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Advanced Manufacturing and China's Future for Jobs

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Advanced Manufacturing and China's Future for Jobs¹

by

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Abstract

This chapter explores how China's push into advanced manufacturing and services through robots and other new disruptive technologies might affect the country's future for jobs.

After decades of rapid-fire growth, China's comparative advantage in manufacturing and the extraordinary size of its economy explain why China has not followed Dani Rodrik's pattern of "premature de-industrialization". However, China now has reached a level of development where catching up through an investment-driven "Global Factory" model is no longer sufficient to create long-term economic growth and prosperity. Chinese firms now need to adopt, absorb and develop advanced manufacturing technologies. At the same time, severe headwinds are constraining China's growth. International trade, a primary source of China's rise, has fallen to its lowest level since 2009, and keeps languishing. Since the turn of the century, a declining labor force, rising wages, and skill bottlenecks are eroding China's international competitiveness.

To break out of this growth impasse, China's leadership has decided to leapfrog into advanced manufacturing and services. Two policy initiatives are the expression of that ambition: the **China Manufacturing 2025 (MIC 2025) Plan**, and China's **Internet Plus (IP) Plan** both seek to promote innovation-driven development through robots, 3D printing, Big Data, and the integration of manufacturing and services through the mobile Internet.

The chapter examines how these two major policy initiatives might affect China's Future for Jobs. While China has improved its position and capabilities in advanced manufacturing (especially in robots), the country still has a long way to go to catch up with global industry leaders. A critical weakness of both the **MIC 2025** and the **IP plans** is an almost exclusive focus on technology, and a failure to collect data on possible impacts of advanced manufacturing and services on jobs, skills, income and inequality.

To reduce this knowledge gap, the chapter reviews newly available data for China on unemployment, income inequality, skill requirements, and the development and quality of service jobs. These data show that China still has a long way to go to create the necessary skills (especially for soft and vocational skills), as well as enough well-paying knowledge-intensive service jobs. Forging ahead in advanced manufacturing thus will face major hurdles.

If China fails to upgrade the quality of the new jobs that are being created in its service sector, this might slow down the growth of household incomes and consumption. As China's push into advanced manufacturing coincides with the "new normal" of a lengthy industrial slowdown, any such slowdown in income might eventually begin to

¹ A revised version will be published as a chapter in Paus, Eva (editor), *The New Technological Revolution: What Future for Jobs and Livelihoods?* Cornell University Press, Ithaca, NY 14850. I am grateful for comments received during the international conference *The Future of Jobs: The Dual Challenges of Globalization and Robotization*, McCulloch Center for Global Initiatives, Mount Holyoke College, South Hadley, Massachusetts 01075, February 19 and 20, 201, especially from Eva Paus (Mount Holyoke College, Mass.), Irmgard Nuebler (ILO, Geneva), and Guy Standing (School of Oriental and African Studies, University of London). The chapter owes much to additional comments from Chen Tain-Jy (National Taiwan University, Taipei); Feng Kaidong (School of Government, Peking University); Ellen Frost (East-West Center Washington, D.C. Office); Scott Kennedy (Center for Strategic and International Studies, CSIS, Washington, D.C.); Dan Kim (USITC, Washington, D.C.); William Lazonick (UMass Lowell/The Academic-Industry Research Network, Cambridge, Mass); Boy Luethje (Sun Yat-sen University, Guangzhou); Keith E. Maskus (University of Colorado, Boulder); Carlota Perez (London School of Economics); Wang Ping (China National Institute of Standardization/CNIS); XIE Linan (National Development and Reform Commission of the People's Republic of China.NDRC, Beijing); and Xue Lan (School of Public Policy and Management, Tsinghua University, Beijing).

constrain the service sector too, as the profit squeeze in manufacturing companies and declining income of workers might lead to a cut in investment in services and in their consumption. In order to avoid this “worst case scenario”, it is necessary that both the **MIC 2025** and the **IP Plans** are based on realistic projections of employment and other labor market impacts.

Keywords

Advanced manufacturing, Jobs, Skills, service jobs, China development model, China Manufacturing 2025 Plan (MIC2025), China’s Internet Plus Plan, premature deindustrialization.

JEL

F66, F68, J08, J21, J24, J31, J48,, J60, J68, O14, O25, O32, O38, O53

China's Challenge

China provides interesting new perspectives for research on the employment effects of the New Technological Revolution. While much of this research has focused on the US, Europe and Japan, this chapter explores how China's push into advanced manufacturing and services through robots and other new disruptive technologies might affect the country's future for jobs.

After decades of rapid-fire growth, China has reached a level of development where catching up through an investment-driven "Global Factory" model is no longer sufficient to create long-term economic growth and prosperity. Serious constraints on environmental, human and financial resources imply that economic growth based on scale expansion is running out of steam, depressing China's economic growth. The closer China has moved to the technology frontier, the less scope there is for imitation and low-level incremental innovation. Of critical importance now is that Chinese firms adopt, absorb and develop advanced manufacturing technologies.

At the same time, severe headwinds are constraining China's growth. International trade, a primary source of China's rise, has fallen to its lowest level since 2009, and keeps languishing². Since the turn of the century, a declining labor force, rising wages, and skill bottlenecks are eroding China's international competitiveness. As a result, corporate profits, export competitiveness and asset prices have slumped.

To break out of this growth impasse, China's leadership has decided to leapfrog into advanced manufacturing and services. Two policy initiatives are the expression of that ambition: the **China Manufacturing 2025 (MIC 2025) Plan**, and China's **Internet Plus (IP) Plan** both seek to promote innovation-driven development through robots, 3D printing, Big Data, and the integration of manufacturing and services through the mobile Internet. In line with the **13th Five Year Plan**, the goal is to upgrade China from being a "big industrial country" to a "powerful industrial country".

How might this push into advanced manufacturing and services affect China's Future for Jobs? **Part One** of the paper highlights China's comparative advantage in manufacturing and the extraordinary size of its economy, which explain why China has not followed Dani Rodrik's pattern of "premature de-industrialization"³. **Part Two** provides a brief overview of the objectives and strategy of the **MIC 2025** and the **IP plans**.

Part Three assesses China's current position and capabilities in advanced manufacturing technologies (with a focus on robots). While China has moved ahead in a very short period of time, the country still has a long way to go to catch up with global industry leaders. A critical weakness of both the **MIC 2025** and the **IP plans** is an almost exclusive focus on technology, and a failure to collect data on possible impacts of advanced manufacturing and services on jobs, skills, income and inequality. Such data however are absolutely necessary to explore China's Future for Jobs.

² The latest data for 2016, published by the *Netherlands Bureau of Economic Analysis*, show that the volume of goods traded around the world has stagnated since January 2015, declining 0.3% in April 2016, and decreasing a further 0.4% in May 2016 (<http://www.cpb.nl/en/figure/cpb-world-trade-monitor-may-2016>).

³ Rodrik, D., 2015, *Premature Deindustrialization*, Economics Working Paper 107, School of Social Science, Institute for Advanced Study, Princeton University, January: 39 pages.

To reduce this knowledge gap, **Part Four** reviews newly available data for China on unemployment, income inequality, skill requirements and the development and quality of service jobs. These data document that official statistics underestimate China's unemployment rate and that the inequality of income is rising. These data also show that China still has a long way to go to create the necessary skills (especially for soft and vocational skills), as well as enough well-paying knowledge-intensive service jobs. Forging ahead in advanced manufacturing thus will face major hurdles.

If China fails to upgrade the quality of the new jobs that are being created in its service sector, this might slow down the growth of household incomes and consumption. As China's push into advanced manufacturing coincides with the "new normal" of a lengthy industrial slowdown, any such slowdown in income might eventually begin to constrain the service sector too, as the profit squeeze in manufacturing companies and declining income of workers might lead to a cut in investment in services and in their consumption. In order to avoid this "worst case scenario", it is necessary that both the **MIC 2025** and the **IP Plans** are based on realistic projections of employment and other labor market impacts.

Part One – China is Different

It is important to state upfront what sets China apart from both developing countries and advanced economies.

As its per capita income is still a fraction of that in advanced countries, China qualifies as a developing country⁴. However, China is very different from other developing countries. China's comparative advantage in manufacturing, combined with the extraordinary size of its economy, makes it unlikely that China will follow Dani Rodrik's pattern of "premature deindustrialization". That concept implies that manufacturing begins "to shrink (or is on course for shrinking) at levels of income that are a fraction of those at which the advanced economies started to deindustrialize."⁵ According to Rodrik, most developing countries tend to be small in global markets for manufacturing, and hence act as price takers. "As price takers ... these developing countries may have "imported" deindustrialization" (ibid.: page 22), especially if they lack a strong comparative advantage in manufacturing (ibid: page 4).

On both accounts, China clearly does not fit this pattern. Since opening up to the international economy in 1978, China has seen rapid growth of industrial manufacturing and exports, followed by massive investments in its innovation system. As a result, China has become a serious global competitor, not only in terms of price, but also technology. China now competes head on with the US and other advanced countries across a wide array of industries, including R&D-intensive sectors.

Add to this a defining characteristic of China's development model - because of its size, this country was able to develop a broad industrial base⁶. This sets China apart from Korea and

⁴ <http://www.worldbank.org/en/country/china/overview>

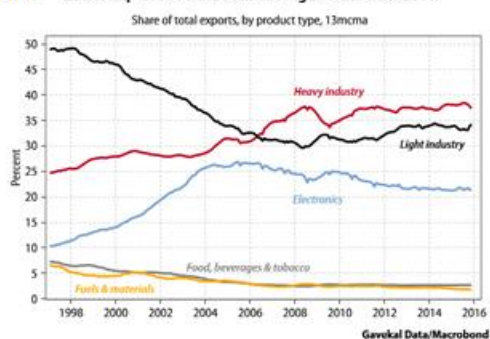
⁵ Rodrik, D., 2015, *Premature Deindustrialization*, Economics Working Paper 107, School of Social Science, Institute for Advanced Study, Princeton University, January: p3.

⁶ Batson, A., 2016, "China's size matters. But do we understand just how it matters?", <https://andrewbatson.com/2016/01/13/chinas-size-matters-but-do-we-understand-just-how-it-matters/>

Taiwan, where initial plans for broad-based economic growth were soon abandoned for specialization in sectors of comparative advantage, with Taiwan in particular serving niche markets around the world⁷.

China is different – despite its deep integration into international trade and global networks, there are as yet no signs of significant specialization (See **Figure 1** below). “Across virtually all industries in China, the optimal firm size—the firm size with lowest per-unit production costs—is below market demand. I.e., there is sufficient market demand in every sector of the economy for several firms to co-exist and compete.”⁸ As a result, “one can expect to see ongoing investment across virtually every sector of the Chinese economy.” (ibid.) In short, China is unlikely to experience premature deindustrialization any time soon.

Figure 1 China's export structure hasn't changed much since 2008



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China also differs from advanced countries. According to Lawrence and Edwards, manufacturing employment in the US and other leading industrialized countries has followed a pattern of “employment de-industrialization”, growing more slowly than employment in the overall economy, due to a “combination of productivity growth, demand for goods, and international trade”⁹ In contrast, China’s manufacturing industry until recently has acted as an absorber of employment. While manufacturing employment in China came down by 18 million or almost a fifth between 1995 and 2000, this decline was driven primarily by an aggressive restructuring of the state-owned enterprise (SOE) sector. But once the effect of this reform receded,

⁷ On Korea, see Kim Linsu, 1997, *Imitation to Innovation. The Dynamics of Korea’s Technological Learning*, Harvard Business School Press, Boston/Mass.; and Ernst, D., 1994, *What are the Limits to the Korean Model? The Korean Electronics Industry under Pressure*, The Berkeley Roundtable on the International Economy (BRIE), University of California at Berkeley: 129 pages. On Taiwan, see Chen, Tain-Jy, 2014, *Taiwan’s Industrial Policy Since 1990*, Department of Economics, National Taiwan University, Taipei; and Ernst, D., 2013, *Industrial Upgrading through Low-Cost and Fast Innovation—Taiwan’s Experience*, East-West Center Working Papers, Economics Series, No. 133, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2389086.

⁸ Holz, C.A., 2015, *China’s Investment Rate: Implications and Data Reliability*, MPRA Paper No. 68120, <https://mpra.ub.uni-muenchen.de/68120/> posted 30. November 2015 14:28 UTC. The author is a leading authority on China’s economic statistics.

⁹ Lawrence, R. and L. Edwards, 2013, “US Employment Deindustrialization: Insights from History and the International Experience”, *Policy Brief # PB 13-27*, Peterson Institute for International Economics, Washington, D.C., October: p.5.

manufacturing employment rose steadily, not only in absolute numbers but also as a share of total employment. From 2002 to 2013, the number of manufacturing workers in China surged by an incredible 27,696,736, whereas in the United States 2,952,000 manufacturing lost their jobs during the same period¹⁰.

A significant displacement of manufacturing jobs has occurred in China since 2014, with most of it however concentrated in the mining and metals sectors (troubled by excess capacity), with textile and apparel makers also shedding jobs as their exports decline. Mining and metals have lost 1.4 million workers over 2014 and 2015; and textiles and apparel have shed around 400,000 jobs each year in 2014 and 2015, as exports decline. For mining and metals, China's labor ministry expects additional 1.8 million job losses in 2016.¹¹ At the same time, China has been experiencing a nationwide labor shortage and steep rises in worker wages, including for immigrant workers¹².

There is still some debate about the precise timing of this shift to labor shortage. A 2013 working paper by the *International Monetary Fund* for instance expects the Lewis turning point in China to emerge between 2020 and 2025.¹³ Development economists call this the "Lewis turning point" (named after nobel laureate economist W. Arthur Lewis - a term that is used to describe a point or rather a period during which the rural wages begin to converge with the industrial sector. At that point, labor shortages appear and urban employers must offer higher wages to lure workers from the countryside.

Figure 2 below provides a comparison of indexed unit labor costs in the manufacturing industry, signaling an asymmetric rise of China's labor costs. In response, Chinese factories are shedding workers to curb rising costs, despite output growth fueled by domestic orders¹⁴.

As we will see in **Part Two**, China's push into advanced manufacturing and services reflects the leaderships' concern that China's industry needs to upgrade beyond low-value added segments of the supply chain in order to compensate for the loss in labor cost advantages and a declining working population.

¹⁰ The Conference Board International Labor Comparisons Program, 2016, <https://www.conference-board.org/ilcprogram/>.

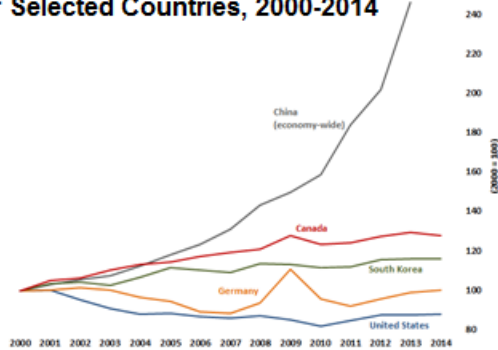
¹¹ Cui, E., 2016, *Behind the Jobs Target, Ideas*, Gavekal Dragonomics July 11: 4 pages

¹² See, for instance Cai, Fang, 2013, "Approaching a neoclassical scenario: the labor market in China after the Lewis turning point", *China Finance and Economic Review*, Vol.1, #1: 8 pages. The author is the Director of the Institute of Population and Labor Economics at the Chinese Academy of Social Sciences and advises the government. He also serves as a Member of the Standing Committee and Agricultural and Rural Committee of the National People's Congress of China.

¹³ Das, Mitali; N'Diaye, Papa M. (2013). "Chronicle of a Decline Foretold: Has China Reached the Lewis Turning Point?", *IMF Working Paper* No. 13/26.

¹⁴ Wang Yuqian and Coco Feng, 2016, "Manufacturing Rebounds after 16 months of Contraction, With Caixin China Purchasing Managers' Index (PMI) at 50.6", <http://english.caixin.com/2016-08-01/100972762.html>.

Fig.2 - Indexed Unit Labor Costs in the Manufacturing Sector of Selected Countries, 2000-2014



Note: Data for China available only through 2013.

<http://acetool.commerce.gov/labor-costs>

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Part Two – Objectives and Strategy

Since the Third Plenum, China’s leadership has emphasized the need to upgrade the manufacturing industry beyond catching-up with global industry leaders to forging ahead in advanced manufacturing¹⁵. Emblematic of the shift to an innovation-driven development model are two complementary policy initiatives:

- The 10-year plan, issued by the State Council on May 19, 2015, entitled "**Made in China 2025 MIC2025**" "中国制造2025", with a focus on upgrading China’s manufacturing industries through the use of productivity-enhancing advanced manufacturing technologies, such as robots, 3D printing and the Industrial Internet.¹⁶
- And on July 4, 2015, the State Council unveiled its **Internet Plus (IP) Plan**, aiming “to integrate mobile Internet, cloud computing, big data and the Internet of Things with modern manufacturing, to encourage the healthy development of e-commerce, industrial

¹⁵ Current debates on “Advanced Manufacturing” technologies emphasize their role as enablers of new products and services that might create new markets and industries. Mass customization, for instance through Additive Manufacturing (3D Printing) and autonomous robots, might enable Continuous Manufacturing in smaller, agile and flexible production facilities, closer to end-users. In turn, integrated solutions through bundling of physical products with services and software might enhance productivity and flexibility in large-scale manufacturing and supply and distribution chains (for instance through RFID tracking and Human-Robot-interaction). Furthermore, Advanced Manufacturing technologies are expected to enhance coordination and flexibility in global production and innovation networks. See for instance, President’s Advisers on Science and Technology (PCAST), 2014, *Accelerating US Advanced Manufacturing*, Washington, D.C, October; or Deutsche Bank Research, 2014, *Industry 4.0. Upgrading of Germany’s industrial capabilities on the horizon*, April 23.

¹⁶ See the MIC2025 website <http://english.cntv.cn/special/madeinchina/index.shtml>. For an unofficial translation of the MIC2025 plan, see <http://www.usito.org/content/usito-made-china-2025-unofficial-translation-2015-5-29>. In July 2016, China-based colleagues expected that a Five-Year Plan (2016-2020) specifically devoted to advanced manufacturing would be published soon.

networks, and Internet banking, and to help Internet companies increase their international presence.”¹⁷

Both plans share three fundamental objectives: a) to upgrade China’s industry through flexible automation and computer-based network integration with knowledge-intensive services; b) to accelerate investment in required digital infrastructure (in order to enhance network convergence, accelerate fiber optic network construction, and improve broadband speed, while strengthening cyber security); and c) to strengthen the capacity of domestic firms to develop Intellectual Property rights for critical core technologies, materials, components, and software, and for scaling up cost-effective production and incremental innovations.

In what follows, a brief review of the still fairly vague policy statements on the **IP Plan** will be followed by a more detailed outline of objectives and implementation priorities of the **MIC 2025 plan**¹⁸.

The Internet Plus (IP) Plan

China has the world’s largest Internet population (65 million), with 85 percent (56 million) using mobile devices to connect to the Internet. China has more mobile device users than any other country. In 2015, China overtook the US to become the world’s largest e-commerce market. However, with an Internet penetration rate of 50.3 percent in 2015, China still has ample scope to catch up with Korea’s record internet penetration rate of 85.1 percent.

Given this huge market potential, it is hardly surprising that large business (both Chinese and multinationals) is the main driver behind the **IP plan**, while the government somewhat belatedly now discovers the Internet as a new growth engine. Main drivers on the business side are China’s immensely powerful internet companies and system integrators, the so-called BATs, i.e. Baidu, Alibaba, and Tencent; China’s leading consumer electronics companies (such as Midea, TCL, Haier, Konka); and mobile telecom and smartphone companies. To a large degree, the dynamics behind the IP Plan is driven primarily by intense competition between online and offline commerce channels, and in particular among the BATs and Alibaba’s rival JD.com. In fact, leading global players like SAP, Microsoft, IBM, Oracle and others have now discovered the China Internet market, which is projected to reach more than \$ 1 trillion over the next five years.

In short, the **IP Plan** provides an example where the Chinese government seeks to piggyback on this wave of corporate Internet penetration strategies. This sets the **IP Plan** apart from the **MIC 2025 plan** which, as we will see, is the brainchild of the government.

In July 2015, the State Council released the *Guiding Opinions on Promoting the Development of Internet Plus* to deepen the integration across industry and services¹⁹. China’s **IP Plan** follows closely Germany’s **Cyber-Physical Systems (CPS)** initiative and the US **Industrial Internet**

¹⁷ Statement by Premier LI Keqing, quoted on the State Council’s web site, July 4, 2015, http://english.gov.cn/policies/latest_releases/2015/07/04/content_281475140165588.htm. See also

¹⁸ For MIC 2025, fairly detailed descriptions of objectives and implementation priorities are available in the public domain, whereas the **IP Plan** has apparently not yet moved beyond the “vision stage”, as reflected in the broad and vague policy statements.

¹⁹ <http://www.usito.org/news/state-council-provides-guidance-internet-plus-action-plan>. See also the web site of Internet Plus plan, at http://www.gov.cn/zhengce/content/2015-07/04/content_10002.htm.

Consortium²⁰. The **IP Plan** describes in fairly general terms: requirements and targets, action plans, and support policies. 11 key "Internet Plus" actions include: entrepreneurship and innovation; collaborative manufacturing; modern agriculture; smart energy; inclusive finance; public services; efficient logistics; e-commerce; convenient transportation; green ecology; and artificial intelligence.

In addition to this laundry list, the *Guiding Opinions* include 25 relevant supportive measures, categorized into five parts:

- *Policy Environment*: eliminate unreasonable mechanisms and policies, ease Internet-integrated product and service market access, and promote entrepreneurship and innovation
- *New-Generation Information Infrastructure Development*: accelerate research and development of new hardware engineering, such as chips and high-end servers, as well as applications of cloud computing, big data
- *Public Resources Sharing*: enhance public services and start pilot programs for public access to government data, encourage online access to national innovation platforms by small and medium enterprises
- *Business Operation Support*: increase government procurement of cloud services, innovate credit products and services, pilot equity crowdfunding
- *Safety Regulations*: improve risk assessment, safeguard network and information security, and protect fair competition.

As business has aggressively signed on to the **IP Plan**, economic impacts are likely to be substantial, including for instance the development of 5G mobile communication technologies and infrastructure for broadband and mobile communications (especially in remote regions in China's mid-west and 'smart cities' in the mid-east); the spread of big data and cloud computing in related industries such as health, education and financial services, wearable mobile devices, and the Internet of Things. In addition, the release of the government's *Guiding Opinions on Promoting the Healthy Development of Internet Finance* in July 2015 seeks to create a more certain environment for internet finance companies to grow.

As for implementation, the IP Plan lists a total of 65 corresponding development tasks, and specifies the respective leading responsible ministries. To fit with the timeframe of the **Made in China 2025 plan**, the **IP plan** is to complete an initial implementation phase by 2018 and full completion by 2025.

The "Made in China 2025 MIC2025" Plan

A primary objective is to upgrade China's industry through flexible automation and computer-based network integration. **MIC 2025** was drafted by the Ministry of Industry and Information Technology (MIIT) over two and a half years, with input from 50 experts from the China Academy of Engineering and the Chinese Academy of Sciences, as well as around 100 experts from industry and research institutes. Issued by the State Council on May 19, 2015, **MIC 2025**

²⁰ See <http://www.gtai.de/GTAI/Navigation/EN/Invest/Industries/Smarter-business/Smart-technologies/cyber-physical-systems.t=agenda-cps.did=626022.html>, and <http://www.iiconsortium.org/faq.htm>.

has the full support of China's leadership – Vice Premier MA Kai heads the Leading Small Group that is responsible for effective implementation.

The focus of **MIC 2025** on Advanced Manufacturing represents a *volte face* in China's development strategy. Since 2007, China's Five-Year Plans had emphasized the expansion of the service sector, in line with then fashionable initiatives in the US. The 12th FYP (2011-2015) had targeted the service sector to become the single biggest contributor to GDP by 2015. However, by that time the pro-service tide had already started to ebb in the rest of the world. In 2011, the Obama administration launched its **Advanced Manufacturing Partnership (AMP)** Program, while Germany formally adopted its **Industrie 4.0** initiative.

MIC 2025 differs from earlier plans, like the **Medium- and Long-Term Plan for Science and Technology Development (MLP)** of 2006, and the **Strategic Emerging Industries (SEI) plan** of 2012²¹. **MIC 2025** moves beyond science and technology and seeks to upgrade all stages of China's industrial supply and demand chains.

MIC 2025 is most closely linked to Germany's **Industrie 4.0** initiative that seeks to integrate factories, research labs, and service providers across domestic and global supply chains through flexible automation and the Internet of Things in industrial manufacturing. Germany has the advanced technology needed, and thus is China's preferred partner.²² The design of **MIC 2025** also draws on other international benchmarks that pursue similar advanced manufacturing upgrading strategies²³.

The challenge for China's industry is that it is still in transition from Industry 2.0, which is mainly assembly lines, to Industry 3.0, which uses more industrial automation, electronics and IT. Today, only about 60% of Chinese companies use industrial automation software, such as Enterprise Resource Planning (ERP). And the internet adoption ratio of Chinese SMEs reaches only 25%²⁴. To reduce this huge gap, **MIC 2025** encompasses upgrading objectives for process management and logistics; R&D; intellectual property rights; as well as technical standards.

²¹ For the science and technology plan, see State Council, "China's Medium- and Long-Term Plan for Science and Technology Development (2005–2020)," February 9, 2006, http://www.gov.cn/english/2006-02/09/content_184426.htm. On the SEI plan, see 国务院关于印发“十二五”国家战略性新兴产业发展规划的通知 [“The State Council Notification on the Long-term Development Plan for Strategic Emerging Industries during the 12th Five Year Plan”], 国发〔2012〕28号, July 7, 2012.

²² In October 2014, China and Germany declared an **Industry 4.0** partnership. And in June 2016, German Chancellor Merkel visited China's first Industry 4.0 production line, jointly built by the German software company SAP and the Chinese Academy of Sciences, at the BMW joint venture plant in Shenyang, Liaoning Province. Germany Trade & Investment, 2015, *Industrie 4.0. Smart manufacturing for the Future*, <http://www.gtai.de/GTAI/Content/EN/Invest/SharedDocs/Downloads/GTAI/Brochures/Industries/industrie4.0-smart-manufacturing-for-the-future-en.pdf>.

²³ The plan is also influenced by the advanced manufacturing initiatives in the European Commission (the European Factories of the Future program), and in France (Usine de Futur), the UK (High Value Manufacturing Catapult), the US (Advanced Manufacturing Partnership), Japan (2014 White Paper on Industry), and Korea (Innovation in Industry 4.0), Taiwan (2014 Industrial Development Plan) and Singapore (iN2015 Masterplan). For instance, in line with the US Advanced Manufacturing Partnership (AMP 2.0) strategy, **MIC 2025** seeks to promote innovation through a network of manufacturing innovation centers (15 by 2020, and 40 by 2025).

²⁴ Deutsche Bank Research, 2015, *Industry 4.0: China seizes an outstanding opportunity in the “Year of Innovation”*, June 18.

MIC 2025 addresses the following over-riding objectives: a big push in firm-level industrial innovation capacity (focused on R&D and patents); quality improvement and accelerated productivity growth and quality; an expansion of informatization and digitization of industry; and “green development”, focusing on a reduction of energy consumption, water usage and pollution. In order to implement these objectives, MIC 2025 seeks to provide a new framework for coordinating industrial support policies to overcome a persistent gap in technological, management and innovation capabilities across the whole gamut of China’s manufacturing industry.

Improved policy coordination is considered to be particularly important in order to reduce the fragmentation of decision-making across government agencies and between the Central government and local governments. There is a broad consensus that improved coordination is essential for overcoming deeply entrenched disconnects between industry, academia and government. As an important step in this direction, MIIT has brought 14 state-run associations from different sectors together and created a voluntary quality management standard for automated and intelligent manufacturing.

MIC 2025 highlights 10 priority sectors for China’s push into advanced manufacturing: 1) New advanced information technology; 2) Automated machine tools & robotics; 3) Aerospace and aeronautical equipment; 4) Maritime equipment and high-tech shipping; 5) Modern rail transport equipment; 6) New-energy vehicles and equipment; 7) Power equipment; 8) Agricultural equipment; 9) New materials; and 10) Biopharma and advanced medical products.

For each of these priority areas, **MIC 2025** provides objectives, albeit still on a quite general level. For instance, for *New advanced information technology*, the plan sets out the following priorities: i) Catch up with world best practice in IC design and design tools; ii) move to the frontier of multicomponent semiconductors (MCOs); iii) win design-in contracts from China-based electronic equipment manufacturers (both large global MNCs and Chinese firms like Lenovo or Huawei); and iv) strengthen China’s capacity to design and produce high-density chip packages and 3D micro-package technology. These specific priorities are practically identical with the objectives of China’s strategy to upgrade its semiconductor industry (as outlined in the *Guidelines to Promote National Integrated Circuit Industry Development*, June 24, 2014²⁵). At least for this particular priority sector, this raises the question whether **MIC 2025** is just repackaging under a different name already well publicized existing policy initiatives.

In essence, **MIC2025** is meant to address the emerging labor cost challenge that was described in **Part One**. To achieve this goal, **MIC 2025** seeks to boost labor productivity through an increased use of robots and through network-based upgrading of the entire industrial value chain and related services. A 7.5% annual growth of labor productivity is projected until 2020, and from then on an annual 6.5% productivity growth. This would require a reversal of China’s long-

²⁵ For a detailed analysis of China’s New Policies for Semiconductors, see Ernst, D., 2015, *From Catching Up to Forging Ahead: China’s Policies for Semiconductors*, East-West Center Special Study, September.

term productivity slow-down from almost 9.5% during 2007-2012 to an estimated 6.7% for 2015²⁶.

A report from the US *Manufacturers Alliance for Productivity and Innovation (MAPI)* concludes that MIC 2025 is likely to produce substantial improvements in manufacturing productivity: “The infrastructure of doing business—education, management, rule of law, and governance—would presumably improve, lowering operating costs and decreasing uncertainty.”²⁷ In short, MIC 2025 appears to be “much better conceived and more appropriate for China's situation than the “indigenous innovation” approach and SEIs ... [the Strategic Emerging Industries plan]. It will be more coordinated and utilize a wider array of policy tools.”²⁸

Part Three – China’s Push into Advanced Manufacturing – What Is Missing?

To assess China’s prospects in advanced manufacturing, it is important to recall that much of China’s industry is still stuck in very basic manufacturing – and many of these factories will not survive the next 10 years without major upgrading of facilities and production processes.

Table 1 below indicates that China’s industrial technological capacity continues to lag well behind comparator countries – it has the lowest percentage share of R&D in GDP, the highest energy consumption, and it faces substantially higher quality problems in its exports. Of particular concern are weak capabilities in high-end molds and dies, i.e. the press metal molds used in automotive outer body panels and for precision motor cores, and all-in-one printer cartridge molds. For those high-end molds and dies, China continues to depend on imports from Japan and Germany²⁹.

In what follows, the analysis will first examine evidence on China’s persistent innovation gap and assess China’s current use and production of robots and related capabilities. The attention then shifts to the arguably most problematic weakness of both the **MIC 2025** and the **IP Plans** – a dearth of robust data on employment, skills and other labor market issues.

²⁶ The Conference Board, 2015, *Productivity Brief 2015*, May: p.16, <https://www.conference-board.org/retrievefile.cfm?filename=The-Conference-Board-2015-Productivity-Brief.pdf&type=subsite>

²⁷ <https://www.mapi.net/forecasts-data/internet-things-industrie-40-vs-industrial-internet#1>

²⁸ Interview with Scott Kennedy of the *Center for Strategic and International Studies*, “Made in China 2025”, <http://csis.org/publication/made-china-2025>. Kennedy emphasizes that “the term ‘indigenous innovation’ appears only twice and “SEI” only once. There is no obvious effort to paint this as the successor to or extension of SEI, but in fact, to show that an SEI-oriented focus was too narrow and built on a misunderstanding of China's core needs and comparative advantage.”

²⁹ Shao Yongyu, 2015, Strategic vision and outlook of “Made in China 2025 (Part 2)” *Mizuho China Monthly*, September.

Table 1 - Technology capabilities in Manufacturing: China, US, Germany, Japan, Korea (2012)

Indicator/ Country	%of R&D in GDP	Mfg indy energy consumption per unit of GDP	Index of recall notices for exported products
China	1.60	0.26	0.285
US	2.85	0.16	0.043
Germany	2.87	0.11	0.038
Japan	3.48	0.11	0.023
Korea	3.45	0.18	0.027

Shao Yongyu, 2015, quoting METI data

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1. A persistent innovation gap

Since 2000, China has made massive investments in R&D infrastructure on a scale and speed never seen before³⁰. China has increased R&D spending roughly 10 percent each year—a pace the country maintained even during the 2008–2009 recession. This sustained commitment to a rapid expansion of R&D sets China apart from the crisis-induced cuts in the United States and Europe. And with the exception of Korea, Taiwan, and Singapore, no other emerging or developing country has ever even contemplated such a big push.

Today, China is the world’s second largest investor in R&D with a forecast spending of \$396.3 billion for 2016.³¹ China is now one of the four leading countries in science and technology publications, with particular strengths in materials science, analytical chemistry, rice genomics, and stem-cell biology. Within materials science, China is especially strong in nanotechnology, ranking third (after the United States and Japan) in the number of nanotechnology publications, and the Chinese Academy of Science is ranked fourth for nano-science citations (after University of California, Berkeley; MIT; and IBM).

Additionally, China is ranked among the top five global R&D leaders in leading high-tech industries such as energy (both nuclear and renewable), satellite and spacecraft, commercial aircraft, automotive (especially electric cars), supercomputers, and life sciences (especially genetics), and it is rapidly catching up in high-speed rail, information and communications technology, and defense and security.

And yet China’s gap in innovation capacity persists. China’s leadership is very conscious that China continues to lag well behind the US in R&D on major breakthrough technologies, in critical capabilities (both management and technological), and in accumulated portfolios of

³⁰ Ernst, D., 2011, *China’s Innovation Policy is a Wake-Up Call for America*, in *Asia Pacific Issues*, No.100, May 2011, East-West Center, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2770063

³¹ Industrial Research Institute (IRI), 2016, *Global R&D Funding Forecast*, Rockaway, NJ., Winter: pages 22 ff.

high impact invention patents. A recent study by the Industrial Research Institute (IRI) finds that, while the US and Chinese investments in R&D are equal, “the R&D quality, productivity, basic research, applied research, development activities and overall trends are considered to be vastly superior in the U.S. than in China by factors of two to eight.”³²

As China’s GDP growth declines, China’s R&D investments are also bound to slow down. In addition, barriers to innovation in China remain substantial, ranging from severe quality problems in education to plagiarism in science³³, a fragmented innovation system (prone to rivalries among different government agencies and between the central government and local governments), and barriers to entrepreneurship and private R&D investment³⁴. Access to high-quality data is critical for networked advanced manufacturing. China’s push into advanced manufacturing will face major impediments, as long as access to data resources remains highly unequal, and as long as there remain questions about the reliability of the data that the government has made available in the public domain³⁵.

As for research on advanced manufacturing technology, China has invested quite some effort, but progress thus far has been limited. A recent *Fraunhofer Institute* study finds that Chinese researchers have patented important inventions in key advanced manufacturing technologies, including wireless sensor networks, embedded systems, low-cost robots and big data³⁶. In terms of the number of patents filed for industry 4.0 technologies, the Fraunhofer study finds that China is one of the largest players, especially for data networks and big data³⁷.

³² Industrial Research Institute (IRI), 2016: p.23.

³³ As one of many examples, see Cui, Xiankang, 2016, “Top Academic Accused of Making false Claims to Win Education Award”, *Caixin*, August 5, 2016, <http://english.caixin.com/2016-08-05/100974886.html>

³⁴ For details, see Ernst, D., 2015, *From Catching Up to Forging Ahead: China’s Policies for Semiconductors*, *East-West Center Special Study*, September; and Ernst, D., 2011, *Indigenous Innovation and Globalization: The Challenge for China’s Standardization Strategy*, UC Institute on Global Conflict and Cooperation; La Jolla, CA and East-West Center, Honolulu, HI., 123 pages <http://www.EastWestCenter.org/pubs/3904> [Published in Chinese at the University of International Business and Economics Press in Beijing, 自主创新与全球化：中国标准化战略所面临的挑战].

³⁵ In a State Council meeting in May 2016, Premier Li Keqiang recognized that 80% of China’s data resources are held by the government (LI Jia, 2016, “Smart Manufacturing”, *NewsChina*, August: page 21). On Data reliability, see Holz, C.A., 2015, *China’s Investment Rate: Implications and Data Reliability*, MPRA Paper No. 68120, <https://mpra.ub.uni-muenchen.de/68120/> posted 30. November 2015 14:28 UTC. The author is a leading authority on China’s economic statistics.

³⁶ Fraunhofer has analyzed 1700 patent documents published in China between January 2013 and April 2015 for industry 4.0 technologies. Technology experts identified the 50 most important inventions, translated the documentation, compiled it by hand and evaluated it accordingly. <http://www.iao.fraunhofer.de/lang-en/technology-innovation-management/iao-news/1230-top-50-chinese-industry-4-0-patents.html>

³⁷ The Fraunhofer study shows that, for instance for wireless sensor networks, Chinese inventors have registered important basic patents over the past three years for energy-efficient technologies intended for industrial use. Leading institutions such as the *Shenyang Institute of Automation (SIA)* developed and patented new approaches for operating energy-efficient and reliable industrial networks. In robotics, China’s largest robot manufacturer, *SIASUN*, has registered around 140 inventions a year for the past three years – and there are 300 or so other Chinese robot manufacturers active in the market as well. Big data is another area in which China ranks among the key patent applicants, with China’s internet giants Alibaba, Tencent and Baidu being joined by less well-known companies in registering important patents for big data processing methods as well as ways to improve data security, for example using quantum encryption.

This indicates that China may emerge over the next decade as a producer of some of those technologies. It is unclear however whether China has the capacity to develop commercially successful *Advanced Manufacturing* technology platforms. The *Fraunhofer* study highlights “...the relatively low innovative quality of Chinese utility model applications and patent submissions when it comes to the application of industry 4.0 technologies. Numerous low-novelty inventions have been registered, usually formulated in very imprecise terms.”³⁸

2. Robots are all the rage, but where does China really stand?

Robots and in particular flexible and autonomous robots are supposed to play an important role in the MIC 2015 plan. Let us look at China’s official data on the use and local production of robots, and on the progress made towards autonomous robots³⁹. From 2009 to 2014, sales of industrial robots in China increased by an annual average of 59%. In 2014, the sales volume in China reached about 57,000 units, which amounted to around 1/4 of the total global robot sales. For 2014, CRIA reports that 29 manufacturing sectors in China were using robots (up from 26 in 2013). For 2015, the growth of robot sales is estimated at 25%, with the growth rate of the domestic robot suppliers’ sales estimated at over 40%.

As **Table 2** below shows, China has rapidly caught up with the global leaders in terms of the operational stock of multipurpose industrial robots. The media have widely reported on prestige projects, like the Swiss ABB robot project in the Zhuhai High-tech Zone (the largest industrial robot R&D and production base in southern China), and the all-robot manufacturing plant in Dongguan.⁴⁰ According to industry observers, many factories in the Pearl River Delta, the heart of China’s world factory, are investing in robots, as labor shortages bite and local authorities face the need to spur innovation to counter the economic slowdown.⁴¹

³⁸ Ibid. The prevalence of low quality Advanced Manufacturing patents implies that “Chinese inventors are protected by a variety of trivial, yet effective, intellectual property rights, so any company wanting to penetrate the Chinese market must expect to encounter quite a few legal disputes along the way.” (ibid).

³⁹ <http://www.ifr.org/news/ifr-press-release/statements-of-ceos-on-the-results-of-world-robotics-2015-774/> These data are provided by the Chinese Robot Alliance (CRIA), an important stakeholder in China’s MIC 2025 plan. Established in April 2013, CRIA is a member of the International Federation of Robotics (IFR). CRIA now has more than 100 members from industry, universities, research institutes, regional or local robotic associations, as well as government-sponsored organizations in the fields of R&D, manufacturing, application and services of the robot industry in China. CRIA’s mission is to implement the government’s industrial policies, to strengthen the exchanges and cooperation regarding technology, market and intellectual property rights among members, and international cooperation.

⁴⁰ A total of 1,000 robots are to be introduced at the factory initially, run by Shenzhen Evenwin Precision Technology Co, with the aim of reducing the current workforce of 1,800 by 90 per cent to only about 200. Interview with Chen Xingqi, the chairman of Shenzhen Evenwin Precision Technology, <http://www.scmp.com/tech/enterprises/article/1786484/building-work-starts-first-all-robot-manufacturing-plant-chinas?page=all>.

⁴¹ The *South China Morning Post* reports that since September 2014, “a total of 505 factories across Dongguan have invested 4.2 billion yuan (USD 644,574,000.00) in robots, aiming to replace more than 30,000 workers, according to the Dongguan Economy and Information Technology Bureau. ... The provincial capital, Guangzhou, has set a goal of fostering a robot-manufacturing industry with an output value of more than 100 billion yuan (USD 15,347,000,000.00) by 2020, as well as automating more than 80 per cent of the city’s manufacturing production. <http://www.scmp.com/lifestyle/technology/science-research/article/1754165/robotics-industry-booming-guangdong-insiders>

Table 2

Estimated operational stock of multipurpose industrial robots at year-end in selected countries. Number of units

Country	2013	2014	2015*	2018*
America	226,071	248,430	272,000	343,000
Brazil	8,564	9,557	10,300	18,300
North America (Canada, Mexico, USA)	215,817	236,891	259,200	323,000
Other America	1,690	1,982	2,500	1,700
Asia/Australia	689,349	785,028	914,000	1,417,000
China	132,784	189,358	262,900	614,200
India	9,677	11,760	14,300	27,100
Japan	304,001	295,829	297,200	291,800
Republic of Korea	156,110	176,833	201,200	279,000
Taiwan	37,252	43,484	50,500	67,000
Thailand	20,337	23,893	27,900	41,600
other Asia/Australia	29,188	43,871	60,000	96,300
Europe	392,227	411,062	433,000	519,000
Czech Rep.	8,097	9,543	11,000	18,200
France	32,301	32,233	32,300	33,700
Germany	167,579	175,768	183,700	216,800
Italy	59,078	59,823	61,200	67,000
Spain	28,091	27,983	28,700	29,500
United Kingdom	15,591	16,935	18,200	23,800
other Europe	81,490	88,777	97,900	130,000
Africa	3,501	3,874	4,500	6,500
not specified by countries**	21,070	32,384	40,500	41,500
Total	1,332,218	1,480,778	1,664,000	2,327,000

Sources: IFR, national robot associations.

*forecast

** reported and estimated sales which could not be specified by countries

However, China still has a long way to go to catch up in the use of robots. Take *robot density*, a key performance indicator. The current global leader in industrial robotic automation is South Korea. In Korea, the robotic density exceeds the global average by a good seven-fold (478 units), followed by Japan (314 units) and Germany (292 units). At 164 units, the USA currently occupies seventh place in the world. At 36 units per 100,000 employees or about half the global average figure, China is currently in 28th place⁴².

On the supply side, China remains heavily dependent on foreign technology: 75% of all robots used in China are purchased from foreign firms (some with assembly lines in China), and China remains heavily dependent on imports of costly core components from Japan.

The latest count of local robot production reports 107 Chinese companies, but many of them produce robots with low quality, safety and design standards. According to industry experts, less than 50 of those companies are likely to survive. And even these companies, including industry

⁴² <http://www.ifr.org/industrial-robots/statistics/>

leaders like *SIASUN Robot & Automation Co.Ltd*, are struggling with excess capacity and the lack of a vibrant local core components industry⁴³.

However, China now makes a concerted effort to catch up in the development of robotics patents. While the share of Chinese patents in total robotics patents in the year 2000 was only two percent, that figure had risen to 37 percent by 2011. Korea's share stood at 17 percent in 2011, while Japan's share fell from 45 percent in 2000 to 10 percent in 2011.⁴⁴ Between 2000 and 2012, the countries with the highest number of filings were Japan, China, Korea and the US, which each filed more than 10,000 patents and together account for about 75 percent of robotics patents, followed by Germany with roughly 9,000 patents and France with over 1,500.

3. Where are employment and other labor market data?

Collecting data on China's manufacturing employment and qualitative examples is quite an adventure - the author had to conduct a considerable amount of detective work, given the imponderability of China's data on manufacturing employment, wages and quality of jobs. The official employment statistics provided by China's *National Bureau of Statistics (NBS)* are organized in such a way that it is quite tedious to construct proxy indicators for newly created manufacturing jobs or layoffs, or for wages and income⁴⁵.

China's employment and labor market data are poor and unreliable. According to George Magnus, a seasoned observer of China's rise, "China lacks a robust system for recording employment and unemployment, and neither figure prominently in macroeconomic planning and management, overshadowed as they are by other quantitative targets."⁴⁶ To cope with this dearth of data, I have relied on interviews with China-based industry experts and researchers. These interviews have helped me to navigate through the maze of fuzzy and sometimes conflicting information.

In what follows, three observations will be presented: a) Outside of mines and minerals, manufacturing apparently continues to act as an employment absorber; b) The 13th Five Year Plan promises to create 50 million new urban jobs until 2020, but fails to provide details; and c) China's push into advanced manufacturing suffers from a lack of serious research on prospective employment effects.

a) Manufacturing as an employment absorber

⁴³ At an April 26, 2016 press conference on **China's Five-Year Plan for the Robotics Industry**, Xin Guobin, vice minister of MIIT, recognized that "too much investment may have been directed towards lower-end robots manufacturers, leaving investment in innovation and core technology relatively weak." (LI Jia, 2016, "Smart Manufacturing", *NewsChina*, August: page 21)

⁴⁴ Keisner, C.A., J. Raffo, S. Wunsch-Vincent, 2015, *Breakthrough Technologies – Robotics, Innovation and Intellectual Property*", WIPO Economic Research Working Paper No.30, November: p.24. Note that proportions are calculated considering only first filings with at least one patent granted within the patent family.

⁴⁵ For instance, the official labor market statistics define "newly created urban jobs" as the increase in urban employment minus "natural decrease," defined as official retirements and death. In other words, the figure does not account for layoffs or other job losses. See discussion below for details.

⁴⁶ Magnus, G., 2015, "China: from surplus labour and unemployment risk, to labour shortages in a decade", January 21, <http://www.georgemagnus.com/china-from-surplus-labour-and-unemployment-risk-to-labour-shortages-in-a-decade/>: p.1.

Research conducted by Judith Banister for the *US Bureau of Labor Statistics* (BLS) shows that China's manufacturing employment showed a continual increase over the 2002-2009 time period, rising from 85.9 million in 2002 to 99.0 million in 2009. As Chinese employment grew by about 15 percent over the 7-year period, manufacturing employment in other countries covered by BLS was stable or declined. China's 2009 manufacturing employment was much greater than manufacturing employment in any other country: for example, manufacturing employment in the United States in 2009 was about 14.2 million, was 10.8 million in Japan, and was about 7.8 million in Germany.⁴⁷

More recent data from the *Conference Board International Labor Comparisons Program* (which has taken over the discontinued BLS research) show that China's manufacturing employment has further increased by almost 15 % from 98,998,570 in 2009 to 113,577,801 in 2013 (the latest year available)⁴⁸. From 2003 to 2014 China's *National Bureau of Statistics* (NBS) reports that total urban manufacturing employment has doubled and the share of the urban workforce employed in manufacturing rose from 15 to 20 percent. In addition, "there are a significant number of manufacturing workers in rural areas, not reflected in the data in the table. Workers in private firms and self-employed engaged in manufacturing in rural areas rose from 14.5 million in 2003 to 23.6 million in 2014."⁴⁹

Table 3 below confirms that manufacturing in China still acts as an employment absorber. While the percentage share of manufacturing in GDP declined from 32.5% in 2003 to 29.9% in 2013, the share of persons employed in manufacturing increased from 27.9% in 2005 to a record-breaking 29% in 2015. Manufacturing industry continues its dominant position. In 2013, only Korea has a higher percentage share of manufacturing in GDP than China. In terms of employment effects, China has by far the largest percentage share of persons employed in manufacturing⁵⁰.

⁴⁷ Banister, J., 2013, "China's manufacturing employment and hourly labor compensation, 2002-2009", International Labor Comparisons (ILC), June 7, http://www.bls.gov/fls/china_method.pdf. Unfortunately, U.S. Congress discontinued funding for the BLS-ILC, thus closing down this extremely useful data source.

⁴⁸ The Conference Board International Labor Comparisons Program, 2016, <https://www.conference-board.org/ilcprogram/>.

⁴⁹ Lardy, N.R., 2015, *Manufacturing Employment in China*, *China Economic Watch*, PIIE, December, <http://blogs.piie.com/china/?p=4593>

⁵⁰ See Shao Yongyu, 2015, "Strategic vision and outlook of "Made in China 2025 (Part 1)" *Mizuho China Monthly*, July; and Part 2, September.

Table 3 – Manufacturing as an Employment Absorber: China, US, Germany, Japan, Korea

Indicator/ year/country	% of mfg in GDP 2003	% of mfg in GDP, 2013	% of persons employed in mfg, 2005	% of persons employed in mfg,2012
China	32.5	29.9	27.9	28.0 (29% in 2015)
US	13.3	12.1	10.1	10.3
Germany	22.1	22.2	20.0	19.8
Japan	19.5	18.8	18.0	16.9
Korea	26.7	31.1	16.9	16.6
Shao Yongyu, 2015, quoting METI data				§§

b) The 50 million new urban jobs promise lacks robust data

The official web site of the State Council contains a stunning promise:

“China will create more than 50 million jobs in Chinese cities and maintain its jobless rate within 5 percent, according to a recently released Plan on Human Resources and Social Security of the 13th Five Year Plan (2016-2020). The plan will prioritize graduate employment, as well as the relocation of workers who were made redundant from industries suffering from overcapacity.”

A government work report, delivered by premier Li Keqiang at the legislative annual session on March 5, 2016 adds that for 2016 alone, “China aims to create at least 10 million new urban jobs and keep the registered urban unemployment rate within 4.5 percent.”⁵¹ As for information on how this goal would be achieved, there is only one sentence at the end of this posting that states: “China’s fast growing service industry is expected to take the baton of job creation.” (ibid.)

Detailed background information could not be found on how this promise would be implemented. A search on the web site of the Ministry of Human Resources and Social Security MOHRSS (which is responsible for managing the employment market in China)⁵² presents a number of general statements, such as “premier Li underlines steady employment”, and that “Premier Li Keqing urged the government to create a unified and accurate job data platform as soon as possible to assist with decision-making and regulation efforts . . . Efforts must be made to ensure employment statistics are correct and accurate, as they are as important as economic data and can provide important clues for effective government decision-making, the Premier said during a visit to the Ministry of Human Resources and Social Security.”⁵³

⁵¹ http://english.gov.cn/premier/news/2016/03/05/content_281475301612181.htm. It is important to recall that China’s official statistics on “newly created urban jobs” does not account for layoffs or other job losses, as explained earlier.

⁵² http://english.gov.cn/state_council/2014/09/09/content_281474986284102.htm

⁵³ http://english.gov.cn/premier/photos/2016/05/06/content_281475343137259.htm

In other words, China does not yet have such a reliable and robust job data base.

c) What explains the serious research gap on prospective employment effects of advanced manufacturing?

Arguably one of the most problematic weaknesses of China's **MIC 2025** and **IP plans** is a failure to take into account employment effects. Interviews with China-based scholars and industry experts conveyed one over-riding message - Chinese policy makers have largely neglected employment effects and other labor market issues when designing their grand visions of industrial policy⁵⁴.

This starts with very basic definitions. According to one observer, *"to my own knowledge, there is no specific statistics on Chinese advanced manufacturing (AM) or on the employment effects of Chinese AM. Indeed, the Chinese government hasn't got a clear concept about AM (even though some policy-makers may think they have). Therefore, quite many companies reported their products as AM equipment, but the policy-makers haven't developed a clear criterion to define AM. ... if there is any report or statistics on this issue, my colleague and I do not think they are serious enough."*⁵⁵

According to a well-informed Chinese source,

*"The Ministry of Industry and Information Technology (MIIT) has not developed any formal statistics for AM yet, and no research has been conducted on the effect of MIC2025 on employment. In fact, what MII emphasizes right now is still the "machinery" technologies, such as the smart manufacturing, 3D print, robots, etc. As for the ten priority sectors highlighted in the MIC 2025 plan, proponents have not raised the issue of employment. In fact, this document was compiled by technical experts, mostly from the Chinese Academy of Engineering. The ten priority sectors reflect ... the competition among different disciplines within the Chinese Academy of Engineering. Indeed, the ten priority sectors were not decided by any strategic policy-makers, but mainly by the community of researchers. it was just a game of competing for policy money. ... those researchers care little about employment and skills.... In short, there is no formal policy discussion about skilled workers as part of the MIC 2025 plan."*⁵⁶

A frequent explanation for the lack of robust employment projections is that at the top leadership level, engineers continue to dominate who *"mostly do not understand the economy. ... [They are] used to the idea that the rural area of China is such a huge pool for the resource of low cost labor - the labor can come or disappear automatically depended on whether you need it."*⁵⁷

⁵⁴ Due to the sensitivity of this topic, all interview partners have requested anonymity.

⁵⁵ Email to the author, dated January 25, 2016, from source A, who requests anonymity. According to some observers, an exception may be the association "China Info 100" (<http://www.chinainfo100.com/>) under the MIIT, which was created around 2005 as the "China's Expert Committee of Informationalization" by the State Council as negotiation and coordination mechanism across different ministries, firms and academia. I was however unable to locate any employment data from this source available in the public domain.

⁵⁶ Email to the author, dated February 1, 2016, from source B who requests anonymity.

⁵⁷ Email to the author, dated February 9, 2016, from source C who requests anonymity.

Furthermore, the concept of MIC2025 “is relatively new for China and the ‘political talk’ was developed only in the first quarter of 2015. According to another well-placed source from within the government, administrative inefficiencies and inter-agency rivalries may also play a role in explaining the scarcity of serious data on expected employment effects of MIC 2025 and related plans: “*I don’t think labor departments participated a lot in industry policy making in the past and present days. From the industry making department perspective, there is a lack of data and expertise on labor issues.*”⁵⁸

In short, Chinese policy makers have failed to base their push into advanced manufacturing on robust projections of possible employment effects and other labor market issues. This is problematic. After all, advanced manufacturing will produce sustainable economic and social benefits only, if a sufficiently large number of well-paid quality jobs is created, whether directly in manufacturing or in related industrial services.

Part Four – How to Reduce the Knowledge Gap? New Data on Unemployment, Income Inequality, Service Jobs and Skills

As we saw, the publicly available data provide no robust projections of future job creation in China. Take unemployment. In China, the unemployment rate measures the number of people actively looking for a job as a percentage of the labor force, a measure that differs from those used in most OECD countries. China’s official unemployment rate, as reported by the *Ministry of Human Resources and Social Security*, has remained practically constant since 2003 slightly below the 4.1 % mark – a quite surrealistic “achievement” for an economy that has grown at lightning speed with drastic changes in its composition⁵⁹. Collecting data on the real amount of manufacturing unemployment however is considered to be quite sensitive, almost as sensitive as research on labor conflicts.

Fortunately, new data are now available that could help to reduce the gap in our knowledge. In what follows, the analysis will present new data on unemployment and income inequality; highlight China’s skills bottleneck, especially for soft and vocational skills; and explore whether service jobs might compensate for the slowing growth of manufacturing jobs.

1. Lifting the veil on China’s real unemployment and income inequality

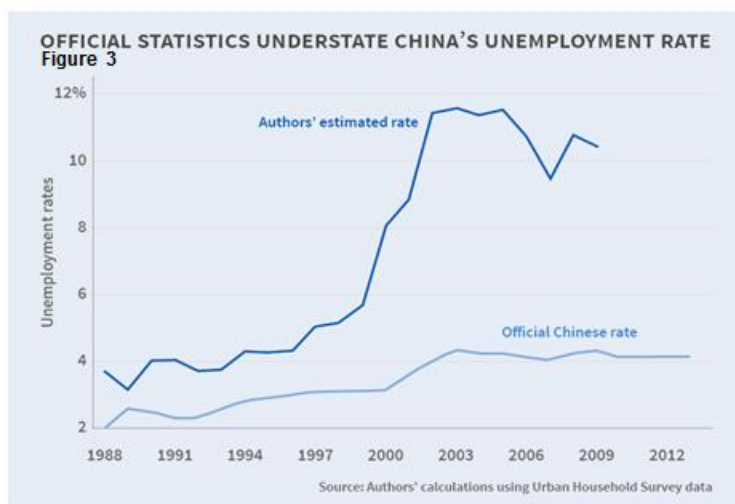
A recent NBER working paper calculates, for the first time, China’s unemployment rate from 1988 to 2009 using a more reliable, nationally representative household survey in China⁶⁰. As shown in **Figure 3** below, the unemployment rates calculated by the NBER study differ dramatically from those supplied in official data. The NBER data also seem to be much more

⁵⁸ Email to the author, dated February 7, 2016, from source D who requests anonymity.

⁵⁹ According to the Ministry of Human Resources and Social Security of the PRC, the unemployment rate in China remained unchanged at 4.05 percent in the fourth quarter of 2015 from 4.05 percent in the third quarter of 2015. The reported unemployment rate in China averaged 4.13 percent from 2002 until 2015, reaching an all-time high of 4.30 percent in the fourth quarter of 2003 and a record low of 3.90 percent in the third quarter of 2002. These official unemployment data are clearly unrealistic, given the dramatic speed of change in China’s manufacturing industry.

⁶⁰ Shuaizhang Feng, Yingyao Hu, Robert Moffitt, 2015, “Long Run Trends in Unemployment and Labor Force Participation in China” NBER Working Paper No. 21460, August; 44 pages, <http://www.nber.org/papers/w21460> The paper argues:” The official unemployment rate series for China is implausible and is an outlier in the distribution of unemployment rates across countries ranked by their stage of development. There is strong evidence that this is the result of mismeasurement of the official rate.” (ibid.:p.23)

consistent with what is known about China's labor market and how it has changed over time in response to structural changes and other significant events. The NBER unemployment rate averaged 3.9% in 1988-1995, when the labor market was highly regulated and dominated by state-owned enterprises, but rose sharply during the period of mass layoff from 1995-2002, reaching an average of 10.9% in the period from 2002 to 2009. The study estimates that the actual unemployment rate in 2002-09 averaged nearly 11 percent, while the official rate averaged less than half that.



Long Run Trends in Unemployment and Labor Force Participation in China (NBER Working Paper No. 21460) 10

Of particular interest for our purposes is that unemployment rates differ significantly across demographic groups, regions, and cohorts. The NBER study finds that “people without college degrees, younger people, and females systematically face more slack labor markets than their more educated, older, and male counterparts... The most striking pattern is that younger people had very high unemployment rates, especially for more recent cohorts... Even at the age of around 30, the 1970s female cohorts had roughly a 10 percent unemployment rate, as compared to only 3 percent for females born in the 1960s.” (ibid.: p.17)

The NBER paper also documents significant regional disparities in unemployment rates, as some regions fared worse than others. The Northeast, South Central, and Southwest regions of the country saw the largest increases in their unemployment rates during the 1995-2002 period. These were also the regions with the greatest number of layoffs by state-owned enterprises (SOEs). In the Northeast region, for example, some 7.3 million workers were laid off during the period – 42 percent of its total SOE employment in 1995.

The NBER paper finds that labor force participation rates (which are not available in official statistics) have declined throughout the whole period, particularly from 1995 to 2002 when the unemployment rate increased most significantly. While China's unemployment rate has soared since the mid-1990s, labor force participation has dropped. Participation averaged 83.1 percent around 1995, fell dramatically during the transition, and stabilized at around 74 percent during the 2002-09 period. Young people were hit especially hard by the layoffs during the 1995-2002 period. The labor force participation rate of young men and women, with and without college education, all fell by more than 10 percentage points.

China's leaders are particularly concerned about the high unemployment rate among university graduates which apparently has been rising over the last years. The Chinese Academy of Social Sciences (CASS) reports a graduate unemployment rate of 12% in 2010, while foreign observers estimate the graduate unemployment may be as high as 27%.⁶¹ A recent study, jointly conducted by the Texas A&M University and China's Southwestern University of Finance and Economics found that 16.4% of university graduates between the ages of 21 and 25 were unemployed, whereas only 4.2% of those in the same age bracket who have dropped out before middle school were unemployed.⁶²

The picture in **Figure 4** below was taken at the summer of 2015 Graduate Job Fair at Tianjin University⁶³. Such was the crowd that the vast University Sports Arena had to be used to accommodate the Job Fair. Competition during the current 2016 Summer graduate job fairs has further intensified, with entry salaries in decline.



In the summer of 2015, 7.5 million college graduates entered China's job market, the most ever and almost seven times the number in 2001. Graduates at a job fair at Tianjin University Sports Arena

Figure 4

The quite significant diversity in employment outcomes, reported in the NBER study, might well reflect the increasing inequality of income that China has been experiencing since the turn of the century. A recent study for the *US National Academy of Sciences (NAS)* finds a rapid increase in income inequality in China's recent past, drawing on newly available survey data collected by several Chinese university survey organizations (see **Figure 5** below)⁶⁴.

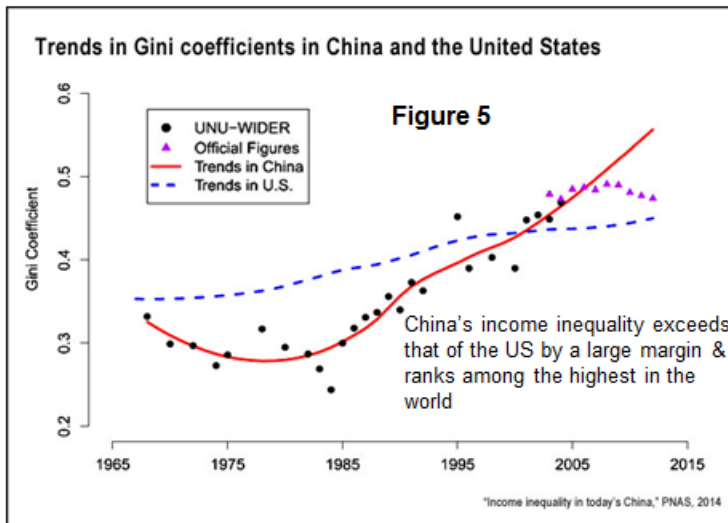
⁶¹ <http://knowledge.ckgsb.edu.cn/2014/07/21/employment/unemployment-in-china-degree-to-nowhere/>

⁶² *China's Household Finance Survey 2014*, quoted in Xin En Lee, 2014, "Unemployment in China: Degree to Nowhere", *CKGSB Knowledge*, July 21, <http://knowledge.ckgsb.edu.cn/2014/07/21/employment/unemployment-in-china-degree-to-nowhere/>

⁶³ <http://www.thanhniennews.com/world/dreams-collide-with-china-slowdown-for-jobseeking-graduates-47480.html>

⁶⁴ Yu Xie and Xiang Zhou, *Income inequality in today's China*, Proceedings of the U.S. National Academy of Sciences, vol. 111 no. 19: pages 6928–6933. Gini coefficients from UNU-WIDER and CHIP 2007 are based on household disposable income per capita. Gini coefficients of family income in the United States from 1967 to 2012 are provided by the US Census Bureau. A Gini coefficient measures the income distribution of a country's residents.

According to the NAS study, China's income inequality not only surpasses that of the United States by a large margin but also ranks among the highest in the world, especially in comparison with countries with comparable or higher standards of living. The study argues that China's current high income inequality is significantly driven by structural factors attributable to the Chinese political system, the main structural determinants being the rural-urban divide and the regional variation in economic well-being.



In short, new data on unemployment and income inequality in China document that both have reached precariously high levels, well before the country started to push into advanced manufacturing and services. To make both the **IP plan** and the **MIC 2025 plan** work, it is no doubt of paramount importance to generate realistic projections of what types of skills are needed, as well as on expected impacts on employment, income and income distribution. The next section reviews limited evidence on skill requirements, while **Part Four** concludes with the challenge that China's service sector faces in creating enough quality jobs to compensate for the slowing growth of manufacturing jobs.

2. China's skills bottleneck

In this section, a few select indicators will be presented on China's skill bottleneck, especially for soft and vocational skills. Both the **MIC2025** and the **IP plans** emphasize the use of robots and Internet-based information networks. The leadership understands that both plans are bound to boost demand for workers with highly specialized skills, both in vocational and in knowledge-intensive services related to mobile communications, software and chip design. In its **National Plan for Medium- and Long-term Education Reform and Development**, the government outlined plans to expand vocational education, established a target of 90 percent secondary enrollment by 2020, and increased investment in secondary and university education

This number, which ranges between 0 and 1 and is based on residents' net income, helps define the gap between the rich and the poor, with 0 representing perfect equality and 1 representing perfect inequality.

Unfortunately, no data seem to be available in the public domain on the size of projected specialized skill requirements. This lack of reliable data constitutes an important handicap for China’s push into advanced manufacturing and services.

In what follows, I first look at what we know about accumulating skills bottlenecks in China. I will then report on interview responses that provide a rough picture of the scarcity of skills required for the big push into advanced manufacturing and services.

a. China’s accumulating skill bottlenecks

Already in 2005, McKinsey warned about “China’s looming talent shortage”, emphasizing that multinational companies are finding few graduates have the necessary skills for knowledge-intensive service occupations⁶⁵. Since then, the danger signals have multiplied. In a 2015 survey of 2,361 China-based employers, representing over 4 million employees, the global recruitment firm *Hays* finds that almost one half (45 per cent) of employers believe that a severe skills shortage has the potential to hamper the effective operation of their business in China.⁶⁶ The most difficult jobs to recruit in China are senior management candidates in sales, marketing, research & development, engineering, accountancy and finance, operations, technical, human resources and IT.

Figure 6 below summarizes key findings of a 2013McKinsey study⁶⁷. The projected skill gaps are especially serious for skills that require vocational training (a gap of 16 million workers is projected for 2020) and university education (a gap of 8 million workers is projected for 2020).

Figure 6
Demand for university and vocational labor in China is expected to exceed supply by ~24 million workers in 2020



b. Little is known about China’s emerging skill gaps for advanced manufacturing and services

⁶⁵ <http://www.mckinsey.com/global-themes/china/addressing-chinas-looming-talent-shortage>

⁶⁶ http://www.hays.cn/en/press-releases/HAYS_248696

⁶⁷ Chen, Li-Kai, M. Mourshed and A. Grant, 2013, *The \$250 billion question: Can China close the skills gap?*, <http://mckinseysociety.com/can-china-close-the-skills-gap/>

Quite a few interviewees emphasize that the scarcity of specialized skills needed for the big push in advanced manufacturing and services is an important factor in explaining the rise in graduate unemployment described before. Interviewees also report that a growing demand for IT-related specialized skills is driving up wages for those skilled workers. This demand boost for highly specialized skills seems to crowd out smaller domestic firms, and leave the field to a few large companies, whether foreign MNCs or large Chinese corporations like Huawei.

For example, one interviewee reports that the entry level pay for IC design engineers are higher today in Shanghai or Shenzhen than in Taipei. It is somewhat perplexing that despite such higher pay levels, leading Chinese IC design houses which are based in Shenzhen or Shanghai (like HiSilicon or Spreadtrum) are competing successfully with Taiwanese counterparts. One plausible explanation may be access to subsidies⁶⁸. Another explanation may be the use of foreign (Taiwanese, US, Korean) engineers who are moonlighting in China (sometimes over the weekends). These foreign chip designers are used to work under best-practice R&D management processes, and thus may well be more productive.

Despite China's high graduate unemployment, US firms in China report a lack of availability of talent as a top-ranking operating challenge⁶⁹. While much of the debate has focused on the insufficient supply of required technical skills (with a focus on science, technology and engineering), the push into advanced manufacturing will increase the need for *soft* management and communication skills that are need to operate and incrementally improve increasingly complex information-based factories, supply chain and support services. In China, the primary and secondary education system is skewed "towards test preparation, leaving limited classroom time for the cultivation of analytical and creative skills. In other words, hard skills are introduced early on and strengthened over time, while soft skills are too often left to languish."⁷⁰ Innovation research has shown that complementary "soft" entrepreneurial, management, and system integration capabilities are of critical importance if a company wants to successfully create, change, improve, and commercialize products, services, equipment, processes, and business models⁷¹

In the end however, *vocational training* may be China's most serious skill bottleneck. China's education system fails to address the needs of the rapidly evolving labor market, especially for skills required for advanced manufacturing and services. While university graduates can't find suitable jobs, there is a growing scarcity in many industries of well-trained and experienced skilled workers who can run smart robots, industrial 3D printers, and Internet-based information networks. A recent study concludes that "China's vocational education and training (VET) system threatens the country's rise to industrial superpower status. ... Reform of the VET system is long overdue. Only if China succeeds in establishing a system that can be adapted to the

⁶⁸ According to some interviewees, Chinese policy-makers seem to understand now better that subsidies are not the best way to create competitive high-tech firms. Quite a few highly subsidized local firms in the Chinese TD-SCDMA alliance have not been successful.

⁶⁹ http://www.amcham-shanghai.org/NR/rdonlyres/CEF3B375-976F-4EED-A306-A44FFAAA4378/13851/mar11_cover_story.pdf

⁷⁰ Chan, J., 2015, "Is China creating a workforce with no soft skills?", British Council Voices, 2 March, <https://www.britishcouncil.org/voices-magazine/china-creating-workforce-no-soft-skills>

⁷¹ Ernst, D., 2009, *A New Geography of Knowledge in the Electronics Industry? Asia's Role in Global Innovation Networks*, *Policy Studies* #54, August 2009, East-WestCenter, Honolulu, USA: pages 13 and 14.

changing requirements of companies will the dream of its political leaders to make the country an industrial superpower materialise.⁷²

To summarize, the above proxy indicators of the increasing scarcity of specialized skills may be the Achilles' heel of China's push into advanced manufacturing and services.

3. Might service jobs compensate for the slowing growth of manufacturing jobs?

China's push into advanced manufacturing coincides with a slow-down of Chinese exports of manufactured goods. At the same time, efforts to reduce overcapacity in mines and metals and to reform the SOE sector have displaced a significant number of manufacturing jobs. As a result, the focus of employment generation will have to shift even more than before to the service sector.

China's service sector has rapidly increased since the late 1970s – its CAGR from 1978 to 2013 was almost 11%⁷³. However, the percentage of GDP generated by services is still low. According to an ADB study, China's per capita GDP in 2013 was \$9,828 (in 1990 US dollars) and the share that services contributed was 46.1 percent, which is about 13 percentage points lower than an economy would typically reach at this level of GDP per capita⁷⁴. Until 2008, the contribution of the service sector to manufacturing has not increased. And until 2010, the number of jobs generated by services (i.e. the “share of services in total employment”) was still lagging behind the sector's contribution to GDP, and remained below international benchmarks⁷⁵.

This raises two important questions:

- From now on, might China's service sector be able to compensate for the declining role of manufacturing as a source of employment growth?
- Specifically, might China be able to create enough quality service jobs, so that domestic demand can grow, based on increasing income?

Within the remaining space of this chapter, it is impossible to do justice to these critical questions. All we can do here is to offer a few observations on what might be realistic options for China to link services to advanced manufacturing. I will first reflect on insights from research on knowledge-intensive manufacturing services in advanced countries. Next, I will review what the 13th FYP has to say on the Reform of China's service industry. Finally, a closer look at data on the rise of China's service sector will help to highlight a major weakness – modern knowledge-intensive services with well-paying jobs still constitute a small share. The overall finding is that China still has a long way to go to create enough knowledge-intensive service jobs to compensate for the declining job growth in manufacturing.

⁷² Klorer, E. and M. Stepan, 2015, *Vocational training may be China's most serious skill bottleneck*, *China Monitor* # 24, Mercator Institute for China Studies, September 2: 9 pages.

⁷³ For details, see discussion below of **Table 4 (The Rise of China's service sector)**.

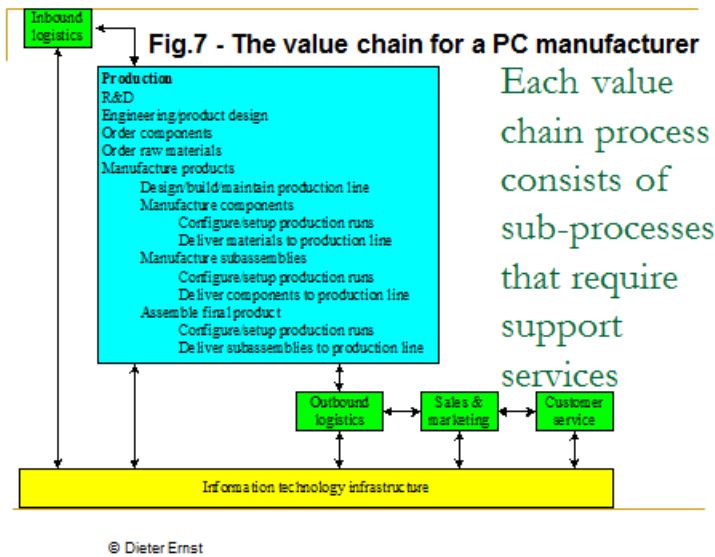
⁷⁴ For details, see Wang Wei, 2013, “Features, Restrictions, and Policy Recommendations in the Service Sector of the People's Republic of China”, in Donghyun Park and Marcus Noland (eds), 2013, in *Developing the Service Sector As an Engine of Growth for Asia*, Asian Development Bank, Manila: pp.236 ff.

⁷⁵ Wang Wei et al, 2016, “Beyond Manufacturing: Developing the Service Sector to Drive Growth in the PRC”, *Asia Pacific Issues* # 124, East-West Center, May.

a. Insights from research on manufacturing services

Research in the US and other industrialized countries leaves little doubt that robots and other advanced manufacturing technologies are bound to reduce the DIRECT labor requirements of China's manufacturing industry.⁷⁶ Recent research by the *US Academy of Engineering* has identified the proliferation of manufacturing services as an important source for quality jobs⁷⁷. By integrating manufacturing, services and R&D, successful firms can use advanced manufacturing technologies to provide packaged solutions that combine high productivity gains with substantial job gains in complementary support services.

Figure 7 below illustrates the great variety of knowledge-intensive support services required for a fairly traditional type of PC manufacturing.



Another important source of quality service jobs necessary for advanced manufacturing can be found in a variety of digital infrastructure platforms⁷⁸, such as broadband as an enabler of new applications (e.g., cloud computing); 4G wireless communications; integrated health information systems; smart electric grids; low carbon energy information systems; intelligent transportation systems; mobile payments systems; and mobile Collaborative Learning Systems⁷⁹.

b. What has the 13th FYP to say on the Reform of China's service industry?

Taking on board these insights from research in advanced countries, let us take a look at China's efforts to upgrade its service sector. A basic assumption is that, in order to sustain future growth, China's economy needs to be less dependent on fixed asset and real estate investment. To achieve this goal, policy makers have committed to liberalize the services sector and expand

⁷⁶ Shipp, S.S. et al, 2012, *Report on Emerging Global Trends in Advanced Manufacturing*, Institute for Defense Analyses- Science Technology Policy Institute (IDA-STPI), Washington, D.C.

⁷⁷ National Academy of Engineering, 2012, *Making Value: Integrating Manufacturing, Design and Innovation*, The national Academies Press, Washington, D.C.

⁷⁸ McDonald, M.P., 2013, *Platforms Are the New Foundation of Corporate IT*, *Harvard Business Review*, August 1.

⁷⁹ See also Atkinson, R. and S. Ezell, 2012, *Innovation Economics. The Race for Global Advantage*, Yale University Press; pages 257 and 258.

domestic consumption to spark new engines of growth⁸⁰. The 2013 Third Plenary Session of the 18th Communist Party of China Central Committee (Third Plenum) outlined how China will expand the services sector so that over time it could rebalance investment's contribution to GDP. These recommendations focused on removing subsidies on the cost of capital, diversifying ownership of state assets, and encouraging private sector investment in the services sector.

The 13th FYP gives even greater weight to the expansion of the service sector and its contribution to GDP and employment.⁸¹ Specifically, the 13th FYP requires intensified efforts “to cultivate production-related services and improve market access”; to “facilitate the transition to new growth model of production services”; and to “build a ubiquitous and fast mobile information network to balance improvements to the transportation and mail delivery services”. In addition, the 13th FYP requests to “change government functions from research and development management to ‘innovations services’, with a focus on making new breakthroughs in next generation communications, new energy, new material, aerospace, biological medicine and smart manufacturing.”

As part of the 13th FYP, Premier Li Keqiang announced a new campaign on “Mass Entrepreneurship and Innovation” to encourage entrepreneurship and innovation in services to spur economic growth in China’s “New Normal” economic phase of slower growth and less reliance on investment. Intended outcomes of the initiative appear to include a more “level playing field” for entrepreneurs and better access to government-controlled business services such as bank loans. The intent of the government appears to be to increase availability of capital for more knowledge-intensive services that will create more employment opportunities, especially for higher skilled workers and college graduates.

c. What do we know about China’s service sector?

In light of these rather broad and general vision statements, what data do we have on the current status and quality of China’s service sector, and on its capacity to generate quality jobs?

Table 4 below documents the rapid rise of China’s service sector since the late 1970s. With a CAGR of almost 11% from 1978 to 2013, the service sector’s share in China’s GDP increased from less than 24% in 1978 to more than 40% since the year 2000. In 2013, the service sector’s share in GDP of 46.1% for the first time exceeded the GDP share of manufacturing. And the most recent data for 2015 show that services now account for 50.5% of China’s GDP.

However, at 50.5 percent, the economic contribution from the service sector in China remains well below the service sector share in the UK (78.4%), the US (78%) or Germany (69%)⁸². By this measure, China’s economic contribution from the services sector is more similar to that of

⁸⁰ Prepared Statement of Mr. David Frey Partner, Markets Strategy, National Head of U.S.-China Strategic Corridor, KPMG China, Hearing on China ahead of the 13th Five-Year Plan: Competitiveness and Market Reform, U.S.-CHINA ECONOMIC and SECURITY REVIEW COMMISSION, U.S. Congress, April 22, 2015: p.155, <http://www.uscc.gov/Hearings/hearing-china-ahead-13th-five-year-plan-competitiveness-and-market-reform>

⁸¹ http://www.pwccn.com/webmedia/doc/635835257136032309_prosperity_masses_2020.pdf

⁸² These are value-added figures for services share in GDP for 2014, as reported in the World Bank data base, <http://data.worldbank.org/indicator/NV.SRV.TETC.ZS>

Vietnam (43.3 percent) and Indonesia (39.0 percent) than to that of other emerging economies, such as Brazil (69.3 percent), Russia (59.9), and India (57.0).⁸³

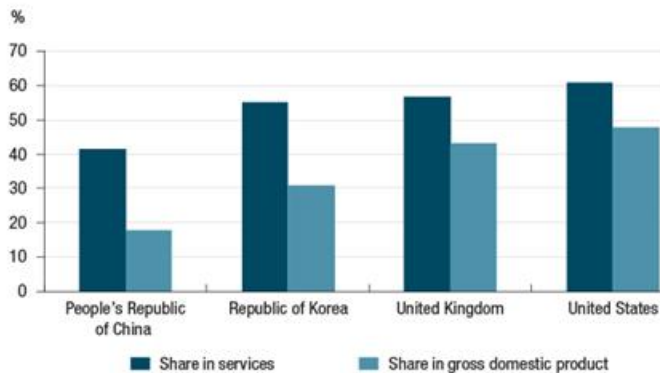
Table 4 - The rise of China's service sector

	1978	2013
CAGR (%)	10.7 (from 1978 to 2013)	
Share in GDP (%)	23.9 >40 (since 2000)	46.1 (exceeding the share of manufacturing for the first time) 50.5% (2015)*
Share of service sector employment in overall employment (%)	12.2	38.5 (generating most of China's new jobs)
# of service sector jobs (million)	48.6 Services provided 7.3 million new jobs annually since 1978	296.4 (6.1 times the # in 1978)
From the late 1970s to 2010 total employment grew by 337 million, of which 208 million was generated by the service sector	... but most were low-skill, low-pay jobs

Wei Wang, 2013: 234 **China Trumpets its Service Economy, Bloomberg Business Week, 1/28/16 13

As documented in **Figure 8** below, both as a share of services and as a share of GDP.

Figure 8 Modern Service Industries as a Share of the Service Sector and of Gross Domestic Product in Selected Economies



Note: Modern service industries include information and communication technology, computer service and software, finance and insurance, scientific research and technical service, public administration and social organization, education, healthcare, social security and social welfare. For the Republic of Korea, the United Kingdom and the United States, the corresponding year is 2006; for the PRC it is 2009.

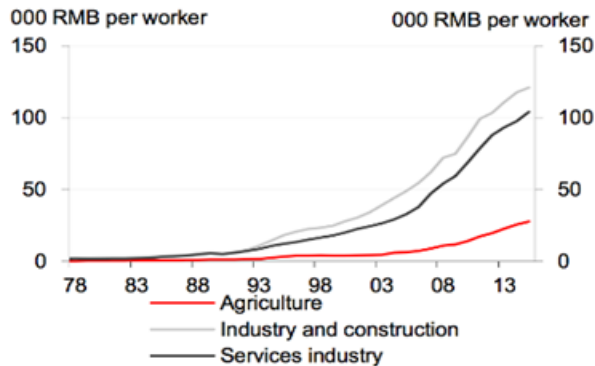
Source: [The People's Republic of] China Statistical Yearbook (2010). 14

The service sector now is a major source of new jobs – an estimated 20 million each year since 2011. However, according to data from the *All-China Federation of Industry and Commerce (CFIC)*, workers in China's service sector have been less productive than workers in industry and construction (see **Figure 9** below). Moreover, many of these service jobs don't pay as well

⁸³ Prepared Statement of Mr. David Frey Partner, Markets Strategy, National Head of U.S.-China Strategic Corridor, KPMG China, Hearing on China ahead of the 13th Five-Year Plan: Competitiveness and Market Reform, [U.S.-CHINA ECONOMIC and SECURITY REVIEW COMMISSION](http://www.uscc.gov/Hearings/hearing-china-ahead-13th-five-year-plan-competitiveness-and-market-reform), U.S. Congress, April 22, 2015: p.160, <http://www.uscc.gov/Hearings/hearing-china-ahead-13th-five-year-plan-competitiveness-and-market-reform>.

as the displaced manufacturing jobs⁸⁴. In fact, service jobs in China fulfill a “catch basin” function – they go to people who cannot find other work (ibid: p.3)

Figure 9
Chart 3: Services sector workers have been less productive in China



Source: CFIC, HSBC

Qu Hongbin and Jing Li, 2016, HSBC note

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Now suppose that the relatively low quality of the new jobs that are being created in services might reinforce a further slowdown in the growth of household incomes and consumption. We have seen that this assumption is quite realistic. If that would happen, this would then raise the following quite disturbing question:

- As China’s push into advanced manufacturing coincides with the “new normal” of a lengthy industrial slowdown, might this not eventually begin to constrain the service sector too, as the profit squeeze in manufacturing companies and declining income of workers will lead to a cut in investment in services and in their consumption? What would need to happen to avoid this “worst case scenario”?

It is too early at this stage to answer this question. What we can say however without any doubt is that services provide the key to China’s push into advanced manufacturing. Thus far, however, services have failed to play this role. While China’s service sector has grown rapidly, it continues to lag behind other countries at similar stages of development. In addition, the sector is dominated by traditional low-end types of services, rather than knowledge-intensive services that could create well-paying jobs.

The 13th FYP certainly goes out of its way to promote knowledge-intensive services as the necessary complement to China’s push into advanced manufacturing. In reality however, efforts to upgrade China’s service industry and to improve its competitiveness are constrained by heavy regulatory burdens, barriers to trade in services, policies that are still shaped by the requirements of industrial manufacturing, and major bottlenecks in the provision of the necessary skills. Given these negative framework conditions for upgrading the service sector, China’s attempts to forge ahead into advanced manufacturing are likely to face major hurdles.

⁸⁴ Cui, E., 2016, *How good are those service jobs?*, Ideas, *GavekalDragonomics*, February 11: 5 pages.

Conclusions

We have seen that China's comparative advantage in manufacturing, combined with the extraordinary size of its economy explain why China has not followed Dani Rodrik's pattern of "premature de-industrialization". But now that China is pushing into advanced manufacturing and services through both the **MIC 2025** and the **IP plans**, the real challenge is to determine how this might affect China's Future for Jobs.

The chapter shows that China is likely to emerge over the next decade as a major user and producer of robots and other advanced manufacturing technologies. However, the country still has a long way to go to develop a broad portfolio of innovation capabilities needed to implement the above transition. The analysis highlights a critical weakness of both the **MIC 2025** and the **IP plans** - an almost exclusive focus on technology, and a failure to collect data on possible impacts of advanced manufacturing and services on jobs, skills, income and equality.

To reduce this knowledge gap, the chapter has reviewed newly available data for China on unemployment, income inequality, skill requirements, and the development and quality of service jobs. These data document that official statistics underestimate China's unemployment rate and that the inequality of income is rising. China still has a long way to go to create the necessary skills (especially for soft and vocational skills), as well as enough knowledge-intensive service jobs that are necessary to forge ahead in advanced manufacturing and services.

The chapter culminates in a "worst case scenario" that should be at the center of further research and policy debates. If China fails to upgrade the quality of the new jobs that are being created in its service sector, this might slow down the growth of household incomes and consumption. As China's push into advanced manufacturing coincides with the "new normal" of a lengthy industrial slowdown, any such slowdown in income might eventually begin to constrain the service sector too, as the profit squeeze in manufacturing companies and declining income of workers might lead to a cut in investment in services and in their consumption. In order to avoid this "worst case scenario", it is necessary that both the **MIC 2025** and the **IP Plans** are based on realistic projections of employment and other labor market impacts.