

**International Mobility Trends of Highly Skilled Workers:  
An Analysis of the Transnational Migration of Highly  
Skilled Immigrants for both Receiving and Sending  
Countries and Their Role on Innovation in a Knowledge-  
Based Economy**

by

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## **ABSTRACT**

In a knowledge-based economy, innovation has become a key driver of economic growth. The return migration of highly skilled workers to traditional sending countries such as Taiwan, China, and India has increased the international mobility of highly skilled workers in the Science and Technology sector. As a result, this will change transnational migration patterns of highly skilled workers in the future and will affect recruitment strategies of traditional receiving countries such as Canada. This research project will analyze highly skilled workers' role in innovation and analyze international migration trends of highly skilled workers. It argues that highly skilled workers have become more valuable in the innovation process as their international mobility has increased in a knowledge-based economy and receiving countries that rely on highly skilled immigrants need to recognize that permanent migration may not be in today's minds of migrants. Rather, onward and circular migration policies need to be framed.

**Keywords:** International Mobility; Highly Skilled Workers; Return Migration; Innovation; Transnational Migration Trends; HRST; Science and Technology

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# 1: INTRODUCTION

The global share of high technology expertise has been altered by the return migration of highly skilled Asian immigrants to their homeland's high technology sector. The traditional high technology leaders like the US, Japan, and Europe have been supplemented by the addition of Taiwan, South Korea, India and China. International mobility patterns of highly skilled workers have changed as a result and constitute a new dimension in the transnational migration of highly skilled workers in the knowledge-based economy. At a time when innovation has become an important driver of economic growth, highly skilled workers are ever more valuable as countries compete to attract them.

In a knowledge-based economy, a nation's economic growth increasingly relies on innovation to remain economically competitive. Highly skilled workers are an important component of innovation because of their knowledge. This knowledge is a key economic resource and a source of creative power in all sectors of the economy from science and technology, business, and health, to the arts and culture industries (Solimano, 2006, p.7). This knowledge also plays a central role in knowledge production and this equates to technological and economic development (OECD, 2008a, p.18; Seguin et al, 2006, p.79).

As a result of the return migration of highly skilled immigrants to their home countries, it has increased the competition for highly skilled workers in the global economy. This is particularly true in the Science and Technology sector,

as both developed and developing countries are now actively promoting inflows of highly skilled workers. This in turn has increased highly skilled workers' international mobility. Their options as to where they may wish to settle have increased. Therefore, highly skilled workers play an integral role in innovation in a knowledge-based economy.

Since the 1980s, highly skilled Taiwanese immigrants living in the US have returned to Taiwan to assist in the development of Taiwan's Science and Technology industry. In the 1990's, this trend has continued with the Chinese and Indian highly skilled workers, who have also assisted in the development of their home country's Science and Technology sectors as well (Zweig, 2006, p. 65). These highly skilled immigrants originally left their home countries to either pursue graduate level education or to seek employment after graduation in the high technology sector abroad. The return migration of these highly skilled immigrants to Taiwan, China, and India has not only contributed to the development of these countries' Science and Technology industries, but have also assisted in their rise from being technology imitators to technology innovators. These highly skilled returnees made this possible because they were transnational entrepreneurs who had established knowledge networks in their adopted homes, in say Silicon Valley, and upon their return transmitted new ideas and technologies to their home country (Lucas, 2005, p.215). The traditional one way flow of highly skilled workers from developing countries to developed countries has now become the two way flow as highly skilled workers are returning to their home countries (Saxenian, 2007, 191). This two way flow

has changed transnational migration patterns as traditional sending countries such as Taiwan, China, and India are now becoming receivers of highly skilled workers.

For developed countries, which are the traditional receiving countries, attracting foreign highly skilled workers can help to compensate for domestic skill shortages, sometimes caused by an aging workforce (Kuptsch and Fong, 2006, p. 1). As developing countries like China and India are luring their nationals to return home, this return migration will have an impact on a receiving country such as Canada that traditionally relies on immigration for population growth. Canada also relies on immigration as a source of skills and for its labour force growth (Industry Canada, 2007, p. 29). Thus, it is important for receiving countries such as Canada to have policies that acknowledge this increased international mobility.

With the fragmentation of the High Technology sector and with the globalization of Research and Development, highly skilled workers will be moving to where the opportunities are. This increased international mobility of highly skilled workers may be a trend in the future, allowing highly skilled workers to become more transnational in their mobility. In some cases, they may go from country to country (onward migration), finding the best opportunity for their careers, rather than settling in a permanent location (Aydemir and Robinson, 2006, p. 4). Therefore, the increased competition for highly skilled workers has made them more valuable in the innovation process as their international mobility

has increased. In a knowledge-based economy, highly skilled workers will become the next great drivers in the global economy as a result.

This research project will analyze highly skilled workers' role in innovation and analyze international migration trends of highly skilled workers. It argues that highly skilled workers have become more valuable in the innovation process as their international mobility has increased in a knowledge-based economy and receiving countries that rely on highly skilled immigrants need to recognize that permanent migration may not be in today's minds of migrants. Rather, onward and circular migration policies need to be framed.

The first section includes a literature review of highly skilled workers' role in innovation, followed by a section on their current transnational migration patterns. Themes in transnational migration trends illustrated by onward and circular migration are used, to illustrate how human mobility is becoming more globalized. A more integrated economy reliant on the movement of people will be fostered as a result.

Four case studies will follow, with the first case study used to analyze a traditional receiving country such as Canada. As a net beneficiary of highly skilled immigration, Canada will be affected by the increased international mobility of highly skilled workers. An analysis on foreign highly skilled workers' contribution to Canada's skilled labour force and their mobility trends is used to show the impact of the return migration of highly skilled immigrants on Canada.

The three remaining case studies are of traditional sending countries, in particular the return migration of highly skilled workers back to Taiwan, China

and India. It will show how highly skilled workers were involved in assisting their home country to develop their Science and Technology industries. It will also look at how these Asian governments implemented policies to attract their highly skilled expatriates to assist in the development of their Science and Technology industries and to show that these highly skilled migrants may have not had the desire to settle abroad permanently, but always had thoughts of returning back to their homeland.

This research project will conclude with a reflection of the return migration and its impact on a receiving country such as Canada. It suggests that Canada's immigration policy of settlement and integration programmes are perhaps out of date in today's era of transnational mobility of highly skilled workers.

## **2: LITERATURE REVIEW**

### **2.1 The Knowledge-based Economy**

In the late 1990's, the GDP of OECD economies have been increasingly based on knowledge and information. This is evidenced by the GDP output and employment that expanded quickly in high-tech industries, such as the computer, electronic and aerospace sectors. Since 1996, it is estimated that more than 50% of GDP in the major OECD economies were knowledge-based (OECD, 1996; p. 9). As BRIC (Brazil, Russia, India, and China) countries have also begun increasing their GDP output from high-tech industries, it has caused the global economy to head toward a "knowledge-based economy" (OECD, 2008b, p. 18).

A definition provided by the OECD defines "knowledge-based economies" as economies which are directly based on the production, distribution and use of knowledge and information (OECD, 1996, p. 7). Another definition provided by the Asia-Pacific Economic Cooperation (APEC) Economic Committee defines the "knowledge based economy" as the production, distribution and use of knowledge as the main driver of growth, wealth creation and employment across all industries (Hwang and Gerami, 2006, p. 99). Both definitions put an emphasis on the role of knowledge and information as being important for economic growth.



Two factors that have created the knowledge-based economy are the rise in knowledge intensity and the increased globalization of economic activity. Knowledge intensity can be attributed by the increasing pace of technological change and information technology, while globalization is being driven by national and international deregulation, and by the IT related communications revolution (Hwang and Gerami, 2006, p. 99). Both of these factors put an emphasis on the importance of technology in the knowledge-based economy.

Major characteristics of a knowledge-based economy include massive knowledge creation, knowledge consumption, and knowledge dissemination. Highly skilled workers are considered assets in a knowledge-based economy because they manage, drive, and shape information. Thus the demand for a highly-skilled labour force has increased international competition among nations creating the increased mobility of high level expertise (Teferra, 2004, p.4).

The OECD states that a knowledge-based economy gives knowledge and information an increased role in economic growth. This increased role leads to a new focus on the role of information, technology and learning in economic performance (OECD, 1996, p. 3). This in turn is reflected by OECD economies in a shift towards growth in high-technology investments and industries, and as a consequence causes a need to attract highly-skilled labour. An integral aspect of a globalized knowledge-based economy is the internationalization of research, development and sustained growth in foreign direct investment, and the mobility of highly skilled workers, in particular in the field of human resources in science and technology (OECD, 2008a, pp. 18-19).

## **2.2 Innovation**

In a competitive “knowledge-based economy”, countries recognize that innovation is the key engine of productivity and economic growth (Cook, 2008, p. 1; Ernst, 2003, p.1; OECD, 1996, p.9). The rate of innovation and technological change are considered to be key determinants of modern growth theory, along with the accumulation of human and physical capital (Rao et al, 2001, p. 11).

There are two types of innovation the first is fundamental innovation, which is “research proper,” and consists of the invention of new products and processes. The second type is applied innovation; this is when new products or processes developed by a firm, is used by another firm or when existing technologies are used in different ways (Rao et al, 2001, p.12). Fundamental and applied innovation is enhanced by investments in R&D and human capital.

Countries that have higher output measures of fundamental innovation have higher labour productivity and higher incomes; and countries with less innovation have lower labour productivity and lower incomes (Rao et al, 2001, p. 13).

### **2.2.1 Innovation Advantage**

The ability to innovate in a global economy is one of the most powerful sources of competitive advantages (Holbrook, 2006, p. 1). For example, the US’s success in being a global leader in productivity can be attributed to its success in innovation. In no small part, as a result, the US is the largest economy in the world (Rao et al, 2001, p. 11). The importance of innovation is recognized by the Canadian government. It believes that innovation is not only

the key to improving growth in productivity, but also in creating higher standards of living (Government of Canada, 2007, p. 17).

## **2.2.2 Elements of Innovation**

An element of innovation can be described as the ability to apply knowledge in new or different ways (Holbrook, 2005, p. 109). Other variables of successful innovation include a firm or organization's ability to acquire, adapt and advance knowledge (Holbrook, 2006, p. 1). The Conference Board of Canada notes that a high proportion of advanced technology-based innovative output and a higher GDP per capita are two results of innovation in countries that make them successful. Other factors that lead to success include spending the bulk of research and development investment on technology development and commercialization rather than on basic research (Stanley, 2008, p. 1).

### **2.2.2.1 Commercialization of Innovation and Importance of Competition**

In the Science and Technology sector, scientific ideas are not necessarily the most important element in innovation. In fact, what is more important is the ability to identify market opportunities and to capitalize an idea or product into a marketable technological concept (Lin et al, 2008, p. 12). This means that the real value in an innovation is its profitability.

The important enabling factors that stimulate investment in innovation and improve productivity are a business environment that includes openness to trade and investment, the degree of competition in the economy, the access to the financial system, the quality of management and intellectual property protection.

However, from that list, the degree of competition, both local and global, in a country or in a sector is considered to be the most important factor (Holbrook, 2005, p. 109). This is because a lack of competition reduces the pressures on firms to adopt and use advanced technologies, re-organize workplace, rationalize production and improve productivity (Rao et al, 2001, p.12).

### **2.2.3 Innovation as a Process**

Innovation should be thought of as a continuous process of discovery, learning and applying of new techniques and technologies from many sources. These techniques and processes are cumulative and interdependent (Rao et al, 2001, p.12).

If innovation is cumulative and interdependent, innovation could be thought to be comprised of various interconnected elements and should be thought of as a supply chain. “In a globalized economy, the system of innovation likely functions at a supra-national level and is embedded in cross-border value chains” (Lin et al, 2008, p. 2). Then, under this scenario, innovation could be thought of as a globalized process, with a country specializing in different sections of the value chain.

Highly skilled labour is an essential input to an innovative economy (Industry Canada and HRSDC, 2008, p. 5). A knowledge-based society relies on a highly qualified labour force, not only for high-technology sectors and research, but increasingly in all sectors of the economy (OECD, 2008a, p. 18).

## **2.3 Highly Skilled Workers**

Highly skilled workers' knowledge is considered to be a key economic resource and a source of creative power in science, technology, business, arts and culture and other sectors (Solimano, 2006, p.7). This knowledge also plays a central role in knowledge production and this equates to technological and economic development (OECD, 2008a, p. 18; Seguin et al, 2006, p. 79). In general terms, highly skilled workers are those who enhance the innovative ability of the economy (Industry Canada and HRSDC, 2008, p. 7). Highly skilled workers thus form an integral role in innovation in a knowledge-based economy.

### **2.3.1 Definition of a Highly Skilled Worker**

Highly skilled workers have many different names ranging from highly skilled labour, highly skilled personnel, highly qualified personnel etc. (Auriol and Sexton, 2001, p. 14). For this research project, the term highly skilled workers have been chosen to refer to any of these groups.

Highly skilled workers are a group of people who are well educated, or who are (or have work experience) in professional or managerial occupations (Industry Canada and HRSDC, 2008, p. 7). They are also a relatively small elite group of individuals that include doctorates, researchers, and high-level engineers (Chaloff and Lemaitre, 2009, p. 10). From an educational perspective, "highly skilled" includes post-secondary education that is university-level but may involve a vocational, technical or professional qualification of shorter duration than a bachelor's degree (Chaloff and Lemaitre, 2009, p. 10).

### **2.3.1.1 Human Resources in Science and Technology (HRST)**

More specifically the type of highly skilled workers at which this project is looking at, are a subgroup within the highly skilled termed human resources in science and technology (HRST). As with all highly skilled workers, “HRST embody knowledge and contribute to innovative activity and play a vital role in economic growth and prosperity or, at a firm level, in profits and success” OECD, 2008a, p. 19).

An internationally agreed term to define highly skilled workers in the science and technology sector was developed together by the OECD and Eurostat (known as the OECD Group of National Experts in Science and Technology Indicators) to measure this group. This is known as the “Canberra Manual” (Auriol and Sexton, 2001, p. 15).

“The ‘Canberra Manual’ defines HRST as people who fulfil one or the other of the following conditions: They have successfully completed education at the tertiary level in an S&T field of study; or they are not formally qualified as above, but are employed in a S&T occupation where the above qualifications are normally required” (Auriol and Sexton, 2001, p. 15). The Canberra Manual covers a very broad population with either tertiary-level education or an occupation in a field of science and technology (S&T). S&T is understood in a very broad sense that covers all fields of education and occupation, including the social sciences and humanities (Auriol and Sexton, 2001, p. 15).

This research project will focus on this subgroup of the highly skilled workers.

### **2.3.1.2 Technical Talent**

To give a more detailed explanation of the HRST, these are people who are experts in information technology, telecommunications and computer science. They hold a university or advanced technical institute degree in mathematics, engineering, and computer science. In the information technology sector, they can be developers of new software and hardware. Lastly, they are sometimes referred as “knowledge workers” or owners of intellectual capital and often receive favourable visa systems in developed countries (Solimano, 2006, p. 8).

### **2.3.1.3 Transnational Entrepreneurs**

Transnational entrepreneurs “are those immigrants physically and/or virtually engaged in two or more locations, often including their country of origin, in entrepreneurial pursuits” (Lin et al, 2008, p.6). Transnational entrepreneurs are mainly involved in the high tech industries (IT, Internet services, telecommunications). They transfer innovation and wealth creation capabilities from one country to another by using their cross-country social networks (Portes et al, 2001, p. 2). They are also “agents of resource mobilization, investment and innovation” (Solimano, 2006, p. 11). In some cases, they are returnee entrepreneurs who have returned to their homeland and created business ventures. Although, some returnee entrepreneurs still maintain ties with their adopted country, and use their high technology skills and their networks that they have made while there to assist them in their business ventures back in their home country (Lin et al, 2008, p.6). These transnational entrepreneurs are highly

skilled immigrants that use transnational entrepreneurship as an alternative form of economic adaptation in developed countries (Portes et al, 2001, p. 2).

Transnational entrepreneurship is also associated with the economic development of sending countries. Some countries' economic development may become linked to the activities of their diasporas (Portes et al, 2001, p. 7). For example, sending governments benefit from emigrant remittances, investments, and technological innovations. Sometimes, the remittances and investments of their emigrants are greater than the total of these countries' commodity exports. For example, the emergence of parallel Silicon Valley's in cities such as Bangalore, Mumbai, Beijing, Shanghai, and Taipei are examples of the development of Science and Technological industries that have been primarily facilitated by expatriate scientists in Silicon Valley. Transnational entrepreneurs in Silicon Valley have brought back valuable experience and knowhow to their local economies. These entrepreneurs travelled back and forth between Silicon Valley and their home country. In early 2000, 80-90 percent of Chinese and Indian emigrant professionals living in Silicon Valley had business relations in their home countries and travelled more than 5 times a year to their countries (Wickramasekara, 2002, p. 13). Also, about 50% of the companies from the largest science park in Taiwan, Hsinchu was started by Taiwanese transnational entrepreneurs from the US. In China, the Ministry of Science and Technology estimates that returning overseas students started most of the Internet-based ventures (Guellec and Cervantes, 2001, p. 87).



### **2.3.2 Fragmentation of the IT Sector**

As mentioned in 2.2.3, if innovation can be seen as a process, then the events that lead to innovation can be divided and be separate entities. For example, in the IT sector and other high technology fields, the trend has been toward fragmentation. It has become increasingly rare for a single firm, even Microsoft, to develop an entirely new “product” in-house. “As a result, knowledge sharing and research collaborations linking different entities have become the norm” (Lin et al, 2008, p. 5).

The fragmentation in the technology sector enhances the ability of individual entrepreneurs to develop innovation projects from the beginning to eventual marketplace success (Lin et al, 2008, p. 6). Since innovation is not limited to “breakthrough” developments, but rather innovation is incremental or cumulative, it gives an opportunity for highly skilled workers to specialize their skills set for a different part of the innovation process. For instance, most innovations in the IT sector are niche-focused, involving an extension or adaptation of an existing technology to improve a system, or a new service integrating various pieces of available technologies (Lin et al, 2008, p. 6).

### **2.3.3 Transnational Entrepreneurs as Part of the Global Supply Chain**

Since innovation is a process and incremental Lin et al. suggests that transnational entrepreneurs should be thought of as agents of innovation and that one should look at innovation from the perspective of the global supply chain (Lin et al, 2008, p. 2).

Two trends are occurring as a result of the transnational entrepreneurs. The first trend is towards a more fragmented industrial structure organized around networks of specialized producers, as evident in the computer industry and ICT sector. As a result, opportunities are emerging for peripheral regions to participate in the value chain of innovation (Lin et al, 2008, p. 8). This is in part due to technologies that are new and have not matured yet, thus economies like India may more easily learn and build up expertise in this sector and give them an opportunity to catch up to the developed countries or even surpass them in expertise (Vijayabaskar and Krishnaswamy, nd, p. 2). The second trend is that the divide in the global economy is increasingly being replaced by partnerships in certain parts of the world, where emerging market economies have accelerated their efforts to catch up (Lin et al, 2008, p.8). The fragmentation of industry structure for example in the IT industry, offers niche opportunities for China to participate in innovation (Lin et al, 2008, p. 12). These transnational entrepreneurs offer opportunities to enable developing countries such as China and India to participate in the globalized innovation process.

#### **2.3.4 Demand for Talent: Codified and Tacit Knowledge**

As previously mentioned in section 2.1, due to the growing intensity of knowledge as a factor for GDP growth in the global economy, the value placed by countries on highly skilled workers has risen (OECD, 2008a, p. 18). This is because countries have a greater demand on highly skilled workers' "talent" to understand and use knowledge. This "talent" differentiates them from other sources of competitive advantage, because "talent" is encapsulated in

individuals. “This ‘talent’ is what makes them a unique, distinct, and irreplaceable resource because it cannot be codified, duplicated, sold, or easily transferred from one person to another” (Schahar, 2006, p. 152). This “talent” gives highly skilled workers the ability to produce the economic value and wealth that causes competition between nations to attract them (Schahar, 2006, p. 152).

Tomassini explains (as cited in EHRD Base, 2009) that this “talent” can be further explained from two dimensions of knowledge creation: **codified** knowledge and the diffusion of **tacit** knowledge. Each requires specialised human expertise, and each is vital for innovation.

**Codified** knowledge can be described as being “easily transferable in information and can be transmitted through information technologies and infrastructures over long distances and across organisational boundaries” (EHRD Base, 2009). **Tacit** knowledge on the other hand, cannot be easily transferred because “it has not been stated in an explicit form; its transfer is extremely sensitive to social context” (EHRD Base, 2009). In other words, it is “any knowledge that cannot be codified and transmitted through documentation, academic papers, lectures, conferences and other communication channels” (OECD, 2008a, p. 19). Another way of understanding **tacit** knowledge is “the idea that people can be perceptually or intellectually aware of certain things that help them to interpret and make use of information but cannot easily communicate this awareness to others” (OECD, 2008a, p. 19).

#### **2.3.4.1 Twin Creators of Knowledge**

Since, innovation requires learning and the creation of new knowledge through the use, adaptation and absorption of what came before both codified and tacit knowledge are considered important (OECD, 2008a, p. 22).

The continuous drive towards codification is a characteristic of the knowledge-based economy as a result of the increase in infrastructure and ICTs which allow for the effective and low-cost transmissions of knowledge (EHRD Base, 2009). The continued growth of formal research and development, the expansion of scientific publications and the rapid rise of patenting, is widely argued to have caused the production and dissemination of codified knowledge to be increasingly important in modern innovation (OECD, 2008a, p. 19).<sup>1</sup>

Yet, tacit knowledge appears to be the real key element for effective utilization of innovative opportunities and abilities (EHRD Base, 2009). This is due to the fact that tacit knowledge cannot be codified (OECD, 2008a, p. 19). As Gertler explains "... the tacit component of the knowledge required for successful performance of a skill is that which defies codification or articulation – either because the performer herself is not fully conscious of all the 'secrets' of successful performance or because the codes of language are not well enough developed to permit clear explication" (Gertler, 2003, p. 78). Thus, tacit knowledge provides the key that leads to advances in science and technology "by providing the combination of information and temporal, spatial, cultural and social contextual understanding needed to create something new" (OECD,

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<sup>1</sup>In an OECD publication, Abramowitz and David (1996) argued that "the secular expansion of education and the growth of occupations for HRST are in fact driven by the enhanced codification of technological knowledge" (OECD, 2008a, p. 19).

2008a, p. 22).<sup>2</sup> A key challenge for firms is how to use the increasing volumes of codified knowledge and how to share tacit knowledge in the workplace and across locations.<sup>3</sup>

In conclusion, tacit knowledge is what makes highly skilled workers more valuable in an economy where they are increasingly becoming more internationally mobile.

### **2.3.5 Highly Skilled Workers: Diffusion of Technology**

The introduction of market and semi-market economies has caused economic activity to become more globalized and this has intensified the movement of people. From this increased movement of people, it has led to the diffusion of technologies globally, which has historically been the result of human mobility (OECD, 2008a, p. 18).

“Human resources for science and technology are vital to innovation and economic growth because highly skilled people create and diffuse innovations“ (OECD, 2008a, p. 46). The best examples of technology diffusion are when highly skilled returnees transfer technical knowhow back to their home country.

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<sup>2</sup>Zucker et al., adds that the “mere knowledge of the techniques of recombinant DNA was not enough to allow scientists to take part in the first lucrative burst of biotechnology innovation – the knowledge was far more productive when embodied in a scientist with the genius and vision to continuously innovate and define the research frontier and apply the new research techniques in the most promising areas” (Zucker et al., 1998, p. 291). This also puts the notion of the value of the individual that holds this tacit knowledge and their role in creating new innovations that may not be replicated by another.

<sup>3</sup>It is argued that tacit knowledge is shared more effectively when people have a common social context, with shared values, language and culture, as it facilitates understanding and the building of trust. It is also thought that tacit knowledge is difficult to exchange over long distances (Gertler, 2003, pp. 78-79).

## 2.4 Internationalization of R&D

Over the past decade, the geography of research and scientific activity has changed with many countries improving their ability to perform research, including newly emerging economies. This is evident by some non-OECD countries that are becoming important R&D spenders and their human capital resources are rapidly increasing. For example, China's gross domestic expenditure on R&D (GERD) was US\$ 87 billion and is spending around one-third that of the EU. Since 2000, it has been growing at around 18% annually in real terms. In 2006, Russia had US 20 billion and India reached US\$ 23.7 billion in 2004. As a result, non-OECD economies account for a growing share of the world's R&D (OECD, 2008b, p. 21).

Human capital resources are also increasing within non-OECD countries as well, looking at the BRIC countries, 171 million people between 25-64, had a tertiary degree in 2004, as many as in the entire OECD area. In 2005 China had about half of the OECD total with 3.9 million students entered in universities (OECD, 2008a, p. 111).

The US and Europe have seen a decline in their share of the triadic patent families total, while Asia has surged<sup>4</sup> (OECD, 2008a, p. 111). Japan's share in triadic patent families gained almost 2 percentage points, to reach nearly 29% in 2005, and the annual rise in triadic patent filing from China, India, Korea and

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<sup>4</sup> These triadic patents are a set of patents taken at the European Patent Office, the Japan Patent Office and the United States Patent & Trademark Office that protect the same invention (OECD, 2008a, p. 111).

Taiwan ranged from 20 to 37%. China has gained 16 spots from 1995 to move into the top 15 (OECD, 2008a, p. 111).

Multinational firms' technological activities are also increasingly internationalized as they search for technological expertise, better adaptation to markets and lower R&D costs, and research activities are being moved abroad. The increasing amount of foreign ownership of domestic inventions and the increase in the domestic ownership of inventions made abroad are some indicators. "The share of foreign affiliates in total R&D is higher than their share in total manufacturing turnover in most OECD countries, a sign that research is now more internationalised than production" (OECD, 2008a, p. 115). Lastly, a global shift of high and medium-high technology manufacturing towards non-OECD countries is occurring (OECD, 2008a, p. 115).

## **2.5 Open Innovation Networks**

To remain globally competitive it has caused firms to increasingly adopt "innovation eco-systems," because knowledge assets needed for innovation is sometimes beyond the scope of the company. To solve problems or to tap into new ideas, companies in different countries use these innovation networks to link up with people, institutions and other companies. This is the "open innovation" model and "refers to the collaborative methods applied, and may still imply the (significant) payment of license fees between companies for intellectual property" (OECD, 2008c, p. 2). Different partners in these networks play multiple roles

depending on their expertise. Therefore, most companies' business models have made "open innovation" an integral part of innovation strategies.<sup>5</sup>

As innovation activities become globalized, it is becoming increasingly important for companies to be involved in both external and intra-firm networks. These global innovation networks include a company's own R&D facilities located abroad as well as collaborations with external partners and suppliers (OECD, 2008c, p. 2).

Most OECD countries' share of R&D performed by foreign affiliates has increased as multinationals have acquired foreign firms and established new R&D facilities outside their home country. In 2004, more than 16% of business R&D in the OECD area was performed by foreign affiliates. The fastest growth can be seen in Asia, while most are still in the OECD area, increases in scientific and technical talent, rapidly expanding markets and lower wages offer opportunities for new investment (OECD, 2008a, p. 38).

The trend towards open innovation also has implications for the future mobility patterns of skilled HRST in the private sector. The movement of HRST can be used to link domestic firms to foreign knowledge and stimulate spillovers from foreign R&D sources to local R&D units and the local economy at large (OECD, 2008a, p. 38).

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<sup>5</sup> "The emphasis of open innovation reflects primarily a greater awareness of the organisation of innovative activities (technological as well as non-technological) across firm boundaries with a more equal importance of internal and external sources of innovation. Recently, globalisation has significantly altered the scope for outsourcing and open innovation as it has broadened the choice of potential partners giving rise to the development of global innovation networks" OECD, 2008c, p. 2).



Thus the increased international mobility of human resources in science and technology is becoming one of the most important aspects of globalization as a result of their role in enhancing innovation in a globalized knowledge-based economy. The following section will analyze international migration trends of highly skilled workers in the Science and Technology Sector.

### **3: INTERNATIONAL MIGRATION TRENDS OF HIGHLY SKILLED WORKERS -- HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY**

The discourse on globalization was previously dominated by the economic impact of increased international trade and capital flows (Salt, 1997, p. 4). However, in recent decades because of globalization, highly skilled workers in the science and technology sector have become more internationally mobile (Industry Canada and HRSDC, 2008, p. 5). Because of this, in the coming years more emphasis may be placed on the increased mobility of highly skilled workers in the global economy (Saxenian, 2007, 191).

#### **3.1 International Mobility of Highly Skilled Workers/HRST**

There is increasing evidence that highly skilled workers are becoming more internationally mobile in the new global economy (Aydemir and Robinson, 2006, p. 17). Countries are now increasingly recognizing the need to compete strategically for recruiting and retaining highly skilled workers, as it is known that they are important to maintain success in innovation, economic growth, and prosperity (Jackson, 2005, p. 13; Rizvi, 2005, p. 176; Teferra, 2004, p.4).

The opportunities for people with scientific and technical talent to study and work in a foreign country has increased in both OECD and non-OECD economies. As firms shift towards more innovation-based activities that rely on R&D, patents, software, human resources, intellectual assets (including those of

highly skilled individuals) have become strategic factors for value creation. The demand for researchers continues to rise, and governments are rapidly developing policies to attract foreign and even sometimes expatriate HRST. For example, employment in HRST occupations grew faster than total employment between 1996 and 2006 in all OECD countries (OECD, 2008a, p. 19).

### **3.2 Global Race for Talent**

Currently, low skilled workers make up the majority of international migration flows (OECD, 2008a, p. 18). At the same time, international migration of highly skilled workers is emerging as an issue of increased relevance (OECD, 2002, p. 1). Furthermore, the higher demand for skills in OECD countries has led to intense international competition for these highly skilled workers in the science and technology sector (Industry Canada and HRSDC, 2008, p. 5).

This higher demand is due to their higher economic value, as highly skilled workers are considered to be more internationally mobile compared to unskilled workers, along with their skills this mobility makes them scarce therefore they receive more favourable immigration policies in receiving countries (Solimano, 2006, p.7). As mentioned in other sections, it is also because highly skilled workers, at both the country and firm levels, can accelerate the accumulation of knowledge and stimulate innovation. As a result, this leads to higher levels of economic activity and prosperity in the receiving country (OECD, 2008a, p. 19).

Also, in most OECD countries, the labour shortages will be the most severe in the next 25 years. Thus, these countries within the OECD may lack local national highly skilled workers in the S&T sector (Chalamwong, 2004, p.3;

Chaloff and Lemaitre, 2009, p.10; Guellec and Cervantes, 2001, p. 72; Teferra, 2004, p.5). In response to the low rate of natural population increase in most of the OECD countries, the promotion of immigration is an attractive measure used to increase the size of the working population and acts to ease the labour shortage (Aydemir and Robinson, 2006, p.3; Chalamwong, 2004, p.3).

Presently, countries with a high per capita income have a shortage of information technology experts, scientists, medical doctors and other types of talent, thus they recruit competitively for highly skilled workers (Solimano, 2006, p.7). In OECD countries, this shortage has made several governments implement policies to facilitate the entry of foreign skilled workers. Demand for them has also risen with higher education and research ministries as well (OECD, 2002, p. 1). This makes international migration of the highly skilled an important theme in most OECD countries (OECD, 2008a, p. 18). For example, with an aging population, Canada acknowledges the importance of recruiting highly skilled workers and looks to immigration to fulfil its labour shortage (Gera and Songsakul, 2005, p. 1).

At the same time, emerging economies such as China and India are now encouraging the return of their highly skilled scientists, engineers and researchers who have benefited from access to international graduate education and overseas work experience. These highly skilled returnees come home because of improved career opportunities, the development of infrastructure, better living conditions and economic growth. Lastly, greater local opportunities

exist that provides for an attractive alternative to a career overseas (OECD, 2008a, p. 26).

### **3.2.1 Traditional Receiving Countries**

According to the OECD database on immigration and expatriates in 2000-2001, major OECD countries including the US, Canada, Australia, France, UK and Germany are net importers of highly educated workers (Industry Canada and HRSDC, 2008, p. 11). In developed countries, the total stock of immigrants grew by 23% from 1995 to 2005, which are now home to 60% of all international migrants (OECD, 2008a, p. 18).

The U.S. is the traditional leader among receiving countries in attracting highly skilled immigrants, but have faced strong competition in the last ten years from Canada and Australia as these two countries have implemented selective immigration programmes aimed at attracting highly skilled workers. More recently, France, Sweden, the UK, and other EU nations have implemented fast-track admission processes for highly skilled workers, especially working in IT. These programs are designed to allow those that have specialized knowledge capital to integrate themselves quickly in the receiving country's workforce (Shachar, 2006, p. 151).

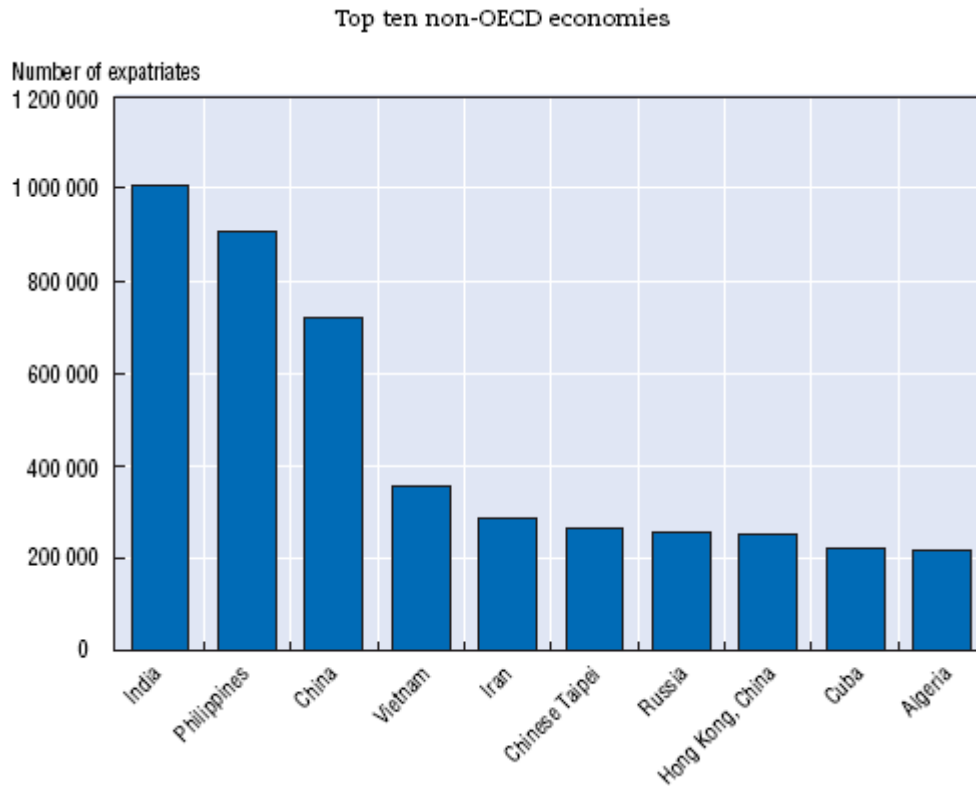
The majority of internationalization of R&D still occurs within the OECD area, however developing countries such as China and India are increasingly becoming strong R&D centres (OECD, 2008a, p. 19). As the demand for highly skilled workers in S&T extends across a wider range of countries, the competition for highly skilled workers will become more intense, as developing countries such

as China and India may become an attractive destination in the future for highly skilled workers globally.

### 3.2.2 Senders

Trends since the 1990's show a noticeable increase in flows of highly skilled workers from Asia to developed countries, and an increase in the exchange of skilled workers among industrialized countries (OECD, 2008a, p. 19). Figure 1 shows the top ten source economies for highly skilled non-OECD expatriates were predominantly Asian, led by India, the Philippines and China in 2001 (OECD, 2008a, p. 78).

**Figure 1 – Foreign born highly skilled expatriates in OECD countries, by country of origin, 2001**



**Source: OECD, 2008a, p. 78 © (reproduced by permission from the OECD)**

### **3.2.3 Numbers**

The UN estimates the stock of international migrants at around 190 million, however these numbers are not large in absolute terms. Within the international flows of migrants, highly skilled workers, including HRST, only make up a small number of that total number. In net terms from 1990 to 2000, about 5 million tertiary-educated workers moved from less developed to more developed countries, while 2 million moved between developed countries (OECD, 2008a, p. 18).

### **3.2.4 Recent Higher Education Trends**

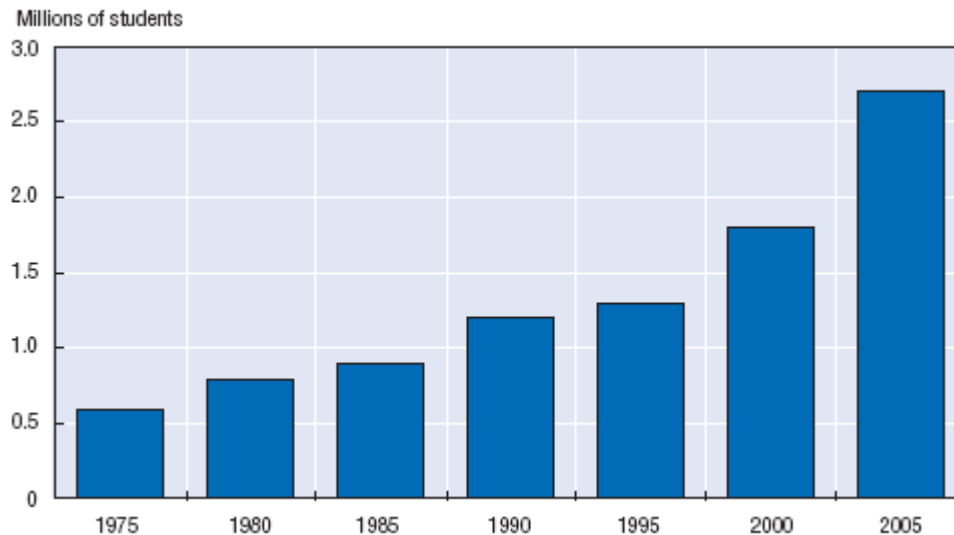
Many students view an investment in international education as “their ticket to migration” (Rizvi, 2005, p. 177). This speaks true with students from developing countries, who often stay in OECD countries for further research or employment opportunities and contribute to innovation in these countries. From the perspective of OECD countries they benefit from the inflow of highly skilled students and scholars.

Many countries actively recruit foreign students because they can provide a highly qualified reserve of labour. Students are ideal because they are more familiar with the norms and conditions of the host country and are able to foster international networks and co-operation when they leave (OECD, 2008a, p. 83-84).

Figure 2 shows the number of students enrolled outside of their country has risen gradually since 1975 according to data from the OECD and the

UNESCO Institute for Statistics. Most of them were enrolled in the OECD area (84%), with the United States as the top destination for foreign tertiary students.

**Figure 2 – Number of students enrolled outside their country of citizenship, 1975-2005**

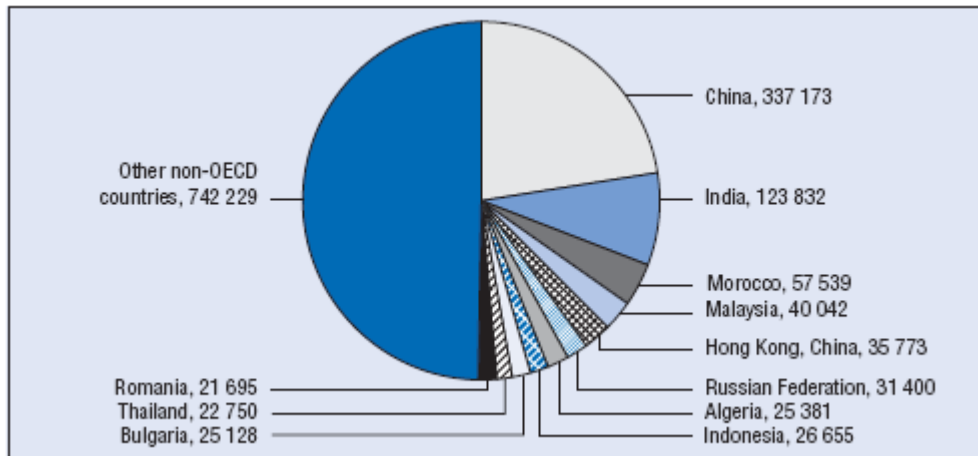


**Source: OECD, 2008a, p. 84 © (reproduced by permission from the OECD)**

Non-traditional OECD and non-OECD countries are also trying to become attractive destinations for students as well. South Korea for example, in 2006 the total number of foreign students reached over 30 000. Most students are from Southeast Asia and study in science and technology fields. After graduation, most return to their home countries or a third country, rather than stay in Korea as researchers (OECD, 2008a, p. 86).



**Figure 3 – Students from non-OECD economies enrolled in tertiary education in OECD countries, 2004**



*Source: OECD, 2008a, p. 86 © (reproduced by permission from the OECD)*

In 2005, two-thirds of international students in OECD countries were from non-OECD countries. Asian students formed the largest group, making up for about half of the overall total. In figure 3, it shows the breakdown of international students from non-OECD countries, with China and India making up about a quarter of the population. The large number of Chinese students studying abroad is reflected as a result of the Chinese government encouraging Chinese students to do so (OECD, 2008a, p. 85).

### **3.3 Human Resources in Science and Technology and International Mobility Patterns**

#### **3.3.1 Return Migration**

Recent trends in global migration patterns suggest that a return migration of previously “lost” highly skilled workers from developing countries to developed countries is occurring. A positive relationship is associated between the economic development and the return migration of developing countries’ highly

skilled workers that can be termed the "brain gain" as the establishment of social networks through migrant diasporas between the home countries is reversing the brain drain (Hunger, 2004, p. 100).

For instance, in Asia a number of developing and emerging economies have attempted to attract their highly skilled expatriates to come back to work in their own academic, research, and business institutions (Teferra, 2004, p.5; Wickramasekara, 2002, p. 11). A great example of this is Korea and Taiwan who have been pioneers in initiating such programmes since the 1970s (Chang, 1992, p. 27; Wickramasekara, 2002, p. 11; Yoon, 1996, p. 4).

As a result, some of the highly skilled returnees that have returned either became professors at major universities or became entrepreneurs. For example, there are some cases of leading IT and software companies founded by those who resigned from their high profile positions in the developed economies to open competitive or joint ventures back in their home country (Teferra, 2004, p.5).

For Chinese highly skilled workers, a growing number of them are returning to China, because they believe they have better prospects and the technology slump in the US has limited their opportunities. The Chinese government is also recruiting more aggressively. Although there are no official statistics recorded, Shanghai's Pudong special economic zone reports that the number of returnees working there rose from 500 in 1999 to 3,200 in 2003 and the numbers of companies set up by returnees tripled to 330 (Teferra, 2004, p. 12). These returnees bring back human, financial and social capital, and

therefore positively contribute to the development of their home economy (Wickramasekara, 2002, p. 8).

The initiatives made by national governments to encourage the highly skilled immigrants to return have been a beneficial factor for the development of these countries (Wickramasekara, 2002, p. 10). In some circumstances, some would argue that because “the contemporary migrants and their predecessors maintained a variety of ties to their home countries while they became incorporated into the countries where they settled” that these migrants always intended to return and were not looking to settle abroad permanently (Levitt and Jaworsky, 2007, p. 3).

#### **3.3.1.1 Rapid Economic Growth Brings Opportunities**

Rapid economic growth provides a sender country with incentives for their emigrants to return, as one of the causes of highly skilled workers to emigrate is the lack of economic opportunities or advancement in their desired sector.

Rapid economic growth also helps to reduce the income gap between the source and host countries (Wickramasekara, 2002, p. 10). For example, India’s ability to attract its diaspora back home should be partially credited to its booming ICT and biotechnology private sectors that offer opportunities for skills that its expatriates can utilize (Seguin et al, 2006, p. 85).

#### **3.3.2 Brain Circulation**

Perhaps the return migration of highly skilled immigrants should be termed the “brain circulation”. In 2002 Forbes Magazine identified this was a growing

trend in Asia and has transformed the brain drain into the “brain circulation” (Saxenian; 2006, p. 18; Yatsko; 2002, online).

The brain circulation is different from the return migration as the “increased mobility of the knowledge workers contributes to increased two-way flows of knowledge, ideas and technology” for both the receiving and sending country (Gera and Songsakul, 2005, p. 12). This means that both the sending and receiving country continues to benefit. Some argue the brain circulation is a better representation of what is occurring in global migration patterns, rather than the return migration, where returnees have no ties with their “host” countries when they return home (Seguin et al, 2006, p. 80). Because highly skilled workers are moving in both directions, they are major catalysts for expanding knowledge, business and venture initiatives and this in turn enhances the knowledge transactions across borders (Teferra, 2004, p.5).

The circulation of highly skilled workers was made possible by a globally integrated knowledge-based economy and the changing structure of economic activities and the opportunities for high technology entrepreneurship, access to leading clusters of research and innovation (Rizvi, 2005, p. 176).

An example of the brain circulation can be seen in the late 80s for the Taiwanese and in the late 90s for the Indians and Chinese (Gera and Songsakul, 2005, p. 12). This is evidenced by the emergence of Bangalore, Beijing, Shanghai and Taipei as new centres of high-tech nodes that parallel Silicon Valley. These regions were developed primarily by expatriate scientists in Silicon Valley. “Instead of draining their native economies of human skills and

resources, these ‘circulating’ immigrants have brought back valuable experience and know-how to local economies” (Wickramasekara, 2002, p. 13).

It has been noted that the promotion of the recirculation of brains or “the re-supply” of highly skilled personnel to the sending country does not have to be achieved through the permanent return or the physical presence of expatriates. Instead, knowledge circulation can occur by implementing diaspora policies, both in developing and developed countries that act together to utilize the capital that skilled diasporas represent for international development (Seguin et al, 2006, p. 80).

#### **3.3.2.1 Scientific Diasporas**

The brain circulation that assisted Taiwan’s high-tech sector to develop was in part due to the government’s policy to tap into its scientific diaspora that was living in the US. The term diaspora is defined as “the breaking up and scattering of a people’ or those ‘settled far from their ancestral homelands” (Seguin et al, 2006, p.80).

Scientific diaspora is a “self-organized community of expatriate scientists and engineers working to develop their home country or region, mainly in science, technology and education” (Seguin et al, 2006, p.80). This scientific diaspora were immigrant scientists and entrepreneurs that were living in developed countries (Seguin et al, 2006, p.80; Wickramasekara, 2002, p. 8).

Diaspora knowledge networks are used by sending countries to engage their diaspora located throughout the globe, often called the diaspora option to assist in their scientific and technological development (Leclerc and Meyer, 2007,

p. 157; Seguin et al, 2006, p.82). The presence of highly skilled expatriates abroad can be mobilized by the sending country and used as an asset (Meyer, 2001, p. 97). Since the diaspora are seen as potential investors, knowledge communities and technology transmitters to the home countries, they are seen as a potential resource to tap into for home country development<sup>6</sup> (Wickramasekara, 2002, pp. 13-14). Even though highly skilled expatriates may not have strong links with their home country, “when called to participate in national support scheme, like diaspora knowledge networks, they may react positively and become unexpectedly involved” (Meyer, 2001, p. 100).

There are several examples of successful diaspora networks in emerging economies. The Indian diaspora, for instance, played a vital role in developing the IT and business process outsourcing industry in India. Taiwan has also benefited from its US-educated engineers and entrepreneurs, who have linked the two economies and contributed to the development of the IT industry (OECD, 2008a, p. 58).

### **3.3.3 Circular Migration**

In a globally integrated knowledge-based economy, both developed and developing countries benefit from the global circulation of highly skilled workers (Rizvi, 2005, p. 175). A considerable proportion of migrants are not considered to be “first movers” in today’s globalized world, but many have made multiple trips within their home country and abroad in order to work. Studies

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<sup>6</sup> There are several established diaspora networks which promote active circulation of scientists to help the home economy. For example, the Thai Reverse Brain Drain project encourages exchanges of scientific personnel and contribution of expatriate scientists to return for short periods to promote knowledge in the home country (Wickramasekara, 2002, p. 13).

show that there is an increasing probability of making multiple moves the more an individual has already moved (Vertovec, 2007, p. 5).

Circular migration has been described as a possible win-win-win for receiving host countries, sending countries, and migrants themselves (Agunias and Newland, 2007, p. 1). Circular migration brings “accelerated economic growth, remittances, relative high wages and brain gain, by means of full circles of migration (Bieckmann and Muskens, 2007, online).

To create a win-win scenario, migrants would be able to come and go in both the sending and receiving countries. This is in contrast to the old concept of migration when migrants either stayed permanently in the receiving country, or they stay temporarily and then return to the sending country. What makes highly skilled migrants different from the past, is that they are now part of broader transnational social networks. Thus, they may have the ability to speak several languages, have multiple identities, and live in several societies at the same time (Bieckmann and Muskens, 2007, online).

#### **3.3.3.1 Onward Migration**

Return migration has raised awareness that migration is not necessarily a permanent move for many migrants. In the increasingly global labour market it may be more appropriate to treat international migration more like internal migration. Individuals may move around from place to place for job-related or other reasons several times in a lifetime (Aydemir and Robinson, 2006, p. 4). For example, in Canada the immigrants who came under the skilled worker class or business class, in particular Hong Kong immigrants, often leave quite soon.

The primary reasons for leaving were for better opportunities elsewhere (Abdurrahman and Robinson, 2006, p. 18). A more detailed analysis can be found in the following Canada case study, in section 4.3 in regards to the numbers that were leaving Canada.



## **4: CASE STUDY OF CANADA**

According to Statistics Canada immigration plays an important role in Canada's net population growth. During the 1990s, immigration has almost doubled to around 220, 000 since 1980s when the annual average was about 125, 000 a year. Within the next 15 to 20 years, immigration will be the only source of net population growth as Canada has reached below replacement fertility rates (Canadian Labour and Business Centre, 2002, p. 2).

### **4.1 Immigration Trends - Top Source Countries**

In 2007, there were 236,758 permanent residents in Canada. Canada has three immigrant classification schemes: economic, family reunification, and refugee, and the breakdowns of the three categories during that year were 131, 248 (economic immigrants), 66, 230 (family Class), and 27, 956 (refugees) (Citizenship and Immigration Canada, 2009).

The proportion of permanent residents coming to Canada has come largely from Asia and the Pacific with 112,659 in 2007 (47%). Of which, 62,298 belonged in the economic immigrant category (47%). Since 1998, China and India have been Canada's top source countries (Citizenship and Immigration Canada, 2009).

In recent years, highly skilled immigrants came from a broad range of areas including Science, Engineering, Health Care, and Education. They are

more likely than the Canadian-born population to have majored in the physical sciences, engineering and trades, with 43% compared to 33% (Industry Canada and HRSDC, 2008, p. 11).

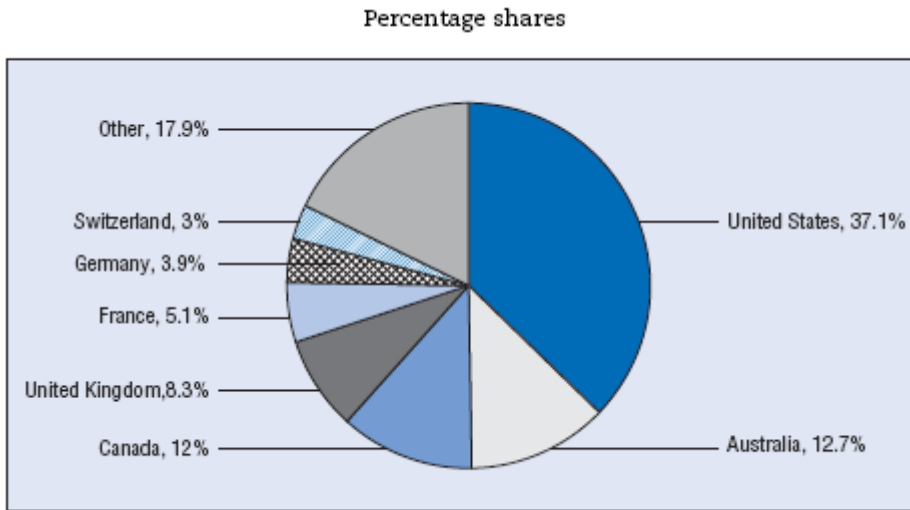
## **4.2 Immigration Policy Attracting Highly Skilled Workers**

Due to its skill-based points system to select immigrants who are highly educated and possess skills that are in demand within the labour market, Canada is among the OECD countries that are net importers of highly skilled workers (Gera and Songsakul, 2005, p. 27; Industry Canada and HRSDC, 2008, p. 7). This skill-based points system was introduced in the early 1990s that favoured the entrance of immigrants with higher levels of education. The impact of this selective immigration policy that favoured highly skilled immigrants were that there were significant increases in the number of highly skilled immigrants who immigrated between 1991 and 2000, compared with the previous decade (Industry Canada, 2007, p. 29).

### **4.2.1 Canada's Rank among OECD Countries in Attracting Highly Skilled Workers**

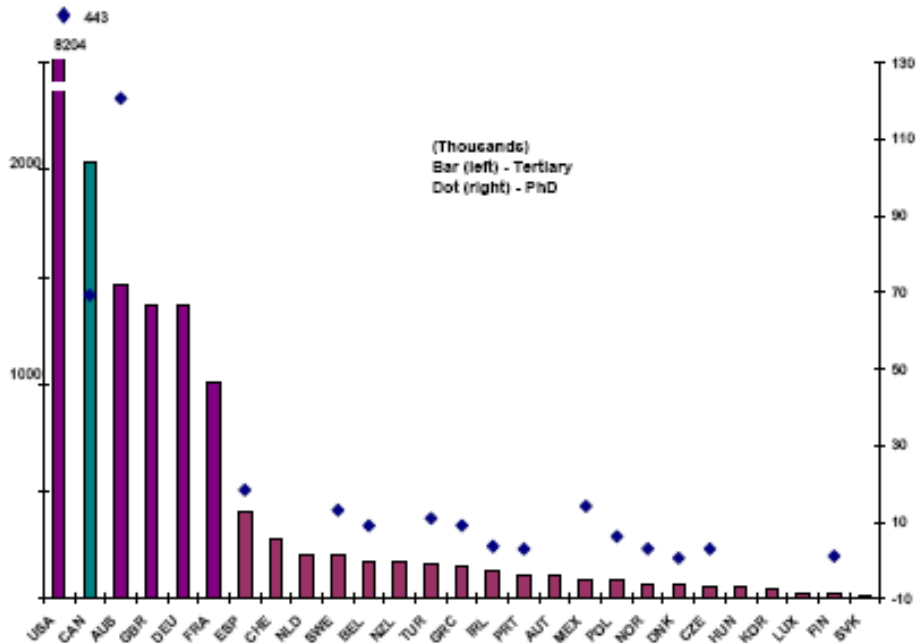
Canada ranks well among OECD countries as a main destination country. This is reflected in figure 4 as it shows that in 2001 Canada was ranked third among the top OECD destinations of OECD-born highly skilled expatriates.

Figure 4 – Main OECD destinations of OECD-born highly skilled expatriates, 2001



Source: OECD, 2008a, p. 74 © (reproduced by permission from the OECD)

Figure 5 – Stock of foreign-born population aged 15+ with tertiary education, OECD countries, 2000-2001



Source: Gera and Songsakul, 2005, p. 6 © (reproduced by permission from Industry Canada)

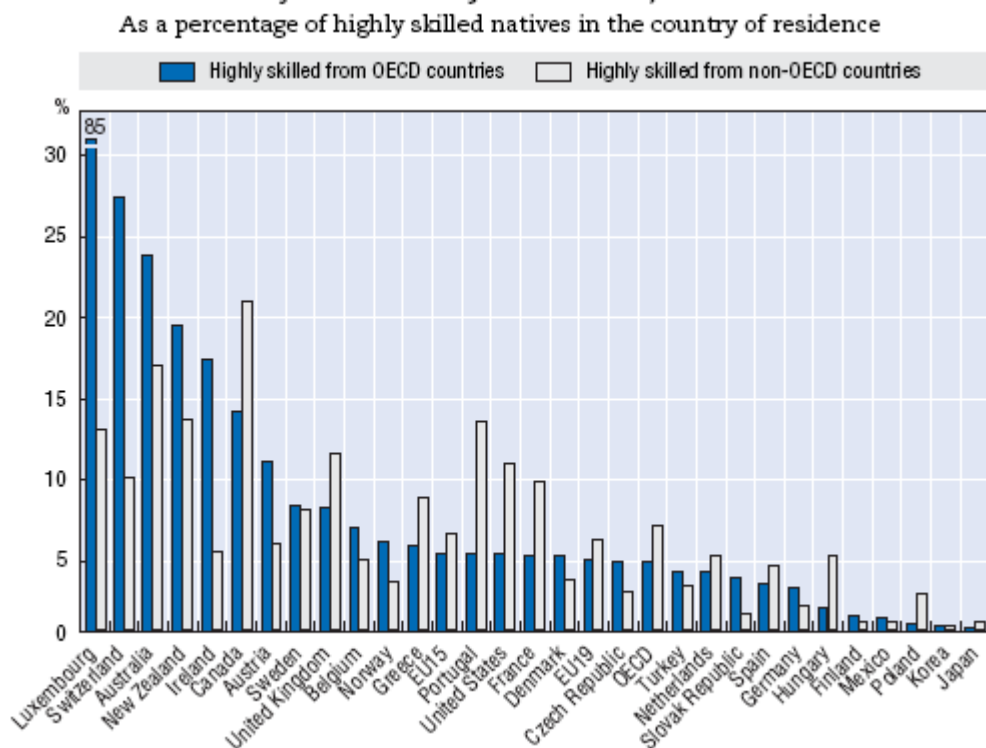
In absolute terms, figure 5 shows that Canada is ranked second within the OECD for the foreign-born immigrants that have tertiary education at slightly

above 2 million and 3% or 69,000 of that are PhDs (Gera and Songsakul, 2005, p. 5).

#### 4.2.2 Comparing OECD vs. Non-OECD Highly Skilled Immigrants

Figure 6 compares the proportion of highly skilled immigrants between OECD and non-OECD countries. Canada has a higher proportion of highly skilled immigrants from non-OECD countries at 21% compared to 14% with OECD countries (OECD, 2008a, p. 76). Which can be explained by the top source countries coming from India and China, as explained in section 4.1

**Figure 6 – Highly skilled migrants from OECD and non-OECD countries, by OECD country of residence, 2001**

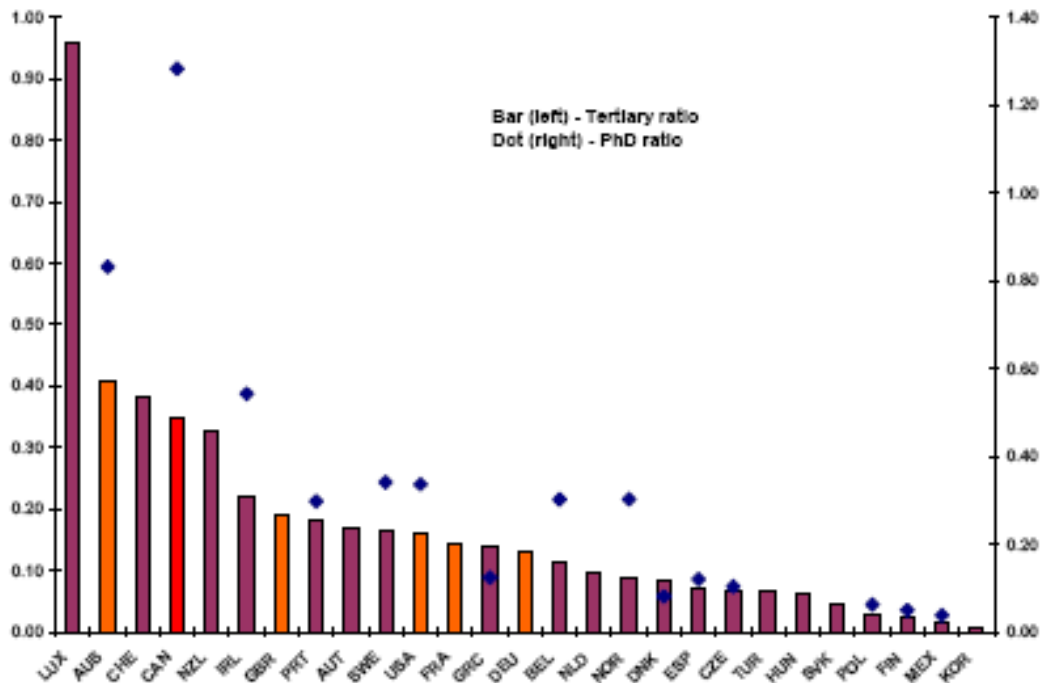


Source: OECD, 2008a, p. 76 © (reproduced by permission from the OECD)

### 4.2.3 Comparing Foreign-born and Native-born Highly Skilled

Figure 7 shows that Canada is ranked fourth among the foreign-born to the native-born with tertiary education, with 35 percent of immigrants to native population that have tertiary education. At the PhD level, Canada has the highest ratio of foreign-born PhDs to native PhDs (1.28) (Gera and Songsakul, 2005, p. 6).

Figure 7 – Ratio of foreign-born to native-born population aged 15+ with tertiary education, OECD countries, 2000-2001



Source: Gera and Songsakul, 2005, p. 6 © (reproduced by permission from Industry Canada)

Table 1 compares Canada’s educational attainment between its foreign-born and native-born population. This table shows that in Canada the ratio of

highly skilled is greater with the foreign-born at 38.0% compared with the native born at 31.5% (ISECD 5/6).

**Table 1 – Educational attainment distribution of foreign-born and native-born population aged 15 or more, competitor countries, 2000/2001**

	Native born (%)			Foreign born (%)		
	ISCED 0/1/2	ISCED 3/4	ISCED 5/6	ISCED 0/1/2	ISCED 3/4	ISCED 5/6
Australia	45.8	15.7	38.6	38.3	18.8	42.9
Canada	31.6	36.9	31.5	30.1	31.9	38.0
UK	51.2	28.7	20.1	40.6	24.5	34.8
US	21.9	51.2	26.9	39.8	34.3	25.9
France	45.8	37.4	16.9	54.8	27.2	18.1
Germany	23.7	56.8	19.5	43.7	40.8	15.5

Notes: ISCED 0/1/2 corresponds to an education attainment of less than upper secondary level, ISCED 3/4 is for upper secondary and post-secondary non-tertiary education, ISCED 5/6 is tertiary education (colleges and university starting from Bachelor's degree).

**Source:** *Gera and Songsakul, 2005, p. 7 © (reproduced by permission from Industry Canada)*

#### 4.2.4 Foreign HRST in Canada

Highly skilled immigrants make a significant contribution to the science workforce in Canada. Table 2 shows that the share of science professionals in the tertiary-educated workforce is frequently higher for migrants, especially those from Asia, than for the native population (OECD, 2008a, p. 79).

**Table 2 – Share of science professionals in tertiary-educated workers, circa 2000**

Percentages						
	Canada	United States	United Kingdom	Australia	France	Sweden
Among Asian migrants	12.8	20.1	10.9	12.4	14.5	8.2
Among other migrants	9.5	10.3	8.6	8.7	10.6	7.1
Among natives	5.8	7.7	9.6	6.7	8.9	8.5

Note: Science professionals defined as ISCO Group 21 (Physical, mathematical and engineering science professionals).

Source: *OECD, 2008a, p. 80* © (reproduced by permission from the OECD)

According to Hall, in 2001 over a quarter of workers employed in high-tech sectors were immigrants, this is higher than the 20% average of all sectors in Canada (Hall, 2006, p. 11). And unlike other sectors such as in medicine or accounting, employers in the high-tech sector appear to recognize and reward foreign qualifications (Industry Canada and HRSDC, 2008, p. 12). Using the first wave of the Longitudinal Survey of Immigrants to Canada collected in 2001-2002, Hall finds that pre-immigration high-tech work experience and foreign education are rewarded with increased likelihood of employment in Canada, while other experience obtained abroad is not similarly rewarded (Hall, 2006, p. 33 - 35).

### **4.3 Trends for Canada**

Looking at the long term patterns of immigrants it appears that with more education, the less likely it is that they will stay in Canada. Table 3 suggests that among countries with selective immigration systems that favour the highly skilled, the percentage of tertiary-educated migrants who stay ten or more years, is considerably lower compared to that of both primary and secondary migrants. This may reflect the fact that more recent cohorts of immigrants are more

educated, but may also suggest that tertiary-educated migrants tend to stay for shorter periods (OECD, 2008a, p. 91).

**Table 3 – Percentage of foreign-born population with a duration of stay of ten or more years**

By country of residence and level of education

	Primary-educated	Secondary-educated	Tertiary-educated
Australia	84.1	76.6	67.8
Canada	74.7	71.3	65.1
New Zealand	79	61.2	57.4
OECD (weighted)	67.4	69.4	64.7

**Source:** *OECD, 2008a, p. 91 © (reproduced by permission from the OECD)*

A study of return and onward migration among working-age men in Canada found that a substantial part of “permanent” migration is in fact temporary, especially for skilled workers (Aydemir and Robinson, 2006, p. 4). This study consisted of a combination of landings records, census data and longitudinal tax filing information. The findings revealed that out-migration 20 years after arrival was around 35% among young working-age male immigrants. They also found that many immigrants make a decision to stay or leave rather quickly, as about six out of ten of those who leave do so within the first year of arrival (Aydemir and Robinson, 2006, pp. 17-18). What is most interesting is that the out-migration rates were higher among immigrants admitted under the skilled worker or business class visa, with around four in ten leaving within ten years of arrival, compared to two or three in ten for those arriving under assisted relative or refugee visa classes (Aydemir and Robinson, 2006, pp. 17-18).



Could this be a global trend? According to the authors, they suggest this finding was consistent within the global labour market, since skilled worker and business groups are more likely to move on the basis of changing relative labour market conditions in various countries. There was also strong evidence of business cycle effects, with cohorts arriving in recessionary periods around 50% more likely to leave than those arriving at other times (Aydemir and Robinson, 2006, p. 18).

In table 4, it shows recent doctorate holders' intentions to move out of the country the next year reveal that 39.2% intended to leave Canada within the next year (compared with approximately 17% of Canadian citizens). This may be a trend that is happening globally (OECD, 2008a, p. 95).

**Table 4 – Percentage of recent doctorate holders having declared their intention to move out of the country in the next year**

	Canada (2003-04)	Portugal (2000-04)	United States (2003)
Citizens	16.6	14.6	5.0
Foreign citizens	39.2	25.0	40.1

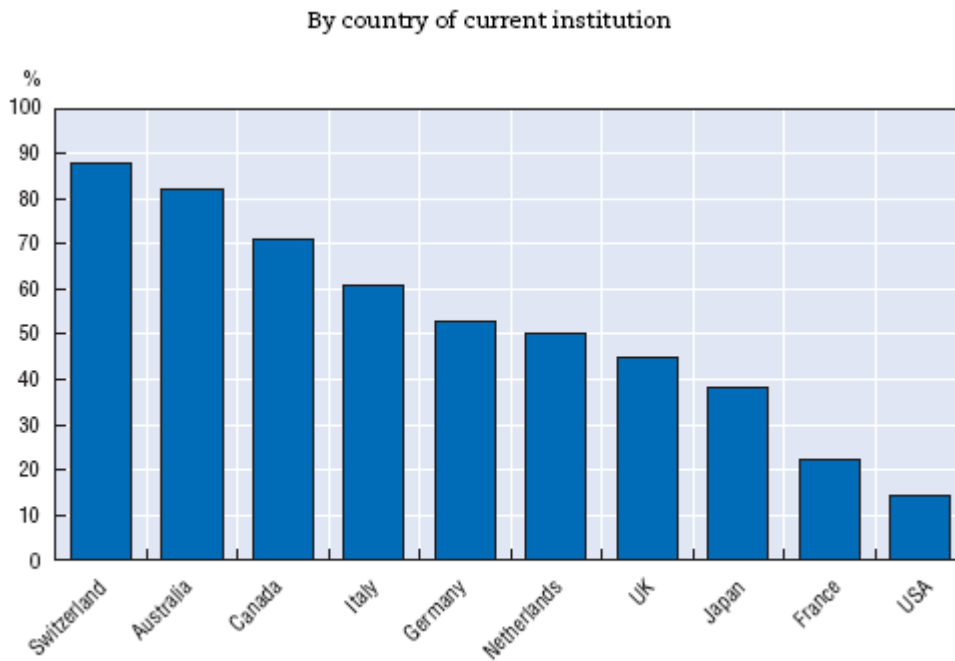
**Source: OECD, 2008a, p. 95 © (reproduced by permission from the OECD)**

#### **4.3.1 What Does This Mobility Mean?**

There is some evidence that academic mobility is associated with higher quality output. From figure 8, roughly 70% of highly cited researchers based in Canada had spent some time in another country during their research careers. This suggests that international mobility and international research performance may be related. In a UK study, career development was the most common

reason given by the highly cited for moving, followed by intellectual opportunities, with 80% of those moving judging that their career had strongly improved (OECD, 2008a, p, 102).

**Figure 8 – Share of highly cited researchers with research experience outside of their home country**



Note: Based on a sample of 494 researchers from the ISI Highly Cited database (1985-2004).

Source: OECD, 2008a, p. 103 © (reproduced by permission from the OECD)

This case study has shown that foreign highly skilled workers make a significant contribution to Canada's skilled labour force. The following three cases studies will show how the return migration is affecting transnational mobility patterns of highly skilled workers. These three countries are source countries for Canada and their return migration may have an effect on Canada in the future.

## **5: THE EMERGENCE OF TAIWAN, CHINA, AND INDIA'S HIGH TECHNOLOGY SECTOR: WHY IS THEIR RISE SIGNIFICANT?**

It is interesting to study Taiwan, China, and India's recent economic success, because all these countries had poor agricultural economies during the post-war boom. Today, Taiwan is a world leader in semiconductors, while India is the global leader in software development services and business process outsourcing, and China has overtaken Japan to become the world's second largest IT manufacturing centre outside the US (Saxenian, 2006, p. 12). How did these three countries get to become the leading technology sectors of the global economy? Their success could be attributed to state policies or on investment patterns of multinational corporations and FDI. However, none of these can explain the rise of home-grown entrepreneurship in these new technology regions.

Policymakers have invested, in varying degrees, in infrastructure, education, and research and development, and multinationals have expanded their investments as well. But the innovative dynamism of the new regions has come not from the state, established firms or foreign investors, but rather from the domestic enterprises started since 1980s with little(if any) state support. The most successful of these, like Taiwan's Acer, India's Infosys, and China's Lenovo, have grown to become significant global competitors (Saxenian, 2006, p. 13).

Instead partial credit could be given to the returnees, who were part of the post-war brain drain, when they earned science and engineering degrees at U.S. universities, and stayed after graduation to work in technology companies.

Countries like Taiwan, India, and China were affected by the post-war brain drain, but now benefit the most directly from the returnees (Saxenian, 2006, p. 13).

These immigrants were often the brightest from their home countries, integrated themselves into local economies by creating ethnic social structures and institutions that supported professional advancement and entrepreneurial success. By extending these social networks to their home countries, they have transplanted the institutions and relationships of technology entrepreneurship and are reshaping global technology competition (Saxenian, 2006, p. 14).

These returnees had a regional advantage, because they had technological knowledge that they were using from Silicon Valley (skills that were scarce in their home countries), and were tapping into their personal networks in their home countries. Using these two advantages, they succeeded in opening up their own businesses, because they also understood the culture and language and how to use the institutions better than anyone else in the world. This is the regional advantage that these highly skilled returnees have in the high technology industry (Johnston, 2006, p. 4).

The link between innovation with the “brain circulation” and regional advantage is that it allowed Taiwan to become a leader in “incremental innovation and improvement on the manufacturing process of technology” (Johnston, 2006, p.5). Taiwan now makes computers and PDAs and anything related to digital devices more flexibly, faster, and at lower cost than anyone else in the world (Johnston, 2006, p.6). In AnnaLee Saxenian’s *The New Argonauts: Regional Advantage in a Global Economy*, she identifies that as people go back and forth, they carry with them all sorts of knowledge and insights into markets,

relationships with customers, technology standards, all of the things that it takes to be innovative. This is what is occurring in these regions with the “brain circulation,” that is creating regional advantages in Taiwan, China, and India that is fostering innovation in the high technology industry (Saxenian, 2006, p. 20).

The following three cases studies will analyze the return migration of traditional sending countries. It will analyze the role of highly skilled returnees in assisting the development of their home countries high-tech sector.

## **6: CASE STUDY OF TAIWAN**

Within its high-tech sector, Taiwan's semiconductor industry has been the hallmark in high-tech industrial achievement. The successful growth of the industry has been attributed to state involvement, especially in the early stages of development. This involvement was government policy to recruit highly skilled expatriates living in the US to work in Taiwan's new Hsinchu Science-based Industrial Park (HSIP) in the 80s (So, 2006, p.64). The establishment of the HSIP was the precursor for semiconductor corporations in Taiwan that were first set up in the science park there and then extended their production networks across Taiwan (So, 2006, p. 67). The HSIP is a centre for IT-related and other high-tech companies. Since its opening, Taiwan has emerged as the world's third largest producer of IT products (Tzeng, 2006, p. 242).

### **6.1 Out-migration of the Highly Skilled**

In the 1960s, Taiwan began to experience an outflow of highly skilled workers as a result of the relaxation of Asian immigration restrictions by Canada, the United States, Australia and New Zealand (Luo and Wang, 2001, p. 255). Thus, between the years from 1960 -1980, over 40 percent of all engineering and science graduates from Taiwan's top universities went abroad for graduate studies (Iredale and Guo, 2001, p.5; Tzeng, 2006, p. 242).

As a result of the American Hart-Celler Act in 1965, this influenced the inflow of Taiwanese highly skilled immigrants to the United States. This act permitted immigration of those who had scarce skills and family ties to citizens or permanent residents (Luo and Wang, 2001, p. 255). Thus, in the 1970s and the 1980s, it became a norm for Taiwanese graduates to go to the United States for higher education degrees and later to stay for possible professional opportunities, resulting in about 95 percent of Taiwanese emigrants to make their choice there (Tzeng, 2006, p. 242).

Taiwanese immigrants in the US have played a large role in Silicon Valley's high technology industry, accounting for 51% of the Asian population. The Asian population made up almost two-thirds of the total foreign-born scientists and engineers, which in turn accounted for one-third of the total employees in Silicon Valley (Luo and Wang, 2001, p. 255-256).

During this period, Taiwan was still relatively poor and under-developed and the average percentage of the returnees based in the US was less than 10 percent (Tzeng, 2006, p. 242.) "In 1977, only 16.2% of students studying abroad returned after the successful completion of their study and fell to 8.2% in 1979. For the major receiving country, the United States, the inflow of foreign talent matched the demand for technical skills in new high-technology industries in Silicon Valley" (Luo and Wang, 2001, p. 255). Part of the reason for not returning was because there were no opportunities in Taiwan for those who had earned an advanced engineering related degree in the US. Consequently, they stayed in the US and worked for high-tech corporations, gaining experience in Silicon

Valley which would later become a valuable resource for Taiwan (So, 2006, p. 67).

## **6.2 When Emigrants Return and Their Role in Development**

In 1952, Taiwan's GNP per capita was US\$196. By the end of 1997, it was around \$US13, 500. Taiwan was now considered to be a newly industrializing economy and this socioeconomic development has been credited by the return migration. This is evident from the 1990 population, where data shows that highly skilled emigrants were returning to Taiwan (Iredale and Guo, 2001, p. 5).

Some may argue that the Taiwanese government's policies to focus on the High tech sector are what enabled them to achieve their economic success as the global High Tech sector was emerging at its height in the late 1980s. This is in fact true, as during that period Taiwan's growth in the high technology industries was associated with three global events in the high technology industry: the boom in the global electronic industry, the specialisation of the electronics manufacturing process and the internationalisation of the division of labour in the electronic industry, as designing companies looked for better and cheaper manufacturers globally (Luo and Wang, 2001, p. 254). These were all characteristics that were mentioned in the literature review that were made possible by globalization. Yet, other factors such as the "professionals, entrepreneurs, politicians, venture capitals" played an important role in Taiwan's high tech transformation as well (Luo and Wang, 2001, p. 254). These factors had important roles that assisted Taiwan's high tech achievement.



The return migration, either temporary or permanent, of highly skilled workers in the Science and Technology sector is argued to be an important factor in Taiwan's economic achievement in the high-tech industry (Tzeng, 2007, p. 242). Because they were a valuable source of transfer of information and know-how, and with their business networks, a substantial amount of credit has been given to the highly skilled returnees . These assets are considered to be crucial for creating high-technology companies (Luo and Wang, 2001, p. 254).

The percentage of returnees jumped to more than 90 percent in the mid-1980s, with the majority holding advanced degrees from American universities (Tzeng, 2007, p. 242). Taiwan's economic prosperity has resulted in a reversal of the brain drain, as a result of the return migration of highly skilled workers and their involvement in Taiwan's high-tech industry.

This return migration of Taiwan's highly skilled personnel is an example of the long term positive impact of its nationals studying abroad. It was these highly skilled returnees who stimulated the establishment of the industrial park of HSIP (Bail and Shen, 2008, p. 21). This industrial park was the main driving force of Taiwan's rapid economic growth in the 1980s. Prior to it, advanced technologies only travelled from the US to Taiwan. However, during the 1990s, Taiwanese nationals that worked in Silicon Valley facilitated and promoted research and development activities back to Taiwan. This was possible because Taiwanese entrepreneurs in the US were highly mobile and had extensive business networks and contacts in Taiwan (Bail and Shen, 2008, p. 21). Thus it was a combination of having high technology knowledge not available in Taiwan,

business networks in Taiwan, and entrepreneurial spirit that allowed the Taiwanese returnees to be a factor in Taiwan's high tech economic achievement.

### **6.3 Government Involvement**

In Taiwan, the loss of Taiwanese students to the US had a negative effect on economic development and attracted nation-wide attention (O'Neil, 2003, online). The Taiwanese government believed they needed to develop tactics to convince overseas Taiwanese, especially foreign university graduates, to return to pursue private and public sector careers. Enticement packages have included reimbursement of moving expenses, free airfare back to Taiwan and job-search assistance (Tzeng, 2007, p. 247).

#### **6.3.1 Science and Technology Parks (HSIP)**

The government decided to create its own version of "Silicon Valley", as it noted the substantial number of expatriates employed in the science and technology and the emergent industries of Silicon Valley in the US (Luo and Wang, 2001, p. 255).

This led to the creation of the Hsinchu Science-based Industrial Park (HSIP) and other initiatives for the creation of high-technology industries. HSIP was established in 1980 as an incubator for new technology-based firms and started out with 17 companies on land totalling 605 hectares (Luo and Wang, 2001, p. 255). The HSIP was also established to lure Taiwanese expatriates back to Taiwan to assist in the national development and to upgrade Taiwan's products to enhance their competitiveness in the global market. It was also an

attempt to foster collaboration between industries, universities, and research institutes (So, 2006 p. 71). The science park was attractive to returnees because it provided good commercial opportunities and services, as well as access to a high-quality living environment resembling that overseas (Luo and Wang, 2001, p. 255).

The Taiwanese government worked to build a transnational community and to develop infrastructure to help recruit highly skilled workers in the US to return home in an effort to minimize the “brain drain.” To lure returnees back to Taiwan, HSIP had Taiwan’s top research institute (ITRI) and two leading universities, Tsing-Hua and Chiao-Tung universities and a wide range of choices for career investment (Luo and Wang, 2001, p. 256).

To initiate cooperation, scientists and engineers based in the United States and Taiwan were brought together in government-sponsored meetings and conferences. These events helped to build personal and professional relationships between engineers, entrepreneurs, executives and bureaucrats for both US and Taiwanese based skilled workers. The Taiwanese scientific diaspora in the US gave advice on the formulation of industrial policies. “They were also willing to bring new technologies and industries to Taiwan and offer opportunities in the then emerging sectors of microelectronics and computer hardware development” (Luo and Wang, 2001, p. 256). Even though the Taiwanese diaspora in the US did not permanently return to Taiwan, they did facilitate cooperation in helping Taiwan develop its IT sector. HSIP was home to

121 high technology companies by the end of the 1980s and many of which were set up by returnees.

## **6.4 Return Migration in Depth**

The impact of Taiwan's highly skilled returnees on its economic development has been widely noted (Iredale and Guo, 2001, p. 9; So, 2006, p.71). The emergence of the returnees began increasing in the late 1980s and correlates with the establishment of the HSIP during the same period. (Iredale and Guo, 2001, p. 9) HSIP became the destination for hundreds of returnees who started new companies or took positions in existing companies (Luo and Wang, 2001, p. 256). The success of the IT and other high-tech industries within HSIP reveals that highly skilled returnees have played a critical role in Taiwan's economic development, even though the number of returnees to Hsinchu was relatively small in the 1990 census (Iredale and Guo, 2001, p. 7). Overall, "the widely cited Hsinchu model has shown that the return flow of human talents has had a strong impact on both regional development (mezzo level), as well as national (macro) economic development" (Iredale and Guo, 2001, p. 9).

### **6.4.1 The Stock of HRST of Returnees**

The number of returnees from 1985-90, were around 50, 000 based on a survey of the 1990 population census (Luo and Wang, 2001, p. 256). After completing their studies, an estimated 33% of students that studied abroad returned with a return rate three times higher than that in 1980. It is estimated that more than 30% of the engineers who studied in the United States returned to

Taiwan, three times the 1970s return rate. About 43% of these returnees have at least a college education and more than 30% are employed as professionals and managers (Luo and Wang, 2001, p. 256).

HSIP had the highest concentration of Taiwan's high-technology industries and had been known for its high capacity to absorb the best-educated returnees, in particular those with graduate education (Iredale and Guo, 2001, p. 9; Luo and Wang, 2001, p. 256). For example, most of the highly skilled workers that had PhDs worked in the six largest industries in HSIP's and had been educated abroad (Luo and Wang, 2001, p. 256). For example, PhD returnees in HSIP accounted for about 78% of its total labour force at that time (Iredale and Guo, 2001, p. 9).

The number of returnees working in HSIP was 27 in 1983, 223 in 1989, but 3 265 in 1999 and 4 108 in 2000. HSIP contained 289 companies in 2000, of which 113 (39%) were started by mainly US educated engineers, often with professional experience in Silicon Valley (Iredale and Guo, 2001, p. 9; Luo and Wang, 2001, p. 256).

#### **6.4.2 Brain Circulation in Action**

Some returnees did not return permanently. These returnees are called "transnational workers" or "astronauts", because they work both in the US and in Taiwan. The majority of this group consists of managers, engineers, investors and venture capitalists, who often travel between Silicon Valley and Hsinchu (Luo and Wang, 2001, p. 256).

While these “transnational workers” are doing business across the two countries, their families are mostly based in the United States. They play an important role as middlemen, linking businesses in the two regions through their personal networks and their technological and market know-how. As a result, a total of 70 HSIP companies now have offices in Silicon Valley, with executives and managers who work in both countries. “These companies often make decisions and obtain new sources of knowledge, technology, capital and business opportunities through their CEO’s personal network and their connection to industrial networks in Silicon Valley” (Luo and Wang, 2001, p. 256). In this way, it allows for a special connection to be made between distant producers to collaborate to upgrade their technological capabilities (Luo and Wang, 2001, p. 256).

## **6.5 Taiwan Case Study Conclusion**

These highly skilled returnees utilised their skills and knowledge gained overseas and through word of mouth, these returnees promoted the opportunities in HSIP to their friends living in Silicon Valley to return to Taiwan. What made the highly skilled returnees valuable were not only their skills and knowledge, but also their international connections. These connections have a positive impact on the development of their business ventures. The returnees’ links with the U.S. are particularly important, not only economically speaking. The Taiwanese government recognizes this and considers them to be highly valued as a group and has gone out of its way to attract them back and support them (Iredale and Guo, 2001, p. 9).

As Taiwan has developed both politically and economically, Taiwan is now an attractive place for returnees. This trend will continue given there are no internal or external political crisis. Overseas Taiwanese will continue to have positive views towards Taiwan's development and thus the return of highly skilled Taiwanese will continue (Iredale and Guo, 2001, p. 9).

The following case study on India will show a similar pattern of highly skilled immigrants returning home to assist in the development of their home country's Science and Technology sector.

## **7: CASE STUDY OF INDIA**

Since the 1990s, India's IT sector has emerged as one of the world's most attractive and dynamic centres for technology development. The Indian government wants India to become one of the leading nations in information technology and a "global IT super power", by having one of the largest manufacturers and exporters of technology products in the world. For India, the information technology sector is seen as a chance to overcome poverty and as a means for economic development (Hunger, 2004, p. 101).

### **7.1 History of the Outflow of Highly Skilled Indians**

Beginning in the 1950s, India experienced a large scale emigration of highly skilled workers to developed countries such as the US, Canada, the UK, and Australia (Khadria, 2004a, p. 6; Soni, 2008, p. 11). At the time of emigration, many were young highly skilled workers and professional experts. They had received their education and training at the best institutions in India (Chacko, 2007, p. 134). For example, about 3, 000 came from Indian Institutions of Technologies, the most prestigious schools in India. They left India to go to the US to pursue higher education. In the US, of the Indian immigrants who reported their occupation, about 65% of them were highly skilled workers. They also ranked near the top of all Asian countries living in the US, which included Japan. Student that attended US Universities for graduate school often remained in the



US. Therefore, emigration had left India with a shortage of workers in the fields of science, engineering and technology. This became a concern for India, as it was producing around 25, 000 workers annually in those sectors (Soni, 2008, p. 12).

This emigration was a major concern for India, but India is now seeing some of its positive effects. As with Taiwan in the first case study, India's highly skilled expatriates are now returning. Today, India has begun to profit from the return migration of its highly skilled workers that immigrated to the US. This return migration is evident by Indian information technology entrepreneurs returning from the US (Hunger, 2004, p. 100; Leclerc and Meyer, 2007, p. 160).

## **7.2 Return Migration**

In the last few decades, India is experiencing the return migration of their highly skilled workers (Chacko, 2007, p. 134). The Indian government does not have detailed figures of these return migrants but their presence can be seen throughout India (Khadria, 2004b, p. 9; Soni, 2008, p. 20). For example, there is evidence of a large portion of top-level management positions that are present in the Indian software sector; that are filled by Indians who left (mainly to the US) in the 1960s, 1970s and 1980s and have now returned (Hunger, 2004, p. 103). Most recently, a trade group of Indian outsourcing companies called Nasscom, estimates that more than 30,000 technology professionals have returned to India during 2004 and 2005 (Soni, 2008, p. 20). The return migration of highly skilled workers to India is thought to be a contributing factor for the success of the information technology sector in India (Hunger, 2004, p. 103).

The most preferred destinations for returnees are Bangalore, Hyderabad and Mumbai. These places are attractive because the work environment is westernized, the salaries are competitive and it is a great place to start their career (Soni, 2008, p. 20). Bangalore, is considered to be the high-tech city of India with over 900 software firms located there and thousands of overseas Indian IT professionals who have relocated there (Dittrich, 2007, p. 48; Soni, 2008, p. 20; Vijayabaskar and Krishnaswamy, nd, p.2). Along with the second-generation of Indians, many returnees are first-generation expatriates. An increase in foreign investment in research and development in India over the last five years has occurred with the return migration. This is an indicator of India's growing reputation as an intellectual powerhouse in the IT services sector. Credit has been given to the return migration of skilled workers and researchers who are working as catalysts in this boom (Soni, 2008, p. 20).

### **7.3 Returnees a Factor in Development**

India's economic liberalization at the beginning of the 1990s coincided with the rise of India's IT industry. This was initiated by India's highly skilled expatriates that either built up networks or enterprises in India either by returning to India or by staying in the US through branches of their US companies (Hunger, 2004, p. 103). In the mid and late 1990s, some of the members of the diaspora started their own IT companies in India such as Cognizant, Techspan, Mphasis, while others invested in growing IT and Dot.com companies in India (Pandey et al, 2004, p. 13).

During late 90s when the US, Canada and UK were facing a shortage of IT workers, the Indian diaspora stepped in to convince their companies to hire Indian IT professionals, creating a stronger Indian IT diaspora network and giving younger expatriates valuable IT experience. As a result, Indians constituted 24 percent of the entire Silicon Valley IT professional population by late 1999. Lastly, the Indian diaspora contributed to the outsourcing of R&D centres in India, with around 100 MNCs implementing R&D facilities in 2003 (Leclerc and Meyer, 2007, p. 164). These Indian expatriates were senior executives at major US corporations, like IBM, GE and American Express, who now played a key role in American companies' decision in where to invest in or outsource work (Pandey et al, 2004, p. 13).

In India, these highly skilled returnees were able to utilize government subsidization policies within the IT sector to their advantage in the software industry and thus, revitalized the IT economy of India. The result was in 2000, 10 out of the 20 most successful software enterprises in India, which represents more than 40% of the total revenues within the industry, were set up and, or were managed by former Non-Resident Indians that were returning from the US (Hunger, 2004, p. 103).

### **7.3.1 Returnee Organization Development and Linkages**

By the 1990s, India's highly skilled diaspora that had immigrated to the US in 1960s had either become entrepreneurs, venture capitalists, or high-level executives in large and medium sized companies. These Indians began to network with one another as many had graduated from the same prestigious

academic institutions in India (such as the IITs) and maintained contacts with their counterparts in India (Pandey et al, 2004, p. 13). Some of these relationships quickly developed into non-profit associations such as TiE and SIPA (Silicon Indian Professional Association).<sup>7</sup> For example the National Association of Software and Service Companies (NASSCOM) is a central organization that represents 96 per cent of all software enterprises and has played a key role within the economic revitalization of India. Since the beginning of the software boom it functioned as the central employer organization of the sector and as a lobby organization (Hunger, 2004, p. 101).<sup>8</sup> Many of these organizations had contributed to the rise of the Indian software sector.

#### **7.4 Government Involvement and Fostering Entrepreneurship**

An information technology incubator was set up in Mumbai's Kanwal Rekhi School of Information Technology in 2001 to slow down Indian Institutes of Technology (IITs) emigration and other engineers. As a result, a culture of entrepreneurship was fostered in the areas of advancing intellectual property and products among them. To encourage engineers to work in India, this incubator had a variety of technical fields and also allowed for commercialization of their technologies. Other cities' IITs such as the IIT Delhi, IIT Kanpur and IIT Madras have also started their own business incubators (Soni, 2008, p. 21).

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<sup>7</sup> TiE, originally designed as a Silicon Valley organization to provide mentoring to promising young expatriate IT professionals, soon developed into a worldwide network of Indian professionals. Currently, TiE has 38 chapters and over 6,800 members, worldwide (Pandey et al, 2004, p. 13).

<sup>8</sup> The Indus Entrepreneur (TIE) is another influential organization. The organization tries to help young Indian entrepreneurs to establish new enterprises and to attract venture capital. In 1998, TIE extended its activities to India where it also contributes to the financing of the central IT training centres (Hunger, 2004, p. 101.)

#### **7.4.1 Pull factors: India an Attractive Place to Return**

When India lacked basic infrastructure and basic amenities, and its private sector was immature, R&D was in its infancy, and was unable to offer opportunities for its highly skilled workforce; India's highly skilled workers looked for other opportunities abroad. Today, that is changing as India has improved in these areas and is emerging as a favourable destination. India's growing economy and Indian research and development institutions are providing a competitive research environment. In addition, Indian multinationals have emerged as global players in the last two decades (Soni, 2008, p. 13). This may be a strong motivating factor for highly skilled emigrants to return to their homeland.

#### **7.5 Bangalore as a Corridor of IT Professionals**

In 2002, Khadria conducted a field study in Bangalore to assess the role of return migrants in the development of Bangalore as a "corridor" for the movement of IT professionals internationally (Khadria, 2004a, p. 6). For this study, because there were no statistics available on return migration, Khadria had used informal contacts with a total of 45 respondents that participated in the study within the IT sector. Therefore, because of the sample design and the sample size, Khadria warns that no statistical significance should be sought in this survey, as the evidence presented was "purely anecdotic" (Khadria, 2004a, p. 7). However, this case study is a good indication of what trends are occurring in Bangalore and its importance for India's S&T sector.

The most popular host country was the US with 36 respondents, followed by the UK (Khadria, 2004a, p.8). According to the study, employers have been the most important motivators for out-migration of professionals from Bangalore, as about half of the respondents (23 out of 45) went on professional assignments abroad (Khadria, 2004a, p.9). The out-migration was relatively short as one third of the return migrants had gone abroad for less than two years. This short stay can be explained by employers in Bangalore giving those returned migrants short assignments abroad. The average time spent abroad for the entire sample was 4.6 years.

In the study, Khadria finds that not a single respondent had intentions of settling down permanently. This may “conclude that the emigration of IT professionals from India was more of a temporary phenomenon aimed at fulfilling the short term gains” (Khadria, 2004a, p. 10). These short terms gains were to obtain experience that would later be highly valued in India. This was based on the belief that developed countries had an edge in technological advancement and were professionally more accomplished (Khadria, 2004a, p. 11).

Some motivating factors to return included family, the recognition of India as a major emerging IT global power, the increase in employment opportunities in India, particularly in the IT sector, higher real earnings’ in India, and expectations of better business and entrepreneurial opportunities in India (Khadria, 2004a, p. 12).

The majority of respondents found that the knowledge and skills gained abroad through higher education and on-the-job training was very useful for their

current jobs in Bangalore. For example, the opportunity to work abroad helped equip them with the most recent technologies. Also, the role of professional networks established overseas has helped them in their current jobs in Bangalore. These networks are important sources of information on several professional issues like technology, management, outsourcing, etc. (Khadria, 2004a, pp. 16-17).

Finally, the study found that if returnees were offered a job abroad, 35 out of 45 expressed a desire to re-emigrate, if arrangements were made by their employer. However, over 39 out of 45 responded that they would not settle abroad permanently (Khadria, 2004a,p. 18).

The final case study on China further elaborates the role of the return migration of highly skilled workers on the development of the home country's science and technology sector and how a traditional sending country such as China has developed policies to recruit their expatriates back home. These highly skilled returnees receive special status and are rewarded when they transfer technology that is new to China.

## **8: CASE STUDY OF CHINA**

To help China modernize since the late 1970s, Chinese leaders have promoted the idea to students to study abroad (Keren et al, 2003, p. 89). In 1980 when Deng Xiaoping opened China to the world, he wanted students to gain management skills, new scientific and technological information, and foreign capital from the West. He claimed it was "part of mankind's common heritage" (Zweig et al, 2006, p. 451). This was followed by Premier Zhao Ziyang in 1983, who introduced educational and scientific reforms that allowed universities to send students abroad on their own. This was done out of a concern that China had fallen far behind the West technologically. Chinese leaders knew the brain drain was occurring in 1998, but the State Science and Technology Commission argued that by allowing people to stay abroad, China would gain easier access to Western technology. Former President Jiang Zemin's slogan of "strengthening the country through science and education" created the incentive for returnees to contemplate on returning to China (Zweig et al, 2006, p. 451).

### **8.1 Time for the Chinese to Return**

The Chinese Ministry of Education statistics states that 1,067 million students and researchers left China to study abroad between 1978 and 2006 (Bail and Shen, 2008, p. 14). These emigrants were often China's brightest, especially in the science and engineering disciplines. Thus, as with the other two



case study examples, China suffered a serious 'brain drain' problem, in its higher education and research institutions (Keren et al, 2003, p. 90). China's talent shortage was evident in a study using data on publications by Chinese scientists from 1995-2000. It found that the brain drain had created a research gap within China's scientific community, as people between the ages of 28-36 were not publishing in China. Many of them were not in China, but were based abroad. In most countries, this group is considered to be the most productive age cohort in the natural sciences (Zweig et al, 2008, p. 3).

However, in recent years, it has been observed that an increasing number of students have returned to China (Zweig et al, 2008, p. 2). In 1998, it was reported that 7,379 students came back, which was a sharp increase, compared with 1,593 returnees in 1990. The Chinese newspaper Xinhua, claimed that about 80 percent of Chinese students overseas intended to return back to China to start a career (Keren et al, 2003, p. 90). The trend is increasing dramatically, for instance in 2000, there were 9,100 returnees, doubling to 20,100 in 2003, doubling again in 2006 to 42,000. Up until 2006, there had been a total of 275,000 returnees to China, more than one quarter of the total outbound migration (Bail and Shen, 2008, p. 14).<sup>9</sup>

## **8.2 Government Programs and Incentives**

There were a series of programmes implemented by Chinese governments at various levels since the mid-1990s aimed to attract 'overseas talent' to return

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<sup>9</sup> However, there are problems of getting reliable data on the numbers of the return statistics, because returnees do not register at the Chinese embassy in their host country and the returnee figures could be higher than the ones issued by the ministry (Bail and Shen, 2008, p. 14).

to China by offering them positions, to manage research projects or to invest in private business or joint ventures (Xiang, 2007, p. 15).

A number of science parks, special development zones and high-tech zones have been created in Beijing, as well as in most provincial cities. In 1990, the Beijing government encouraged Chinese students and scholars abroad to work in its ZhongGuanCun Science Park. The government provided returnees with a number of benefits that included, “simplified application and registration procedures for setting up a business venture, waiver of business taxes in high-tech areas,.. to eligibility to import some tax-free durable goods for personal use” (Keren et al, 2003, p. 92). The Beijing government welcomed returnees that had scientific and technological projects or programmes that had potential to develop and produce new high-tech products.

The returnees that settled in the Science Parks were offered excellent facilities and beneficial policies. In return, they were supposed to turn their research innovation into commercial projects. The Beijing municipal government invested about USD 3 million to support returnees and set up 12 parks in Beijing in 2004 (Xiang, 2007, pp. 15).<sup>10</sup>

A special name, Haigui, or Sea Turtle, has been given to student returnees from overseas (Xiang, 2007, pp. 15-16). The Human Resources bureau at ZhongGuan Village Enterprise Park defines Haigui “as those who have studied abroad, either have obtained a university degree abroad or have spent

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<sup>10</sup> In other cities, Shanghai has six high-tech parks designated for returnees, and every enterprise in the parks is entitled to an interest-free loan up to RMB 150,000. Returnees in Shenzhen in the Guangdong province, can apply for a grant of RMB 100,000 – 150,000 to start a firm once their project proposals are approved by the municipal government (Xiang, 2007, p. 16).

more than one year abroad under the frame of an exchange program” (Bail and Shen, 2008, p. 12).<sup>11</sup> These returnees today hold a special status and are regarded as missionaries helping to serve in China’s development (Bail and Shen, 2008, p. 12).

An emerging trend of highly skilled and business returnees in China is occurring, in part because of the government policies that encouraged the return of these highly skilled workers. Returnees play a critical role in transferring to China what they learned and gained while overseas. Also, many of them were placed in high profile positions either in enterprises or research institutes when they returned (Keren et al, 2003, p. 109).

### **8.3 Impact of Returnees**

The return migration is being driven by technology as governments at all levels want returnees to bring back technology to enhance economic development and are rewarded when they do so. The returnees’ technology is needed in the high-tech zones as it is part of these zones’ mandate to promote high-tech development, because China had lacked modern technology, returnees that have new technology help to promote the development of newer firms in China to develop (Zweig et al, 2006, p. 468). For example, “these returnees have brought back innovation in management and technical skills, capital, talents and a new mentality. They have introduced China to venture

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<sup>11</sup>A brief profile of a Haigui is as follows: “the Haigui’s average age is 26 years old when leaving China and 32 when returning. They studied for five years and worked for three years abroad on average. In China they mainly work in consulting and other services, in the cultural sector or in the media. Many work for foreign or foreign-founded companies or in industrial parks dedicated to returnee entrepreneurs. The average income is between 60,000 to 120,000 yuan” (Bail and Shen, 2008, p. 13).

capital and launched start-ups which were necessary for the development of the IT sector” (Bail and Shen, 2008, p. 23).

### **8.3.1 Profiles and Accounts**

AsialInfo was founded by two returnees. AsialInfo had a significant role in the construction of China’s national infrastructure and provincial access networks when it relocated its major operations from the US to China in 1995. It is now a leading provider of high-quality telecom software solutions and IT security products and services to some of China's largest enterprises such as China’s national telecom carriers including, China Mobile, China Netcom, China Telecom and China Unicom<sup>12</sup> (Bail and Shen, 2008, pp. 23-24).

### **8.3.2 What Makes Returnees Special**

Returnees have brought back important contributions to China with leading edge research in nuclear engineering, superconductor technologies and gene mapping. These returnees often work in key research fields in terms of the knowledge economy (Bail and Shen, 2008, pp. 24-25.)

In a study by Zweig et al, returnee entrepreneurs bring back technology that allows them to have a comparative advantage in the domestic economy. In 2001, among returnees interviewed in high-tech zones, 48% had imported a

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<sup>12</sup>Another example is Zhang Zhaoyang who returned in 1997 from the US, and is considered to be “an emblem of the engineer-entrepreneurs” who had returned to China to work in the Internet sector. He founded one of the three main portals on the Chinese net: Sohu.com. Also, in 1999, Tan Haiyin and Shao Yibo, two MBA students at Harvard University, created eachnet.com. This was an auction website, however it was bought out by eBay at the beginning of the 2000s (Bail and Shen, 2008, pp. 23-24). The same year, Li Yanhong founded Baidu.com, which is the leading Internet search engine in China, and is used more widely than Google (Bail and Shen, 2008, pp. 23-24).

foreign technology compared with 21% of locals. While another survey found that in 13 technology incubators, 55% of returnees who had set up companies had brought in independent patented technology. Also, it was found that a large part of the overseas students who have returned to set up ventures belong to enterprises that directly utilize technology and knowledge acquired abroad to enter service trades in China that were short of technology and knowledge (Zweig et al, 2006, p. 459-460).

Even though the returnees may not be transferring the newest international technology, it was found that many returning entrepreneurs had technology that would be competitive in China's expanding market economy. Therefore, this technology gives returnees a comparative advantage in China where the product faced few competitors, but was in great demand. This comparative advantage could motivate reverse migration (Zweig et al, 2006, p. 465).

#### **8.4 Push and Pull Factors of Chinese Professionals in Canada**

In Canada, Lin et al., found that the push factor for highly skilled Chinese transnational entrepreneurs (CTEs) were the barriers they faced associated with “glass-ceiling” and racial discrimination, both at individual and institutional levels. Another push factor was a feeling that their career development was stalling and they did not see their future match their vision and ability. Instead they realized a personal business venture would be the most viable next step in their professional growth (Lin et al, 2008, p. 10).

The most influential pull factor is the emerging economy in China. As mentioned in 8.3.2, even though returnees may not have had the leading technology, they had identified a gap of some kind between the two countries. The gap may not necessarily be technological but rather related to market structure. Another reason could be to avoid competition from the US. For example, a Chinese transnational entrepreneur developed an innovative piece of software with the potential to challenge the market leader in North America. He is now considering returning to China to avoid head-on competition with the U.S. companies (Lin et al, 2008, p. 10).

One powerful force attracting Chinese expatriates are the various efforts by the Chinese government to lure diaspora professionals back “home”. In Lin et al’s study, they found that about half of their interviewees had participated in the “China Venture Tours” organized by a Chinese science park designated for Western returnees and as a result, several of them decided to set up a business in the park.

Lastly, another pull factor is the social capital, for example personal ties in China. These CTEs tend to believe that opportunities are embedded in the social structure, as according to one CTE, “social connections are one of the three things that would enable a successful venture in China, the other two being technology and money” (Lin et al, 2008, p. 10).<sup>13</sup>

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<sup>13</sup>Thus, when a Chinese immigrant in Canada has substantial social connections in China, s/he is likely to consider taking advantage of them when launching a business venture. According to one CTE, before he knew what kind of business his new venture would be in, he had already decided that it should involve China (Lin et al, 2008, p. 10).

As a traditional receiving country, Canada will definitely be affected by this outmigration of highly skilled immigrants that had chosen Canada as a country to settle. The return migration of these Chinese transnational entrepreneurs is a prime example that immigration may not be permanent, but rather temporary. The final section comments on Canada's settlement and integration programmes for newly arriving immigrants and considers an alternative means for maintaining a relationship with Chinese students that are returning to China at the end of their studying period in Canada.

## **9: REFLECTIONS**

For a receiving country like Canada, within the next 15 to 20 years, immigration will be the only source of net population growth because Canada has reached below replacement fertility rates (Canadian Labour and Business Centre, 2002, p. 2). Like most OECD countries, Canada uses immigration as a method to increase the size of the working population (Aydemir and Robinson, 2006, p.3; Chalamwong, 2004, p.3).

Canada is currently a net beneficiary of highly skilled immigration, partially due to Canada's skill-based points system that was introduced in the early 1990s. This skill-based points system has helped Canada raise the number of highly skilled immigrants significantly between 1991 and 2000, compared to the previous decade (Industry Canada, 2007, p. 29). As mentioned in section 4.2.4, highly skilled immigrants make a significant contribution to Canada's science workforce. With China and India currently being Canada's top source countries for immigration, the possible return migration of these immigrants may have a negative impact on Canada in the future. During a time when the mobility of highly skilled workers has increased, it is important for a receiving country like Canada to acknowledge that permanent migration may not be on the minds of today's migrants.

Canada is an example of a country that spends resources on settlement programs for their newly arrived immigrants (Aydemir and Robinson, 2006, P. 3).



If some of these immigrants intend to return to their country or immigrants that use Canada merely as a stepping stone to go to another country, such as the US, the investment in these services will be reduced if these returning immigrants have used these services (Aydemir and Robinson, 2006, P. 4). Of course Canada should try to continue to develop settlement and integration programs for newly arriving immigrants, in hopes that they do choose to decide to stay permanently. However, an acknowledgement of their increased international mobility should also be made and considerations should be made to accept this mobility and develop strategies to make use of this knowledge.

For example, learning from the three case studies of the return migration of highly skilled immigrants to Taiwan, China, and India, these three countries had developed diaspora policies to tap into their expatriate communities. Canada can do a similar strategy by developing a network or association of immigrants that are currently in Canada. This strategy is slightly different, in that it is a proactive approach that can be used as a forum to exchange ideas and create potential business partnerships between all members, but separated into different sectors. This network should not be exclusive for immigrants in Canada, but rather inclusive to all Canadians. However, if it is membership based, and if members leave, in this case, immigrants, they can be tracked (by asking where and why they are leaving). Thus, if it is an immigrant that is leaving, an invitation could be offered to be an alumnus of the network to continue to engage with current members of the community in Canada for future business opportunities and partnerships.

Another issue for Canada is that it faces a challenge of getting people it has educated to stay. Since students are the future, Canada needs to consider how to keep them in Canada, or figure a way to maintain ties with them if they are returning. The following study by Zweig raises the issue if Canada should increase education subsidies to Chinese students studying in Canada, in hopes that it will create positive views of Canada and foster future ties with Canada when they return to China.

## **9.1 What Canada Could Do**

In a study by Zweig, he studied the return migration of Chinese students in Canada that went back to China after completing their studies. He analyzed how these returnees felt about Canada, specifically how they felt about their educational and work experience in Canada. He wanted to know if academic flows into Canada and the subsequent “reverse brain drain” back to China could enhance Canada’s soft power. For example, positive feelings could translate into more frequent interactions, while negative feelings could lead to fewer interactions (Zweig, 2008, p. 1).

From Zweig’s research, he noted that the type of Chinese students that are going abroad to study have changed, as the new middle class can now afford to study abroad. Also, since 1999, the number of Chinese students studying abroad has increased from 1995-1999 the number was 22, 000 compared with the yearly average from 2002-2005 it was 117, 000 (Zweig, 2008, p. 3). These students are found to be concentrated in the Business (50.5%), and Industrial & Applied Science (19.9%) disciplines (Zweig, 2008, p. 5). Since these students

returned to China relatively quickly, 4 years or less, the ties that were developed in Canada may not have been that strong (Zweig, 2008, p. 6).

In Zweig's study, he found that Chinese students had very positive views towards Canada and was the only country, out of seven listed which included the US and Japan, which saw the percentage of supporters increase as the feelings get very positive (Zweig, 2008, p. 9). Zweig argues that the source of funding of Canadian university education could affect Chinese students' level of positive experience while in Canada (Zweig, 2008, p. 18). While these students still go back to China, returnees may enhance Canada's soft power in China. Thus, the students that received full funding from the Canadian government had the highest percentage of positive experience while in Canada, compared to the students that had to pay their own way (Zweig, 2008, p. 19). Also, Canadian funded students were far more likely to revisit Canada, which indicates established ties between the two countries. Once these students returned to China, their salaries were high, suggesting that they are part of China's middle or dominant social class, making them good partners for future Sino-Canadian ties (Zweig, 2008, p. 20).

These students left Canada, not because they weren't doing well, but because they thought they could do much better in China. About 25% of the returnees in the Chinese workforce work in companies that carry out trade with Canada. They might not be in influential positions at the moment, but they are well positioned to play a role in the future of Sino-Canadian trade (Zweig, 2008, p. 2008). Lastly, Zweig suggests that Canadian consulates should network and

be engaged with the returnee community, suggesting that Canada should create “Returnees from Canada” associations in major cities in China that would maintain links between students who studied in Canada (Zweig, 2008, p. 22).

## **10: CONCLUSION**

The return migration of highly skilled workers to their homeland has changed the transnational migration dynamic and the organization of R&D in the Science and Technology sector. With the fragmentation of the high-tech sector, it gives developing countries an opportunity to catch up with developed countries in high-tech expertise and leadership. The developing countries such as China, India and Taiwan called on their diaspora to assist in the development of their Science and Technology sector, and their highly skilled expatriates answered their call.

These highly skilled expatriates were transnational entrepreneurs and are valuable assets to their homeland because of their knowledge and expertise within the Science and Technology sector, transnational networks, and their ability to work in both the home and adopted countries' work environments. Their mobility has increased as they are now being attracted by both developed and developing nations to work in their Science and Technology sectors.

With open innovation, companies will need to collaborate with other companies to be competitive. Some of this collaboration will be with global companies. Highly skilled workers can be valuable assets to companies, as they may be able to assist in creating partnerships and links through their networks.

For a receiving country such as Canada, which relies on immigration to increase its population, it should make note that not all immigration is permanent,

but rather return or onward migration is possible. Canada needs to recognize this and should consider developing policies to attract highly skilled students to remain in Canada by providing them with incentives such as job opportunities or subsidies to their higher education.

In a knowledge-based economy, innovation will become a key driver in the global economy. Those countries that are most successful in attracting and maintaining a highly skilled work force will be the leaders in this new economy. A successful response to the growth of the knowledge-based economy of the future means that we recognize and prepare a policy that embraces the global migration patterns of highly skilled workers.

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