ASECU South-Eastern Europe Journal of Economics 1 (2016) 37-57 SEEJE

THE DYNAMICS OF CHINA'S EXPORT GROWTH: AN INTERTEMPORAL ANALYSIS[1]

FRANCIS TUAN[a], AGAPI SOMWARU[b*], SUN LING WANG[c], EFTHIMIA TSAKIRIDOU[d]

[a]Renmin University of China, Beijing, China and East Asia Economic Consulting, USA

[b]Economic Consulting, USA and East Asia Economic Consulting, USA

[c]Economic Research Service, USDA, USA

[d]Aristotle University of Thessaloniki, Greece

Abstract

China experienced dramatic growth throughout its entire economy during the 1978 to 2008 period. This significant economic expansion may be attributed to China's open policy after its 1978 overall economic reform. Our inter-temporal analysis of China's export growth between 1978 and 2008, based on the statistical stochastic decomposition approach, indicates that, in the first ten years after China's trade openness, most of its export growth occurred in the extensive margin of trade, but later most of China's export growth appeared in existing varieties or the intensive margin of trade. We find that the distribution of the extensive margin is more dispersed than of the intensive margin, as we use the country-product approach. After applying formal tests, the results show that the intensive margin plays a significant role in the growth of China's exports.

JEL Classification: F10, F14, F43, C5, C6, O40

Keywords: China, trade, intertemporal analysis, intensive margin, extensive margin.

**Corresponding Author:* Agapi Somwaru, 607 Hawkesbury Lane, Silver Spring, Maryland 20904, USA. e-mail: agapi.somwaru@gmail.com

1. The views expressed herein are those of the authors and not necessarily those of the U.S. Department of Agriculture or the Economic Research Service.

Introduction

China has now emerged as one of the world's largest trading nations for both agricultural and non-agricultural commodities. Moreover, China's trade is unique in many respects. The country is noted for its outstanding activities in the "processing trade" sector that involves importing inputs, which are then assembled into final products in China, and then re-exported (Naughton 1997). These activities play an important role in China's changing trade composition and patterns. China is one of the world's largest importers of raw materials and intermediate inputs. The country's exceptional processing trade ability impacts its trading partners, whether exporting or importing countries (Naughton 2004). China has been perceived as a competing threat by other labour-abundant developing countries that trade with developed countries. In recent years, however, the country's direct trade with developing countries, such as India, and countries in Southeast Asia and Africa has intensified dramatically (Batra 2007; Somwaru *et al.* 2007). In just 5 years, China's exports to India increased from $2 billion to over $50.49 billion in 2011 (WDI, 2013).

China competes world-wide not only on the basis of lower labour costs and abundance of natural resources, but also in terms of location that takes advantage of China's proximity to capital-rich East Asian economies and rapidly growing, developing markets in the Asia-Pacific region. In theory, geographic proximity often explains why neighbouring countries trade disproportionately, as Krugman (1991) suggests, in that neighbourhood trade is so strong as to create natural trading blocs. However, such explanations provide little insight into the roots of the rapid growth of China's exports.

Much of the recent theory assumes that developing countries imitate the production of goods invented in developed countries, *ceteris paribus* (Grossman and Helpman 1989; Hausmanne *et al.* 2005; Rodrik 2006). However, the speed at which countries can transform their productive structure and upgrade their exports depends on the basis of the knowledge of products and manufacturing technologies that has been acquired. China has entered a growth phase in its industrial development for producing and exporting a variety of goods. Many papers highlight a strong positive correlation between the number of export varieties a country produces and its living standard. For example, Hummels and Klenow (2005) find that larger and richer countries export more varieties of new goods or what they call the extensive margin of trade. Schott (2008) and Rodrik (2006) argue that China's exports are in high-quality sectors, which is similar to what happens in highly-developed countries. Amiti and Freund (2010), however, find that, despite the dramatic shift in China's exports to the United States over the 1992-2005 period, China's manufacturing exports remained unchanged after accounting for the processing trade. They find that China's export growth trade occurs in existing varieties or what they call the intensive margin of trade. Amiti and Freund find that the intensive margin of trade plays an important

role in China's exports. Our intertemporal analysis of China's export growth for the period 1978 to 2008 indicates that, in the first ten years after China's trade openness, most of its export growth occurred in the extensive margin of trade. Later, most of China's export growth has been in existing varieties (intensive margin trade). Our test results confirm that the intensive margin is a crucial factor in the growth of China's exports for the period 1978 to 2008.

The rest of the paper is organized as follows. Section 2 presents a snap-shot of China's economy and trade from an aggregate perspective. Section 3 discusses the methodology used to develop export growth and to decompose export flow patterns. Section 4 then follows and lays out all data employed in this study. Section 5 presents the empirical analysis, starting with the dynamics of export product differentiation, and continuing with the results of decomposing China's exports. We use bootstrapping to obtain the distributional stochastic characteristics of the trade margins and their variability over the study period. Section 6 empirically captures China's export growth and presents formal tests to identity the intertemporal relationship between China's export growth and extensive/intensive margin of trade following the country's significant economic expansion after its 1978 overall economic reforms. Finally, Section 7 concludes the study.

2. Structural shifts in China's economy and trade - an overview from an aggregate perspective

China has achieved the most persistent economic growth among developing countries. The annual growth rate in the country's real gross domestic product (GDP) averaged about 10 percent per annum from 1978 to 2011 (WDI, 2013). The country's GDP *per capita* or its purchasing power parity adjusted in constant 2005 U.S. dollars was $523.95 in 1980 and $7,417.89 in 2011. The importance of the agricultural sector's value added output, with respect to the entire economy, continued to decrease over the past decades, while the importance of the service sector increased and the manufacturing sector's shares remained largely the same (WDI, 2013). The agricultural share of the GDP decreased from 28.2% in 1978 to 10.0% in 2011, while the share of the service sector increased from 23.9% in 1978 to 43.4% in 2011 (WDI, 2013).

As expected, the share of China's workforce employed in agriculture decreased, while employment share in services increased over the period examined. Many economists maintain the hypothesis that a fundamental feature of growth and development is the decline in the proportion of the workforce employed in agriculture. China has been experiencing a similar trend since the 1980s.

In terms of the broader economy, China's agricultural exports have been playing a smaller role in the country's total exports. Since the middle 1980s, the share of agriculture in total merchandise exports gradually declined, from 5.71% in 1984 to 0.54% in 2011 (WDI, 2013). Manufacturing exports continued to grow and accounted

for 47.65% of total merchandise exports in 1984, a share that rose to an astonishing 93.30% in 2011. Exports of total merchandise to high income countries reached 88.25% in 1991 and then declined to 72.20% in 2011 (WDI, 2013). These high income countries include the United States, Canada, 18 European Member States (Austria, Belgium, Denmark, France, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and Germany), Japan, Australia, and New Zealand. During the same period exports to developing countries increased from 7.55% to 20.02%. Among developing economies, the East Asia and Pacific regions accounted for most of China's merchandise exports, followed by Latin American and Caribbean countries. Manufacturing accounted for the largest and fastest growing share of total imports, while agriculture's share declined to about 4.65% in 2011 (WDI, 2013). From 1984 to 2011, imports of ores and metals along with fuel import shares into China dramatically increased by 10 and 16 percentage points, respectively (WDI, 2013).

3. Methodology for decomposing export growth

An examination of the time path of trade flows for any economy swiftly reveals that trade of both exports and imports tend to fluctuate along a long-term growth path. For this reason, to obtain the long-term growth of China's exports and to identify deviations from the growth path, we use the technique known as the Hodrick-Prescott (HP) (1997) method or Trend and Cycle Decomposition (TCD). We applied the HP/TCD method and derived the growth rates of China's exports (Diao *et al.* 2001; Somwaru *et al.* 2007).

The HP method, developed by Hodrick and Prescott (1997), removes a smooth trend, g_t component, from observed given data y_t by solving the following expression:

$$\min_{(g_t)_{t=-1}^{T}} \left\{ \sum_{t=1}^{T} (y_t - g_t)^2 + \lambda \sum_{t=1}^{T} \left[(g_t - g_{t-1}) - (g_{t-1} - g_{t-2}) \right]^2 \right\} \quad (1)$$

The residual $c_t = y_t - g_t$ (the deviation from the trend) is commonly referred to as the business cycle component and it is the deviation from g_t, *for t=1,..., T.* The measure of the smoothness of the $\{ g_t \}$ path is the sum of the squares of its second difference. The notion is that, over a long time period, the cycles, c_t, where $c_t = y_t - g_t$, average near zero.

The λ parameter is a positive number that penalizes variability in the growth component of the series. The larger the value of λ, the 'smoother' the underlying growth trend g_t is. For a sufficiently large λ, at the optimum, all $g_{t+1} - g_t$ must be arbitrarily near some constant β_t and, thus, the g_t approaches $g_0 + \beta_t$. This implies that at the limit, as λ approaches infinity, the solution is the least squares fit of a linear time trend mode, and for $\lambda = 0$, smoothed data are exactly the same as sample data.

The selection of *the smoothing parameter* λ is based on a probability model. If the cyclical components and the second differences of the growth components are identically and independently distributed normal variables with mean zero and variances σ_1^2 and σ_2^2 (which they are not), then the conditional expectation of the g_t, given the observations, would be the solution of the above equation when $\sqrt{\lambda} = \sigma_1 / \sigma_2$. Different values of λ provide different information, e.g., a large λ value approximates the annual average rate of growth given by an ordinary least squares fit to the log of the data. In other words, the λ parameter should be adjusted according to the fourth power of a change in the frequency of observations (King and Rebelo 2000; Baxter and King 1999; and Diao *et al.* 2001). In this paper, for the purpose of our annual data series, we adopt the procedure for the smoothing parameter given in Ravn and Uhlig (2002).

There is a wealth of studies in the literature on the importance of export growth and intensive and extensive margins. For example, Evenett and Venables (2002), and Hummels and Klenow (2005) find that the extensive margin played a significant role for growth in exports. When examining cross-country differences, Hummels and Klenow, using 1995 data, find that the extensive margin accounts for 60 percent of the greater exports of larger economies. On the other hand, Felbermayr and Kohler (2006) find that the intensive margin was a more important factor for trade growth between 1970 and the mid-1990s. Helpman *et al*. (2008), Eaton *et al*. (2008), and Amiti and Freund (2010), among others, find that the intensive margin of trade is more important for export growth.

Evenett and Venables (2002) define the extensive/intensive margin at the *country-product* level, while Amiti and Freund (2010) at the *product* level and, in particular, concerning exporting industries. However, Helpman *et al.* (2008) and Felbermayr and Kohler (2006) define the extensive/intensive margin at the *country* level. Unlike other studies in this paper, we adopt a *country-product* approach definition of the extensive/intensive margin. In other words, we account for all products that China exports to each of its trade partners during the period under study. Moreover, we do not compare the export growth in an initial year with the export growth in some year ahead (the so-called comparative approach), but we apply a dynamic approach in which export growth is attained for each year of the period under study (Besedes and Prusa 2011).

Below we provide a quick overview of the method adopted for obtaining the margins of trade. We employ the method originated by Feenstra (1994) and adopted by Amiti and Freund (2010) to distinguish between the intensive and extensive margins of China's exports. Unlike Amiti and Freund (2010), we define the extensive and intensive margin at the country-product level and not just at the product level. We employ an intertemporal method to decompose export growth flows into the intensive and extensive margins of trade for China for each product and country. The original

idea of Feenstra's work is to include new product varieties into an index. Denoting I as the set of varieties available in both periods, $I \subseteq (I_t \cap I_{t-1})$, the net variety growth index is defined as the fraction of expenditure in period *t-1* on the goods $i \subset I$ relative to the entire set $i \subset I_{t-1}$ as a ratio of the fraction of expenditure in period *t* on the goods $i \in I$ relative to the entire set $i \in I_t$, minus one. Let V_{it} be the value of trade at time *t* in product *i* ($V_{it} = p_i q_i$), then the Feenstra index of *net variety growth* (Amiti and Freund 2010) is defined as follows:

$$\frac{\sum_{i \in I} V_{t-1i} / \sum_{i \in I_{t-1}} V_{t-1i}}{\sum_{i \in I} V_{ti} / \sum_{i \in It} V_{ti}} - 1 \tag{2}$$

Feenstra's (1994) seminal work on measuring export prices incorporating new goods leads to a natural index of variety growth (equation 2) that has been widely used in relevant literature. The index will be equal to zero if there is no growth in varieties relative to the base period and positive if the number of varieties has grown. If export growth classifications are split (or reclassified) then new classifications are merged and the index will tend to overstate the extensive margin.

Our analysis focuses on whether the growth in China's product exports to its partners falls into existing or new varieties. Using this decomposition concept, the value of trade, V_{it}, for the i^{th} product at time *t*, can be decomposed into the value of existing varieties $V_{it} \cdot D^e$ disappearing varieties $V_{it} \cdot D^d$ and new varieties, $V_{it} \cdot D^n$ where D^e, D^d, and D^n are dummy variables indicating whether the product exists in both period *t* and *0*, only in period *0*, or only in period *t*, respectively. Thus, $D^e = 1$ indicates an existing variety, $D^d = 1$ a disappearing variety, and $D^n = 1$ a new variety. The following decomposition equation is then used to identify the presence of new or existing varieties:

$$\frac{\sum_{i=1}^{I} V_{it} - \sum_{i=1}^{I} V_{it-1}}{\sum_{i=1}^{I} V_{it-1}} = \frac{(\sum_{i=1}^{I} V_{it} D^e - \sum_{i=1}^{I} V_{it-1} D^e) - \sum_{i=1}^{I} V_{it-1} D^d + \sum_{i=1}^{I} V_{it} D^n}{\sum_{i=1}^{I} V_{it-1}} \tag{3}$$

In the equation above, total growth in trade relative to the base period is decomposed into three parts: (i) the growth in products that were exported in both periods, the *intensive margin*; (ii) the reduction in export growth due to products no longer exported, disappearing goods; and (iii) the increase in export growth due to the export of new products. The share of export growth due to the *extensive margin* is defined as the new-goods share less the disappearing-goods. In other words, equation (3) separates export growth in trade into growth in existing varieties or the intensive margin, disappearing goods and growth in new varieties or the extensive margin. Note that, by construction, the intensive and extensive margins of exports sum up to one. There is a direct relationship between the Feenstra index of net variety growth

and the decomposition index in equation (3). Feenstra's net variety growth index combines new exports and disappearing exports into one. In this respect, the net index is more robust than the decomposition index because the decomposition index attributes reclassified varieties to the extensive margin.

We apply an intertemporal approach as we develop a series of measures of extensive, intensive and export growth measures, as follows:

$$Int_t = \frac{(\sum_{i=1}^{I} V_{it} D^e - \sum_{i=1}^{I} V_{it-1} D^e)}{\sum_{i=1}^{I} V_{it-1}} \quad ,for\ t=1979\text{-}78,\ 1980\text{-}79,\ 1981\text{-}80,\ldots,\ 2008\text{-}07 \tag{4}$$

$$Ext_t = \frac{\sum_{i=1}^{I} V_{it} D^n}{\sum_{i=1}^{I} V_{it-1}} \quad ,for\ t=1979\text{-}78,\ 1980\text{-}79,\ 1981\text{-}80,\ldots,\ 2008\text{-}07 \tag{5}$$

$$Net_t = \frac{\sum_{i\in I} V_{t-1i} / \sum_{i\in I_{t-1}} V_{t-1i}}{\sum_{i\in I} V_{ti} / \sum_{i\in It} V_{ti}} - 1 \quad ,for\ t=1979\text{-}78,\ 1980\text{-}79,\ 1981\text{-}80,\ldots,\ 2008\text{-}07 \tag{6}$$

Where, *Int* denotes intensive margin, *Ext* denotes extensive margin and *Net* denotes the Feenstra index for the i^{th} product for each one of China's country partners. The share of export growth attributed to each margin is calculated using equation 3. Note that variety growth is 1/Feenstra index. This measure has the nice feature that if classifications are simply split, and their share of total trade remains unchanged, the index remains unchanged. However, if classifications tend to be split into their share of total trade changes, then the index is more likely to overstate the extensive margin.

Unlike other studies, we consider China's exports to all its trade partners. Thus, our analysis of trade growth is based on *country-product* relationships. We account for all exporting products that had never previously been sold abroad, as well as for all products already exported to a new destination country, as they can both change China's extensive margin.

Besedes and Prusa (2011) argue that, while a firm may have a clear idea of its home market conditions, it may not know the level of demand abroad or have all information about ongoing costs associated with exporting. Their empirical approach is motivated by an extension to the Melitz (2003) model to account for information uncertainties associated with foreign markets. In our paper we employ *bootstrapping* to quantify uncertainties associated with market risks. The bootstrap is a computing intensive statistical resampling technique. Its advantage is that it is less restricted by parametric assumptions than more traditional approaches to market uncertainties. We employ the "bootstrap" technique (Efron and Tibshirani 1994; Varian 1996) for assessing the variability associated with market risks and provide confidence intervals for the exporting margin of trade and export growth.

Let $\theta = \left[\frac{\sum_{i=1}^{I} V_{it} D^{e} - \sum_{i=1}^{I} V_{it-1} D^{e}}{\sum_{i=1}^{I} V_{it-1}}\right]$ represent the intensive margin. Drawing 1,000 bootstrap samplings of existing varieties, then we can obtain the *expected value* denoted as $\mathrm{E}(\hat{\theta})$ of the estimator ($\hat{\theta}$) of the intensive margin along with the variance, denoted as $\mathrm{var}(\hat{\theta}) = \mathrm{E}\left[\left(\hat{\theta} - \mathrm{E}(\hat{\theta})\right)\right]$. Similarly, we draw an additional three 1,000-bootstrap samplings for the extensive, net trade margin, and the export growth of all China's merchandise to obtain estimates of their mean, variability, and confidence intervals.

4. Data

China's trade data used in this study are at the 4-digit Standardized International Trade Classification (SITC) level, Revision 4 (United Nations 2006 and UNCTAD/WTO 2010). The data source is the Commodity Trade Statistics Database (UN-COMTRADE) maintained by the Statistic Division of the United Nations (UN) (United Nations 2010). China started to share public trade statistics with international organisations in 1984. However, the validity of some trade flows reported remains questionable (Gehlhar 1996). Thus, we draw upon data reported by China's *trade partners* and compiled by the UN, starting from 1978 (Gehlhar 1996). The SITC 4-digit data of China's bilateral trade flows (United Nations 2006) for each year of the period under study were processed using the Statistical Analysis System (SAS). We adopted the same approach for processing bilateral data as in Gehlhar (Gehlhar 1996 and https://www.gtap.agecon.purdue.edu/databases/trade_data.asp, 2012; Somwaru *et al.* 2008).

In each one of the study years we processed the bilateral trade for each country/partner of China (United Nations 2010, Country Classification). By maintaining the country-product association, we were able to obtain the extensive and intensive margins at the country level for each product. It should be acknowledged that defining the extensive margin at the product level might artificially impose an upper bound on the extensive margin, as there might be no additions on the extensive margin. For this reason, we defined the margins at the country-product level. This allows the extensive margin to have the largest possible role.

Moreover, we developed aggregate country groups and these were used to develop growth margins to understand the impact of country aggregation. Such groups include: the EU-25, the High Income country group, the Developing country group, the Oceania country group, the High Income South East Asia, the South and South East Asia, the Central and South America, the High Income Oil Exporting group, the Africa country group, and the Transitional Economies country group (see Appendix, Table 1 for country list in country groups; the Africa country group includes all China's African trade partner countries). Some country groups, such as the African country group or the Transitional Economies, are subsets of larger groups.

A primary drawback encountered when using the Harmonized System (HS) trade flow classification is that there have been major reclassifications of trade data in 1996

and 2002 at the HS 6-digit level; thus, a product might be classified as a new variety simply because there has been a new product code or because previous codes were split (United Nations 2010, Economic and Social Classifications, and UNCTAD/WTO 2010). Amiti and Freund (2008, 2010), using China's exports to the world from 1997 to 2005 in HS 8-digit categories, show that the extensive margin accounted for only 26 percent of the total export growth. They find that reclassifications push the extensive margin up. They state that existing product codes are not likely to be a random sample since entirely new products will, by definition, require a new code; therefore, this can be treated as a lower bound of the extensive margin.

Besedes and Prusa (2011) use the 10-digit data of the Harmonized System (HS) to verify whether results of measuring the margins of trade are specific to the 1972–1988 period or extend to the 1989–2001 period, as well. They conclude that when measuring growth in the extensive margin, it is more insightful to consider changes over a *longer-run horizon,* since the value of exports in new product codes is generally small when they are first introduced. Furthermore, Besedes and Prusa (2011), using 4-digit *long horizon* trade data (SITC), argue that their choice arises from concerns about quality and inconsistency due to reclassification of product codes in consequent years. Following Besedes and Prusa (2011), this study uses relationships defined at the 4-digit SITC level.

Our extended data work is aimed at better understanding changes and trends in China's export growth over time across products and countries. For this reason, we draw data from all China's bilateral trade partners/countries in the datasets. Our analysis focuses on the growth rates of exports, including both agricultural and non-agricultural products, over the study period. For each year of the study we account for all *cross sectional* data of exports from China to its trade partners.

5. Empirical analysis

5.1 The dynamics of export product differentiation

Our technique for analysing China's export growth pattern is based on the Trend and Cycles Decomposition (TCD) approach. This approach, by capturing the dynamics of growth in trade and trade policy regimes, allows us to obtain factually based evidence of China's annual trade growth. We find that one of the distinguishing features of China's trade growth is the persistent diversification of partners over time. Table 1 captures China's export growth pattern using trade data at 4-digit SITC (Somwaru *et al.* 2007).

To capture the dynamic features of China's exports, we use its annualized growth rates. The resulting series of growth rates indicate relatively large annual variability due to a range of reasons. Many of the causes for these fluctuations in year to year data are not essential for capturing a "true" trajectory in China's trade growth. Instead, these deviations tend to obscure the underlying longer-term trend in export

growth rates. The longer-term trends in China's export growth would better reveal China's prevailing export patterns. Thus, by employing the TCD methodology, we were able to remove or 'filter' these fluctuations from the primary data (Diao *et al.* 2001, Somwaru *et al.* 2007).

Table 1. China's estimates of total merchandise trade annual growth* by trading partners

Item	1980s	1990s	2000s
Total imports	17.36	13.39	22.40
Total exports	16.67	16.75	20.25
Imports from Developed countries	14.57	13.56	17.39
Exports to Developed countries	14.30	19.73	21.87
Imports from Developing countries	20.27	13.31	25.96
Exports to Developing countries	18.05	15.03	18.97
Imports from India	11.34	33.61	38.12
Exports to India	47.23	23.88	36.96
Imports from South America	7.86	13.44	33.42
Exports to South America	7.87	28.16	29.21
Imports from Southeast Asia	5.76	24.42	28.72
Exports to Southeast Asia	14.31	18.94	23.06
Imports from Africa	3.03	25.67	37.68
Exports to Africa	0.94	20.07	26.45

* *Note:* Growth rates estimated using Trend and Cycle Decomposition method annualized by time period.

Source: Authors' calculations.

In the 1980s, China's average annual trade growth rates with the developing country group outpaced the average annual trade growth rates with the developed country group. It was in the 2000s that China's average annual growth import rates from the developing country group were almost the same as its average annual growth rates of exports to developed countries. The ongoing global relocation of labour-intensive manufacturing has accommodated China's export growth, while the transition to a more market-based economy has helped diversify China' product mix. This, however, did not necessarily mean that China's trade growth has limited developing country export opportunities from direct competition in the case of similar products. In fact, the growth of China's imports from developing countries generally out-

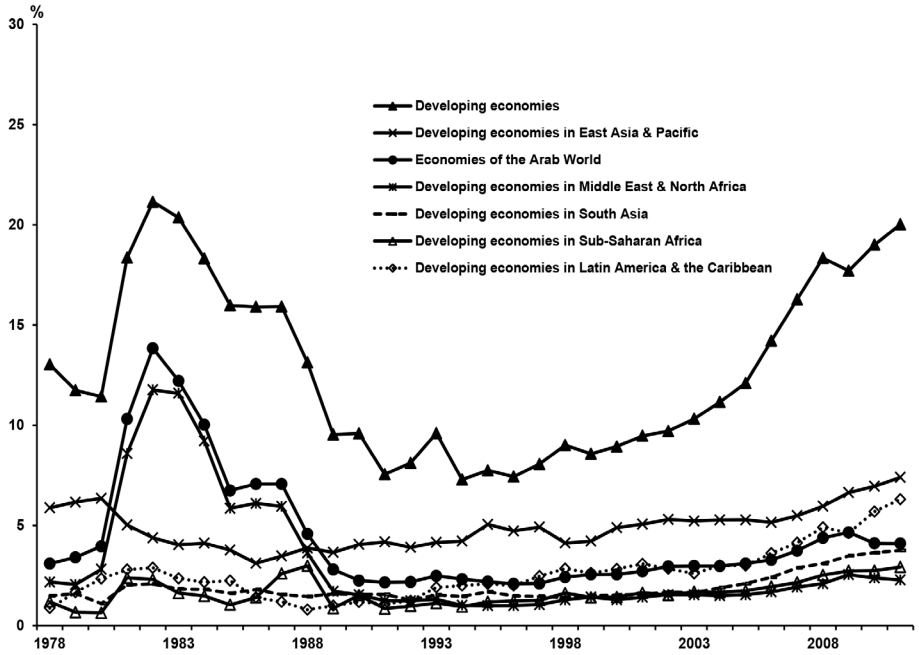
paced import growth from developed countries (Table 1). In the most recent decade, China's import growth has been greater than its export growth, an acceleration of China's trade with developing countries that has often been overlooked.

To clearly capture the dynamic features of China's trade and competitiveness, we calculated the annual growth rate of China's detailed trade. Unlike other studies that concentrated on China's trade with the United States (Hammer 2006, Naughton 2004), we include all of China's major high-income trade partners (see Appendix Table 1 for the list of all countries and country groups). While we process China's bilateral trade with all of its trade partners, we only report the growth rates with selective countries/country groups due to space limitations.

Although the growth rates of total exports with India were unstable in the early 1980s, during the last 15 years, China's trade growth with India has steadily increased (Table 1). This growth coincides with India's liberalising industrial sectors and India's higher sustained growth rates in income and consumer purchasing power.

Numerous studies have analysed the importance of trade in intermediate goods and the influence of geographic proximity on production for countries sharing borders (Naughton 1997, Gupta 1997, Ng and Yeats 1999). China's trade performance indicates that geographic proximity is a factor enhancing the value-added processing chain observed in the country (Figure 1). In the 1980s trade with the economies of the Arab world and Middle East and North Africa countries dominated China's trade flows. In the 1990s and 2000s trade with neighbouring East Asia and Pacific countries dominated China's trade (Figure 1). China's rise in international processing activities reflects the strategies of Asian firms to relocate their industries to China so as to take advantage of China's comparative advantage in production processing that arises primarily from competitively lower labour costs. China's trade policy has favoured assembly and processing operations through tariff exemption on intermediate goods, and set off the expansion of China's trade in intermediate goods in foreign-invested enterprises (FIEs) and economic and technological development zones (ETDZs) (Berger and Martin 2013, Tan and Khor 2006; Somwaru *et al.* 2007). These selective trade policies have accelerated China's international processing activities and became the engine for rapid diversification of its manufacturing exports, well beyond geographic proximity regions (Berger and Martin 2013). Indeed, the most noticeable annual growth of China's total merchandise exports and imports are with African countries in the 1990s and 2000s (Table 1 and Figure 1). Intermediate products, while amounting to almost two-thirds of China's total imports, display China's comparative advantage in production "by stage." These findings tend to weaken the Krugman-Bhagwati (Krugman 1991, Bhagwati 1992) debate on whether neighbourhood determines the direction of trade or geographic proximity is more irrelevant, a fact also supported by the annual growth rates of trade between China and its neighbouring South and Southeast Asian countries (Table 1).

Figure 1. China's total merchandise export shares by country group, 1978-2011



Source: Authors' calculations.

5.2 Intensive versus Extensive Margin of Trade

By applying equations (4), (5) and (6), we obtain the intensive and extensive margins of trade of China's total merchandise along with net variety growth for each year of the period under study. The decomposing measures confirm that China's exports grow primarily along the intensive margin trade. Based on China's export data from 1978 to 2008, we find that only 32.1 percent in the period from 1978 to 1989 are existing product varieties (Table 2) while in the 2000 to 2008 period, exports in existing product varieties account for 87.3 percent (Table 2). For the entire period (1978-2008), China's exports in the intensive margin trade account for 79.8 percent of total exports and present the largest variability (measured by the standard deviation). The 90-percent confidence interval of the mean measured by the lower (66.5) and upper bounds (99.3) indicates the probability that the confidence interval contains the true population mean at 90 percent confidence level (Table 2).

Results show that there was a significant reorientation of China's export growth during the period under study. In this sense, in the first ten years after China's trade openness, most of its export growth occurred in the extensive margin, at 67.9 percent

versus 32.1 percent for the intensive margin. After 1989, the pattern switches with the intensive margin accounting for 74.5 percent of export growth, and the extensive margin for 25.5 percent. Between 1978 and 1989 China started exporting many products. The growth in the number of products peaks during that period. Afterwards, much of the export growth occurred in the intensive margin. In sum, during the period under study we observed reallocation/reorientation of export growth.

Table 2. Variety growth in China's exports, 1978-2008

All type of mechandise Partner-World		Mean %	Standard deviation	Confidence interval of the mean * Lower bound	Upper bound
Intensive					
	1978-1989	32.14	2.62	28.91	36.21
	1990-1999	74.51	4.34	70.89	82.57
	2000-2008	87.29	8.13	76.18	97.18
	1978-2008	79.83	12.32	66.46	99.03
Extensive					
	1978-1989	67.86	9.75	55.54	78.91
	1990-1999	25.49	5.36	19.65	32.57
	2000-2008	12.71	8.35	4.18	28.18
	1978-2008	20.17	11.01	8.03	31.97
Net variety growth (Feenstra index)	1978-1989	17.67	7.56	6.21	28.91
	1990-1999	14.25	4.43	8.57	20.69
	2000-2008	25.74	7.56	14.18	36.18
	1978-2008	22.06	12.25	8.03	41.97
Total export growth					
	1978-1989	224.01	32.01	174.41	259.54
	1990-1999	320.01	45.58	262.69	387.65
	2000-2008	337.45	32.56	296.18	384.18
	1978-2008	8230.47	315.96	7735.97	8631.46

** 90% Confidence level.*
Source: Authors' calculations.

Besedes and Prusa (2011), argue that they use a 4-digit level trade dataset (SITC) "due to concerns about quality and consistency of more disaggregated data as well as for earlier years' data". Our analysis, using 4-digit level data, is in agreement with Amiti and Freud (2010) in that export growth to the U.S. from China took place along its intensive margin from 1997 onwards. They demonstrate this by using a Törnqvist chain-weighted price index to measure the term-of-trade effect, namely, that this growth in the intensive margin supports the traditional theory of welfare gains for importing countries through lower import prices. In this sense, as China increases

its supply of existing varieties in world markets, this is likely to exert downward pressure on world prices of these goods.

The export growth from 1978 to 2008 for the extensive margin amounts to 20.17 percent (mean), with variability being almost the same as that of the intensive margin (11.01, see Table 2). The 90-percent confidence interval of the mean measured by the lower (8.03) and upper bounds (31.97) indicates the probability that the confidence interval contains the true population mean.

It should be noted that by employing the bootstrapping technique we are able to assess the *variability*, and derive estimates of the intensive and extensive margins, the export growth of China's total merchandise statistics, such as mean, standard deviation, and confidence intervals. Otherwise, the intensive and extensive margins derived and the intertemporal export growth estimates would completely lack statistical properties or measures of uncertainty. Since the bootstrapping procedure is distribution-independent, it provides an indirect method of assessing the stochastic properties underlying the intensive and extensive trade margins and export growth. Furthermore, the 90-percent confidence interval of the mean measured by the lower and upper bounds indicates the probability that the confidence interval contains the true population mean.

The variability (measured by the standard deviation) of the extensive margin for the entire study period is almost the same as that of the intensive margin, while the mean and median of extensive and intensive margin distributions are different. This implies that their distributions are not limited by the number of product codes (4-digit) or by how the data of each distribution are spread apart. It should be noted that the distribution of the extensive margin is more dispersed than the intensive margin in our analysis because we use the country-product approach.

6. Export-variety growth

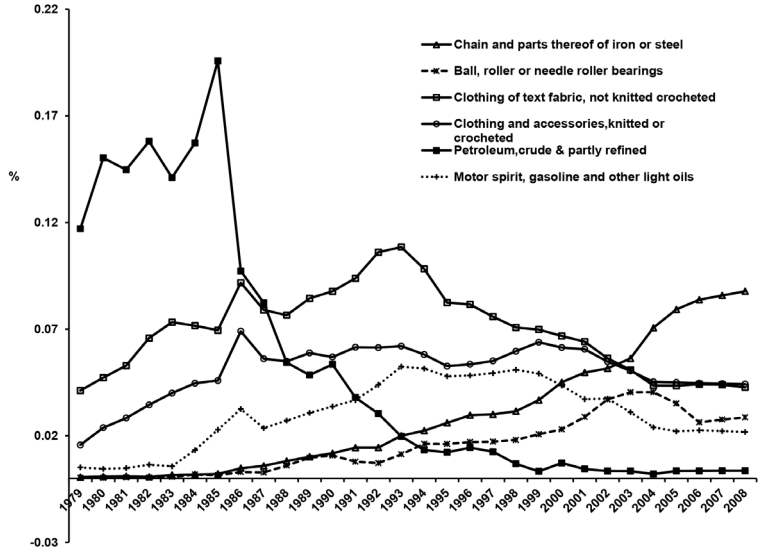
In the late 1970s and 1980s, China's export growth surged from its base that largely consisted of consumer goods. Thereafter, during the 1990s, China's export growth of capital goods took the lead. This indicates that China's trade growth was broad-based and not fuelled by a few products (see Somwaru *et al.* 2007). Figure 2, depicting the export shares of selected commodities, clearly show that China has entered a growth phase in its industrial development for producing broad-based exporting goods. China's exports of apparel, textiles, and footwear have heavily shifted towards chain and parts thereof of iron or steel.

China's adoption of open foreign direct investment (FDI) strategies might have attracted multinational enterprises, which are more likely to have expanded their trade flows to an extensive margin growth pattern through growth in the number of trade varieties in the late 1970s. China's spur of export growth in more recent years, however, lies in value added goods along the intensive margin (Amiti and Freund 2010). China's rise in international processing activities reflects the strategies of Asian firms

for relocating their industries to China so as to exploit China's comparative advantage. Moreover, China's trade policy has favoured assembly and processing operations through tariff exemptions (Somwaru *et al.* 2007). This selective trade policy might have accelerated China's international processing activities with China's high export growth on existing products. China's trade growth with developing countries has taken the lead as the country gains in intensive margin goods of trade. The increased supply of existing varieties of China's exports in recent years is the engine for its trade with emerging and developing countries.

Following Kreuger (1999), we perform formal statistical tests in an attempt to gain insight into the correlation of export growth and the intensive and extensive margins of trade in an *ex-post* mode. The advantage of nonparametric methods over econometric methods is that nonparametric methods do not require any specification of a functional form. In addition, nonparametric methods account for more complicated non-linear relationships between different policies and export growth. Moreover, nonparametric methods accommodate non-linear relationships between different policies and export growth or intensive and extensive margins of trade. Two nonparametric tests - the Kruskal-Wallis and the Van der Waerden Scores (Normal) test - are performed to investigate the effects of China's policies. The Kruskal-Wallis test statistic is given by:

Figure 2. China's export shares of selected merchandise, 1978-2008



Source: Authors' calculations.

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{T_i^2}{n_i} - 3(N+1) \tag{7}$$

Where, N is the sample size, T_i is the sum of ranks for the i^{th} group, and n_i is the number of observations in the i^{th} group. Test statistic H approximately follows a chi-squared distribution with *k-1* degrees of freedom, where k is the number of groups or populations. The Van der Waerden (Normal) Scores are the quantiles of a standard normal distribution and are computed as follows:

$$a(R_j) = \Phi^{-1}\left(\frac{R_j}{n+1}\right) \tag{8}$$

Where, Φ is the cumulative distribution function of a standard normal distribution. Our aim is to test China's independence of export growth and the margin of trade. The Kruskal-Wallis statistic for the intensive margin and export growth is 4.67 and 2.33, respectively, for the extensive margin 8.00, while for the critical value 6.49. The Kruskal-Wallis X^2 statistic rejects the null hypothesis at 0.05% significance level for the intensive margin and export growth, but fails to reject it for the extensive margin. This implies that the first moments of the distribution (mean and variance) of export growth and the intensive margin are the same, but the null hypothesis is rejected for the extensive margin (Table 3). In other words, the intensive margin plays a significant role for the growth of China's exports. The Van der Waerden X^2 statistic also rejects the null at the 0.05% significance level for the intensive margin (-0.09) and exports (-0.79) but not for the extensive margin (6.88), since the value of the asymptotic statistic is 6.31 (Table 3).

In sum, China experienced dramatic growth throughout its entire economy during the 1978-2008 period. Export growth along the intensive trade margin seems to have benefited from this great economic expansion.

Table 3. Results of the paired - t test on export growth and trade margins

Item	Kruskal-Wallis statistic (Wilcoxon mean score)	Van der Waerden statistic (mean score)
Extensive	8.00	0.88
Intensive	4.67	-0.09
Exports (growth)	2.33	-0.79
Asymptotic statistics (X^2)	6.49	6.31
Critical value @ 0.05 significance	0.039	0.043

Source: Authors' calculations.

7. Conclusions

Despite extensive discussions about China's benefiting from embracing globalization, better understanding of the dynamics of China's trade patterns requires a comprehensive profile of China's trade growth using bilateral time-series data. Our methods allowed us to perform such an analysis and results indicate that China's rapid export growth is largely driven by expanding trade in existing goods, or the intensive margin of trade, especially in more recent years. We find that other developing countries are not only playing a complementary role in China's trade growth through trading with China, but have also enabled China's export growth to acquire a faster pace. China's trade growth patterns with major high income countries clearly indicate that the partners' adjacency or neighbourhood hypothesis alone is unlikely to explain the country's unprecedented export growth.

China's outstanding performance in export growth can be traced back to the late 1970s and early 1980s with changes in its policies and increasing involvement in the international segmentation of production processes through FIEs and ETDZs. China's great flexibility via FDI and 'joint ventures' spurred by accumulated assets might have provided the foundation for China to redeploy its capabilities from sector to sector and, consequently, to its export growth expansion. This study finds that there was significant reorientation of China's export growth during the 1978-2008 period. Our intertemporal analysis of China's export growth for the period 1978 to 2008, based on the statistical stochastic decomposition approach, indicates that in the first ten years after China's trade openness, most of its export growth occurred in the extensive margin of trade. However, after 1989, the pattern switched with the intensive margin accounting for 74.5 percent of the growth of exports, and the extensive margin for 25.5 percent. Export growth in the 1990s and 2000s is mainly accounted for by high export growth of existing products (the intensive margin) rather than by new varieties (the extensive margin). One caveat is that the extensive margin might be facing with an upper bound given the definite number of exporting 'codes.' In this study, we define each observation at the country-product level so that we have better estimates of the extensive and intensive margins. Additionally, this study can be treated as the starting point of further research into identifying China's trade growth and patterns.

References

Amiti, M. and and C. Freund. 2008. "The Anatomy of China's Export Growth." Policy Research Working Paper 4628, The World Bank, Development Research Group, Trade Team, Washington, DC.

Amiti, M. and and C. Freund. 2010. "An Anatomy of China's Export Growth." in Robert C. Feenstra and Shang-Jin Wei, (Eds.) China's Growing Role in World Trade, The University of Chicago Press.

Batra, Amita. 2007. "Structure of Comparative Advantage of China and India: Global and Regional Dynamics." *China & World Economy*, Volume 15, Issue 6, November–December 2007, Pages: 69–86.

Baxter, M. and Robert King. 1999. "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series," The Review of Economics and Statistics, 81:4 (1999), 573–593.

Berger, B. and R.F. Martin. 2013. "The Chinese Export Boom: An Examination of the Detailed Trade Data." *China & World Economy*. Volume 21, Issue 1, January-February 2013, Pages: 64–90.

Besedes, Tibor and Thomas J. Prusa. 2011. "The Role of Extensive and Intensive Margins and Export Growth." *Journal of Development Economics*, 96(2), 71-379.

Bhagwati, J. 1992. "Regionalism vs. Multilateralism." *The World Economy*, 15, 5.

Diao, X., T. Roe, and A. Somwaru. 2001. "What is the Cause of Growth in Regional Trade: Trade Liberalisation or RTA? the Case of Agriculture." *World Economy*, 24(1): 51-79.

Eaton, J., M. Eslava, M. Kugler, and J. Tybout. 2008. "The Margins of Entry into Export Markets: Evidence from Colombia." in Elhanan Helpman, Dalia Marin, and Thiery Verdier, 15 eds., The Organization of Firms in a Global Economy, Cambridge, MA: Harvard University Press, 231-72[12].

Efron, B., and R. Tibshirani (1994), R. J. *An Introduction to the Bootstrap*. Boca Raton, FL: CRC Press.

Evenett, S. and A. J. Venables. 2002. "Export Growth in Developing Countries: Market Entry and Bilateral Trade Flows." University of Bern working paper, mimeo.

Feenstra, R. 1994. "New Product Varieties and the Measurement of International Prices", *American Economic Review*, LXXXIV, 157-77.

Felbermayr, G. and W. Kohler, 2006. "Exploring the Intensive and Extensive Margins of World Trade." *Review of World Economics*, 42(4): 642-674.

Gehlhar, Mark, 1996. "Reconciling Bilateral Trade Data for Use in GTAP." *Global Trade Analysis Project (GTAP) Technical Paper No.10*, Purdue University
and https://www.gtap.agecon.purdue.edu/databases/trade_data.asp, 2012

Grossman, G. and E. Helpman, 1989. "Product development and international trade." The *Journal of Political Economy* 97(6): 1261-1283.

Gupta, D.D. 1997. "China Engaged: Integration with the Global Economy." The World Bank Publication.

Hammer, A. 2006. "The Dynamic Structure of U.S.-China Trade, 1995-2005." U.S. International Trade Commission, Working paper No 2006-07-A.

Hausmann, R. J. Hwang and D. Rodrik. 2005. "What You Export Matters." NBER Working paper 11905. National Bureau of Economic Research, Cambridge, MA.

Helpman, E., M. Melitz and Y. Rubinstein. 2008. "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics*, 123(2).

Hodrick, R.J., and E.C. Prescott. 1997. "Postwar U.S. Business Cycles: An Empirical Investigation," Journal of Money, Credit and Banking, 29, 1997.Hollander, M. and D. A. Wolfe. Nonparametric Statistical Methods. New York: John Wiley & Sons, pages 115–120.

Hummels, D. and P. Klenow. 2005. "The Variety and Quality of a Nation's Exports." *American Economic Review*, 95, 704-723.

King, R. and S. Rebelo. 2000. "Resuscitating Real Business Cycles," National Bureau of Economic Research (NBER), Working Paper 7534. http://www.nber.org/papers/w7534, 1050 Massachusetts Avenue, Cambridge, MA 02138.

Krueger, A.O. 1999. "Trade Creation and Trade Diversion under NAFTA." NBER Working Paper 7429. pp 32. http://www.nber.org/papers/w7429

Krugman, P. 1991. "Is Bilateral Bad?." in E. Helpman and A. Razin, (eds), *International Trade and Trade Policy*, Cambridge, MA, MIT Press.

Melitz, M. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica*, 71(6):1695-1725.

Naughton, B. 1997. *The China Circle: Economics and Technology in the PRC, Taiwan, and Hong Kong,* Brookings Institute Press.

Naughton, B. 2004. "China's Economic Growth and Technology Development: International Linkages and Implications for the U.S." Prepared Statement for a hearing before the U.S-China Economic and Security Review Commission, One Hundred Eighth Congress, Second Session.

Ng F. and A. Yeats. 1999. "Production Sharing in East Asia: Who Does What, for Whom and Why?" World Bank, Policy Research Working Paper, WPS 2197, 1999.

Rodrik, Dani. 2006. "What is so Special About China's Exports?" *China & World Economy*, Volume 14, Issue 5, September/October 2006, Pages: 1–19.

Ravn, M. and H. Uhlig. 2002. On Adjusting The Hodrick-Prescott Filter For The Frequency of Observations, *The Review of Economics and Statistics*, 84(2): 371–380.

Statistical Analysis System (SAS). SAS Institute Inc., 100 SAS Campus Drive, Cary, NC 27513-2414, USA (www.sas.com).

Schott, Peter. 2008. "The Relative Sophistication of Chinese Export." *Economic Policy*, 53, January, 5 – 49.

Somwaru, A., F. Tuan, M. Gehlhar, S. Langley and X. Diao. 2007. "Forces Behind China's Surging Trade: Competitiveness or Policy Driven?" Selected paper, International Agricultural Trade Research Consortium, Summer Symposium, Beijing, China, July 8-9.

Somwaru, A., F. Tuan, M. Gehlhar, X. Diao and J. Hansen. 2008. "Developing Country Trade: Implications of China's Changing Trade and Competitiveness in Intensive and Extensive Margin Goods." Selected paper, American Agricultural Economics Association, Annual Meeting, July 27-29, Orlando, Florida.

Tan, K. S. and H. E. Khor. 2006. "China's Changing Economic Structure and Implications for Regional Patterns of Trade, Production and Integration." *China & World Economy*, Volume 14, Issue 6, November–December 2006, Pages: 1–19.

UNCTAD/WTO. 2010. International Trade Center, Market Analysis and Research, Difference between the Standard International Trade Classification (SITC) and the Harmonized System (HS) http://legacy.intracen.org/mas/sitchs.htm

United Nations. (2010). Commodity Trade Statistics Database (UNCOMTRADE), Statistic Division of United Nations, http://comtrade.un.org/db/

United Nations. 2006. Department of Economic and Social Affairs, Statistics Division, Statistical Papers, Series M No. 34/Rev. 4, Standard International Trade Classification, Revision http://unstats.un.org/unsd/publication/SeriesM/SeriesM_34rev4E.pdf

United Nations. 2010. Statistics Division, International Family of Economic and Social Classifications, http://unstats.un.org/unsd/cr/registry/regso.asp?Ci=50&Lg=1

United Nations, (2010). Conference on Trade and Development, UNCTADSTAT, Country Classification, http://unctadstat.unctad.org/EN/Classifications/UnctadStat.DimCountries.IndividualEconomiesList.Classification.pdf

Varian, H. 1996. Computational Economics and Finance: Modeling and Analysis with Mathematica. Springer-Verlag, New York, Inc.

World Development Indicators (WDI), International Bank for Reconstruction and Development (IBRD), World Databank, Database, 2013 http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators#c_c

Appendix Table 1

South and South East Asian Country Group	**Central & South America Country Group**	**High-Income Asian Country Group**
Bangladesh	Argentina	Japan
Burundi	Barbados	South Korea
Cambodia	Bermuda	Taiwan
Sri Lanka	Bolivia	Singapore
Indonesia	Brazil	Malaysia
Nepal	Costa Rica	
Philippines	Cuba	**Ocean Country Group**
India	Dominica	Australia
Viet Nam	Dominican Republic	New Zealand
Thailand	Ecuador	
Laos	El Salvador	**Oil-Exporting Country Group**
Pakistan	Guatemala	
	Guyana	Bahrain
	Haiti	Canada
	Honduras	Iran
	Jamaica	Iraq
	Mexico	Kuwait
	Nicaragua	Oman
	Panama	Nigeria
	Paraguay	Qatar
	Peru	Saudi Arabia
	Antigua and Barbuda	Venezuela
	Bahamas	Yemen
	Belize	
	Chile	
	Colombia	
	Suriname	
	Grenada	
	Uruguay	

Transition Economies Country Group

CEE Albania
Bulgaria
Croatia
Czech Republic
FYR Macedonia
Hungary
Poland
Romania
Slovak Republic
Slovenia
Estonia
Latvia
Lithuania
Armenia
Azerbaijan
Belarus
Georgia
Kazakhstan
Kyrgyz Republic
Moldova
Russia
Tajikistan
Turkmenistan
Ukraine
Uzbekistan
Cambodia
Laos
Vietnam

European Union Country Group

EU12-
Austria
Belgium
Finland
France
Germany
Greece
Ireland
Italy
Luxembourg
Netherlands
Portugal
Spain
EU15
Austria
Finland
Sweden
EU25
Cyprus
Czech Republic
Estonia
Hungary
Latvia
Lithuania
Malta
Poland
Slovakia
Slovenia