



Learning and knowledge diffusion in a global economy[☆]

Kunal Dasgupta

University of Toronto, Canada

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ABSTRACT

I develop a dynamic general equilibrium model to understand how multinationals affect host countries through knowledge diffusion. Workers in the model learn from their managers and knowledge diffusion takes place through worker mobility. Unlike in a model without learning, I present a novel mechanism through which an integrated equilibrium represents a Pareto improvement for the host country. I go on to explore other dynamic consequences of integration. The entry of multinationals makes the lifetime earning profiles of host country workers steeper. At the same time, if agents learn fast enough, integration creates unequal opportunities, thereby widening inequality. The ex-workers of foreign multinationals also found new firms which are, on average, larger than the largest firms under autarky.

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1. Introduction

One of the most common arguments in favor of activities of multinational enterprises (MNEs) in developing countries is that knowledge/technology can thereby diffuse from MNEs to domestic firms. This belief is reflected in the widespread use of investment incentives by many host country governments to attract prospective MNE investors (Oman, 2000). Yet, how does this knowledge diffuse to domestic firms? And what are the consequences of such diffusion for the domestic economy? In an era of unprecedented globalization, answers to these questions have taken on a great deal of policy relevance.

The last two decades have seen the development of a large literature that examines whether and how knowledge diffuses from MNEs to domestic firms (see Lipsey and Sjöholm, 2005, for a survey). While the focus of most of these studies has been on finding evidence of knowledge

spillovers, the precise mechanisms through which the spillovers occur are less well-understood. In particular, the mobility of workers from MNEs to domestic firms has not received enough attention. Casual observation, however, indicates that this could be an important channel for knowledge diffusion. For example, in the year 1981, four employees working in Patni Computer Systems Limited, a MNE, left to form (along with three others) Infosys Limited, an information and technology (IT) firm. Infosys has gone on to become one of the largest IT firms of not only India, but the entire world. More recently, two former Amazon.com employees founded Flipkart, which has turned into the largest online bookstore in India.

Infosys and Flipkart might be two of the more notable examples, but instances of employees learning from MNEs and then founding their own firms are widely prevalent. For example, Giarratana et al. (2004) look at the spin-offs from MNEs that were created in India after the country liberalized in 1991 and find that the founders brought a high level of technological expertise from the MNEs to the new firms. Similarly, many potential entrepreneurs in China perceive the MNEs as schools where they can train themselves; many of them leave to start their own business, once they have the required expertise.¹ Easterly (2001) discusses the Korean company Daewoo's decision to train the workers of a Bangladeshi textile firm in 1979; most of them left the parent firm during the 1980s to start their own garment export firms,

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E-mail address: kunal.dasgupta@utoronto.ca.

¹ "China's people problem", *The Economist*, 14th April, 2005.

laying the foundation for the \$2 billion dollars Bangladeshi garment industry.²

Until recently, the evidence on knowledge spillover from MNEs through worker mobility had been confined to anecdotes and surveys. This, however, is changing slowly. The availability of longitudinal linked employer–employee data sets for a number of countries has made it possible to track workers over time. These data sets allow the researcher to observe workers who switch from one firm to another, together with a host of worker and firm characteristics (See *Abowd and Kramarz, 1999*, for a discussion of some of these data sets). Taking advantage of such a data set from Brazil, *Poole (2011)* estimates MNE spillovers through the hiring of workers with MNE experience by domestic firms. *Poole* shows that the wages of workers in domestic establishments go up in the presence of MNE-trained workers; at the aggregate level, such spillovers have the potential to generate wage increases to the tune of 0.6% of GDP.³ *Balsvik (2011)* uses a similar data set from Norway to test for knowledge spillovers from MNEs. He finds that workers with prior MNE experience contribute 20% more to productivity of domestic firms, relative to workers without such experience. Other studies to examine this particular channel for knowledge spillovers include *Görg and Strobl (2005)*, *Malchow-Møller et al. (2007)*, *Markusen and Trosimenko (2009)*.⁴

In light of the evidence presented above, in this paper, I develop a model that sheds light on the impact of MNE entry on welfare, wages and occupational choice. At the forefront of my analysis is diffusion of knowledge through learning and worker mobility.⁵ Specifically, I develop a dynamic general equilibrium model with three key features: (1) every period, agents with heterogeneous knowledge choose their occupation and sort into production teams, (2) within teams, workers learn from managers, and (3) there is perfect mobility of workers within a country. Complementarity between the worker's and manager's knowledge in the production and learning technologies leads to positive assortative matching (or PAM), whereby more knowledgeable workers team up with more knowledgeable managers to produce and learn.⁶

Globalization or integration allows managers to hire workers from other countries—MNEs are formed.⁷ I consider a two country model, where the foreign country has relatively more knowledgeable agents (in a sense to be made precise shortly) compared to the home country. This results in lower wages under autarky in the home country, creating incentive for foreign managers to hire home workers. Following integration, new teams are formed as foreign managers try to leverage their superior knowledge with respect to home workers.

² Evidence on founders of spin-offs inheriting knowledge from their parents in the U.S. economy is provided by *Klepper (2002)* for the automobile industry, *Klepper and Sleeper (2005)* for the laser industry, and *Filson and Franco (2006)* for the rigid disk drive industry.

³ As *Poole* argues, this is probably a lower bound for spillovers since it ignores the direct increases in establishment productivity (a part of which may be captured by profits, rather than wages).

⁴ Looking at a firm survey from Ghana, *Görg and Strobl (2005)* show that firms which are run by owners who worked for foreign MNEs in the same industry immediately prior to opening their firm, are more productive than other domestic firms. Using a matched employer–employee data set from Denmark, *Malchow-Møller et al. (2007)* show that both workers, as well as, self-employed agents experience an increase in earnings if they had previous experience in MNEs. *Markusen and Trosimenko (2009)* provide evidence that the use of foreign experts has a positive effect on both wages and value-added of workers in Colombian plants.

⁵ The finding of *Keller (2002)* that knowledge spillovers are local, combined with the result that speaking the same language facilitates diffusion of knowledge, suggests that one possible channel for diffusion is human interaction. Building on this idea, (*Keller and Yeaple (2009a)*) build a model where transfer of knowledge requires face-to-face interaction between co-workers.

⁶ In their study of variation in management practices across firms and countries, *Bloom and Reenen (2010)* find that the education of both workers and managers is strongly correlated with management scores; more educated workers are hired by more educated managers.

⁷ In this paper, MNEs are synonymous with international production teams. I abstract from the issue related to the boundaries of international firms. For some recent papers which deal with this issue, see *Antràs (2003)*, *Grossman and Helpman (2003)*, *Antràs and Helpman (2004)*.

In this setting, I identify two effects that determine home wages. First, integration increases the competition for workers, which tends to raise wages. This is the labor demand effect. This alone would make some of the incumbent managers worse off. But there is also a new effect: integration creates the possibility for the workers to be matched with very knowledgeable foreign managers. By working for these managers, workers can learn and earn more than under autarky. PAM, however, implies that the less knowledgeable workers can expect to work for the MNEs in the future only if they learn from the less knowledgeable home managers, and this creates a rent. Since learning is fully foreseen by the agents, the managers extract part of this rent by paying lower wages and thereby internalize the knowledge “spillover”. This is the learning effect. If agents learn fast enough, this effect dominates and the wage schedule shifts down by enough to make the incumbent managers better off. The workers are better off too, because the increase in their continuation value outweighs the reduction in current wage. The above mechanism through which integration can lead to a Pareto improvement in the host country is new in the literature.⁸

The model is explored further in the numerical section. I present three sets of results concerning lifetime earnings profiles, inequality and spin-offs from MNEs. The learning dynamics of the model imply that the lifetime earnings profiles of agents born as workers are upward sloping. The slope of the earnings profile depends on the matching function. By improving the matches, integration increases the amount of knowledge that agents can acquire in each period, thereby raising the gradient of the lifetime earnings profiles.

Since the distribution of knowledge is endogenous, the model also allows me to talk meaningfully about inequality and how it changes following integration. A change in inequality in this model reflects not only a change in the agents' earnings but also a change in the entire knowledge distribution following integration, a feature that is absent in static models of trade or FDI. I show that if agents learn fast enough, integration can increase aggregate inequality.⁹

Another novel prediction of the model concerns the spin-offs from the MNEs. Among the new managers entering the economy every period, a fraction consists of those who were previously working in other firms. I show that the biggest and most productive firms operating at home are, on average, run by foreign managers. Combined with PAM, this implies that founders of spin-offs who have previous MNE experience are, on average, more knowledgeable than those who do not. Furthermore, some of these spin-offs are larger and more productive than the largest firms under autarky.¹⁰

This paper adds to the large literature on international knowledge diffusion and, in particular, to the literature on knowledge diffusion through MNEs. MNE activity is not the only conduit of knowledge diffusion across countries, but it is widely perceived to be an important one.¹¹ *Griffith et al. (2003)* and *Haskel et al. (2007)* show that small

⁸ MNEs extracting learning rents from workers also feature in the model of *Malchow-Møller et al. (2007)*. In their model, MNEs provide workers with learning opportunities while domestic firms do not. Since workers are homogeneous, in equilibrium they must be indifferent between joining both types of firms. This results in the workers in MNEs earning lower wages in the first period; the workers “pay” to acquire knowledge.

⁹ See *Goldberg and Pavcnik (2007)* for evidence on episodes of globalization, which include both trade and FDI liberalization, being accompanied by increasing inequality. *IMF (2007)* reports that inward FDI has exacerbated inequality in developing countries.

¹⁰ Recent years have witnessed the arrival of a new breed of emerging market multinationals in global business (“The Challengers”, *The Economist*, 10th January, 2008).

¹¹ Other possible channels for knowledge diffusion include trade, ethnic communities and travel. *Coe and Helpman (1995)*, *Coe et al. (1997)* provide evidence of knowledge spillovers through imports, although *Keller (1998)* casts doubt on their findings. The evidence on knowledge spillovers through exports is mixed too; *Clerides et al. (1998)*, *Bernard and Jensen (1999)*, *Aw et al. (2000)* do not find any evidence of learning through exporting, while *Biesebroeck (2005)* and *Loecker (2007)* do. *Kerr (2008)* shows that codified and tacit knowledge flows between U.S. ethnic research and entrepreneurial communities and their home countries. Examining the flow of business travelers between U.S. and seventy-four other countries, *Keller and Hovhannisyan (2010)* find that international business travel leads to the diffusion of knowledge.

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