

Simola, Heli

Research Report

China's growing role in global production boosted by strong competitiveness: Evidence from international input-output tables

BOFIT Policy Brief, No. 2/2017

Provided in Cooperation with:

Bank of Finland, Helsinki

Suggested Citation: Simola, Heli (2017) : China's growing role in global production boosted by strong competitiveness: Evidence from international input-output tables, BOFIT Policy Brief, No. 2/2017, Bank of Finland, Institute for Economics in Transition (BOFIT), Helsinki, <https://nbn-resolving.de/urn:nbn:fi:bof-201703061177>

This Version is available at:

<https://hdl.handle.net/10419/251664>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

BOFIT Policy Brief

2017 No. 2

Heli Simola

China's growing role in global production
boosted by strong competitiveness – evidence
from international input-output tables



Bank of Finland, BOFIT
Institute for Economies in Transition

BOFIT Policy Brief
Editor-in-Chief Juuso Kaaresvirta

BOFIT Policy Brief 2/2017
6.3.2017

Heli Simola

China's growing role in global production boosted by strong competitiveness – evidence from international input-output tables

ISSN 2342-205X (online)

Bank of Finland
BOFIT – Institute for Economies in Transition

PO Box 160
FIN-00101 Helsinki

Phone: +358 10 831 2268
Fax: +358 10 831 2294

Email: bofit@bof.fi
Website: www.bofit.fi/en

The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Heli Simola

China's growing role in global production boosted by strong competitiveness – evidence from international input-output tables

Abstract

We examine the role of China in world production and its development by utilizing the international input-output tables of the WIOD database that has been recently updated to cover years 2000–2014. We concentrate on the value added created in China and trace the evolution of China's share in world production and exports. We also examine the specialization of China's production and export structure and try to evaluate its significance for China's performance through constant market share analysis. We find that China has gained shares hugely both in global production and exports, although the pace has slowed down in recent years. The share gains have been supported by its rapidly growing domestic market as well as strong global competitiveness. China's production and export structure have shifted to more high-technology sectors both in manufacturing and services, but these sectors still represent much smaller share in Chinese economy compared to developed economies.

Keywords: China, trade in value added, constant market share, competitiveness

Contents

| | |
|---|----|
| 1. Introduction | 4 |
| 2. Data and methodology | 4 |
| 3. China's role in global production has increased dramatically and progressed gradually | 6 |
| 3.1 Share of higher technology sectors increasing gradually in value added production | 6 |
| 3.2 China's share in global production has increased steadily | 8 |
| 3.3 Production growth supported by domestic markets and global competitiveness | 9 |
| 4. Competitiveness and improved sophistication boosting Chinese exports | 10 |
| 4.1 Signs of improving sophistication in exports | 10 |
| 4.2 Strong competitiveness enabling export market share gains | 11 |
| 5. Conclusion | 13 |
| References | 14 |
| Appendix 1. Description of the data and classifications | 16 |
| Appendix 2. Calculating the global value added production and exports | 18 |
| Appendix 3. Constant market share analysis | 19 |
| Appendix 4. An example of differences between indicators calculated from the WIOD data and OECD TiVA data | 20 |

1. Introduction

After three decades of spectacular economic performance, China has risen among the largest economies in the world. In recent years, China's development has become an ever more topical issue, as economic growth has notably started to slow down. China's growth model, which has relied heavily on investment and exports, is losing steam and the economy has started to gradually shift towards more balanced growth led by domestic consumption and services. This rebalancing of the economic structure could maintain a sustainable although more moderate growth of Chinese economy in coming years.

Fast economic growth and exhaustion of surplus labour force has led to rapidly increasing wages and currently the wage level in China is higher than in many other emerging economies. This has undermined China's cost advantage in relation to other countries, which has traditionally been seen as the country's main strength in international competition enabling rapid export growth. To remain competitive, China needs to shift its production structure to more sophisticated and higher value-added production, i.e. "climbing up the value chain". There is much research on the issue to which extent China has already managed to proceed on this path, but the results are somewhat mixed. The role of higher value added sectors has indeed increased in Chinese output and production, but this is often related to use of foreign inputs, whereas the value added actually created in China may account to only a few percentages in the most extreme cases.¹

The goal of this paper is to bring additional insight to discussion on the above mentioned issues utilizing new data and some complementary analysis. Our analysis suggests that a gradual rebalancing towards domestic consumption and higher value-added production has indeed proceeded in past years, although moderately. The role of services both in Chinese production and exports has increased and there has been a gradual shift from lower technology sectors to higher technology sectors both in manufacturing and services. Our focus on value added data alleviates the challenges caused by the increased international fragmentation of production, although the analysis is still subject to several caveats. Our analysis illustrates the importance of domestic market for the huge increase of China's share in global production, but also gives support to the common view on China's strong export competitiveness.

The paper is organized as follows. First we describe the main features of the data and methodology used in the analysis. In the next sections we present the actual analysis separately for China's role in global production and in global exports. The last section concludes by discussing the results briefly.

2. Data and methodology

In order to concentrate on the actual value added created in China, we use the global input-output tables provided by the WIOD project. It is one of several recently developed databases depicting global production and trade structures. The databases differ e.g. by their time and country coverage as well as compilation methodologies², but the basic principles are similar. Total value added created globally is allocated to different countries utilizing national statistics on production and trade flows and complemented with estimated inputs. The resulting global input-output tables make it possible to trace the value added created in different countries. The data also allows splitting a country's

¹ See e.g. Rodrik (2006), Schott (2008), Koopman & al. (2008), Wang & Wei (2010), Dean & al. (2011), Baldwin & Lopez-Gonzalez (2013), Koopman & al. (2014).

² For introduction and discussion on WIOD and other global input-output tables see e.g. Timmer & al. 2015 and Tukker & Dietzenbacher (2013).

production and exports to the value added that has been created by themselves and to the value added that has been imported from other countries in the form of raw materials, intermediate inputs and services. Value added exports often differ distinctly from gross exports especially in countries that are actively participating in international value chains like China³.

All the different databases have their advantages and drawbacks. We chose WIOD data for our analysis since it has been updated recently and covers comparable figures for years 2000–2014. The data includes 43 individual countries (all 28 EU member countries and other world's largest economies) and a rest of the world block. It is divided to 56 sectors based on the ISIC classification. The data is expressed in nominal USD.⁴

Since the data is in terms of gross output, we first separate the value added created by different countries following the methodology used in the previous literature⁵. We calculate the value added produced in different countries and sectors needed for the final demand in each of the countries. This includes all the value added originating in country i that is used in the final demand of country j , whether it is exported directly from country i as a final product or as an input in exports from country i or from other countries. Therefore in this framework e.g. service exports include both directly exported services as well as services needed as inputs e.g. for manufacturing production like engineering. For the first part of the analysis, we include the domestic demand of countries, so we cover the total global value added production. In the second part we concentrate on value added exports by excluding from the analysis the value added produced for domestic demand in each country.

We use the value added data to examine the development of China's production and exports. We describe the overall trends and apply the traditional constant market share (CMS) analysis to examine the competitiveness of Chinese production and exports more closely. The CMS analysis has been relatively widely applied to gross exports and with modifications also to value added exports⁶, but to our knowledge it has not been applied to the data we are using. Although the method is usually applied in analysis of export competitiveness, we think it can be applied similarly for examining changes in countries roles in total global production of value added.

The CMS analysis is basically an accounting framework that decomposes the variation in the market share of a country to a structure effect and a "pure" market share effect that is interpreted as the competitiveness effect. The structure effect can be further decomposed into market and product effects. If a country is specialized in supplying markets or products which demand grows faster (slower) than the total demand, then its market share increases (decreases) due to a structure effect. It is impossible to completely separate the structural market and product effects, so the structure effect also contains a residual interaction effect. After eliminating the structure effect originating from market and product specialization, the residual is considered as the competitiveness effect. Therefore, competitiveness effect should be considered only as an indicative measure of true competitiveness. Moreover, within this framework we cannot say much on the factors driving the changes in competitiveness.

³ Jonhson & Noguera (2012b), Baldwin & Lopez-Gonzalez (2013), Johnson (2014), Koopman & al. (2014).

⁴ More detailed description on data and classifications used is in Appendix 1. Comprehensive information on the underlying data sources is provided by Timmer & al. (2016).

⁵ The approach has been recently applied in the context of examining the structure of global value added by e.g. Johnson & Noguera (2012a) and on WIOD data in particular by e.g. Timmer & al. (2015). Brief description of the methodology is provided in Appendix 2.

⁶ Our analysis mainly follows ECB (2005), whereas other recent applications of the method to gross exports include e.g. Piezas-Jerbi & Nee (2009), Husted & Nishioka (2013), Cheptea & al. (2014), Pandiella (2015). Related analysis with comparison of gross and value added exports is provided e.g. in Benkovskis & Wörz (2015) and Felettigh & Oddo (2016). Brief description of the methodology used in our analysis is provided in Appendix 3.

It should be underlined that the results of the analysis should be interpreted with caution as there are several caveats related both to the data and to the methodology. First, especially data on services is often lacking or measured with imprecision in the statistics used for compiling the international input-output tables. Second, as the data is in nominal USD, changes in prices and exchange rates mechanically affect the calculations. We try to alleviate the price problem by excluding commodity sectors in some parts of the analysis, as is common in the literature. The exchange rate effect should be limited in the first years of our time period as China's exchange rate was fixed to the USD, but since mid-2005 it strengthened continuously against the USD until the beginning of 2014. This strengthening mechanically increases to some extent the Chinese market share. Third, compilation of the data is based on the assumption that the production processes are identical and independent of the final use of the output. This may be unrealistic especially in the case of China, where production structure for exports and domestic use can be quite different, with export production using more imported inputs. Therefore the share of domestic value added in Chinese exports may be overestimated. In addition, the data is on a relatively aggregate sector level for a CMS analysis. Despite these shortcomings, the analysis provides some additional insights to discussion on development of the Chinese economy.

3. China's role in global production has increased dramatically and progressed gradually

3.1 Share of higher technology sectors increasing gradually in value added production

China's production has increased very rapidly during 2000–2014 reaching an astonishing average of nearly 17 % per year (in nominal USD) compared to the average of 5 % for the rest of the world. In addition to the rapid growth, the structure of Chinese production has also changed considerably. In particular, the share of the primary sector has decreased while the share of services has increased. The development is in line with the general trend of “servicification” seen in many other countries⁷. However, in China the trend is even more pronounced, which reflects the fact that China is still emerging economy and the share of services was very small in early 2000s. Even with the rapid change, China's production structure is still quite dissimilar compared to the (unweighted) average over the other (mainly high-income) countries included in the database. Shares of the primary sector and manufacturing are still much higher and the share of services correspondingly much lower than in the other countries.

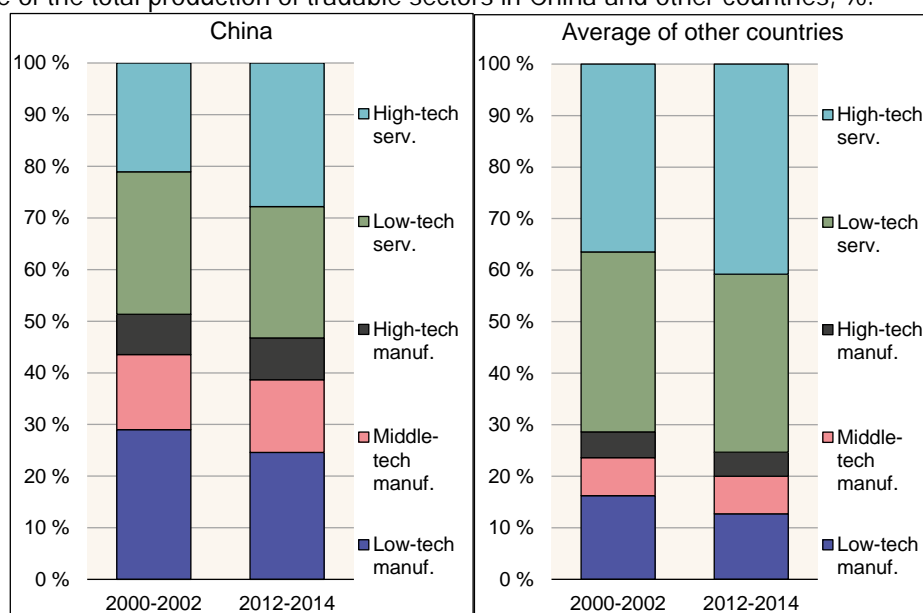
As we are interested in China's role in the global economy, we concentrate on the sectors of manufacturing and business services which are the sectors most widely involved in international transactions. We exclude the primary sector as well as the manufacturing of coke and oil products which are the most sensitive to price changes. As the data is in nominal terms, the significant price variations that have occurred during the past decade could otherwise blur the results. In addition, we exclude the industries and services most strongly oriented towards domestic economy, like electricity supply and public services. In order to roughly approximate qualitative changes in production, we divide manufacturing and services by their technological sophistication. This approximation is merely

⁷ For discussion on “servicification”, see e.g. Baldwin & al. (2015).

indicative, as we cannot assess the sophistication level of production within sectors with the data available. We have no information on which production stages or tasks in each sector are performed in China. Therefore we cannot distinguish to what extent an increase in the share of a sector is due to larger production of low value added production stages like assembly or to a shift to production stages creating higher value added.

Even when concentrating on tradable sectors, the development of Chinese production structure has been very similar to the other countries of the sample, but again with somewhat larger changes (Figure 1). The main change is the decline in the share of low-tech manufacturing and to a lesser extent also low-tech services, which have been replaced by high-tech services. The shares of middle-tech and high-tech manufacturing have remained relatively stable throughout the time period.

Figure 1. Structure of the total production of tradable sectors in China and other countries, %.



Source: Author's calculations based on WIOD data.

The evidence supports the view of China “moving up the value chain” in manufacturing, but progress is slow and taking place mainly in the latest years of the sample⁸. Within manufacturing, the share of low-tech industries has declined somewhat and been replaced by middle- and high-tech industries. This is visible especially in the textile and clothes industry: in 2000 it was China's largest manufacturing industry with a share of 13 %, but its share had declined steadily to below 9 % in 2014 making it the 5th largest industry. From middle-tech industries, the largest increase has been recorded for the motor vehicle industry, as its share has increased from 4 % to 8 % in 2000–2014, with a strong growth especially in the latest years of the sample. Among high-tech industries, the shares of both computer and electronic equipment have – unsurprisingly – increased, but actually only little.

Within services, there has been a shift from low-tech to high-tech services during 2000–2014. Of low-tech services, in particular the share of transport services has declined from 21 % to 13 % of total services. This could reflect cost gains in the sector achieved e.g. by the huge infrastructure investment seen in China in past decades. Of high-tech services, the share of all individual sectors has increased slightly. It should be noted that the service sector data is subject to many uncertainties and imprecisions so these results should be taken with caution.

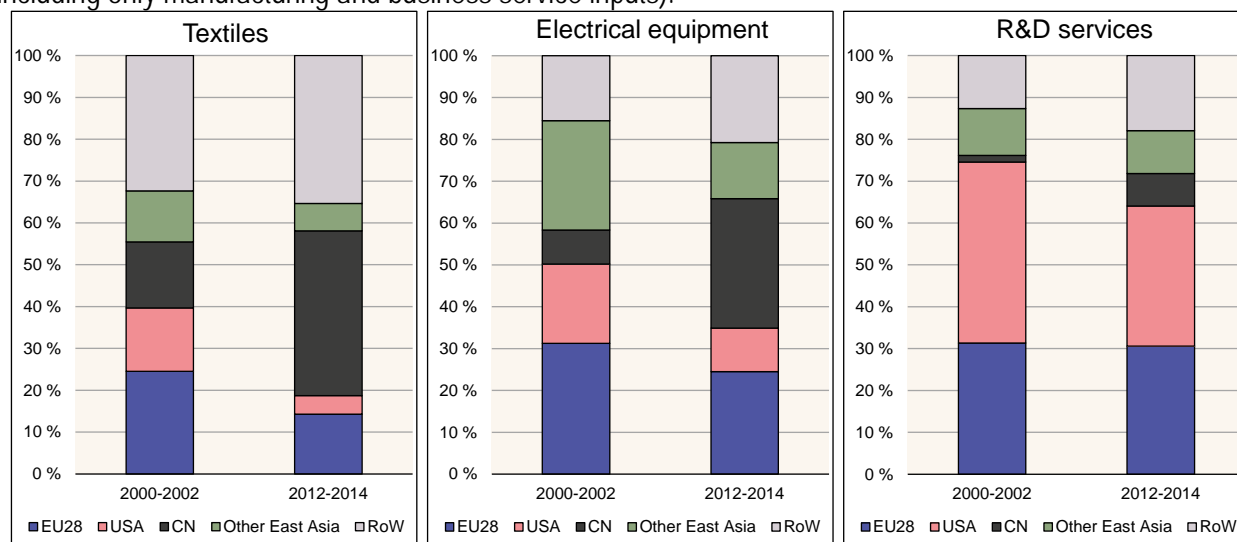
⁸ Baldwin & Lopez-Gonzalez (2013) obtained similar results analyzing the earlier version of WIOD data covering 1995–2009.

3.2 China's share in global production has increased steadily

As the Chinese production has increased very rapidly, its share in supplying global final demand has also increased substantially during 2000–2014. Starting from below 4 % of global value added in 2000 (the analysis concerns only tradable sectors), China has steadily gained foothold with its share reaching already nearly 15 % in 2014. The trend has been similar across almost all individual markets, although there is obviously much variation in levels. In 2000, China's share in the total final demand of individual (foreign) countries varied between 0.3–1.8 %, whereas in 2014 the corresponding figures were 1.6–6.3 %⁹. The largest shares for Chinese value added were recorded in Korea and Taiwan. In China's domestic market, the development is somewhat different. In 2000, China's share in its domestic market was 81 %, but it declined to below 75% by 2004. Since 2005, the share has increased almost continuously and reached 85 % in 2014. China's domestic market share is high compared to the average of 65 % in the other countries and close to the levels found in the U.S. and India.

China's performance has been impressive also in sectoral terms, as its share of global production has been growing continuously especially in manufacturing industries but also in services, although more moderately. The country is already the largest producer in several industries, accounting for over 30 % of global production e.g. in the manufacturing of textiles and clothes, wood products, non-metallic minerals, basic metals and electrical equipment (Figure 2). China has gained shares from nearly all developed economies, but most markedly from the U.S. and East Asian countries. The share of EU-28 has also declined in most industries, but somewhat less than the share of other regions.¹⁰ This apparently reflects the increased role of the CEE countries. China's share has increased substantially also in services, including high-tech services like finance and R&D, but most service branches are still dominated by developed economies.

Figure 2. Distribution of global value added by region in selected industries in 2000–2002 and 2012–2014 (including only manufacturing and business service inputs).



Note. Other East Asia includes Japan, Korea and Taiwan.

Source: Author's calculations based on WIOD data.

⁹ Estimates calculated from the OECD TiVA database are slightly different due to methodological differences, but qualitatively the results are very similar. For a brief comparison, see Appendix 4.

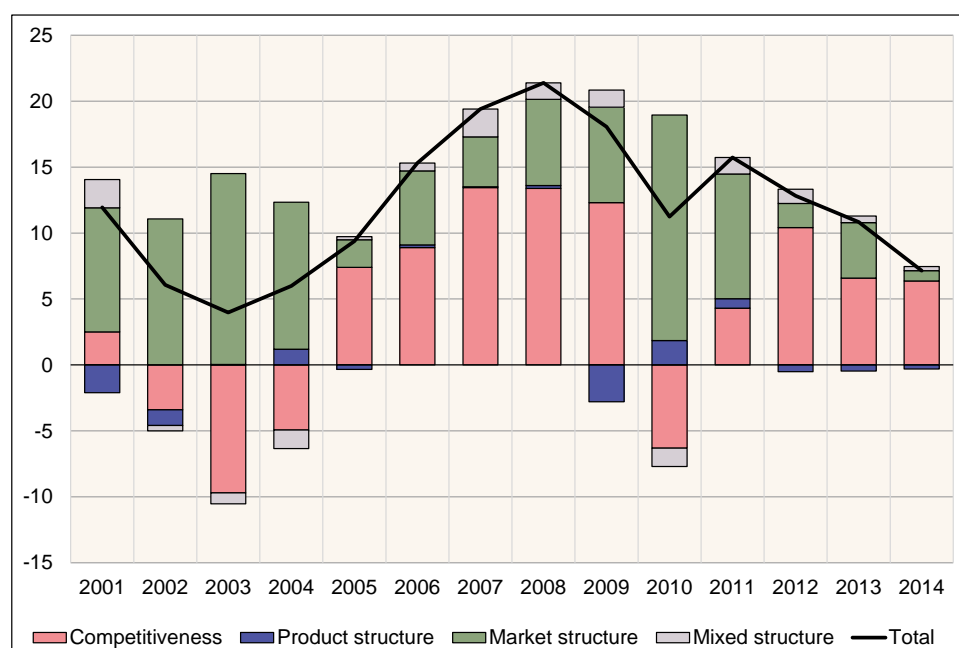
¹⁰ China gaining share especially from developed economies and more from the U.S. and Japan than the EU has also been found in earlier analysis on gross export data e.g. in Husted & Nishioka (2013) and Chepeta & al. (2014).

3.3 Production growth supported by domestic markets and global competitiveness

We use the constant market share analysis¹¹ to examine the changes in China's share in global production in more detail. This is done by comparing the growth of China's production to that of the rest of the world and decomposing the changes in China's global market shares to structural and competitiveness effects.

As noted above, China's production has grown substantially faster during the whole 2000–2014 period than production in the rest of the world and hence, it has gained share in global production. Two factors behind the development stand out (Figure 3). Despite some variation by year, China's competitiveness has improved and its domestic economy has grown rapidly (market structure effect). The market effect is obviously positive in all years, as the share of the domestic market is practically always higher in a country's own production than in the production of any other country. Therefore the rapid growth of the domestic market has been an important factor behind the rise of China as a key global producer and even brought the main contribution to China gaining share in global production during the first years of the 2000s. The structural product effect has mostly been very small and in some years even negative, so the sectoral structure of Chinese production has not played a key role in market share gains. This might, however, to some extent also reflect the aggregate level of the data, as noted above. The competitiveness effect has actually been small or even negative in the first years of the time period, whereas since 2005 it has been the main factor behind China's market share gains in most of the years.

Figure 3. Decomposition of the constant market share analysis for Chinese value added production in tradable sectors



Note. Total is the difference between growth in Chinese and world production (%-points) and the columns show the contributions of different effects to the total difference.

Source: Author's calculations based on WIOD data.

¹¹ See Appendix 3 for brief technical details.

We can examine the competitiveness effect further to illustrate in which sectors and markets the gains or losses of competitiveness have originated. From the sectoral perspective, China's competitiveness gains have arisen especially from low-tech and later middle-tech manufacturing sectors in the first half of the time period. In the latter part of the period, main competitiveness gains have realized in particular in low-tech services but increasingly also high-tech services. From the viewpoint of the destination markets, the development of China's competitiveness has mainly been defined by the domestic market. During the first years of the time period, China actually lost competitiveness in the domestic markets, but since 2005 the effect has, in contrast, been positive and large in most years. From foreign markets, China has recorded largest competitiveness gains in the emerging economies (rest of the world block), but they have also been significant in the U.S. markets.

China appears to have grabbed market shares in foreign markets both from domestic producers and other exporters. The correlation between domestic and Chinese market share calculated on a country-sector level was -0.49. Although the negative correlation is to some extent mechanical it suggests that some but not all market share gains have come from domestic producers. In the aggregate level, the relationship is, however, less clear cut. In some countries, the share of domestic production has even increased at the same time than China's share has increased. This might suggest that while in some countries Chinese production has replaced domestic production in one sector, domestic production has still gained share in another sector or that use of Chinese inputs has supported the domestic production to gain market shares.

4. Competitiveness and improved sophistication boosting Chinese exports

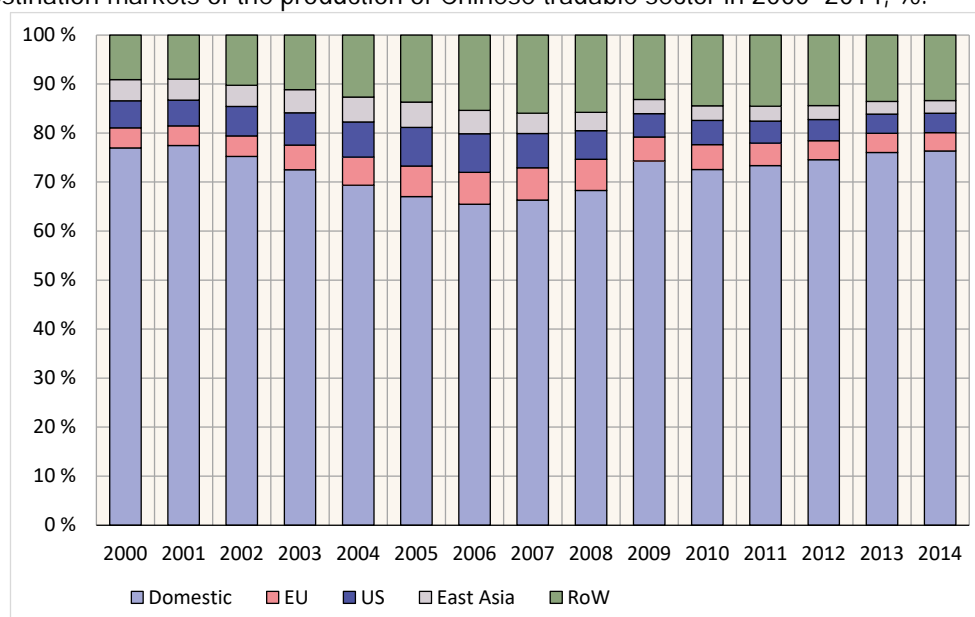
4.1 Signs of improving sophistication in exports

Despite the supportive role of the domestic demand for Chinese production, it is widely recognized that exports have been a key factor behind China's growth success. The development of exports is indeed quite similar to the overall production: spectacular growth and huge gains of market shares throughout most markets and sectors.

In value added terms, the share of exports in Chinese production is actually even surprisingly low. In 2000, the share was 18 %. The share increased in early years of 2000s and reached its peak in 2006 at 28 %, but since then it has steadily declined, reaching 19 % in 2014. Throughout the period the share of exports in Chinese production was somewhat smaller than the average calculated over the sample countries. In 2014, China's share was similar to those found in many large European countries, like France, Italy and Spain. However, the share of exports in Chinese production is quite large compared to the largest individual economies like the U.S. and Japan, where only around 10 % of production is destined to exports.

The trend is similar even if we concentrate only on tradable sectors, but the share of exports is obviously higher starting from 23 % in 2000, peaking at 35 % in 2006 and returning to 24 % in 2014 (Figure 4). In Chinese export destinations, the share of many developed economies has decreased and correspondingly the share of emerging markets (as proxied by the rest of the world block) increased. The U.S. has, however, remained the most important individual export market accounting for a share of 17 % in Chinese value added exports of tradable sectors or 4 % of their production in 2014.

Figure 4. Destination markets of the production of Chinese tradable sector in 2000–2014, %.



Note. East Asia includes Japan, Korea and Taiwan.

Source: Author's calculations based on WIOD data.

The sectoral structure of China's exports compared to overall production is a bit different as high-tech manufacturing has a larger share in exports while high-tech services have a larger share in overall production. However, the trends are very similar with the share of low-tech manufacturing declining and the share of high-tech services increasing in both. In addition, the share of high-tech manufacturing sectors has increased slightly in exports. These developments reflect mainly decreasing significance of the textile and clothes industries and increasing significance of the computer equipment manufacturing. However, the changes within manufacturing are quite small. Among service sectors, the shares of trade and financial services have slightly increased, whereas the share of transportation has decreased.

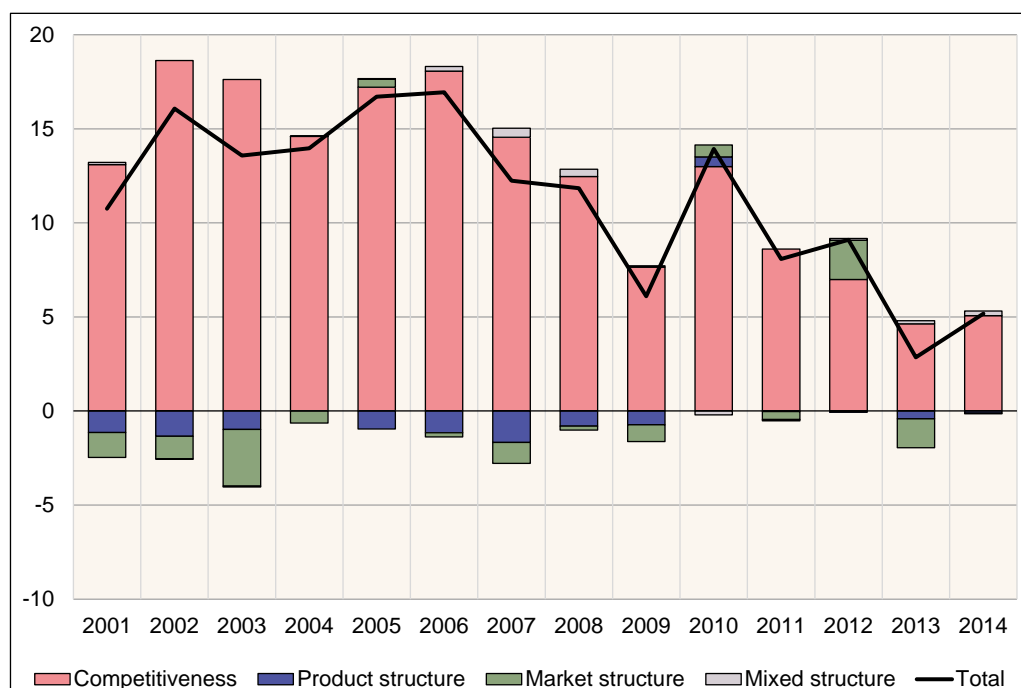
4.2 Strong competitiveness enabling export market share gains

As in global production, China's share in global exports has also increased substantially from 4 % in 2000 to nearly 15 % in 2014, as Chinese exports have grown considerably faster than those of the rest of the world. Since the international financial crisis, however, the growth difference between Chinese and world exports has narrowed. The development has been similar across markets and sectors.

The constant market share analysis for exports reveals that China's superior performance has been nearly completely due to improved competitiveness, whereas the structural effect has been slightly negative during most of the time period (Figure 5). The contributions of both the product and market components of the structural effects have been negative in most years so Chinese exports have not been oriented towards sectors and markets that have grown faster than average¹².

¹² Results remain very similar even if Chinese imports are excluded from the world exports.

Figure 5. Decomposition of the constant market share analysis for Chinese value added exports in tradable sectors



Note. Total is the difference between growth in Chinese and world production (%-points) and the columns show the contributions of different effects to the total difference.

Source: Author's calculations based on WIOD data.

Taking a closer look at Chinese export competitiveness shows that it improved in every sector. In early 2000s, it was driven in particular by low-tech manufacturing, whereas in the latter part middle- and high-tech manufacturing gained more competitiveness. This is in line with earlier research finding that in the early years of 2000s Chinese competitiveness was mainly due to cost factors, whereas in latest years also the sophistication level of manufacturing products has increased to some extent. Our analysis shows that after the global financial crisis, Chinese competitiveness has been increasingly boosted by service sectors, especially low-tech, but in the latest years of the dataset also high-tech services have played an increasingly important role. Among different export markets, China has gained competitiveness especially in the emerging economies throughout the time period. In the first years, China recorded significant competitiveness gains also in the U.S. markets, but in recent years these gains have been much smaller. Our results are in line with earlier findings that China's export success is mainly due to competitiveness and that despite the dominance of cost factors this competitiveness has been increasingly boosted also by sophistication and quality improvements.¹³

¹³ See e.g. Husted & Nishioka (2013), Benkovskis & Wörz (2015), Xie & Zhang (2015).

5. Conclusion

In this note we examined the evolution of Chinese value added production and exports in 2000–2014 on the basis of recently updated WIOD global input-output tables. We find that the sectoral structure of Chinese production and exports has shifted towards services and high-tech manufacturing from low-tech manufacturing. This suggests a qualitative advancement in Chinese production, but we cannot assess its actual depth as the data gives no information on production stages or tasks performed within sectors. China's development follows the trends observed in other, mostly higher income countries, but its production and exports are still more specialized in manufacturing and lower-tech sectors than in the other countries.

Role of the domestic market has been important for China's rise to one of the largest producers in the world. The domestic market has supported especially the development of service sectors. China's impressive export growth is mainly due to its strong competitiveness that has reached practically all markets and sectors. Chinese production and exports have grown faster than those of the rest of the world even in latest years, but the difference has narrowed notably from the peak years. This partly reflects the rebalancing of the economy with the increasing share of services, as productivity tends to be lower in service sectors than in manufacturing. This trend may be expected to continue also in coming years, if Chinese economy continues to follow similar development path as the current high income economies have experienced previously.

6. References

- Baldwin, R., R. Forslid and T. Ito (2015). Unveiling the Evolving Sources of Value Added in Exports. IDE-JETRO Joint Research Program Series No. 161, March 2015.
- Baldwin, R. and J. Lopez-Gonzalez (2013). Supply-Chain Trade. A Portrait of Global Patterns and Several Testable Hypotheses. CEPR Discussion Paper No. 9421, April 2013.
- Benkovskis, K. and J. Wörz (2015). “Made in China” How Does it Affect Our Understanding of Global Market Shares? ECB Working Paper 1787, April 2015.
- Cheptea, A., L. Fontagne and S. Zignago (2014). European Export Performance. *Review of World Economics*, 2014 (150), pp. 25–58.
- Dean, J.M., K.C. Fung and Z. Wang (2011). Measuring Vertical Specialization: The Case of China. *Review of International Economics* 19(4), pp. 609–625.
- ECB (2005). Competitiveness and the Export Performance of the Euro Area. Occasional Paper No. 30, June 2005.
- Felettigh, A. and G. Oddo (2016). Market Shares in Manufacturing Value-Added: Is the Picture Different? Bank of Italy Occasional Papers 336, July 2016.
- Husted, S. and S. Nishioka (2013). China's Fair Share? The Growth of Chinese Exports in World Trade. *Review of World Economics* 149(3), pp. 565–586.
- Johnson, R.C. and G. Noguera (2012a). Accounting for Intermediates: Production Sharing and Trade in Value Added. *Journal of International Economics* 86, pp. 224–236.
- Johnson, R.C. and G. Noguera (2012b). Fragmentation and Trade in Value Added over Four Decades. NBER Working Paper 18186, June 2012.
- Johnson, R. (2014). Five Facts about Value Added Exports and Implications for Macroeconomics and Trade Research. *Journal of Economic Perspectives*, Vol. 2, No. 28, Spring 2014, pp.119–142.
- Koopman, R., Z. Wang and S.J. Wei (2014). Tracing Value Added and Double Counting in Gross Exports. *American Economic Review* 104 (2), pp. 459–494.
- Koopman, R., Z. Wang and S.J. Wei (2008). How Much of Chinese Exports is Really Made in China? Assessing Domestic Value Added in Trade When Processing Trade is Pervasive. NBER Research Working Paper 14109.
- Pandiella, A.G. (2015). A Constant Market Share Analysis of Spanish Goods. OECD Economic Department Working Paper No. 1186, February 2015.

-
- Piezas-Jerbi, N. and C. Nee (2009). Market Shares in the Post-Uruguay Round Era: A Closer Look Using Shift-Share Analysis. WTO Economic Research and Statistics Division Staff Working Paper ERSD-2009-14, December 2009.
- Rodrik, D. (2006). What's So Special about China's Exports? *China and the World Economy*, Vol. 14, Is. 5, pp. 1–19, September-October 2006.
- Schott, P.K. (2008). The Relative Sophistication of Chinese Exports. *Economic Policy*, Vol. 23, Is. 53, pp. 6–49, January 2008.
- Timmer, M.P., B. Los, R. Stehrer and G.J. de Vries (2016). An Anatomy of the Global Trade Slowdown Based on the WIOD 2016 Release. Groningen Growth and Development Centre Research Memorandum 162, November 2016.
- Timmer, M.P., E. Dietzenbacher, B. Los, R. Stehrer and G.J. de Vries (2015). An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production. *Review of International Economics*, 23(3), pp. 575–605.
- Tukker, A. and E. Dietzenbacher (2013). Global Multi-Regional Input-Output Frameworks: An Introduction and Outlook. *Economic Systems Research*, Vol. 25, pp. 1–19, March 2013.
- Wang, Z. and S.J. Wei (2010). What Accounts for the Rising Sophistication of Chinese Exports? In Feenstra, R.C. & S.J. Wei (ed.), *China's Growing Role in World Trade*. National Bureau of Economic Research, March 2010.
- Xie, Z. and X. Zhang (2015). The Patterns of Patents in China. *China Economic Journal*, Vol. 8, No. 2, pp. 122-142.

Appendix 1. Description of the data and classifications

Countries and areas covered in the WIOD database

| | | | |
|----------------|---------------|-------------|-------------------|
| Australia | Estonia | Japan | Romania |
| Austria | Finland | Korea | Russia |
| Belgium | France | Latvia | Slovakia |
| Brazil | Germany | Lithuania | Slovenia |
| Bulgaria | Great Britain | Luxembourg | Spain |
| Canada | Greece | Malta | Sweden |
| China | Hungary | Mexico | Switzerland |
| Croatia | India | Netherlands | Taiwan |
| Czech Republic | Indonesia | Norway | Turkey |
| Cyprus | Ireland | Poland | United States |
| Denmark | Italy | Portugal | Rest of the world |

Sectors covered in the WIOD database and classifications used in the analysis

| | | | |
|---|--------------------|---|-----------------|
| A01 Crop and animal production, hunting and related service activities | | H50 Land transport and transport via pipelines | Low-tech serv. |
| A02 Forestry and logging | | H51 Water transport | Low-tech serv. |
| A03 Fishing and aquaculture | | H52 Air transport | Low-tech serv. |
| B Mining and quarrying | | H53 Warehousing and support activities for transportation | Low-tech serv. |
| C10–C12 Manufacture of food products, beverages and tobacco products | Low-tech manuf. | H54 Postal and courier activities | Low-tech serv. |
| C13–C15 Manufacture of textiles, wearing apparel and leather products | Low-tech manuf. | I Accommodation and food service activities | Low-tech serv. |
| C16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials | Low-tech manuf. | J58 Publishing activities | High-tech serv. |
| C17 Manufacture of paper and paper products | Low-tech manuf. | J59–J60 Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities | High-tech serv. |
| C18 Printing and reproduction of recorded media | Low-tech manuf. | J61 Telecommunications | High-tech serv. |
| C19 Manufacture of coke and refined petroleum products | | J62–J63 Computer programming, consultancy and related activities; information service activities | High-tech serv. |
| C20 Manufacture of chemicals and chemical products | Middle-tech manuf. | K64 Financial service activities, except insurance and pension funding | High-tech serv. |
| C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations | High-tech manuf. | K65 Insurance, reinsurance and pension funding, except compulsory social security | High-tech serv. |
| C22 Manufacture of rubber and plastic products | Middle-tech manuf. | K66 Activities auxiliary to financial services and insurance activities | High-tech serv. |
| C23 Manufacture of other non-metallic mineral products | Low-tech manuf. | L68 Real estate activities | High-tech serv. |
| C24 Manufacture of basic metals | Low-tech manuf. | M69–M70 Legal and accounting activities; activities of head offices; management consultancy activities | High-tech serv. |
| C25 Manufacture of fabricated metal products, except machinery and equipment | Low-tech manuf. | M71 Architectural and engineering activities; technical testing and analysis | High-tech serv. |
| C26 Manufacture of computer, electronic and optical products | High-tech manuf. | M72 Scientific research and development | High-tech serv. |
| C27 Manufacture of electrical equipment | High-tech manuf. | M73 Advertising and market research | High-tech serv. |
| C28 Manufacture of machinery and equipment n.e.c. | Middle-tech manuf. | M74–M75 Other professional, scientific and technical activities; veterinary activities | High-tech serv. |
| C29 Manufacture of motor vehicles, trailers and semi-trailers | Middle-tech manuf. | N Administrative and support service activities | |
| C30 Manufacture of other transport equipment | Middle-tech manuf. | O84 Public administration and defence; compulsory social security | |

| | | | |
|---|-----------------|--|--|
| C31–C32 Manufacture of furniture; other manufacturing | Low-tech manuf. | P85 Education | |
| C33 Repair and installation of machinery and equipment | | Q Human health and social work activities | |
| D35 Electricity, gas, steam and air conditioning supply | | R–S Other service activities | |
| E36 Water collection, treatment and supply | | T Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use | |
| E37–E39 Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services | | U Activities of extraterritorial organizations and bodies | |
| F Construction | | | |
| G45 Wholesale and retail trade and repair of motor vehicles and motorcycles | Low-tech serv. | | |
| G46 Wholesale trade, except of motor vehicles and motorcycles | Low-tech serv. | | |
| G47 Retail trade, except of motor vehicles and motorcycles | Low-tech serv. | | |

Appendix 2. Calculating the global value added production and exports

In calculating the global value added production and exports we follow the methodology presented in Timmer & al. (2015). We denote the output vector of countries and industries by Q , the coefficient matrix of intermediate inputs by B and the final demand vector by C . Then the output can be expressed:

$$Q = (I - B)^{-1}C,$$

where I is the identity matrix and $(I - B)^{-1}$ is so called Leontief inverse.

Next we need to extract the actual value added from the gross output by multiplying Q by a diagonal matrix F that contains the ratios of value added to gross output of all countries and industries in its diagonal. Now we can calculate the value added production K needed to supply final demand C :

$$K = F(I - B)^{-1}C$$

In order to get the value added production of different countries and sectors needed to supply final demand of country i , we use C_i for the calculation. Summing over the countries gives the total value added production, whereas excluding the production that is supplied for domestic demand results in value added exports.

Appendix 3. Constant market share analysis

Constant market share analysis is used for analyzing the factors that contribute to differing export performance of a country in comparison to its competitors, usually comprising all other countries. The following brief description is based on ECB (2005).

The total effect refers to the growth difference between total exports of China and the world aggregate. It can be decomposed into two main effects in the following way:

$$g^{CN} - g^W = [\sum_i \sum_j (\theta_{ij}^{CN} - \theta_{ij}^W)] + [\sum_i \sum_j \theta_{ij}^{CN} (g_{ij}^{CN} - g_{ij}^W)] \quad (1)$$

where g refers to percentage change in exports in period t and θ to share in exports in period $t-1$. Superscript CN stands for China and W for the world (excluding China), whereas subscripts i and j refer to sectors and destination markets respectively.

The first term in square brackets in (1) is the structure effect. It can be further decomposed to product effect (2), market effect (3) and mixed effect (4) in the following way:

$$\sum_i (\theta_i^{CN} - \theta_i^W) g_i^W \quad (2)$$

$$\sum_j (\theta_j^{CN} - \theta_j^W) g_j^W \quad (3)$$

$$\sum_i \sum_j \left[(\theta_{ij}^{CN} - \theta_{ij}^W) - (\theta_i^{CN} - \theta_i^W) \frac{\theta_{ij}^W}{\theta_i^W} - (\theta_j^{CN} - \theta_j^W) \frac{\theta_{ij}^W}{\theta_j^W} \right] g_{ij}^W \quad (4)$$

The product and market effects compare the specialization of China in individual sectors and markets with that of the rest of the world. The product and market effects are positive if China is more specialized on sectors and markets that are growing faster. The mixed effect is a residual and there is no straight-forward interpretation to it, but it reflects the interaction of product and market effects.

The second term in square brackets in (1) is the competitiveness or “pure” market share effect that sums the market share gains of China that are due to other factors than the structure effect.

Appendix 4. An example of differences between indicators calculated from the WIOD data and OECD TiVA data.

Share of Chinese value added in the final demand of individual countries, % (including only tradable sectors, i.e. manufacturing and business services both as destination and source sectors).

| | 2000 | | 2005 | | 2011 | | Difference, %-points | | |
|---------|------|------|------|------|------|------|----------------------|------|------|
| | WIOD | OECD | WIOD | OECD | WIOD | OECD | 2000 | 2005 | 2011 |
| AUS | 1.2 | 0.9 | 2.2 | 2.2 | 3.8 | 3.1 | 0.3 | 0.1 | 0.7 |
| AUT | 0.4 | 0.5 | 0.8 | 0.8 | 1.5 | 1.7 | -0.1 | 0.0 | -0.2 |
| BEL | 0.8 | 0.4 | 1.6 | 0.9 | 2.7 | 1.4 | 0.4 | 0.7 | 1.3 |
| BGR | 0.4 | 0.4 | 1.2 | 1.3 | 2.1 | 1.7 | 0.1 | -0.1 | 0.4 |
| BRA | 0.3 | 0.2 | 0.8 | 0.7 | 1.8 | 1.8 | 0.1 | 0.1 | -0.1 |
| CAN | 0.8 | 0.6 | 1.8 | 1.6 | 3.0 | 2.9 | 0.2 | 0.2 | 0.1 |
| CHE | 0.4 | 0.5 | 0.7 | 0.8 | 1.4 | 1.5 | 0.0 | -0.1 | -0.2 |
| CYP | 0.8 | 0.8 | 1.3 | 0.9 | 2.4 | 1.9 | 0.0 | 0.4 | 0.6 |
| CZE | 0.5 | 0.6 | 1.3 | 1.5 | 3.1 | 3.4 | 0.0 | -0.2 | -0.3 |
| DEU | 0.7 | 0.5 | 1.5 | 1.1 | 2.8 | 2.2 | 0.2 | 0.4 | 0.7 |
| DNK | 0.8 | 0.6 | 1.4 | 1.0 | 2.2 | 1.6 | 0.2 | 0.4 | 0.7 |
| ESP | 0.5 | 0.6 | 0.9 | 1.2 | 1.8 | 2.2 | -0.1 | -0.2 | -0.4 |
| EST | 0.7 | 0.6 | 1.5 | 1.6 | 3.3 | 3.3 | 0.0 | -0.2 | 0.0 |
| FIN | 0.6 | 0.5 | 1.5 | 1.2 | 2.6 | 2.0 | 0.1 | 0.3 | 0.6 |
| FRA | 0.6 | 0.5 | 1.0 | 1.1 | 1.9 | 2.1 | 0.1 | -0.1 | -0.2 |
| GBR | 0.7 | 0.6 | 1.2 | 1.1 | 2.4 | 2.3 | 0.2 | 0.1 | 0.0 |
| GRC | 0.5 | 0.5 | 1.0 | 1.1 | 2.3 | 1.5 | 0.0 | -0.2 | 0.8 |
| HRV | 0.4 | 0.3 | 1.2 | 1.2 | 2.5 | 2.2 | 0.0 | 0.0 | 0.3 |
| HUN | 1.0 | 0.5 | 1.3 | 1.3 | 2.2 | 2.1 | 0.4 | 0.0 | 0.2 |
| IDN | 1.8 | 1.1 | 2.2 | 2.2 | 3.8 | 4.1 | 0.7 | 0.0 | -0.2 |
| IND | 0.4 | 0.4 | 1.6 | 1.5 | 2.9 | 3.3 | 0.1 | 0.2 | -0.4 |
| IRL | 0.5 | 0.6 | 1.1 | 1.0 | 1.8 | 1.8 | -0.1 | 0.1 | 0.0 |
| ITA | 0.4 | 0.5 | 0.8 | 0.9 | 1.7 | 1.9 | 0.0 | -0.1 | -0.2 |
| JPN | 0.8 | 0.8 | 1.8 | 1.7 | 2.5 | 2.8 | 0.0 | 0.1 | -0.3 |
| KOR | 1.6 | 1.5 | 3.2 | 3.4 | 6.0 | 5.9 | 0.0 | -0.2 | 0.1 |
| LTU | 0.3 | 0.4 | 1.1 | 0.9 | 2.4 | 1.5 | -0.1 | 0.2 | 1.0 |
| LUX | 0.9 | 0.4 | 2.1 | 0.7 | 2.3 | 2.0 | 0.5 | 1.5 | 0.3 |
| LVA | 0.4 | 0.3 | 1.1 | 0.6 | 2.9 | 1.8 | 0.1 | 0.5 | 1.1 |
| MEX | 0.4 | 0.3 | 1.1 | 1.0 | 2.7 | 2.1 | 0.2 | 0.2 | 0.6 |
| MLT | 0.9 | 0.7 | 1.2 | 0.8 | 4.6 | 1.5 | 0.1 | 0.4 | 3.1 |
| NLD | 0.9 | 0.4 | 1.3 | 0.5 | 3.7 | 1.1 | 0.5 | 0.8 | 2.6 |
| NOR | 0.6 | 0.6 | 1.1 | 1.1 | 1.9 | 2.6 | 0.0 | 0.0 | -0.6 |
| POL | 0.6 | 0.5 | 1.1 | 1.2 | 2.6 | 3.2 | 0.1 | -0.1 | -0.6 |
| PRT | 0.3 | 0.3 | 0.6 | 0.5 | 1.3 | 1.2 | 0.0 | 0.1 | 0.1 |
| ROU | 0.5 | 0.3 | 1.1 | 0.9 | 2.1 | 1.4 | 0.2 | 0.2 | 0.7 |
| RUS | 1.4 | 0.8 | 2.5 | 1.3 | 4.6 | 3.4 | 0.6 | 1.2 | 1.2 |
| SVK | 0.3 | 0.4 | 1.1 | 0.9 | 2.3 | 2.0 | 0.0 | 0.2 | 0.3 |
| SVN | 0.3 | 0.5 | 1.0 | 1.4 | 2.8 | 3.0 | -0.2 | -0.4 | -0.2 |
| SWE | 0.5 | 0.4 | 1.1 | 1.1 | 2.2 | 2.6 | 0.1 | 0.1 | -0.4 |
| TUR | 0.3 | 0.3 | 1.0 | 1.0 | 2.6 | 2.8 | 0.0 | 0.0 | -0.2 |
| TWN | 1.0 | 1.8 | 2.6 | 3.7 | 4.3 | 6.6 | -0.8 | -1.1 | -2.4 |
| USA | 0.6 | 0.7 | 1.3 | 1.5 | 2.2 | 2.6 | -0.1 | -0.2 | -0.4 |
| Average | 0.7 | 0.6 | 1.4 | 1.2 | 2.7 | 2.4 | 0.1 | 0.1 | 0.2 |
| MAX | 1.8 | 1.8 | 3.2 | 3.7 | 6.0 | 6.6 | 0.7 | 1.5 | 3.1 |
| MIN | 0.3 | 0.2 | 0.6 | 0.5 | 1.3 | 1.1 | -0.8 | -1.1 | -2.4 |
| CHN | 81.1 | 80.8 | 75.2 | 74.4 | 81.7 | 80.4 | 0.2 | 0.8 | 1.2 |

- 2013 No 1 K.C. Fung, Hsiang-Chih Hwang, Francis Ng and Jesús Seade: International trade and production networks: Comparisons of China and greater China versus India and South Asia
 No 2 Heli Simola, Laura Solanko and Vesa Korhonen: Näkökulmia Venäjän energiasektoriin
 No 3 Heli Simola, Laura Solanko and Vesa Korhonen: Perspectives on Russia's energy sector
 No 4 Hubert Fromlet: The Chinese Government Debt – What Do We Know and What Should Be Done?
 No 5 Laura Solanko and Lauri Vilmi: Globaalit energiamarkkinat murroksessa
 No 6 Laura Solanko and Lauri Vilmi: The transformation of global energy markets
 No 7 Andrei Yakovlev: Is there a 'new deal' in state-business relations in Russia?
 No 8 Ilkka Korhonen, Vesa Korhonen, Seija Lainela and Laura Solanko: Venäjän kasvu vaatii muutakin kuin energiaa. BOFIT Venäjä-tietoisuus 2013
 No 9 Sergey Vlasov: Analysis of Russia's fiscal sustainability under the new fiscal rules
 No 10 Heli Simola: Turkin talous – saadaanko kasvu kestäväälle pohjalle?
 No 11 Juuso Kaarevirta, Ilkka Korhonen, Jouko Rautava, Heli Simola and Laura Solanko: Kiina ja uudistusten aika. BOFIT Kiina-tietoisuus 2013
- 2014 No 1 Jouko Rautava: Crimean crisis will cost Russia too
 No 2 Jouko Rautava: Krimin kriisi on jo nyt tullut kalliiksi Venäjälle
 No 3 Heli Simola: Tracing trade interdependency between EU and East Asia
 No 4 Heli Simola and Laura Solanko: Kaasu jälleen kiistakapulana Venäjän ja Ukrainan välillä
 No 5 Heli Simola and Laura Solanko: Gas once again a bone of contention between Russia and Ukraine
 No 6 Ilya Voskoboinikov and Laura Solanko: When high growth is not enough: Rethinking Russia's pre-crisis economic performance
 No 7 Ilkka Korhonen, Vesa Korhonen, Seija Lainela, Heli Simola and Laura Solanko: BOFIT Venäjä-tietoisuus 2014
 No 8 Zuzana Fungáčová and Laurent Weill: A view on financial inclusion in Asian countries
 No 9 Heli Simola: Russia's restrictions on food imports
 No 10 Zuzana Fungáčová and Ilkka Korhonen: Ukrainian banking sector in turmoil
 No 11 Yin-Wong Cheung: The role of offshore financial centers in the process of renminbi internationalization
 No 12 Lev Freinkman and Andrey Yakovlev: Institutional frameworks to support regulatory reform in middle-income economies: Lessons from Russia's recent experience
 No 13 Yao Lei: Policy discussion of internet finance in China
 No 14 Riikka Nuutilainen: Shanghain ja Hongkongin pörssiysteistyökoikeilu avasi Kiinan osakemarkkinat ulkomaisille yksityissijoittajille
 No 15 Hubert Fromlet: Deregulation of financial markets and the risk of financial crises: Lessons from Sweden for China and other emerging economies
 No 16 Annikki Arponen, Ilkka Korhonen, Riikka Nuutilainen, Jouko Rautava and Heli Simola: BOFIT Kiina-tietoisuus 2014
- 2015 No 1 Alexey Kudrin and Evsey Gurvich: A new growth model for the Russian economy
 No 2 Heli Simola: Venäjän valuuttavaroja ja rahastot
 No 3 Stephan Barisitz and Zuzana Fungáčová: Ukraine: Struggling banking sector and substantial political and economic uncertainty
 No 4 Heli Simola: Russia's international reserves and oil funds
 No 5 K.C. Fung, Alicia García-Herrero and Jesús Seade: Beyond minerals: China-Latin American Trans-Pacific supply chain
 No 6 Anni Norring: Suomen ja Venäjän välisten suorien sijoitusten tilastot
 No 7 Vesa Korhonen, Zuzana Fungáčová, Laura Solanko, Ilkka Korhonen ja Heli Simola: BOFIT Venäjä-tietoisuus 2015
 No 8 Yang Yao: When are fixed exchange rates an appropriate policy tool for growth?
 No 9 Heli Simola: Rebalancing of demand in China – illustrating possible effects with an input-output analysis
 No 10 Ilkka Korhonen: How fast can Russia grow?
 No 11 Jouko Rautava, Riikka Nuutilainen, Anni Norring, Ilkka Korhonen ja Jyrki Kallio: BOFIT Kiina-tietoisuus 2015
- 2016 No 1 Riku Niemi: The Eurasian Union – much potential, little results
 No 2 Andrei Yakovlev: What is Russia trying to defend?
 No 3 Andrei Yakovlev, Lev Freinkman and Anton Zolotov: Domestic and external factors in the development of Russia's economic think tanks sector
 No 4 Mikko Mäkinen: Nowcasting of Russian GDP growth
 No 5 Ilkka Korhonen, Tuomas Forsberg, Vesa Korhonen ja Heli Simola: BOFIT Venäjä-tietoisuus 2016
 No 6 Heli Simola: Economic relations between Russia and China – Increasing inter-dependency?
 No 7 Ivan Lyubimov: Are educational reforms necessarily growth-enhancing? Weak institutions as the cause of policy failure
 No 8 Laura Solanko: Opening up or closing the door for foreign trade – Russia and China compared
 No 9 Heli Simola ja Vesa Korhonen: Arktisen alueen taloudellinen merkitys Venäjälle
 No 10 Masaaki Kuboniwa: Estimating GDP and foreign rents of the oil and gas sector in the USSR then and Russia now
 No 11 Masaaki Kuboniwa: Considerations on new Rosstat data on the contribution of Russia's military goods sector to GDP growth in recent years
- 2017 No 1 Jouko Rautava: Kiinassa talouspolitiikka ei pysy maan muutosten vauhdissa
 No 2 Heli Simola: China's growing role in global production boosted by strong competitiveness – evidence from international input-output tables