ธนาคารแห่งประเทศไทย
BANK OF THAILAND

เมื่อเศรษฐกิจแดนมังกรพลิกโฉม: นัยต่อเศรษฐกิจไทย

China's Growth in Transition: Implications for the Thai Economy

ณชา อนันต์โชติกุล
พรพินันท์ ฉันทภักดีพงศ์
โชติมา สิทธิชัยวิเศษ

เพื่อความเป็นอยู่ที่ดีอย่างยั่งยืนของไทย

www.bot.or.th

สัมมนาวิชาการประจำปี 2554

เมื่อเศรษฐกิจแดนมังกรพลิกโฉม: นัยต่อเศรษฐกิจไทย

ณชา อนันต์โชติกุล
พรพินันท์ ฉันทภักดีพงศ์
โชติมา สิทธิชัยวิเศษ*

สายนโยบายการเงิน และสายนโยบายสถาบันการเงิน
ธนาคารแห่งประเทศไทย
ตุลาคม 2554

บทคัดย่อ

จีนผงาดขึ้นอย่างรวดเร็วสู่ความเป็นมหาอำนาจทางเศรษฐกิจ และกลายเป็นความหวังสำคัญในการขับเคลื่อนเศรษฐกิจโลกในระยะต่อไป คำถามสำคัญคือ เศรษฐกิจจีนจะยังสามารถโตอย่างรวดเร็วอย่างที่ผ่านมาได้อีกนานเท่าไร ทิศทางเศรษฐกิจจีนจะเปลี่ยนไปอย่างไร และการเปลี่ยนแปลงนี้จะนำมาซึ่งโอกาสและความเสี่ยงต่อเศรษฐกิจไทยอย่างไร จากการวิเคราะห์รูปแบบและแหล่งที่มาของการเติบโตที่ผ่านมาของจีน บทวิจัยได้ข้อสรุปว่า ในระยะปานกลาง จีนจะยังสามารถโตต่อไปได้โดยการทุ่มทรัพยากรเพื่อยกระดับการสะสมทุน ที่ยังคงอยู่ในระดับต่ำเมื่อเทียบกับประเทศพัฒนาแล้ว แต่ในระยะยาว ปัญหาด้านโครงสร้างการจัดสรรทรัพยากรการผลิต และปัญหาด้านโครงสร้างประชากร จะกลายมาเป็นข้อจำกัดที่สำคัญมากยิ่งขึ้นในการที่จีนจะรักษาความยั่งยืนของการขยายตัวทางเศรษฐกิจให้คงอยู่ในระดับสูงต่อไป ทางหนึ่งที่จีนกำลังเร่งดำเนินการอย่างจริงจังเพื่อก้าวข้ามข้อจำกัดเหล่านี้ คือ ใช้ความก้าวหน้าทางเทคโนโลยีในการยกระดับผลิตภาพและไต่ห่วงโซ่มูลค่าขึ้นไปให้ได้ ซึ่งจะส่งผลให้เกิดการเปลี่ยนโครงสร้างการผลิตและการส่งออกของจีน

แม้ว่าที่ผ่านมาเศรษฐกิจไทยจะได้รับประโยชน์อย่างมากจากการเติบโตของประเทศจีนผ่านทางช่องทางการค้าต่างๆ แต่การที่เศรษฐกิจไทยหวังจะโตไปกับจีนโดยการพึ่งพาโครงสร้างการส่งออกแบบเดิมๆ เพียงอย่างเดียวนั้น ไม่ใช่การเติบโตที่ยั่งยืน ไทยควรจะมองความสำเร็จของจีนเป็นตัวอย่างในการพัฒนาศักยภาพและเทคโนโลยีของตัวเอง เพื่อสามารถพัฒนาอุตสาหกรรมในประเทศได้อย่างต่อเนื่องซึ่งจะทำให้เศรษฐกิจไทยเติบโตอย่างยั่งยืนจนกระทั่งสามารถก้าวข้าม middle income trap ได้ในที่สุด

---

* คณะผู้วิจัยขอขอบคุณ ดร.อัมพร แสงมณี และคุณสุพัฒน์พงษ์ นาวารัตน์ เป็นอย่างสูง ในฐานะที่ปรึกษาของบทความนี้ และขอขอบคุณ ดร.รุ่ง มัลลิกะมาส ที่ให้ข้อคิดเห็นที่เป็นประโยชน์ตลอดการทำวิจัย

BOT Symposium 2011

China's Growth in Transition: Implications for the Thai Economy

Nasha Ananchotikul

Pornpinun Chantapacdepong

Chotima Sitthichaiviset*

Bank of Thailand

October 2011

The views expressed in this paper are those of the authors and do not necessarily represent those of the Bank of Thailand

Abstract

China has rapidly emerged as a global economic superpower and is expected to remain the main growth driver in the next phase of the global economy. Questions often raised are: How long can China's extraordinary growth be sustained? What direction the Chinese economy is heading towards and what does it imply about opportunities and risks for other countries, including Thailand from our point of interest? From a review of China's growth pattern and an in-depth analysis of sources of growth, we put forward that, in the short to medium term, China's potential output growth will remain strong driven mainly by continued capital deepening. In the longer term, however, factor market distortions, misallocation of resources, and the demographic shift in China will increasingly become the key bottlenecks to China's sustainable growth. Realizing these growth limitations, the Chinese leaders have recently shifted the growth paradigm by resorting to technology leapfrogging in lifting productivity and moving up the value chain. This will significantly change the future pattern of production and exports in China.

The Thai economy has greatly benefited from the rising of the Chinese economy through various trade channels. But in order for Thailand to continue to reap these benefits, a sole reliance on the same export pattern will not be enough. Thailand should learn from China's success in productivity and industrial upgrading and technological advancement, as serious efforts in this direction are much needed for Thailand to escape the middle income trap.

* We are grateful to Amporn Sangmanee, Supatpong Navaratan, Roong Mallikamas, and discussants at the Bank of Thailand for their helpful comments. Any errors are our own. The views expressed in this article are not necessary those of the Bank of Thailand.

เมื่อเศรษฐกิจแดนมังกรพลิกโฉม: นัยต่อเศรษฐกิจไทย
บทสรุปผู้บริหาร

การที่จีนผงาดขึ้นอย่างรวดเร็วสู่ความเป็นมหาอำนาจทางเศรษฐกิจ และกลายเป็นความหวังสำคัญในการขับเคลื่อนเศรษฐกิจโลกในระยะต่อไป ทำให้เกิดคำถามสำคัญคือ เศรษฐกิจจีนจะยังสามารถโตอย่างรวดเร็วเหมือนเช่นที่ผ่านมาได้อีกนานเท่าไร ทิศทางเศรษฐกิจจีนจะเปลี่ยนไปอย่างไร และการเปลี่ยนแปลงนี้จะนำมาซึ่งโอกาสและความเสี่ยงต่อเศรษฐกิจไทยอย่างไร

<u>การเติบโตของเศรษฐกิจจีนที่ผ่านมา</u>

จากการวิเคราะห์รูปแบบและแหล่งที่มาของการเติบโตทางเศรษฐกิจจีนที่ผ่านมา พบว่า ปัจจัยสำคัญที่ทำให้การขยายตัวทางเศรษฐกิจจีนอยู่ในระดับตัวเลขสองหลักมาเป็นเวลากว่า 30 ปี คือ การลงทุนในระดับสูง (เฉลี่ย 40% ของ GDP) และการปรับปรุงผลิตภาพ (Total Factor Productivity: TFP) ด้วย (1) การปรับโครงสร้างทางเศรษฐกิจจากภาคเกษตรกรรมสู่ภาคอุตสาหกรรม (2) การปรับโครงสร้างองค์กรการผลิต โดยลดบทบาทของภาครัฐ และหันมาใช้ระบบตลาดมากขึ้น (3) การเรียนรู้เทคโนโลยีจากต่างประเทศ และ (4) การพัฒนาความก้าวหน้าทางเทคโนโลยีภายในประเทศเอง ซึ่งที่ผ่านมาจีนได้ประโยชน์จาก 3 ช่องทางแรกอย่างมาก แต่ในระยะต่อไปทั้ง 3 ช่องทางนี้จะมีข้อจำกัดมากขึ้น ทำให้จีนมีความจำเป็นมากขึ้นที่ต้องอาศัยช่องทางที่ (4) ในการพัฒนาผลิตภาพ

<u>ทิศทางต่อไปของเศรษฐกิจจีน</u>

การศึกษาพบว่า เศรษฐกิจที่ขยายตัวอย่างรวดเร็วพอถึงจุดหนึ่งจะไม่สามารถรักษาการขยายตัวทางเศรษฐกิจให้อยู่ในระดับสูงต่อไปได้ เพราะถึงแม้ว่ายังสามารถรักษาระดับการเติบโตของการสะสมทุน การจ้างงาน และการสะสมทรัพยากรมนุษย์ (human capital) แต่อัตราการเติบโตของ TFP มักลดลงมาก (ลดลงเฉลี่ย 3.3%) ดังนั้น คำถามที่ว่าจีนจะยังสามารถโตอย่างรวดเร็วเท่าที่ผ่านมาได้หรือไม่นั้น ขึ้นอยู่กับว่าจีนจะสามารถยกระดับ TFP ให้สูงขึ้นอย่างต่อเนื่องได้อีกนานเพียงใด

บทวิจัยได้ข้อสรุปว่า ในระยะสั้นถึงระยะปานกลาง เศรษฐกิจจีนยังสามารถโตต่อไปได้ไม่ต่ำกว่าอัตราเฉลี่ยปีละ 7% โดยตัวขับเคลื่อนหลักยังคงเป็นการทุ่มทรัพยากรเพื่อยกระดับการสะสมทุนต่อหัว (capital to labor ratio) ที่ยังคงต่ำเมื่อเทียบกับประเทศพัฒนาแล้ว ประกอบกับระดับการออมในประเทศที่สูง ทำให้มีศักยภาพในการลงทุนได้ในระดับสูงต่อไป แต่อัตราการเติบโตทางเศรษฐกิจจะสูงกว่านี้หรือไม่ ขึ้นอยู่กับความสามารถในการยกระดับ TFP ในระยะยาว ซึ่งปัญหาด้านโครงสร้างการจัดสรรทรัพยากรการผลิต เช่น การมีรัฐวิสาหกิจยังคงมีบทบาทค่อนข้างมากในระบบเศรษฐกิจ และและปัญหาด้านโครงสร้างประชากรที่มีอายุมากขึ้น จะกลายมาเป็นอุปสรรคสำคัญ จีนจึงจำเป็นต้อง **(1) ปฏิรูปโครงสร้างเศรษฐกิจครั้งใหญ่อีกครั้ง** จากที่เคยมีการปฏิรูปรัฐวิสาหกิจในช่วงปลาย 1990s เพื่อจัดสรรทรัพยากรอย่างมีประสิทธิภาพยิ่งขึ้น โดยให้ราคาของปัจจัยการผลิตเป็นไปตามกลไกตลาดเพื่อสะท้อนต้นทุนที่แท้จริง และส่งเสริมให้เกิดระบบตลาดแข่งขันเสรีระหว่างเอกชนและรัฐวิสาหกิจ และ **(2) พัฒนาความก้าวหน้าทางเทคโนโลยีภายในประเทศ และปรับโครงสร้างอุตสาหกรรมเพื่อไต่ห่วงโซ่มูลค่าขึ้นไป** ซึ่งสอดคล้องกับสิ่งที่รัฐบาลจีนเร่งดำเนินการในระยะที่ผ่านมา ยกตัวอย่างเช่น การเร่งลงทุนอย่างมากในด้านการวิจัยและพัฒนา (R&D ต่อ GDP เพิ่มขึ้นเฉลี่ย 8.6% ต่อปี ในช่วงปี 2000-2009) ซึ่งหากจีนสามารถเร่งการลงทุนในอัตราเช่นนี้ต่อไป จะทำให้จีนมีระดับ R&D ต่อ GDP เทียบเท่าสหรัฐอเมริกาภายในปี 2016 ความชัดเจนในการพัฒนาด้านเทคโนโลยีอย่างจริงจังส่งผลให้เกิดการเปลี่ยนในโครงสร้างการผลิตและโครงสร้างการส่งออกของจีนในระยะต่อไป สะท้อนได้จากการที่สินค้าหมวดเครื่องมือทางเทคนิคและทางการ

แพทย์ติดใน 5 อันดับแรกของสินค้าส่งออกของจีน เข้าแทนที่สินค้ากลุ่มรองเท้าและของเล่น นอกจากนั้น ส่วนแบ่งตลาดโลกของสินค้าส่งออกประเภท hi-tech ของจีน ก็เพิ่มขึ้นมากกว่าประเทศอื่นๆในภูมิภาค (จาก 4.6% เป็น 16.3% ในช่วง 10 ปีที่ผ่านมา)

<u>นัยต่อเศรษฐกิจไทย</u>

แม้ว่าที่ผ่านมาเศรษฐกิจไทยจะได้รับประโยชน์อย่างมากจากการเติบโตของประเทศจีนผ่านทางช่องทางการค้าต่างๆ แต่ต่อไปไทยมีความเสี่ยงที่จะได้รับผลประโยชน์จากช่องทางเหล่านี้ลดลง ดังนี้

(1) **การส่งออกสินค้าโภคภัณฑ์และผลผลิตทางการเกษตร** แม้ไทยจะสามารถส่งออกสินค้าในหมวดนี้ได้มากขึ้นตามความต้องการของจีนที่เพิ่มขึ้น แต่การผลิตสินค้าเกษตรมีข้อจำกัดทั้งจากทรัพยากรที่มีอยู่อย่างจำกัด และจากการปรับปรุงผลิตภาพของไทยที่ยังล่าช้ากว่าประเทศคู่แข่ง นอกจากนี้ การส่งออกสินค้าเกษตรของไทยยังมีมูลค่าเพียง 8% ของการส่งออกทั้งหมด

(2) **การส่งออกสินค้าสำเร็จรูปและบริการ**ให้กับผู้บริโภคจีนที่มีรายได้เพิ่มขึ้น แต่การแข่งขันกับผู้ผลิตจีนในตลาดล่างจะทำได้ยาก ขณะที่การแข่งขันเพื่อตอบสนองตลาดบนขึ้นอยู่กับว่าผู้ผลิตไทยจะสามารถสร้างสินค้าที่มีคุณภาพสูงและสร้างความแตกต่างจากผู้ผลิตจากประเทศอื่นได้หรือไม่ ซึ่งในปัจจุบัน สินค้าส่งออกของไทยยังเป็นสินค้าที่มีมูลค่าต่อหน่วยต่ำ ทำให้ไทยไม่สามารถได้รับประโยชน์จากการขยายตัวของตลาดผู้บริโภคในประเทศจีนได้อย่างเต็มที่

(3) **การส่งออกสินค้าต้นน้ำและกลางน้ำเพื่อไปอยู่ในเครือข่ายการผลิตของจีน** โดยเฉพาะสินค้าอิเล็กทรอนิกส์และอุปกรณ์คอมพิวเตอร์ แต่จากการที่จีนเริ่มผลิตสินค้าส่งออกที่ใช้เทคโนโลยีขั้นสูงเกินกว่าที่ไทยสามารถก้าวตามได้ทัน และการที่จีนเริ่มลดบทบาทการเป็นผู้รับจ้างประกอบ ทำให้ไทยมีความเสี่ยงที่จะหลุดออกจากการเป็นส่วนหนึ่งของเครือข่ายการผลิตของจีน

ดังนั้น การที่เศรษฐกิจไทยหวังจะโตไปกับจีนโดยการพึ่งพาโครงสร้างการส่งออกแบบเดิมๆ และเน้นการขยายประเภทสินค้าส่งออกในแนวราบ (export diversification) โดยขาดการพัฒนาอุตสาหกรรมในเชิงลึก (industrial upgrading) จึงไม่ใช่การเติบโตที่ยั่งยืน ไทยต้องปรับตัวให้ทันกับการเปลี่ยนแปลงของจีนในบริบทใหม่ และควรมองความสำเร็จของจีนเป็นตัวอย่างในการพัฒนาศักยภาพและเทคโนโลยีของตัวเอง ซึ่งจะทำให้เศรษฐกิจไทยเติบโตอย่างยั่งยืนจนกระทั่งสามารถก้าวข้าม middle income trap ได้ในที่สุด

Contents

Section 1: Introduction 1
Section 2: China's growth in transition 2
2.1 Background on China's growth pattern 2
2.1.1 Demand-side growth decomposition 4
2.1.2 Supply-side growth accounting 6
2.2 Sources of TFP growth 7
2.2.1 Structural change 7
2.2.2 Change in organization of production 9
2.2.3 Borrowed technology 12
2.2.4 Indigenous innovation 12
2.3 What the future holds for China's potential output growth 13
Section 3: China's evolving role in global trade 14
3.1 China's growing importance in global trade and its impact 14
3.2 China's rising demand for primary commodities 16
3.3 Evolution of China's export structure: Moving up the ladder 18
Section 4: Thailand: Alternative ways to grow with China 22
4.1 Supplying agricultural products 22
4.2 Serving growing Chinese middle class 24
4.3 Being part of China's supply chain 25
Section 5: China's industrial development strategy: Lessons for Thailand 28
5.1 China's industrial and technology development policies 28
5.1.1 Maximizing absorption of foreign technology 29
5.1.2 Promoting indigenous innovation 30
5.2 Remaining challenge in industrial and technology upgrading in China 32
5.3 Industrial strategy: How Thailand compares 33
Section 6: Conclusions 36
Reference 37

Box

Box 1: Semiconductor industry in China 20

Figures

Figure 1: Annual average real GDP growth since take off (percent) 2
Figure 2: Nominal GDP (trillion USD) 2
Figure 3: China's export and investment (percent of GDP) 3
Figure 4: Investment-GDP ratio at peak level 3
Figure 5: Nominal GDP growth contributions 4
Figure 6: GDP components (percent of GDP) 4
Figure 7: Domestic savings (average 2005-2009) 5
Figure 8: Capital-to-labor ratio (2008) 5
Figure 9: Cross-country average growth contribution (percent) 7
Figure 10: Sectoral reallocation 8
Figure 11: Urbanization ratio 8
Figure 12: Labor demand-supply ratio in urban areas 9
Figure 13: Demographic projections 9
Figure 14: Organizational reallocation 10
Figure 15: Product market regulation index (2008) 10
Figure 16: Y/K ratio 11
Figure 17: Fixed asset investment 11
Figure 18: Property right protection index 12
Figure 19: Countries' GDP and degree of trade openess 14
Figure 20: International trade network 15
Figure 21: Contributions of countries' final demand to partner's GDP (weighted average across major trading partners) 16
Figure 22: China's global import share of soft commodities 17
Figure 23: China's global import share of hard commodities 17
Figure 24: Breakdown of semiconductor industry in China 20
Figure 25: Export sophistication index (EXPY) 22
Figure 26: Export similarity index (ESI) 22
Figure 27: Thailand's export value of top three agricultural products to China 23
Figure 28: Rice yield (tons/hectare) 23
Figure 29: Share of Chinese urban households (percent) 25
Figure 30: Net export to world demand 25
Figure 31: Thailand's export of top five manufacturing products to China 26
Figure 32: Trade complementarity index 27
Figure 33: Processing trade share in China (percent of total export or import) 27
Figure 34: Research and development expenditure (percent of GDP) 31
Figure 35: Number of graduates in Science and Engineering 31
Figure 36: Invention patent application (thousand pieces) 32
Figure 37: Difference in industrial strategy 35

Tables

Table 1: Summary of China's growth accounting results 6
Table 2: Top five exporting products in China 19
Table 3: Countries' export and import market share of hi-tech products in the world market 21
Table 4: Top three agricultural product export to China in 2010 23
Table 5: Thailand's export of top five manufacturing products to China 26
Table 6: Timeline of policies regarding technology transfer in high-tech industries 29
Table 7: Type of patent application (pieces) 32
Table 8: Competitiveness of Chinese products across industries 32
Table 9: Science and technology development indicators 35

China's Growth in Transition: Implications for the Thai Economy

Section 1: Introduction

China has surprised the world time and again by its ability to deliver rapid and stable growth that continued for more than three decades long, notwithstanding shocks that shook major part of the world.[1] As a result of the extraordinary performance, China's place in the global economy has gone through a dramatic shift from being one of the poorest nations to a leading economic power within a relatively short time span. If rapid growth continues, China is likely to become the world's largest economy within the next decade or two.

Two questions naturally follow: (1) How long can China's rapid growth continue? (2) Due to its large size and growing interlinkages, what will be the implications of the next phase of China's growth for the rest of the world, particularly for Thailand from our point of concerns? These two questions set a theme for analyses in this study which aims to understand sources of China's growth in the past and to envisage a direction of the Chinese economy in the future, so as to identify opportunities and risks for Thailand in the context of China as a new economic superpower.

We maintain that behind China's remarkable growth was major structural transformation due to both initial conditions that allowed China to tap into great growth potential, thanks to very low base at the beginning of economic take-off, as well as prudent policy framework that guided the development process. Several economic and structural reforms starting from the launch of the open door policy were key factors that gave a forceful thrust to Chinese growth in the past.

After three decades of smooth transformation we argue that the Chinese economy has come to an important turning point as the old sources of growth have begun to run out of steam while several structural distortions have increasingly become bottlenecks to long-term growth. In order to maintain strong growth going forward, China will need to press ahead with further market reform to eliminate incentive distortions in the system as well as to seek a new and sustainable engine of growth. Fostering innovation can play a major role in achieving the latter and China is working hard towards that end.

In the medium term, however, we posit that China still has many opportunities to continue its growth momentum in the coming years. This provide opportunities for Thailand to rise with China through at least three channels: first, supplying agricultural productions and other commodities that China needs for continued growth; second, serving consumer goods and services to growing Chinese middle class; and lastly, being part of China's supply chain. However, growth benefits for Thailand through these links with China all have self-imposed limitations due to Thailand's lack of serious efforts to move fast enough to reap full benefits from China's rapid social and technological transformation.

The remainder of this paper is organized as follows. Section 2 analyzes China's growth pattern and sources of growth in the past and argues that China will be able to maintain its impressive growth momentum in the medium term. Section 3 elaborates on the impact of further rise of China on the global trading system as well as describes the evolution of China's export structure that will bear implications for other countries in rising or competing with China. Section 4 identifies and evaluates alternative channels for Thailand to grow with China. Section 5 looks further into China's success in industrial and technological upgrading to draw lessons for Thailand's industrial policy. The final section concludes.

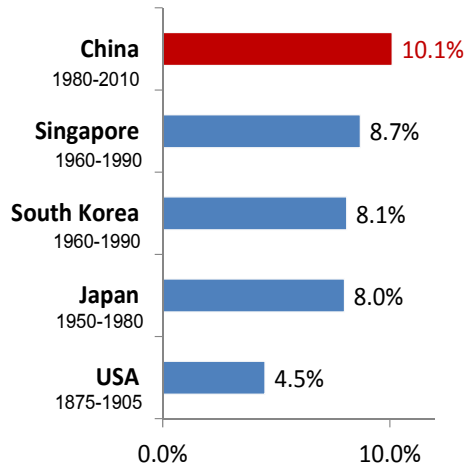
[1] Some observes discount the Chinese growth figures as exaggerated. Other observers, on the other hand, relying on proxies such as energy consumption, argue that China's growth rate is actually higher than the official numbers suggest. Data accuracy notwithstanding, rapid developments and improvement in people's living standards observed in China over relatively short time period confirmed that China's growth is nothing short of extraordinary.

Section 2: China's growth in transition

2.1 Background on China's growth pattern

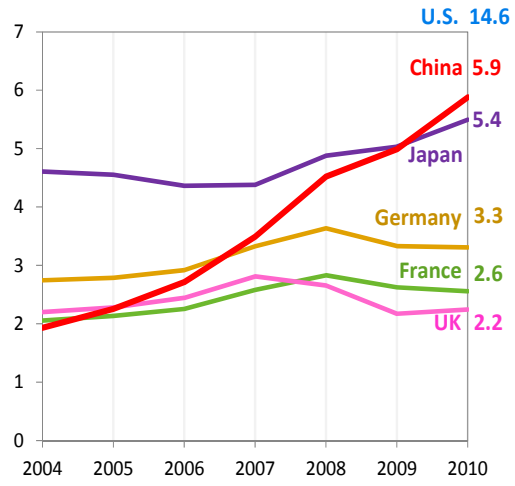
China's growth over the past 30 years has been nothing short of extraordinary. China is the first nation in modern history to achieve a double-digit average real GDP growth over a three-decade long period, breaking the growth record of even the fastest growing countries like Singapore and South Korea (hereafter, "Korea") that have successfully lifted their status to advanced economies (Figure 1). Real GDP per capita in China has increased more than thirtyfold, and the share of world GDP rose from less than 2 percent in 1980 to almost 10 percent in 2010 even as its share of the world's population declined from 25 percent to 20 percent. In recent years, China has rapidly surpassed U.K., France, Germany, and Japan to become the second largest economy in the world (Figure 2). Some has considered China's transformation over the past thirty years analogous to the Gilded Age in the U.S., where a boom industrialization following the Civil War led the U.S. economy to rise to number one overtaking Britain.

Figure 1: Annual average real GDP growth since take off (percent)



Sources: Author's calculation based on World Development Indicators and Maddison's History Statistics of the World Economy

Figure 2: Nominal GDP (trillion USD)



Source: World Development Indicators

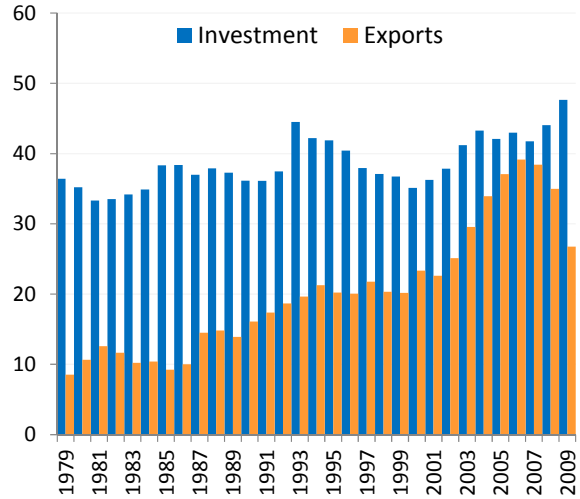
This remarkably high growth rate sustained for three decades is often regarded as the Chinese growth miracle. However, if 'miracle' refers to events impossible to explain and unlikely to be repeated, we argue that not all of China's growth story is miraculous. What is not so miraculous or novel about it is the strategy China used to jumpstart the economy. Similar to the model used in previous growth-miracle episodes in Japan, Korea, and other South-East Asian economies in the early stages of industrialization, China's growth strategy has also focused on expanding exports and investment. Key policies adopted in China to support export-oriented industrialization were also similar to what have been used in the earlier risers, including reducing tariff barriers, maintaining a fixed exchange rate, and providing direct government support to promote exporting and capital-intensive sectors.[2] Like other recent fast-growing economies,

[2] There are several good reasons why countries might want to follow export-oriented growth strategies. First, trade allows countries to take advantage of specializing in their comparative advantage, thereby increasing overall productivity. Second, exporting allows a developing country to tap foreign demand when the domestic market is still small. Moreover, opening up to foreign trade also allows developing countries to borrow technologies from abroad through imported machinery and hence improving industrial productivity.

China's spectacular performance is also attributable to the latecomer advantage that allows the country to leap forward by catching up with the developed counterparts.

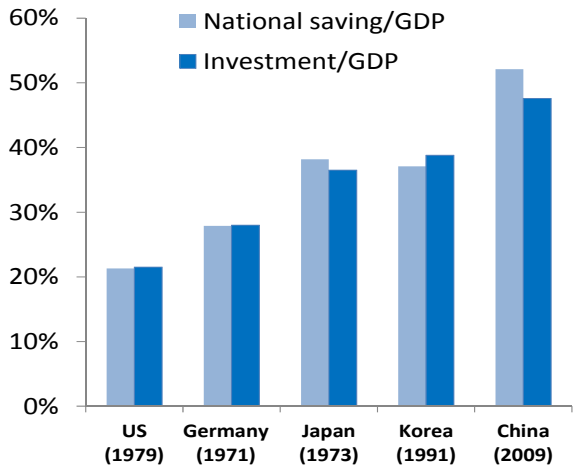
Nevertheless, what is a true miracle about China's growth is the *extent* to which China employed this export- and investment-led strategy as well as the *length of time* China can prolong its business cycle under this growth model. Since the adoption of 'open door' policy in 1978 and the accession to the World Trade Organization (WTO) in 2001, China has become the most open among the large economies from both developed and developing world. Exports increased more than fivefold from 7 percent of GDP to peak at 39 percent in 2006 (Figure 3). China's share in world export skyrocketed from as small as 0.8 percent in 1980 to almost 10 percent in 2010. As for the level of investment, high and rising share of investment has been one of the unique aspects of China's growth, with investment to GDP averaged at around 40 percent over the past three decades. This ratio has recently surged to almost 50 percent—the level never before observed in other earlier risers (Figure 4).[3] That fact that investment has been largely financed out of domestic savings also made China sui generis.

Figure 3: China's export and investment (percent of GDP)



Sources: World Development Indicators

Figure 4: Investment-GDP ratio at peak level



Sources: World Development Indicators

Another miracle about China's growth is the unprecedentedly long period of high growth without crashing. The business cycle in China is now into its fourth decade, and the 10-year rolling average on real per capita growth has never dipped below 7.7 percent. In comparison, Japan's boom period in the 1980s was characterized with remarkably similar rates of strong GDP growth with low variability and ended with a burst of credit bubble. Other countries, notably South East Asian economies, that experienced growth miracle before China all ended up with some kind of economic or financial crisis even before the boom time reached a two-decade mark.

In sum, although China's general approach to economic development may be hardly unique, the fact that a country as large as China can manage a smooth economic transition to generate such high and protracted growth without major interruption is what truly miraculous about China's growth. Credits must be given to the Chinese leaders' long-term vision, adaptability, and the commitment and the wherewithal to deliver on the well-paced development strategy that has taken China this far in such short time span.

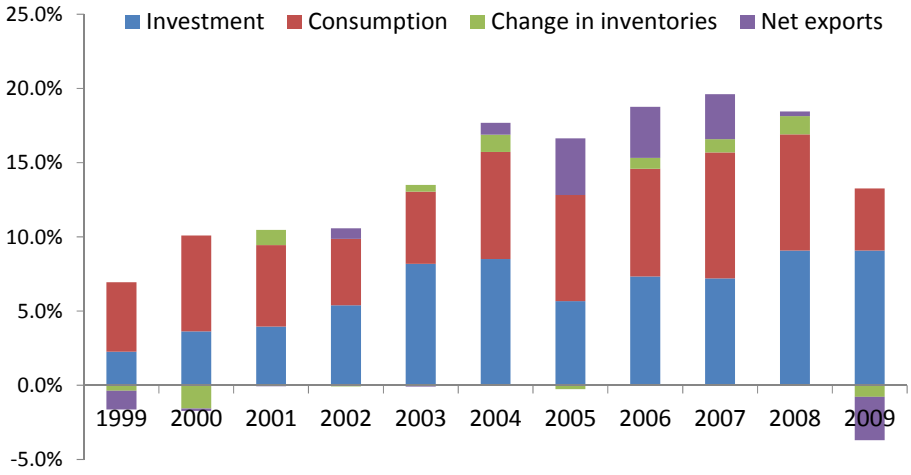
[3] However, some believe that the high share of investment in GDP is overestimated due to an insufficient deduction of land costs and price changes as well as possible over-report of fixed asset investment data. (Goldman Sachs Global Economics, Issue No. 10/03, February 11, 2010)

The question naturally followed is, how much longer can China continue to expand at this spectacular rate? What does China need to do to sustain economic prosperity? Given the size of the economy and its trade interconnectedness, any development in China will entail important bearings for the rest of the world and, thus, answering the above questions will help shape forward-looking strategy in other countries. Looking at the pattern of growth and analyzing the Chinese growth engines in the past and their prospects will help answer these questions.

2.1.1 Demand-side growth decomposition

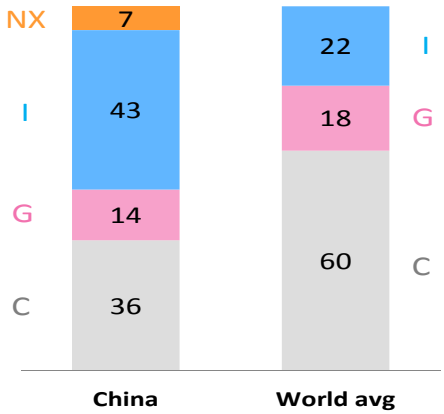
The demand or expenditure composition of China's GDP reaffirms investment as a major contributor to growth during the past decade. As for net exports, the direct growth contribution of net exports was relatively small but consistently positive over the past decade until it turned negative during the global crisis in 2009 (Figure 5). This small contribution of trade balance may mask the importance of exports in China's growth. After all, high level of investment has essentially been directed to support an expansion of the export sector, which tends to be relatively capital intensive.

Figure 5: Nominal GDP growth contributions



Source: Authors' calculation based on CEIC

Figure 6: GDP components (percent of GDP)



Note: China for 2009 and world average over 2005-2009
Source: China Statistical Yearbook 2010 and World Development Indicators

High level of investment level in China has been made possible by exceptionally high and rising national savings, at the expense of low private consumption which declined from around 50 percent of GDP in 1990 to merely 35 percent in 2009, much lower than the world average at 60 percent (Figure 6). Precautionary motives appear to be behind much of high household savings, reflecting concerns over limited social safety nets as well as demographic factors that increased age dependency ratio. Moreover, the current level of financial sector development and regulation also provides few alternatives for households to

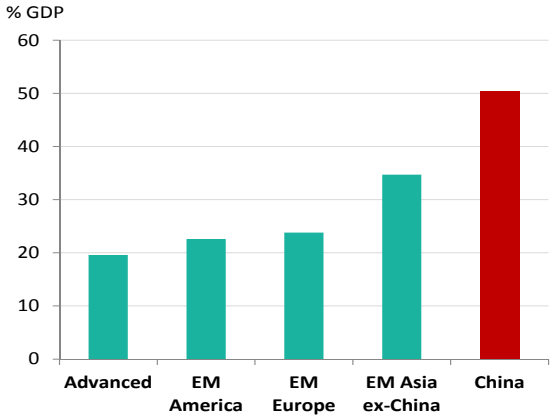
funneling these savings to deposits in the banking system regardless of very low real rates of return,[4] let alone to borrow against future income to finance consumption, implying the need for higher savings to purchase a house or consumer goods.

The bigger part of China's domestic savings belongs to the corporate sector. The high level of China's corporate savings rate is attributable to firms' tendency to retain earnings. Profitable state enterprises were not, until recently, required to pay dividends. This means growth in corporate savings is closely linked to growth in corporate profits. Since 2000 corporates have enjoyed profit growth of around 30 percent per annum. While the growth of private firms has been an important factor driving overall profit growth, high and sustained profitability of SOEs mostly reflect financial repression and government's direct support—including low borrowing rates, subsidized land and energy cost, and depressed value of nominal exchange rate, for instance—that spurred high profits, high savings and hence high investment in the SOE sector.

The current system essentially means that part of China's growth is supported by a constant transfer of household wealth to the corporate, especially SOEs, sector. The Chinese policymakers are aware of these imbalances and recently made a promise to correct these imbalances through measures that allow domestic consumption to grow.[5] However, it will take time until these measures comes into effect. And as long as the underlying distortions in the economic and financial system—those that repress factor costs in favor of producers and exporters and at the expense of households[6]—remain, the imbalances will persist for foreseeable future.

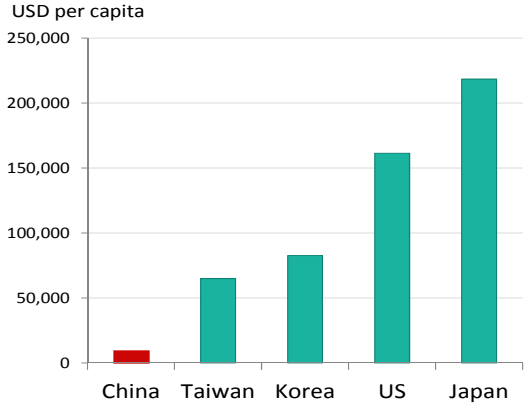
Because of high domestic saving (Figure 7), high investment is still possible going forward even if capital account remains relatively closed. Given the extensive and prolonged investment booms, many might question whether China has overinvested and hence there is no room to invest further in the future. True, overinvestment in some pockets of the economy may already be evident especially in the real estate sector in some urban areas. But considering the capital-to-labor ratio, so-called the level of capital deepening, in China compared to developed economies, China is still very far from being capital-saturated (Figure 8). Thus there remains plenty of room for China to continue with further capital deepening.

Figure 7: Domestic savings (average 2005-2009)



Source: CEIC, World Development Indicators, and authors' calculation

Figure 8: Capital-to-labor ratio (2008)



Source: CEIC and Morgan Stanley Research estimate

[4] Commercial bank benchmark lending and deposit rates are directly controlled by the People's Bank of China (PBC). In 2004, the PBC removed the floor on deposit rates and allowed lending rates to vary between 10 percent less and 90 percent higher than the benchmark. In practice, deposit rates are fixed at the level of the ceiling, which is artificially low in China, while average lending rates have risen above the reference floor.

[5] Action plan for stimulating domestic consumption as stated in the 12th Five-Year Plan includes expanding urban and rural employment, increasing the minimum wage standard, improving coverage of the pension scheme and medical insurance, cutting taxes for residents, for example.

[6] Financial repression can be reflected in highly regulated interest rates, state-influenced credit allocation, a frequently adjusted statutory reserve requirement, a strictly controlled capital account, undervalued currency, as well as distorted costs of land, resources and the environment (Huang and Wang, 2010).

2.1.2 Supply-side growth accounting

Table 1: Summary of China's growth accounting results

Author(s)	Period	Output growth	Growth contribution			
			K	L	H	TFP
Hu and Khan (1997)	1979-1994	9.3	4.2	1.2	-	3.8
Zheng, et al. (2008)	1978-1995	10.1	4.6	1.8		3.7
	1995-2005	9.3	6.2	1.3		1.8
Bosworth and Collins (2008)	1978-1993	8.9	2.4	2.5	0.4	3.5
	1993-2004	9.7	4.2	1.2	0.3	3.9
World Bank (2009)	1978-1994	9.9	2.9	3.3	0.5	3.1
	1995-2009	9.6	5.5	1.0	0.3	2.7
OECD (2010)	1998-2003	8.7	4.7	0.5	-	3.2

Source: Authors' compilation from various studies.

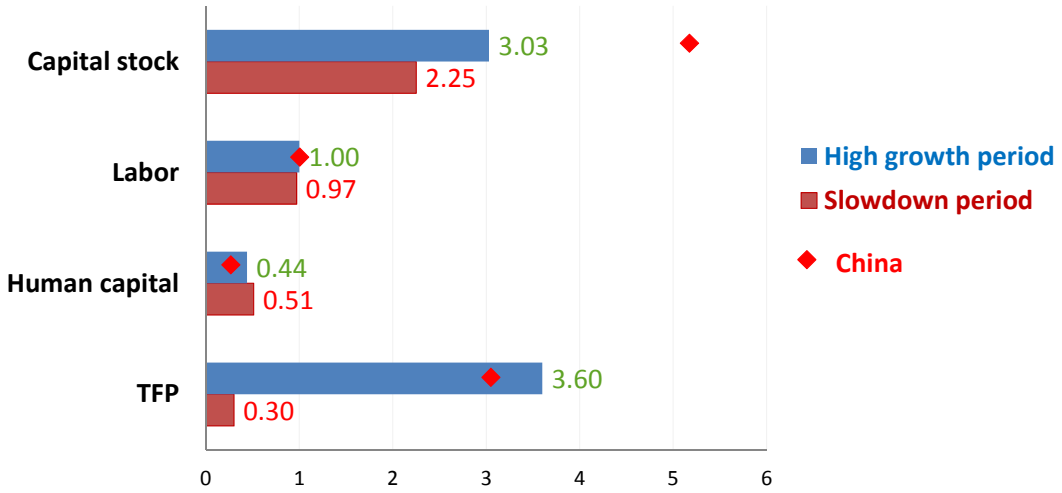
Table 1 summarizes the results of several recent growth accounting studies for China.[7] Consistent with the high investment share in the expenditure composition of China's GDP, the Chinese potential output growth viewed from the supply side has largely been driven by a continued rapid expansion of the capital stock, which is estimated to have contributed around 3.5 percent annually during the first half of the post-reform period and rose to over 5 percent annually in the latter half. The second largest driver of potential output growth is total factor productivity (TFP) growth, which measures improvements in overall efficiency of the utilization of labor and capital. In contrast to capital accumulation, TFP growth—though still registered a high level—has slightly fallen in the more recent period, from 3.5 to 3 percent. Similar pattern is observed in employment growth with a more significant drop over time.

Overall, the contribution of capital deepening and TFP improvements to GDP growth have significantly boosted potential output, i.e. the capacity to produce, thus allowing China to enjoy rapid GDP growth without running into macroeconomic stress such as high inflation or large external deficits.

When compared with other economies during their high-growth period, it is obvious that China's pattern of the supply-side growth is not different from a typical fast-growing economy that relies on intensive capital deepening and significant improvements in TFP to elevate growth, except for the much larger extent of capital investment in China (Figure 9).

[7] As is well known, growth accounting estimates are sensitive to a large number of assumptions, particularly the relative shares of capital and labor in the economy, which result in discrepancies in growth contribution of each factor. Our aim is not to try to get the most accurate estimates, but rather to get a sense of relative importance of each factor to GDP growth. We thus compile growth accounting estimates from previous research to see if any pattern emerges consistently across those studies and use their averages as reference points.

Figure 9: Cross-country average growth contribution (percent)



Source: Authors' calculation based on cross-country growth accounting data from Eichengreen, et al. (2011)
Note: "High-growth" period defined as the 7-year period during which average growth exceeds 5% followed by a subsequent "slowdown" period during which 7-year average growth declines by more than 2%.
For China, average of growth contribution around 1995-2005 from various studies.

What is more intriguing is the pattern of growth contribution observed in formerly fast-growing economies during their subsequent slowdown episodes. The experience of these countries shows that when countries slow down, it is mainly because of the inability to maintain high TFP growth—possibly due to an inability to shift additional workers from agriculture to industry and diminishing gains from importing foreign technology—while the other growth components did not shrink much. The sharpness and extent of the drop in TFP growth from above 3 percent to virtually zero is striking.

Thus, maintaining high TFP growth will be the most important challenge for China and will determine how much longer China can sustain high GDP growth into the future. Being able to sustain TFP growth after three-decade long of success would constitute another phenomenon about China's growth story.

2.2 Sources of TFP growth

To predict the future of China's TFP growth, we need to first understand the underlying sources of TFP growth in China in the past and gauge whether these forces will continue to boost Chinese TFP going forward as well as consider possibility of new source of TFP.

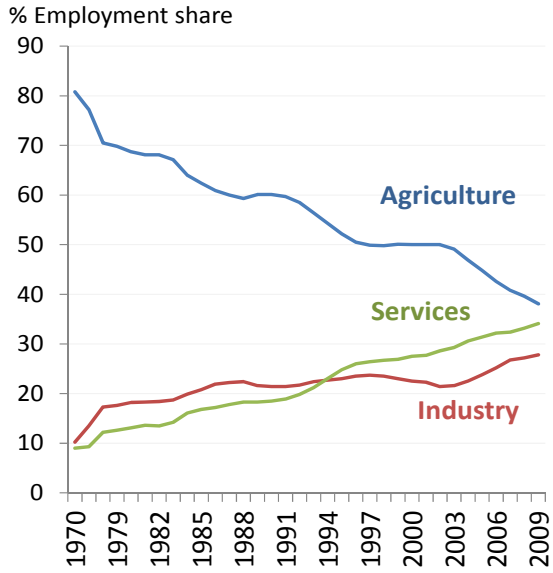
We can decompose TFP growth into four groups according to their sources:

2.2.1 Structural change

Structural change in the Chinese economy is broadly characterized by a shift of labor out of agricultural work into more productive jobs in industry and service sector. Share of employment in agriculture has reduced by half from roughly 70 percent in 1980 to 38 percent in 2009 (Figure 10). Depending on methods used, sectoral reallocation of labor has been found to contribute between one-third to two-thirds of the total productivity gains during the two decades following the 1993 reform (Heytens and Zebregs, 2003, and OECD, 2010).[8]

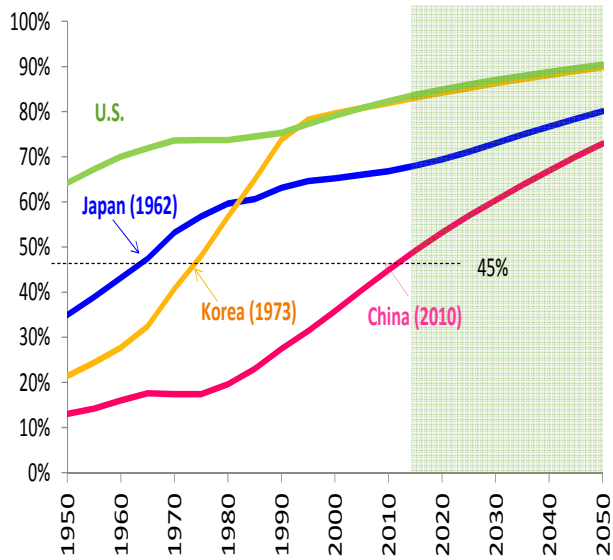
[8] According to OECD (2010), in China the agricultural sector's average productivity is six times lower than in the rest of the economy.

Figure 10: Sectoral reallocation



Source: China National Bureau of Statistics

Figure 11: Urbanization ratio



Source: United Nations Secretariat's World Urbanization Prospects (2007) and World Development Indicators

Urbanization is also a related process of structural change. There has been estimated that roughly 200 million workers have moved from rural to urban area in the post-reform period (Hu, 2007). As of end of 2009, China's urbanization rate was 46.6 percent and is targeted to reach 51.5 percent by the end of 2015 according to China's 12th Five-Year Plan. Considering the current share of urban population in some advanced economies such as Japan (67 percent), Korea (81 percent), and the U.S. (82 percent), China still has much more room to continue urbanization, which means more investment in real estate and public infrastructure is expected and further reallocation of labor from rural to urban associated will imply potential increase in productivity (Figure 11).

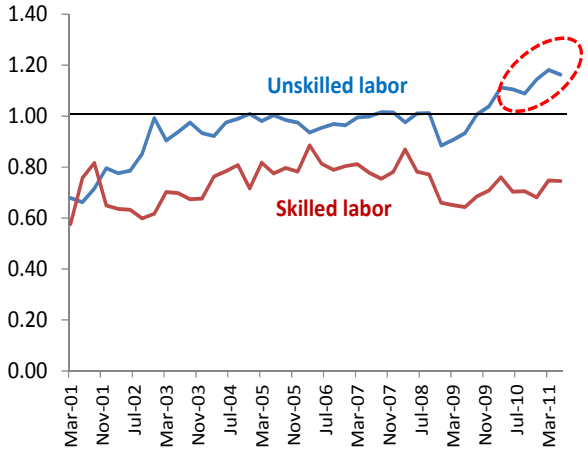
However, going forward the productivity gain from further structural change in China will not be as large as before due to (1) labor immobility and (2) demographic shift towards ageing population. On the former, many factors play a part in creating growing disincentives for rural workers in moving to urban areas. These include rapidly rising urban housing prices as well as institutional factors, namely, the persistence of the *hukou* household registration system that—regardless of its virtue of protecting minimum agricultural output and job security in the cities—has become a constraint on free labor migration from rural into urban areas by tying citizens' social eligibility and benefits to their birthplace.[9] In addition, labor market segmentation is partly a result of local government competition—each local government aims to protect local urban residents, and, therefore, the labor force from outside faces a different institutional environment compared with local residents in terms of employment, social security and children's education (Lu and Jiang, 2008). Although substantial amount of surplus labor may still be available in the rural areas as some scholars have advocated,[10] the key problem is the inflexibility of labor supply as reasoned above that prevents the economy to continue rapid structural change going forward.

[9] Established in 1958, the *hukou* regime was designed to restrict the rural population from flooding into urban cities. Restrictions included (1) migration from township/villages to smaller cities and from smaller to larger cities, but the other way was allowed, (2) restrictions extended to whole families and relatives, (3) food allowances related to hukou type. Although implementation of the *hukou* has become lax over time, it continues to take a leading role in setting rights and benefits among population today.

[10] For example, Kwan (2009) and Minami and Ma (2009).

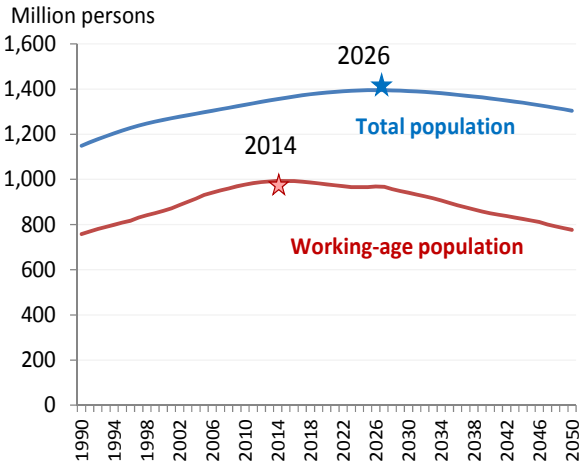
As depicted in Figure 12, unskilled labor shortage captured by increasing excess demand in the urban areas reflects signs of labor immobility.

Figure 12: Labor demand-supply ratio in urban areas



Note: Data based on Labor Market Survey of 100 cities in China
Source: CEIC, authors' calculation

Figure 13: Demographic projections



Source: Authors' calculation based on U.S. Census Bureau, International Database

On the demographic shift, demographic projections from the U.S. Census Bureau reveal that the Chinese working-age population will peak soon in 2014 (Figure 13). With shrinking pool of labor supply, ensuring a continuing net inflow of migrants into the cities will be an increasingly difficult task.

Looking ahead, productivity gain as a result of employment reallocation and urbanization that has come relatively easily in China in the post-reform period is now set to decelerate significantly. Thus, given no radical reforms to increase labor market flexibility and induce further structural change, TFP growth from this source will soon fade away.

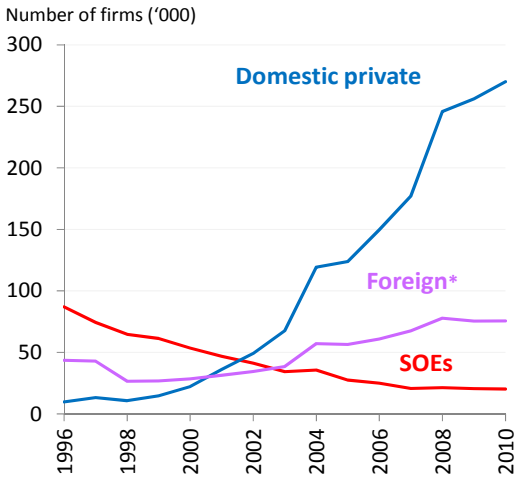
2.2.2 Change in organization of production

Another important source of China's TFP growth in the past is related to liberalization of the private sector and rationalization of the SOEs. When the landmark decision was made to replace central planning with a "socialist market economy", virtually all industry was owned by the state or by collectives.[11] After the approval of private firms in the early 1990s, the share of output produced by non-state and non-collective enterprises increased rapidly from virtually zero to about 70 percent in the economy.[12] Number of domestic private firms grew almost thirtyfold from as little as 9,500 firms in 1996 to 270,000 in 2010 while state-owned and state-holding

[11] "Socialist market economy" is the term used to refer to the economic system in China after Deng Xiaoping's reforms which combines the concept of market economy with central planning system. Under this system, private enterprises are approved and allow to be a major component of the economy along with the central SOEs and collectively-owned enterprises.

[12] The private sector was acknowledged as "a supplementary component of the economy" for the first time in 1993. It was upgraded to "an important component of the economy" in 1997 and its role formally incorporated in the constitution in 1999.

Figure 14: Organizational reallocation

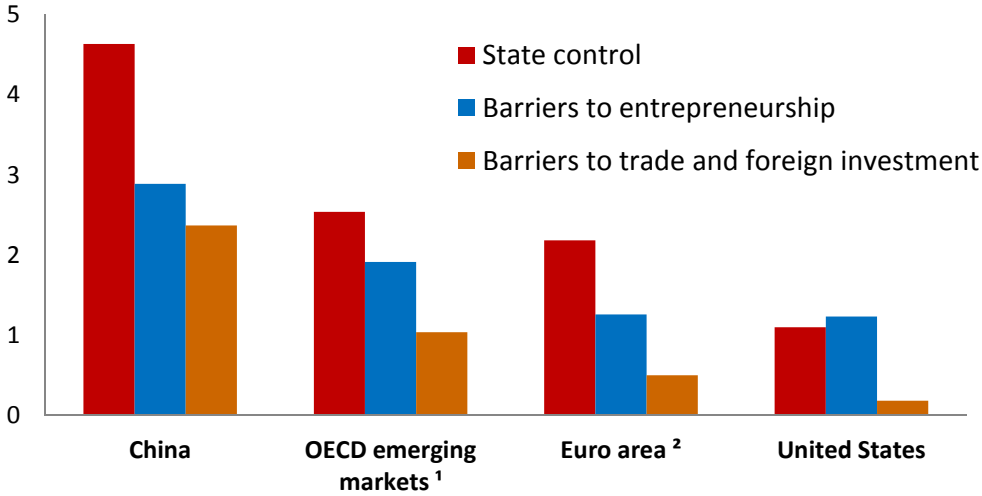


Note: *Also includes non-mainland private
Source: CEIC

companies shrank from 87,000 to 20,000 firms during the same period (Figure 14). SOEs' share of employment also declined significantly from 60 percent of urban workers in 1996 to about 20 percent today. This dramatic decline in the SOE's production and employment share was a result of drastic SOE restructuring during the late 1990s and early 2000s with the aim to improve efficiency and profitability of SOEs due to their poor performance and increasing financial losses. The ownership of small and mid-sized SOEs was diversified and privatized and SOEs incurring significant losses were encouraged to merge or go bankrupt. The reform was also set to transform SOEs into "modern enterprises" with clarified property rights, clearly defined responsibility and authority, separation of enterprises from the government, and scientific internal management in an effort to resolve corporate governance problems in the public enterprises.

The declining role of SOEs in the economy also gave rise to the bourgeoning of the private sector and increased market competition, contributing significantly to economy-wide productivity gains. However, the current level of product market regulation still indicates significant barriers to competition for the private sector due to persistence of state control in some key industries, regulatory and administrative barriers to entrepreneurship and entry, and discriminatory and regulatory barriers to trade and foreign investment, as measured by the Product Market Regulation indicators constructed by the OECD (Figure 15).[13]

Figure 15: Product market regulation indicators (2008)



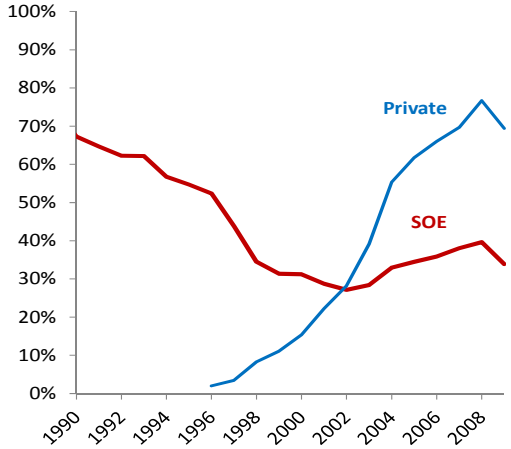
Note: ¹ Czech Republic, Hungary, Korea, Mexico, Poland, Turkey
² Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Spain
Source: OECD

[13] The Product Market Regulation (PMR) indicators summarize a large number of formal rules and regulations that have a bearing on competition. They can be grouped into three broad regulatory area: (1) state control, (2) barriers to entrepreneurship, and (3) barriers to international trade and investment. An advantage of this PMR indicators is that they only record "objective" information about rules and regulations, as opposed to "subjective" assessments based on opinion surveys. See OECD (2010) for more details.

In addition, regardless of improvements in SOE governance, the reforms undertaken to raise the efficiency and profitability of SOEs met only limited success, because the fundamental problems of SOEs remain—that of distorted incentives such as financing privileges, and basic principle-agent problem inherent in the state ownership. A long list of previous studies generally finds that China's SOEs are significantly less efficient than enterprises with other ownership forms.[14] Moreover, despite rapid privatization, the extent of state ownership and control in the Chinese economy remains high and SOEs continue to dominate some key sectors especially capital-intensive industries, including power generation and distribution, natural resource extraction, and aviation and shipping. Outside of industrial sector, SOEs also maintain disproportionate control in banking, telecommunications and the media.[15]

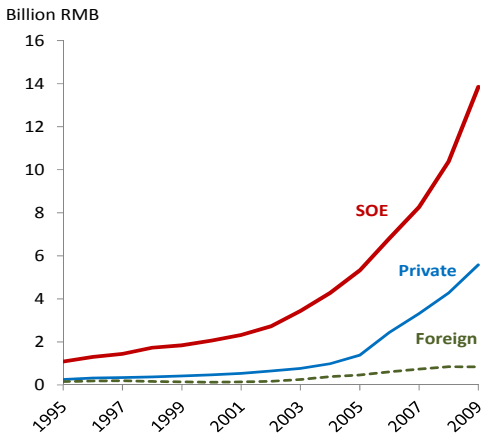
With SOEs' concentration in capital-intensive industries which require disproportionally large share of total investment and with capital accumulation a key driver of GDP growth, low productivity in the SOE sector compared to the private sector amounts to inefficient allocation of capital and hence a significant drag on TFP growth (Figure 16 and 17). A major challenge is thus to once again take up bold reforms to allow for more efficient allocation of resources by further restraining the SOEs' role and encouraging more vibrant and free market competition.

Figure 16: Y/K ratio



Note: Y is gross industrial output, K is accumulated fixed assets investment
Source: Author's calculation based on China National Bureau of Statistics

Figure 17: Fixed asset investment



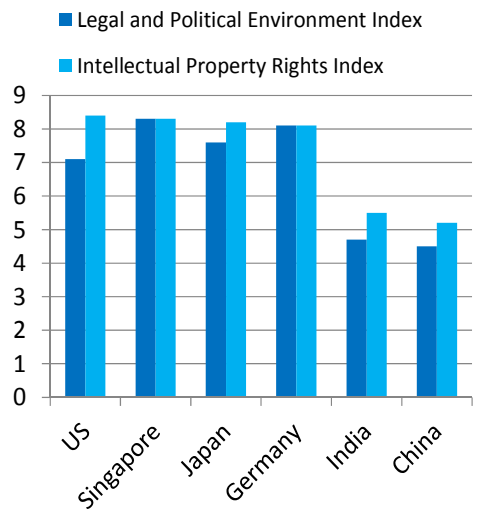
Source: Author's calculation based on China National Bureau of Statistics

[14] For example, Bai, et al. (2008), Hsieh and Klenow (2009), and OECD (2010).
[15] And, though with lower and declining share, SOEs continue to operate in less capital-intensive industrial sectors as well including machinery, transport equipment, medicines, and some light manufacturing.

2.2.3 Borrowed technology

The only source of sustainable growth is technological progress. So far China has relied heavily on technology imported from abroad, and the development of its scientific and technological capability has until recently lagged behind its economic growth. With explicit policy requesting for transfer of technology, China has been able to speed up its catch-up process through inward foreign direct investment (more details in Section 5). However, as the level of technology comes closer to that in developed countries, the rate of catch up will be sure to decline. Besides, with relatively weak intellectual property protection in China (Figure 18), foreign-invested firms may have been reluctant to lend technologies to China, especially state-of-the-art innovations. It is evident that foreign-invested companies are less R&D-intensive than domestic firms and core technologies mostly remain controlled by the foreign partners in joint ventures or by company headquarters abroad (OECD, 2007). Thus, until improvements in the area institutional framework has been put forward, China must increasingly rely on own innovation to drive further technological progress.

Figure 18: Property right protection index



Source: International Property Rights Index 2011 Report and World Development Indicators

2.2.4 Indigenous innovation

This final source of TFP growth—own scientific innovation—is the most difficult to generate among all sources of TFP improvements. But at that same time it is the only sustainable source of growth as it can put the economy on the path of endogenous growth by allowing the economy to exhibit increasing, rather than diminishing, returns to factors of production. Until recently, China's own technological progress had not played a major role in productivity gains while the three other sources of TFP growth dominated. This is partly due to the development strategy in the early stage that focused on expansion of factor inputs, while upgrading of input quality through technology and innovation had taken a backseat. Innovativeness of the economy has also been suppressed by several market failures including ineffective enforcement legislation in the area of intellectual property right protection; government policies focused on SOEs that may have crowded out support to the private sector; insufficient incentive for SOEs to undertake long-term risky investment in R&D; and lack of financing of innovative business firms and projects in small and medium-sized enterprises.

Nevertheless, realizing an increasing importance of own technological innovation in lifting TFP and hence overall economic growth, since the end of last decade the Chinese leaders have made significant progress towards developing the country's innovative capabilities in the presence of market or system failures. These actions have been reflected in much higher expenditures on R&D and an increase in the number of scientists and engineers engaged in research. Section 5 of the paper is devoted to impressive efforts and outcomes of science and technology progress in China.

2.3 What the future holds for China's potential output growth

What is the prospect of the Chinese economy after three decades of spectacular growth? The review of China's growth pattern and analysis of sources of growth above reveal that rapid capital accumulation and substantial productivity improvements since the implementation of the open door policy and economic reforms after 1978 have been the most important contributors to China's high growth performance. Looking ahead, capital investment, particularly in infrastructure, urban housing, and industry will remain important as the economy needs to continue with capital deepening, to carry on the process of urbanization which still has more room to grow, and to expand and upgrade industrialization of the economy to catch up with the frontiers. With persistently high domestic savings, a continuation of high investment level can be made possible and hence the contribution of capital accumulation to growth is expected to remain strong. Assuming that capital formation continues to contribute 5-6 percent, the potential output growth rate of at least 7 percent annually would not be hard to reach in the short to medium term.[16]

Whether the Chinese potential output can stretch beyond 7 percent per annum will depend crucially on how much and how fast further TFP improvement can be achieved. TFP growth in the past has come mostly from structural change and reforms including sectoral reallocation of employment, privatization and state enterprise restructuring, as well as opening up to technology transfer through imports and FDI. However, some of these *automatic* sources of TFP growth have started to lose punches. After the benefits of these one-off reforms feed through, the underlying distortions and inefficiencies in the growth model—as manifested in financial repression, dominance of the SOEs, limited market competition—will dominate again and will put a drag on TFP growth going forward. This raises concerns about sustainability of the current growth pattern that continues to suppress market flexibility, especially as the economy grows more complex that central planning will soon start to lose grips on the economy.

One important lesson from the experiences of other countries is that periods of high growth can sometimes mask deep underlying problems. China has now reached its turning point at which extensive developments (by simply adding more inputs), built on policy distortions, can no longer sustain economic prosperity for much longer. Economic growth from now on must be of high quality and high efficiency to ensure new growth engines can emerge while the old ones start to run out of steam. To this end, much will depend on the government's willingness and ability to push through further structural reforms—particularly, 1) labor reforms to increase labor market flexibility, 2) market and SOE reforms to allow competition to drive productivity growth—as well as 3) improved framework conditions for innovation including establishing proper intellectual property right protection and the rule of law to create impetus for technological progress.

There is no question that Chinese policymakers are well aware of the needs to press ahead with these and other reforms as manifested in the 12th Five-Year Plan that promises to take bold strategic initiatives to correct the Chinese economic structure that is increasingly "unstable, unbalanced, uncoordinated, and ultimately unsustainable" in the words of Premier Wen Jiabao. However, it is hard to predict how fast and to what extent the Chinese leaders are willing to push forward with further reforms to give a freer rein for market-based mechanisms to command the economy, since this will be more and more in conflict with the ideology of the central planning system. Although the Chinese leaders have shown time and again their readiness to give up dogmatic ideology in favor of pragmatism in their commitment to economic development up to now, for the remaining journey towards to full-scale market-oriented

[16] Investment rate in China is set to edge down gradually due to policy direction to boost domestic consumption. But the existing pattern of growth and resource allocation has a strong momentum and the rebalancing measures have so far been modest.

economy will be increasingly hard to grasp and thus will be the true test of political will. To be sure, there is no precedent for a country under the rule of a Communist Party to make a successful transition to a fully-fledged market economy. If China can make it happen, this will utterly be the most impressive of the true Chinese miracles.

Section 3: China's evolving role in global trade

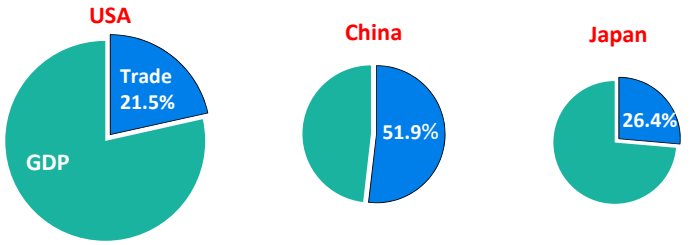
Due to its sheer size and high degree of trade openness, the continued rise of China will immensely impact the world economy in terms of changing global trade pattern.[17] How large is the magnitude of "China effect" on its trading partners and in what direction is the influence will depend on China's degree of trade linkages with the rest of the world, rising demand for imports especially for primary commodities, and lastly the evolution of China's export structure.

3.1 China's growing importance in global trade and its impact

Before 1980s, China remained a closed economy and played only marginal role in international trade. China's export accelerated in the 1990s and skyrocketed in the 2000s after WTO accession. At present, China claims the largest world exporter by taking up 11 percent of world trade in 2010 (overtook United States in 2007 and Germany in 2009). The magnitude of China's influence on the global trading system depends on three factors: size of the economy and its degree of trade openness; the degree of trade interlinkage; and its role as a final demand destination.

On the first factor, needless to emphasize how large the Chinese economy is, but what is striking is the exceptionally high degree of trade openness that makes China unique among other economic superpowers. Trade openness in China registered at as high as 51.9 percent of GDP,[18] well above twice of that of the U.S. (21.5 percent) and also twice the ratio of Japan (26.4 percent) (Figure 19).

Figure 19: Countries' GDP and degree of trade openess



(billion USD)	US	China	Japan
GDP	14.6	5.9	5.5
Trade volume	3.1	3.1	1.5

Source: Directions of Trade Statistic, World Bank

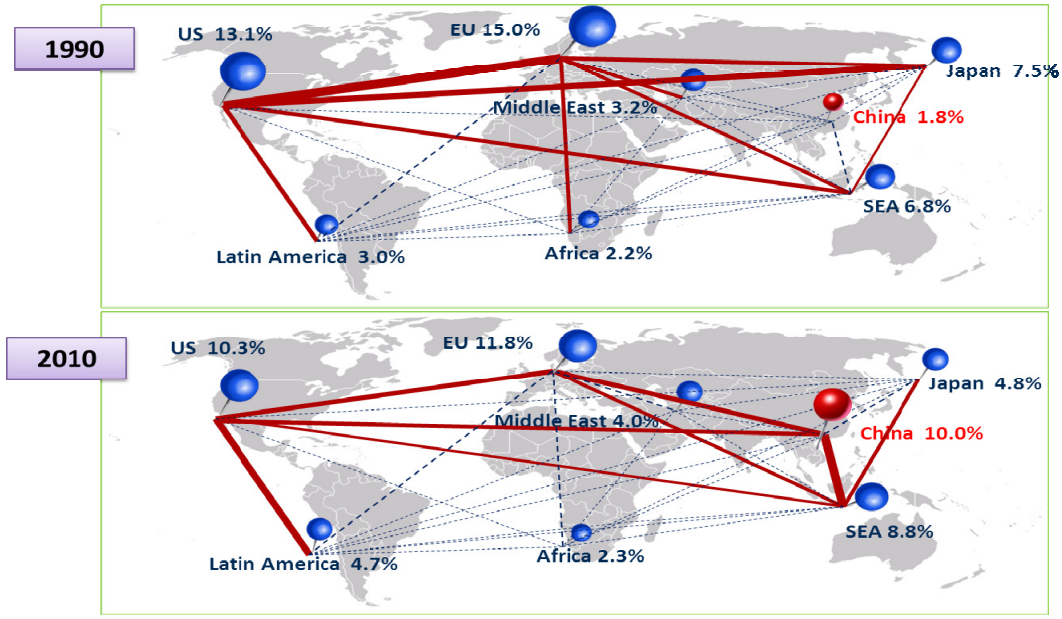
Secondly, not only has China increased its role from being a negligible trader to be the world's second largest trading nation, it has also become a major systemically important trading

[17] We believe that China's impact on global financial landscape will be limited in the short to medium run since China's financial system remains relatively weak and thus allowing for foreign competition and full liberalization on the financial front will take place at a very slow pace.

[18] The ratio of country's import plus export to its GDP.

hub, based on network analysis.[19] Figure 20 depicts international trade network using 180 countries' trade data from Directions of Trade Statistics. It is found that China gains the highest degree of trade interlinkages in the global trading system, reflected by two statistical features: First, China's total trade share in global trade has increased more than fivefold over two decades while the other global trade leaders i.e. EU, U.S., and Japan appear to be withdrawing (represented by size of the bubbles). Second, China raises its trade interconnectedness by increasing number of significant trading partners as well as bilateral trade volume. Interestingly, while the trade volume between China and other jurisdictions have been increasing, trade volume among those other jurisdictions have been on a decline, i.e. each country trades more with China and trades relatively less among themselves. For instance, trade volume (as percentage of total world trade) between China and Japan increased by 3.9 times over two decades, while the trade relationship between Japan and the US declined by 3.4 times. Consistently, IMF's centrality calculation based on network theory found that China is the most central to the global trading system, surpassing even the U.S. and the EU.[20]

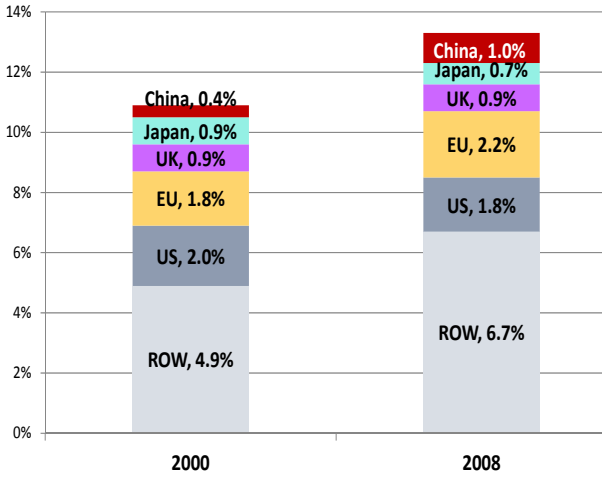
Figure 20: International trade network



Note: Size of bubble is proportional to size of trade share in global trade. Thickness of connecting lines represents value of trade between the two countries/regions.
Source: Authors' calculation based on Direction of Trade Statistics

[19] International Trade Network (ITN) analysis is a relatively new approach to study the patterns of international trade integration in a framework of complex network analysis. In the ITN, a node depicts a country and an undirected link exists between any pair of nodes if the trade volume between the corresponding countries is non-zero. Under this approach, several country-level indicators that measure how well connected a country is into the global trading system can be calculated, such as *node strength* and *node centrality* that capture the country's trade share in world trade and how central or "star-like"a node is relative to a perfect star, respectively.
[20] See "Changing Patterns of Global Trade", IMF (2011) for more discussion.

Figure 21: Contributions of countries' final demand to partner's GDP
(weighted average across major trading partners)



Source: IMF

Lastly, China increasingly gains more important role as a source global final demand. The contribution of China's final demand to trading partner's GDP doubled during 2000–2008, according to IMF's calculation based on Input-Output analysis.[21] Although the importance of China's final demand is still half of the US and Euro areas in 2008 (Figure 21), the speed of improvement is projected to be very rapid, due to growing middle-class population and China's clear policy direction to boost domestic consumption. After all, there is ample room China's consumption to expand given its consumption share to GDP averaged at 36 percent in recent years which remains extremely low compared to the world average of 61 percent.

Going forward, given China's huge economic size and ability to maintain high economic growth rate in the medium term (as concluded in the previous section), its implications on the world economy will be even greater in terms of both as a shock stabilizer and a shock generator. On the one hand, China's role as a shock stabilizer—that is, its ability to cushion global growth slowdown by acting as an alternative global growth engine—for the world economy can be observed recently during the financial and economic crises in the U.S. and EU. Although China's role as a world stabilizer is still limited owing to China's relatively low share of global final demand, it is rising continuously due to China's anticipated growing consumption share. On the other hand, China's role as a shock generator is also increasing. China could increase the cross-border transmission of shocks through the trade channel that seem increasingly intensified. Given that China is the most central trader and has the greatest trade interconnectedness, the shocks originated by China will be large and widespread. At the same time, the ability for other countries to diversify shocks from China has also become limited since their trades are more concentrated with China and less with others.

3.2 China's rising demand for primary commodities

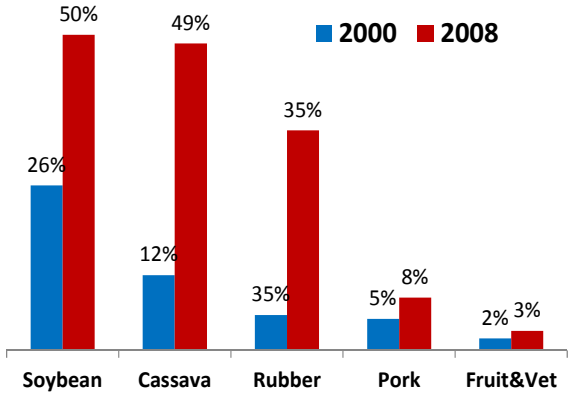
China's role in global commodity markets has been increasing rapidly as China switched from being a self-sufficient country to heavily relying on imported resources as a result of rapid industrialization and urbanization as well as limitations from being poorly endowed with natural resources.

Nowadays, China has become the world top consumer of a broad range of commodities, mostly in base metals and to a lesser extent, agricultural products.[22] Its global import shares of these commodities, which can be classified into two major segments, namely soft and hard commodities, are rising at an extraordinary pace over the past decade (Figures 22 and 23).

[21] See more technical discussion in "Changing Pattern of Global Trade", IMF (2011)

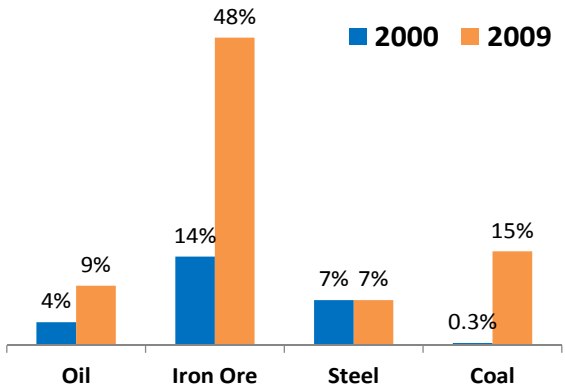
[22] Although China's share of world energy imports is rising, it has not yet assumed a large role in global energy market. In 2009, China obtained much smaller share of world consumption of crude oil (9 percent), comparing to the U.S. (21 percent).

Figure 22: China's global import share of soft commodities



Source: Food and Agriculture Organization

Figure 23: China's global import share of hard commodities



Source: EIA, Steel Statistical Year book 2010

3.2.1 Soft commodities

China's imports of agricultural products are used for final consumption (e.g. rice), animal feed (e.g. soybean), and intermediate manufactured products (e.g. rubber). Supply-side limitations such as limited arable lands and water shortage are among the crucial reasons that transformed China from being a self-sufficient country to be a resources-importing country, apart from growing demand for resources. China only possesses about 7.8 percent of global arable lands while it is home to about 19.6 percent of global population, implying that China needs to rely on imports of soft commodities no matter how effective its agricultural sector might become.[23]

Looking ahead, Chinese consumption pattern may change as income grows which will definitely shift China's import pattern. For example, it can be observed recently that Chinese consumption has changed in such a way that demands for meat expanded. This increased intensive use of crops for animal feeds and therefore China's agricultural imports have increasingly been concentrated in animal feeds and products that compete with grains for land use. In addition, the "Go green" policy towards clean energy will boost China's demand for biofuel crops and reduce coal consumption as targeted in the 12th Five-Year Plan.

3.2.2 Hard commodities

China's imports of hard commodities consist of raw materials used in processing and investment such as mineral and base metals, including aluminum, copper, lead, nickel, tin, zinc, iron ore, coal, and steel. China's demand for hard commodities grew as a consequence of substantial investment in infrastructure and the expansion of the manufacturing sector.

Going forward, China will maintain high demand growth for some raw materials used in processing and investment according to infrastructure projects stipulated in the 12th Five-Year plan such as building of 36 million affordable housing in the cities. However, China's consumption growth for hard commodities may be decreasing in the much longer run when the country successfully moves away from production-led growth to consumption-led and

[23] In order to achieve food security of the nations, a self-sufficiency policy in grains was launched since 1995 to ensure domestic production meeting 95 percent of domestic demand (Anderson and Pend, 1998 and World Bank, 2010). Thereby, apart from the constraint on the land use, the policy itself does not allow China to increase production of other soft commodities on demand.

innovation-led growth.[24] The latter is rather human capital intensive than physical capital intensive.

As for the implications for the world economy, being the world top consumer of primary commodities implies that a small shift in China's import will undeniably impact the global commodity prices and countries' terms of trade. Moreover, China's strategic movement, such as diversifying supplies of key resources by importing from various resource-rich countries and investing abroad directly to secure resources, will also affect other nations significantly in certain different ways.

3.3 Evolution of China's export structure: Moving up the ladder

During 1980s, China's export structure has been dominated by labor-intensive manufactured industries, comprising of textile and clothing, with the stunning growth of 31 percent per year from 1980 to 1990 and the successive slower growth of 16 percent per year from 1990 to 2000. Not surprisingly, China with the largest population in the world enjoyed cheap abundant supply of labor. China thus has become a "world factory" thanks to low labor costs and proactive FDI policies that have attracted international manufacturing companies to base or source in China.

According to Yue and Hua (2002), the revealed comparative advantage (RCA)[25] shows that "China has moved from a position of comparative advantage in both resource and labor-intensive products at the beginning of the 1980s to one of comparative advantage in only labor-intensive products in the 1990s".

In the late 1990s, China gained more comparative advantage in capital-intensive as a result of exogenous Chinese government's tremendous effort in building economic infrastructure and promoting capital investment in 1998. China's export structure increasingly shifted to capital-intensive manufactured products such as electric and electronic (E&E) equipment and machinery with the growth of 200 percent in half a decade. However, the manufacturing industry was still mostly dominated by processing trade, imported hi-technology components from host MNC countries like United States and Japan while exporting finished hi-tech products with relatively low value added.

Since 2001, after China joined WTO, China continued to shift towards more capital-intensive and technology-intensive industries and rapidly moved up the value chain by upgrading to more sophisticated products. This can be indicated from various indicators as discussed below.

Firstly, moving up the value added chain can be reflected by the change in the ranking of top five exporting sectors between 2001 to 2010 as shown in Table 2 (with percentage share of total export in parentheses).[26] In 2010, optical, medical and technical devices became one of the top five exporting product categories in place of labor-intensive products such as apparel, footwear, and toys and games. For E&E equipment and machinery which have been the top two product groups in China, though their rankings have not changed, they have become more concentrated over time as reflected by higher shares of these two sectors in Chinese total exports (the former increased from 19.3 percent in 2001 to 24.6 percent in 2010 and the latter increased from 12.6 percent to 19.6 percent during the same period).[27] Apart from higher contribution in terms of export shares, these top two exporting product groups also have higher level of product complexity over time.

---

[24] Innovation-led growth model will be discussed in Section 5.1 in this paper.

[25] Due to Balassa (1965), RCA measures a specific product's share in the country's total exports relative to a share of this product in the world trade.

[26] It should be noted that some subgroups in these broad capital-intensive sectors are labor-intensive.

[27] During 2001 to 2010, E&E equipment and machinery, the top two contributors to Chinese exports, grew annually by 29.7 percent and 26.4 percent respectively. Whereas, for United States, the second largest E&E exporters, these categories grew much slower with average annual growth rate of 0.7 percent and 5.4 percent, respectively.

Table 2: Top five exporting products in China

2001	Rank	2010
Electrical and electronic equipment (19.3%)	**1**	Electrical and electronic equipment (24.6%)
Machinery and parts (12.6%)	**2**	Machinery and parts (19.6%)
Apparel (12.2%)	**3**	Apparel (7.7%)
Footwear (3.8%)	**4**	Optical, medical and technical devices (3.3%)
Toys, games (3.4%)	**5**	Furniture, lighting (3.2%)

Source: Trade Map database, authors' calcualtion

Within this broad E&E category, the compositions have also changed. In the early 2000s, China exported mostly televisions and parts, accounting for 30 percent of E&E exports in 2006. But televisions and parts subcategory started to decline significantly in their importance and no longer made top exporting products in the E&E category since 2007. Instead, telephone and communication equipment, which are classified as more sophisticated products, has become the first rank with the average annual growth rate of 11 percent from 2007 to 2010.[28]

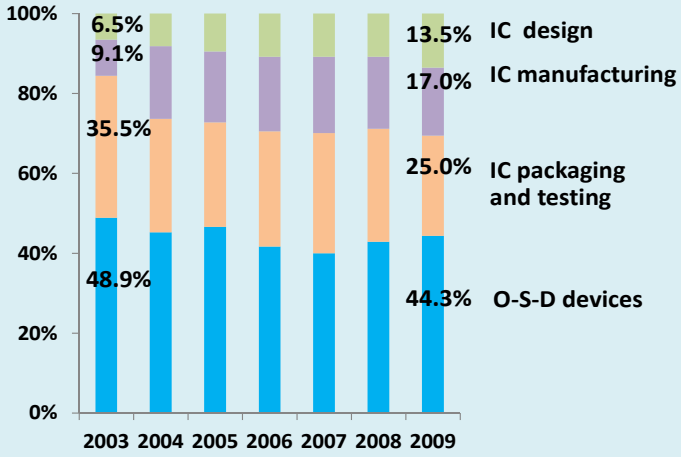
[28] In contrast, there is a stable export pattern within machinery category, ranging from automatic data processing machines, computer and office machinery, to air conditioning machines, which accounted for 45 percent, 17.7 percent and 3.3 percent, respectively, in 2010.

Box 1: Semiconductor industry in China

Chinese semiconductor industry provides a good case study of China's success stories in moving up the value chain. Thanks to gains in specialization, the composition of Chinese semiconductor industry has evolved rapidly towards more sophisticated production by local firms, substituting imports of technology-intensive components from host MNC countries. The industry was originally dominated by optoelectronics –sensors-and discrete devices (O-S-D devices) and IC packaging and testing, which are less sophisticated process in the IC line of production, accounting for 48.9 percent and 35.5 percent of IC industry share in 2003, respectively. Their shares declined to 44.3 and 25.0 percent in 2009. Whereas, IC design sector, which requires higher skills and innovations, is the fastest growing sector. Its market share rose from 6.5 percent in 2003 to 13.5 percent in 2009 (Figure 24).

In the late 2000s semiconductor manufacturers in China, namely, Intel and Hynix, started to have a complete vertical specialization as they became capable of operating wafer fabrication facility. Domestically-produced wafers are then exported to be assembled in other countries as China has moved out of being just an assembler in the value added chain. Chinese semiconductor manufacturers continuously evolved from being merely original equipment manufacturer (OEM) to original design manufacturer (ODM) and currently on the rise to become original brand manufacturer (OBM).[29]

Figure 24: Breakdown of semiconductor industry in China



Source: PWC

Secondly, using highly disaggregated data in classifying hi-technology products, we found that China has quickly gained higher world market share in exporting hi-technology manufactured goods[30] from 4.6 percent in 2001 to 16.3 percent in 2010. In comparison, Thailand's market share in hi-tech products has been quite stable at a very low level (Table 3).

[29] According to Pecht, et al. (2001), MNCs in China are transferring technology to China, investing capital, building wafer fabs, and forming joint ventures with Chinese partners.

[30] According to OECD's classification of manufacturing industries into categories based on R&D intensities (2011), hi-technology industries include aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, TV and communications equipment; medical, precision and optical instruments.

Table 3: Countries' export and import market share of hi-tech products in the world market

Exporters	2001	2010
China	4.6%	16.3%
Singapore	5.4%	5.5%
Japan	8.8%	5.2%
Republic of Korea	3.8%	4.7%
Chinese Taipei	4.0%	4.4%
Malaysia	3.9%	3.0%
Thailand	1.4%	1.6%
Philippines	1.8%	1.2%
Hong Kong, China	4.6%	0.6%
Indonesia	0.5%	0.3%

Importers	2001	2010
China	4.9%	14.0%
Singapore	4.2%	3.6%
Japan	5.5%	4.1%
Republic of Korea	2.6%	2.5%
Chinese Taipei	2.9%	2.2%
Malaysia	2.5%	2.1%
Thailand	1.3%	1.1%
Philippines	1.2%	0.8%
Hong Kong, China	5.2%	7.1%
Indonesia	0.1%	0.6%

Source: Authors' calculation based on Trade Map database

On the other hand, China's imports of hi-technology components and finished products from the world market also increased from 4.9 percent in 2001 to 14 percent of world hi-tech imports in 2010 (Table 3). Nonetheless, in terms of net trade, China has switched from being a net importer of hi-tech products in 2001(net import value 4,549 million USD) to a net exporter in 2010 (net export value 21,692 million USD).[31]

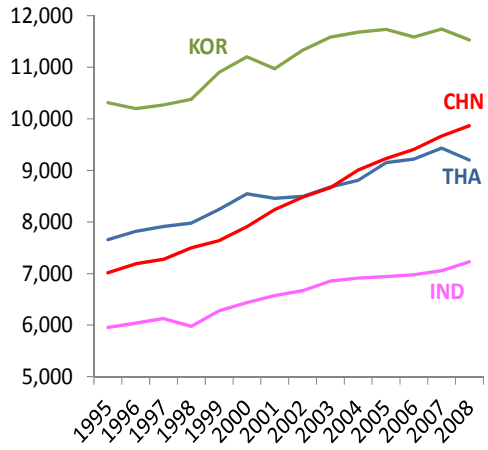
Thirdly, the income level embodied in a country's exports (EXPY)[32] is used as an indicator to determine level of export sophistication. The higher the EXPY, the more sophisticated is the country's export products. The EXPY shows that China's level of export sophistication had steadily climbed up and outperformed Thailand since 2004 (Figure 25).[33] This trend of product upgrading is expected to continue in China, and at this rate it will soon catch up with Korea, whereas those of many other Asian countries such as Japan, Singapore, and Malaysia started to stall.

[31] However, most of hi-technology export is still largely processing export produced by foreign-invested firms and thus contains high foreign content, accounted for about 80 percent in electronic devices according to Koopman and Wang (2008). Moreover, Xu and Lu (2009) find that an (Chinese) industry's level of export sophistication is positively related to the share of wholly foreign owned enterprises from OECD countries and the share of processing exports of foreign-invested enterprises."

[32] According to Hausmann and others (2007), the EXPY assigns to each 6-digit product category a (weighted) average income level of those countries producing the same product. A product exclusively produced by advanced countries is assigned a high value.

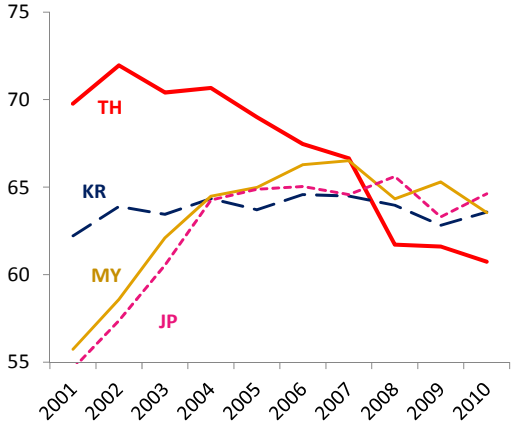
[33] The EXPY index is calculated based on UN Comtrade. We thank the IMF's Strategy Policy and Review Department for kindly providing the EXPY database.

Figure 25: Export sophistication index (EXPY)



Source: IMF

Figure 26: Export similarity index (ESI) between China and other countries



Source: Authors' calculation based on Trade Map database

Finally, Export Similarity Index (ESI)[34] is commonly used to measure the overlapping between two countries' structure of exports to the world market. We calculate the ESI using 99 product categories (2-digit HS) based on Trade Map database.[35] The ESI reveals that China's export structure is becoming more similar to advanced economies such as Japan and Korea over time, as well as Thailand's competitive neighboring countries like Malaysia (Figure 26).[36] Conversely, Thailand's export structure appears to be increasingly less similar to that of China over time which can possibly be interpreted in two ways. First, Thailand is diversifying its exports towards more variety of goods. Second, Thailand is diverging from China's export structure partly due to an inability to keep up with being part of China's supply chain. These two assumptions will be explored more in details later along with discussions on key ingredients for Chinese successful upgrading of export sophistication.

Section 4: Thailand: Alternative ways to grow with China

Having explored the evolution of China's trade structure, this part identifies alternative ways for Thailand to grow with China, mainly through trade channel, and briefly discusses prospects and challenge of each choice.

4.1 Supplying agricultural products

Thailand has been a major exporter of rubber, cassava products and rice to Chinese market and earned market share of 47 percent, 54 percent, and 90 percent, respectively (Table 4). Viewed from the other side of the mirror, China is also a major importer of rubber and cassava products from Thailand; the Chinese market accounts for 34 percent and 62 percent of Thailand's total exports of each product, respectively. Rubbers exported to China are mainly used as raw materials for manufacturing, while cassava products are mainly for bio-fuel production.

---

[34] According to Finger and Kreinin (1979), export similarity index is calculated as $S(j,k) = \sum_i [\min(X_{ij}, X_{ik}) \cdot 100]$, where X_{ij} and X_{ik} are product i's export shares in country j's and country k's exports to the world. The index ranges between 0 and 100; index value of 100 means two countries have identical export patterns.

[35] Note that ESI is subject to aggregation bias.

[36] Similarly, Schott (2008)'s ESI calculation reveals that China's export overlapping with the OECD countries across products is substantial and increasing over time, rendering it more "sophisticated" than countries with similar relative endowments.

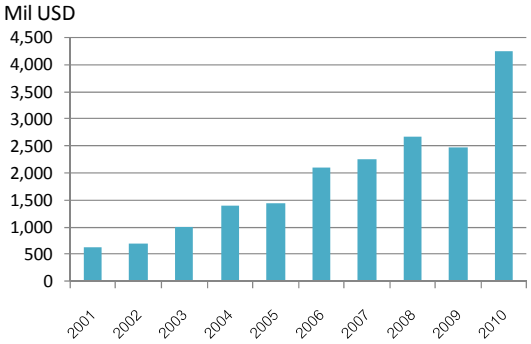
As Chinese growth has led to a sharp rise in its share of global demand for commodities during 2001-2008, Thailand has also enjoyed the boom in agricultural exports (in terms of both price and quantity) (Figure 27). Nevertheless, agricultural products account for only 8 percent of total Thai export value and thus cannot be counted on to significantly lift Thailand's overall economic growth. In addition, the production capacity of agricultural products itself has certain limits due to domestic resource constraints (e.g. land limits) and cannot be expanded fast enough to meet the rapidly rising demand from China.

Table 4: Top three agricultural product export to China in 2010

Rank	Agricultural Products	Export to China/ Export to world[1]	Market share in China[2]
1	Rubber	33.7%	47.0%
2	Cassava products	62.3%	53.9%
3	Rice	4.3%	89.6%

Note: [1] Thailand's export of product i to China divided by Thailand's export of product i to the world.
[2] China's import of product i from Thailand divided by China's total import of product i.
Source: Author's calculation based on Trade Map database

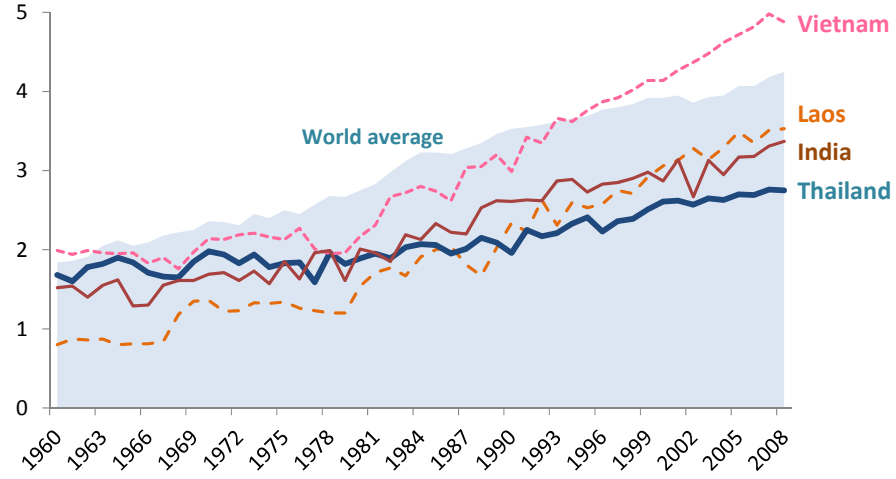
Figure 27: Thailand's export value of top three agricultural products to China



Source: Author's calculation based on Trade Map database

Thailand's low agricultural productivity and slow improvement thereof is found to be another limitation for Thailand to reap the full benefit of China's rapidly growing demand. As a case in point, Figure 28 shows that Thailand has relatively lower rice yield than India and Vietnam, the other major rice exporting countries.[37] More strikingly, rice yield in Laos has also been higher than that of Thailand since the early 1990s. The productivity growth as reflected by the slope of the lines also confirms Thailand's lackluster performance: Thailand's productivity growth of rice is 0.67 percent on average over 2000-2008, which is considerably lower than world average of 1.03 percent, while productivity growth for India, Vietnam and Laos registered at 2.45, 2.09 and 1.88 percent, respectively.

Figure 28: Rice yield (tons/hectare)



Source: United States Department of Agriculture

[37] It should be noted that the *level* of rice productivity should not be compared across countries directly because each country produces different proportion of different kinds of rice. Thailand's average rice yield may appear low because Thailand produces high proportion of jasmine rice which is of higher quality but with relatively lower yield.

4.2 Serving growing Chinese middle class

Growing Chinese middle and high-income class offers ample opportunities for other economies to tap into this large consumer market in China. Over the past decade, number of the poor has declined considerably and was replaced by an emergence of massive middle class.[38] The upper middle class is expected to grow from 12.6 percent of population in 2005 to 21.2 percent in 2015 and 59.4 percent in 2025 (Figure 29). As income of China's new middle class rises, so too will their consumption.[39] Owing to its large population, rapid economic growth, as well as a shift of policy direction toward more reliance on domestic consumption, China's consumption is expected to grow by more than an 8 percent annually over the next 15 years, making China the world's third largest consumer market (behind the U.S. and Japan) by 2020.[40]

Not only the quantity of spending by rising Chinese middle class will increase, the pattern of spending will also change dramatically, too. Share of expense has been shifting steadily away from necessities (such as food and clothing) toward discretionary spending (such as luxury goods and services). Today discretionary spending constitutes approximately 55 percent of total urban spending, and was expected to rise to 74 percent by 2025 (Diana, et. al., 2006b). China is also on its way to become the biggest luxury-goods market[41] as it has now reached the top league of luxury consumption owing to the blossoming of rich Chinese consumers who regard these expensive consumer goods as trophies of success. Products and services that have tendency to benefit greatly are those that can serve growing needs for (1) healthcare[42] (2) personal financial services (e.g. wealth management), (3) products to show off of superior social status, (4) high quality and safety and (5) stylish designs and images.

However, Thailand still could not do well in getting the hands on the share of Chinese consumer's wallet. For instance, in some areas that Thai products or services gain favorable market share in China—such as processed food, tourism, and some handicrafts—these products' per-unit value is not high enough to capture greater share of Chinese's growing expenditure. The success cases are the Switzerland's wealth management companies and Germany's export of luxury cars, which could offer high value added services and products.

In addition, Thailand also lags behind their competitors in promoting product differentiation due to the lack of internationally-established brands, and lack of sufficient promotion of product quality and safety. These are keys to tap the demand of Chinese individuals who can afford to pay higher prices. Moreover, Thailand still has limitation of resources to offer higher value added services due to limited numbers of infrastructure and human resources in healthcare, science, R&D, financial services.

---

[38] Large segment of population moves into the middle class. The middle class comprised of 2 segments: lower aspirants earning 25,000 to 40,000 renminbi per year, and upper aspirant earning 40,000 to 100,000 renminbi per year. The poor earns lower than 25,000 Renminbi per year. Mass affluent and global affluent earn 100,000-200,000 renminbi and over 2000,000 renminbi, respectively. The urban middle class is expected to grow from 22 percent of population in 2005 to 71 percent in 2015 and 80percent in 2025. This new middle class have spending power.

[39] While the production side of China's economy has boomed with three decades of high growth, the consumer side has yet more room to grow. Consumption has grown at a significantly slower pace than output-consumption at a share of GDP is currently at 35percent, which is relatively lower than world average. Although private consumption has not yet play important role in contributing to the GDP figure, however, the amount itself increase with the rising income. In addition, China's consumption is expected to play more important role in the future after the improvement of the social safety net.

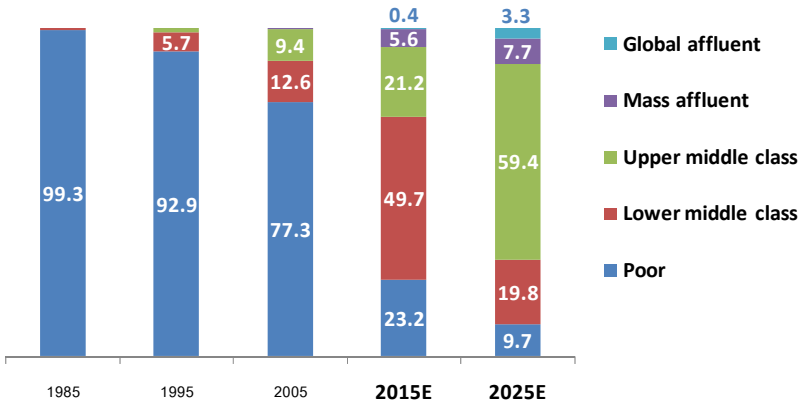
[40] Woetzel et. al. (2009)

[41] China will become the world's biggest luxury goods market by 2020. ("Dipped in Gold: Luxury lifestyles in China and Hong Kong,", CLSA Asia-Pacific Markets, February 2011)

[42] The private health expenditures by urban consumers will grow more than 11 percent annually over the next two decades given rapidly aging population and the underdeveloped public healthcare system, which would increase opportunity for healthcare providers, insurance companies, medical equipment manufacturers, and pharmaceutical companies. (Diana, et. al., 2006a)

Inability to create high-value products and services that meet the demand of Chinese middle- and high-income class would limit the extent to which this channel can contribute to Thailand's overall export growth.

Figure 29: Share of Chinese urban households (percent)



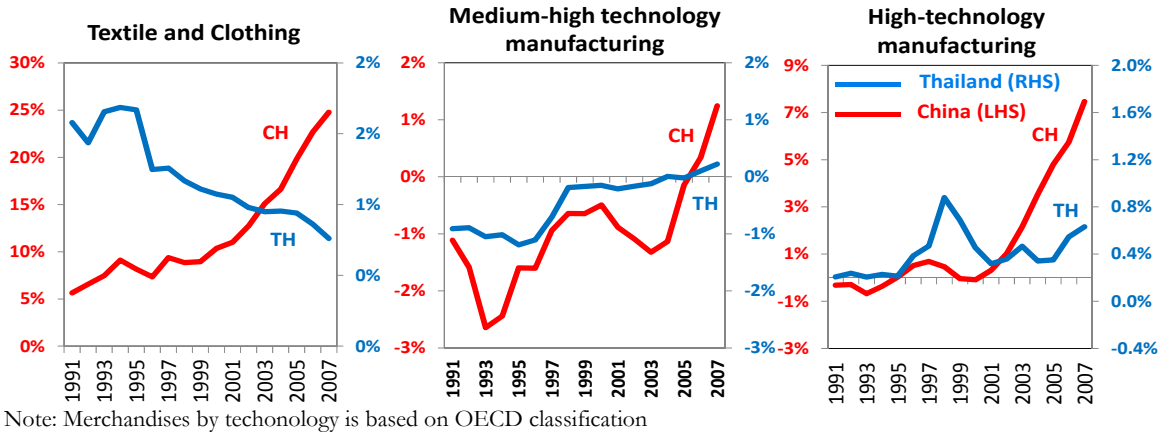
Source National Bureau of Statistics of China; McKinsey Global Institute analysis, 2006

4.3 Being part of China's supply chain

Historically, Thailand's growth has benefited from being part of China's supply chain. However, these benefits are about to deplete if Thailand cannot adjust fast enough to catch up with China's pace in climbing up the ladder.

To answer whether Thailand has risen with China in the past decade, we first consider net exports to world demand as a rough indicator to measure Thai manufacturing performance, classified by level of technology, comparing to those of China. In a broad picture, it is found that while China's net export share in low-technology industries, such as textile and clothing, has been rising while Thailand's share has been on the decline. This may imply that Thailand is losing competitiveness relative to China in these industries. Nonetheless, for medium-technology—such as electrical machinery other machinery, motor vehicles, and chemicals—and hi-technology sectors, Thailand's net export share has been rising along with that of China, though at a considerably lower rate, possibly through being a supplier for China's medium- and high-tech imports of upstream products (Figure 30).

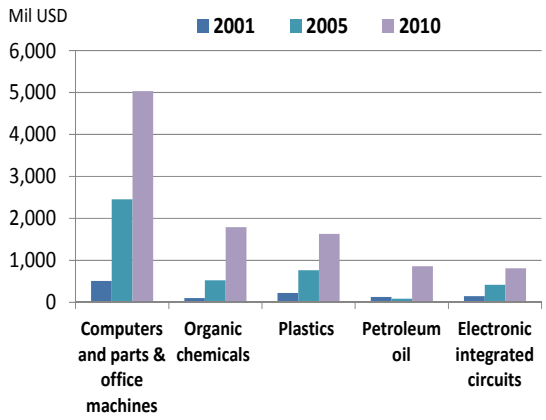
Figure 30: Net export to world demand



Note: Merchandises by techonology is based on OECD classification
Source: WTO statistics database, Thai NESDB, and authors' calculation

Next, we consider directly Thailand's exports of upstream products to China. Thailand's top five manufactured products being exported to China are computers and parts and office machine, organic chemicals, plastics, petroleum oil, and electronic integrated circuits which have grown significantly during 2001 to 2010 (Figure 31); they account for shares of 27 percent, 31 percent, 26 percent, 12 percent, and 10 percent in Thailand's total exports in 2010, respectively (Table 5). It is worth highlighting that Thailand is the largest supplier for China's imports in the automatic data processing machines category, specifically the hard disk drives (HDD), which accounts for 27.5 percent of China's imports from the world. Given that HDD industry is the key manufactured product for Thailand which contributes the most to Thailand's MPI growth since 2003, China's growing exports in this automatic data processing machines category appears to have tremendously benefited Thailand's export sector. On the other hand, the electronic integrated circuits (IC) industry, which commands the third largest export share in Thailand[43], has not been performing very well in terms of taking advantage of being part of China's supply chain. Thailand's IC export to China accounted for only 2.5 percent of China's imports from the world. And this share has remained low throughout the past decade while Korea and Malaysia are gaining increasingly greater market shares in the Chinese IC imports.

Figure 31: Thailand's export of top five manufacturing products to China



Source: Authors' calculation based on Ministry of Commerce

Table 5: Thailand's export of top five manufacturing products to China

Rank	Manufacturing products	Export to China/ Export to world
1	Computers and parts & office machines	27%
2	Organic chemicals	31%
3	Plastics	26%
4	Petroleum oil	12%
5	Electronic integrated circuits	10%

Source: Authors' calculation based on Ministry of Commerce

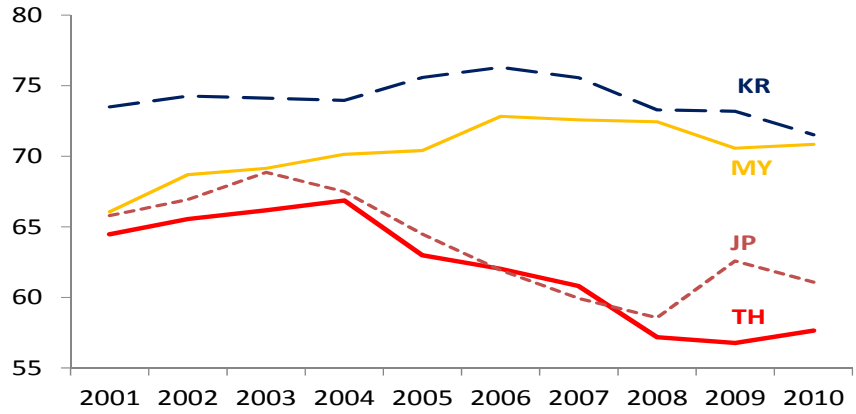
There are three risk factors for the Thai manufacturing sector in rising with China by being part of China's production chain: (1) China's rapid upgrading of export sophistication; (2) China's lesser role as "world assembler"; and (3) intensive regional competition.

Firstly, it is shown above from the EXPY and ESI indices that Thailand's export structure is facing the risk of deviating from China's increasingly sophisticated supply chain. In addition, measured by trade complementarity index[44] between Thailand and China, the pattern of China's imports from the world has become less matched with Thailand's overall export pattern, indicating increasing incompatibility between what China demands and what Thailand specializes (Figure 32).

[43] After computers and parts and office machine, and vehicles.

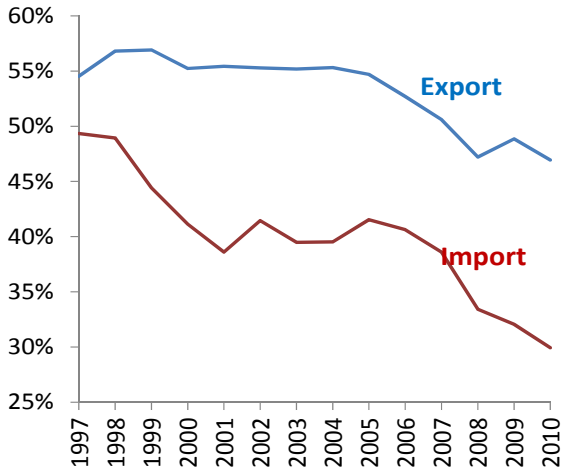
[44] According to Michaely (1994), trade complementarity index indicates how well export profile of one country matches the import profile of another country. It is calculated as $C(j,k) = \sum_i [\min(X_{ij}, M_{ik}) \cdot 100]$, where X_{ij} and M_{ik} are country j's export share and country k's import share of product i, similar to the concept of ESI. The index ranges from 0 to 100, with index value of 100 indicating trade flows between the two countr9es match perfectly.

Figure 32: Trade complementarity index



Source: Author's calculation based on Trade Map database

Figure 33: Processing trade share in China (percent of total export or import)



Source: CEIC

Secondly, China has tended to play a lesser role as "world assembler". Processing trade in China has accounted for about half of total trade on average since 1995. Recently, China's reliance on processing trade has been declining. Processing import shrank dramatically by 22 percent during 1998 to 2001 and continued to drop by 28 percent during 2005 to 2010. Its share reduced from 50 percent of total imports in 1997 to 30 percent in 2010. This means China has been reducing its imports of foreign supplied materials, parts and components to emphasize more on local contents in processing trade (Long, 2004; Liang, 2008).[45] According to Long (2004), government policy is an influential factor for a noticeable increase in percentage of local content of China's processing export. Likewise, there has been a decrease in processing export share, but to a lesser extent, from 55 percent of total export in 1997 to 47 percent in 2010 (Figure 33).

Finally, regional competition is another risk factor for Thailand in maintaining the benefits of tagging on China's production supply chain as other countries such as Malaysia and Korea have been proactive to reap benefits from China's rising as well. They also show much clearer directions compared with Thailand in moving forward with policies to attract high value added FDI and industrial upgrading strategies. As a case in point, the evolution of E&E equipment exports to China revealed that Thailand has been much slower than regional competitors in gaining competitiveness in the Chinese market. Using the constant market share (CMS) analysis,[46] the market share of E&E equipment exports to China that was gained

[45] According to Liang (2008), although local value-added has been increasing, the share of value-added to the total trade value still hovered at around 30 percent, which means that most of the value-added is generated elsewhere, however.

[46] Constant market share analysis is used to decompose a country's aggregated export (share) growth into "total growth" effects (overall change in world imports and change in commodity composition) and "competitiveness" effects. It is calculated as $X_1 - X_0 = r_m X_0 + \sum(r_{mi} - r_m) X_0 + \sum[(X_{i1} - X_{i0}) - r_{mi} X_{i0}]$, where X denotes the country's total export value; r_m denotes rate of change of world imports; i represents export sector, 0 and 1 indicate base year and the final year.

exclusively from increased competitiveness improved by only 7.2 percent for Thailand over 2001-2010, compared to 45.2 percent for Korea and 17.7 percent for Malaysia.

In sum, Thailand may have benefited from China's rising by taking part in China's production network, thanks to long-standing MNCs' decisions to locate their middle-stream electronics production in Thailand. However, going forward Thailand is facing the risk of being left behind as China is rapidly moving up the value-added ladder while also playing a lesser role as world assembler.

The bottom line is that, there remains opportunity for Thailand to grow with China ut it will crucially depend on Thailand's own efforts and ability to upgrade its technological absorption capacity to maintain and attract more sophisticated FDI by promoting research and development activities, building stock of human capital, establishing institutional framework conducive to technological development. Without a strong determination and serious efforts by the Thai policymakers to tackle obstacles for Thai businesses in moving up the value chain, opportunities presented to Thailand that arise with China's continued rising may just slip through, and what we have benefited before may be considered just a windfall gain.

Section 5: China's industrial development strategy: Lessons for Thailand

Besides opportunities presented to others to benefit directly from increasing Chinese demand for a broad range of goods and services, China's experience of rapid growth also offers valuable lessons to be learned by other developing countries. This section analyzes the forces behind China's success through the review of its technology and industrial development policies and the promotion of national innovation system. We also compare industrial development strategy in Thailand to that of China in order to draw policy recommendations for the Thai economy.

5.1 China's industrial and technology development policies

China's industrial policy was clearly in favor of high-technology and capital-intensive industries. The policy goal of the Chinese government includes not just the creation of technology capacity domestically, but also the development of internationally competitive Chinese firms. In recent years, the goal has been directed towards transforming China into an economy of homegrown leading edge technologies.

As illustrated in the earlier section, China has been rapidly moving towards a new stage of development by shifting from a low- and middle-technology manufacturing economy to a producer of high technology products since the late 2000s. Of course, this successful industrial development did not happen just by chance or luck. The government decisively and prudently crafted its policy strategy in a way that allows it to climb up the technology ladder at a much faster pace than other countries that started out at the same level of development.

According to Lall (2003), there are two approaches to manufacturing expansion strategy: 1) a better exploitation of existing advantages such as the abundance of natural resources and unskilled or semi-skilled labor, and 2) a creation of new advantages such as skills, technological capabilities, clusters and so on. The first option requires less effort and involves less risk than the latter and has been usually chosen by many developing countries through attracting FDI to realize existing advantages. In contrast, China chose *not* to rely on FDI-dependent industrial development strategy, where source of technological change remains largely in the hands of foreign investors. Instead, China opted for the "autonomous" industrial development strategy[47]

47 Formerly, countries that developed this policy include Korea and Taiwan. These two countries relied on indigenous efforts in developing management and technology capability and allowed high competitions among

that involved a great number of industrial policies and government intervention in factor markets and institutions. With direct support from the government, this strategy allowed domestic enterprises to become significant global players, on top of promoting national ability to keep up with new technology.

China's development strategy aims to upgrade the production process through two channels: 1) maximizing absorption of foreign technology, and 2) promoting indigenous industry.

5.1.1 Maximizing absorption of foreign technology

Chinese government carefully picked FDI from multinational corporations (MNCs)[48] that were equipped with high technology in order to obtain advanced technology from developed countries and then established domestic innovation capacity based on this. Similar to other developing countries, the Chinese government has been well aware that inward FDIs can stimulate innovation activities in the domestic market via spillover effects through reverse engineering, skilled labor turnovers, demonstration effects, for example.

China's policy for promoting high-technology industries shares some common features with the policies adopted elsewhere in East Asia such as opening up to foreign investors and providing direct government support to domestic firms. We thus observe the common phenomena of foreign-investment-fueled export boom within the region. Nevertheless, there exist a number of key distinctive features in China's capabilities and potentials that allow it to surpass its peers in several aspects such as capacity for absorbing and developing technology and better endowment and industrial structures.

With the advantages of being one of the world's largest and fastest growing markets, central government could enforce several policies upon foreign companies tapping into the Chinese market, including forcing technological transfer in technology-based industries such as air transportation, power generation, high speed rail, information technology, and electric automobiles. The central government also stipulated a high degree of local content in equipment produced locally as well as limited foreign joint ownership to ensure government's control over corporate decisions and operations. In late 2009, central government announced that it would only purchase products in which technology was developed within the country. This effectively enforced MNCs to a set up more R&D projects and facilities locally. Table 6 illustrates timeline of policies regarding technology transfer in high-tech industries.

Table 6: Timeline of policies regarding technology transfer in high-tech industries

Year	Activities
1990	Alcatel (France), NEC (Japan), and Siemens (Germany) were given exclusive rights to sell expensive telecom switches in exchange for transferring integrated circuit (IC) technology to Chinese IC manufacturers[49].
1993	Received world 2nd largest inflow of FDI (after US), with significant investment in electronics sectors, including computing, communications, consumer, and components. MNC perused low cost export platforms and sales in China market.
2006	Implement new policies of "created-in-China technology" through 1) State's influence over equipment purchases, sales and technology development in certain

domestic firms (Chaebols-Korea and SMEs-Taiwan), while the imports of entrepreneurial skill and technical knowhow were limited.

[48] Inward FDI to China has been on a large scale since 1993 after Deng Xiaoping's South Tour which greatly reduced the political uncertainty of investing in China. In addition, the government launched measures to attract FDI such as substantial amendment of patent law (in 1993) to extend the patent length from 15 to 20 years for innovation patents and from 5 to 10 years for patents on utility model and external design.

[49] "Peking Using Digital Switching Market", Business China, 24 December 1990, Linden (2004).

	key industries, such as CSR & China railways, AVIC, and China Eastern Airlines; through its role as both buyer and seller. 2) Consolidated several manufacturers into a few national champions such as CSR and AVIC were from merging small & loss making enterprises. 3) Obtain high-technology from MNCs in several technology based industries such as air transportation, power generation (nuclear reactors), high-speed rail, information technology (satellite), semiconductors, water purification, and protein science. These rules includes - limit investment by foreign companies - limit access to local market - stipulate high degree of local content in equipment produced domestically - force the transfer of proprietary technologies from foreign companies to their joint ventures with China's SOEs. 4) Offer tax incentives for investment in R&D facilities and tax breaks on returns from venture capital investment in technology based start-ups. 5) Increased government spending in 17 areas in which state's research institutions and its enterprises collaborate. 6) Banks offer cheap loans and special funding supported the development of domestic technologies that can replace imported one.
Late 2009	Indirectly forced MNCs to locate many more of R&D activities in a country though the tailored procurement policies to favor locally developed technologies. A global leader in semiconductor-making equipment, "Applied material", relocated its chief technology officer to China.

5.1.2 Promoting indigenous innovation

Realizing that innovation was essential for the next stage of development, China aimed to transform its development mode to be less resource reliant and more innovation driven. Since 2006, innovation became China's new national strategy as stated in its medium-and-long term Science and Technology development plan (2006-2020). The policy aimed to advance the nation into the top rank of innovative countries by 2020.

The Chinese government's endeavor to promote indigenous innovation can also be reflected by recent implementation of preferential policies, financing scheme, and other tools to support the development of Chinese-owned technology, as well as the efforts to enhance innovative capacities of the economy.

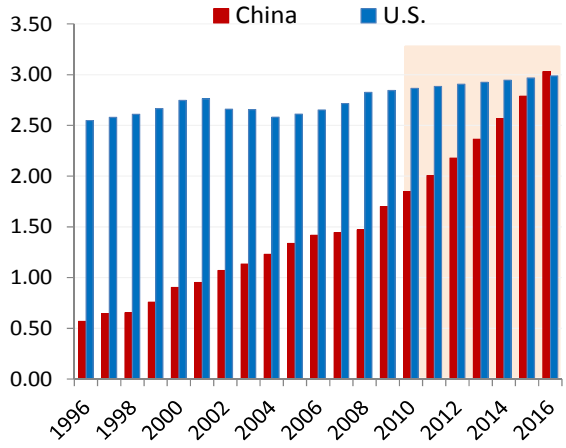
Following the Korean model,[50] China deliberately restricted inward FDIs as well as limited existing MNCs' investment and access to local market in order to build up its own innovative capabilities. The Chinese industrial policies favor domestic technology companies and support local company to produce advanced products. The government provides lavish subsidies and protection on those target industries through providing incentive packages for technology industries and funding for megaproject in sunrise areas such as new-generation nuclear reactors, nanotechnology, quantum physics, clean energy and water purification. Other measures to promote the supported sectors includes public research, promotion of domestic technology standards, trade protection, preferential loans, selective government procurement rules mandating purchase of domestic hardware and software, control of foreign participation, relaxed antitrust regulation provision of training, and education for sector-specific skills (Dahlman,1993).

[50] Korea implemented both import substitution with forceful export promotion, protecting and subsidizing targeted industry that could have potential for export. Government promoted growth of Chaebol, the local giant private firms to forefront industrialization and export. Chaebol was selected from successful exporters and were given subsidies and privileges, including restriction of TNCs entry. FDI was allowed only where considered necessary. The government supported technological effort in Korea in several ways such a promoting private R&D through (1) tax-exemption for Technology Development Reserve funds (2) tax credits for R&D expenditures, upgrading human capital related to research and setting up industry research institutes (3) reduced duties for imported research equipment, and (4) reduced excise tax for technology intensive products (Lall, 2003). These measures help encouraged reserve engineering and R&D by technology-importing firms to develop indigenous technological capabilities.

Regarding fostering innovative capacities, targets have been clearly set by the Chinese government that China's R&D investment will be raised to over 2.5 percent of GDP by 2020 and the dependence on foreign technology will be below 30 percent.[51] Currently, China's R&D expenditure is at 1.7 percent of GDP, while the US figure is 2.7 percent. But, the government spending in this area has recently risen at a spectacular rate in China (about 8.6 percent a year over the past decade compared to the U.S. at 0.7 percent). At this rate of growth, China's R&D spending will catch up with the U.S. by 2016, much sooner than targeted (Figure 34).

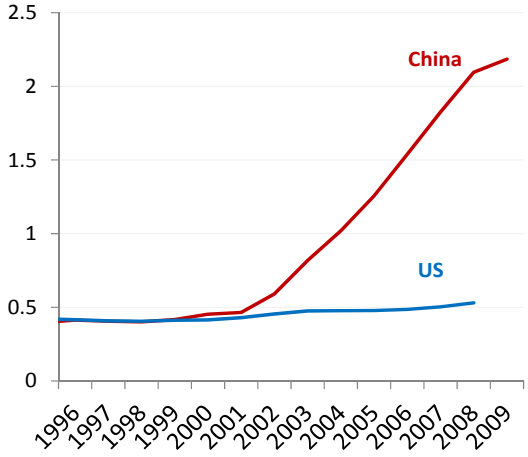
China also realized that human capital is one of the key factors for obtaining comparative advantage in technology and differentiating itself from countries with similar endowments and similar openness to investment and technology flows. With its huge population, China is endowed with the potential to become the world's largest technology leader if it could achieve relatively high proportion of students and workers in the fields of science and technology as the gross number of high-skilled human resources implies greater capacity to produce sophisticated products and innovations. Government efforts in human capital development have been geared towards this direction and from the latest data, the number of engineers and scientists that China produced was already nearly six times greater than those of the U.S. (Figure 35). Two strategies employed by the Chinese government to improve its human capital are (1) undertaking a fundamental reform of the educational system and (2) bringing home scientists and engineers studying abroad in industrialized nations. This repatriation of foreign-educated students together with improvements within Chinese educational and research organizations is seen as a way to foster interaction between exogenous and endogenous knowledge to make the best of human capital capabilities.

Figure 34: Research and development expenditure (percent of GDP)



Source: Authors' estimates based on World Development Indicators and China Statistical Yearbook

Figure 35: Number of graduates in Science and Engineering



Source: CEIC and U.S. National Science Foundation

Moreover, China also aimed to be the world's top five in both the annual granted indigenous innovation patents and science and technology research publications. Since the early 2000s the world witnessed a significant rise in the number of patent applications from Chinese domestic inventors, especially invention patents (Table 7 and Figure 36).[52] The latest figures in 2009 shows that the invention patent applications of domestic inventors, which used to be

[51] According to Dianhua (2008), China's dependence on foreign key technology is more than 50 percent, while those of developed countries are below 30 percent, and the US and Japan is around 5 percent

[52] Application for "invention patents" must meet the requirement of "novelty, inventiveness, and practical applicability". Successful discovery of inventions requires higher R&D costs and longer period of time. Small firms usually invest in Innovative effort on short-term R&D project such as utility model and external design patent.

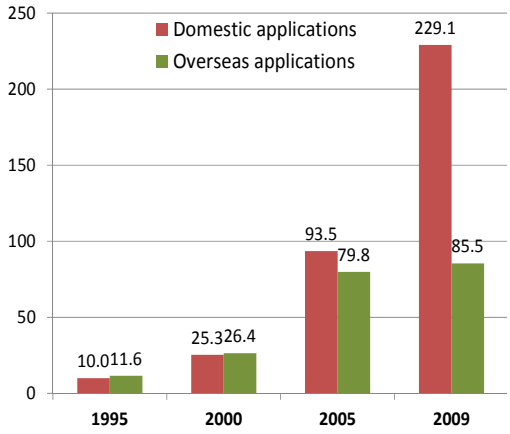
criticized for contributing only small proportion to overall patent applications, has by far outnumbered the overseas or foreign inventors. The fact that the patent application structure was no longer concentrated in mere utility model and external design, and was driven by domestic rather than foreign innovators, signified initial success of the efforts to promote innovation-led economy.

Table 7: Type of patent application (pieces)

	1995	2000	2005	2009
Domestic application	**68,880**	**140,339**	**383,157**	**877,611**
Invention	10,018	25,346	93,485	229,096
Utility model	43,429	68,461	138,085	308,861
External design	15,433	46,532	151,587	339,654
Overseas application	**14,165**	**30,343**	**93,107**	**99,075**
Invention	11,618	26,401	79,842	85,477
Utility model	312	354	1,481	1,910
External design	2,235	3,588	11,784	11,688

Source: China's Statistical Yearbooks for Science and Technology, 2010

Figure 36: Invention patent application (thousand pieces)



Source: China's Statistical Yearbooks for Science and Technology, 2010.

5.2 Remaining challenge in industrial and technology upgrading in China

China's industrial policy has yielded large success to varying degree across industries (Table 8) in terms of effective absorption of technology, a fast-track transition to more sophisticated industries, rapid development of own innovative capacity and continued emergence of competitive domestic firms. The private sector has also played an increasingly important role in technology development as China's most innovative technology has mostly come from privately owned companies.

Table 8: Competitiveness of Chinese products across industries

Products	Situations
Rail and wind	Chinese companies replaced MNC in local market as well as boosting export.
Jet aircraft manufacturer and power generation	Chinese companies lag well behind Western market leaders (AVIC became partner with IBM in 2009 to develop commercial aircraft)
Solar panels	Profit scarce. Foreign rivals own higher technology products with more price competitiveness and profits.
Electronic	Face high competition with slim profit margins. Most of the profit made electronic items made in China for foreign companies end up outside China, for example, Apple iPhone which was assembled in China under the guidance of Hon Hai, Taiwanese company.
Computer hardware manufacturer	Lenovo could compete with sophisticated Taiwan's and Korea's products
Mobile phone designer	Techfaith could compete with sophisticated Taiwan's and Korea's products

Source: Author's compilation from Harvard business reviews (2010) and news articles.

Nevertheless, regardless of impressive improvements in the areas of industrial and technology upgrading, China still cannot close technology gap with the advanced nations such as Japan, the U.S., and Germany. China is not expected to be the leader in high-technology fields any time soon since its technological advancement has not yet at the mature level. China's brands themselves have not yet equipped with cutting-edge R&D capabilities; brand value remains

relatively low compared to the advanced countries' counterparts; also, China's local high-technology companies still rely on the government as a main customer.

More importantly, the quality gap between Chinese products and those of the advanced countries remains considerably large. After all, China still maintains its comparative advantage in in quantity development than quality improvement, and the quality and safety of Chinese-made products are still much questioned even by their own people. This is due to the pattern of industrial growth in the past that emphasized the cost advantage over the quality in leading market growth, thus resulted in the lack of adequate quality and safety control. Without disappearing quality gap, China's industrial and exports expansion will continue to be constrained by lack of consumer confidence and cross-border trade protection.

Although the quality gap will remain an imperative issue that will take time to resolve because the underlying reason may be deep-rooted in the culture and institutions governing production organization, China's ability to close the technology gap is conceivably much greater relative to that of the quality gap. This is due to China's strong ambition and endeavor to produce goods that reflect its status as the world technology leader, supported by the continuation of clearly targeted policies, the readiness of human resources and improving provision of technical infrastructures. With these serious efforts, soon enough China will be able to close the technology gap and achieve sustain growth.

5.3 Industrial strategy: How Thailand compares

Although Thailand could achieve favorable economic growth and export growth figures, the basis for its growth was hardly solid. Strong exports performance was mainly due to horizontal expansion of exports products without upgrading product sophistication that would otherwise be possible by scientific and technological improvements. In fact, Thailand's technological catch up is different both from developed countries and previously "learning intensive" developing countries such as Korea, Taiwan and Singapore.[53] The story is different in case of China, which chose to follow the path of forerunners in technological advancement. As a result, China could finally achieve speedy industrial and technological development, while Thailand lags behind in several areas such as industrial and upgrading policy effectiveness, human resource development, and provision of technological infrastructure.

First, although related policies and strategies to build up indigenous technological capabilities in Thailand have been set, action plan and implementation procedure remained unclear and ineffective. In fact, Thai industrial policy is rather fragmented (Intarakumnerd, et al., 2002; Lall, 2003; and Doner, 2008). It fails to give importance to the development of indigenous technology, which is an important ingredient in the process of industrialization (Sripaipan, et al., 1999). For instance, the promotion of FDI aims primarily at enjoying the benefit of employment expansion rather than for technological absorption (in case of China) and promoting local technological capability (in case of Singapore). The import tariff measure was mainly used to improve the balance of payment more willingly than being used strategically to promote technological learning like many other countries in NIEs (Chang, 1994 and Lall, 1996). In addition, the industrial policies have been limited to the "functional intervention", which is rather general and broad based development such as providing infrastructure, general education and overall export push, while the selective policies that target particular industries or clusters remain lack (Intarakumnerd, Chairatana, and Tangchitpiboon, 2002).

Thailand's science and technology institutional structure as well as national innovation policy and its implementation remain unclear and fragmented (Lall, 2003). Although "innovation" was mentioned in the recent National economic and social development plan (2007-2011) and the National Science and Technology Strategic Plan (2004-2013), they do not

[53] In comparison, Korea, Taiwan and Singapore developed more aggressive industrial policies and "intensive technological learning", and successfully caught up with developed countries.

have clear policy implementation regarding promoting innovation. In contrast, innovation has been given high priority in China's national policy making, and has an obvious implementation policy. China had a clear goal to enhance domestic industrial and innovative capabilities and to build national brands of homegrown industries. As a result, it enjoyed significant spillover effects from inward FDI on R&D activity by local companies. Thailand, on the other hand, failed to reap the benefit of technology transfer from FDI. It has thus been simply importing foreign technologies without developing ability to innovate on its own[54] and could at best absorb merely minor innovation, of which the spillover effects are found to be the most common among countries that relied on foreign technology.

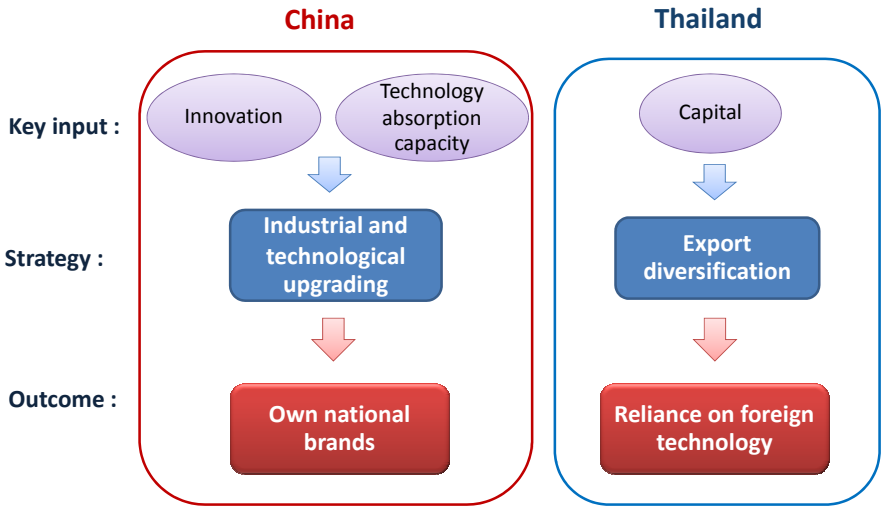
Second, Thailand also lags behind in industrial upgrading—the strategy which involves developing deep competencies in a narrower range of sectors and is the key factor allowing a country to move into higher value added products at high level of efficiency with local inputs. Instead, Thailand opted for the strategy of diversification, which is a horizontal expansion of product ranges and involves identifying and promoting new sectors or sub-sectors.[55] As a result, the growth of production capabilities had not led to deepening of capabilities into design, research and new technology development. In addition, Thailand participation in global value chain has not resulted in the expansion of local capacities. Even though its export figures have turned to be more technological intensive, the technologically sophisticated and high value added components are mainly imported. Obvious consequence is that Thailand, as a foreign-dominated manufacturing base, still needs to heavily rely on foreign technology and investment while being unable to establish own indigenous supplier base.

In fact, Thai local firms have no incentive to improve its technological capabilities and spend on R&D. Instead, they are more concerned with building up more basic operational capabilities, together with craft, and upgrading of fairy standard technology (Arnold, et al., 2000). The R&D and Innovation survey (2000) also shows that most of the sampled local firms require shallow level of technological capabilities in their production process such as simple quality control and testing (Intarakumnerd, et al., 2002). Small proportion of sampled local firms has capabilities in more advanced technology such as design (less than half), reverse engineering (around one-third), and R&D (less than 15%). Activities in areas of advanced technology mentioned above are mainly driven by most large TNC subsidiaries

[54] Thailand developed the "FDI dependent strategies", which allow the MNCs to drive the country's technological change. The FDI dependent strategy itself is not bad, if it followed the "targeted strategies", like the case of Singapore. Another type is called "passive strategies", which usually yields unfruitful results for the technological development such as the case of Thailand.

[55] Over the period, Thailand has successfully transformed itself from an agrarian economy (heavily dependent on rice and land-intensive production) to a world export leaders in agriculture, agro-industry, manufacturing and services. Product range includes rice, rubber, cassava, canned pine apple, processed tuna, sugar, prawns, frozen chicken, tourism, auto assembly, garments (see Doner, 2008).

Figure 37: Difference in industrial strategy



Third, Thailand lacks readiness of human resources, skill, technology facilities to make the most of technological spillovers from FDI and to raise the capacity of indigenous firms. The weak engineering base and the relatively deficient human capital development are among the major problems in Thailand. The adequacy and quality of scientists, engineers and technicians have been relatively low. During 2005-2009, percentage of scientists and engineers out of total graduates was only 18.5, while Korea and China have more than double that figure at 40.2 and 41.1 percent, respectively (Table 9). Another indicator for small stock of science and engineering skills for Thailand is the number of researchers in R&D relative to total population, which was less than a third of China's figures and was several times lower than higher income countries. The education system itself leaves ample rooms for improvement. For instance, the tertiary level educational institutions tend to have outdated curricular, insufficient practical training and little contact with evolving needs of industry (Lall, 2003). The university itself paid more attention to teaching, while research was considered secondary. It thus has rather poor research capability, while most of research has low level of industrial relevance. There is also weak industry-university link (Intarakumnerd, et al., 2002). In addition, government funding for R&D is relatively lower than other countries.

Table 9: Science and technology development indicators

Annual average 2005-09	R&D expenditure (% GDP)	Researchers in R&D (per million people)	Science and engineering (% total graduates)[1]	Invention patents (per million people)
High-income	**2.0**	**3,780**	**20.8**	**407**
Upper-middle income	**0.5**	**668**	**22.2**	**16**
Korea	3.0	4,198	32.8	1,688
China	1.4	950	41.1	30
Malaysia	0.6	372	40.2	12
Thailand	**0.2**	**311**	**18.5**	**1**

Note: [1] 2010
Source: World Development Indicators, World Intellectual Property Organization, International Property Rights Index 2011, OECD Statistics, UNESCO Education database, authors' calculation

Since the process of technological absorption is capability-driven and depends more on national ability to exploit and adapt technologies, rather than on factor endowments, the policies to strengthen learning and technology adaptation capabilities are crucial for creating Thailand's comparative advantage over neighbor countries with similar factor endowments

The challenge is even greater given that Thailand is now facing rising wage pressure due both to labor scarcity and political agenda. Improving labor productivity to achieve faster rate of growth than wage increase is thus even more pressing. Thailand should also learn from Korea, which used to experience increase in real wage and losses of comparative advantage in simple labor-intensive activities, and therefore strived to improve human resource development by heavily investing in public education, training, and supporting facilities until Korea successfully transited into a knowledge-based economy.

The domestic industrial capabilities in Thailand need to be strengthened in the following ways.

(1) Internalizing the technology through attracting FDIs with more technology, particularly, in the areas that can improve Thailand's industrial performance and improving the capability for technology absorption though providing sufficient soft infrastructures for technological learning, skill training, R&D support, research facilities, and communication and IT supporting.
(2) Spur diversification of local firms into high technology products in order to improve technological capability of local private enterprises by means of supporting privately developed R&D and training, and pay more attention to industrial upgrading.
(3) Lastly, human resources and knowledge are among the urgent areas for development. The latest data confirm that Thailand lags behind China and other middle income countries in all areas of technology infrastructure and absorption capacities (Table 9). For instance, Thailand spend relatively less on R&D investment and produce less technical personnel comparing to China and other middle income countries. The efficiency of its investment is even worse as reflected by the number of invention patents per researcher which is considerably lower that other countries. For instance, the proportion of Thailand's investment efficiency was 1 over 311, which was about ten times lower than the ratio of China.

Section 6: Conclusions

China has maintained fascinating economic growth and development over several decades largely driven by capital accumulation and total factor productivity improvements. From a review of China's growth pattern and an analysis of the current situations, we arrive at a conclusion that continued capital deepening is both feasible and much needed in China, and will remain the key driver of China's growth in the near future.

Beyond the effect of capital formation, the long-run potential output growth of the Chinese economy will depend crucially on how much and how fast productivity improvements can be achieved. After three decades of smooth transformation, China now faces the challenge of transiting from sustained to sustainable development as the old sources of productivity growth—including a shift from agriculture to industry, market and state-enterprise reforms, as well as the catch up in technological advancement—have begun to lose their punches while several structural distortions have increasingly become bottlenecks to long-term productivity growth.

In order to maintain strong growth going forward, China will need to press ahead with further market reforms to eliminate incentive distortions in the system as well as to seek a new engine of growth that allows endogenous growth effect to take hold. Realizing the importance of technology advancement in sustaining growth, the Chinese leaders have recently shifted the

growth paradigm towards innovation- and knowledge-based growth model. Significant progress has been made towards moving up the value chain, upgrading industrial capabilities, and developing innovative capacities. These efforts have started to yield fruits as reflected in the rapid transformation of the country's production and exports structure towards higher value added and hi-technology manufacturing.

The Thai economy has greatly benefited from the emergence of the Chinese economy through various trade channels—including exporting agricultural products to feed China's growing demand for commodities, providing high-quality or differentiated consumer products and services to serve Chinese rising middle class, and supplying upstream materials as part of China's production chain. However, growth benefits for Thailand through these links with China all have self-imposed limitations due to Thailand's lack of serious efforts to move fast enough—in terms of productivity and quality improvement, value added enhancing, industrial upgrading, innovative capacity building—to reap full benefits from China's rapid social and technological transformation.

Evidence confirms that Thailand has lagged behind China and neighboring countries in all areas of scientific and technological development, which is a key ingredient for a successful escape from the middle income trap. This is a result of the country's industrial and export strategy that relies largely on product diversification, which involves horizontal expansion of product ranges and promotion of new sectors, rather than upgrading existing technology. Certainly, Thailand's strategy of export diversification has a virtue in that it strengthens the country's resilience to external demand shocks, and so far has performed well as reflected in the overall exports growth. Nonetheless, without developing deep competencies and specialization that can add higher value to the country's production, this diversification approach to industrial development will only take Thailand just as far as the country can keep diversifying into perpetually broader range of products while maintaining cost advantage over its competitors in the existing export sectors. As one can perceive, economic growth under this approach is obviously not sustainable and cannot move Thailand out of the middle income trap. One reflection for Thailand is that, we used to have the need to move up the ladder to shift away from low-end markets where China came to dominate; now we need to move up the ladder precisely in order not to be fall behind other countries in rising with rapidly advancing China. Needless to say how our development policy framework deserves a serious reconsideration.

Our takeaway from China's experience is thus beyond understanding how the Chinese economy evolved and identifying how Thailand can grow with China, but rather, to take China's success in industrial and technological development, based on long-term vision and a continuity of policy implementation, as an example and as an urge for Thailand to push harder towards advancing the economy.

Reference

Amiti, M. and Calorine Ferund (2007): "An anatomy of China's export growth", paper presented at the Trade Conference, Research Development, Washington DC, 6 April. [On-line], Available: http://www.nber.org/books_in_progress/china07/amiti-freund2-1-08.pdf

Arnold, Erik, Martin Bell, John Bessant, and Peter Brimble (2000): "Enhancing Policy and Institutional Support for Industrial Technology Development in Thailand", World Bank.

Bai, Chong-En, Jiangyong Lu, and Zhigang Tao (2009): "How does privatization work in China? Journal of Comparative Economics, vol. 37(3), pp 453-470.

Balassa, Bela (1965): "Trade liberalization and revealed comparative advantage", Manchester School of Economic and Social Studies, vol.33(2), p 99-123.

Bosworth, Barry, and Susan M. Collins (2008): "Accounting for growth: comparing China and India." Journal of Economic Perspectives, vol.22(1), pp 45–66. [On-line], Available: http://www.aeaweb.org/articles.php?doi=10.1257/jep.22.1.45

Cattaneo, Olivier, Gary Gereffi, and Cornelia Staritz, editors (2010): Global value chains in a postcrisis world: a development perspective, Washington, DC: World Bank.

Chang, H., (1994): "The Political Economic of Industrial Policy", Macmillan, London.

Cheung, Kai-yin and Lin, Ping (2004): "Spillover effects of FDI on innovation in China: Evidence from the provincial data", China Economic Review, 15, pp 25-44.

CLSA Asia-Pacific Markets (2011): "Dipped in Gold: Luxury lifestyles in China and Hong Kong", February.

Dahlman, Carl J. (1993): "Electronics Development Strategy: The Role of Government", in "Developing the Electronics Industry", edited by Bjorn Wellenius, Arnold Miller, and Carl J. Dahlman, Washington DC, World Bank.

Diana, Farrell, Ulrich A. Gersch and Elizabeth Stephenson (2006a): "The value of China's emerging middle class" The Mckinsey Quarterly. Serving the new Chinese consumer, Special Edition, pp 60-69. [On-line], Available: http://www.siboni.net/resources/China$27s+Middle+Class.pdf

Diana, Farrell et al. (2006b): From 'made in China' to 'sold in China': the rise of Chinese urban consumer, Mckinsey Global Institute, November. [On-line], Available: http://www.mckinsey.com/mgi/reports/pdfs/china_consumer/MGI_china_consumer_demand_fullreport.pdf

Dianhua, Wang (2008): "Beijing-Tianjin-Hebei Technological Innovation under the Background of International Industrial Transfer trend", Canadian Social Science, 4(4), August.

Doner, Rick (2008): "The Thai government and Thailand's uneven Economic development", paper presented at annual symposium organized by NESDB and TDRI, Thailand, 29-30 Nov.

Eichengreen, Barry, Donghyun Park, and Kwanho Shin (2011): "When fast growing economies slow down", NBER working paper no.16919, March. [On-line], Available: http://www.nber.org/papers/w16919.pdf?new_window=1

Finger, Joseph and Mordechai Elihau Kreinin (1979): "A Measure of 'Export Similarity' and its possible uses", The Economic Journal, vol 356, pp 905-912.

Fung, Kwan (2009): "Agricultural labour and the incidence of surplus labour: experience from China during reform", Journal of Chinese Economic and Business Studies, vol 7(3), pp 341-61.

Hausmann, Ricardo, Jason Hwang and Dani Rodrik (2007): "What you export matters", Journal of Economic Growth, vol 12, pp 1-25.

Heytens, P. and Zebregs H. (2003): How fast can China grow? China: Competing in the Global Economy, Washington, D.C: International Monetary Fund.

Hout, Thomas M. and Ghemawat, Pankaj (2010), "China VS the world: whose technology is it?", Harvard Business Review, December, 95-103

Hsieh, Chang-Tai, and Peter J. Klenow (2009): "Misallocation and manufacturing TFP in China and India", The Quarterly Journal of Economics, vol 124(4), pp 1403-1448.

Hu, Xiaoyi (2007): Problems related to the present 200 million farmers-turned workers are complex, (in Chinese.) [On-line], Available: http://www.gov.cn/zwhd/ft3/20070126/content_509539.htm

Hu, Zuliu F., and Mohsin S. Khan (1977): "Why is China growing so fast?", IMF staff paper, vol. 44 (1), March. [On-line], Available: http://www.jstor.org/stable/3867499

Huang, Yiping, and Bijun Wang (2010): "Cost distortions and structural imbalances in China", China & World Economy, vol.18(4), pp 1-17. [On-line], Available: http://www.icrier.org/pdf/Yiping%20Huang%20-%20Session%203-Paper%20.pdf

IMF (2011), "Changing Patterns of Global Trade", June. [On-line], Available: http://www.imf.org/external/np/pp/eng/2011/061511.pdf

Intarakumnerd, Patarapong, Pun-arj Chairatana, and Tipawan Tangchitpiboon (2002): "National innovation system in less successful developing countries: The case of Thailand", Research Policy, 31, 1445–1457.

ISIC REV.3 Technology intensity definition. Classification of manufacturing industries into categories based on R&D intensities. [On-line], Available: http://www.oecd.org/dataoecd/43/41/48350231.pdf

Kalish, Ira (2005): China's consumer market: opportunities and risks , A Deloitte Research Study. [On-line], Available: http://www.bglegis.com/China_Consumer.pdf

Kim, Jongil (2011), "Structural Transformation of the NIEs and Its Implication for Thailand", unpublished Handout, September.

Koopman, Robert, Zhi Wang, and Shang-Jin Wei (2008): "How much of Chinese exports is really made in China? Assessing domestic value-added when processing trade is pervasive", NBER Working Paper no. 14109, June.

Kroeber, Arthur (2006), "China's industrial and foreign trade policies: what are they and how successful have they been?", May, Available: http://www.polsci.indiana.edu/china/papers/kroeber.pdf

Kuijs, Louis (2009): "China through 2020 - a macroeconomic scenario", World Bank China office research working paper no.9, June. [On-line], Available: http://siteresources.worldbank.org/CHINAEXTN/Resources/318949-1268688634523/medium_term_scenario.pdf

Lall, S., (1996): "Learning From the Asian Tigers: Studies in Technology and Industrial Policy". Macmillan, London.

Lall, S. (2003): "Investment and Technology Policies for Competitiveness: Review of Successful Country Experiences", Technology for Development Series, New York and Geneva, UNCTAD.

Lardy, Nicholas R. (1998): China's unfinished economic revolution , Washington, D.C. : Brookings Institution Press.

Liang, Yan (2008): "Why are China's exports special? The role of FDI, regional trade, and government", The Chinese Economy, vol.41(6), pp 99–118.

Linden, Greg (2004), "China Standard Time: A Study in Strategic Industrial Policy", Business and Politics, Vol. 6, issue 3, article 4.

Long, Guoqiang (2005): "China's Policies on FDI: Review and Evaluation", In Theodore Moran, Edward M. Graham, and Magnus Blomstrom, eds. Does Foreign Direct Investment Promote Development. Washington, DC: Peterson Institute for International Economics. [On-line], Available: http://www.piie.com/publications/chapters_preview/3810/12iie3810.pdf

Lu, Ming, and Shiqing Jiang (2008): "Labor market reform, Income inequality and economic growth in China", China and World Economy, vol.16(6), pp 63- 80.

Nataraj, Geethanjali, and Anjali Tandon (2011): "China's changing export structure: a factor-based analysis", Economic & Political Weekly, vol. xlvi (13), pp 130-136.

Michaely, M. (1994): Trade Preferential Agreements in Latin America: Ex-ante Assessment, Washington, D.C.: The World Bank Latin America and Caribbean Region.

Minami, R., and Xinxin Ma (2009): The turning point of Chinese economy: compared with Japanese experience, Conference paper, ADBI, Tokyo, June.

OECD, and The Ministry of Science and Technology China (2007): "OECD reviews of innovation policy: China", synthesis report. [On-line], Available: http://www.oecd.org/dataoecd/54/20/39177453.pdf

OECD Economic department (2010): "OECD economic survey of China 2010". [On-line], Available: http://www.oecd.org/document/43/0,3746,en_2649_34571_44477419_1_1_1_1,00.html

OECD Working Group on Privatisation and Corporate Governance of State Owned Assets (2009): "State owned enterprises in China", occasional paper. [On-line], Available: http://www.oecd.org/dataoecd/14/30/42095493.pdf

Pecht, Michael, Weifeng Liu and David Hodges (n.d.): "China's semiconductor industry". [On-line], Available: http://itri2.org/ttec/aemu/report/c2.pdf

Riedel, James, Jing Jin, and Jian Gao (2007): How China grows: investment, finance, and reform, Princeton, N.J. : Princeton University Press.

Schott, P. K. (2008): "The relative sophistication of Chinese exports", Economic Policy, vol.23(53), pp 5−49, 01.

Sripaipan, C., Vanichseni, S., Mukdapitak, Y., (1999): "Technological Innovation Policy of Thailand", Thai version, National Science and Technology Development Agency, Bangkok.

Teja, Ranjit et al. (2011): "People's Republic of China. Spillover report for the 2011 article IV consultation and selected issues", IMF Country Report No. 11/193, July.

Woetzel, Jonathan, Janamitra Devan, Richard Dobbs, Adam Eichner, Stefano Negri, Micah Rowland (2009): "If you've got it, spend it: Unleashing the Chinese consumer", McKinsey and Company, McKinsey Global Institute, August. [On-line], Available: http://www.mckinsey.com/mgi/reports/pdfs/unleashing_chinese_consumer/MGI_Unleashing_Chinese_Consumer_full_report.pdf

Xu, Bin, and Jiangyong Lu (2009): "Foreign direct investment, processing trade, and the sophistication of China's exports", China Economic Review, vol.20(3), pp 425–439.

Yue, Changjun, and Ping Hua (2002): "Does comparative advantage explains export patterns in China?", China Economic Review, vol.13(2-3), pp 276–296.

Zheng, Jinghai , Arne Bigsten, and Angang Hu (2009): "Can China's growth be sustained? A productivity perspective", World Development, vol.37(4), pp 874-888.