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Brain drain or brain gain?

Review of *The International Mobility of Talent and Innovation – New Evidence and Policy Implications*, edited by Carsten Fink and Ernest Miguelez (2018), Cambridge University Press, Cambridge, UK. 306 pages.

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Introduction

Migration has been part of human history forever. Great nations were created by immigrants and emigration has been one solution for people and countries in times of despair.

Globalization can be defined as the process that makes mobility across borders and over long distances easier and cheaper. Mobility involves goods, services, capital, knowledge, but also people. But migration is possibly more controversial, and more regulated, than mobility of goods, services, capital and knowledge. Migration is controversial in recipient countries as well as in the migrants' home countries.

This book is about international mobility of high-skilled people. As such it departs from the most commonly debated migration patterns, that of international mobility of workers. Still the topics are related.

Migration has important consequences for countries' functional distribution of income, i.e. the distribution of income between workers and capital owners. A classic illustration is figure 1.

Insert figure 1 here

The model illustrates two countries, a *home* country and a *foreign* country. Their total population is L , which is the length of the horizontal axis. The demand for workers in the *home* country is the downward sloping curve d^h . Similarly, but measured from the right hand side vertical axis, the demand curve in the foreign country is d^f . The positions of the two demand curves are determined by the production capabilities of the two countries, as e.g. endowments of capital, knowledge, technology or natural resources. The population in each of the two countries constitute their supply of labour. This is illustrated by the vertical curve S . The position of S determines the division of L between the two countries, and therefore their supply of labour. Wages in the two countries are determined where the supply curve and the demand curves intersect. In the illustrated example, the home country is a high wage country while the foreign country is a low wage country.

The simple model gives an illustration of motives for migration and its distributional consequences. Workers in the low wage foreign country have a motive for migrating to the high wage home country. In the model, migration is illustrated by a rightward shift of the supply curve. As a consequence, labour supply increases in the home country and labour supply decreases in the foreign country. Wages decrease in the home country and increase in the foreign country. Workers in the home country lose and workers in the foreign country (both the immigrants and the remaining workers) gain from increased wages. Capital owners

in the home country gain from lower wages and capital owners in the foreign country lose from higher wages.

The theory has been used to illustrate migration in many cases. In his *Penguin History of the USA*, Hugh Brogan cites slogans written to motivate migration from England to the American settlements in the 17th century (p. 16):

“In Virginia land free and labour scarce; in England land scarce and labour plenty.”

Figure 1 shed light on why immigration is controversial. Migration has the potential to change countries' functional distribution of income. But the illustration is controversial itself. As noted, demand for labour is assumed to depend on countries' production capabilities. It therefore also depends on human capital and technology. But human capital is embodied in humans and technology is produced by humans.

John McLaren's textbook *International Trade* explains why and how the simple model does not capture all consequences of migration.

Figure 1 presumes that domestic and foreign workers are perfect substitutes. Immigrants are therefore competitors to domestic workers. Immigration increases the labour supply and therefore reduces wages. McLaren (ch. 12) discusses two alternative approaches. The first is that domestic and foreign workers may be complements rather than substitutes. The second is that a country's market size depends on their population and that increased market size increases economic opportunities.

Debates on brain drain have centered on the extent to which high skilled workers move, particularly from developing countries to developed countries. Such migration may have very different consequences than those depicted in figure 1. High skilled foreign workers may complement rather than substitute for domestic workers. Complementarity implies that domestic workers' productivity increases when foreign workers enter the labour force. If high skilled foreign workers produce new technology, domestic workers working with the new technology may produce more. If this is the case, demand for workers in a country may *increase* rather than decrease when the supply of high skilled workers increases via immigration.

The second approach is that countries' market sizes determine their productive capabilities. Larger markets support more industries, more firms and more varieties in production. If there is increasing returns to scale in production, for instance due to fixed costs, firms may need a large market size in order to cover these fixed costs. In terms of knowledge production *scale economies* may be particularly important. Knowledge production depends on *input* of human resources in terms of researchers and knowledge workers and of the *stock of* existing knowledge. There are two sources of scale economies. The first is that research productivity depends on cooperation with other researchers. Each researcher's productivity may well increase with the size of the research community. The second source of scale economies is that existing knowledge is an input by itself into knowledge production. Researchers build on existing knowledge to produce new knowledge. If access to research communities and access to existing knowledge depends on co-location, knowledge workers may tend to cluster geographically. International migration of knowledge workers will therefore tend to be unidirectional and self-reinforcing.

Knowledge workers are main contributors to knowledge creation. Knowledge creation, i.e. science, technology and innovation, is a central driver of economic growth. Economists have tried to estimate the contribution of new technology to growth relative to investments and growth of labour supply. Robert Solow (1957) pioneered the research tradition. He estimated that 87.5 percent of observed growth was explained by technological change. In more recent studies, estimates are often more modest, but still large (see e.g. Barro and Sala-I-Martin, 1995, for an overview).

Mobility of knowledge workers and the location of knowledge production are therefore important issues for understanding innovation, economic growth as well as the global distribution of income.

New data

Carsten Fink, Ernest Miguelez and their co-authors' book constitutes an important contribution to these questions. The book summarizes existing knowledge and provides new evidence. The book describes main trends and patterns shaping international knowledge worker migration. But the book also contains analyses of pros and cons of talent migration, for receiving countries as well as possible consequences in sending countries.

In 2013, the global population of migrants was estimated to be 231.5 million people. This was 50 per cent more than in 1990, but migrants represented only 3.2 percent of the world's total population. World's migrant population does not distribute equally around the globe. The share of migrants in OECD countries is 11 percent of the population. Migrants are not representative for the population in the sending countries nor for the population in receiving countries. Caglar Özden and Christopher Parson (ch. 2) present results from a study that breaks down the global migrant population by country of origin, receiving country and *skill level*. Skills are defined by migrants' educational levels. The analysis indicates that the United States, other developed English-speaking countries and OECD countries are the main recipients of high-skilled immigrants. In the 1990-2000 period, this concentration of high skilled migrants in high-income countries, increased. A major drawback for research in high skill migration is the quality of the data. Özden and Parson show that there are large differences in wages within individual occupation groups. This is evidence of heterogeneity among high-skilled immigrants. In particular, the role on migrants in research and development activities can hardly be analyzed with the use of statistics on aggregate flows of skilled labour.

The book presents two alternative approaches for analyzing mobility of very high-skilled workers. Both of them are based on *patent data*. Patents are documents provided by legal authorities that give the holders the exclusive right to commercial exploitation of the described innovation for a certain period. A prerequisite for patent protection is that the innovation has a potential commercial value. Purely scientific inventions are not patentable. It is also required that the patented innovation is new. In addition, the innovation has to be non-trivial and differ substantially from existing technology. Patent documents are public and contain information about the patented technology, the owner of the patent and about the innovators. Patent documents also describe the existing state of the art within the technology field, and related existing patents are cited in patent documents.

The information contained in patent documents have been used by researchers for many purposes to investigate the role of technology in economic development (see e.g. Griliches, 1990). Patents are *output* from the R&D processes. Many alternative indicators of innovation processes use *input* measures (such as R&D investments). Patent data are available as long time series as well as for many countries. Patent data contain detailed descriptions of the patented technology.

Patent offices, and therefore patent data, are mainly national (as e.g. the USPTO in the USA or Patentstyret in Norway) or they are regional (as e.g. the European Patent Office, EPO). The Patent Cooperation Treaty (PCT) facilitates patent applications internationally, i.e. to many patent offices.

Patent data are not without pitfalls, however. For instance, the propensity to patent inventions vary considerably between countries or industries.

Patent data contain information about the inventors. Miguelez and Fink (ch. 4) make use of data for patents filed under the Patent Cooperation Treaty (PCT). For a limited time period, these data contain information about the inventors' nationality as well as their country of residence.

Patent data traditionally do not contain information about the nationality of inventors nor their country of residence, however. Stefano Breschi, Francesco Lissoni and Gianluca Tarasconi (ch. 3) use a supplementary methodology. Their point of departure is the *names* of the inventors in main countries. Names often indicate ethnic origin. The idea is that the names of inventors can indicate the origin of the inventor (with a probability). Based on a database of the ethnic origin of names (the Melissa Ethnic-Name Database), the authors attempt at assigning patents to the *likely* origin of their inventors. The authors argue that this latter approach is valid since the results are consistent with the prior – and more reliable – methodology.

The result of the data work presented in the book is a generous well of information about international mobility of inventors (as evidenced in patent documents). An important finding is that inventors are even more mobile than other high skilled groups. The authors estimate that of the global population of inventors, the migrant share is 8-9 per cent. The OECD countries receive the most migrant inventors. Switzerland, the United States, Ireland and Belgium are major receiving countries, whereas Japan, the Republic of Korea and Italy receive few migrant innovators.

The first part of the book (chapters 2 through 4) describes the data and the methodology. The second part of the book presents research results from using the data.

Effects in receiving countries

Figure 1 illustrates that wage differences between countries may stimulate migration. Existing research has documented that migrant flows are determined by income differences between countries, migration costs, immigration policies and diasporic networks between sending and receiving countries, such as the size of a migrant population from a specific country. Fink, Miguelez and Julio Raffo (ch. 5) document that these variables also explain inventor migration. They find, however, that inventor migrants are less sensitive to migration

cost indicators than other migrants. Sharing the same language, on the other hand, is more important for inventor migrants than for it is for other migrants.

Figure 1 illustrates that immigration may reduce domestic wages. Positive shifts in a country's labour supply may reduce wages. The counter argument is that, through complementarities or scale economies, demand for domestic workers could potentially increase because of immigration. If so, immigration may well increase wages. The evidence presented by William Kerr (ch. 6) indicates that both types of mechanisms are at work. The balance between them depends on the geographical and sectoral level of aggregation, as well as the time span. One evidence of complementarity is that after immigration inflows, skilled foreign workers specialize in quantitative and analytical tasks while domestic skilled workers specialize in communication intensive tasks that require higher levels of social capital. For instance, after the dissolution of the Soviet Union, many mathematicians migrated from former Soviet republics to the United States. As a response, native mathematicians shifted into fields where the Soviet colleagues were less active.

Inventor immigration increases a country's population of inventors. Kerr shows that immigrants constitute a growing and important share of the United States' high skilled workforce. In 2008, immigrants represented 16 percent of the US college educated workforce. Immigrants accounted for 24 percent of innovations in 2004 (up from 10 percent in 1975). Further, immigrants account for 50 percent of Ph.D. holders and 26 percent of US-based Nobel Laureates. Kerr concludes that (p. 213):

“We overall conclude, as many others have, that immigration has been essential for US leadership in innovation and entrepreneurship.”

Brain drain or brain gain? Effects in sending countries.

Whether innovation is good or bad for receiving countries, effects are likely to go in the other direction for sending countries. According to figure 1, emigration from a country will reduce its labour force. When workers are substitutes, the effects are higher wages in the sending country. If, on the other hand, emigrants would have complemented the remaining workers, wages in emigrants' home countries may decrease. This book documents that migrants are not representative for their home countries' labour force. Emigrants are generally better educated and possess higher skills than the average worker in their home country. Francois Paxisnewende Kaboré (ch. 9) focus on effects in Africa. 28.5 percent of Africans living in OECD countries have higher education. This compares with 5.5 percent of Africans living in Africa. One out of every eight African with university education lived in an OECD country in 2011.

But migration of high skilled workers *within* Africa is also high. A large survey with almost 10 000 students in Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe, indicates that 79 percent of students considered moving to another country. 53 percent expected to migrate during the first five years after graduation. Other African countries were likely choices for almost one third of these.

The evidence presented in the last chapter of the book indicate brain drain of significant magnitudes. On the effects of high skilled migration from African countries, the author concludes that (p. 281):

“...it makes sense to conclude that skilled migration substantially reduces both inputs (human capital and R&D expenditures) and outputs (patents, scientific, and technical journal articles) that drive or reflect the level of innovation.”

Figure 1 illustrates one important reason why emigration is not necessarily detrimental for sending countries. Wages for the remaining workers may increase. Research has also indicated other effects. Incomes for emigrants increase when they get better paid jobs abroad. Emigrants' incomes are often remitted to their home countries. The opportunity of migration may increase incentives to invest in higher education. In many developing countries, higher education is private. Therefore, income opportunities abroad after graduation may stimulate people to pay the costs of higher education. Ajay K. Agrawal (ch. 8) presents a formal model for the effects of migration on the sending countries' innovation capability. Knowledge production depends on human capital, i.e. researchers and high skilled workers. Knowledge production also depends on knowledge that is available to the researcher. Such knowledge is both local and global. Local knowledge can easily be incorporated into new local knowledge production. Global knowledge, on the other hand, is less accessible. It becomes more accessible for local researchers if other local researchers emigrate and contribute to its production. Therefore, emigration of skilled workers can increase the innovative capabilities in the sending countries through formal and informal ties with researchers in the receiving countries. For instance, the presence of Chinese workers at universities in the United States may enhance R&D productivity for researchers in China. In the book, evidence of this type of mechanisms is presented. For instance, Chinese patents more often cite US patents if one of the innovators of the cited US patents are Chinese.

For most sending countries, the net effects of migration for innovation and development are likely to be negative. Effects may vary depending on policies both in sending countries and in receiving countries. Alireza Naghavi (ch. 8) discusses whether *intellectual property rights* (IPRs) could play a role in mitigating negative effects from brain drain. He suggests that IPRs (p.252) “could be beneficial only once a country passes a certain stage of development”.

Conclusion

This book gives new insights into effects of high skilled migration and migration of inventors. Fink and Miguelez have edited a volume that is of great interest for their *research community*. The authors have made a great effort in their data construction. That has made them able to investigate a range of topics that has received less attention in previous research. They also suggest a productive agenda for future research. With the data at hand, there are reasons to believe that international knowledge flows will be high on future research agenda. The book is highly relevant for developed and developing countries alike. Therefore, this volume deserves a wider audience.

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Figure 1

