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Foreign workers and productivity in an emerging economy: The case of Malaysia

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Abstract

Many developed and developing countries are experiencing large and growing levels of international migration of labor. However, the large majority of research on the economic impact of inflows of migrant workers on host economies focuses exclusively on developed countries. In this paper, we address this gap in the literature by examining migrant-induced productivity effects in the emerging economy of Malaysia. Importantly, the Malaysian case is typical for many Asian economies where, next to high skilled foreign workers, large numbers of migrants consist of low skilled workers that are employed in host economies on a temporary basis. Using detailed industry level data for the period 2005 to 2009, we find that both high skilled and low skilled foreign workers generate positive productivity effects in Malaysian manufacturing industries. Furthermore, our results identify a strong presence of industry heterogeneity, as the effects of foreign workers, in general, and low skilled foreign workers, in particular, are pronounced in labor and assembly intensive modern industries with a strong export focus. This indicates the importance of foreign workers for the contemporary international competitiveness of the Malaysian manufacturing sector. As such, our findings provide important new input to the debate on the role of low skilled foreign workers in processes of development of the Malaysian economy.

1 | INTRODUCTION

Recent decades have witnessed large and growing levels of international migration. The total stock of migrants in OECD countries has surpassed 113 million, whereas in Asia the stock of migrants is more than 71 million, surpassing the number of migrants in the European Union (OECD, 2014; United Nations, 2013). Often, these migrants act as an important transmission channel of new knowledge and technologies, facilitate international trade relations, and generate important remittance flows to their home countries. As a result of this, international migration is increasingly recognized as an important driver of growing levels of interconnectedness and interdependency in the world economy (Longhi, Nijkamp, & Poot, 2005; International Organization for Migration [IOM], 2008).

The growing magnitude of international migration has rekindled research into the economic impact of foreign-born workers on host economies. Traditionally, research on the effects of migrants has focused on static labor market impacts. In particular, many studies have followed a spatial correlations approach (Hatton, 2014), addressing the question whether migrant-induced increases in labor supply in regional labor markets within host countries decrease employment and wages among native workers (Borjas, 1994; Kerr & Kerr, 2011). Overall, the evidence indicates that regional negative labor market effects from migrants are modest or absent (Card, 2005; Kerr & Kerr, 2011). Findings from studies that examine the impact of migrants within detailed skill and experience categories are more diverse. For the United States, Borjas (2003), and Borjas and Katz (2007) examine the impact of migrants at the national level using skill/experience categories in which migrants and native workers are perfect substitutes, finding evidence of substantial negative effects. In contrast, Ottaviano and Peri (2012) present evidence rejecting the notion that migrants and native workers are perfect substitutes within these categories and find that migrant workers only generate negative wage effects among previous immigrants.

Recently, a heterogeneous set of empirical studies has started to link immigration to wider positive economic effects. For instance, immigration may generate productivity gains from specialization when native and foreign workers specialize in different tasks and occupations (Peri & Sparber, 2009; Amuedo-Dorantes & De la Rica, 2011). Other studies examine the effects of a migrant-induced increase in the level of diversity of the workforce on trade, innovation, and the creation of new firms (Parrotta, Pozzoli, & Pytlikova, 2014; Ottaviano & Peri, 2006; Hunt, 2011). Finally, a limited number of studies test the hypothesis that foreign workers incorporate special skills and experience that contribute directly to the performance of firms or industries. By hiring migrant workers, firms can benefit from these attributes in the form of productivity improvements (Aleksynska & Tritah, 2015; Markusen & Trofimenko, 2009).

In the present paper, we extend upon research on direct productivity effects by conducting an empirical study on the effects of foreign workers in the manufacturing sector of Malaysia. Using detailed manufacturing industry level data for the period 2005 to 2009, we make the following contributions to the literature. First, the case of Malaysia is a very interesting one. The vast majority of studies on economic impacts of migrant workers focus on the United States, European Union or OECD countries. However, migration flows between developing countries, so-called South–South migration, occur at such a scale that they are likely to generate sizeable effects. Malaysia is a prime example of a migrant receiving country. In 2013, more than 25% of all foreign-born workers in South-East Asia were employed in this country, representing about 9% of its population and over 30% of its workforce in the manufacturing sector (World Bank, 2013).

Second, most studies that identify positive productivity effects from migrant workers in developed economies link these effects to the presence of high skilled foreign workers. It is less clear whether low skilled foreign workers also generate such effects. A key characteristic of South–South migration flows in Asian countries is that, next to high skilled migrants, large shares consist of low skilled workers with temporary contracts. A good example is Malaysia, where around 90% of the stock of migrant workers consists of low skilled migrant workers. Our dataset contains information on the skill level of foreign workers, allowing us to distinguish between productivity effects of high skilled and low skilled migrants.

Importantly, although Malaysia has a long history of using low skilled foreign workers, there are persistent public concerns about potential negative effects on native workers and on wider processes of economic development (Gill & Kharas, 2007; Chin, 2002). Especially in times of economic stagnation, the Malaysian government has shown to be prone to introduce policies restricting the use of foreign workers. A good example is the "foreign workers first out" policy, implemented in the second half of the 2000s, where the government introduced several measures favoring the use of native over foreign-born low skilled workers (Oostendorp, Jordaan, & Kinuthia, 2014). As the evidence on the actual economic effects of foreign workers in this economy is limited, the findings from our analysis provide important new input to the debate on the role of (low skilled) foreign workers in the Malaysian economy.

Third, we assess whether and to what degree productivity effects of foreign workers are subject to industry heterogeneity. Given that (sets of) industries can differ across a range of dimensions, it is likely that the effects from foreign workers are subject to such heterogeneity (e.g., Paserman, 2013; Huber, Landesmann, Robinson, & Stehrer, 2010). To examine this, we assess whether the effects of foreign workers are affected by heterogeneity regarding technology, trade, capital intensity, skill intensity, and productivity. We also assess whether the skill level of foreign workers matters for the effects of industry heterogeneity, thereby obtaining more detailed evidence on the variety of productivity effects that migrant workers may create.

The paper is constructed as follows. In Section 2 we present a selective review of studies on the economic impact of migrant workers. Section 3 discusses the research setting, dataset, model specifications, and estimation issues. Section 4 presents the main findings from our analysis, which can be summarized as follows. First, we find that foreign workers generate positive productivity effects, especially when we control for endogeneity of the industry share of foreign workers. Second, positive productivity effects are linked to the presence of both high skilled and low skilled foreign workers. Third, we find clear evidence that industry heterogeneity is important. In particular, foreign workers generate marked productivity effects in labor and assembly intensive, export oriented modern industries, indicating the importance of low skilled migrant workers for these types of manufacturing industries. In Section 5, we summarize our findings and discuss their relevance for the debate on the effects of foreign workers, in general, and low skilled foreign workers, in particular, on the international competitiveness and the development of the Malaysian manufacturing sector.

2 | LITERATURE REVIEW

The majority of studies on static regional labor market impacts of migrants do not find evidence of large negative effects (Friedberg & Hunt, 1995; Longhi et al., 2005, Kerr & Kerr, 2011; Nathan, 2014; Hatton, 2014). In response to this, new research is developing along two lines. One set of studies is examining the impact of migrant workers within skill-experience categories. The evidence from these studies is mixed. Under the assumption of perfect substitutability between migrants and native workers in these categories, Borjas (2003), Borjas and Katz (2007), and Borjas (2015) find evidence of substantial negative wage effects in the United States.[1] In contrast, Ottaviano and Peri (2012) identify a small but significant degree of imperfect substitutability and subsequently find a small positive wage effect from migrants. Negative wage effects only materialize among previous immigrants.[2] In related research, Peri and Sparber (2009) and Foged and Peri (2016) find that the entry of migrants causes native workers to specialize in less manual-intensive occupations, generating positive wage effects. Most recently, Burstein, Hanson, Tian, and Vogel (2017) examine regional wage impacts of migrant workers at the occupational level and find that this impact varies both with the degree of immigrant intensity and with the tradability of occupations.

The second research line focuses on identifying wider positive effects from migrant workers. As Borjas (1995) already notes, the earlier literature has shown a tendency to focus on the costs of migrant workers to host economies, whereas potential benefits received much less attention. An explanation for the absence of evidence of negative regional wage effects in the spatial correlations approach is that migrants create positive effects that counter-balance any negative static labor market effects. These effects include increased levels of investment and entrepreneurship, innovation, and international trade (Hunt, 2011; Mitaritonna, Orefice, & Peri, 2014; Parrotta et al., 2014; Ottaviano & Peri, 2006).

A small set of studies examine direct productivity effects from the use of foreign-born workers. *A priori*, it is not clear what the nature of these effects is. One reason to expect that migrants create positive productivity effects is that they may solve structural bottlenecks in labor markets that would otherwise constrain productivity. In relation to this, productivity gains may also be created when native and migrant workers specialize in different tasks and activities or when diversity of the workforce generates productivity improvements (Peri & Sparber, 2009; Ottaviano & Peri, 2006). Furthermore, high skilled migrants may incorporate special skills and knowledge that improve firm performance (Markusen & Trofimenko, 2009). In contrast, the use of migrant workers can generate negative productivity effects when it lowers incentives for firms to invest in capital intensive, productivity enhancing new technologies (Lewis, 2005; Acemoglu, 2002). Also, the use of migrant workers is likely to create additional communication and integration costs that may outweigh any positive effects that may occur (Parrotta et al., 2014).

The evidence on productivity effects from migrants is diverse. Ortega and Peri (2014) find for a large cross-section of countries that the degree of openness to migrants enhances long run income per capita by fostering total factor productivity. For OECD countries, Alesynska and Tritah (2015) also find evidence that migrants create positive productivity effects in the form of a positive association between the number of migrants and labor productivity. Kangasniemi, Mas, Robinson, and Serrano (2012) examine the effects of migrants in broad economic sectors in the UK and Spain, and find that whereas foreign workers lower productivity growth in Spain, their effect in the UK is positive. For U.S. states, Peri (2012) finds that migrants enhance productivity; Quispe-Agnoli and Zavodny (2002) however report a negative relation between the regional share of migrants and productivity growth. Huber et al. (2010) find for a selection of E.U. countries that positive associations between migrants and productivity are sensitive to estimation specifications.

As is the case with research on the labor market impact of migrants, studies on productivity effects address the importance of the skill level of foreign workers. Especially concerning high skilled migrants, the expectation is that their special skills and experience will enhance productivity of host economies (Nathan, 2014). Markusen and Trofimenko (2009) use firm level data for Colombia to test the hypothesis that firms benefit from hiring “foreign experts.” Their findings suggest this to be the case as the hiring of high skilled foreign workers increases firm level wages and value added per worker. Malchow-Møller, Munch, and Skaksen (2011) use a matched employer–employee dataset for Denmark and find that hiring such foreign experts enhances both productivity and trade. In strong contrast to these positive findings, Paserman (2013) uses firm level data for Israel and finds that, if anything, the use of high skilled migrants lowers productivity growth.

Fewer studies attempt to identify differences between the effects of high skilled and low skilled foreign workers. In their study on several E.U. countries, Huber et al. (2010) classify migrants into low, medium, and high skilled workers, and find that it is mainly the latter type of worker that generates positive productivity effects. In their regional analysis of the United States, Quispe-Agnoli and Zavodny (2002) also examine the effect of the skill level of migrant workers, classifying migrants based on their educational history. Their findings indicate that the negative effect of migrants on regional productivity growth can be attributed in its entirety to the level of regional participation by low skilled migrants.

Finally, several studies investigate whether productivity effects from foreign-born workers are subject to industry heterogeneity. For instance, it is likely that positive effects from high skilled foreign workers are more pronounced in technology intensive industries. Paserman (2013) estimates the effect of high skilled migrants in high technology and low technology industries separately, and identifies a positive productivity effect in high technology industries. Huber et al. (2010) find that high skilled migrants generate positive productivity effects in industries that are characterized by a relatively high level of use of high skilled workers. Quispe-Agnoli and Zavodny (2002) find for the United States that regional economic sectors with an intensive use of low skilled workers are subject to a larger decrease of productivity growth from the use of low skilled foreign workers. Finally, Parrotta et al. (2014) find for Denmark that ethnic diversity of the workforce lowers productivity growth. This negative effect does not materialize in industries with a high level of R&D expenditures, suggesting that these industries experience additional positive productivity effects that counter-balance the negative productive effects from increased diversity.

Summing up, recent research is focusing on identifying positive economic effects that migrant workers may create. A small but growing set of studies tries to identify direct productivity effects from the use of foreign workers. The evidence is heterogeneous, with findings ranging from positive to negative effects. As is the case with research on labor market impacts, studies on direct productivity effects indicate that it is important to distinguish between high and low skilled migrant workers, as the nature and the magnitude of their effects may differ. Overall, it appears that positive productivity effects are predominantly linked to high skilled foreign workers. In addition, it is important to acknowledge that productivity effects from migrants are likely to be subject to industry heterogeneity, as several studies find that the effects from foreign workers differ across (sets of) industries.

3 | RESEARCH SETTING, DATA AND MODEL

3.1 | Research setting

In the 1980s and 1990s, the introduction of trade liberalization policies and the facilitation and attraction of international inward investment fostered a period of impressive economic growth in Asia. Several Asian countries started to encounter labor shortages, which were met largely by attracting foreign workers from other countries in the region (Manning, 2002). One of the key characteristics of these so-called South–South migration flows is that most migrants consist of low-skilled workers that are employed in host countries for a limited duration. Together with Singapore, Malaysia is a key net importer of such foreign workers in the region (World Bank, 2013).

However, despite its long tradition of using migrant workers, there are persistent concerns in Malaysian society that the continued reliance on foreign workers may generate negative effects on native workers and economic growth (Chin, 2002). Especially in times when the economy is slowing down, the government responds to such concerns by implementing policies restricting the use of migrant workers (e.g., World Bank, 1995).[3] A good example is the introduction of the so-called "foreign workers first out" policy. In response to the economic downturn during the second half of the 2000s, the government implemented a range of policies to lower the use of foreign workers in favor of domestic workers. These include raising the fees that firms have to pay for using foreign workers and the implementation of training programs facilitating native workers to replace foreign workers (Oostendorp et al., 2014). As for possible negative effects on economic growth, the concern is that the use of foreign workers prevents the Malaysian economy from moving away from low value added activities towards higher skilled segments of the manufacturing sector. Without such a move, the economy may get stuck in a middle-income trap (Hill et al., 2012; Gill & Kharas, 2007; National Economic Advisory Council [NEAC], 2010), limiting the capacity to enhance economic growth and generate higher income levels.

The limited available evidence suggests that concerns about large negative effects on the Malaysian labor market are unfounded. For instance, Athukorala and Devadason (2012) use manufacturing industry data for the first half of the 2000s to estimate the wage impact of foreign workers. Although they identify a negative impact, the effect is small. Yean and Siang (2014) use data from a sample of manufacturing firms for the same period and also identify only a small negative effect. In contrast, a study by the World Bank and the Malaysian Ministry of Human Resources (MMHR) based on data from labor force surveys for the period 1990 to 2010 finds no evidence that migrant workers have created negative employment or wage effects among native workers in the manufacturing sector (World Bank, 2013). As for productivity effects, Noor, Isa, Said, and Jalil (2011) use annual time series data for 1972 to 2005 and identify a positive association between the number of foreign workers and aggregate labor productivity. The report by the World Bank and MMHR reports findings from a study on drivers of firm level productivity that identify a modest positive productivity effect from the use of foreign workers, be it that this effect materializes mainly in large firms (World Bank, 2013).

3.2 | Data

The dataset that we use for the present study was provided by the Malaysian Department of Statistics (MDS). Because of confidentiality restrictions, the MDS was unable to provide firm level data that it collects via its annual survey among manufacturing firms. Instead, they provided data for the period 2005 to 2009 at the detailed 5-digit manufacturing industry level. The dataset contains information on output, inputs, R&D expenditures, and international trade. Furthermore, it contains information on the use of different categories of workers, including managers, professionals, technical professionals, and blue collar workers. For these different categories, the dataset also provides the numbers of native and foreign-born workers.

Table 1 shows the distribution of foreign workers over the various manufacturing industries. Columns (1) and (2) report the industry shares in total manufacturing employment and total number of foreign workers. Overall, there is a broad pattern that most foreign workers are employed in the larger industries. The industries of nonmetal furniture, electronics and electrics, food, machinery and equipment, and wood and wood products employ the largest numbers of nonnative workers. Together, these industries employ over 75% of all foreign workers.

TABLE 1 Distribution of foreign workers across manufacturing industries: Averages 2005 to 2009

Industry	(1) Share in manufacturing employment	(2) Share in foreign workers	(3) Share foreign workers in industry employment	(4) Share low skilled foreign workers in low skilled industry employment	(5) Share high skilled foreign workers in high skilled industry employment
Food products	13.8	13.6	24.9	24.1	2.4
Tobacco	0.3	0.1	2.9	2.5	5.7
Textiles	2.1	2.6	31.9	39.0	2.4
Leather	0.1	0.1	31.8	35.2	3.9
Wood and wood products	6.9	14.1	52.2	56.4	9.5
Paper and paper products	2.2	1.8	20.9	24.9	1.9
Printing and related activities	2.1	1.3	15.3	18.3	1.1
Chemicals and chemical products	3.6	1.6	11.2	15.3	2.4
Rubber and plastic	3.0	2.4	20.4	23.7	3.0
Other nonmetallic mineral products	4.1	3.4	20.7	25.3	2.6
Basic metals	3.2	2.5	20.1	25.0	4.4
Fabricated metal products	4.2	4.4	25.9	32.4	4.2
Machinery and equipment	11.2	9.9	22.3	27.8	3.4
Electrics and electronics	15.8	10.4	16.9	22.2	2.2
Transport equipment	5.0	3.1	15.9	19.8	2.6
Medical, optical and scientific instruments	0.4	0.2	15.7	18.4	3.8
Nonmetal furniture	20.4	27.6	34.7	39.8	4.4
Average	5.78	5.82	20.0	24.0	3.0

Note: High skilled workers: managers, professionals and executives, and technicians and associate professionals. Low skilled workers: all other categories.

Next, column (3) shows the relative importance of foreign workers in the various industries. The average share of foreign workers in total employment in the manufacturing sector is around 20%. The industry of wood and wood products has by far the strongest dependence on foreign workers with more than 50% of the work force consisting of foreign workers. A second group of industries including furniture, textiles, and leather products rely on foreign workers for more than 30% of their workforce. Over 20% of the workforce consists of foreign workers in the industries of metal products, machinery and equipment, and basic metals. Most remaining industries have a dependency on foreign workers of around 15% of total industry employment.

The last two columns report the shares of foreign low skilled and high skilled workers in the industry total numbers of high and low skilled employees. Overall, 24% of all low skilled workers in the Malaysian manufacturing sector are foreign born. Looking at the shares of low skilled migrant workers in the various industries, the relative importance of this type of foreign worker is strongly in line with the industry shares of nonskill specific foreign workers. As for high skilled foreign workers, their average share in total high skilled employment is much lower at around 3%. However, the industry share of high skilled workers shows substantial variation across the various industries. This suggests that differences in industry performance may be linked to the cross-industry variation of the use of this type of foreign worker. Industries with a relative large share of high skilled foreign workers include wood and wood products, tobacco, basic metals, nonmetallic furniture, and metal products.

3.3 | Regression model

We assume that the production process at the industry level can be captured by a standard Cobb–Douglas production function:

$$Y = AK^{\alpha}L^{\beta} \tag{1}$$

Y is output, measured by value added. A is the technology shifter. K is capital, measured by the end year net book value of fixed assets. L is labor input, measured by the total number of industry employees.[4]

To identify productivity effects from the use of foreign workers, we follow Paserman's (2013) specification of the production function. Total industry employment L consists of native workers L_n and foreign workers L_f. Native and foreign workers are perfectly substitutable but may have different levels of productivity. This gives the following production function:

$$Y = AK^{\alpha}[L_n + (1+\tau)L_f]^{\beta} \tag{2}$$

where τ captures productivity differences between native and foreign workers. Defining FW as the share of foreign workers in industry employment, L_f becomes $FW \times L$ and L_d becomes $(1 - FW) \times L$. Substituting these into the production function gives

$$Y = Ak^{\alpha}L^{\beta}[(1-FW) + (1+\tau)FW]^{\beta} \tag{3}$$

or

$$Y = AK^{\alpha}L^{\beta}[(1+\tau)FW]^{\beta} \tag{4}$$

Taking logs, adding industry i and year t subscripts and dummies and the idiosyncratic error term gives the production function specification that can be estimated with the data:[5]

$$\text{In}Y_{it} = \text{In}A_{it} + \alpha\text{In}K_{it} + \beta\text{In}L_{it} + \delta FW_{it} + I_i + T_t + \varepsilon_{it}, \tag{5}$$

where $\delta = \beta\tau$.

To identify the productivity effects from high and low skilled foreign workers separately, we follow a similar specification. The production function can be rewritten as:

$$Y = AK^{\alpha}L_{HS}{}^{\beta}L_{LS}{}^{\gamma}. \tag{6}$$

Total high skilled and low skilled employment L_{HS} and L_{LS} consists of high skilled native and foreign workers L_{HSn} and L_{HSf} and low skilled native and foreign workers L_{LSn} and L_{LSf}. Substituting these into the production function leads to:

$$Y = AK^{\alpha}[L_{HSn} + L_{HSf}]^{\beta}[L_{LSn} + L_{LSf}]^{\gamma}. \tag{7}$$

Defining the shares of high skilled and low skilled foreign workers in the total numbers of high- and low skilled workers as FW_HS and FW_LS, L_{HSf} becomes FW_HS) $\times$ L_{HS} and L_{LSf}

becomes FW_LS) $\times L_{LS}$. Domestic high skilled and low skilled workers are equivalent to $(1 - FW\_HS) \times L_{HS}$ and $(1 - FW\_LS) \times L_{LS}$. Substituting these into (7) gives:

$$Y = AK^{\alpha}L_{HS}^{\beta}[(1 - FW\_HS) + (1 + \rho)FW\_HS]^{\beta}L_{LS}^{\gamma}[(1 - FW\_LS) + (1 + \vartheta)FW\_LS]^{\gamma} \quad (8)$$

where ρ captures productivity differences between foreign and native high skilled workers and ϑ productivity differences between foreign and native low skilled workers. Simplifying (8) in a similar way as (4) gives:

$$Y = AK^{\alpha}L_{HS}^{\beta}[1 + \rho FW\_HS]^{\beta}L_{LS}^{\gamma}[1 + \vartheta FW\_LS]^{\gamma} \quad (9)$$

The log linear specification gives the function to be estimated:

$$\text{In}Y = \text{In}A + \alpha\text{In}K + \beta\text{In}L_{HS} + \omega FW\_HS + \gamma\text{In}L_{LS} + \varphi FW\_LS + I_i + T_t + \varepsilon_{it} \quad (10)$$

Where $\omega = \beta\rho$ *and* $\varphi = \gamma\vartheta$.[6]

Finally, to include additional factors that may influence productivity, we assume that the technology shifter A contains the following three variables. First, we include the variable HC, capturing the industry level of human capital. This variable is measured as the share of high skilled workers in total industry employment. Second, we control for productivity effects that may arise from international trade (Wagner, 2007; Bernard & Jensen, 1999). To do so, we include the log of industry level exports. Third, we include the log of industry R&D expenditures, to capture productivity effects associated with the creation and introduction of new technologies (Grilliches, 1979; Griffith, Redding, & Van Reenen, 2004; Hall & Mairesse, 1995).

3.3.1 | Endogeneity of industry share foreign workers

A potentially problematic issue surrounding the estimation of models (5) and (10) is that the estimated effect of foreign workers may be affected by endogeneity. The literature on the labor market impact of migrants shows that the large majority of studies address this potential problem of endogeneity of the share of migrants by using instrumental variable (IV) estimation techniques. For instance, studies that try to identify the regional wage impact of migrants need to account for the possibility that the regional distribution of foreign workers in a host economy is not exogenous to the regional distribution of wages or productivity (e.g., Ottaviano & Peri, 2006; Peri, 2012). If migrants are attracted to regions with relatively high wages, any identified wage impact will be biased as a result of this gravitation force. This estimation bias is avoided by using instruments for the regional employment share of foreign workers.

In the present analysis, the estimations may be affected by endogeneity when the industry share of foreign workers is influenced by industry characteristics. In particular, it is likely that foreign workers gravitate towards labor intensive, low productivity industries. This would cause the estimated effect of foreign workers in model (5) and low skilled foreign workers in model (10) to be biased downwards, because of the relation between the level of industry productivity and the use of foreign workers.

To deal with this we use instrumental variable techniques. We use the following two variables to instrument for the industry share of foreign workers. One instrument is a variable capturing the industry distribution of foreign workers during the 1990s, labeled *FW*1990s. In the 2000s, the number of foreign workers increased considerably. However, the distribution of foreign workers over the various industries has remained similar to earlier decades. This suggests that historically certain industries are more inclined to rely on the use of foreign workers. This may be because some industries have developed more experience in hiring and using such temporary workers. We take the required data on the industry distribution of foreign workers during the 1990s from Devadason (2012).[7]

We take the second instrument from Ramstetter and Ahmad (2009). They report detailed information on the participation by multinational enterprises (MNEs) in Malaysian manufacturing industries for the period 2000 to 2004. If foreign firms differ in their use of temporary foreign workers, the industry distribution of MNEs will be related to the industry share of foreign workers. Another reason why the share of foreign workers may be related to the industry participation by MNEs is that foreign workers may expect foreign-owned firms to pay higher wages than domestic firms, which would result in a positive relation between the industry participation of MNEs and the industry share of foreign workers. In our estimations, we use the annual share of MNEs in industry output for the period 2000 to 2004 as an instrument, labeled *MNEpart*.

In Table 2 we report the findings from OLS regressions of the industry share of foreign workers on the two instruments to assess the nature of their relationships. The industry distribution of foreign workers in the 1990s is positively associated with the industry distribution of foreign workers in our dataset, as expected. The variable capturing the share of MNEs in industry output carries a negative coefficient. This suggests that MNEs are less inclined to use foreign workers, and/or that foreign workers prefer to work for Malaysian firms.

4 | EMPIRICAL FINDINGS

4.1 | Productivity effects from foreign workers

Table 3 presents the findings from estimating several specifications of models (5) and (10). The first column with findings presents the results from regressing output on capital, labor, the industry share of foreign workers and year effects, omitting industry effects. The estimated effect of the share of foreign workers is significant and negative, suggesting that the use of foreign workers lowers productivity. However, when we include industry effects in the next column, the estimated coefficient of *FW* turns positive. This marked change in estimated effect is a first indication that foreign workers gravitate towards low productivity industries.[8] In column (3) we add the variables

TABLE 2 Relation between industry share foreign workers and instruments

Estimation method	(1) OLS	(2) OLS	(3) OLS
FW1990s	0.37		0.37
	(0.04)***		(0.04)***
MNEpart		–0.12	–0.14
		(0.04)***	(0.04)***
Constant	0.16	0.24	0.21
	(0.004)***	(0.02)***	(0.02)***
Industry and year dummies	Yes	Yes	Yes
F	76.18 (0.00)	8.22 (0.00)	44.67 (0.00)
Adj. R^2	0.20	0.02	0.18
n	496	496	496

Note: ***Denotes significance level of 1%.

capturing the industry variation of human capital, exports, and R&D to the model. All three variables carry positive coefficients, as expected. The effect of foreign workers persists to be positive and significant. To assess whether the effect of foreign workers is affected by nonlinearity, we include the squared term of the foreign worker variable to the model. As the findings in column (4) indicate, there is no indication that the effect is characterized by nonlinearity.

Columns (5), (6) and (7) report the results when we estimate the separate effects of the shares of foreign high skilled and low skilled workers.[9] The findings in column (5) show that both types of foreign worker create positive productivity effects, as the estimated effect of the shares of high and low skilled foreign workers are both positive and significant. Similar to the estimation using the overall share of foreign workers, adding the additional right-hand side variables does not change this finding. As the findings in column (7) indicate, the effect of the two foreign worker variables does not appear to be nonlinear, given the nonsignificance of the squared terms of the two variables.

Columns (8) and (9) contain the second stage results from the IV estimations. To assess the endogeneity of the foreign worker variables, we carried out Hausman tests, reported in Table A4 in the Appendix. A Hausman test comparing the OLS estimation of the effect of *FW* with the estimation where we instrument *FW* with the two instruments rejects that *FW* can be treated as exogenous. We obtain similar findings when we conduct a Hausman test on the OLS estimation of the effects of *FW_HS* and *FW_LS* and an estimation where both the foreign worker variables are instrumented. However, a Hausman test comparing the estimations where we either instrument both *FW* variables, or only *FW_LS*, indicates that there is no need to instrument the *FW_HS* variable. Therefore, in our IV estimations we instrument for *FW* in the estimations that control for the overall industry share of foreign workers and *FW_LS* in the estimations that control for the shares of high skilled and low skilled foreign workers.

The findings of the IV estimations show that the OLS estimations are biased as they do not control for the tendency of foreign workers to gravitate towards low productivity industries.[10] The estimated effect of the instrumented industry share of foreign workers in column (8) is much larger compared with the effect in column (3), confirming that foreign workers gravitate towards low productivity industries. A comparison of the findings between columns (6) and (9) show that this is also the case for the estimated effect of the share of low skilled foreign workers, confirming that it is the industry distribution of low skilled foreign workers that is affected by endogeneity. The estimated effect of high skilled foreign workers is also positive, be it that its effect is smaller in the IV estimation. Therefore, the instrumental variable estimations indicate that both low skilled and high skilled foreign workers generate significant positive productivity effects in the manufacturing industries.

4.2 | Industry heterogeneity

Most studies that examine productivity effects from migrants indicate that it is important to investigate whether industry heterogeneity influences the effects of foreign workers. To identify the presence and importance of such heterogeneity, we can follow two strategies. One strategy entails the use of interaction variables between the foreign worker variables and variables capturing industry heterogeneity; the other strategy is to divide the sample into subsets of industries according to their score on indicators of industry heterogeneity and compare the effect of foreign workers between the sets of industries. In preliminary exploratory regressions, we estimated random coefficient models following Swamy (1970) . We regressed output on capital, labor, and the industry share of foreign workers, allowing the coefficients to vary over the industries. An examination of the coefficients showed evidence of significant parameter variability across the industries for all three

TABLE 3 Productivity effects from foreign workers: OLS and IV estimates

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) IV	(9) IV
K	0.57	0.09	0.07	0.07	0.07	0.06	0.06	0.07	0.065
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.015)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***
L	0.39	0.71	0.78	0.79				0.73	
	(0.03)***	(0.05)***	(0.05)***	(0.05)***				(0.06)	
L_{HS}					0.61	0.44	0.44		0.43
					(0.06)***	(0.08)***	(0.09)***		(0.12)***
L_{LS}					0.24	0.39	0.41		0.34
					(0.06)***	(0.10)***	(0.10)***		(0.11)***
HC			1.99	1.99		0.77	0.79	2.31	1.02
			(0.24)***	(0.24)***		(0.35)**	(0.36)**	(0.30)***	(0.40)**
Exports			0.05	0.05		0.05	0.05	0.04	0.04
			(0.02)**	(0.025)**		(0.025)**	(0.025)**	(0.03)	(0.03)
R&D			0.02	0.02		0.02	0.024	0.02	0.02
			(0.01)**	(0.01)**		(0.10)**	(0.01)**	(0.01)**	(0.01)**
FW	–0.95	0.41	0.65	0.56				2.20	
	(0.20)***	(0.20)**	(0.20)***	(0.21)**				(0.45)***	
FW_squared				0.97					
				(0.99)					
FW_HS					1.99	1.63	1.78		1.09
					(0.48)***	(0.50)***	(0.72)**		(0.55)**
FW_LS					0.36	0.32	0.26		1.76
					(0.15)**	(0.15)**	0.14)**		(0.38)***
FW_HS_squared							–1.34		
							(3.73)		
FW_LS_squared							0.74		
							(0.71)		
Year	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry	no	yes	yes	yes	yes	yes	yes	yes	yes
F	736.26	151.37	88.27	75.79	134.80	76.86	61.50	52.53	64.88
Adj. R^2	0.91	0.81	0.89	0.89	0.86	0.87	0.87	0.51	0.53
n	496	496	496	496	496	496	496	496	496
Hansen *J*								0.96	0.63
								(0.61)	(0.72)

Note: ***,**,*Denote significance levels of 1%, 5% and 10%, respectively. Estimated standard errors robust to heteroskedasticity and autocorrelation. IV estimations in columns (8) and (9) are fixed effects estimations using FW1990s and MNEpart as instruments. First stage statistics are reported in the Appendix.

variables. This suggests that estimating the model on subsets of industries is more appropriate than adding interaction terms to the model, as estimations on subsets of the sample allows for the coefficients of all the right-hand side variables to vary between the groups of industries.

In our analysis, we consider the following sources of industry heterogeneity: productivity (value added/employees), capital intensity (fixed assets/employees), R&D intensity (R&D expenditures/output), trade intensity (exports/output), assembly style production (raw materials + intermediate inputs/output) and low skill intensity (low skilled employees/employees). For each of these factors we classify the industries into one of two groups, based on whether their score is above or below the sample's median value.

Table 4 presents the findings for the subsets of industries.[11] The top part of the table shows the estimated effect of the overall industry share of foreign workers. The first two sets of findings show the effect of foreign workers in low and high productivity and low and high capital intensive industries. In all the subsets of industries, foreign workers create a productivity advantage. A comparison of the coefficients indicates that the productivity effect of foreign workers does not differ between low and high productivity industries. In contrast to this, compared with low capital intensive industries, the productivity effect of foreign workers is significantly larger in industries with an above median level of capital intensity.

The next set of columns contains the results for industries with a low or high R&D intensity. It appears that the positive productivity effect of foreign workers is larger in industries with a relatively high R&D intensity, although the difference is moderate. An explanation for this difference could be that foreign workers incorporate special skills and knowledge, which enhances productivity in industries that rely on the creation of new technologies. However, as the large majority of foreign workers consist of low skilled workers, it is unlikely that the effect of high skilled foreign workers provides a full explanation. Therefore, to further assess the relationship between technology and productivity effects of migrant workers, we estimate the model for groups of industries using the OECD technology intensity classification (OECD, 2011). Using this classification, we categorize the industries as low, medium or high technology industries.[12]

The findings from estimating the model on these subsets of industries are shown in Table 5.[13] According to these findings, the productivity advantage of foreign workers increases with the level of technology of the industries, with the caveat that the Hansen *J* statistic questions the validity of the instruments for the estimation with the group of low technology industries. Industries classified as high or medium-high technology-intensive include office, accounting and computing machinery, radio and TV equipment, electrical machinery and apparatus, and motor vehicles. Although these industries are technology intensive at the international level, this is likely not to be the case in Malaysia. In fact, the correlation between the industry level of R&D expenses and the technology intensity classification in our sample is –0.41. As a result of ongoing processes of international fragmentation of production processes, labor intensive parts of production processes of technology-intensive industries are located in economies such as Malaysia. Therefore, we interpret the finding that foreign workers generate larger productivity effects in industries classified as technology-intensive by the OECD as evidence that foreign workers generate positive effects in the routine and labor intensive parts of modern industries.[14]

The last sets of columns in Table 4 present the effects of foreign workers when we consider trade intensity, reliance on assembly style production, and the overall use of low skilled workers. Regarding trade intensity, there is a clear and significantly larger productivity advantage attached to foreign workers employed in industries with a high dependence on international trade. The estimations for the groups of industries with a low or high degree of assembly style production indicate that foreign workers also have a significantly larger positive productivity effect in assembly-intensive industries. Together with the findings reported in Table 5, these findings indicate that positive productivity effects from foreign workers are more pronounced in modern, trade-oriented industries with a focus on assembly style production. Interestingly, it is not the case however that

TABLE 4 Productivity effects from foreign workers: Industry heterogeneity

	Productivity		Capital–labor ratio		R&D intensity		Trade intensity		Assembly intensity		Low skilled intensity	
	(1) Low	(2) High	(3) Low	(4) High	(5) Low	(6) High	(7) Low	(8) High	(9) Low	(10) High	(11) Low	(12) High
L	0.85	0.50	0.78	0.62	0.66	0.78	0.62	0.79	0.70	0.75	0.60	0.65
	(0.07)***	(0.11)***	(0.09)***	(0.11)***	(0.06)***	(0.08)	(0.07)***	(0.07)***	(0.07)***	(0.10)***	(0.10)***	(0.09)***
FW	1.89	1.88	1.97^{b}	2.96^{b}	2.05	2.37	1.57^{b}	2.81^{b}	1.47^{b}	2.62^{b}	2.77^{b}	1.45^{b}
	(0.48)***	(0.74)**	(0.53)	(0.84)***	(0.50)***	(0.78)***	(0.54)***	(0.78)***	(0.51)***	(0.73)***	(0.73)***	(0.55)**
F	57.24	14.25	32.06	27.87	46.85	35.65	34.87	41.0	37.95	18.75	22.98	34.47
Adj. R^2	0.70	0.25	0.54	0.48	0.56	0.49	0.51	0.50	0.63	0.44	0.40	0.55
Hansen *J*	4.27	4.63	4.14	1.64	0.44	1.36	0.75	0.66	2.30	2.00	6.11	2.67
	(0.11)	(0.09)	(0.12)	(0.44)	(0.80)	(0.51)	(0.69)	(0.72)	(0.32)	(0.37)	(0.05)	(0.26)
L_{HS}	0.56	0.32	0.68	0.24	0.32	0.49	0.29	0.53	0.23	0.67	0.28	0.40
	(0.13)***	(0.14)**	(0.19)***	(0.14)*	(0.11)***	(0.15)***	(0.12)**	(0.15)***	(0.17)	(0.20)***	(0.16)*	(0.20)**
L_{LS}	0.34	0.24	0.11	0.47	0.37	0.34	0.40	0.26	0.52	0.08	0.38	0.29
	(0.13)**	(0.14)*	(0.18)	(0.14)***	(0.11)***	(0.17)**	(0.12)***	(0.10)**	(0.16)***	(0.19)	(0.15)**	(0.19)
FW_HS	1.25^{a}	0.64^{a}	1.48^{a}	2.01^{a}	-0.24^{c}	1.63^{c}	0.79	1.34	0.51	1.88	1.49	1.57
	(0.60)**	(1.29)	(0.70)**	(1.35)	(0.87)	(0.79)**	(0.93)	(0.81)*	(0.57)	(1.31)	(1.69)	(0.65)**
FW_LS	1.88	1.33	1.52	1.95	1.55	1.82	1.10^{c}	2.43^{c}	1.27^{b}	2.12^{b}	1.89	1.09
	(0.44)***	(0.58)**	(0.46)***	(0.62)***	(0.39)***	(0.64)***	(0.41)***	(0.68)***	(0.41)***	(0.66)***	(0.60)***	(0.47)**
F	48.13	16.12	29.41	30.08	40.13	25.99	21.56	27.34	39.26	17.26	22.89	38.65
Adj. R^2	0.72	0.28	0.58	0.52	0.60	0.52	0.56	0.48	0.65	0.47	0.44	0.59
Hansen *J*	5.13	4.26	0.33	3.04	0.82	1.48	0.93	0.44	2.20	2.22	4.97	2.46
	(0.08)	(0.11)	(0.84)	(0.22)	(0.66)	(0.48)	(0.63)	(0.80)	(0.33)	(0.33)	(0.08)	(0.29)

Notes: ******Denote significance levels of 1%, 5% and 10%, respectively. Estimated standard errors robust to heteroskedasticity and autocorrelation. All estimations are fixed effects IV estimations using the instruments *FW*1990s and *MNEpart*. First stage statistics are reported in the Appendix.

[a,b,c]Denote significance levels of 1%, 5% and 10% from χ^2 test on differences between the estimated coefficients for the relevant subsamples.

TABLE 5 Technology intensity and productivity effects of foreign workers

	Low technology (1)	Medium technology (2)	High technology (3)
L	0.75	0.78	0.73
	(0.09)***	(0.14)***	(0.07)***
FW	–1.65	2.00	2.69
	(0.90)*	(0.95)**	(0.59)***
F	18.10	28.35	35.15
Adj. R^2	0.56	0.65	0.44
n	108	118	262
Hansen J	9.63	2.87	4.20
	(0.01)	(0.24)	(0.12)
L_{HS}	0.34	0.15	0.52
	(0.20)*	(0.23)	(0.14)***
L_{LS}	0.50	0.65	0.23
	(0.20)**	(0.20)***	(0.12)**
FW_HS	0.36	1.66	0.86
	(2.86)	(1.37)	(0.66)
FW_LS	–1.27	1.83	2.10
	(0.66)**	(0.69)***	(0.51)***
F	15.13	26.49	29.30
Adj. R^2	0.60	0.70	0.48
n	108	118	262
Hansen J	9.70	2.26	4.33
	(0.01)	(0.32)	(0.11)

Note: ***,**,*Denote significance levels of 1%, 5%, and 10%, respectively. Estimated standard errors robust to heteroskedasticity and autocorrelation. All estimations are fixed effects IV estimations using the instruments *FW*1990s and *MNEpart*. First stage statistics are reported in the Appendix.

these effects are stronger in industries with a relatively strong reliance on low skilled workers. In fact, as the findings in the last two columns indicate, the positive productivity effect of foreign workers is smaller in industries with an above median level use of low skilled workers.

The second part of Table 4 contains the findings on industry heterogeneity when we distinguish between the effects of the industry shares of high and low skilled foreign workers. The findings for low and high productivity industries differ from the results reported in the first part of the table. When we distinguish between the shares of high and low skilled foreign workers, we find that high skilled foreign workers create a positive productivity effect only in low productivity industries. Low skilled workers create positive productivities in both low and high productivity industries; this effect is larger in low productivity industries. As for industries with a low or high capital intensity, we find that high skilled foreign workers create a significantly larger positive productivity effect in industries with a below median level of capital intensity. The productivity effect of low skilled foreign workers is positive in both sets of industries.

The findings for industry heterogeneity based on R&D intensity indicate that foreign workers are more productive in industries with an above median level of R&D expenses. The productivity advantage of high skilled foreign workers is only significant in R&D intensive industries, whereas low skilled foreign workers have a moderately larger productivity advantage in these industries than in industries with a relatively low level of R&D intensity. In extension of this, Table 5 presents the findings from estimating the model for industries classified as low, medium, and high technology industries. Similar to the findings for the overall industry share of foreign workers, the productivity advantage of low skilled foreign workers increases with technology intensity.[15] The explanation for this effect is that foreign workers are creating positive productivity effects in labor intensive segments of modern industries. The effect of high skilled foreign workers is less clear, as the effect of the variable capturing the share of high skilled foreign workers is insignificant for all three industry groupings. Looking at the magnitude of the estimated coefficient suggests that if the effects would be significant, productivity advantages would be the largest in medium technology industries.

The final sets of columns capture industry heterogeneity regarding trade intensity, assembly style production, and industry use of low skilled workers. Looking at the results for trade intensity, the positive productivity effect of high skilled workers is mildly significant only in trade intensive industries. The positive productivity effect of low skilled foreign workers occurs in both sets of industries but is significantly larger in export orientated industries. Furthermore, low skilled foreign workers also create significantly larger positive effects in assembly intensive industries. High skilled foreign workers do not appear to create any significant effect. Finally, high skilled foreign workers create positive productivity effects in industries with an above median level of use of low skilled workers. Low skilled foreign workers create positive productivity effects in both types of industry; this effect is larger in industries with a below median level use of low skilled workers.

5 | SUMMARY AND DISCUSSION

In this paper, we contribute to the growing literature on positive economic effects of migrants in host economies. By analyzing the case of Malaysia, we address a gap in the literature that is focused strongly on identifying positive impacts in developed economies. Furthermore, most studies that examine productivity effects from migrant workers link the occurrence of positive effects to the presence of high skilled foreign workers in host economies. Much less is known about the capacity of low skilled foreign workers to create such effects. This issue is particularly relevant for Asian economies where, next to high skilled migrants, most South–South migrant flows consist of low skilled migrants that are employed in host economies on a temporary basis. Malaysia is a key migrant receiving country, where the manufacturing sector employs large numbers of such temporary migrants from other countries in South East Asia.

Our empirical findings can be summarized as follows. We find that foreign workers create positive productivity effects, especially when we control for the endogeneity of the industry share of foreign (low skilled) workers. When we distinguish between low and high skilled foreign workers we find that both types of migrant worker create positive productivity effects. The positive productivity effect of high skilled foreign workers is in line with findings on other economies. High skilled migrant workers incorporate special skills and experience that materialize as productivity improvements in firms or industries. Our finding that also low skilled foreign workers create positive productivity effects is more novel. We believe that the positive effect of low skilled migrant workers captures the feature that these workers have an intrinsically higher level of motivation and work ethos compared with native workers. As low skilled foreign workers are employed in

Malaysia for a limited duration, they have a clear incentive to ensure that they perform to the satisfaction of their temporary employers, materializing as positive productivity effects in our estimations. Whether low skilled workers in other Asian economies also create such effects is of course a matter of empirical verification, but it is clear that our findings indicate that, depending on the host economy in question, the skill content of foreign workers is not an all-determining factor for the creation of positive productivity effects.

In extension of this, we also find substantial evidence that industry heterogeneity matters for the impact of high skilled and low skilled foreign workers. To identify the importance of heterogeneity, we estimate the effects of foreign workers in different sets of industries, distinguishing between industries according to their overall level of productivity, capital intensity, R&D intensity, export orientation, assembly production style, and use of low skilled workers. A comparison of the estimated effects of foreign workers across these various sets of industries indicates that, at least for the Malaysian case, positive productivity effects from the use of (low skilled) foreign workers are particularly pronounced in export oriented modern industries, characterized by assembly-intensive production processes.

These findings bear relevance to persistent public concerns in Malaysia that the use of foreign workers creates negative effects on native workers. As findings from other studies indicate, there is no evidence that foreign workers create large negative wage or employment effects. Importantly, as Chin (2002) notes, even in times of economic downturn, employers have declared that they face substantial difficulties in recruiting native workers for low skilled, low wage jobs, indicating that there appear to be limitations to the need, effectiveness, and benefits of policies that restrict the use of foreign workers. Furthermore, our results indicate that the manufacturing sector enjoys productivity advantages from the use of foreign workers. Of course, to be able to fully assess these positive effects, the additional costs that employers have to pay to use foreign workers should also be taken into account. However, the finding that low skilled (as well as high skilled) foreign workers create positive productivity effects constitutes an important argument against persistent claims that the reliance on this type of foreign worker is directly damaging the Malaysian manufacturing sector. In any case, a full assessment of the effects of policies that aim to restrict the use of foreign workers should take into account that a decrease in the use of foreign workers is likely to create negative productivity effects in important manufacturing industries.

Finally, our findings also contribute to the debate on wider growth processes of the Malaysian economy. The main concern is that economic growth is slowing down as the economy persists to rely on low value added, low productivity activities. If the economy is unable to move towards higher skilled activities, the worry is that the economy gets stuck in a middle-income trap (NEAC, 2010; Hill, Yean, & Zin, 2012; World Bank, 2009). Given the reliance of low value added industries on foreign workers, a direct link is usually made between the use of foreign workers and the potential stagnation of the Malaysian economy. Our findings suggest that this interpretation of the role of foreign workers is too narrow and one-sided. Foreign workers often fill structural gaps in the labor market and generate positive productivity effects, enhancing the level of international competitiveness of key Malaysian manufacturing industries. This is important especially given the strong reliance of the Malaysian economy on international trade as main source of economic growth (World Bank, 2014).

Concerns about the need to develop higher value added activities to foster future economic growth are clearly valid and need to be addressed. However, the issue is far more complex than the criticism of the use of low skilled foreign workers reflects. In fact, there are a number of structural issues that constrain the contemporary Malaysian economy, including a lack of R&D activities, shortcomings in higher education, a lack of native high skilled workers, insufficient institutional progress, and a lack of diversification of the economy towards the service sector (Hill et al., 2012; Flaaen, Ghani, & Mishra, 2013; World Bank, 2009; Rasiah, 2009). In such a context, the transformation of the Malaysian economy towards an increased reliance on high skilled, high productivity industries is likely to be a costly and time-consuming process, as all these structural limitations need to be addressed. As our findings indicate, the use of foreign workers is generating positive productivity effects, particularly in trade oriented industries, thereby creating important economic gains that can be used as source of investment in a process of gradual change of the economy towards higher value added activities. Premature policies that restrict the use of low skilled foreign workers will generate economic costs to the economy and will obstruct, limit, or at least slow down the required process of structural transformation of the Malaysian economy.

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ENDNOTES

[1] Ortega and Verdugo (2014) use the Borjas (2003) methodology on French data and present evidence of substantial positive wage effects among native workers.

[2] D'Amuri, Ottaviano, and Peri (2010) present similar evidence for Western Germany.

[3] Kaur (2010) and Chin (2002) provide good overviews of the history of government policies towards the use of foreign workers in Malaysia.

[4] See Tables A1-A3 in the Appendix for a list of all the variables, descriptions, and summary statistics.

[5] Following Paserman (2013), as an approximation we take $\ln(1 + \tau FW) \approx \tau FW$.

[6] $\ln(1 + \rho FW\_HS) \approx \rho FW\_HS$; $\ln(1 + \vartheta FW\_LS) \approx \vartheta FW\_LS$.

[7] Devadason (2012) provides information on the industry distribution of foreign workers for 1992 and 2000. We calculate the annual rate of change for this period and input values for 1994, 1996, and 1998 to obtain the instrumental variable for the period 2005 to 2009. Other studies on Malaysia use a more simple instrument in the form of a 1-year lagged value of the industry share of foreign workers (see e.g., Athukorala & Devadason, 2012). In preliminary analysis we did estimate the models using the 1-year lag of *FW* as an instrument but obtained first stage statistics regarding under-identification and weak identification less favourable compared with the first stage statistics that we obtain with the instrument *FW*1990s.

[8] Figure A1 in the Appendix shows the added variable plot between the industry share of foreign workers and the dependent variable. A visual inspection suggests the absence of outlier observations.

[9] Figures A2 and A3 in the Appendix show the added variable plots between high or low skilled workers and the dependent variable.

[10] The first stage statistics are presented in the Appendix, Table A5. The estimated effects of *FW*1990s and *MNEpart* on *FW* and *FW_LS* are significant and of a similar nature to the effects reported in Table 2. Furthermore, the *F* statistic and R^2 are satisfactory and the Kleibergen–Paap and Stock–Wright statistics indicate that the instruments are sufficiently correlated with the endogenous variables and relevant to the model.

[11] Because of space considerations we only report the second stage effects of the labor variables and the foreign workers' share variables. Full results are available upon request. First stage statistics are presented in Table A6 in the Appendix.

[12] The OECD classifies industries as low technology, medium-low technology, medium-high technology, and high technology. We merged the low technology and medium-low technology categories to obtain sufficient observations in our low technology subsample.

[13] First stage statistics are shown in Table A7 in the Appendix.

[14] In their analysis of the changing nature of comparative advantage in East Asia owing to processes of technological and trade specialisation, Uchida and Cook (2005) find that Malaysia is partially specialized in exporting products

from high technology industries. However, this trade specialization is not accompanied by technological specialization, leading the authors to conclude that the specialization in trade-oriented high technology industries can be explained by the presence of labor or assembly intensive activities within these industries (see Uchida & Cook, 2005).

15 Again, the Hansen *J* statistic rejects the validity of the instruments for the group of low technology industries.

APPENDIX

TABLE A1 List of variable names and descriptions

Variable	Description
Y	Ln(Value added)
K	Ln(End year net book value of fixed assets)
L	Ln(Number of employees)
L_{HS}	Ln(Number of managers, professionals & executives, technicians and associate professionals)
L_{LS}	Ln($L - L_{HS}$)
L_n	Ln(Number of employees with Malaysian nationality)
L_f	Ln(Number of employees with foreign nationality)
FW	Share employees with foreign nationality in total number of employees
FW_HS	Share high skilled employees with foreign nationality in total number of high skilled employees
FW_LS	Share low skilled employees with foreign nationality in total number of low skilled employees
HC	Share of high skilled employees in total number of employees
Exports	Ln(Value of exports)
R&D	Ln(Value of R&D expenditures)
*FW*1990s	Share foreign workers in total number of employees for years 1992, 1994, 1996, 1998 and 2000
MNEpart	Share of multinational enterprises in total output for years 2000, 2001, 2002, 2003 and 2004

Note: Value added, fixed assets, exports, and R&D expenditures are measured in Malaysian Ringgit (000s) and expressed in constant (2005) prices.

TABLE A2 Correlation matrix

	K	L	L_{HS}	L_{LS}	*FW*	*FW_HS*	*FW_LS*	*HC*	Exports	R&D	*FW*1990s	*MNEpart*
K	1											
L	0.75	1										
L_{HS}	0.85	0.95	1									
L_{LS}	0.71	0.99	0.92	1								
FW	0.01	0.23	0.10	0.26	1							
FW_HS	0.03	0.11	0.04	0.13	0.45	1						
FW_LS	0.04	0.23	0.12	0.25	0.99	0.41	1					
HC	0.14	–0.11	0.01	–0.13	–0.33	–0.19	–0.25	1				
Exports	0.78	0.69	0.77	0.67	0.02	0.002	0.04	0.07	1			
R&D	0.58	0.55	0.69	0.52	–0.009	–0.02	0.01	0.04	0.72	1		
*FW*1990s	–0.10	0.001	–0.07	0.02	0.44	0.18	0.42	–0.23	–0.07	–0.08	1	
MNEpart	0.22	0.20	0.29	0.18	–0.10	0.008	–0.08	–0.18	0.18	0.27	–0.17	1

TABLE A3 Summary statistics

	Mean	Standard deviation	Minimum	Maximum
K	10.99	1.88	4.77	15.56
L	8.70	1.40	5.03	12.52
L_{HS}	6.97	1.52	3.04	10.76
L_{LS}	8.47	1.40	4.88	12.35
FW	0.20	0.12	0	0.72
FW_HS	0.03	0.03	0	0.33
*FW*_LS	0.23	0.14	0	0.77
HC	0.33	0.13	0.09	0.89
Exports	14.66	1.83	7.64	19.20
R&D	9.12	1.92	1.38	14.96
*FW*1990s	0.10	0.08	0	0.42
MNEpart	0.39	0.23	0.03	0.98

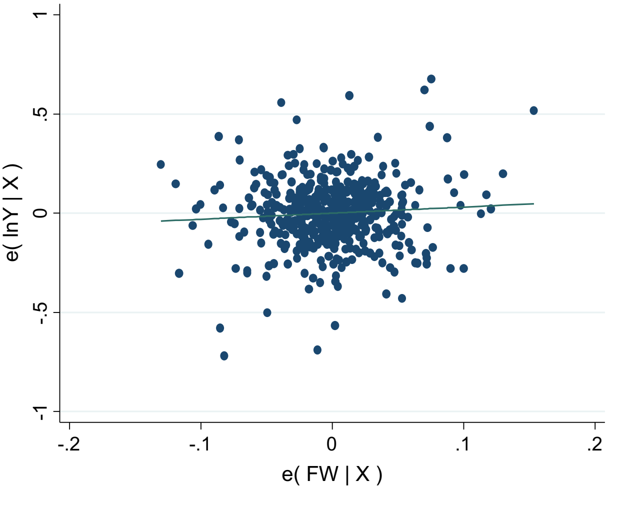

FIGURE A1 Added variable plot *FW* and *Y* [Colour figure can be viewed at wileyonlinelibrary.com]

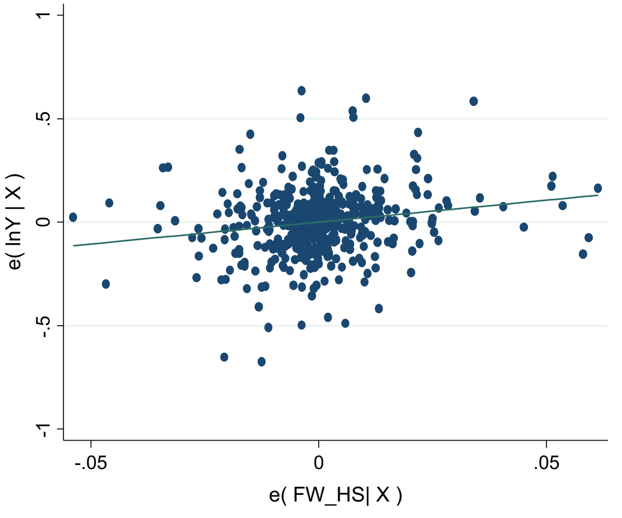

FIGURE A2 Added variale plot *FW_HS* and *Y* [Colour figure can be viewed at wileyonlinelibrary.com]

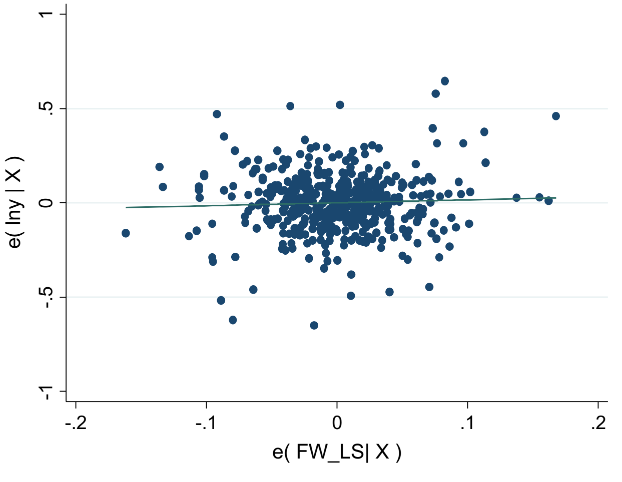

FIGURE A3 Added variable plot *FW_LS* and *Y* [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE A4 Hausman test

	(1) *FW* instrumented	(2) *FW_HS* and *FW_LS* instrumented	(3) *FW_LS* instrumented
χ^2	14.31	16.89	0.11
Prob>χ^2	0.02	0.03	0.99

Note: Table reports Hausman statistic. Column (1): OLS vs. instrumented *FW*; Column (2): OLS vs. instrumented *FW_HS* and *FW_LS*; Column (3): Instrumented *FW_HS* and *FW_LS* vs. instrumented *FW_LS*.

TABLE A5 First stage statistics of Table 3

	Column (8)	Column (9)
K	0.004	0.003
	(0.004)	(0.005)
L	0.02	
	(0.12)*	
L_{HS}		0.008
		(0.03)
L_{LS}		0.02
		(0.03)
FW_HS		0.30
		(0.17)*
HC	–0.25	–0.21
	(0.06)***	(0.14)
Exports	0.008	0.008
	(0.006)	(0.005)
R&D	–0.001	–0.009
	(0.002)	(0.03)
*FW*1990s	0.39	0.46
	(0.05)***	(0.05)***
MNEpart	–0.16	–0.18
	(0.04)***	(0.05)***
F	28.90	30.21
	(0.00)	(0.00)
Shea partial R^2	0.21	0.19
Kleibergen–Paap *LM*	57.28	60.82
	(0.00)	(0.00)
Stock–Wright *LM*	24.48	25.19
	(0.00)	(0.00)

Note: ***,**,*Denote significance levels of 1%, 5% and 10%, respectively.

TABLE A6 First stage statistics of Table 4

	Productivity		Capital–labor ratio		R&D intensity		Trade intensity		Assembly intensity		Low skilled intensity	
	(1)a Low	(2)a High	(3)a Low	(4)a High	(5)a Low	(6)a High	(7)a Low	(8)a High	(9)a Low	(10)a High	(11)a Low	(12)a High
F	18.24	15.09	15.80	15.83	29.22	12.54	21.59	12.18	16.00	17.34	9.92	17.12
Shea partial R^2	0.24	0.19	0.19	0.23	0.29	0.17	0.27	0.16	0.22	0.20	0.20	0.21
Kleibergen–Paap *LM*	37.34	22.10	31.08	28.87	30.44	28.56	30.67	25.76	27.34	33.91	17.94	28.84
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Stock–Wright *LM*	18.32	10.84	15.47	13.85	15.49	10.06	7.83	18.83	13.32	12.98	22.74	10.51
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
F	20.71	11.96	16.86	13.44	26.20	12.03	22.18	11.87	18.07	13.14	7.38	18.93
Shea partial R^2	0.26	0.16	0.19	0.20	0.30	0.16	0.28	0.15	0.20	0.17	0.16	0.20
Kleibergen–Paap *LM*	20.71	20.81	34.31	26.40	32.50	29.44	34.26	25.37	33.00	29.51	14.42	31.70
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Stock–Wright *LM*	21.18	9.47	14.15	9.22	14.73	11.68	6.18	22.90	15.44	13.16	17.78	9.79
	(0.00)	(0.02)	(0.00)	(0.02)	(0.00)	(0.00)	(0.10)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)

TABLE A7 First stage statistics of Table 5

	(1)a Low technology	(2)a Medium technology	(3)a High technology
F	7.54	10.98	20.96
Shea partial R^2	0.21	0.26	0.23
Kleibergen–Paap *LM*	15.06	17.12	37.65
	(0.00)	(0.00)	(0.00)
Stock–Wright *LM*	10.98	6.01	24.65
	(0.01)	(0.11)	(0.00)
F	5.94	11.15	20.97
Shea partial R^2	0.20	0.27	0.23
Kleibergen–Paap *LM*	10.89	17.44	39.33
	(0.01)	(0.00)	(0.00)
Stock–Wright *LM*	10.88	8.38	24.48
	(0.01)	(0.05)	(0.00)

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