</td>
<td>757.1</td>
<td>964.4</td>
<td>1,065.0</td>
<td>1,203.1</td>
<td>1,189.4</td>
</tr>
<tr>
<td>EU-28</td>
<td>1,049.5</td>
<td>1,152.4</td>
<td>1,234.3</td>
<td>1,309.1</td>
<td>1,094.0</td>
<td>1,353.2</td>
<td>1,554.2</td>
<td>1,684.2</td>
<td>1,736.6</td>
</tr>
</tbody>
</table>

Source: Eurostat, WTO Taken from European Commission Directorate General for trade
Appendix 2 Figure 1: China-EU Revealed Comparative Advantage Index in different Sectors

- **Manufacturing**
- **Chemicals**
- **Pharmaceuticals**
- **Machinery & Transport Equipment**
- **Office and Telecom**
- **Electronic Data Equipment**
- **Telecom Equipment**
- **Integrated Circuits**
Appendix 3 A
Normalised Revealed Comparative Advantage Index: Normality Tests

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Shapiro-Wilk Test</th>
<th>Anderson-Darling</th>
<th>Kolmogorov-Smirnov</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manf EU</td>
<td>0.91</td>
<td>0.43</td>
<td>0.18</td>
</tr>
<tr>
<td>Manf Ch</td>
<td>0.94</td>
<td>0.27</td>
<td>0.14</td>
</tr>
<tr>
<td>Textile EU</td>
<td>0.94</td>
<td>0.27</td>
<td>0.13</td>
</tr>
<tr>
<td>Textile Ch</td>
<td>0.94</td>
<td>0.29</td>
<td>0.13</td>
</tr>
<tr>
<td>Clothing EU</td>
<td>0.79</td>
<td>1.28</td>
<td>0.30</td>
</tr>
<tr>
<td>Clothing Ch</td>
<td>0.79</td>
<td>1.17</td>
<td>0.22</td>
</tr>
<tr>
<td>Chemicals EU</td>
<td>0.98</td>
<td>0.15</td>
<td>0.12</td>
</tr>
<tr>
<td>Chemicals Ch</td>
<td>0.98</td>
<td>0.34</td>
<td>0.14</td>
</tr>
<tr>
<td>Pharma EU</td>
<td>0.86</td>
<td>1.00</td>
<td>0.32</td>
</tr>
<tr>
<td>Pharma Ch</td>
<td>0.85</td>
<td>0.91</td>
<td>0.25</td>
</tr>
<tr>
<td>Mach/trans equ EU</td>
<td>0.90</td>
<td>0.46</td>
<td>0.19</td>
</tr>
<tr>
<td>Mach/trans equ Ch</td>
<td>0.95</td>
<td>0.26</td>
<td>0.14</td>
</tr>
<tr>
<td>Office/tele equ EU</td>
<td>0.96</td>
<td>0.29</td>
<td>0.15</td>
</tr>
<tr>
<td>Office/tele equ Ch</td>
<td>0.90</td>
<td>0.59</td>
<td>0.22</td>
</tr>
<tr>
<td>Elec data Equ EU</td>
<td>0.89·</td>
<td>0.56·</td>
<td>0.18</td>
</tr>
<tr>
<td>Elec data Equ Ch</td>
<td>0.86·</td>
<td>0.78·</td>
<td>0.22</td>
</tr>
<tr>
<td>Telecom Equ EU</td>
<td>0.94</td>
<td>0.35</td>
<td>0.19</td>
</tr>
<tr>
<td>Telecom Equ Ch</td>
<td>0.91</td>
<td>0.49</td>
<td>0.20</td>
</tr>
<tr>
<td>Integrated Circuits EU</td>
<td>0.94</td>
<td>0.34</td>
<td>0.13</td>
</tr>
<tr>
<td>Integrated Circuits Ch</td>
<td>0.93</td>
<td>0.36</td>
<td>0.15</td>
</tr>
<tr>
<td>Automotive EU</td>
<td>0.95</td>
<td>0.29</td>
<td>0.15</td>
</tr>
<tr>
<td>Automotive Ch</td>
<td>0.83</td>
<td>0.90</td>
<td>0.22</td>
</tr>
</tbody>
</table>

H0: $F(Y) \equiv N(\mu, \sigma)$, The distribution of the population is normal with unspecified mean and standard deviation. H1: $F(Y) \neq N(\mu, \sigma)$, The distribution of the population is not normal.
Do not reject the null hypothesis at 1%, 5%·, and 10% level.
Appendix 3 B

Rank Correlation Tests

<table>
<thead>
<tr>
<th>Sectors (EU, China)</th>
<th>Spearsman Test</th>
<th>Pearson Test</th>
<th>Kendall Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture</td>
<td>0.582</td>
<td>0.593</td>
<td>0.462</td>
</tr>
<tr>
<td>Textile</td>
<td>-0.703</td>
<td>-0.909</td>
<td>-0.487</td>
</tr>
<tr>
<td>Clothing</td>
<td>0.747</td>
<td>0.851</td>
<td>0.513</td>
</tr>
<tr>
<td>Chemicals</td>
<td>-0.846</td>
<td>-0.909</td>
<td>-0.744</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>-0.934</td>
<td>-0.917</td>
<td>-0.846</td>
</tr>
<tr>
<td>Mach/trans equ</td>
<td>0.654</td>
<td>0.686</td>
<td>0.513</td>
</tr>
<tr>
<td>Office/tele equ</td>
<td>0.501</td>
<td>0.512</td>
<td>0.410</td>
</tr>
<tr>
<td>Elec data Equ</td>
<td>0.670</td>
<td>0.744</td>
<td>0.410</td>
</tr>
<tr>
<td>Telcom Equ</td>
<td>-0.505</td>
<td>-0.529</td>
<td>-0.410</td>
</tr>
<tr>
<td>Integrated Circuits</td>
<td>0.841</td>
<td>0.819</td>
<td>0.692</td>
</tr>
<tr>
<td>Automotive</td>
<td>-0.484</td>
<td>-0.681</td>
<td>-0.385</td>
</tr>
</tbody>
</table>