The role of intangible capital in wage inequality between skilled and unskilled workers in China

Qi Hong Dong, Michael S. Miller

(Department of Economics, DePaul University, Chicago IL 60604, USA)

Abstract: Wage inequality between skilled and unskilled workers has increased rapidly in China, right along with its major trading partner—the United States. Trade liberalization and technological improvement have been proposed as causes for the inequality, yet trade liberalization and technological improvement have set the stage for another, possibly more important, cause of the inequality: the movement of intangible capital to China. Intangible capital works synergistically with other inputs to make skilled-workers and tangible capital more valuable. Once the accumulated tangible capital reaches a certain level, its lower unit cost will attract the inflow of intangible capital, which will further expand the demand for skilled workers. As a result, wage inequality becomes larger in China. This paper takes the first step in an attempt to understand the role that the movement of intangible capital plays in the increasing wage inequality in China, and sets out several possible policy prescriptions for China to deal with this inequality.

Key words: intangible assets; skilled workers; wage inequality

1. Introduction

Data published by the World Bank[1] provide solid evidence that the Gini coefficient for China increased from 0.16 before the Economic Reform of 1978 to 0.47 presently, thirty years after the policy of economic openness was introduced. A coefficient of 0.47 is not only higher than the reading for all developed countries, but also exceeds the accepted "warning line" of 0.4. Only 29 countries' Gini coefficients are higher than China's, 27 of which are from Latin America and Africa. The remaining two countries are in Asia: Malaysia and Philippines. The causes of the gap between the rich and the poor in China are varied, and include wage inequalities between the urban and the rural workers, gender differences in compensation, regional differences in activities and productivity, and, importantly, the wage differentials between skilled and unskilled labor. This paper will focus on the skilled/unskilled differential.

Wage inequality between skilled and unskilled workers is common worldwide, Considering, for example, the growing gaps in both the United States and China. Fig. 1 plots the 90th, 50th and 10th percentiles of the overall wage distribution in the US for white male workers between 1963 and 1997 (with the 1963 values for all series indexed to 100).

Qi Hong Dong, associate professor of economics, Department of Economics, DePaul University; research fields: economics, international trade and policy.

Michael S. Miller, associate professor of economics, Department of Economics, DePaul University; research fields: economics, applied macroeconomics and policy.

[1] Source: World Bank. (2007b). *World Development Indicators*, CD-ROM. Washington, D.C. 2007/2008 Human Development Report.

In China, wage inequality increased at an average rate of 11% per year from 1997 to 2000 (LI & XU, 2003). Fig. 2 shows China's wage inequality for the period 1995-2000[2]. The ratio of skilled and unskilled wage increased from 1.17 (1995) to 1.64 (2000).

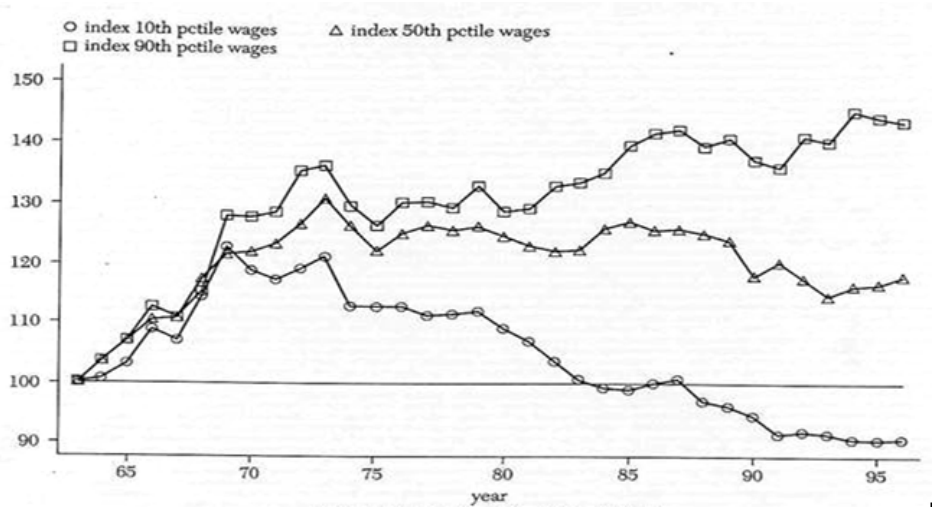

Fig. 1 Indexed wages for white males of the United States (1963-1997)

Data source: Acemoglu, D.. (2002). Technical change, inequality, and the labor market. *Journal of Economic Literature*, *40*(3), 7-72.

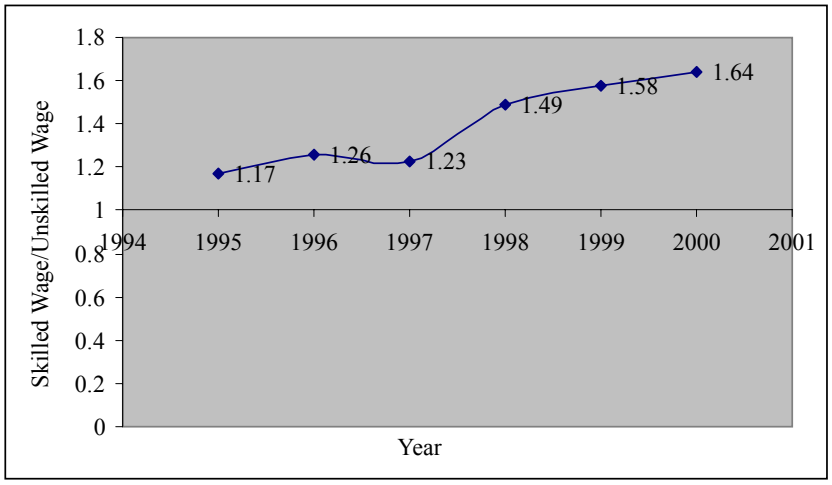

Fig. 2 China's wage inequality, 1995-2000

Data source: Based on a sample survey of 1500 firms published in *China Labor Statistical Yearbook*.

China has an abundance of unskilled labor while the United States has an abundance of skilled labor. If the conventional Heckscher-Ohlin theory holds, China should export unskilled-labor-intensive goods, while the United States should export skilled-labor-intensive goods. One result of this specialization should be a concurrent rise in the wages of unskilled workers in China (and thus a drop, not a rise, in wage inequality) and skilled workers in the United States. If the conventional Stolper-Samuelson theory holds, the relative price of skilled labor in the United States will increase as the relative price of skill-intensive goods increases (e.g., the price of

[2] Skilled-workers are defined as those with college education and above; Unskilled-workers are defined as those with junior middle school education and below.

computers rises relative to the price of apparel), but this does not happen, either. Also according to Rebezisky, when a country increases its capital endowment, more capital-intensive goods should be produced, but XU's (2003) empirical study of data from 14 developing countries finds when a developing country increases capital stock by trade liberalization, more skilled-labor-intensive goods have been produced. All these puzzles create skepticism as to whether the conventional theory is a valid explanation for the wage inequality.

One line of research argues that wage inequality is caused by trade liberalization, a "trade effect" if you will (Wood, 1994; Wood, 1995; Leamer, 1996; XU, 2003). Wood and Leamer point to the outsourcing of manufacturing jobs by developed countries. The resultant job losses of the unskilled workforce puts downward pressure on wages, adding to income spreads, yet this cannot explain the wage inequality in China as outsource only started in recent years. Bernard & Jenson (1997) note that trade liberalization expands the export sector, and after enough workers shift out of low-wage, non-exporting plants, the living standards of unskilled workers will increase and inequality may decline. They also find that the plants experiencing the greatest increase in relative nonproductive employment and earnings are precisely those that were engaged in exporting. The empirical work of Laurence and Slaught (1993) finds that goods produced by less skilled-workers result in the highest price increases, so output price movements due to trade liberalization cannot explain the wage movement.

Another line of research focuses on the inequality caused by technological improvement, called both the "technical effect" and the "catch-up effect". The increasing use of computers requires skilled workers and this change in demand increases the wage ratio between the skilled and unskilled. The authors agree with this explanation. The question is how skill-biased technical change will cause wage inequality between the skilled and unskilled workers. One of the authors' explanations is that within a short period, the supply of skilled-workers will increase but not increase in as large a proportion as demand, so wages for skilled-workers increase. This paper proposes we explain inequality by focusing on the role of intangible capital and its effects on the labor market and wages. Part 2 specifies the definition and roles of intangible capital. Part 3 sets out a four-factor model where wage inequality can theoretically be rooted in part to intangible capital, and the last part briefly comments on the conclusions the authors draw from the model and the policy implications of this study for China.

2. Defining the role of intangible capital

In the 1950s, economists separated labor into skilled and unskilled categories to solve the Leontief Paradox. The authors propose to separate capital into tangible and intangible capital to explain a portion of the shift in demand for skilled and unskilled workers. Companies generate profits both by selling physical products and capabilities, experience and expertise. The latter three are at the core of intangible capital. Berchan (1998) argues that companies often buy knowledge to help overcome challenges in their daily operations. For many firms, intangible capital is their most significant capital, becoming more valuable in the past 20 years than fixed capital. King (1999) observes that "a company may be worth 5, 10, or even 50 times of its current sales revenue when its balance sheet has little fixed capital and little inventory" simply because book value is only one facet of corporate wealth. Even for companies with large investments in fixed capital, intangible capital is undeniably important and in recent years a number of firms have increased the value contained in their intangible capital. Hall (2001) finds American companies accumulated an enormous stock of intangible capital in the 1990s, while Cummins (2003) finds that organizational capital created by information technology (IT) generates a return of 70 percent at an annual rate. Low (2000) points out that traditional accounting value has little relevance in e-commerce, which has

a unique set of value drivers—innovation, brand investment, strategic alliances, and number of users, minutes per page… About 90% of the value of e-commerce companies is attributable to intangible factors. Considering the growing importance of intangible capital, we must first be clear on what it is, and then will study how it can affect wages.

In essence, intangible capital has two general characteristics—property right qualification and economic value, and then is classified into four distinct categories: intellectual capital, human capital, structural capital and customer capital. The first category—intellectual capital, includes patents, contracts, copyrights, trademarks or brand names, secret formulas, software (especially valuable when it has been designed for that particular business and provides efficiency as well as benefits), goodwill (for example, reputation as well as location to repeat business), and innovation ability. Human capital, the second category, involves hiring practices and relationships. Empirical results suggest that the measures of human capital are, either directly or indirectly, important sources of cross-sectional differences in productivity. Human capital is more important for the service sector than manufacturing and more important for the "new" economy than the "old" economy (Joia, 2001). The third category is structural capital, which encompasses business models, designs and routines that create value from information technology, corporate culture and supply-chain logistics. These types of organizational structures could have a potentially large effect on market valuation. For example, a company may have a contract that allows it to sell its products or service for a higher price than other current market participants, or it may have earlier purchased or leased items at below-market prices (Boulton, 2000). The last category is customer capital. Duffy (2000) stresses that customer capital—the relationship between the customer and the organization—is fundamental in assessing the success of an organization. Customer capital includes an organization's customer base (e.g., a magazine's list of advertisers), customer relationships, customer potential, and brand recognition. Customer relationships refer to the way the organization delivers on its commitment to customers, and customer potential is maximizing the company's position in the market by knowing preferences and needs of the customer base. Brand recognition refers to the market's recognition of consistent quality, satisfactory physical attributes of the product, and other emotional satisfiers. Now let's study the effects of intangible capital on wages.

3. A four-factor trade model that includes intangible capital

The rapid movement of intangible capital to China has increased the relative demand for skilled-workers as they are a substitute for unskilled workers in their role as a complement to intangible capital. "It is by now a cliché that in the modern economy knowledge is at least as an important input as factors of production like labor, capital and raw materials. This is especially true in highly innovative industries, where being only a few months behind the cutting edge in production techniques or product design can put a company at a major disadvantage". (Krugman & Obstfelt, 2003, p.152). To incorporate the effects of the movement of intangible capital, the authors propose the inclusion of this factor into the standard three-factor trade model. Traditionally, the three factors highlighted in trade models are skilled workers, unskilled workers, and tangible capital. Adding a fourth factor—intangible capital, will allow us to study its effect on wage inequality.

Using the Feenstra and Hanson (1996) model, let the index $z \in [0, 1]$ denote the many activities undertaken in the production and delivery of a product to the consumer. Rather than list these activities in random order, an increasing order of skilled/unskilled-workers is used, where, for example, the least skill-intensive activity is assembly and the most skill-intensive activity is R&D.

$$x\ (z)\ =\ A\{\min[(\frac{L_u(z)}{a_{Lux(z)}})^{\alpha_1}(\frac{L_s(z)}{a_{Lsx(z)}})^{\alpha_2}(\frac{K_t(z)}{a_{ktx(z)}})^{\beta_1}(\frac{Z(z)}{a_{zx(z)}})^{\beta_2}]\} \quad (1)$$

x (z) denotes the quantity produced of an import or export intermediate input, L_u denotes unskilled labor, L_s skilled labor, K_t capital, K_i intangible capital, and the units of the skilled-workers $a_{Lsx(z)}$, the unskilled-workers $a_{Lux(z)}$, the tangible capital $a_{ktx(z)}$ and the structural variable $a_{zx\ (z)}$, dominated by prominent intangible capital are needed to produce one unit of an import or export intermediate input *x(z)*. As stated, $a_{Lsx(z)}/a_{Lux(z)}$ and $a_{zx(z)}/a_{ktx(z)}$ are non-decreasing in *z*. Rather than assuming constant returns as Feenstra does, the authors note intangible capital is non-rival in nature, so that the use in one case does not prevent the use in another. This scalability (Joia, 2001), or the ability to use it over and over after you have made the initial investment in intellectual capital, which means we can have increasing returns. This synergistic relationship between intangible capital and the traditional factors of production results in economies of scale. The spillover of knowledge reduces production costs of individual firms as the industry as a whole accumulates experience, called "dynamic increasing returns" (Krugman & Maurice, 2003). Therefore, the authors shall assume increasing returns rather than constant returns (Feenstra's Model, 1996). The parameters α_1, α_2 denote the shares of unskilled and skilled-workers. β_1, β_2 denote the shares of tangible capital and structural variable in the cost of producing each input. Observing that $\alpha_1+\alpha_2+\beta_1+\beta_2>1$ means the authors have increasing returns to scale because of the nature of the intangible capital. Feenstra (2003) also posits "The challenge for researchers is to uncover what structural factors explain the underlying movement in prices and productivity: Are these changes due to skill-biased technological upgrades, or due to trade in intermediate inputs?" The authors propose, besides the technological upgrades and trade in the intermediate inputs, the movement of intangible capital could also play an important role. Thus, the structural variable *z* now includes intangible capital stock explicitly. Here is a convenient dual unit-cost function:

$$c^*\ (w_{u^*}, w_{s^*}, r_{t^*}, r_{z^*}) = w_{u^*}a_{Lux(z)\ *} + w_{s^*}\ a_{Lsx(z)^*} + r_*a_{ktx(z)^{*}} + r_{z^*}\ a_{zx(z)}\ * \quad (2)$$

where $c^*\ (w_{u^*}, w_{s^*}, r_{t^*}, r_{z^*})$ denotes the cost of producing one unit of *x(z)* in China, considering the trade between the United States and China as an example. The inputs can be produced in either the United States or China and are then combined into the production of a final product. The following assumptions on relative factor prices are made:

$$w_s/w_u < w_{s^*}/w_{u^*} \quad (3)$$

$$r_z/r_t < r_{z^*}/r_{t^*} \quad (4)$$

The first assumption in equation (3) states that the relative wage of skilled-workers is lower in the United States than in China, because the United States is relatively skilled-labor abundant. Skilled-workers get a relatively lower return. Despite the increase in the relative wage of the skilled to unskilled-workers in the United States during the past two decades, the wage ratio between the skilled and unskilled workers is still much lower than in China. The second assumption in equation (4) states that relative rental of the structural variable is also lower in the United States than in China, because the United States is relatively intangible-capital abundant. With the assumptions in equation (3) and equation (4), the slope of the cost curve for the United States will be flatter. The problem of choosing the minimum cost location for each input can be illustrated graphically for the United States given fixed factor prices. The unit cost $c\ (w_u, w_s, r_t, r_z)$ as a function of *z* can have any shape whatsoever and does not need to be a continuous function. For convenience, however, assume that it is continuous and illustrate this function as an upward sloping curve *cc* (see Fig. 3). Then the question is: How does the locus of unit cost $c^*(\ w_u^*, w_s^*, r_t^*, z)$ in China, denoted by *c*c**, relate to *cc* in the United States? If the unit costs of all activities were lower in the United States, for example, then all inputs would be produced there. The opposite would be true

if all unit costs were lower in China.

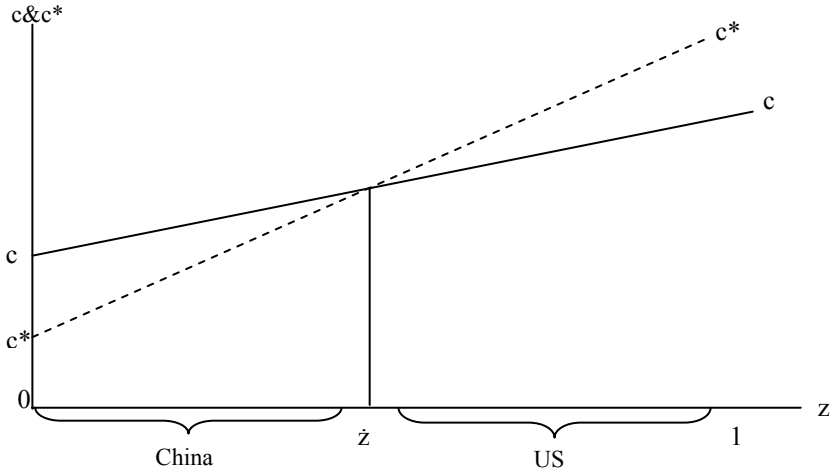

Fig. 3 US and China unit cost curves

To determine *z*, the authors must assume that the curves *c*c**and *cc* intersect at least once, and denote this input by *ż*, with:

$$c\ (w_u, w_s, r_t, r_{ż}) = c^*(\ w_u^*, w_s^*, r_t^*, r_{ż}^*) \tag{5}$$

With the assumptions in equation (3), it is safe to conclude that the cost of unskilled labor intensive goods will be less expensive in China than in the United States, such that $c\ (w_u, w_s, r_t, r_{ż}) > c^*(\ w_u^*, w_s^*, r_t^*, r_{ż}^*)$ for $z < ż$ and the *c*c** curve is lower than *cc*. However, for the skilled labor intensive goods, the cost will be less expensive in the United States and $c\ (w_u, w_s, r_t, r_{ż}) < c^*(\ w_u^*, w_s^*, r_t^*, r_{ż}^*)$ for $z > ż$ and *c*c** curve is higher than *cc*. Thus, the loci *c*c** and *cc* intersect at most once as shown in Fig. 4[3].

With more intangible capital moving from the United States to China, the less intangible capital in the United States will cause its relative return to increase, i.e., the unit cost curve (*cc*) in the United States will shift up while more intangible capital in China will cause its relative return to decrease, thus the unit cost curve *c*c** will shift down. For fixed wages, this has the effect of increasing the equilibrium value of *z*, from *ż* to *z'*. Therefore, China now specializes in the expanded range of activities [0, *z'*), while the United States specializes in the contracted range of activities (*z'*, 1]. Jobs have been shifted to China. Moreover, in the long run, as more intangible capital is accumulated in China, more skilled-workers will required, so the relative returns for wage and intangible capital (w_s^{**}/w_u^{**} and r_z^{**}/r_t^{**}) will decline when the endowments increase, i.e.,

$$w_s^{**}/w_u^{**} < w_s^*/w_u^* \tag{6}$$

$$r_z^{**}/r_t^{**} < r_z^*/r_t^* \tag{7}$$

*c*c** will not only be lowered but also become flatter to $c_2^*c_3^*$, which will further push the structural point *z* to *z''* (see Fig. 4). As a result, more jobs will be shifted to China and a larger wage inequality will be seen. Therefore, the movement of intangible capital is crucial. If there was no intangible capital in the model, an increase in tangible capital would still shift *z*. But the shifted *z*-goods in China would be intermediate levels in the technology ladder.

[3] The graph has been proved by Feenstra and Hanson (1996), but this model adds the fourth factor: intangible capital.

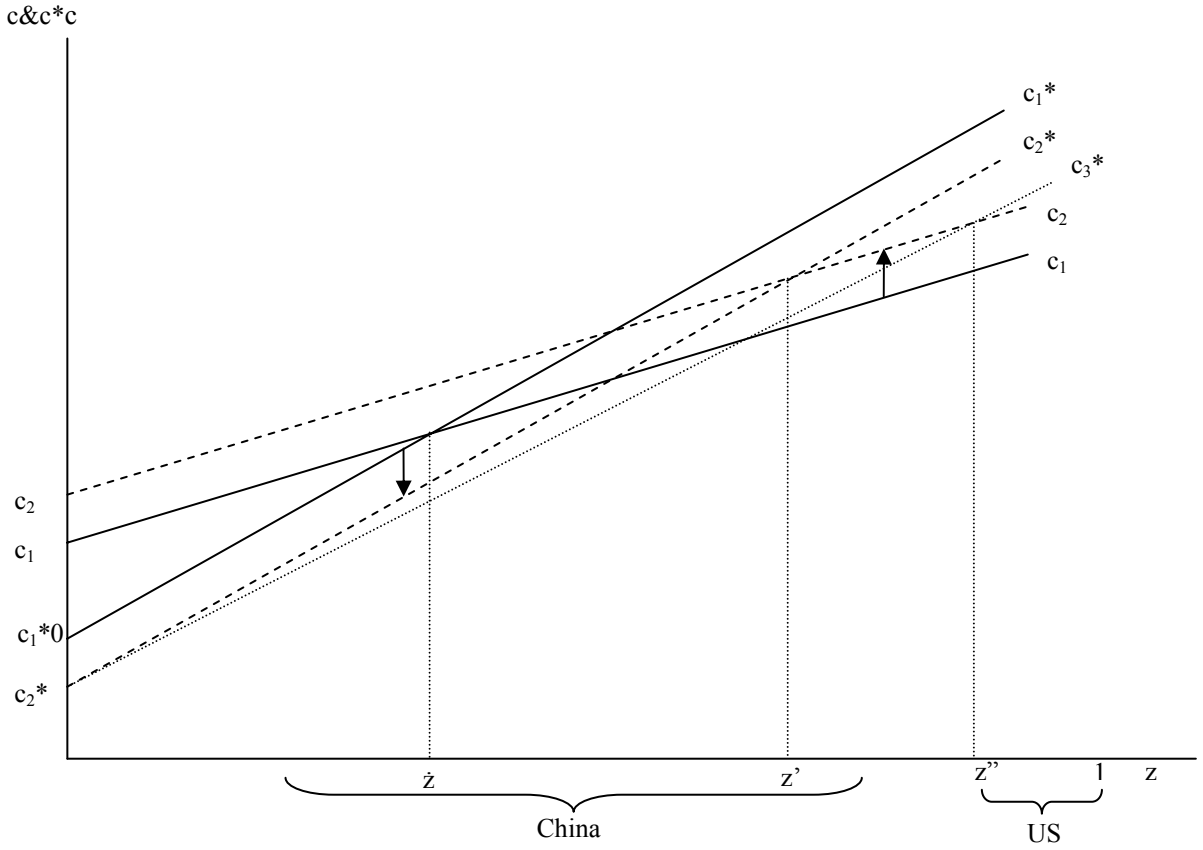

Fig. 4 More intangible capital moves to China

4. Policy implications and conclusions

Firms always attempt to minimize costs, but governments will always try to protect jobs. The lower cost of skilled-labor in China will prompt the inflow of more intangible capital, which, in turn, will require more skilled workers. Given the trade between China and the United States, both unskilled and skilled workers in the US will lose jobs. Given the political necessity that countries try to foster job growth and avoid job losses, China will seek more open trade and the United States will seek more protective trade policy. The recent trade protectionism in the United States is consistent with this prediction.

How should China deal with the challenge? Considering the implications of the simple model in this paper, innovation and technological growth will create more jobs in China, and attract more foreign intangible capital to China (see Fig. 4). This outcome will require more skilled workers, adding further to wage inequality between the skilled and unskilled workers. In order to solve this problem, three things can be done.

Firstly, China has surplus of labor, e.g., the millions of university graduates and the millions of excess farm workers, but is still short of skilled labor. While students are completing university degrees, the degrees are no assurance that the graduates have marketable skills which are suited to the current skilled-labor needs of Chinese corporations. Unfortunately, under the current curriculum in Chinese universities, we cannot immediately conclude that a university degree translates into a skilled worker. China needs to reform higher education by abandoning obsolete curricula and replacing them with ones more attuned to marketable, job-related skills. At the

same time, more emphasis could be placed on the need for students to get work experience while attending school. For those unskilled farmer workers who have lost jobs due to plummeting export demand, the government can assist in the workers' transition to the corporate sector by supporting training centers that coordinate the market's needs with the workers' skills.

Secondly, China should consider establishing an effective and enforceable intelligence property right (IPR) protection system to ensure fairness of competition and encourage creation and innovation. Protection of property rights, including intangibles such as intellectual and patent-related property, is at the core of entrepreneurial activity. Ideas and capital, both tangible and intangible, will flourish if the creators of those ideas can be assured a just and legally protected reward.

Thirdly, it's essential to establish a comprehensive income and property tax system, free of loopholes and unnecessary favoritism. The tax revenues can then be redistributed fairly and efficiently toward ameliorating wage differentials; It is especially crucial for China to take some actions to soothe income inequality to maintain the social stability. Further discussion of how to achieve these three goals is outside the scope of this paper.

Wage inequality between skilled and unskilled workers has increased rapidly in China and the United States. Trade liberalization and technological improvement have been proposed as culprits in the United States. Actually, trade liberalization and technological improvement have only made the movement of intangible capital to China feasible. Intangible capital works synergistically with other inputs to make skilled workers and tangible capital more valuable. Once the accumulated tangible capital reaches a certain level, its lower unit cost will attract the inflow of intangible capital, which will demand higher skilled workers as they are complementary. As a result, wage inequality will become larger in China. This paper takes the first step in an attempt to understand the role of intangible capital movement that plays in the increasing wage inequality in China. Analyzing the shift in the structural point z's movement, this paper concludes that intangible capital movement could be a cause of wage inequality in China.

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(to be continued on Page 26)