Economic Growth and Foreign Workers in ASEAN and Singapore

Shandre Mugan Thangavelu
Department of Economics
National University of Singapore
1 Arts Link, AS2, 6th Floor
Singapore 117570
ecssmt@nus.edu.sg

Abstract
This paper studies the trends of foreign immigrants in Asia and their effect on the growth of the Singapore economy. The paper also discusses the key labor market trends and the rationale for foreign workers in a small open economy like Singapore. Further, the paper highlights key simulations of the impact of foreign immigrants on output growth and wage gap for the Singapore economy by using Thangavelu’s (2011) dynamic general equilibrium model. The study accounts for the flow of skilled and unskilled foreign workers on (a) steady-state growth; (b) the wage gap between the skilled and unskilled workers; and (c) innovation capabilities of the domestic economy. Further, the model also accounts for the contribution of immigrants on the welfare of the domestic economy through the immigration surplus that will accrue to the domestic economy.

1. Introduction
In a globalized environment, immigrant labor is an important source of human capital to complement and enhance economic growth. In the past two decades, international labor mobility is increasingly becoming an important component in driving global trade and integration. Between 1990 and 2010, the United Nations estimated that the stock of international migrants has increased from 155 million to almost 215 million, and is growing at an average annual

I would like to thank Huang Xiaodan for research assistance. I would also like to thank Chia Siow Yue, Iris Claus, and participants at Asian Economic Panel Meeting at Keio University, 16–17 September 2011, for their comments on an earlier version of the paper.

Asian Economic Papers 11:3 © 2012 The Earth Institute at Columbia University and the Massachusetts Institute of Technology
growth rate of 3.3 percent.\(^1\) In most cases, migrants are moving to developed countries such as the EU, United States, United Kingdom (UK), Canada, and Australia. This is reflected by the growing proportion of migrants in these countries, as shown in Figure 1.

Recent studies highlight that the inflow of skilled immigrants could increase the expected returns on education and that the host economy could benefit from the inflow of skilled immigrants in terms of complementing the domestic human capital and increasing the domestic innovation activities (Vidal 1998; Mountford 1999; Stark and Wang 2002; Chander and Thangavelu 2005). Migrant workers can be an important source of human capital for economic growth. Recent studies point to the positive effects of highly skilled immigrants on innovative activities in the domestic economy such as increasing innovation and generating beneficial spillover effects (Peri 2007; Hunt and Gauthier-Loiselle 2008; Chellaraj, Maskus, and Mattoo 2008).

Recent empirical evidence, however, indicates that the productive impact of immigrants depends on their level of skills and the skills of the native workers, and also on the host economy’s domestic productive capacity to “absorb” foreign labor. For example, the studies by Borjas and Hanson (2008), Ottaviano and Peri (2008), and Peri and Sparber (2009) indicate that the effects of immigrants on the domestic economy depend on the skilled characteristics of the native and immigrant workers in

\[\text{Figure 1. Migrants as a percentage of total population, 1990–2010}\]

\[\text{Source: International Migrant Stock, 2010 (United Nations).}\]
the production process. Recent evidence on the U.S. economy suggests that immigrants increase total factor productivity (TFP) through efficient task specialization in the labor market. The U.S. economy also uses unskilled-biased technology due to a large inflow of unskilled workers that induce adoption of low-cost technologies (Peri 2009), however. The study on the UK and Spain highlights a different impact of immigrants on the domestic economy, where immigrants have a more productive impact in the UK compared with Spain (Kangasniemi et al., 2008).

Several other studies have also shown that less-skilled immigrants may cause a shift toward labor-intensive techniques, as a result of efforts to complement the less-skilled migrant workers (Peri 2007; Chia 2006; Thangavelu 2011). These studies imply that the impact of immigration on technological progress depends largely on the skill level of the migrant workers and the characteristics of the host economy.

The effect of immigration on wages is less clear cut, as some studies find an improvement in average native wages (Ottaviano and Peri 2008; Card 2007; Peri 2008), whereas others report an overall decline (Aydemir and Borjas 2006; Borjas 2009). There is less ambiguity on the issue of wage inequality, which is found to be alleviated if foreign labor is mostly high-skilled, and aggravated if they are generally low-skilled (Aydemir and Borjas 2006; Peri 2008).

Despite an extensive volume of research on the wage effect of immigrants, the literature has yet to reach a consensus. Peri (2009) predicts a 0.5 percent increase in income per worker as a result of a 1 percent increase in employment due to immigration inflow, whereas Borjas (2003) finds that recent immigration puts downward pressure on the native workforce wages, particularly for unskilled workers. Borjas (2009) further argues that the short-run wage effect is most likely to be negative and that the long-run effect may be negative, too, if the size of the consumer base expands less than that of the workforce as a result of immigration. Card (2004) uses empirical evidence to show that in high-immigration U.S. cities, firms adapt to the changes in relative supplies of workers with different skill levels by adjusting their production technology, and there is no significant change in the relative wage rates after immigration. Chang (2002) uses Taiwanese data to calibrate a dynamic intertemporal general equilibrium model, and concludes that foreign workers exert a negative impact on the local unskilled workers by widening the wage gap. Choi (2004) shows that for the Korean economy the positive impact of immigration critically depends on the price flexibility in the economy and there are larger welfare gains if the immigration policy is skilled-biased.

More recent studies highlight the importance of a general equilibrium framework to study and quantify the impact of immigrants on the domestic economy. There are
several key advantages of competitive general equilibrium models. Partial equilib-rium that focuses on single markets mainly neglects the effects of other markets on its equilibrium. In a general equilibrium framework, the choices of economic agents in the economy are explicitly accounted and coordinated across all products and factor markets. Thus, a general equilibrium model provides the framework to study (a) the impact of random shocks on the economy; (b) factors affecting the long-term steady-state growth of the economy; (c) institutional and structural changes on the welfare of the agents; and (d) the impact of policy changes on domestic markets and the welfare of the agents.

According to Borjas (1995), the immigration surplus is defined as the increase in income of the native population in the host country as a result of immigration due to lower cost of labor, increase in capital investments, and overall productivity improvements from skilled immigrants. He shows that the increase in workforce from immigration workers can increase GDP. For example, the GDP of the U.S. economy increased by nearly 0.105 percent with a 10 percent increase in workforce from immigrant workers. This is accompanied by a 3 percent fall in the wage rate with no significant re-distributional effects between capital and labor. He also highlights that the immigration of skilled workers will generate higher immigration surplus due to the complementarity of skilled labor and capital investments.

Borjas (1995) highlights that the magnitude of immigration surplus depends on the differences of skill components between the native and the immigrant workers, and it could reach a maximum level when the immigration inflow is sufficiently different from that of the native work force (i.e., when their production complementarities are fully exploited). He also pointed out that underlying the immigration surplus lays a significant redistribution of wealth from the native workers to the employers of the immigrant workers, and the surplus only arises when immigrants lower the wage rate of native workers. This raises the issue of a potentially harmful impact on the wage gap in the indigenous labor market.

Drinkwater et al. (2007) revisit Borjas’ work by calibrating a three-sector general equilibrium model with endogenous growth to the EU economies, and redefine immigration surplus in terms of the increase in welfare levels among the natives in the post-immigration era. These studies conclude that unskilled immigration has a negative impact on the size of immigration surplus and indicate support of immigration policies favoring the skilled immigrants. By comparing their results with that of Borjas (1995), they concluded that the positive effect of skilled immigrants is larger in the dynamic case than that of the Borjas’ static case. Skilled immigrants tend to increase the long-term growth by stimulating “more skill-intensive R&D activities”
in the innovative sector. There are gains in growth and the immigration surplus increases further when there is complementarity between skilled workers and physical capital.

The paper is organized as follows. The next section provides the literature review. Section 3 gives an overview of the international labor mobility in Asia. We discuss the foreign worker policy in Singapore in Section 4. In Section 5, we discuss the theoretical model using Drinkwater et al.’s (2007) three-sector general equilibrium model for Singapore as given in Thangavelu (2011). We propose policy conclusions in Section 6.

2. Literature review

2.1 Wage impacts

The importance and impact of international labor mobility on output growth is an important area of study. This has motivated extensive research efforts to ascertain the local labor market impacts of immigration, such as labor demographics, activity and participation rates, wages, employment, technology adoption, and productivity. Most studies have focused on wage effects, but empirical results are inconclusive. In a departure from the “spatial correlation” framework, which is typically used to analyze the labor market impacts of immigration, Borjas (2003) introduces a model that assumes that workers with similar educational qualifications, but different experience levels, are imperfect substitutes. Using data from the United States covering the period 1980–2000, Borjas reports that immigration caused average native wages in the United States to decrease by 3.2 percent, with low-skilled (high school dropouts) workers suffering the greatest decline of 8.9 percent. Aydemir and Borjas (2006) apply the methodological framework developed by Borjas (2003) in a comparative study of Canada, Mexico, and the United States, and find a negative impact of immigration on native wages in the United States and Canada. The reverse is observed for Mexico, as the economy experiences net emigration. A dissimilar impact of migration on the wage structure in the United States and Canada is highlighted, which is attributed to the average skill level of migrants. Aydemir and Borjas (2006) highlight that Canada attracts mostly high-skilled immigrants, whereas migrants to the United States are disproportionately low-skilled. As a result, immigration has reduced wage inequality in Canada, while increasing it in the United States.

Since Grossman (1982), most empirical studies have exploited the clustering of immigrants in particular areas to study the labor market impacts of immigration. After identifying an area as the labor market experiencing immigration, these studies compute a “spatial correlation,” which measures the relationship between native wages and the relative number of immigrants in that area.
Empirical studies have not always found the wage impact of immigration to be negative. In an extension of the framework developed by Borjas (2003), Ottaviano and Peri (2008) use a general equilibrium approach and established a positive effect of immigration on the average wage of native U.S. workers. Approximately 90 percent of native workers experienced real wage gains, while the remaining 10 percent, comprised of high school dropouts, suffered a less severe real wage loss of 1.1 percent compared with earlier estimates. Moreover, any adverse wage effect of immigration is mainly borne by earlier generations of immigrants. A positive effect of immigration on native wages is also found in separate studies by Card (2004) and Peri (2008), despite a large proportion of low-skilled workers among the migrant populations examined. Card (2004), however, points out that positive labor market impacts of migration could be negated by perceived negative externalities posed by immigrants. An interesting finding from Peri (2008) is the rapid adjustment of capital to immigrant inflows, which keeps capital intensity relatively constant. In addition, workers of all skill groups experience productivity gains from immigration. The favorable responses of capital and productivity compensated for the adverse relative supply effect and result in small wage effects for low-skilled workers. On the other hand, high-skilled workers experience significant and positive wage effects accruing from the affirmative capital, productivity, and labor supply effects.

2.2 Technology adoption
The impact of foreign workers on technological development can be a double-edged sword. On one hand, skilled immigrants may be complementary to the native labor force, introducing skills that are relevant to promoting new innovation and technological progress. A study by Hunt and Gauthier-Loiselle (2008) shows that skilled immigrants (college graduates, postgraduates, scientists, and engineers) increase innovation in the United States, and have positive spillover effects on native innovation. In fact, native inventors were not crowded out by foreign-born inventors, as these skilled immigrants increased per capita patenting without decreasing native patenting. The positive impact of skilled immigrants on innovation is supported by Peri (2007). Using patents as a proxy for innovation, that study finds that foreign-born PhDs contributed significantly to innovation in the United States, and increasing the share of doctorate degrees in the country by 3 percent would increase innovation rates and TFP growth by 1 percent a year. Other studies have also highlighted the significant and positive contributions of skilled immigrants, particularly scientists and engineers, to innovation in the host economy (Stephan and Levin 2001; Chellaraj, Maskus, and Mattoo 2008).

On the other hand, unskilled immigrants with low human capital may reduce the incentive of firms to innovate, increasing their tendency to shift toward cheaper and
more labor-intensive production. In a cross-sectional study of the impact of skill mix in U.S. labor markets on the adoption of manufacturing automation technologies, Lewis (2005) finds that technology adoption in the U.S. manufacturing sector is strongly and negatively influenced by the relative supply of low-skilled labor. As immigration increases the relative supply of low-skilled labor, plants may adopt labor-intensive production techniques that are complementary to the low-skilled workers. This tendency of firms to make technological adjustments to complement the skill level of workers is also demonstrated by Acemoglu (1998). The study uses a model of directed technical change to show that technological progress complements the skill level of the workforce. If the proportion of skilled workers is larger, there would be a faster pace of technological advancement. The contrary is true when the labor market is dominated by unskilled workers. A recent study by Thangavelu (2010) on Singapore’s manufacturing sector finds that the influx of foreign workers and capital investment decisions of firms are negatively correlated. Foreign workers are more productive if firms utilize less capital and technology-intensive investments. Therefore, firms in Singapore’s manufacturing sector have tended to adopt labor-intensive technologies. Ultimately, the overall effect of immigration on technological progress would depend on the characteristics of immigrant labor and the absorptive capacity of the receiving economy.

2.3 Productivity

Similar to the impacts on technology adoption, immigrants can exert either an upward or downward pressure on labor productivity. Most empirical studies, however, tend to find a negative impact of immigration on productivity, as the migrant populations examined are disproportionately composed of low-skilled workers. In a panel study of 24 OECD countries, Llull (2008) finds that immigration had adverse effects on productivity, as each migrant worker is estimated to be only two-thirds as efficient as a native worker. Kangasniemi et al. (2008) also finds a negative impact of immigration on productivity in a comparative study of Spain and the UK. By decomposing the impact of migrant workers into quality and quantity effects, it is found that immigration in both Spain and the UK has overall negative effects on productivity. They find that the negative productivity effects of migrant workers in the UK is relatively smaller, however, hinting that the negative impact of immigration on productivity will decrease over time as an economy develops and immigration policy evolves. The adverse effects of migrant workers on productivity can also manifest itself in the rate of productivity growth. Using state-level data, Quispe-Agnoli and Zavodny (2002) find that in states that absorbed a larger share of immigrants in the 1980s, labor productivity experienced a relatively slower increase in both low-skill and high-skill industries.
Contrary to these findings, a study of migration in 14 OECD countries from 1980–2005 by Ortega and Peri (2009) reveals no significant impact of immigration on TFP. Immigration increased employment one-to-one, and investment adjusted rapidly to the increase in workers, leaving the capital intensity of production unchanged. In a recent study of Israeli manufacturing firms, Paserman (2009) finds no correlation between the shares of immigrants employed and firm productivity. When the analysis was conducted according to the level of industrial technology, however, the share of immigrants is found to be negatively correlated with productivity in low-tech industries. The increase in the pool of unskilled workers due to immigration raises the incentives of firms to adopt labor-intensive production methods, which are both cheaper and complementary to the unskilled workforce. Clearly, labor productivity and technology adoption are intricately correlated. The presence of a large proportion of unskilled workers discourages technology adoption, which results in decreasing capital investments. With a lower capital intensity of production, labor productivity inevitably falls.

3. International labor mobility in Asia

The inflow and outflow of migrant stock of selected countries in Asia is shown in Table 1. The inter-region migration matrix is created using data from the updated bilateral migration matrix in World Bank (2010). It contains data from 212 countries, compiled from various sources such as national censuses and national statistical bureaus.3

<table>
<thead>
<tr>
<th>Destination country</th>
<th>Outflow</th>
<th>Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>24,343</td>
<td>148,123</td>
</tr>
<tr>
<td>Cambodia</td>
<td>350,485</td>
<td>335,829</td>
</tr>
<tr>
<td>China</td>
<td>8,344,726</td>
<td>685,775</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>718,990</td>
<td>2,741,800</td>
</tr>
<tr>
<td>India</td>
<td>11,360,823</td>
<td>5,436,012</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,504,297</td>
<td>122,908</td>
</tr>
<tr>
<td>Japan</td>
<td>771,246</td>
<td>2,176,219</td>
</tr>
<tr>
<td>Korea</td>
<td>2,077,730</td>
<td>534,817</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1,481,202</td>
<td>2,357,602</td>
</tr>
<tr>
<td>The Philippines</td>
<td>4,275,612</td>
<td>435,423</td>
</tr>
<tr>
<td>Singapore</td>
<td>297,234</td>
<td>1,966,865</td>
</tr>
<tr>
<td>Thailand</td>
<td>811,123</td>
<td>1,157,263</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2,226,401</td>
<td>69,507</td>
</tr>
</tbody>
</table>


Contrary to these findings, a study of migration in 14 OECD countries from 1980–2005 by Ortega and Peri (2009) reveals no significant impact of immigration on TFP. Immigration increased employment one-to-one, and investment adjusted rapidly to the increase in workers, leaving the capital intensity of production unchanged. In a recent study of Israeli manufacturing firms, Paserman (2009) finds no correlation between the shares of immigrants employed and firm productivity. When the analysis was conducted according to the level of industrial technology, however, the share of immigrants is found to be negatively correlated with productivity in low-tech industries. The increase in the pool of unskilled workers due to immigration raises the incentives of firms to adopt labor-intensive production methods, which are both cheaper and complementary to the unskilled workforce. Clearly, labor productivity and technology adoption are intricately correlated. The presence of a large proportion of unskilled workers discourages technology adoption, which results in decreasing capital investments. With a lower capital intensity of production, labor productivity inevitably falls.

3. International labor mobility in Asia

The inflow and outflow of migrant stock of selected countries in Asia is shown in Table 1. The inter-region migration matrix is created using data from the updated bilateral migration matrix in World Bank (2010). It contains data from 212 countries, compiled from various sources such as national censuses and national statistical bureaus.3

<table>
<thead>
<tr>
<th>Destination country</th>
<th>Outflow</th>
<th>Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>24,343</td>
<td>148,123</td>
</tr>
<tr>
<td>Cambodia</td>
<td>350,485</td>
<td>335,829</td>
</tr>
<tr>
<td>China</td>
<td>8,344,726</td>
<td>685,775</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>718,990</td>
<td>2,741,800</td>
</tr>
<tr>
<td>India</td>
<td>11,360,823</td>
<td>5,436,012</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,504,297</td>
<td>122,908</td>
</tr>
<tr>
<td>Japan</td>
<td>771,246</td>
<td>2,176,219</td>
</tr>
<tr>
<td>Korea</td>
<td>2,077,730</td>
<td>534,817</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1,481,202</td>
<td>2,357,602</td>
</tr>
<tr>
<td>The Philippines</td>
<td>4,275,612</td>
<td>435,423</td>
</tr>
<tr>
<td>Singapore</td>
<td>297,234</td>
<td>1,966,865</td>
</tr>
<tr>
<td>Thailand</td>
<td>811,123</td>
<td>1,157,263</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2,226,401</td>
<td>69,507</td>
</tr>
</tbody>
</table>


Contrary to these findings, a study of migration in 14 OECD countries from 1980–2005 by Ortega and Peri (2009) reveals no significant impact of immigration on TFP. Immigration increased employment one-to-one, and investment adjusted rapidly to the increase in workers, leaving the capital intensity of production unchanged. In a recent study of Israeli manufacturing firms, Paserman (2009) finds no correlation between the shares of immigrants employed and firm productivity. When the analysis was conducted according to the level of industrial technology, however, the share of immigrants is found to be negatively correlated with productivity in low-tech industries. The increase in the pool of unskilled workers due to immigration raises the incentives of firms to adopt labor-intensive production methods, which are both cheaper and complementary to the unskilled workforce. Clearly, labor productivity and technology adoption are intricately correlated. The presence of a large proportion of unskilled workers discourages technology adoption, which results in decreasing capital investments. With a lower capital intensity of production, labor productivity inevitably falls.

3. International labor mobility in Asia

The inflow and outflow of migrant stock of selected countries in Asia is shown in Table 1. The inter-region migration matrix is created using data from the updated bilateral migration matrix in World Bank (2010). It contains data from 212 countries, compiled from various sources such as national censuses and national statistical bureaus.3

There is a clear trend that large countries like China and India are experiencing a large outflow of labor—8.3 million and 11.3 million, respectively. Among the East

3 The original bilateral migration matrix was developed by Ratha and Shaw (2007).
Asian countries, other than China, Korea also tends to experience outflow of people—around 2 million as of 2010. Across the South East Asian countries, we also observe a different trend among the key ASEAN countries. Indonesia and the Philippines tend to experience outflow of migrants of nearly 2.5 million and 4.7 million, respectively. This is not surprising as both Indonesia and the Philippines are the key labor export countries in the region. The other emerging countries of Malaysia and Thailand also experience outflow of migrants of nearly 1.5 million and 0.8 million people. As a small-open economy, Singapore has an out-migration of nearly 0.25 million as of 2010. We also observe key inflows of migrants in Hong Kong, India, Japan, Malaysia, Singapore, and Thailand that are much higher than the outflow of migrants. As compared to China, there is a large migrant inflow in India of nearly 5.5 million as of 2010, which might be indicating the reverse migration of Indian-origin migrants back to India. For the small open economies of Hong Kong and Singapore, there is a larger inflow of migrants of nearly 2.7 million and 2 million as of 2010, which is much higher than migrant outflow. Increasingly these small open economies are relying on skilled-migrants to drive their economic growth. The other ASEAN countries of Malaysia and Thailand are also relying on inflow of migrants to drive their economy. Malaysia has a migrant inflow of nearly 2.2 million and Thailand nearly 1.1 million as of 2010. Interestingly, we also observe a large inflow of migrants into Japan of nearly 2.7 million.

The inflow of migrants by region is shown in Table 2. It is interesting to observe that most of the migration is regional. Japan, Hong Kong, and Korea tend to experience greater inflow of migrants from the East Asian region. For example, the inflow of migrants to Japan is from Korea and China. Hong Kong experiences greater inflow from China and Macau. As of 2010, the key migrants to Korea are from China. We also observe a similar trend for India, where the major migrants are from the South Asian region. The key migrants into India are from Sri Lanka, Nepal, and Bangladesh.

In contrast to the other regions, the South East Asian countries tend to have different regional sources for their migrant inflows. Malaysia and Singapore still rely on the South East Asian region for their labor supply, where the region migrant inflow is nearly 80 percent and 60 percent, respectively, for Malaysia and Singapore. Singapore and Thailand also rely on the East Asian region, however, and, in particular on China, for migrant inflows, which accounts for nearly 25 percent and 35 percent of labor supply, respectively. Brunei and Cambodia also rely heavily on migrant inflows from the South East region. It is important to highlight that most of the migrants in South East Asia region are temporary and unskilled.
The key trends of regional migration could be mainly explained by the trade, production structure, and culture within the region. Due to cross-border trading activities and a similar cultural base, there is greater flow of migration across the South East Asian countries. Due to the cross-border relationship in trade, Cambodia experiences greater inflow of migrants from Vietnam and Thailand. The inflow of migrants into Thailand is mainly from Lao, Myanmar, and Cambodia. The key factors that drive regional migration are the regional production network and intra-regional trade.

4. The foreign worker policy in Singapore

Increasingly the Singapore economy is relying on foreign workers to maintain economic competitiveness and growth. Foreign workers are expected to fill the labor shortage and also to maintain the cost competitiveness of domestic firms in global trade. Foreign workers, both skilled and unskilled, serve a dual purpose for this small open economy. Given that the Singapore economy is transitioning to higher value-added activities, it faces a strong shortage of skilled domestic workers to maintain the viability of high-end value-added industries. Thus, skilled foreign workers are expected to augment domestic human capital and thus induce innovative activities in the domestic economy. This is expected to maintain competitiveness of exports of the local firms in high-end products (Tan et al. 2001).

In contrast, the economy also attracts low-skilled foreign workers to manage the “hollowing-out” effects of multinationals as they restructure their production structure toward low-cost countries such as India and China. Because the “hollowing-out” effects of multinationals could create structural unemployment of local
workers in the economy due to the dislocation of the low-end production chain, the unskilled foreign workers are seen as one way to keep the cost of production down and manage the dislocation of multinationals in the domestic economy (see Chia, Thangavelu, and Toh 2004).

The aggregate trends of labor force by resident (Singapore citizens and permanent residents) and non-resident (foreign workers) are shown in Figures 2 and 3. The total employment increased rapidly since 1992, with total employment doubling in 2008, increasing from nearly 1.5 million in 1992 to around 3 million workers. Non-resident employment in the Singapore economy has also shown an upward trend since 1992. In 1992, resident employment accounted for nearly 79 percent of the total employment and non-resident employment was only around a 20 percent share of total employment. By 2008, the share of non-residents increased to nearly 36 percent of the total employment (see also Ministry of Manpower 2008b). The growth trends of residents and non-residents are also shown in Figure 2. The non-resident employment shows greater dynamics in the labor market compared with the resident employment in the Singapore economy, growing at an annual rate of nearly 7.9 percent in 1992–2008. In contrast, from 1992 to 2008, the resident employment grew by only
an average annual rate of 2.7 percent, thereby highlighting the labor constraints in the small-open economy. In fact, there was greater inflow of permanent immigrants in the economy in terms of permanent residents to augment the residents, as the growth rate of Singapore citizens is constrained by a falling fertility rate. From 1997 to 2006, the employment of permanent residents in the total employment grew at the rate of 8.4 percent, compared with 1.5 percent for Singapore citizens (see Ministry of Manpower 2008a).

4.1 The labor market policy on foreign workers
The foreign worker policy in Singapore is to manage the flow of skilled and unskilled foreign workers into the domestic economy. The structure of the foreign employment work pass is explained in the Appendix.

The key focus of the foreign worker policy is to allow skilled workers to augment domestic human capital accumulation. The Employment Pass (EP) is crucial to attracting foreign skilled workers into the economy. The EP is targeted at skilled foreign workers employed as professionals and executives in Singapore. The eligibility criteria for the EP are that skilled foreign workers (a) earn a fixed monthly salary of more than US$ 2,500; and (b) have a recognized qualification. To create more flexibility for different types of foreign skills to flow into the domestic economy, the S-Pass was introduced to capture semi-skilled professionals and technicians in

Figure 3. Share of foreign labor in the labor force and the manufacturing sector in Singapore, 1999–2008

Note: Data for 2000 and 2005 are not available as the Labor Force Survey was not conducted in those years.
specialized jobs. The S-Pass applications are assessed using a point system that includes salary (minimum of US$ 1,800 monthly salary), educational qualifications, skills, job type, and experience.

The government also allows unskilled foreign workers into the economy to keep the cost of non-tradable production low and affordable for the local population. To maintain employment for local workers, the government manages the flow of unskilled foreign workers across industries through a dependency ratio (the ratio of foreign to local workers). To manage the inflow of unskilled foreign workers, the government introduced the Work-Pass (WP). The WP is managed by both the foreign workers’ levy and a quota (dependency ceiling) to ensure that local workers are not disadvantaged by the inflow of foreign workers. The foreign workers’ levy is imposed on employers and it varies according to the skill level of foreign workers. Unskilled foreign workers are considered for the WP if they earn less than an US$ 1,800 monthly salary and employers are required to apply for WP based on the quota of local to foreign workers in their company (see the Appendix for details).

5. Three-sector general equilibrium model for Singapore

Several recent studies have attempted to measure the overall immigration surplus to the domestic economy using a partial and a general equilibrium framework (Borjas 2003; Drinkwater et al. 2007; Thangavelu 2011). A recent study by Thangavelu (2011) on immigration surplus using a general equilibrium framework for the Singapore economy highlights the importance of highly skilled immigrants and investment in innovative activities affecting the overall immigration surplus in the domestic economy. This study highlights the key results of the simulation and the model and the key parameters are available in Thangavelu (2011).

Thangavelu (2011) adopts Drinkwater et al.’s (2007) three-sector general equilibrium model with endogenous growth and calibrated it to the Singapore economy. The paper models three major sectors in the Singapore economy: a labor-intensive service sector, which is assumed to produce a homogenous good and the value-added goes to physical capital accumulation; a capital-intensive manufacturing sector, which produces differentiated goods with growing varieties; and an innovative sector, which is assumed to be the engine of growth of the economy that conducts the necessary research activities for new product development. All sectors employ three factor inputs, namely, skilled workers, unskilled workers, and physical capital. Because there is no closed-form solution, the paper adopts a numerical method, which narrowed down the scope to the steady-state analysis. The full details of the three-
sector general equilibrium model and the numerical solution for the steady-state values for the Singapore economy is given in Thangavelu (2011).

In the simulation with a large share of unskilled workers and a weak innovation sector, the economy moderated to a steady-state growth of around 1.1 percent with a higher share of skilled foreign workers. With the share of total unskilled workers in the economy at nearly 45 percent of total employment, a higher share of unskilled foreign workers tends to lower steady-state growth. The simulation results of the steady-state growth rate with increasing inflow of skilled immigrants (decrease in the share of unskilled foreign workers) for the scenario of higher share of unskilled workers is shown in Figure 4.

From Figure 4, there is clear evidence that there is a positive effect of skilled immigrants on the steady-state growth rate of around 1.1 percent, and it also increases the size of the innovative sector when their fraction within the total immigrant workforce is increased. The inflow of skilled immigrants relative to unskilled workers...
workers tends to encourage more research activities in the economy and hence promote long-term growth. The increase in skilled immigrants in the economy tends to increase the growth rate and size of the R&D sector at a diminishing rate, however, and both variables started to decline when the fraction of the skilled immigrants exceeds a threshold of 60 percent. The diminishing return is expected to set in once the reward from the complementarities between the physical capital and the skilled immigrants is fully exploited. The “crowding-out” effect on the total physical capital causes the steady-state growth rate and the size of the innovative sector to decrease after reaching the threshold. The maximum percentage growth gain is achieved when the physical capital is fully exploited by the skilled workers in the economy, which corresponds to a 60 percent share of the skilled workers among immigrants.

In the second simulation (see Figure 5), the flow of total foreign workers was moderated by maintaining the share of foreign at 30 percent of the total labor force. The skilled employment share in the pre-immigration state is also taken to be higher at 0.55 and 0.45 for unskilled workers. This reflects the current government policy to
increase the number of skilled workers in the economy and concurrently moderate the flow of unskilled foreign workers.

It is interesting to observe that the high share of skilled workers produce a higher steady-state growth rate of nearly 5 percent and the economy also experience less diminishing returns due to the increasing share of skilled immigrants on the output growth and conversely on the innovative sector (see Figure 5). This result is mainly driven by the high share of capital accumulation (capital share) in the innovative sector and thus there is a greater complimentarity between skilled and capital investments, which is not fully exploited. The greater inflow of skilled immigrants tends to complement capital and increase the innovative activities in the domestic economy, thus leading to higher steady-state growth.

The simulation result of the wage gap is reflected in Figure 6. It is interesting to observe that the wage gap between the skilled and unskilled wage narrows as the foreign share is maintained at 40 percent of the workforce. This is mainly due to
the increased supply of skilled workers in the economy due to the inflow of skilled immigrants and the reduction of unskilled foreign workers in the economy. We also observe that the factor shares of unskilled workers also increases moderately as their demand increases due to higher output growth.

6. Policy conclusions

The flow of labor across Asian countries is becoming an important component of growth and wealth creation. The general trend of international labor mobility indicates that labor flows tend to be regionally focused. In Asia, there are some clear trends that countries like China, India, the Philippines, and Indonesia tend to experience a high share of outflow of labor and thereby “export” a greater share of their labor to the region. We also observe a greater flow of skilled immigrants from developed Asian countries like Korea. Thus, we should have international labor mobility to have a significant impact on the domestic labor market, trade, innovation and cross-cultural activities across Asian countries. Chia (2006) highlights the impacts of migrants are different for labor-exporting and labor-importing countries. In particular, the welfare effects of outflow of skilled migrants out of labor-exporting countries such as the Philippines and unskilled migrants from Indonesia, for example, could affect the productivity of the local workforce and create structural changes in the domestic economy. Chia (2006) also shows the importance of the interaction between trade and international labor mobility. The results of our study indicate that foreign workers, particularly skilled foreign workers, tend to complement local employment and increase the productivity of the domestic economy especially in the innovation sectors.

There are several key implications from international labor mobility in terms of balancing innovation and growth in the domestic economy. The result of the model indicates that skilled immigrants do exert a positive effect on the indigenous economy, but at a diminishing rate. Skilled immigrants tend to encourage more research activities in the economy and hence promote long-term growth. We also observe that diminishing returns begin when the reward from the complementarity effect between physical capital and skilled immigrants is fully exploited.

The simulation results also highlight that moderating foreign workers at 40 percent of the workforce with high capital intensity produces positive output growth. In this equilibrium, we also observe higher steady-state growth with a higher share of skilled foreign workers. The rising share of skilled foreign workers reduces the skilled wage rate and also the wage gap between skilled and unskilled workers in the economy.
The results also indicate that the positive impact of immigrants, and in particular skilled immigrants, depends on innovative activities in the economy. In particular, there is diminishing return from having additional skilled foreign workers in the economy, for a given level of capital stock in the economy. This indicates that there is a threshold level of skilled immigrants that will have a positive impact on the innovative sector and the growth of the economy. This is crucial for Asian economies to drive their innovation activities. This is particularly important for the Singapore economy as it moderates the flow of foreign workers and increases its competitiveness in the global economy.

Investments in local human capital are also vital for the long-term growth of Singapore’s economy. In a globalized environment, workers have to constantly upgrade their skills to stay relevant. At present, most training programs are designed for and targeted at low-skilled local workers. This enables them to improve their productivity levels and command higher wages, thereby reducing wage inequality. With the shift toward higher value-added activities, Singapore will need to implement general training schemes for the entire workforce. Constant re-training and skills upgrading is necessary to meet the rapidly evolving demands of the labor market. These investments in local human capital will grant productivity gains, thereby improving the long-term growth potential of the Singapore economy.

The declining capital-to-labor ratio in the manufacturing sector is of great concern to the Singapore economy. The declining capital-to-labor ratio is also in line with high inflow of foreign labor, thereby suggesting that a large inflow of foreign workers might affect the investment decisions of firms to adopt new technologies. As indicated by Peri (2009), a large inflow of foreign workers is likely to increase the unskilled-biased technology investment as observed in U.S. economy. Peri’s (2009) results indicate that the productivity of foreign workers increases with less capital investment, thereby indicating that the foreign workers are more productive with less capital and technology-intensive production structure. In contrast, local workers are more productive with high capital investment, indicating that there is more complementarity between capital investments and local human capital. Thus the skilled types of foreign workers does affect the technology adoption decisions of firms and hence their competitiveness.

This study could be extended in several directions. First, the results indicate that skilled types might have some impact on the trade and productive performance of the economy. It is also important to study the foreign manpower policy in the region, especially in Singapore and Malaysia where foreign levies and quantity controls in terms of quotas are imposed. It might be interesting to study the
effectiveness of such policies simultaneously imposed on the economy in more of a general equilibrium framework. In particular, it might be important to study the welfare implications of foreign workers in terms of economic and social welfare for the domestic economy. The inflow of foreign workers not only creates economic effects on the domestic economy—there are several social implications of having a large inflow of foreign workers in the economy in terms of competing for public infrastructure and affecting the local cultural diversity in the economy. The overall net social benefit to the economy seems to be related to the assimilation of foreign workers to the domestic economy and myriad cultures (Borjas 2003).

The results of the paper support the recent policy recommendations of the Economic Strategic Committee in terms of increasing the medium- to long-term growth of the Singapore economy by increasing productivity growth and reducing the reliance on foreign workers. For a small open economy, policies on capital and labor mobility will be crucial to sustain the competitiveness of the economy. The Singapore economy has effectively managed to balance capital and labor mobility to enhance the overall competitiveness of the economy since its independence. As the domestic economy moves toward a knowledge-based economy, the impact of foreign capital and labor on the innovative activities of the small open economy will be crucial. Even with the large inflow of skilled workers, Thangavelu (2011) indicates that the positive impact of immigrants, and, in particular, skilled immigrants, depends on innovative activities in the economy. In particular, there is diminishing return from having additional skilled-foreign workers in the economy, for a given level of capital stock in the economy. This indicates that there is a threshold level of skilled immigrants that will have a positive impact on the innovative sector and growth of the economy. This is crucial as the Singapore economy moderates its flow of foreign workers and increases its competitiveness in the global economy.

Appendix

Types of foreign workers in Singapore

1. Employment Pass (EP)
   a. Employment Pass (EP) Holders: The employment pass is targeted at skilled foreign workers employed as professionals and executives in Singapore. The eligibility criteria for EP is that a skilled foreign worker (a) earn a fixed monthly salary of more than US$ 2,500; and (b) have a recognized qualification (see MOM Web site: http://www.mom.gov.sg).
b. There are three categories of EP:
   i. P1 pass is for foreign workers earning a fixed monthly salary of more than US$ 7,000
   ii. P2 pass is for foreign workers earning a fixed monthly salary between US$ 3,500 and US$ 7,000 and possesses recognized qualifications
   iii. Q1 pass is for foreign workers earning a fixed monthly salary between US$ 2,500 and US$ 3,500 and possesses recognized qualifications

2. S-Pass

a. S-Pass applies to mid-level skilled workers such as technicians and semi-skilled workers applying for professional and specialized jobs.
b. S-Pass applicants are assessed in terms of point system that includes salary, educational qualifications, skills, job type, and experience.
c. Foreign workers are eligible to apply for an S-Pass if they earn a monthly salary of at least US$ 1,800 and possess recognized qualifications with a minimum level degree or diploma.
d. The employment of S-Pass workers is subject to a quota (dependency ceiling) of 25 percent of the company’s total workforce.

3. Work Pass (WP)

a. A Work Pass (WP) applies to foreign workers earning a monthly basic salary of not more than US$ 1,800.
b. The prospective employer must first apply to the Singapore Ministry of Manpower for a WP before hiring a foreign worker (minimum age of 16 years).
c. A Skilled Work Pass applies to foreign workers with at least a recognized national trade certificate (NTC-3 [Practical] Trade Certificate) or equivalent that is relevant to the worker’s occupation.
d. Employer pays a lower levy for skilled WP foreign workers.

[Information as of 2011]

References


