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Effects of economic development in China on skill-biased technical change in the US ☆

Angus C. Chu [a], Guido Cozzi [b,*], Yuichi Furukawa [c]

[a] University of Liverpool Management School, University of Liverpool, UK
[b] Department of Economics, University of St. Gallen, Switzerland
[c] School of Economics, Chukyo University, Nagoya, Japan

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ABSTRACT

In this study, we explore the effects of a change in unskilled labor in China on the direction of innovation in the US by incorporating production offshoring into a North–South model of directed technical change. We find that intellectual property rights (IPRs) and offshoring are different ways for the labor endowment of the South to affect the size of the market for innovations in the North. Absent offshoring and lacking IPRs in the South – as in China in the early 1980s – an increase in Southern unskilled labor should lead to skill-biased technical change. If instead offshoring is present and/or IPRs are better enforced (as in China in more recent times), then a decrease in unskilled labor in the South should lead to skill-biased technical change. Furthermore, an increase in Southern per capita stock of capital reduces offshoring and also leads to skill-biased technical change. Calibrating the model to China–US data, we find that under a moderate elasticity of substitution between skill-intensive and labor-intensive goods, the decrease in unskilled labor and the increase in capital in China can explain about one-third of the recent increase in the skill premium in China through skill-biased technical change in the US.

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1. Introduction

After decades of economic development, China is now experiencing a rapid decrease in the share of unskilled labor. According to the Barro–Lee dataset on education attainment, the share of population (over the age of 25) in China without tertiary education decreased from 97.1% in 1995 to 94.0% in 2010. If we consider individuals with the completion of secondary education as moderately skilled workers, then the decrease in unskilled labor in China would be even more dramatic. The share of population (over the age of 25) in China without completion of secondary education decreased from 76.3% in 1995 to 53.6% in 2010, which even implies a decrease in the *number* of unskilled workers in China since 1995. In this study, we explore the effects of a decrease in the supply of unskilled labor in the South (e.g., China) on the direction of innovation in the North (e.g., the US) by incorporating production offshoring into a North–South model of directed technical

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* Corresponding author.
E-mail addresses: angusccc@gmail.com (A.C. Chu), guido.cozzi@unisg.ch (G. Cozzi), you.furukawa@gmail.com (Y. Furukawa).

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change. We find that a decrease in Southern unskilled labor leads to a reduction in the offshoring of labor-intensive goods from the North to the South, which in turn triggers skilled-biased technical change in the North.

Our result is consistent with the following observations. A recent article in *The Economist* documents a decreasing trend in production offshoring from the US to China[1]; for example, "[t]he Boston Consulting Group reckons that in areas such as transport, computers, fabricated metals and machinery, 10–30% of the goods that America now imports from China could be made at home by 2020". Furthermore, as a result of skilled-biased technical change, the skill premium has been increasing in both the US and China. Acemoglu and Autor (2011) document that the relative wage between workers with college education and workers with high school education in the US increased from 1.80 in 1995 to 1.97 in 2008. Ge and Yang (2014) document that the relative wage between workers with college education and workers with high school education in China increased from 1.21 in 1992 to 1.52 in 2007.

Our result also highlights the different implications of offshoring and conventional trade on the direction of technological progress. We find that if the equilibrium features offshoring, then a decrease in unskilled labor in the South would lead to skill-biased technical change in the North. In contrast, if the equilibrium does not feature offshoring, then a decrease in Southern unskilled labor would lead to unskill-biased technical change. To obtain these results, we incorporate offshoring into a standard North–South model of directed technical change. In this growth-theoretic framework, the incentive to develop a new technology depends on the size of its market and on the price of the goods produced by this technology. If intellectual property rights (IPRs) are weakly protected in the South and there is no offshoring, which is the typical case studied in the literature, the market size of the South does not matter, because new technologies generate no royalties or licences there. Thus, the South can affect the direction of technological progress only through its impact on world prices. Under these assumptions, a decrease in unskilled labor in the South would increase the world price of goods produced with unskilled labor and induce innovations complementing the unskilled, as in Acemoglu (2003). The main contribution of this paper is to show that this result is reverted in the presence of offshoring.

Intuitively, when offshoring is absent in equilibrium, a reduction in the supply of unskilled labor in the South causes through international trade a price effect that raises the world price of goods produced with unskilled labor and improves incentives for innovation in labor-intensive goods. In contrast, when offshoring is present in equilibrium, some Southern workers are hired to work with Northern intermediate inputs that are protected by strong patent protection in the North. In this case, a reduction in the supply of unskilled labor in the South causes also a market size effect that decreases the value of labor-intensive inventions and improves incentives for innovation in skill-intensive goods. In other words, Southern IPRs and offshoring serve as two substitutable channels for the labor endowment of the South to affect the size of the market for Northern innovations.

The above theoretical result has the following implications. When China first opened up its economy for international trade in the early 1980's, there was essentially no offshoring in the Chinese economy. Together with a low level of patent protection in China at that time,[2] the opening of the Chinese economy implied a massive increase in the supply of unskilled labor in the world causing predominantly a price effect that improved incentives for innovation directed to the relatively scarce factor, i.e., skilled labor, and this contributed to the skill-biased technical change in developed economies. After the mid 1990's, the amount of offshoring to China has started to increase rapidly. Together with an increased level of patent protection in China,[3] the decrease in unskilled labor in China has been causing also a market size effect that improves incentives for innovation directed to the now more abundant factor, i.e., skilled labor, and this also contributes to skill-biased technical change in developed economies.

Another stylized fact of economic development in China is that capital investment as a share of gross domestic product (GDP) is about 40% and substantially higher than many developed economies. So long as the depreciation rates of capital are not substantially different across countries, China is accumulating capital at a much faster rate than developed countries. From our theoretical analysis, we find that an increase in the stock of capital in the South relative to the North reduces offshoring. Intuitively, a larger stock of capital in China increases the wage rates of Chinese workers rendering offshoring to China less attractive. This decrease in offshoring is like a decrease in the supply of unskilled labor to Northern firms triggering a market size effect. Therefore, a larger stock of capital in the South also leads to skill-biased technical change in the North. In other words, rapid capital accumulation and a decrease in unskilled labor in China could both contribute to skill-biased technical change in the US.

We calibrate the model to China–US data to provide numerical results. Due to skill-biased technical change, either a decrease in unskilled labor or an increase in capital in the South would raise the skill premium in both countries. The magnitude of the changes depends on the elasticity of substitution between skill-intensive and labor-intensive goods. We consider as our benchmark a value of two for the elasticity of substitution between skill-intensive and labor-intensive goods. In this case, the decrease in unskilled labor and the increase in capital in China explain about one-third of the recent increase in the skill premium in China through skill-biased technical change in the US. Quantitatively, the increase in capital causes a much larger effect on the rising skill premium than the decrease in unskilled labor.

[1] The Economist, "The Third Industrial Revolution", April 21, 2012.

[2] For example, the Ginarte–Park index of patent rights in China was 1.33 in 1985; see Park (2008). The Ginarte–Park index is on a scale of 0 to 5, and a larger number implies stronger patent rights.

[3] The Ginarte–Park index of patent rights in China was 4.08 in 2005; see Park (2008).

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