全球價值鏈的新趨勢與中國的創新能力

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中文摘要

近期全球貿易凸顯的新現象是全球貿易的成長持續低於全球國內生產總值(Gross Domestic Product, 簡稱GDP)。2005年以前，全球貿易量的成長速度一直比產量為快，且通常是比後者快兩倍。但自2000年以後兩者間的差距開始縮小，而至2005年起GDP增長超越貿易成長速度(除2008年全球金融風暴後短暫例外)。此一發展伴隨而來的驚人事實是新智能技術與跨境資料流動的竄起。許多國際公司正採用新技術如3D來生產零件與組件，這對中國的創新與工業升級議程構成新的而且是迫切的挑戰。目前中國已高度融入全球價值鏈(global value chain, GVC)之中，且就全球附加價值而言已成為世界最大的製造王國。但若檢視服務業、製造業與主要出口對GVC參與的貢獻，中國服務業對製造業出口的貢獻，與南韓、日本與其他新興經濟體相較，仍然很低(尤其是在研發、設計與商業服務等)。

這意味著中國不斷增加的研發與技術創新支出並未能產出相對應的成效，出口的競爭力仍主要來自製造與加工的活動。此一情況有賴進一步改善中國的創新生態體系(ecosystem)。

New Trends of Global Value Chains and China's Innovation Capacity

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Abstract: A new phenomenon of the global trade is that its growth has been lower than the global GDP growth. Before 2005, global trade has been growing much faster than the output, and used to be twice as fast, however, since 2000, the gap between the global trade growth and GDP growth began to narrow, and from 2005, the GDP growth surpassed the trade growth except the brief period following the 2008 financial crisis. A striking fact that accompanies this change is the rapid emergence of new intelligence technologies and trans-border data flow. Many international companies are adopting new technologies such as 3D to manufacture parts and components. This poses new and more urgent challenges to China's innovation and industrial upgrading agenda. Currently China is highly integrated into the global value chain, and has become the biggest manufacturing country in terms of global value added. However, when examining the contributions of services, manufacturing and primary exports to the global value chain (GVC) participation, the contribution of Chinese services (especially R&D, design, and business services, etc.) to the manufacturing exports is still low compared with Korea, Japan and other emerging economies. This shows that China's increasing inputs in R&D and technology innovation has not yielded

the commensurate outputs and the export competitiveness is still mainly coming from the manufacturing and processing activities. This situation calls for further improvements in its innovation ecosystem.

I. New Trends of Global Trade and GVC

Global trade growth remains modest following three years of weak expansion. The growth of merchandise trade in terms of volume were just 2.2% in 2012, 2.5% in 2013 and 2014. In 2015, the value of total goods trade fell 13.8% -- the biggest plunge since 2009, but in terms of volume, it grew 2.5%, lower than the global GDP growth of 3.1% (Figures 1 and 2). In 2014, the exports of developing and emerging economies grew faster than those of developed countries, 3.1% in the former and 2.0% in the latter. Meanwhile, imports of developing countries grew more slowly than those of developed economies, 1.8% compared to 2.9%. In 2015, the exports and imports showed the same trend.

Figure 1. Index of World Trade by USD Value

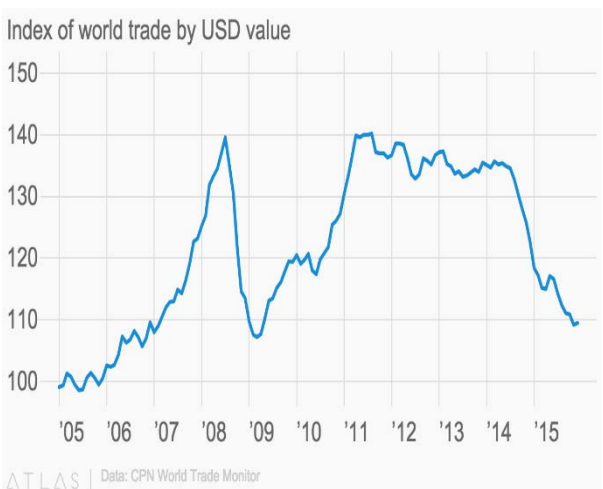
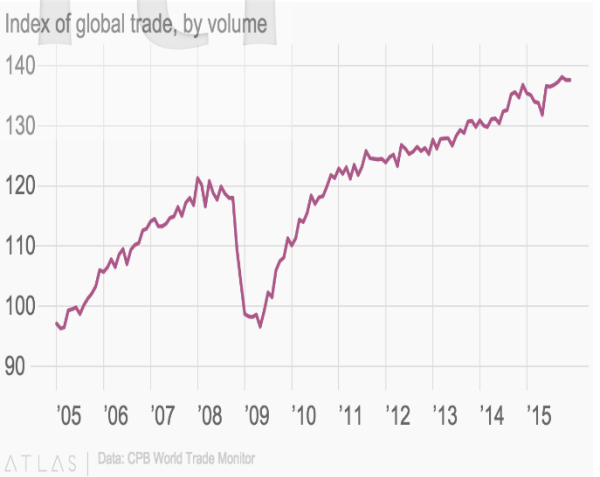


Figure 2. Index of World Trade by Volume



A. Trade vs. GDP Growth

A new phenomenon of the global trade is that its growth has been lower than the global GDP growth. The chart below shows that before 2005, global trade has been growing much faster than the output, and used to be twice as fast, however, since 2000, the gap between the global trade growth and GDP growth began to narrow, and from 2005, the GDP growth surpassed the trade growth except the brief period following the 2008 financial crisis (Frankel 2015). Furthermore, the flows of finance, people and trade have slowed – falling from a peak of 53% of global output in 2007 to 39% in 2014 (McKinsey Global Institute 2016; Financial Times 2016; Donnan 2016). Meanwhile, the elasticities of global merchandise trade with respect to real GDP was declining since 2000, and the speed of decline has accelerated in recent years (UNCTAD 2013).

There are several reasons which contributed to this change, which include China slow-down, and rebalancing of the growth model, which leads to reduction of demand for commodities and manufacturing inputs. Another reason could be the sluggish global demand, especially the Europe. However, all these factors seem not enough to explain the all the drop of global trade.

A striking fact that accompanies this change is the rapid emergence of new intelligence technologies and trans-border data flow (Donnan 2016). The flow of digital information around the world more than doubled between 2013 and 2015, to an estimated 290 terabytes per second. That figure will grow by a third again this year, meaning that by the end of 2016 companies and individuals around the world will send 20 times more data across borders than they did in 2008. In 2014, cross-border flows of capital, goods, services and data added an extra $7.8tn to the global economy. The added value of data flows alone accounted for $2.8tn of that total, slightly more than the $2.7tn attributed to the global trade in goods (Donnan 2016).

Major companies adopt new technologies, like General Electric, which is using 3D printers to make fuel nozzles for jet engines and expects its aviation unit to be manufacturing 100,000 parts using the technology by 2020. For larger standardized items, such as telecom infrastructure equipment, the impact of 3D technology might be limited since the benefits of scale will still outweigh the requirements for customization. However, the impact could be huge on the production of highly

customized products, such as consumer products, specialized personal devices, that are less amenable to large scale standardized production. For these products, we will see more de-centralized networks of production with smaller scale entities producing tailored products for local markets (World Bank 2016a).

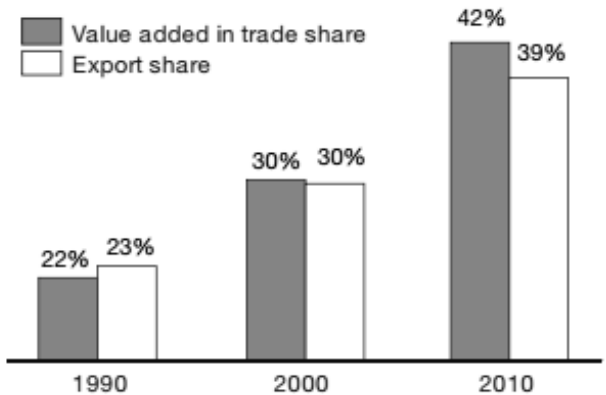
The emergence of Internet of Things, so called "the Fourth Industrial Revolution", coupled with intelligent technologies and "big data", may alter the principles by which value and efficiencies are generated in a wide range of industrials and will fundamentally transformed the global supply and value chains. Manufacturing footprints are likely to be more de-centralized, moving away from the past paradigm of consolidation and maximization of economies of scale. More specifically, the following new trends are expected to happen in the global supply and value chains (World Bank 2016a):

- Moving from economies of scale to lower minimum economic scale wither lower barriers to entry for new companies;
- Moving from complex multi-tier supply chains to fewer tiered supply chains with less intermediate tiers of sub-contractors; and
- Moving from global supply chains to more localized and customized manufacturing, with distribution of world's manufacturing being more regional and local.

B. Developed Countries vs. Developing Countries

Share of developing countries in global value added trade and in gross exports had increassed from 22% and 23%, respectively, in 1990 to 42% and 39% in 2010 (Figure 3). The G20 developing countries have been developing especially fast in terms of imports of parts and components (UNCTAD 2013).

Figure 3. Shares of Developing Countries in Global Value Added and Exports



Source: UNCTAD-Eora GVC Database.

C. GVC Participation and GDP Per Capita

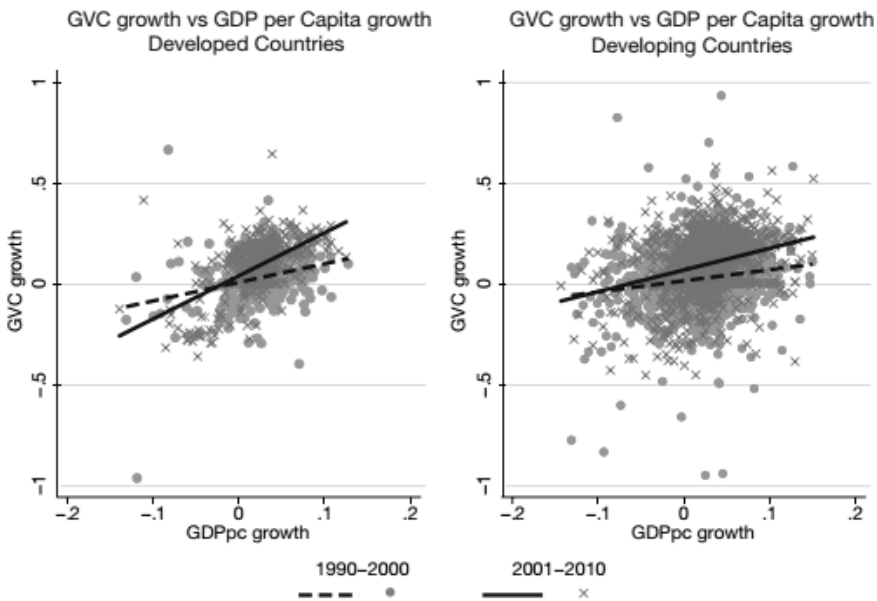
Among the top 25 exporters in the world, US is still the No.1 in terms of the domestic value added as a share of the total export, followed by China, Germany, Japan, France and UK.

In terms of the participation rate in the global value chain, Singapore was the first with a ratio of 82% in 2010. US

has a much lower participation rate of 45%, but its exports are mostly in the downstream part (UNCTAD 2013).

Regressions show that there is a strong correlation between GVC growth and GDP per capita growth in both developed and developing countries, and since 2000, this correlation seems to have become stronger (Figure 4).

Figure 4. The Correlation between GVC Growth and GDP Per Capita Growth



Source: UNCTAD-Eora GVC Database, 2013. Cited from UNCTAD, "Global Value Chains and Development: Investment and Value Added Trade in Global Economy" (A preliminary analysis), 2013.

II. China's GVC Participation

China's trade has been growing very rapidly since 2005 and China is now the biggest trading nation in the world (World Bank, 2016b). China is also highly integrated into the global value chain, and has become the biggest manufacturing country in terms of global value added (Boffa, et al. 2015). In 1995, China was only a supplier to the U.S., but by 2011, China has become a key producer of global value added, together with the U.S. and Germany.

China's share of global value added in manufacturing rose from less than 7% in 2000 to nearly 26% in 2014 (WEF, 2015). From 2000 to 2011, China's ratio of domestic value added embodied in gross exports increased from 63 percent to 68 percent (Boffa, et al. 2015).

Table 1 shows the growth of domestic value added in different sectors in relation to Japan and Korea. Based on the research of Botta et al. (2015), the foreign value added embodied in the gross exports of China had decreased from 37.2% in 2000 to 32% in 2000, and meanwhile, China's domestic value added embodied in third countries' exports had increased from 10.8% to 15.6%. China's share of imports of parts and components (foreign value added) in its exports has been falling rapidly, which shows that its supply chain has become mature (Constantinescu, Mattoo, and Ruta 2015).

Table 1. Growth of Domestic Value Added by Sectors in China (2000-11)

Sector	Compounded Average Growth Rate (%), 2000-11,			Percentage Share of Suppliers, 2011
	China	Japan	Korea	China
Total economy	20.6	4.4	8.8	54.5
Textiles, leather & footwear	16.6	2.6	-2.4	67.7
Computer, electronic and optical equipment	32.0	0.2	6.6	56.5
Electrical machinery and apparatus, nec	25.5	7.1	15.5	65.3
Other non-metallic mineral products	19.9	8.3	6.2	55.0
Manufacturing nec; recycling	18.1	3.9	-7.0	67.6
Wholesale and retail trade; repairs	18.2	4.2	7.3	30.2
Transport and storage	18.4	4.8	3.3	41.5
R&D and other business activities	24.0	4.4	14.4	61.8

Source: Boffa, et al., 2015.

China has larger opportunities for further lengthening the value chain domestically in sectors where its imports tend to be upstream and exports tend to be downstream. Two sectors with the highest potentials seem to be the textiles and electronics, which show large gaps between import and export upstreamness.

China is still the largest exporter of textile products. In 2014, its exports was US$112 billion, 35.6% of the global market share (Statista 2016), although Vietnam has become No.1 in terms of the textile exports as a share of total merchandise exports. China absorbs 27.5 percent of global value added flows, followed by Italy, which is the second market for foreign value added in textiles (12.9 percent) then by France (5.1%) and Germany (4.2%) (WEF 2012).

III. China's Innovation Capacity – A GVC Perspective

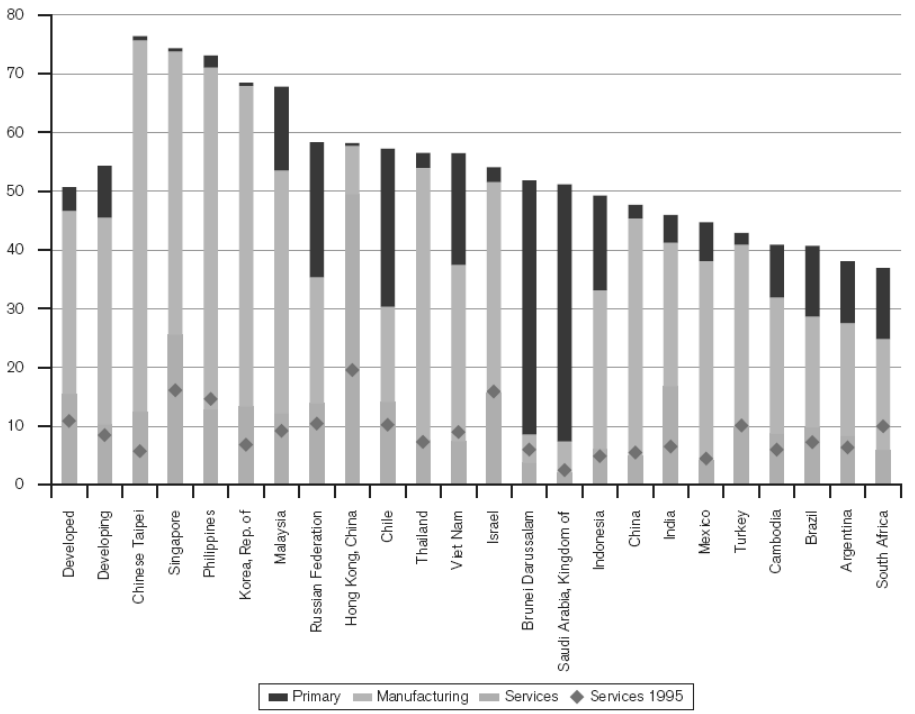
China has achieved export competitiveness in many sectors, but is China's industry truly innovative? If we examine the contributions of services, manufacturing and primary exports to the GVC participation by economy, from 1995 to 2008, China's contribution of services (including R&D, design, logistics, distribution, business consulting, branding, marketing, etc.) had remained at low level and had almost not changed in almost 14 years, and the dominant contribution of China's GVC participation is from the manufacturing activities (WTO 2014). At the same time, in Singapore, Korea, Hong Kong (China), Taiwan (China), and India, the contribution of services have all gone up (Figure 5).

If we look at the sectoral level, even in the strongest sector – textiles and leather, the value added contribution of domestic services (especially R&D and business services) for exports is still much lower than East Asian rivals and other emerging economies, such as Japan, Korea, Mexico and Poland in 2011, though higher than Thailand, Singapore and Malaysia. In terms of the value added contribution of foreign services, China is still lower than Korea, Singapore, Malaysia, Mexico and Poland (Boffa, et al. 2015).

In the electronics sector, the value added contribution of domestic services is also much lower than Korea and Japan, and even lower than Singapore and Mexico, though higher than Thailand and Malaysia in 2011. In terms of the contribution of foreign services for exports, China is comparable to Korea and Thailand, higher than

Japan, but lower than Singapore, Poland and Mexico (Boffa, et al. 2015).

Figure 5. Contributions of Services, Manufacturing and Primary Exports to the GVC Participation (1995 vs. 2008)



Note: Utilities are included with agriculture and mining in the primary sector.

Source: OECD-WTO TiVA Database. Cited from WTO: World Trade Report, 2014.

This shows that, despite the impressive progress China has made in increasing its technology and innovation capacity and industrial upgrading in the recent decade, its increasing inputs in R&D and technology innovation has not yielded the commensurate outputs in the production sectors and the export competitiveness is still mainly coming from the manufacturing and processing activities.

Although China is making the transition from “Made in China” to “Invented in China” in an economy that is slowing, its vast manufacturing sectors (especially SMEs in labor-intensive sectors) are facing difficulties moving up the global value chain. Some of them have moved overseas. Despite its rapid growth of patent applications, China’s total number of patents that were granted by the USPTO was 7,921 in 2014 – less than half of Korea’s or Germany’s number. Many of China’s successful patent applications were actually owned by multinationals. Universities generate a large volume of patents, but their utilization rate is only about 5 percent, with the bulk of the research not relevant for business.

Overall in 2013, China invested relatively little of its R&D spending (just 4 percent) in basic research compared to most OECD economies (17 percent), and its R&D spending is still heavily oriented toward developing S&T infrastructure, i.e. buildings and equipment (OECD 2015). With regard to top-cited scientific publications, China may seem to be converging with the United States in terms of volume, but the same does not hold true in terms of quality, if measured by the percentage of domestic documents in the top 10 percent of most-cited publications (OECD 2015).

China is still far behind the United States and Germany in terms of firm-level technology absorption, the rule of law, regulatory quality, private-sector spending on R&D and quality of management schools, among other priorities. The recent Global Competitiveness Report 2015 from the World Economic Forum underscored these weaknesses by ranking China at No. 68, out of 140 countries, for "higher education and training" and at 74 for "technological readiness" (WEF 2015). Although China has the world's largest pool of human resources for science and technology, the share of tertiary graduates in general, and of doctoral graduates in science and engineering in particular, are still low. These have prevented China from fully reaping the benefits from its rapidly increasing S&T inputs (Zeng 2015).

This situation calls for further improvements in its innovation ecosystem. Among other priorities, China will greatly benefit from the following (Zeng 2015):

- Strengthen its intellectual property rights (IPR) protection, especially the enforcement of the laws. This is important not only for attracting foreign high-tech firms and R&D centers, but also for encouraging firms to increase their spending on R&D and technology innovation.
- Encourage competition through a more level playing field. This requires further opening up many sectors now dominated by state-owned enterprises, and to provide more opportunities for SMEs. Government and the banking and financial sectors will also need to help SMEs to enhance their access to finance. Certain

programs such as innovation vouchers could be applied for technology-type SMEs.

- Strengthen the effectiveness and quality of R&D. The current research evaluation system at universities needs to be revised to put a greater focus on utilization, and needs to strike a balance between quantity and quality, especially in the applicability of research. This will also require some institutional reforms, such as reforming the curriculum and pedagogies, increasing the autonomy of researchers, encouraging business-academia linkages, and creating better incentives for market-driven R&D and entrepreneurial activities.

- Further promote process, organizational and management innovation. The current system puts too much emphasis on the technological aspects, and does not devote enough attention to the organizational and management aspects, including business and innovation management. Many firms still need process innovation, including business process reengineering. There is a great shortage of talent in the areas of business consulting, especially knowledge of how to link technologies to the market.

- Strengthen technology diffusion. To effectively let technologies migrate from high-tech parks, universities and research labs to industries and firms, China needs to further strengthen its various technology incubators, engineering and productivity centers; its sectoral extension services, which need a market-driven approach; and its technology norms and standards, especially those related to quality, safety and green production.

IV. Conclusion

China has achieved spectacular growth of domestic value added embodied in gross exports, as firms substituted domestic inputs for imported ones, suggesting upgrading in both upstream industries as well as in the processing trade sector. China has also achieved export competitiveness in many manufacturing sectors, such as textiles, electronics, equipment, etc., and has become the world's largest exporter. In 2015, the highest value of Chinese export products were topped by technology-related goods, from sophisticated telecommunications equipment to computer device components.

However, on the other hand, the contribution of Chinese services, especially R&D and business services, to the manufacturing exports is still low compared with Korea, Japan and other emerging economies, and the rapid increase of R&D and S&T inputs has not effectively translated into commensurate business results.

China has set a national target of becoming a leading innovative country by 2020. Reaching this target depends on continuing policy reform to further improve a balanced relationship between the government and market forces; to establish a more comprehensive innovation ecosystem; to nurture a legal and regulatory system that encourages investment in innovation and entrepreneurship by all sectors; and to foster open and fair competition among private, state-owned, and foreign enterprises (Dutta, Lanvin and Wunsch-Vincent 2015).

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