# **Globalization of industry and Occupational Health Safety:**

# A Case Study in China's Automobile Industry

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#### Abstract

Automobile industry has been considered to be the most risky industry in Occupational Health and Safety (OHS). As the growing global competition and cost production, increasing number of Automobile Multinational Companies (MNCs) use Foreign Direct Investment (FDI) to keep their peace of growth. Due to vary modes of original production and degree of localization, different ownership of assembly Joint Ventures (JVs) may have very different effect on OHS. This study looks at the relations between different ownership JVs, common work system practices, and OHS. Using a worker survey of 12 factories in seven cities and a clustered regression, we find that different ownership and regional have very different effect on OHS. We also discover that the usual claim that "flexibility of work" may be associated with OHS positively because of labor exploitation does not stand. Instead, fixed term contract and without contract in hand is associated positively with OHS. That may meant firms may use labor contract to push workers to work harder and therefore more OHS. We also find that work system alone may not associate with OHS directly. Alternatively, we realized that work pressures such as pressure from group and leaders, from wage, and from company atmosphere may have positive relations with OHS.

Keywords: Automobile Industry, Occupational Health Safety, globalization of work

JEL: J28, J81, J83.

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"Labour is a process in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material re-actions [Stoffwechsel] between himself and Nature. He opposes himself to Nature as one of his own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants... Thus, the elementary factors of labour process include: the personal purposeful activity of man (i.e., work itself), the subject of that work and its instruments." (Marx 1969: 192-93).

"Unlike physical capital, however, property rights in human capital—patents, copyrights, workplace safety rights—have often not been strong enough to encourage the most enterprising use of human capital resources." (Schultza, 1993).

#### **1. Introduction:**

Foreign Direct Investment (FDI) has been a trendy strategy of Globalization of industry for Mulitnational Companies (MNCs) to expand their business for cost saving and market expansion (Novak and Stern, 2007).<sup>2</sup> To save the cost of production, MNCs usually expand their production to Developing Countries (LDCs) where with lower production cost such as land and labor are plentiful (Yang, 1995).<sup>3</sup> While modernization of factory facilities may be helpful for better work practices and development (Piore and Sabel, 1984), other critical social scientist accused that nature of FDI is still exploitative to labor; that is in order to maximize their profit, MNCs may reducing the worker's safety prevention facility but increase workers' shift, working hour, and flexibility of work (Butz and Leslie, 2001).<sup>4</sup> Therefore, growing concern with this globalization tren is that if there is any common practices such as work system and pressure or the modes of automobile production from different countries may that related to Occupational Health and Safety issue (OHS) occurrence at the host countries?<sup>5</sup>

As automobile industry is considered to be one of the most highly risk in OHS issues, according to the ILO Encyclopedia of Occupational Health and Safety published in 1998, and China is arguably the largest one of the largest Automobile producers. In the past one and half decades China has become a big player in global passenger car manufacturing, from producing only under half a million passenger cars in 1998 to almost 14 million in 2011 (the respective output was 6m down to 2.2m in the USA and 8.5m to 8.3m in Japan).<sup>6</sup> Different automobile MNCs have developed their assembly JVs in China. However, due to

<sup>&</sup>lt;sup>2</sup> Novak and Stern (2007) used a set of luxury automobile segment data in the US and show that outsourcing and vertical integration could enhance firms performance significantly in longer run.

<sup>&</sup>lt;sup>3</sup> Yang (1995) using the automobile industry to illustrate the globalization of industry effects on national, firm, and individual level. Yang argues that with increasingly globalization [of taste], a continuous decline in cultural nationalism will be resulted.

<sup>&</sup>lt;sup>4</sup> Butz and Leslie (2001) examine employment in the Canadian automobile industry and show that risk transcends terms of employment, to encompass injury, lay-off, and displacement. They argued that automobile labor work becomes increasingly risky with the blurring of employment relations within and among three geographic scales: the globe, the locale and the plant.

<sup>&</sup>lt;sup>5</sup> OHS injuries often known as musculoskeletal disorders, or RSI (repetitive stress injuries), or CDT (cumulative trauma disorders) that are caused by highly repetitive motions, over exertion, heavy lifting, long periods of working in strained and awkward positions, etc.

<sup>&</sup>lt;sup>6</sup> The International Organization of Motor Vehicle Manufacturers website <a href="http://oica.net/category/production-statistics/">http://oica.net/category/production-statistics/</a>

interactions of original countries' production and management model, FDI regulations, and localization speed, it is difficult to disentangle these factors' relation to OHS. This project, therefore, links the concept of globalization of production and the OHS occurrence in Automobile industry and investigates the common work system and different JVs management models in China may have their effects on OHS occurrence.

In this project, we survey 12 major passenger car production factories' workers from major automobile production centers at seven cities (Beijing, Guangzhou, Tianjing, Zhuzhou, Shanhai, Yantai, Shenzhen). We randomly surveyed around 100 workers from each factory between July and August 2011 outside 12 automobile assembly plants of various types of ownership-joint ventures, state-owned and domestic private. The joint ventures include major automobile companies from American, German, Japan, Korean, in addition to two State Owned and two Chinese private companies.<sup>7</sup> Each of these joint ventures represents a kind of managerial model. For example, the Japanese production model is called "the just in time" or "Toyota" model, while the German model are used to be considered to be more generous European model than the American model.<sup>8</sup>

The survey questions documented demographic character, current contract information, work system, work pressure, and work satisfaction. To test the correlation between these variables with OHS stated above, since our dataset is a clustered random sampling survey data, we employ clustered regression with fixed effects models to obtain robust estimations. The other advantage of the clustered regression with fixed effects model can is that it can look allow for intra-factory corrections in the model that could produce robust results. However, since we have only one cross-section of survey data, all we can estimate here is about the correlations between these variables.

The regression results uncovered that first, there are different relations among JVs ownerships. For example, using American ownership as a base for comparison we found, after controlling for other factors, Germany and Korean JVs have significantly less OHS, while Japanese JVs, Chinese SOEs and Chinese Private assembly plants, however, are not significantly different from the American JVs. That may means some learning from each others' managerial practises may have happened. Second, regional variations are also very high, using GZ as a base, we discovered that BJ and SH have higher OSH rate but YT and SZ does not have any significant different. These regional differences may be related to the assembly plants relations with different level of government. Third, we also found that the traditional claim that the flexibility of work using agency work may cause "exploitation" to those temporary workers does not seems to be the case in our study. After control for other variables, we found no different in OHS occurrence between the two worker types: the

<sup>&</sup>lt;sup>7</sup> There are more joint ventures in our sample than state owned and domestic private plants because one of the intensions of the project was to compare work condition variations among major foreign partners. Also, because of the Central Government's policy since the later 1990s, most of original automobile SOEs producers have formed the joint-venture companies with foreign producers

<sup>&</sup>lt;sup>8</sup> Allen (2011) shows that, in 2010, Germany produced more than 5.5 million automobiles; the U.S produced 2.7 million. At the same time, the average auto worker in Germany made \$67.14 per hour in salary in benefits; the average one in the U.S. made \$33.77 per hour. Yet Germany's big three car companies—BMW, Daimler (Mercedes-Benz), and Volkswagen—are very profitable.

factory direct employee and agency contract. This suggests the used of and conditions of temporary workers may be vary very differently among different factories. Instead, plants may use labor contract to squeeze the low level and fixed term workers. Our forth analysis looks at this issue from another way round, labor contract could be able to protect workers from OHS problems if the term is good and properly enforced. We found that comparing to fixed term contract workers and no contract in hand, workers with indefinite term contract and the contract is in hand, in average, have around 1.8 less OHS. Fifth, we found the work system variables are not significantly related to OSH, however work pressures does. It may because of the fact that the "problems in the work system" have strong association with those pressure factors. After we introduce a set of work pressure variables, we discovered that pressure from group and leaders, from wage, and from company atmosphere have positively significant relations with 0.19, 0.23, 0.27 more OHS number, respectively, than those who feels not. In sum, the overall result is consistent with the theoretical predictions that firms may utilized measures such as production model, contract, work system, and work pressures to maximize their profit.

The rest of the paper is organized as followed. Next section reviews literatures related to changing mode of automobile production and its implications to OHS. Section three will evaluate the current situation and localization of automobile industry in China. A set of hypotheses will be therefore derived at section four accordingly. Section five and six will be the descriptions of survey and methodology. Section seven will show the results and robustness checks. A conclusion and discussion will be at section eight.

# 2. Changing mode of production in Automobile production and OHS?

This section, we look at the changing production model as the world automobile production is increasing globalized and localized into the LDCs and their impacts to industrial relations.<sup>9</sup> In particular, as the production mode is growing to be globalized and production technology is increasing modernized, OHS occurrence may or may not be reduced.

# 2.1 Globalization of production mode and its implications to labor systems:

FDI has been a trendy strategy of Globalization of industry for Mulitnational Companies (MNCs) to expand their business for cost saving and market expansion.<sup>10</sup> To save the cost of production, MNCs usually expand their production to Developing Countries (LDCs) where with lower production cost such as land and labor are plentiful (Butz and Leslie, 2001; Novak and Stern, 2007).<sup>11</sup> The positive impacts to labor conditions at LDCs from FDI could be the modern technological spill-over and standardization of work system that may be helpful to reduce the occurrence of OHS incidence (Chakowski and Slotsve, 1992).<sup>12</sup> This kind of innovation can be regarded as the Schumpeter's "constructive destruction."(Piore and Sabel, 1984; Schumpeter, J. A. 1934) However, other critical social scientist accused that FDI may be exploitative to labor; that is in order to maximize their profit, MNCs may reducing the worker's safety prevention facility but increase workers' shift, working hour, and flexibility of work.<sup>13</sup>

Indeed, researches have shown that management have been modifying the work systems to maximize their profit to cope with the increasing competitions. For example, the "labor process theory" (LPT) from critical management literature stated that in order to minimize cost and generate more profit, MNCs may choose to control workers by intensify workers' work and deskill workers (Braverman, 1974; Littler 1990) by the work system through repetitive and monotone work tasks (Hall, 1993).<sup>1415</sup> Recent studies also find that

<sup>&</sup>lt;sup>9</sup> Noble, Ravenhill, and Doner (2005) reviewed the development of the automobile joint ventures in China and argue that the initial development was not very successful, exception of two investments by Volkswagen. Until China entered WTO in 2009, the lower tariff, de-nationalization of automobile industry, inexpensive local parts and assembly and more competitive industrial policies provide conditions for its industrial development.

<sup>&</sup>lt;sup>10</sup> See also Kawai and Wignaraja (2011) for the impacts of trade agreement such as the Aisa's Free Trade Agreement to the Automobile production network in Asia.

<sup>&</sup>lt;sup>11</sup> Butz and Leslie (2001) examine work and employment conditions in the Canadian automobile industry and argue that the automobile work is becomes increasingly risky among three geographic scales: the globe, the locale and the plant, when the industry is getting more globalized.

<sup>&</sup>lt;sup>12</sup> Blank, et. al. (1997) reviewed 23 published papers on the relations between production technology advancement and industrial injuries in referee journals and found while improvements in production technology may enhance productivity and occupational safety, they are not necessarily come simultaneously. Also, technological change may have some positive effects to injury occurrence and also promote personal well-being. But the conditions and moderating factors enabling favourable outcomes are not yet fully understood. They therefore proposed a framework to this understand this relation. Factors considered in this framework are: technology, work organization, job performance (man, machine, environment), and accident.

<sup>&</sup>lt;sup>13</sup> Butz and Leslie (2001) examine employment in the Canadian automobile industry and show that risk transcends terms of employment, to encompass injury, lay-off, and displacement. They argued that automobile labor work becomes increasingly risky with the blurring of employment relations within and among three geographic scales: the globe, the locale and the plant.

<sup>&</sup>lt;sup>14</sup> One of the attempts to theorize the impacts of Taylorism production model is the so-called "Labor Process Theory" initiated by Braverman (1974) and formed the later "critical management theory." Labour Process

management are "strategic" in designing work system when they are targeting into different group of customer and under different institutional arrangement such as country system (Holman, et. al., 2009; Locke and Thelen, 1995; Locke et. al., 1995; Littler, 1982; Rubery, 1978).<sup>16</sup> Therefore, instead of reducing OHS occurrence, this kind of management could increase the OHS occurrence.<sup>17</sup>

Different countries also modifying their own production models and work system under the global crisis and increasingly competitions. For example, during the 1980s, a core element of the German model debate is the concept of diversified quality production (DQP). The DQP calls for the diversification of product range, aiming at non-price competitive market segments and organizing production on the basis of skilled labour (J ürgens, 2004). However, this high cost – skilled labour model has been challenged by the global financial crisis and have not been changed according to the increasingly global competition even a new approach has been adopted. Schumann (1997) described the new approaches the German automobile industry developed during the crisis in mid 2000 regarding the product strategy, production concepts, work organization, industrial relations and technology.

The introduction of "team concepts and groupwork" has been considered to be the most important innovations in increasing efficiency. There are two fundamentally different approaches to team work. The concept of 'structurally conservative groupwork' is a more or less modernized version of Taylorism. The job descriptions of production workers remain narrow, there is not much work autonomy and nor professionalization. By contrast, 'structurally innovative groupwork' builds on the specific assets of the German industrial

Theory looks at how people work, who controls their work, what "skills" they use in work, and how they are paid for work. The Labour Process Theory is a late Marxist theory of the organization of work under Fordist labour management and production techniques in manufacturing. It critiques scientific management as authored by Frederick W Taylor in the early 1900s, and explains the changing workers' bargaining power under contemporary globalized production system. Braverman (1974) has developed into a broader set of interventions and texts linked to critiquing new forms of management strategy of an exploitative nature. Indeed, Braverman (1974) studies also coincided with the Autonomist Marxist theory in Italy which paid similar attention to the factory floor.

<sup>&</sup>lt;sup>15</sup> According to the labor process theory, for profit maximization, monopoly Capital deskills labor through very small processes of work, such as the Fordist labour management and production techniques in manufacturing in LDCs. By doing so, the capitalise reduces the pleasurable nature of work and the power workers have through controlling skill, while cutting their wages by reducing their wages to those of unskilled workers and increasing the amount of exertion required from workers. The direct results of this deskilling process could be, on one hand, increase the psychological pressure or frustrations at work; on the other hand, this production process also increase likelihood or OHS incidents because of increasing monotonous of work and pressure of wage. However, other researchers have criticised his "deskilling" thesis as not universal (Chakowski and Slotsve, 1992).

<sup>&</sup>lt;sup>16</sup> Littler (1982) put together a three level frame, the employment relationship, the structure of control and job design, in understanding the labor relations; Rubery (1978) has emphasized the role of state in shaping the labor relations. Locke and Thelen (1995) have advocated contextualized Comparisons in muti-level cross country analysis of comparative labor study because international force is not translated into all countries in the same degree and to all levels. Locke et. al. (1995) further emphasize the comparative labor relations into the firm-level competitive strategies on employment practices, from employer, government and labour organizations' responses to international market and technological changes.

<sup>&</sup>lt;sup>17</sup> Using an employee survey data from a single Canadian firm about the changes on work practices and job dimensions as a consequence of the introduction of new production technologies, Chakowski and Slotsve (1992) show that modernization resulted in the creation of new jobs, while many previous tasks were either made redundant or altered; however, they found no evidence to suggest that deskilling had occurred.

order: the tradition of craft work (Facharbeiter), the strong focus on qualified, self-directed work, and the consensus orientation in the field of industrial relations. Perhaps, while the producers face direct price competition globally might have adopted the model closer to the 'structurally conservative groupwork' model, only the more luxury brand names that allow for more expenditure spend on "skilled labor" have been using a model closer to the craft work model. Similar, Wergin (2003), after studied the teamwork production model in four automobile plants in Germany and Britain, argue that, instead of the a bi-polar production model is closer to a continuum type that, while moving away from traditional taylorist models of production, it does not over-come Taylorism altogether.

Another example is the changing production models in Japanese Automobile industry. J ürgens, Malsch, and Dohse (1994) also argued that the so-called "Japanisation" in production is indeed more about a form of industrial relations system institutions and new forms of control of labor by group and supervisor, instead of culture factor. The pressure from wage and from company atmosphere are consistent with the argument of "lean-and-mean" production that management use wage incentive and pressure in the workshop to press the workers' productivity to maximum level (Munakata, 1998; Zhang, 2008, 2011).

In addition to modifying the production line works and teamwork system, firms tended to increase productivities by increasing pressures in works that are not in production lines, so as to squeeze all the available workers' strength and time for productive activities. For example, in addition to the formal production lines, management may develop the taskflows that resemble to production in other noon production lines workers, the "assembly line build-in workers' head" that control the speed of work through pressures from team members and pressures from procedures (Taylor and Bain, 1999). As a result, Automobile industries' OHS problems could be increasingly challenging.

In this regard, management strategies and production models may have the strongest association with OHS number. In particular, psychological pressure has the strongest positive association with OHS number. This founding is consistent with researches in labor process that the "assembly line build-in workers' head" (Munakata, 1998; Taylor and Bain, 1999).

#### 2.2 Automobile assembly process and OHS

The assembly process consists of several distinct units each with their specific hazards. It is in the trimming section where upholstery and internal trim are fitted that demands the most monotonous hazardous movements that contribute from moderate to severe risk factors for musculoskeletal disorders.

As the lean production philosophy and organization restructuring came to be adopted by America firms in the 1980s and 1990s. Between 1980s and 1992 there was a general increase of occupational injuries. These findings discredited lean production managerial enthusiasts who argued that the new practice would lead to higher workers' autonomy and better OHS environment. Instead lean production intensified work place. A very telling example was that in the General Motors plant that used to have a real work time<sup>18</sup> cycle of 43 seconds per minute (i.e. leaving 17 seconds of down time per minute), after the plant because a joint venture with Toyota (called NUMMI, short for New United Motors Manufacturing Inc.), the real time was increased to 55 seconds leaving workers almost no down time to recuperate the pressure to catch-up (Askenazy, 2001).<sup>19</sup>

A detailed longitudinal study of lean production on Canadian auto workers in the early 1990s showed that after initially thinking lean production could improve work life, they became disillusioned after a few years (Rinehart and Robertson, 1997).<sup>20</sup> Team production, which was said to give workers more autonomy and task rotation, actually increased musculoskeletal disorders due to work intensification. The lean philosophy of cutting waste to combat global competition demanded longer work hours, longer and irregular shifts and speedups that are all conducive to putting more psychosocial and physical stress on workers. Outsourcing of some of the easier jobs that used to be given to older workers who begin showing signs of wear and tear are no longer easily available.

Furthermore, as industrial production is growing globalized, production models developed from companies' in different countries, such as the American "lean production" and Japanese "Just-in-time" production model. However, as increasingly FDI and globalizing competition, Automobile MNCs have started to learn from each other's the "best practices" since the 1980s (Ikeda, 1988; Munakata, 1998).<sup>21</sup>

As MNCs are learning from their counterparts for "best practices," little is known about the extent to which localization of these practices to the host countries and the relations

<sup>&</sup>lt;sup>18</sup> Real work time means within the minute that is allocated for a particular task or set of tasks, the worker has to work for 43 seconds, leaving him 17 seconds of down time to take a short break. If the real work time is close to 60 seconds the worker will be near impossible.

<sup>&</sup>lt;sup>19</sup> Frazer et. al. (2003) using simulations of realistic rotations between two jobs to show that workers in low demand jobs who rotate into higher demand jobs experience a linear increase in reporting probability under the Time Weighted Average (TWA) approach. The increase was greater for those who rotated into the demanding job compared to the reduction experienced by those who rotated out of the demanding job.

<sup>&</sup>lt;sup>20</sup> James Rinehart, C. H., and David Robertson (1997). <u>Just Another Factory? Lean Production and Its</u> <u>Discontents</u>. Ithaca, ILR Press, Cornell University Press.

<sup>&</sup>lt;sup>21</sup> Ikeda (1988) show that due to strong Yan and global competitions, Japanese Auto makers have to cut cost and develop new subcontracting system and overseas manufacturing bases. Munakata (1998) documented the history that western companies, particularly, the US companies have paid serious attention to the "Japanese model" to restore their competitive poser since 1980s.

OHS; therefore, it is of our interest to compare and to test the impacts to OHS from different ownership joint-ventures in China.

# **3** Current situation of China's Automotive Industry

In the past one and half decades China has become a big player in global passenger car manufacturing, from producing only under half a million passenger cars in 1998 to almost 14 million in 2011 (the respective output was 6m down to 2.2m in the USA and 8.5m to 8.3m in Japan).<sup>22</sup> As yet, China's ability to make world-class cars remains reliant on technology transferred from mainly American, European and Japanese big auto companies.<sup>23</sup> These joint venture models dominate the Chinese car market because consumers trust foreign technology more than Chinese technology. The foreign partners of these joint ventures, having adopted and adapted to lean production practices in their home plants, have all introduced their latest production platforms and lean production practices to their Chinese joint ventures. Under pressure from the Chinese government to use the latest technology these joint ventures tend to be state of the art facilities built on greenfield sites.

[Figure 1 about here]



Figure 1: Passenger Car Production in China 1997-2011

Note: 2011: China 14m; USA 8.5m; Japan 8.3m

 $<sup>^{22}</sup>$  Harwit (2001) also noticed that the exisiting automobile firms were concerning about the survival problems followed by the tariff reduction and competition after China entering WTO.

<sup>&</sup>lt;sup>23</sup> See the review of the Auto-component Supply Chain in China and India in Sutton (2004).

#### Source:

The hardware, so to speak, is first class. Some shopfloors we visited are replete with shiny floors and pot plants. Compared to a dirty, dark and dilapidated Chinese state owned auto plant we visited in the early 1990s and a few state owned auto plants two years ago, China has entered the world of industrial modernity. The contrast is like night and day. One has to reread the decrepit conditions of Beijing Jeep described by Jim Mann in the early 1980s to appreciate the improvements since the days when American Motors set up the first automotive joint venture in China (Mann, 1989). Today paint shops in joint venture plants use the latest technology and have greatly reduced the hazard of toxic fume exposure. Welding, which used to be one of the most dangerous and hazardous manual tasks is now generally highly automated needing only a small number of workers. Some shopfloors appear almost deserted. Despite Chinese labour being still cheap by developed country standards, automation and robotization can standardize and raise quality and disappearance of some heavy lifting has greatly helped to reduce back injuries.

So that is the hardware. How about software like work hours, shifts, rest time, length of work cycles, etc? The arrival of lean production practices has cancelled out some of the improvements in hardware as in the mother plants of the joint ventures. But we should bear in mind that in the US and Canada, at one time the unions were relatively strong and was able to negotiate against excessive speedups, advocate for ergonomics improvement and reduce risk exposure. This legacy still exists to a certain extent. Unions still act as a kind of brake to placing excessive demands on workers despite conditions having been eroded in the past two decades. But in China where the All China Federation of Trade Unions (ACFTU) is part of management, workers do not have a strong institution to advocate on their behalf. Despite the modern hardware, speedups and short work cycles are unavoidable and there is no workers' representation to confront an worsening in work conditions. If in the US and in Europe their trade unions could no longer hold the line against degeneration of work conditions and pay as they were able to previously, one can only imagine what the situation is like in China.

In term of adaptation of foreign production model and management, China has got through a non-linear development paths. Noble, Ravenhill, and Doner (2005) reviewed the development of the automobile joint ventures in China and argue that the initial development was not very successful, exception of two investments by Volkswagen. Until China entered WTO in 2009, the lower tariff, de-nationalization of automobile industry, inexpensive local parts and assembly and more competitive industrial policies provide conditions for its industrial development. However, the managerial boundary between the local and foreign management has been continuously reshaping over the course of development (Taylor, 1995; Hoon–Halbauera, 1999), as will be discussed below.<sup>24</sup>

<sup>&</sup>lt;sup>24</sup> Hoon–Halbauera (1999), after the field works on the managerial problems of two leading JV pioneers in China, Shanghai Volkswagen Automotive Company Ltd. (SVW) and Beijing Jeep Corp. (BJC), argues that the managerial dynamics between Chinese and foreign mangers can be summarized in three principle managerial relationships: 1) between two/more parents; 2) between parents and the venture; and 3) between two groups of staff.

## 3.1 nonlinear localization of assembly process in china:

Some researches also find that the paths of localization are slow and incomplete. utilizes data gathered from a variety of Japanese, Korean, Hong Kong, and European ventures in China, Gamble (2000) suggested that localization is likely to proceed at a much slower pace than its main advocates may wish or anticipate, and that there are practical, cultural, and strategic factors which may, and perhaps should, inhibit rapid localization. Such factors range from the lack of suitably qualified local managers, to control and surveillance functions and expatriates' roles as trainers, co-ordinators, and relatively neutral 'outsiders'. Among other factors, norm and cultural factors are usually highlights as one of the most important factors for a successful adaptation of foreign models (Chen and Francesco, 2000; Depner and Bathelt, 2005; Gamble, 2000, J ürgens, Malsch, and Dohse, 1994).

In term of the adaptation of foreign model of production and managerial strategy, Taylor's (2001) field work show that first, that, despite claims of cultural similarity between China and Japan, personnel management practices were generally not transferred from Japan to the plants in China. Second, practices that may appear as Japanese inspired were often informed by local practices. Third, there was diversity in the forms of practices used, indicating neither sophistication nor a singular recipe of management methods. Thus, the paper seeks to challenge proponents of Japanization who claim, essentially, that Japanese management techniques are predicated on the construction of particular forms of social relations around work that allow sophisticated, and integrated, production-management systems to function. Instead, depending on a complex interrelation between location industry and the history of each plant, managers sought to use various local and 'universal' (generic to capitalism) strategies and practices to control and utilize labour. Furthermore, internal management issues may also matter; Hoon-Halbauera (1999) after investigated the Shanghai Volkswagen Automotive Company Ltd. (SVW) and Beijing Jeep Corp. (BJC) and suggests that the most of the managerial problems within the JVs are attributed to managerial relationships and human interaction. She suggests, in particular, Chinese managers within JVs would benefit from understanding the dynamics of these relationships.

As of the subcontracting system, Liu and Brookfield (2006) using an qualitative work based on visits to Toyota's China headquarters in Beijing and its technical center in Tianjin, Shanghai Koito Company, Sichuan Toyota, and Tianjin Toyota from 1995 to 2003, show that Japanese-affiliated enterprises in China are moving away from an insular, vertical subcontracting structure dominated by a single assembler. In the new subcontracting system, characteristic features – such as a broad customer base and localization – contrast with earlier features that included a substantial delegation of authority, regulated interfirm competition, and long-term relations (Scherrer, 1991; Chung, 1994).<sup>25</sup> This case shows the subcontracting system may be very different in China than in Japan. Furthermore, Fukao et. Al. (2007) used both quantitative and qualitative data to show that Japanese MNCs are less localized than the American counterparts in China. The reason beyond this issue is that Japanese MNCs tends not to choose subcontractors according to their current productivity but future productivity.

<sup>&</sup>lt;sup>25</sup> While Scherrer (1991) reviews the transformation of labor and suppliers relations in American automobile industry; Chung (1994) focuses on the changing subcontracting system in the JIT management approach in Korean and found that Korean assemblers would have gain potential for flexibility (in terms of qualifications, skills.

organization, etc.) in the differentiation of the subcontracting system.

Furthermore, governments from different levels in China may have different degree of control, regulations, and influence over the JVs across regions (Beamish and Wang, 1989; Gan, 2001; Wang, 2003). That makes the localization process even more complicated. For example, The government taskforces that look at the automobile JVs are the "automotive industrial groups;" the powers and limitations of these automotive industrial groups" are varied by city and by the nature of the JVs that links with different level of government. Their main function was to coordinate the suppliers to the main auto manufacturers in their jurisdiction, although JVs may have greater degree of financial and political independence than SOEs based on the joint venture laws (Lee, Chen, and Fujimoto, 1996; Harwit, 1992, 1995, 1996).<sup>26</sup>

Therefore, different degree of "hybridization" transformation process may have been development (Lane, 2000); in this regards, since the JVs may not fully adopted the MNCs' management practices, it will be important to understand the effects of different ownerships' JVs' effects on OHS. Indeed, few researches have been done on this issue.

# 4. Hypotheses

The hypotheses of the relations between the automobile assembly systems and OHS number could be in form of the following aspects:

1.If all different ownerships have successfully learn from each other and the localization of production modes were completed, we shall see few different effects of ownership on OHS occurrence. However, due to the fact that the different in origins of production model and degrees in localization and "hybridization" of management practices, different ownerships' JVs might have very different effects to OHS occurrence, in additions to the following common practices' effects. Similarly, due to different levels governments' influences and partnerships, regional variations in OHS may be high.

2. labor contract type and duration to control the worker's incentive to work may be matter with the occurrence of OHS. That is, the fixed term contract are usually given to the workers at a lower level, who may face higher risk of OHS occurrence before they qualify to be a higher level contract, after two consecutive fixed term contract. Therefore, higher OHS number may positively associated with fixed term contract.

3. The work system and production line, according to the discussions before, may use different shift system to control workers for profit maximization; therefore, with work on production line or more shift in a work plan may result in higher OHS number. In this regard, workers with work on production line or with three, higher, shift system may have higher OHS number than others, day shift and two shift.

<sup>&</sup>lt;sup>26</sup> For example, under the system of "Big Three, Small Three & Mini Two," Joint Ventures under different level of Government. For example, First Auto Works (FAW)-VW and Shenlong (with Citroen) are directly under the auspices of central government. Shanghai-VW and Small Three –Beijing Jeep (with Chrysler), Tianjin Daihatsu and Guangzhou Peugeot are controlled by the local governments. The Mini Two—Chang'an Suzuki and Guizhou Air (with Fuji Heavy Industries) are under the administration of Ministry of Aviation and Spaceflight. Therefore, joint ventures' management may have influence by the related government. For example, the Shanghai government has positioned the auto industry as the city's "first leading industry", and has strong support to Shanghai-VW (Lee, Chen, and Fujimoto, 1996).

4. Furthermore, work pressures could be generated intentionally by factories in order to stimulate workers to work faster for more profit through generating. These work pressures could be from different dimensions, such as pressure from colleagues, leader, work speed, wage, company environment, psychological pressure from work could be generated under this labor process. It is logical to expect that with the present of work pressure, workers may force to work faster than their limit and may cause higher injury rate.

5. Similar, the OHS number generated from factory work may also affected workers satisfaction of their overall assessment of the company (Chen and Francesco, 2000; Yu and Egri, 2005).<sup>27</sup> In more detail, we can also look at their satisfactory score at work condition, income, working hours, job prospect, and their expected work life (work until 40 in the factory). The hypothesis could be that OSH number may be inversely related to workers' satisfaction scores. Alternatively, this set of variable could serves as a robustness check of the workers' self-reported OSH number since, if workers miss-reported their OSH number because of their discomposure with the company, we shall see positive correlations between OSH number and the assessment scores. Furthermore, this set subjective score variables can serve as a robustness check of workers' answers' subjectivity; that is, if the incorporations of this set of subjective score variables could reduce the relationship between dependent and covariances above, the above estimated relationship may be related to subjective projection of worker's view instead of an objective report.

#### 5. The Survey

A randomized sample survey at factory level was conducted in July and August 2011 outside 12 automobile assembly plants of various types of ownership--joint ventures, stateowned and domestic private. These are geographically spread over seven cities (Beijing, Guangzhou, Tianjing, Zhuzhou, Shanhai, Yantai, Shenzhen). The joint ventures include German, Japan, Korean and American partners, all major automobile companies. There are more joint ventures in our sample than state owned and domestic private plants. This is because one of the intensions of the project was to compare work condition variations among major foreign partners. Also, because of the Central Government's policy since the later 1990s, most of original automobile SOEs producers have formed the joint-venture companies with foreign producers; with this limitation, we are able to survey two state and two private companies in this study.

<sup>&</sup>lt;sup>27</sup> Chen and Francesco (2000) show that Personalism and guanxi (personal relation network) has a positive effect on Chinese employees' commitment to organization. Yu and Egri (2005) show that JV employee satisfaction with their organization's recruitment, compensation, and job security practices was positively related to affective commitment.

#### 5.1 Basic information of the surveyed workers in the sampled auto plants

In addition to the survey, the research team were able to enter five plants to conduct some brief interviews with management. because of sensitivity of this study, we do not contact the management teams of the plants in this study. Also, the have precise information on the size and profile of the workforce of all the plants, nor the distribution of the population in the various departments because this information is not available to public or to general workers in the factories. The survey therefore had to use a simple random method of surveying about 100 fulltime workers outside each plant while taking care that all major departments were covered in rough proportion to the normal size of the departments. This enables us to make cross plant comparisons.

A potential bias in the sample is the higher proportion of young and junior assembly line workers to older and more senior workers than the ratio in the population. This was due to differences in accessibility. More senior level workers usually drive to work in their own cars bought at a discount under company in-house purchasing policy, making it impossible for surveyors to approach them as they drive out of the factory gate. Younger and junior workers either go home in company buses or take public transport and are therefore more easily approachable by the surveyors at bus stops and inside buses. Many single and young workers also live in company dormitories or private housing near the plants offering settings that are more open to surveyors. Fortunately, we believe this bias does not constitute a big problem as our focus is on injuries of lower level assembly line workers who are young and junior.

We collected 1091 valid questionnaires. Due to the astronomical expansion of the industry in one decade and in greenfield sites the workforce is very young compared to the auto workforce of the developed world. The average age is 24 years old which by international standards is a very young workforce. 97% of them are male; 16% are married and 12% have children. 80% of them have been working in their respective plants for three years or less. About 60% are either graduates from vocational, technical schools or tertiary technical colleges with the rest either hold high school diplomas or university degrees. For 60% the present job is their first job. Being so young, the vast majority have little idea of what work conditions were like in the Maoist period or in economic transition period of the 1980s. This means that they have no means to compare the past when the pace of work was much slower in state enterprises and the present when work cycles are timed by the seconds. In Beijing Jeep, for instance, in 2004, when one of us visited the plant the work cycle was 4 minutes. After Mercedes-Benz took over the foreign partnership and built a new plant in a new greenfield site south of Beijing, some of the workers came over, but only a small number of these veteran workers are still there today. Most of them either are retired or promoted to supervisory positions. The young recruits have no comparative perspective of, say, what is the acceptable speed of the assembly, or what alternatives are there to their current work conditions. Understandably, apart from the availability of space, companies generally prefer to set up plants on greenfield sites and hire new workers who do not need to unlearn "bad" habits, as Canadian workers had done in the early 1990s. When they began to realize that lean

production was more demanding than Fordism they went on strike.<sup>28</sup> The Chinese auto workforce in general in contrast is quite compliant.

Among the sampled workers there were 720 contract worker and 371 dispatch workers hired through labor agencies. A minority of the twelve plants, such as GZJ#1, wants only a stable workforce and does not hire dispatch workers. SZP located in Shenzhen, a city where migrant workers are readily available, also does not have to hire dispatch worker migrant workers can be treated just casually. Most regular workers in the sample have signed three or five year contracts, whereas dispatch workers have one or two year contracts. In year 2011 at the time of the survey, German American and Japanese joint venture passenger cars were having roaring sales in China. A few of them have plans to build new plants and therefore need to keep the labor turnover rate low.

[Table 1 about here]

Acronym	Regional	Ownership	Number of workers questionnaires
SHV	SH	JV	98
SHG	SH	JV	110
YTG	YT	JV	76
GZH	GZ	JV	118
GZT	GZ	JV	113
BJ B	BJ	JV	71
ВЈ Н	BJ	JV	116
ТЈ Т	TJ	JV	86
TJ F	TJ	State	50
TJ X	TJ	Private	33
ZZ B	ZZ	State	88
GZB	SZ	Private	132
Total			1091

# Table 1: Sampled Plants, Location and Ownership, and Sample Size

<sup>&</sup>lt;sup>28</sup> Op.cit. Rinehart.

# 6. Methodology:

In order to test the hypotheses stated above, since our dataset is a clustered random sampling survey data, we needs to employ clustered regression with fixed effects model using ownership, factory's city, and factory respectively in various models to obtain robust estimations. The other advantage of the clustered regression with fixed effects model can is that it can look allow for intra-factory corrections in the model that could produce more vigorous results. However, since we have only one survey data, all we can estimate here is about the correlations between covariances.

The specification of equation is as follow:

OHS number = demographic variables + ownership dummies + regional dummies + work history information + labor contract information + work system information + work pressures + job satisfaction scores

Variable description and summary of statistics:

Using our survey data, we generate indices on each set of variables described above.

Our dependent variable is OSH number which is the sum of the number of OHS injuries reported by workers. There are thirteen OHS injuries including: psychological system, ear, throat, shoulder, abdominal region, forearm/wrist, knee, neck, arm, back, hand and fingers, feet, others, as shown in Table 2.

[Table 2 about here]

OHS problem	NO		YES		% of total OHS	Total
	Frequency	%	Frequency	%	%	Frequency
Ear	905	82.95	186	17.05	6.77	1091
Neck	857	78.55	234	21.45	8.51	1091
Throat	936	85.79	155	14.21	5.64	1091
Shoulder	872	79.93	219	20.07	7.97	1091
Arm	881	80.75	210	19.25	7.64	1091
Back	711	65.17	380	34.83	13.82	1091
Abdominal	1037	95.05	54	4.95	1.96	1091
Forearm/wrist	875	80.2	216	19.8	7.86	1091
Knee	883	80.93	208	19.07	7.57	1091
Hand and fingers	781	71.59	310	28.41	11.28	1091
Feet	771	70.67	320	29.33	11.64	1091
Psychological	877	80.38	214	19.62	7.78	1091
Others	1048	96.06	43	3.94	1.56	1091
Total number of re	eport OHS		2749			

Table 2: Reported Occupational Health and Safety Problems

Demographic variables are used as the control variables here. The variables include: gender, education year, marital status, age, and hukou status.

Ownership variables noted the assembly plants' original ownership, using American MNCs as a base. The reason to use American as a base because they are named to be one of the classic "lean and mean" productions. This mean any firms that is higher/lower than this base can be regarded as higher/lower than the classic "lean and mean" production.

We also include the regional variables because different JVs would have very different relationships with different level of governments. Therefore we expect high regional variation. We use GZ as a base because it has recently outbreak of labor strike in the area.

The work related information includes: work year, factory year, and production line work or not, and regular worker or not. These information are considered to be positively correlated with the occurrence of OHS because as worker get older, more OHS may be occurred. Similarly, production line works, as theoretical predictions that would be more closely related to OHS occurrence. One important variable here is the worker is a regular worker or a dispatched worker. As the theory and hypothesis predicted that factories utilize dispatched workers in their "flexible production" and may cause higher OHS than regular workers.

Similarly, we also document labor contract information to investigate if factories would utilize labor contract to push worker to work harder and cause higher OHS. Labor contract information includes: contract year, type of contract, and contract in hand. We would expect employers, instead of using dispatched workers who are not necessary very tractable, may use the fixed term contract worker who would need to work much harder than those indefinite contract workers to earn another contract offer from their employers; therefore more OHS would be expected. Similarly, if the worker would have contract in their hand, they would know better about their legal rights and would have less likely to suffer from high OHS.

As discussed in the literature review and hypothesis that employers may use the work system to control workers and may cause higher OHS. To investigate work system relations with OHS, we therefore use work information below: we expect higher average daily working hour and longer working hour in a day may associate positively with OHS, while less often change shift and more rest days in a week could associate negatively with OHS.

Since management may use work pressures to push workers' productivities, we, therefore, expect work pressures may have positive association with OHS. However, little is known as to the kind of work pressures that may be associated with OHS positively. This study perhaps is one of the few systematic study to look at this pair of relationship. To be specific, we use the following variables to measure work pressures: time (days) needs to be skilled, enough manpower at team, work monotonous, pressures from fellow workers, from group and leaders, from speed, from wage, from company atmosphere, and if worker could catch up with work speed.

For the robustness check, we use the Job satisfaction scores to evaluate the extent to which workers reports could be influence by their subjective feelings. We use not only the "overall work situation score" but also more detailed breakdown of subjective scores: work condition score, income score, working hour score, job prospect score, and if workers can work until 40 years old.

# [Table 3 about here]

#### Table 3: Variable Definition and Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
overall OHS number	1091	2.52	2.51	0	13
regular worker: (1=yes)	1091	0.66	0.47	0	1
Demographic variables:					
gender: (1=male)	1090	1.03	0.16	1	2
education year: (year)	1091	13.51	1.78	9	18
marital status: (1=married)	1090	0.16	0.37	0	1
age: (year)	1089	23.95	4.37	16	54
hukou (2=rural)	1090	1.51	0.50	1	2
working year: (year)	1085	4.19	4.02	0.08	33
work year in this factory: (year)	1091	2.89	2.95	0.08	27
Production line (2=yes)	1091	1.73	0.44	1	2
Current contract information:					
contract year: (year)	1063	2.92	4.36	0.5	100
type of contract (2=indefined term)	1082	1.04	0.19	1	2
contract in hand (2=yes)	1088	1.87	0.33	1	2
Work system:					
dayshift system (1=day,2=2 shifts,3= 3 shifts)	1087	1.83	0.50	1	3
average daily working hour: (hour)	1083	9.24	1.46	4.1	15
how often change shift (day)	1069	6.74	6.17	0	60
rest days in a week: (day)	1085	1.74	0.65	0	8
longest working hour in a day: (hour)	1082	11.19	2.03	8	24
Pressures from work:					
time needs to be skilled: (day)	1077	25.46	63.08	0	1000
enough manpower at team. (1–very few, 2–rew, 3–enough, 4– more man enough)	1091	2.55	0.68	1	4
work monotonous: (1=very, 2=somewhat, 3=not monoton, 4=interesting)	1088	1.99	0.80	1	4
pressure from fellow workers: (1=never, 2=sometime, 3=usually, 4=always)	1090	1.50	0.68	1	4
pressure from group and leaders: (1=never, 2=sometime, 3=usually, 4=always)	1081	1.71	0.79	1	4
pressure from speed: (1=never, 2=sometime, 3=usually, 4=always)	1090	1.80	0.83	1	4
pressure from wage: (1=never, 2=sometime, 3=usually, 4=always) pressure from company atmosphere: (1=never, 2=sometime, 3=usually,	1090	1.91	0.93	1	4
4=always)	1090	1.65	0.80	1	4
catch up with work speed: (1=never, 2=sometime, 3=usually, 4=always)	1089	3.69	0.61	1	4
Subjective score of factory conditions:					
overall work situation score: (0=worst, 60=pass, 100=perfect)	1091	70.36	15.54	0	100
work condition score: (0=worst, 60=pass, 100=perfect)	1091	65.78	19.49	0	100
income score: (0=worst, 60=pass, 100=perfect)	1090	63.81	19.78	0	100
working hour score: (0=worst, 60=pass, 100=perfect)	1090	64.91	22.95	0	100

job prospect score: (0=worst, 60=pass, 100=perfect)	1087	56.90	26.46	0	100
can work until 40 years old: NO vs unsure: (-1=NO, 0= not sure, 1=YES)	1088	-0.14	0.90	-1	1
Ownerships: 0=American, 1=Germany, 2=Japan, 3=Korea, 4=SOEs, 5=Private)	1091	2.32	1.65	0	5
Regional variation: 1=GZ, 2=BJ, 3=TJ, 4=ZZ, 5=SH, 6=YT, 7=SZ	1086	3.57	2.02	1	7

# 7. Results:

# [Table 4 about here]

Table 4: Clustered Regression of OHS and Factory Variables

	(1)	(2)	(3)
	Work	Contract + Work	Work
Set of variable added	history	system	pressures
Ownerships: base=American			
Germany	-2.02***	-2.08***	-1.69***
	(0.13)	(0.11)	(0.10)
Japan	1.45***	1.45***	0.67
	(0.47)	(0.48)	(0.65)
Korea	-1.64***	-2.43***	-1.88***
	(0.12)	(0.28)	(0.36)
Chinese SOE	1.04	1.11	0.36
	(0.67)	(0.83)	(1.02)
Chinese Private	0.41	-0.14	-0.94
Regional variation: base = $GZ$	(0.60)	(0.51)	(0.71)
BJ	2.56***	2.57***	1.73***
	(0.41)	(0.43)	(0.56)
TJ	-1.47***	-1.45***	-0.74***
	(0.23)	(0.26)	(0.21)
ZZ	-2.02***	-2.69***	-2.44***
	(0.19)	(0.33)	(0.43)
SH	2.56***	2.41***	1.51*
	(0.61)	(0.74)	(0.84)
YT	-0.79	-1.32*	-1.38*
	(0.69)	(0.68)	(0.73)
SZ	-0.11	-0.03	-0.01
Work history:	(0.25)	(0.43)	(0.40)
regular worker	-0.18	-0.15	-0.09
	(0.37)	(0.43)	(0.45)
work year	0.12***	0.10***	0.08**
	(0.03)	(0.03)	(0.03)
factory year	-0.02	-0.03	-0.04
-	(0.04)	(0.05)	(0.04)
Production line	0.36*	0.34*	0.19
Current contract information:	(0.19)	(0.19)	(0.15)
contract year		0.02	0.02
-		(0.01)	(0.01)

type of contract		-1.17**	-1.30**
		(0.48)	(0.56)
contract in hand		-0.47	-0.60
Work system:		(0.35)	(0.37)
day vs 2 shift		-0.09	-0.04
		(0.45)	(0.49)
day vs 3 shift		0.68	0.70
		(0.60)	(0.65)
average daily working hour		0.22**	0.18*
		(0.09)	(0.09)
how often change shift		-0.02	-0.02
		(0.02)	(0.02)
rest days in a week		-0.11	0.02
		(0.11)	(0.07)
longest working hour in a day		0.06	0.04
Pressures from work:		(0.05)	(0.04)
time (days) needs to be skilled			-0.00
			(0.00)
enough manpower at team			-0.04
			(0.07)
work monotonous			-0.27**
			(0.12)
pressure from fellow workers			-0.01
			(0.13)
pressure from group and leaders			0.22*
			(0.11)
pressure from speed			0.21
			(0.16)
pressure from wage			0.34***
			(0.11)
pressure from company atmosphere			0.32***
			(0.11)
catch up with work speed			-0.21*
			(0.11)
constant	2.01	1.73	3.53**
	(1.71)	(1.49)	(1.49)
R-squared	0.20	0.21	0.30
dfres	11	11	11
BIC	4848.0	4456.7	4259.5
Number of observation	1075	997	977

Note: Standard Errors are in the parentheses.

\* significant at 10% level; \*\* significant at 5% level; \*\*\* significant at 1% level. Control variables: gender, education year, marital status,

age, hukou

We will add sets of variables incrementally at Table 4, starting from the Column 1, the basic model. The purpose of adding the covariances at the regressions is to see the changes of the variables' significant level when other variables are introduced. In general, when the original significant level reduced after the introduction of additional variables means some of the explanatory powers of the original variables have been shared by the additional variables. In general, we will keep comparing the new regression with the one before and discuss the results.

The first set of variable included in Column one of Table 4 is the average ownership different in OHS occurrence, using American ownership as a base for comparison. We found, after control for demographic variables, Germany and Korean JVs have significantly less OHS that compare to American JVs Germany JVs and Korean JVs have 2.02 and 1.64 less OHS in average. While Japanese JVs have significantly (1.45) more OHS in initial models, it turns to be insignificant when subjective evaluation of factory conditions have introduced to the model; that suggests the reasons of higher OHS at Japanese JVs were at least partially related to pressures at work. Chinese SOEs and Private, however, are not significantly different from the American JVs; that may due to their system similarity to the American model.

Second, regional variations are also very high, using GZ as a base, we discovered that BJ (2.56) and SH (2.56) have higher OSH rate; but YT does not have any significant different. Three places, SZ, TJ, and ZZ have significantly less OSH may be because of the fact that the JVs there were newly established (ZZ) or restructured (TJ). The case of SZ, however, is not robust, as you will see at column two that it negative effects turns to not significant when more variables are introduced to the model momentary.

While we add the third set of variable, work history information, we found, first, working year and production line workers are positively related to OHS number, in which, one additional year in working year associated with 0.12 OHS number increment. Also, production line workers are in average have 0.36 OHS number than otherwise. However the significance of these variables will turn to be insignificant when other variables added later.

Another important observation in this set of work related information is that we found that the conversational claims that "the use of flexible workers such as agency work may cause more exploitation to those temporary workers" does not seems to be the case in our study. After control for other variables, we found no different in OHS occurrence between the two worker types: the factory direct employee and agency contract. This suggests the used of and conditions of temporary workers may be vary very differently among different factories. This, however, does not mean that factories will not use measures to press workers and lead to higher OHS, as we will show below. This result may also suggests that the boundary between the factory direct employee and agency workers has been blurred because more younger workers jointed the factory under the new contract arrangement and the work system might have pressure to all kind of worker regardless, as will be show below. For example, one factory in SZ does not have agency workers, while another factory in TJ used mostly agency workers. However, factories may use the terms in contract to squeeze workers to

work at maximum capacity so as to retain their position at the factory, as below results in contract information will be showed.

Column 2 of Table 4 added the current labor contract information. The results show that better labor contract could not be able to protect workers from OHS problems. However, these results will be revised when more covariances added later. For example, as the work system variables added to Column 3 of Table 2, indefinite term workers are generally have 1.16 less OHS than those who are in fixed term contract.

Another interesting observation at Column 2 of Table 4, we found factories instead of using the so-called "flexibility work", they may manipulate the term of contract to control workers work intensity. It is because labor contract could be able to protect workers from OHS problems if the term is good and properly enforced. To look at the issues from another angle, we found that comparing to fixed term contract workers, indefinite term contract workers, in average, have 1.17 less OHS. However, we find no evident that having the labor contract in hand will be helpful for worker to reduce OHS. It may be because of the fact that the contract content information could be easily available by workers' request for protection and compensations. In this regards, the "flexibility" of work could be in terms of contract type; that makes a different in protecting workers from OSH problems. These observations are consistent with the labor process that management may use the pressure of work to put worker to work faster and may case higher incident of OSH.

Furthermore, at column 3 of Table 4 also show that one additional average working hour per day could associate with 0.18 more OSH number. That suggests, no matter the shift system or working pattern, daily working hour is the most important to OHS occurrence.

After introduced a set of work pressure variables at column 3 of Table 4, we found that pressure from group and leaders, pressure from wage, pressure from company atmosphere, and have positively significant relations with OHS number; that means, everything being equal, in average, workers who feels pressure from group and leaders or feels pressure from wage will have 0.20 more OHS, while those feels pressure from wage and company atmosphere might have 0.28 and 0.27 more OHS, respectively; more importantly, workers who feel catch up with work speed and less monotonous in work may have less OHS than not!

In this regression, we also find that if works are interesting (not monotonous), the likelihood of having OHS is reduced; each level of increment of interesting level of work will be associated with 0.27 less OHS. However, this variable's significant effect will be vanished when subjective scores introduced in the model at Table 5 below. That suggests this variable may be associated with the subjective scores.

One interesting note is that, after the introduction of pressure variables, the explanatory power of Japanese JVs and production line works have disappeared. This change may means the relationship of OHS is originally comes from the pressure of work that transit through production line works that may also particularly relate to Japanese JVs.

# 7.1 Robustness Check: are subjective feelings of workers affect the results?

# [Table 5 about here]

Table 5:	Clustered 1	Regression of	OHS,	Factory	Variables,	and S	Subjective	evaluation	score

	(4)	(5)	(6)	(7)
~	overall subjective	detail subjective	work until 40 years	factory
et of variable added	score	score	old	dummies
wherships: base=American				
Germany	-1.69***	-1.75***	-1.82***	
	(0.10)	(0.11)	(0.10)	
apan	0.64	0.29	0.14	
	(0.63)	(0.58)	(0.60)	
lorea	-1.87***	-1.98***	-2.10***	
	(0.35)	(0.39)	(0.37)	
hinese SOE	0.32	-0.13	-0.15	
	(1.00)	(0.94)	(0.93)	
hinese Private	-0.99	-1.26	-1.45	
egional variation: base = GZ	(0.69)	(0.73)	(0.73)	
J	1.67***	1.33***	1.24***	
	(0.53)	(0.43)	(0.43)	
J	-0.75***	-0.86***	-0.95***	
	(0.20)	(0.17)	(0.16)	
Z	-2.47***	-2.37***	-2.53***	
	(0.44)	(0.31)	(0.30)	
Н	1.48*	1.15*	1.14*	
	(0.82)	(0.61)	(0.59)	
Т	-1.40*	-1.59**	-1.75***	
	(0.71)	(0.62)	(0.61)	
Z	-0.03	-0.16	-0.18	
/ork history:	(0.38)	(0.37)	(0.37)	
gular worker	-0.07	-0.06	-0.04	-0.09
-	(0.46)	(0.43)	(0.42)	(0.45)
ork year	0.08**	0.07*	0.08*	0.08**
•	(0.03)	(0.04)	(0.04)	(0.04)
actory year	-0.04	-0.03	-0.03	-0.03
	(0.04)	(0.04)	(0.04)	(0.04)
roduction line	0.20	0.25	0.21	0.23
urrent contract information:	(0.15)	(0.17)	(0.16)	(0.17)
ontract year	0.01	0.01	0.01	0.01
· · · · · · · · · · · · · · · · · · ·	(0.01)	(0.01)	(0.01)	(0.01)
me of contract	-1 29**	-1.17**	-1.22**	-1 11**
Pe or contract	(0.55)	(0.55)	(0.55)	(0.50)
ontract in hand	-0.61	-0.57	-0.60	-0.57
	-0.01	(0.26)	(0.26)	(0.27)

day vs 2 shift	-0.05	-0.08	-0.07	-0.07
	(0.48)	(0.47)	(0.46)	(0.46)
day vs 3 shift	0.70	0.69	0.70	0.67
	(0.64)	(0.60)	(0.61)	(0.60)
average daily working hour	0.18*	0.13*	0.13	0.13
	(0.09)	(0.08)	(0.08)	(0.08)
how often change shift	-0.02	-0.01	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
rest days in a week	0.02	0.01	0.01	0.03
	(0.08)	(0.07)	(0.07)	(0.07)
longest working hour in a day	0.04	0.02	0.02	0.02
Pressures from work:	(0.04)	(0.04)	(0.04)	(0.04)
time (days) needs to be skilled	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
enough manpower at team	-0.04	0.00	0.02	0.02
	(0.07)	(0.08)	(0.08)	(0.08)
work monotonous	-0.24*	-0.18	-0.14	-0.14
	(0.12)	(0.11)	(0.11)	(0.10)
pressure from fellow workers	-0.01	-0.01	-0.02	-0.01
	(0.13)	(0.12)	(0.12)	(0.12)
pressure from group and leaders	0.21*	0.21**	0.21**	0.20*
	(0.11)	(0.10)	(0.10)	(0.10)
pressure from speed	0.21	0.20	0.21	0.19
	(0.15)	(0.16)	(0.16)	(0.16)
pressure from wage	0.33***	0.31***	0.29***	0.28***
	(0.12)	(0.10)	(0.10)	(0.10)
pressure from company atmosphere	0.32***	0.31***	0.30**	0.33***
	(0.11)	(0.11)	(0.11)	(0.11)
catch up with work speed	-0.21*	-0.20*	-0.17	-0.16
Subjective score of factory conditions:	(0.11)	(0.11)	(0.11)	(0.11)
overall work situation score	-0.00			
	(0.01)			
work condition score		0.00	0.00	0.01
		(0.01)	(0.01)	(0.01)
income score		-0.01	-0.01	-0.01
		(0.00)	(0.00)	(0.00)
working hour score		-0.01*	-0.01*	-0.01*
		(0.00)	(0.00)	(0.00)
job prospect score		-0.01	-0.00	-0.00
		(0.00)	(0.00)	(0.00)
can work until 40 years old: NO vs unsure			-0.17	-0.17
			(0.19)	(0.19)
can work until 40 years old: NO vs Yes			-0.46**	-0.48**
factory dummies: base BJ_Benz			(0.17)	(0.18)
BJH				-0.26
				(0.35)
GZH				0.81***
				(0.23)

GZT				0.60**
				(0.26)
SHG				1.72***
				(0.28)
SHW				-0.13
				(0.31)
SZB				-1.04***
				(0.32)
TJF				-0.61
				(0.57)
ТЈТ				-0.25
				(0.31)
TJX				-1.86***
				(0.45)
YTG				-1.19***
				(0.33)
ZZB				-2.13***
				(0.50)
constant	3.89**	4.92***	4.96***	4.15***
	(1.57)	(1.33)	(1.20)	(1.16)
R-squared	0.30	0.31	0.32	0.32
dfres	11	11	11	11
BIC	4258.4	4223.5	4216.3	4238.5
Number of observation	977	973	973	973

Note: Standard Errors are in the parentheses.

\* significant at 10% level; \*\* significant at 5% level; \*\*\* significant at 1% level.

Control variables: gender, education year, marital status, age, hukou

One of the criticisms of the validity of worker's survey is that the answers are "subjective" from workers' feeling; therefore, the results may not reflect the true situation.<sup>29</sup> As a robustness check for the influence of workers' subjectivity, Table 5 looks at correlations between OHS number and worker subjective evaluation of work situation, using the overall assessment score, ranging from 0 to 100. We further investigate this effect by decomposing the overall score into specific scores, such as, work conditions, income, working hours, and job prospects. Each individual score also ranges from 0 to 100. If the introduction of "subjective scores" would have significant changes of covariances' explanatory power, the workers' answers are highly correlated to workers' subjective feeling. Otherwise, the answers that workers reported are likely to be objective than subjective.

When we introduced the variable of "overall assessment score of workers' work condition" at Table 5 Column 1 and have shown that OHS number have literally no association with the variable. This result remains unchanged when we further use a set of

<sup>&</sup>lt;sup>29</sup> Some theorists may argue that the labor process is a subjective projection from labor; see review of the debate subjectivity in labor process theory at O'Doherty and Willmott (2001).

more detail assessment scores to replace the overall assessment score; all variables show no relations with the OSH. However, when we introduce a set of more detail subjective scores of work conditions such as the subjective score of working hour, it has significantly negative correlations with the OHS number, meaning that if workers evaluation score the working hours is high (or good) at the their factories, less OHS will be resulted. Interestingly enough, as the same time the significant association of average daily working hour, working year, and work monotonous with OHS has been vanished. This result may mean that the significant relationship with these variables might have elements of subjective reports by workers.

We further investigate the relationships between OSH number and the selfexpectation of worker will be able to work until 40 years old. The purpose of this analysis is to see if OSH may be related to workers' future expectation to stay in the factory. The interesting results is that for those workers answering "yes" would expect to have 0.46 OSH number less than those who answering "No," while the different in expected OSH between "unsure" and "No" are not significant. That gives a reasonable expectation that workers with OHS are less likely to stay in the factory until 40 years old, holding other variable constant. At the same time, the original significant negative relation of "catch up with work speed" and OHS is now insignificant. This result is reasonable because both of the variable: can work until 40 year old and catch up with work speed measuring very similar relationship with OHS; therefore, it is reasonable to see some of the significant relation at catch up with work speed reduced when the work until 40 years old is introduced. Also, this finding is consistent with Landau, et. al. (2008) that early retirement scheme has been introduced to avoid musculoskeletal problems arise.

Perhaps, we should pay particular attention to the factory's dummy variables, as measures of unexplained factory characteristics in the model. Using BJB, a German JV that produce luxury brand car that regards a more skilful work and better welfare, as baseline, we found that three factories, GZH, GZT, and SHG, have significantly higher average number of OHS than our baseline. In particular, SHG is the most serious case, with 1.63 OHS number in average higher than the baseline factory. Interestingly, SHW, another JV that originally from Germany as well, does not show any significant different to the baseline; one may infer that both of them may be similar in production model due to the same country of origin. Other three factories, BJH, TJF, and TJT does not have any significant different with the baseline as well, while TJX, YTG, and ZZB, show significantly lower average OSH than the baseline; in which, TJX has the lowest average OSH number, 1.85 average OHS number lower than the baseline. Since TJX, YTG, and ZZB are relatively new assembly plants; therefore the OHS cases may be much less than other more established plants. In overall sense, the effects of factory dummy variables are consistent with the ownership and place dummy variable we have used. However, we shall interpret the results careful since these dummy variables' coefficients just represent the unobservable or unmeasured variances with the dependent variables. In other words, a factory with higher/lower average OHS than the baseline does not means that the factory is in fact worse than the baseline. For example, ZZB and TJX have lower average OHS numbers because it is a new factory that just started their operation less

than a year ago of our survey. <sup>30</sup> That is, if we add the year of the factory in the model, the current result that ZZB and TJX has significantly lower OSH may be vanished. However, if there is not the case, one may infer that a factory may be worse than the other.

# 8 Conclusion and discussions:

Automobile industry has been named to be one of the highest OHS occurrence industries. As the automobile industry has been growing globalized, the OHS issues at the host countries have not been well understood. This issue is complicated because the original production models at the original countries would have been localized at the host countries with different rate and speed, due to government regulations, partnerships, local norm, and culture.

This study focus on OHS issues in automobile industries in China as it is one of the larger players in the industries. We develop one of the first and largest worker's survey at 12 passenger car production factories' from major automobile production centers at seven cities (Beijing, Guangzhou, Tianjing, Zhuzhou, Shanghai, Yantai, Shenzhen). We randomly surveyed around 100 workers from each factory between July and August 2011 outside 12 automobile assembly plants of various types of ownership-joint ventures, state-owned and domestic private. The joint ventures include major automobile companies from American, German, Japan, Korean, in addition to two State Owned and two Chinese private companies

The contribution of this study to the literature is that, first, we conducted a systematic workers' survey which is considered to be the largest of the kind in Chinese Automobile Industry. Second, by using rigorous statistical method, clustered regressions, we effectively compared the several important groups. We make clear the myth that regular workers are better off than dispatched workers; alternatively, management may use the contract conditions to put fixed term contract workers and may cause higher OHS than the indefinite term contract workers. We also clarify that ownerships and regional variations of OHS is high; that means different management mode and local authority may exist in influencing the OHS occurrence. Third, we illuminate the kind of work pressures may be strongly associated with OHS. In particular, we show that, among other pressure variables, pressure from group and leaders, pressure from wage, and pressure from company atmosphere are significant related to OHS, even control for subjective scores. In addition, high OSH incident may reduce the workers' expected work life. In sum, this study suggests that under the globalization of manufacturing system, although some companies' distinctive management style still exist, some practices on pressure to work are common to all companies.

Although the Chinese official union, ACFTU, have been accused as a rubber stamp in protecting labor rights, Chen and Chan (2004), using the national survey of employees of enterprises in manufacturing industry conducted in 1997 by the ACFTU, finds that the input of the trade union and the worker congress (SWRC) does have a significant impact on the

<sup>&</sup>lt;sup>30</sup> From our research record, ZZB just started the operation at early 2012, while TJX have just finished restructuring when we were conducting the survey at summer 2012.

protection of the workers' occupational health and safety. The possible solution to this issue is related to the ways to reflect labor voices about OHS to management collectively (Freeman and Medoff, 1984; Knights and Willmott (1990); Wray-Bliss, 2002).<sup>31</sup> Some further works along the line in other LDCs will be instrumental to consolidate the OHS predictions.

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<sup>&</sup>lt;sup>31</sup> Freeman and Medoff (1984) first bring the concept of collective voice in labor union research; Knights and Willmott (1990) argue that workers self-organization could be more effective in optimize production; Wray-Bliss (2002) putting voice as an important factor in labor process theory.

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