

From ‘Labour Dividend’ to ‘Robot Dividend’:

Technological Change and Labour Power in South China

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Abstract

China became the world’s largest market for industrial robots in 2013. The robotic revolution sprouted after the 2008 financial crisis as many export-oriented firms coped with dwindling orders, rising labour costs, and growing concerns over occupational safety. Unlike workers in the global North who experienced automation in the 1960s and 1970s against a backdrop of strong union activism, the semi-proletarian peasant-workers in China might be less likely to enjoy the ‘trickle-down’ effects of industrial upgrading. However, very little social science research has investigated how automation, in light of the negative consequences of unemployment and deskilling, can continue to be advanced. Drawing on Beverley Silver’s concept of ‘labour power’, this paper explores how workers’ *marketplace* and *workplace* bargaining power facilitates or hinders technological change. The Chinese case may offer important lessons to those in the under-technologized South seeking to conceptualize strategies for social change in the context of industrial upgrading.

Keywords: robotization, industrial upgrade, semi-proletarianization, labour power, China

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I. Introduction

In summer 2011, Foxconn Technology Groups, one of China's largest employers, declared that it would use one million robots to replace human labour over the next three years. The company, which has excelled by deploying a military-style labour regime and has rapidly become the world's largest contract manufacturer of electronics, cranking out gadgets for Western firms such as Apple, decided to alter its mix of capital and labour (The Economist, 2011; Pun & Chan, 2012). Although the adoption of robots proceeded at a slower pace than expected, when news came in May 2016 that the Foxconn factory in Kunshan, Jiangsu Province culled 60,000 workers, over half of the total workforce, it triggered an ambivalent feeling in readers (Zuo, 2016). The city of Kunshan had grabbed headlines in 2014 following an explosion in a sand-blasting workshop in an auto parts factory, killing 75 people in one of the most serious recent industrial accidents. Since then, the Kunshan municipal government has been trying to shift its growth strategy by replacing humans with robots.

The trajectory of Foxconn's industrial policy change warrants academic attention because it reflects the dynamic relations between the state, capital, and labour as China witnesses its economic engine shifting gradually from leveraging its 'demographic dividend' to developing a 'robot dividend' (X. Huang, 2015). Until the 2008 global financial crisis, China's economic growth was rooted firmly in its massive workforce, a dividend associated with a relative increase in the age and participation rate of the labour force. However, China's traditional low-end, labour-intensive, and export-oriented mode of production encountered a bottleneck following the financial crisis. In 2014, China's economy recorded GDP growth of 7.4%, its slowest rate of expansion since 1990 (Bird, 2015). The government and media began to champion the 'robot dividend' that emphasized accelerating efforts to use

automated machinery and robots in place of human labour.¹ Premier Li Keqiang, when presenting the ‘Made in China 2025’ policy, vowed that the government would upgrade China’s manufacturing industry within a decade through ‘intelligent manufacturing’² backed by automated factories and big data to develop an innovation-driven and value-added sector (Xinhua Net, 2015). Local governments in the major manufacturing bases of the Yangtze River Delta (YRD) and the Pearl River Delta (PRD) also actively echoed the central government’s initiative. For example, in the city of Dongguan, where this study was conducted, the municipal government launched a policy called ‘Replacing Humans with Robots’ and pledged to offer 10–15 percent subsidies to qualified firms to upgrade their equipment (Dongguan People’s Government, 2014).³

In fact, Foxconn is not the only Chinese manufacturer betting on automation, as China’s robotic revolution is well under way, albeit without great fanfare. China became the world’s largest market for industrial robots in 2013, with demand skyrocketing to 57,096 units in 2014, a 25% share of the total global supply (IFR, 2015). Demand is expected to continue to rise in the foreseeable future as robot density in China, which is only 30 units/10,000 workers, remains very low, less than

¹ Authorities classify robots as either industrial robots used in manufacturing or service robots performing tasks other than industrial automation. In our research, we studied only industrial robots, which are defined by the International Organization for Standardization ISO 8373 as ‘automatically controlled, reprogrammable, multipurpose manipulator[s] programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications’ (IFR, 2015). An industrial robot is a typical component of programmable automated systems. The term ‘automation’ denotes technology designed to replace human labour in the manufacturing process, combining industrial technologies for physical operations and computer technology for information management (Siciliano et al., 2009, p. 16). Here we use these terms interchangeably because in introducing robots manufacturers are, at the same time, automating their production lines.

² For a full definition of ‘smart manufacturing’ please refer to ‘Guidance on National Intelligent Manufacturing Standard System Construction (2015)’, jointly published by the Ministry of Industry and Information Technology (MIIT) and the Standardization Administration of China.

³ The literal translation of this policy should be ‘replacing humans with machines’ (*jiqi huanren*). However, we decided to adopt the translation ‘replacing humans with robots’ because the application of machines in itself does not make a firm eligible for the subsidy, although some degree of automation is required. The 2014 plan awarded subsidies to 438 firms, but only 5 percent adopted industrial robots, while 95 percent used non-robotic automated equipment.

half of the world's average and far behind countries with higher levels of automation such as Korea and Germany (Ministry of Industry and Information Technology [MIIT], 2016).

China's robotic revolution might paint a rosy picture for the state and capital. However, its impact on labour remains very controversial. As shown in the Foxconn case, automation might improve workers' well-being by taking over operations that are repetitive, monotonous, and hazardous. On the other hand, in light of the lethal power of robots to cull the workforce in the world's most populous country, one might hesitate to embrace the robotic revolution without reservation. Yet, it is surprising to see that the Made in China 2025 plan, drafted by the Ministry of Industry and Information Technology (MIIT) with the input of more than 20 other ministries, did not invite trade unions, the Ministry of Labour and Social Security, or Labour Bureaus at the provincial and local levels to participate (Butollo & Lüthje, 2017). In this effort, labour was represented as a 'cost' to be overcome in the notorious 'migrant labour shortage (*mingong huang*)' discourse, but no assessments of the mid- and long-term impacts on the labour market or skill development have been conducted (Ernst 2017 forthcoming). Paralleling the 'labour blind' tendency of the government agencies, labour scholars on China tend to be 'technology blind' as they focus largely on workers' misery in labour-intensive and dehumanizing environments while being slow to respond to the impact of industrial upgrading on workers (Chan, 2013; Friedman & Lee, 2010).

Drawing from Beverly Silver's (2003) theory of 'labour power', this paper explores contradictions between technological upgrading and labour activism in China's burgeoning robotic revolution. Countries in the global North such as the U.S., Japan, and Germany achieved automated production in the 1960s and 1970s, when

labour unions still wielded strong bargaining power. This process also predated the emergence of the global value chain that assigns the value-added tasks of R&D and marketing to the global North and low-value jobs of Original Equipment Manufacturer (OEM) production and parts supply to the global South (Chan et al., 2013; Lüthje, 2002). In contrast, China's automation took place during an economic downturn in the aftermath of the 2008 financial crisis. Chinese migrant workers, as a semi-proletarian labour force with weak trade unions and low labour protection standards, might be less likely to enjoy the trickle-down effect of an industrial upgrade (Butollo & Lüthje, 2017). However, very few social science studies have investigated how automation, in light of the negative consequences of unemployment and deskilling, can continue to be pushed forward in society. We seek to answer the following questions: 1) How did automation take place in a country in the global South? How does migrant workers' semi-proletarian status harbor conditions amenable to industrial upgrading? 2) Despite the lack of craft or industrial union protections, how might workers' identity as 'peasant-workers' give them labour power that will affect the trajectory of technology-driven accumulation? The case of China, a late industrializing nation, is likely to offer important lessons for those in the under-technologized South seeking to conceptualize strategies for social change in light of weak labour protection.

II. Literature Review: Technological Change and Labour Power

Mainstream economists insist that industrial upgrading and innovation are necessary steps for establishing and maintaining competitive edge in the globalized economy (Freeman & Soete, 1997; Dai & Zhang, 2016). They often adopt a Schumpeterian perspective to consider innovation to be relevant only to a firm's entry into and exit

from the market (Howell, 2015; Li, 2011), but they have largely dismissed the role of labourers in the process as a whole. On this model, labour represents a ‘static factor of production, something that pre-exists in a raw homogenous form awaiting mobile capital to touch down and set it to work’ (Taylor, 2009, p. 439). Labour is not, however, a homogenous factor, as industrial upgrading might weaken some kinds of labour power and strengthen others. Moreover, labour’s reaction will also influence the path of technological change.

In the 1970s and 1980s, labour scholars explored changes in union power after automation in the global North. Harry Braverman (1998 [1974]: 8) lamented that the unionized working class ‘lost the will and ambition to wrest control of production from capitalist hands’ when automatic numerical control (NC) machines were introduced in the postwar era. Unlike Braverman, Tessa Morris-Suzuki (1988) adopts a less deterministic and more contextualized understanding of the union response. In her account of the automobile industry’s automation process in 1970s Japan, the Nissan union initially played a central role in the company’s policy-making and disavowed the dismissal of workers. However, entering the 1980s, an economic crisis and union split severely weakened the union’s bargaining power as its members had to compromise with the employer’s demand for substantial layoffs. To obtain a dialectical understanding of labour power, Silver (2003) draws on Erik Olin Wright’s concept of ‘structural power’ to show that industrial development does not necessarily disempower workers, although it may have divergent effects on workers’ *marketplace* and *workplace* power.

Despite Silver’s call to follow labour movement dynamics in the global South, few studies have investigated the effects of technological change on labour activism in countries that have industrialized recently. Scholars studying Chinese labour issues

tend to be, as noted above, ‘technology blind’ as they continue to prioritize research on sweatshop-like, alienating, welfare-deficient, and labour-intensive working conditions (Chan 2013; Friedman & Lee, 2010). Lu Zhang’s (2015) ethnographic study of the dilemmas facing the Chinese automobile industry is an exception. She showed that, while just-in-time (JIT) production methods may jeopardize workers’ *marketplace* bargaining power by widening the gap between fulltime and temporary workers, the automation system itself is extremely vulnerable to disruption and thus augments workers’ *workplace power*. Zhang’s research has helped us conceptualize the complex relationships between technological change and labour politics.

However, she focuses mainly on skilled and well-paid workers in the automobile industry, but has not studied workers employed in the more volatile OEM industries.

This research is based on a larger project that investigates the barriers to and incentives for adopting automation in the city of Dongguan in South China. We conducted three months of ethnographic fieldwork between September 2015 and January 2016, during which time we conducted participant observations and interviews with managers in 12 firms, comprising four robot suppliers and eight robot users. Eight of the factories adopted automation, and these firms were in the metal processing, electronics, automobile parts, furniture, and bicycle and motorcycle helmet manufacturing industries. Among them, four factories were recipients of Dongguan government subsidies under the Replacing Humans with Robots program. In addition, we conducted 51 interviews with workers, labour NGO staff and volunteers, factory owners and managers, and academics and government officials, 31 of whom were informants directly involved in the automation process.

III. The Semi-Proletariat “Peasant-Workers”

A Rock along the Roadside⁴

Ji Zhishui (2013)

A gust of wind blew upon us

Lifting us up beyond the soil

Descending upon machines and assembly lines in a distant land

Immersed in noise, engine oil, red and black adhesives, lead powder, and rust

We were lashed together, screwed down, and nailed tight

We were spun around so fast

Draining our rustic accent, howls, and hot tears

Until our last drop of sweat was shed

And we were ossified into a rock

Only to be discarded along the roadside

Crops will not grow even if we were to return to the fields

The rocks keep piling up along the roadside

One by one, cheek to cheek, in the cold

During the 2017 Chinese New Year Holiday, Dongguan captured news headlines as the top ghost town in the country, with nearly 70 percent of its population departed during the *Chunyun* (Lunar New Year Travel Rush) (Ye, 2017). Covering an area of 2,460 km², the city hosts over 80,000 manufacturers and boasts a population of 8.3 million, divided between only 1.9 million permanent residents with urban *hukou* (household registration) and 6.4 million migrants, most of whom are employed in factories (Dongguan Statistical Yearbook, 2015). The poem vividly portrays how migrant workers, troped as soil, have their life sucked up by machines and then

⁴ Translation by Yu Huang and Edwin Schmitt.

disposed back to the countryside when they are no longer productive. Now, drained of all nutrients, the once-fertile soil has turned into a barren rock, unfit to grow crops.

The same can be said of the ‘land’ of Dongguan. Despite of its fame as the ‘world’s factory’, for hundreds of years it was better known as a ‘land of fish and rice’ (*yumi zhixiang*), as the fertile alluvial soils of the PRD turned the area into a grain basket for Guangdong Province (Liu, 2010). At the beginning of the reform era, the Dongguan government was lured into the drive towards rapid industrialization and pursued an export-oriented policy called ‘both ends abroad’ (*liangtou zaiwai*), meaning the production process would begin and end in international markets, a prototype of OEM production that Dongguan firms continued to adopt in the later years of the reform (Dongguan Municipal Government Office, 1998). The migrant labour population jumped from only 156,222 in 1986 when records first became available to 1.42 million in 1995, almost equal to the population of permanent residents (Dongguan Municipal Office, 1998). After the privatization of Township and Village Enterprises (TVEs) in 2003, the population of migrant workers in Dongguan grew to 4.33 million, almost three times that of *hukou*-holding residents (Dongguan Statistical Yearbook, 2003).

The massive rural exodus that started in 1985 in China can be understood as a process called ‘the emaciation of the rural’, when the post-Mao government abandoned the pro-rural policy and reoriented economic development to an urban-centered approach (Yan, 2008). In 1978, the Household Responsibility System (HRS) instituted two-tiered land rights: landownership was vested at the village level, while land-use rights were distributed equally and leased for family contract farming.⁵ With

⁵ In 1982, the term of the contract was designated to be 15 years. To stabilize agriculture production and overcome the problem of further fragmentation of farmland, the principle of “more people but no more land, fewer people but no less land” (*zengren bu zengdi, jianren bu jiandi*) was adopted. In 1997, the contract term was extended to 30 years (Wen, 1999).

the decline of state investment in agriculture following de-collectivization, family-based production experienced a range of new problems, including the deterioration of irrigation systems, the fragmentation of farm land, and a need for major investments in inputs and machinery (Y. Huang, 2015). After the state lowered grain procurement prices in 1985, the urban–rural income gap began to widen and remained wider in the 1990s than it was prior to 1978 (Yan, 2008). The farmers’ plight was further exacerbated by the exorbitant taxes and charges that village and township governments imposed to compensate for their revenue shortfalls (Tao et al., 2011). The decline of grain production between 1999 and 2003 prompted the central government to launch incentive policies such as the grain subsidy program in 2004 and the abolishment of agricultural taxes in 2006, partly contributing to the first round of a putative labour shortage (Chan & Nadvi, 2014; Zhan, 2009). However, sustained low prices for farm produce and the rising costs of agricultural inputs failed to deter farmers from opting for urban migration. Here, the countryside definitely serves as a reservoir for disposable labour, although during intervals favorable to rural development workers might enhance their *marketplace* bargaining power by choosing not to migrate.

At first glance, the rural exodus in China echoes similar migratory movements that have happened in other late-industrializing countries in the global South. However, the China case stands out because of the institutionalized process of semi-proletarianization brought about by the *hukou* system. Migrant workers are better known as *nongmingong*, people who are caught between being *nongmin* (peasants) and *gongren* (workers). As stated in the poem, migrants are called on to *work* in the city but not to *stay* in the city. As rural *hukou* holders, they are supposed to return to the countryside for education, healthcare services, retirement, and other socially

reproductive activities. This ‘spatial separation of production in urban areas and reproduction in the countryside’ rendered by the *hukou* system can trace its roots to the socialist era of the 1950s when it was instituted both as a population control mechanism and as a welfare package (Pun & Lu, 2010, p. 497). In the reform era, the *hukou* system was re-deployed first as a means by which authorities could maintain social stability by avoiding ghettoization and second as an excuse to legitimate the low wages of migrant workers who are deprived of benefits enjoyed by urban residents. By 2015, the average salary of a migrant worker was only 60 percent that of an urban resident (Bai, 2016).

Migrant workers also suffer from weak labour rights protection. Before enactment of the Labour Contract Law in 2007, migrant workers had to endure low wages, abusive work conditions, and lack of employment security (Gallagher & Dong, 2011). Still, by 2015, eight years after the law was implemented, 63.8 percent of migrant workers had not signed labour contracts (National Bureau of Statistics, 2016). Moreover, although the Labour Contract Law was drafted to stabilize industrial relations, due to the imbalance of influence in the legislative process between labour and capital, the final draft of the law even expanded the class of permissible reasons for layoffs to include technological upgrading and management reshuffling (Gallagher & Dong, 2011). Also, despite the significant contributions of migrant workers to urban GDP figures, local city governments lack incentives to support their labour and social rights, which is evident by their passive enforcement of labour laws, especially during economic downturns. Finally, despite the state’s endeavor to advance workers’ rights through regulatory interventions, these measures aimed at improving individual contractual rights have failed to engage with the critical aspect of collective labour rights (Chan & Nadvi, 2014).

Nongmingong, as a quasi-identity, has trapped migrant workers in the process of ‘unfinished proletarianization’ as they shift between the city and the countryside while finding no permanent home (Pun & Lu, 2010). While the *hukou* system plays a major role in legitimizing the minimal costs of labour reproduction, we need to note that low incomes and weak social protections are not unique to the Chinese system—they are common labour conditions in the global South, where workers are often denied decent wages and access to consumer goods as a result of the specific feature of accumulation in peripheral capitalism (Amin, 1974; Jha et al., 2017). Migrant workers’ semi-proletarian status significantly affects the trajectory of technological change in the urban manufacturing sector. First, rural development and livelihoods are tightly linked to *nongmingong*’s decision of migration, indexing labour market changes that influence industrial upgrading decisions. Second, the high turnover rate among migrant workers likely affects how employers consider factors they weight when balancing the costs of human labour and automated equipment. Third, without collective rights, senior workers might soon experience the process of deskilling brought about by automation and fail to prevent their replacement by machines. In the next section we will examine how workers’ semi-proletarian status facilitates or obstructs industrial upgrading.

IV. Automation and Labour Politics

Workers’ *Marketplace* Bargaining Power

‘Labour shortage’

In August 2014, the Dongguan Municipal Government passed a resolution called ‘Promotion of Dongguan Enterprises for “Replacing Humans with Robots (2014–2016)”’, outlining the government’s determination to transform the city from being

the workshop of the world to serving as a base of intelligent manufacturing. In three years' time, the government would allocate an annual fund of 200 million yuan to sponsor firms that adopt 1,000–1,500 automation programs, helping to boost the productivity rate from 80,000 yuan to over 110,000 yuan per capita. Purchasing the capital equipment to automate does not alone qualify a manufacturer for the subsidy; such a firm needs to demonstrate how its industrial upgrade has fulfilled four criteria: workforce reduction, productivity increase, quality upgrade, and improvement of work safety protections (Dongguan People's Government, 2014).

Considering the dramatic increases in labour costs of the past few years, it is not surprising that 'work force reduction' topped the list of criteria for eligibility. According to official statistics, the city's annual average salary jumped 1.57 times, from only 16,108 yuan in 2010 to 41,285 yuan in 2015 (Tang, 2016).

Emerging first in the spring of 2004, the recent round of labour shortage began in earnest as early as the summer of 2009 (Xinhua Net, 2010). Soon after the Chinese New Year Holiday in early 2010, Dongguan witnessed a workforce deficit exceeding one million, a stunning 30 percent shortage. Labour-intensive industries were hit extremely hard, including electronics, furniture, garments, toys, and others (Wuhan Evening News, 2010).

A prevalent scholarly interpretation of the labour shortage can be found in the theory of the 'Lewisian turning point', which adopts an analysis of demographic change to posit new mechanisms of rural-to-urban migration. Cai Fang and his colleagues were among the first to propose such a thesis, as they showed how the one-child policy took a steep toll in ending the seemingly unlimited supply of migrant labour (Cai, 2007). To justify the Replacing Humans with Robots policy, both the media and the Dongguan government offered statistics indicating demographic

change: China's working age population dropped from the peak level of 941 million in 2011 to 916 million in 2014, a decline of 25 million in three years (Li & Yang, 2015; National Bureau of Statistics, 2015).

The problems with the 'Lewisian turning point' hypothesis are two-fold: first, it is predicated on a rigid divide between urban industrial and rural agricultural sectors and hence assumes that the subsistence-based economy of the countryside will continue to send out 'surplus' labour to the city (Zhan & Huang, 2013). Here labour migration is understood as a rational process governed by the law of supply and demand, but this approach fails to consider migrant workers' voluntary choices or even involuntary struggles. Recently, scholars have increasingly begun to unveil the dynamic relations between the urban and rural sectors in a critique of this rigid hypothesis. For example, scholars have shown that rural 'surplus' labour is far from being exhausted. In fact, the total number of migrant workers has continued to rise, from 253 million in 2011 to 274 million in 2014, an increase of 21 million (National Bureau of Statistics, 2015). In 2009, just less than one-third (31%) of the total rural labour force of 469 million chose to migrate. Zhan and Huang (2013) reveal how rural development, especially the rise in Township and Village Enterprises in the 1990s and the government's 'Developing the West' and 'Constructing the Socialist Countryside' programs of the 2000s, contributed the major portion of income growth in the countryside. Moreover, it has been found that rural labourers prefer local nonfarm employment to labour migration if the two offer commensurable economic rewards.

While Zhan and Huang cogently unveil how rural development helped increase the *marketplace* bargaining leverage of migrant workers in the urban manufacturing sector, as evident in the 153.8 percent hike in wage growth between 2003 and 2009, labour scholars have emphasized the importance of workers' struggles in elevating

their social and economic status, contributing to the second critique of the ‘Lewisian turning point’ hypothesis. A most inspiring case was the workers’ strike at the Honda Auto Parts Manufacturing plant in Foshan that involved 1,800 workers and lasted for 17 days, forcing management to nod to workers’ demand for a significant 32.4 to 70 percent wage increase and democratic election of new trade union leaders (Chan, 2013). In addition to the struggle for higher wages, migrant workers have been fighting for the benefits and rights of full proletarianization, forcing the government to pass a series of laws to protect workers’ rights, such as the Labour Contract Law in 2008 and the Social Security Law in 2011.

Therefore, the so-called labour shortage reflected workers’ growing *marketplace* power rather than a real shortage in the labour supply. However, rising labour costs can also turn against workers if employers refuse to offer higher salaries, instead replacing workers with robots. Currently, the average monthly salary in the manufacturing sector in Dongguan was 4,062 yuan,⁶ and with social security expenditures labour costs easily exceeded 50,000 yuan per year. In comparison, industrial robots averaged less than 100,000 yuan/unit (General Administration of Customs, 2015). Therefore, typically it takes only two years for employers to get their investment back from upgrading their equipment, a tempting solution to the pressing ‘labour shortage’ issue.

According to Dongguan government statistics, from September 2014 to December 2015, among the 1,262 subsidized programs, work force reduction totaled 71,253. Our research identified an alarming rate of job replacement (Table 1).

Table 1. Workforce change before and after automation⁷

⁶ The average annual salary for the manufacturing sector was 48,750 yuan in 2015. See Yu (2016).

⁷ We were able to collect data on four out of the eight factories that adopted robots and automation systems. For the four factories from which we were not able to gather data, Factory M already had automation equipment

Factory	Product	Equipment	Previous workforce	Present workforce	Workforce reduction
P	Printer transmission wheels (plastic)	industrial robots for plastic injection molding machine	1 worker 1 machine	1 worker for 5 machines	80%
C	auto parts (plastic)	industrial robots for plastic injection molding machine	1 worker 1 machine	1 worker for 3 workers	67%
H	bicycle helmets	industrial robot for helmet venting hole cutting	40 workers	10 workers	75%
L	Mobile Phone LED die-cut modules	automation system	20 workers/line	3 workers/line	85%

In the four factories we studied we saw, following technological upgrades, a dramatic reduction in the labour force ranging between 67 and 85 percent.⁸ Factory P cut its operational workers by 80 percent after the introduction of robotic arms that took finished products out of the injection molding machines, enabling one worker to manage five machines in contrast to only one per machine before automation. Still, the facility increased productivity by 10 percent. The production line for bicycle helmets, cut the workforce even more dramatically, from 40 to 10.

Surprisingly, most of the workers we interviewed welcomed the encroachment of industrial upgrading, which represents what they see as somewhat unstoppable ‘progress’. In a focus group discussion, Meng,⁹ a fourth-generation carpenter,

(CNC) at the time of establishment. Therefore, there was no information on the labour force before automation. We obtained information on Factory D mostly from workers who had grievances with the owner and did not feel it would be appropriate to interview the owner. Factory J was still testing its automation line, which was not yet in production. The owner of Factory K did not want us to take notes of our conversion and did not want his factory to be reported on, even anonymously.

⁸ The table reflects only workforce changes in the same production line, not in the whole factory. For example, Factory L reduced labour in the production unit but increased personnel in the still labour-intensive QC unit. However, it is foreseeable that with automation technology implemented in QC, the overall workforce for the whole factory will decline significantly.

⁹ All informants’ names have been anonymized.

suggested that the new automatic sculpturing machines helped reduce work intensity, lowered workers' exposure to dust, and yet turned out higher-quality doors. Later in a personal interview, however, he did mention a case in which veteran workers resisted reductions in salary, which we will discuss later. Another worker, Gang, who worked in an electronics factory but suffered from Myelodysplastic Syndromes (MDS), a kind of blood disorder associated with exposure to toxic chemicals, highlighted the advantages of automation:

Gang: The automation process in Dongguan epitomizes social progress. . . . Some people are concerned about the consequences of worker displacement. I don't think that this is a problem to be worried about. I feel that the government should guarantee resource sharing. I used to be a farmer. Initially farming was manual work. The crops 100 farmers grew were not enough to feed 100 people. Now (with machines), two farmers can feed 100 people. . . . With automation, fewer workers will be needed as per capita productivity increases.

However, after hearing about the government's subsidy to employers, participants began asking why the government did not subsidize laid-off workers.

Later, when I interviewed Mr. Tan from the Dongguan government and conveyed the workers' concerns to him, he implied that it was the workers' responsibility to keep up with the 'wave':

There is a saying that in the Yangtze River the waves from behind push forward those in the front. . . . At this time, it is difficult for the government to consider offering them humanistic care . . . such as assigning them psychiatrists. It is not feasible. Workers can only depend on themselves to learn new technology. . . . Everyone needs to cultivate themselves so as to develop a competitive edge. . . . This is a trend. . . . A society's progress comes with costs. . . . Everyone here endures the pressure of survival.

We can see here that, while local governments benefit from migrant workers' economic contributions, they are reluctant to take responsibility for these non-residents' social well-being. However, Mr. Tan later admitted that the government's indifference to the adverse outcomes of automation was due partly to the workers' muted reaction. 'Now for people who petition the State Bureau for Letters and Visits (*shangfang*), they do it because of wage arrears and runaway bosses. I haven't heard any case of a petition due to replacement by machines'.

High labour turnover

Laying off workers does not present a major problem to employers. The manager of Factory H reported that they had 240 employees in their plastic injection molding department prior to automation in 2010 and now have only 120 workers, but they never had to ask the workers to quit.

The high turnover rate is a very special phenomenon in China. Therefore, I adhere to the law of natural selection, separating the wheat from the chaff (*quwu cunjing*). For a corporation, you can't lose your human rights as a result of evolution. That is a fundamental social right. The turnover rate is high in China, which matches my hiring freeze initiative. This works like an ecological cycle in nature. We utilize this natural cycle to add to or reduce our workforce.

Here the manager uses the trope of 'natural selection' to deflect employers' responsibility for compensating laid-off workers. Before 2014, the turnover rate in his factory was 150 percent, having just recently dropped to 100 percent in 2015. Although Chinese labour law requires employers to offer severance pay calculated at one-month's salary for each year of service, in reality there are various ways by which an employer can circumvent this regulation. Currently, the basic salary in Dongguan is only 1,510 yuan. Considering the average monthly salary of 4,062 yuan in

manufacturing, the bulk of workers' salaries comes from overtime work. Therefore, if an employer does not offer overtime tasks to its workers, the workers might quit their jobs 'of their own free will', obviating employers' mandate to offer severance pay.

Some labour scholars on China have not paid enough attention to the relationship between labour market factors and industrial upgrading. They tend to view high labour turnover as a force that threatens workers' skill development, employers' human capital accumulation, and even social stability (C. Huang, 2012; Li et al., 2012). The 'Migrant Workers' Employment Trends Report', released by Tsinghua University, indicates that the trend in temporary employment intensified in recent years, with the average duration of continuous employment for migrant workers lasting 3.8 years in the early 2000s while dropping to 1.4 years for the cohort entering employment in 2008. The unemployment rate for migrant workers in 2011 approached 40 percent, with the average period of unemployment lasting eight months. What is worse, frequent job shifting has not led to upward mobility, as has commonly happened in other countries, instead apparently representing nothing more than 'horizontal' career development or 'marking time' (Tsinghua Sociology Department Project Group, 2013). Over one-third of their informants reported no improvement whatsoever in this respect.

Like the 'labour shortage' factor, the high turnover rate can also work as a double-edged sword insofar as, on the one hand, it can enhance workers' *marketplace* power through so-called 'voting with the feet', but on the other hand can also be utilized by employers to enforce automation that further marginalizes workers' *marketplace* bargaining power.

Workers' *Workplace* Bargaining Power

Under labour shortage conditions as well as high turnover, some manufacturers consider automation a viable solution to reducing their reliance on skilled labour. In our visit to Factory H, the manager explained to us that previously it took six months to train an operator to become proficient in cutting venting holes in a bicycle helmet. Now, the worker who operates the robotic arm can finish the tasks very effectively in only three days. The reduction in the training period from six months to three days meant that, for employers, the ratio of the cost of training an operator to produce identical parts by conventional methods compared with the cost of using industrial robots is approximately 60 to 1. This issue was already observed by Braverman in his study of the numerical control machinery (NC) in the post-WWII U.S., when he reported the difference between training an artisanal machinist and a NC machine operator to be four years versus four months (Braverman, 1998 [1974], p. 139). At that time, trade unions in the U.S. were still proactive and powerful so that employers had to '(in public at least) . . . conceal the downgrading' of the trained machinist 'in the interest of a smoother transition and for public relations reasons' (Braverman, 1998 [1974], p. 139). If veteran machinists in the U.S. silently accepted their labour degradation fate, how did non-unionized workers in China react to the encroachment of automation?

Our research has found that with the increased productivity brought by advanced machinery, workers' pay immediately changed from a piece rate to a time rate. Employers used various strategies to persuade veteran employees to accept the reality of higher productivity for the same or even lower pay.

Rong worked in a factory that produced metal car seat frames. In 2013, the owner purchased one automatic lathe for metal punching-stamping and one for welding. The punching-stamping lathe includes a series of tools that revolve to the next tool as the previous one completes its cycle, and is capable of finishing tasks that previously required ten small lathes to accomplish. Rong estimates that the automatic lathe produces at least 30 items per minute, compared with only five items per minute produced by the ten small lathes combined. The automatic welding lathe can weld at three points simultaneously and even remove welding slag and polish surfaces afterwards, replacing the labour of four to five workers. However, Rong's boss did not intend to replace all the old lathes immediately because the automatic lathes are economical only for large orders. The factory still relies on the skilled senior (40+) workers to operate the small outdated lathe.

When the factory owner purchased the three automatic lathes, productivity increased almost tenfold. This time, rather than asking veteran skilled workers to operate the automatic machines, he hired three younger workers to operate them. Now, the younger operators are paid 5,000 yuan per month, almost the same as the veteran workers with more advanced skills and experience but lower productivity. Rong considered the automation operators' work to be easy (*qingsong*) and desirable. However, younger workers are preferred to veteran workers apparently because the younger workers are better able to adjust to small errors to which the machines are prone.

Factory H maintains dual payment systems for manual and robotic cutting of helmet venting holes. Manual cutting is paid at a piece rate, while robotic cutting operators are paid by time. At the time of the study, the latter group could produce 40 pieces per hour and were paid on average 4,000 yuan per month. In contrast, manual

workers produce 15 pieces per hour and are paid 5,000 yuan per month in recognition of their skills. In the future, skilled workers will be replaced increasingly by robots. Currently the factory uses the internal labour market to convert manual workers to robot operators rather than hiring younger unskilled workers from outside. The barrier is that the factory environment is noisy and dusty, making the job unattractive to younger workers.

To conclude our presentation of interview responses and observations, we will recount a story of some veteran workers' experience with a failed strike to reflect on the dilemmas they encountered during the transition. Jun is a third-generation carpenter and works with his father in Factory D, which specializes in manufacturing doors. The factory was set up in 2002 with fewer than 20 workers, but expanded to over 300 workers in 2009. Today it has only a little more than 100. However, replacing workers was not a smooth process because the veteran skilled workers organized a strike to protest the drop in pay that automation brought.

Before the introduction of automatic lines, the factory had already launched a Taylorized approach to manufacturing that divided the production process into small steps. Jun's father had joined the factory soon after its establishment. At that time, his co-workers were all rural craftsmen who acquired woodworking skills from generations of practice. As the factory expanded, the owner found it hard to recruit a sufficient number of experienced carpenters and started to organize a division of labour, forming five door manufacturing units: feeding raw materials, cutting parts, pressing boards, assembling doors, and painting. Previously, the factory manufactured conventional doors, catering to the booming real estate industry. After the real estate bubble burst following the 2008 financial crisis, the factory owner decided to increase his firm's competitiveness and also shifted its market from conventional doors selling

at 1,000 yuan per piece to high-end, fire-resistant doors with average prices of 5000–6000 yuan, launching automatic and semi-automatic lines for laminating, cutting, and painting.

The urgency to continue automating also came with the need to reduce pollution in the workshop. Manufacturing fire-proof doors required the insertion of asbestos and gypsum plaster. Long-term exposure to asbestos increases the risks of lung cancer, while immediate exposure will cause skin irritation. In 2011, the factory owner introduced a semi-automatic veneer pressing machine that accomplished a series of tasks from glue application to pressing the asbestos and gypsum plaster together. Before automation, veteran workers in the veneer pressing unit were paid at a piece rate of about 6,000 yuan per month. The first month after automation, increased productivity helped push the average salary to 8,000 yuan per month.

The owner quickly began recruiting younger workers. The head of the pressing unit became angry because his unit was composed mostly of workers who had worked at the plant for more than four years and even a few who had joined the factory at its inception in 2002. After a quick discussion with his fellow workers, the pressing-unit head decided to call a strike early one morning. He successfully used his authority to gain the support of not only veteran workers but also newly recruited younger ones. They halted production for about two hours before the owner came to yell at them: ‘Do you still want to work here or not? If you choose to quit today, I will settle your wages’. The veteran workers suddenly realized that they were no longer the backbone of the factory and their skills no longer automatically granted them *workplace* bargaining power. In their 40s, most feared that they would have great difficulty finding other jobs if they were fired, and quickly returned to their positions. Each striking worker was fined 100 yuan as punishment. After the strike, the owner

accelerated the automation process to cover operations in painting and cutting. Later, in their bi-monthly assembly, the owner would scold the workers: ‘You are just a speck. The factory won’t stop without you.’

Jun attributed the failure of the strike to the lack of solidarity among the workers. In the factory, the head of each unit liked to recruit fellow workers from their hometowns, a trend that became more pronounced after the factory introduced Taylorized form of production. For example, the veneer pressing unit is composed of workers from Hunan, while the painting unit has workers mostly from Henan. As the employer introduced automation to various production units, workers from automated units installed later lacked incentives to support workers from units that had been automated earlier. Jun thought that if all the workers had participated in the strike together, the employer would have had to yield to the workers’ requests. Jun did notice that, with the introduction of automation machines, veteran workers like him were no longer desirable. After the strike, the skilled workers all experienced pay cuts, while younger workers, although still earning lower salaries than the veteran workers, were paid slightly above the market rate. In a sense, automation stirred up tensions between skilled and younger workers through the process of de-skilling.

Finally, we can see from the above examples that workers do not resist deskilling but rather the unfair treatment they experience in the transition to deskilling. As semi-proletarians lacking union representation, migrant workers were omitted from industrial policy decision-making, giving free reign to employers to determine the process of industrial upgrading and to reduce salaries as they desired. Labourers’ semi-proletarian status in this regard has weakened their *workplace* bargaining power.

A limitation of this study is that we did not conduct in-depth participant observation of shop-floor transformation after automation and did not encounter cases in which automation contributes to workers' increased *workplace* bargaining power. In her analysis of the 'labour force dualism' that is widely practiced in the automobile industry in China, Zhang (2015) does not perceive temporary workers necessarily as 'weak', as they have taken collective action to resist wage arrears as well as unequal treatment between themselves and formal workers. More importantly, she refuses to take it for granted that the sophisticated JIT production system, assisted by the modular assembly method, third-party logistic scheduling, and computerized system control, is inherently totalitarian as she identifies the limitations of the system. 'JIT production requires continuous and smooth operation of machines to keep down time to an absolute minimum if profitability is to be achieved. That suggests that localized stoppage or disruptions by a small group of workers . . . can lead to large losses for capital' (90).

V. Conclusions

As the country with the largest population in the world, China, by shifting from an economy based on exploiting its 'demographic dividend' to one based on possibly leveraging the upcoming 'robotic dividend,' will see the significant impact that industrial upgrade imposes on the labour force. Drawing on Beverly Silver's theory of the 'structural' power of workers, this paper seeks to disentangle the complex relationship between technological change and labour power. While a 'labour shortage' and high turnover rate might epitomize workers' increasing *marketplace power*, the rising labour costs that result might jeopardize workers' interests, as employers are incentivized to use robots to replace human labour. Moreover,

employers can capitalize on the high turnover rate to avoid offering severance pay. In terms of workers' *workplace* bargaining power, with a state-led union that has become 'haplessly impotent and incapable of representing workers' (Chen 2009: 663), the potential for initiating large-scale, well-organized resistance against deskilling might be weak.

In *Capital* Volume I, Marx vividly shows how the introduction of large-scale machinery led not only to a quantitative change in productivity growth, but also and more importantly to a qualitative change in capital accumulation, from formal subsumption via the extension of the working day to real subsumption via increased work intensity. In the latter phase, the actual labour process is subsumed by the valorisation process, when '*capitalist production* now establishes itself as a mode of production *sui generis* and brings into being a new mode of material production' (Marx 1976 [1867], p. 478, emphasis original).

While it is beyond the focus of this paper to discuss whether automation will lead to real subsumption and full proletarianisation of the workforce, it is worth noting that China's robotic revolution is taking place simultaneously with the acceleration of rural land transfers. The Ministry of Agriculture recently announced that one-third of the farmland in the country has been transferred from small farmers to rural elites or agribusinesses (China Net, 2016). If workers are displaced by robots but have no countryside to which to return, China might soon see the rise of urban ghettos and the mounting social problems. However, the national government still has not conducted a comprehensive study of the impact of automation on workers, not to mention offering prospective solutions. Local governments still refuse to treat the semi-proletarian migrant workers as permanent residents and are reluctant to shoulder the negative consequences that industrial upgrading might impose on those workers. In

regards to the workers themselves, it is likely that automation will lead to deskilling and produce a more homogenized workforce. Will technological change help provoke class consciousness? How might worker activism be organized in the era of the robotic revolution? Further research is needed to look at the transformation of both the macro-level labour market and the micro-level labour process to understand how automation affects countries in the global South that are quickly industrializing to move up the value-added chain through industrial upgrades.

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