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MODELLING THE IMPACT OF FOREIGN WORKERS ON NATIVE'S UNEMPLOYMENT RATE

Atif Awad[1], Ishak Yussof[2] and Rahmah Ismail[3]

Abstract: *Present study examines the direct and indirect effects of foreign workers on native's unemployment rate for Malaysia economy during the period between 1982 and 2012. We had constructed two models. The first was in regard to the direct effects; while the second included both the direct and the indirect effects. Interestingly, our results showed that: in the first model, foreign workers appeared to affect unemployment negatively; and, in the second model, unemployment rate was positively affected by the flow of foreign workers. Our findings were robust, even when we utilized different estimation method or different proxy on some of the variables.*

Key words: *foreign labour, unemployment, demand and supply of labour JEL: J61, J64, J21*

1. INTRODUCTION

Malaysia is one of the Asian countries that had experienced a surge in the inflow of immigrants for the past few decades. The figures tell us that during the period from 1982 to 2012, the number of registered or legal foreign workers had improved in proportion to labour force, from 3.2% to 17% (i.e. from 220 thousand to more than 2 million) (Thukorala and Devadason 2012). In addition to that, there were additional 2.2 million of illegal foreign workers (Amnesty International, 2010). Most importantly, during the same period, the number of foreign workers had grown by an average of 0.61% annually; which is nearly threefold the average of annual growth rate of; the number of labour forces, and the number employment (i.e. each registered an average of 0.19% in annual growth rate). The influx of the foreign workers into the country is mainly due to labour shortage problem following to the transformation in the nation's economy, from an agricultural based economy to manufacturing and services-based economy that began in the early 1980s (Idris & Ismail 2006, Thukorala and Devadason 2012).

1. Assistant Professor, College of Business Administration, Department of Finance & Economic, University of Sharjah, P.O. Box = 27272, Sharjah, UAE, *Email: aawoad@sharjah.ac.ae*

2-3. Professor, School of Economics, Faculty of Economics and Management, The National University of Malaysia, 43600 UKM Bangi.

The issue of economic impact of immigrant workers had been widely discussed by economic literature, mainly by taking into consideration, for example, the characteristics of both foreign and native workers; the degree of the complementary and substitutability between them; the demand and supply elasticities; the openness of the economy, and the movement of the factors of production. There is a quasi-consensus on the limited negative economic impact by foreign workers (Weyerbrock 1995, Keuschnigg and Kohler 2002, Heijdra et al. 2002, Brücker and Kohlhaas 2004, and Boeri and Brücker 2005 Mouhoud et Oudinet 2010, Okkerse 2008, Longhi et al. 2010). However, according to Borjas (1994) "*the most important lesson is that the economic impact of immigration varies by time and place and can be beneficial or harmful*". This implies that we cannot generalize the experience of a particular country in dealing with foreign labour with other countries. Thus, the effects of immigrant workers remain an empirical issue.

Notwithstanding, very few empirical studies on the impact of immigration on economy in general, and on the labour market's performance in particular, had been conducted on Malaysia. In addition, these few studies concentrated on the impact of foreign workers on only one sub-sector of economy in general, and on the manufacturing sector in particular (Narayanan and Lai 2005, Idris and Ismail 2006, Mohd Noor et al. 2011, Renuka 2001, Sulaiman 2012, Athukorala and Devadason 2012, Abdul-Rahman et al. 2012, Ismail et al. 2013). For instance, Narayanan and Lai (2005) addressed the causes and consequences of foreign workers in the construction sector; while Athukorala and Devadason (2012) examined the impact of foreign workers on wages in the manufacturing sector.

As such, there is no specific theoretical model that predicts the direct impact of foreign workers on native wage or unemployment rate. Most past empirical studies estimated the impact by incorporating a measurement for foreign labour in conjunction with several other factors that represent the specific characteristics of the country, state or industry (Todaro 1969, Harries and Todaro 1970, Winter and Zweimuller 1999, Pope and Withers 1993, Athukorala and Devadason 2012, Fromentin 2013). A study conducted by Carrasco et al. (2008) had summarized the main conclusions of these studies. First, it acknowledged the difficulty in confirming the implications of the standard classical model; in which the effects of immigrant workers on the host country's labour market depend on the labour market's regulation. In flexible labour markets, because demand and supply factors adjust relative to wage, an increase in labour supply due to these immigrants tends to shrink the wages of the native labourers.

Alternatively, a rigid labour market prevents the adjustments of relative wages; an increase in labour supply due to immigration tends to reduce the employment rate in labour market. Second, empirical studies on the impacts of immigration on labour market that are time-and country-dependent had derived

different estimates for such impacts. The common feature in most of these studies in this strand of literature was the utilization of what is called as "area-analysis" approach. In this approach, local labour market, wages and employment rate correlate with the prevalence of immigration. Nonetheless, because production inputs such as labour and capital are always mobile across labour market, the correlation approach failed to capture the degree of substitution / complementary between foreign and native workers (Borjas 1999). In addition, changes in industry composition, labour productivity, capital, or other factors may explain why immigration does not appear to affect employment at state level studies (Winter-Ebmer and Zweimuller 1999, Carrasco et al. 2008, Christofides et al. 2009).

Moreover, while the competitive model predicts the negative effect of immigrants on native workers, there are a variety of reasons as to why the wage and employment effects could instead be positive. First, the foreigners complement native workers in the production process, thus leading to the increase in demand for native workers. Second, in a segmented labour market, immigrant workers will fill the unwanted jobs by natives without any competition from local workers. If those jobs are complementary, new employment opportunities for natives will become available in the primary sector. This leaves the magnitude and the sign of the direct impact of foreign workers on the labour market's outcomes of native to be theoretically and empirically undetermined (Piore 1979, Friedberg and Hunt 1995, Pischke and Velling 1997, Abdul-Rahman et al. 2012).

The contribution of the present study to the economic literature in general, and that to Malaysia in particular is to identify the exact channel through which foreign workers affect labour market, namely, unemployment rate of the natives. We assumed that by entering a measurement for foreign workers in a regression analysis, even with the incorporation of others factors (that may constitute the channels through which foreign workers affect labour), will lead to misleading results. This is because the foreign labour measurement in this case will only capture the direct impacts, i.e. demand and supply factors, and not the indirect impacts, which are essential. In other words, the complementary and substitutability processes between the natives and foreign workers might affect unemployment rate of natives through their effects on either labour productivity, or changes in trade composition in the host country's economy.

In the present study and to examine the validity of this assumption, first, we examined the direct effect of foreign worker by regressing foreign worker (% labour force) with other proxies that represent labour productivity, openness and labour market regulation on native's unemployment rate. Second, to identify the indirect impact, we created an interaction term between foreign worker and each of, native's labour productivity and openness of the economy; and re- examined

the foreigners' effect. Interestingly, our results in both cases were quite different. In the first case, the long and short run coefficients of the foreign workers appeared to be positive and statistically significant, indicating negative impact of foreign workers on unemployment rate of the natives. In contrast, in the second case, the coefficient turned out to be negative and statistically significant indicating positive impact of foreign workers on unemployment rate of the natives. However, in both cases, the magnitudes of the long and short run coefficients were small; and are consistent with earlier findings. Our findings were robust even when we utilized different estimation method or different proxy for some variables. These findings implied that in modelling the impact of foreign workers on labour market's outcome, researchers should consider the indirect impact of foreign workers.

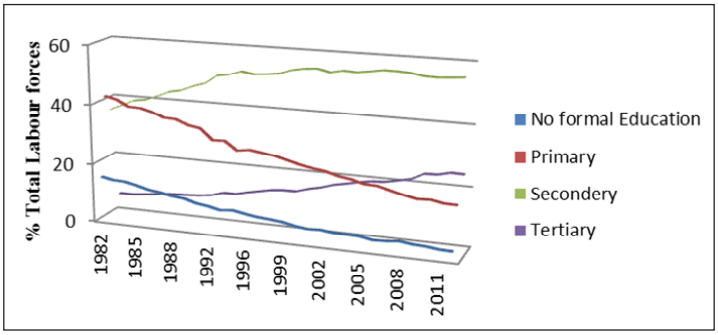
To our knowledge, this is the first study of its kind in Malaysia where a quantitative assessment on the dynamic relationship between immigrant workers and unemployment rate of natives, is conducted. In section 2 and in brief, we highlight the labour market, while in Section 3 we discuss the theoretical models. The methodology which includes information on the model, variables and data, and estimation method will be addressed in Section 4. Section 5 deals with the results and discussion; and section 6 is on conclusion and policy implication.

2. LABOUR MARKET AND FOREIGN WORKER IN MALAYSIA

This section describes in brief the main characteristics of labour market in the Malaysian economy, including information on the influx of foreign workers. We will start by describing the skills of native labour force, the sectoral distribution of employment, general trend of unemployment, and unemployment by educational level. Thereafter, we will focus on the foreign labourers and their skills as well as the share of foreign workers to total labour force and employment.

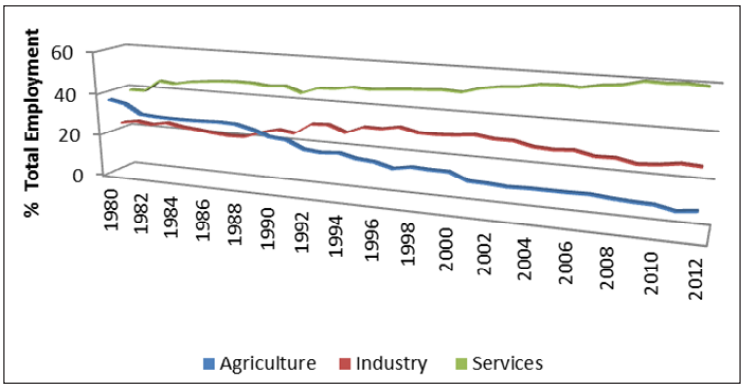
Until 2012, the labour force's participation rate had not exceeded 68%; and the rate grew annually at an average rate of 0.33%. In terms of skills, Figure 1 shows that the share of low skilled labour tends to decrease over time, while the shares of medium and higher skilled workers are expanding. Although by the end of 2012 majority of the labour force possessed medium skills (i.e. secondary education), the average annual growth rate during the period between 1982 and 2011 for workers who possessed high skills (i.e. tertiary education) was relatively higher (i.e. 5.13%) as compared to medium skilled group (i.e. 1.54%). In fact, the year 1982 marked the beginning of the structural transformation of the economy from agricultural based economy towards industrial based economy. In view that this transformation process requires high- skilled labour, the country had devoted quite a substantial amount of its resources on education and training programs; and this can be seen in the gradual improvement in the skills of its labour force.

Figure 1: Labour force by education level, Malaysia, 1982-2012



In terms of distribution of employment across the sectors in the economy, Figure 2 shows that the share of the agricultural sector in the total employment had declined to 13% in 2012 from 36% in 1980. During the same period there was a sharp improvement in the share of services sector in the total employment; but due to the fluctuation in the international markets, the share of industrial sector in the total employment also fluctuated. Thus, the trend of sectoral distribution of the employment in the economy is consistent with the trend of the skills of the labour force.

Figure 2: The sectoral distribution of employment (% total employment), Malaysia, 1980-2012



Malaysia has one of the lower and to some extent, stable unemployment rate among the Asian countries. Table 1 shows the level and trend of unemployment rate in Malaysia and selected Asian countries during the period from 1990 to 2013. In 1990, Malaysia had the second highest unemployment rate among those selected countries, but since 2000, the rate of unemployment had since decreased

and remained stable at 3.1%. During the period from 1990 to 2013, unemployment rate in Malaysia had decreased by 38.67%; in contrast, some other countries in the region registered an increasing unemployment rate such as Indonesia and Japan.

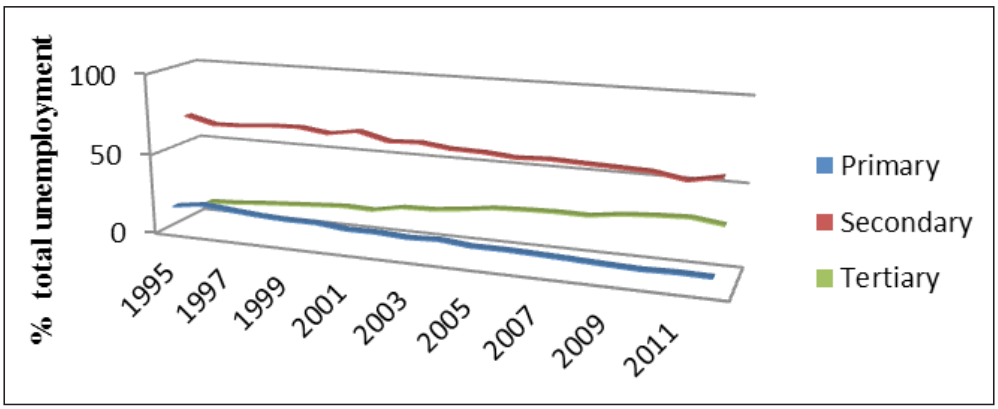
Table 1
Unemployment rate in selected Asian countries, 1990-2013

Country	*1990*	*2000*	*2013*	*Change (%)1990-2013*
China	2.5	3.1	4.1	64
Indonesia	2.4	6.08	5.9	145.83
Korea, Rep.	2.5	4.4	3.5	40
Malaysia	5.06	3.1	3.1	-38.67
Philippines	8.4	11.18	7.03	-16.37
Singapore	2.11	3.7	3.08	45.97
Thailand	2.2	2.4	0.65	-70.45
Japan	2.1	4.73	4.2	100

Sources: Data on unemployment rate are from Asia Development Bank.

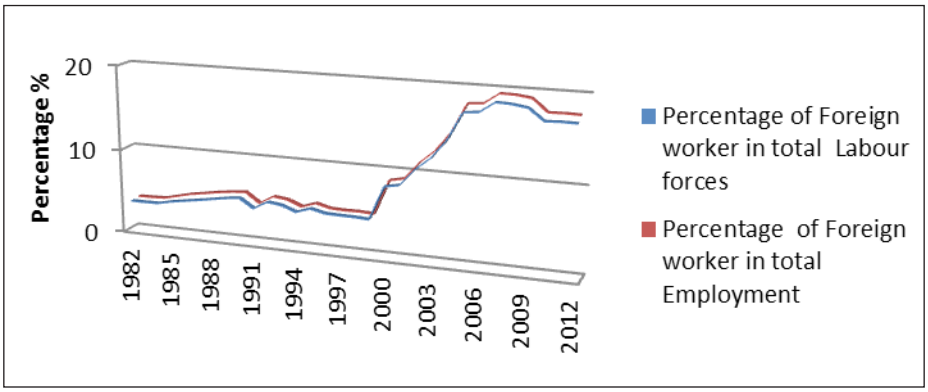
Surprisingly, there is a positive correlation between unemployment rate (% of total unemployment) and education level. Figure 3 shows that unemployment rate tends to be high among those with higher education, but low for those with primary and secondary education. This may be due to the mismatch problem that started to appear in the Malaysian economy (see Annic and Hamali 2006, Yussof and Ismail 2012, Sook Fan et al. 2013).

Figure 3: Unemployment by education level, Malaysia, 1995-2012



Now let us discuss the issue of interest to the present study, foreign labour and its size, and growth in the Malaysian economy. Figure 4 describes the proportion of the foreign worker to; total labour force, and total employment in the country for the period from 1982 to 2012. In view that unemployment rate is low, the proportions of the foreign worker to; total labour force, and total employment, are nearly identical. Clearly, since 1982 and until 2000 the proportion of the foreign worker to the total labour force remained stable and nearly constant, but after 2000 it sharply increased. This implies that over time foreign workers turn out to be one of the essential components to Malaysian labour market.

Figure 4: The Percentage of foreign workers to each of total labour forces and total employment, Malaysia, 1982-2012

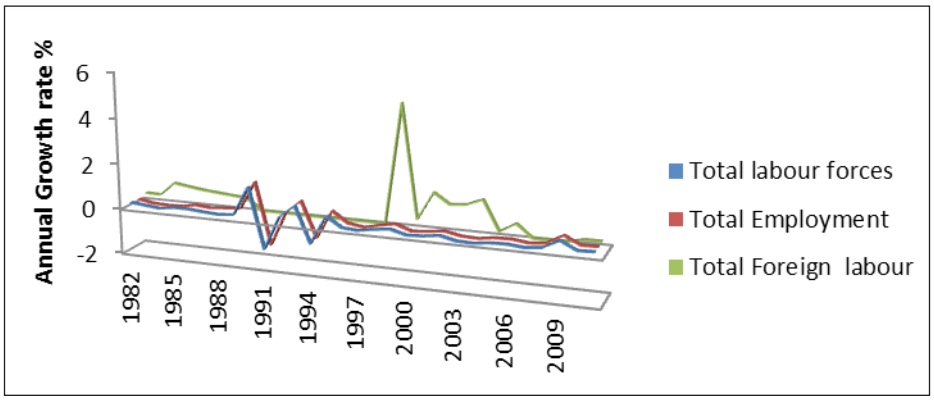


To examine the influx of foreign workers into the country as compared to that of labour force and employment, we had calculated the annual growth rate of foreign labour, labour force and unemployment during the period from 1982 to 2011 as shown in Figure 5. We observed two outcomes from these figures. First, during the period under consideration, the annual growth rate of foreign workers exceeded the annual growth rate of labour force, and employment in general and after 2000 in particular. Second, although labour force, and employment registered negative annual growth rate during the same period (i.e. in the mid- 1990s), the number of foreign workers continued to record positive annual growth rate in all periods. This implies that not only the inflow of foreign workers into the country is high, but it grows faster than the growth rate of the natives.

Concerning the skills of the foreign workers, according to the Annual Report of Ministry of Finance Malaysia in (2013) foreign workers with no formal education or primary education background accounted 67.0% of the total foreign workers. The available information on the distribution of foreign workers by occupation at

sectoral level confirmed the flow of low skilled foreign workers into the country. For instance, according to Athukorala and Devadason (2012), in 15-sub manufacturing industries, over 80% of foreign workers had engaged in low-skilled jobs as compared to less than half of the native workers. The proportion of skilled workers among foreign workers had declined across all industries. In 1990, approximately 78% of all foreign workers in the manufacturing sector were production workers/ operatives. This figure had then increased to 96% in 2008. The share of foreign production workers in total production workers had similarly increased from 2% to 38% over the period from 1985 to 2008. Interestingly, the share of low skilled foreign workers was uniformly high (over 90%) across all industries (with the exception of petroleum and chemical industries). These patterns reaffirmed the assumption that the concentration of foreign workers in unskilled jobs is not industry specific, but a common phenomenon. Similar distribution pattern was also observed in the construction sector that, by nature, relies heavily on medium and low skilled workers.

Figure 5: Annual growth rates (%) of number of total labour force, employment and foreign workers Malaysia, 1982-2011



Regarding Malaysian policy on the entry of foreign workers, until the mid-1990s, most of the policies were on short-term requirements and labour shortage rather than an active and well thought out approach in meeting long-term needs for labour. In brief, in order to prevent illegal immigrants and to regulate foreign labour inflows, since 1980s the government had signed a number of bilateral agreements with the source countries of immigrant workers. Under these agreements, the skill requirements and the sectors in which the workers will be employed are delineated. The first agreement (the Medan Agreement) was signed with Indonesia in 1984, and this was followed by simile agreements in 2004 with the Philippines, Thailand,

Bangladesh, Vietnam, and Sri Lanka. Private employment agencies are only allowed to recruit foreign workers from these countries; subject to quotas periodically set by the Malaysian government. In 1991, the Malaysian government had introduced an annual foreign worker levy (payable by the employer), which varies by sector and skill categories. There are basically two types of work permit: the unskilled and semiskilled workers are issued with visit passes for temporary employment that are valid for a year and can be renewed annually for a maximum of 5 years. Meanwhile, visit passes for professional workers are issued quite liberally to all sectors and all occupations, except for those who have direct implications to national security. In response to the growing concerns on the suppression of domestic wage resulting from the heavy reliance on immigrant labour, the government is currently considering to quadruple the levy by 2015 and to introduce security bond to ensure that the employers are accountable to responsible for the adherence of employment contracts (Kok 2011, Athukorala and Devadason 2012).

3. MODELING NATIVE'S UNEMPLOYMENT IN THE PRESENCE OF FOREIGN WORKERS USING AN INDIRECT EFFECT APPROACH

The question that remains unsolved is as to whether the host country's unemployment rate will be higher due to the presence of foreign workers. So far, existing theoretical models had only applied the structural approach of the labour market (which specified that the linkages between immigration and unemployment to be empirically estimated[1]). These approach models of conventional labour market aggregate simultaneously with immigration flows. Applying this technique, one could obtain a structural model, which is a system of four simultaneous equations for unemployment, labour force participation, real wage and immigration rate. However, this structural model still fails to show the effect of foreign workers on native's unemployment.

Another paper by Simon (1989) and most recently Gross (1998) had provided a better modelling framework that links foreign workers and unemployment rate in the native country. The main idea is to check on the difference in the native's unemployment rate before and after the arrival of foreign workers through job creation. The model is set up based on the idea that immigrants create more job vacancies through their demands for goods and services; and thus, benefitting local workers through production process. In this paper, we extended the basic theoretical framework by Gross (1998) and then analyzed several factors which are believed to affect native's unemployment rate indirectly. The idea is as the following. In doing so, we first discuss the existing theory on unemployment

1 See Andrews (1988) or Layard *et al*. (1991)

that allows the arrival of foreign workers and identify factors that can determine native's unemployment indirectly. Foreign workers may not only affect the unemployment of the native country directly but also indirectly such as through their effect on productivity of the native workers (Peri and Sparber 2009, Peri 2010), labour market regulation in the host country (Gross (1998, 2002 & 2004)), and the degree of openness (Friedberg and Hunt (1995) & Heid and Larch (2011)).

By allowing foreign workers, local representative firm can demand labour from both domestic (N) and foreign workers (F). Thus, the total post-migration labour force is $L = L_N + L_F$. The wage rate w^r, is assumed to be fixed and expressed in real term, which is the minimum wage required to attract foreign workers to the host country. While, $w(L_t)$ is the reservation wage for the marginal foreign worker when L_F workers have already been hired, the domestic firm faces the following inverse labour supply of foreign workers:

$$w(L_t) = w^r L_F \tag{1}$$

According to Gross (1998), given fixed wages, unemployment of the host country can be defined as follows:

$$U_N^A = U_N^B + tE - (tE + dL_F)\left[\frac{tE + U_N^B}{tE + U_N^B + aL_F}\right] \tag{2}$$

Where, U_N^A and U_N^B are the levels of unemployment after and before the arrivals of foreign workers, respectively. tE is the job turnover defined as the number of natives employed before foreign workers arrival (E) times the proportion of natives who leave their jobs each year (t). The term dL_F is the "effective" number of job seekers (foreign workers) with coefficient d as the relative likelihood of a foreign worker and a local of being hired for a particular job opening while L_F is the number of foreign workers. The last term on the right hand side of equation (2) is the ratio of the number of native job seekers to the sum of the foreign job seekers plus the "effective" number of foreign job seekers. It reflects the rate at which vacancies are filled by native job seekers. The coefficient value a here represents the "effectiveness" of foreign workers in competing with local job seekers for jobs.

Unlike Gross (1998) who assumed d and a as exogenous and constant with coefficient $0 < d < 1$ and $0 < a < 1$ respectively, here we assumed d and I a as endogenous. In particular, variable d (which is the relative likelihood of a foreign worker and a local being hired for a particular job) actually relies on the level of productivity and the degree of openness. From the perspective of good market, having higher productivity in the economy and more openness of the economy will increase demand for goods and services. Due to high demand, firms will produce more output by demanding more workers either from local or foreign

workers. As a result, the level of unemployment will decrease and the effect is even larger in the case of when the foreigners are complement to native workers. Based on this idea, we defined d as following:

$$d = (\alpha + \mu_i) + \eta(q) \tag{3}$$

Where, productivity, $\alpha + \mu_i$ can be decomposed into two common productivities, α for all firms and specific industry/sector productivity shock (μ_i). The last term in equation (3) represents the degree of openness in which q is the volume of trade; and it is usually represented by the ratio of export plus import relative to output.

Now, let's take a look at the indirect effect of foreign workers on native's unemployment. This can be answered by taking the derivative of domestic unemployment with respect to productivity and openness. From equation (2), we know that $\frac{\partial U_N^A}{\partial d} < 0$. Since $\frac{\partial d}{\partial(\alpha+\mu i)} > 0$ and $\frac{\partial d}{\partial \eta(q)} > 0$, the total effects of productivity and openness on unemployment rate are:

$$\frac{\partial U_N^A}{\partial d} \cdot \frac{\partial d}{\partial(\alpha+\mu i)} < 0 \tag{4}$$

and,

$$\frac{\partial U_N^A}{\partial d} \cdot \frac{\partial d}{\partial \eta(q)} < 0 \tag{5}$$

This result implies that the higher (lower) level of productivity in the economy or the more (less) open the economies, the more (less) job openings there are in the native country; and thus these can be filled by both local and foreign workers. As a result, native's unemployment rate will decrease. In other words, there is a negative relationship between productivity and unemployment as well as between openness and unemployment.

Furthermore, coefficient aa (that reflects on the "effectiveness" of foreign workers in competing with local job seekers for jobs) is assumed to rely on labour market regulations. As such, regulations on free entry and exit of foreign workers as well as the degree of complement or substitution between local and foreign workers could be the best determinants of how effective a foreign worker is in finding a job relative to a local worker. L_N^S and L_F^S are are total labour supplied by locals and foreigners, respectively, prior to arrival of foreign workers; and it is assumed that a fraction (ρ) of foreign workers is allowed to enter the native's country while the remaining fraction ($1 - \rho$) is not allowed to enter the country. Hence, the "effectiveness" of foreign workers in supplying their labour is:

$$a = \frac{L_N^S(1-\rho) + L_F^S(\rho)}{L} \tag{6}$$

Where, L is the total post-migration labour force with $L = L_N = L_F$. Accordingly, we obtained $\frac{\partial a}{\partial \rho} = -L_N^S + L_F^S$ and since L_N^S is always greater than L_F^S, the total effect is positive, i.e. $\frac{\partial a}{\partial \rho} < 0$. From equation (1), we know that $\frac{\partial U_N^A}{\partial a} > 0$. Thus, the total effect of labour market regulation on unemployment rate is negative as:

$$\frac{\partial U_N^A}{\partial a} \cdot \frac{\partial a}{\partial \rho} < 0 \tag{7}$$

Thus, if the government realizes that local workers are likely to compete with foreign workers in getting job, it will try to be more restrictive by decreasing a fraction (ρ) of foreign workers allowed to enter native's country. As a result, it will be more difficult for the foreign workers to secure jobs as compared to local workers. Thus, more local workers can be employed, reducing the unemployment rate of the host country.

4. THE MODEL, VARIABLES & DATA AND ESTIMATION METHOD

4.1 The model

In this section, data and methodology of the underlying model specification are discussed. In line with the theoretical framework modelled in Section 3, we further developed a model specification for empirical estimation. In other words, in this section we analyze the impact of foreign workers on unemployment rate from the empirical point of view by taking into account both direct and indirect approaches. The model takes the following form:

$$UN_t = \beta_0 + \beta_1 FL_t + \beta_2 LMR_t + \beta_3 LP_t + \beta_4 OP + \varepsilon_t \tag{8}$$

Where, UN is native's unemployment rate (% of total labour force), FL is the share of foreign workers in the total labour force, LMR is labour market regulation, LP is real total output per worker or the labour productivity, OP is openness and ε_t is the error term. The present study measures labour market institutions according to the labour market regulation index from the Economic Freedom of the World's database (Gwartney et al. 2013). The index consists of six sub indicators that measure the influence of hiring regulations and minimum wages; hiring and firing regulations; centralized collective bargaining; working hour regulations; mandated costs of worker dismissal; and conscription. The index is calculated to measure

the extent to which these infringements exist. The indicators are normalized to range from 0 to 10, where a high score denotes high economic freedom and less regulation (flexible labour market regulation). The aggregate index is calculated as the arithmetic mean of the ratings of its six sub indicators. The summary measures trade openness (used virtually universally in existing empirical studies) as nominal imports plus exports relative to nominal GDP, which is usually referred to as (trade) openness.[2] In the present study, imports plus exports relative to real GDP is used as a proxy for the openness.

Equation 8 represents the direct impact of foreign workers on unemployment rate. To capture the indirect impact, we added an interaction term constructed as the product of share of foreign labour (FL) as well as LP and OP (i.e. *FL* LP and FL*OP*) into Equation 1 as additional explanatory variables, apart from the standard variables used in the unemployment equation. Nevertheless, it is important to ensure that the interaction term is not a proxy to *FL*, or the levels of LP, and OP variables are included into the regression independently. Here it is worth mentioning that the inclusion of an interaction term may lead to multicollinearity as interaction term tends to be strongly correlated with the original variables used to construct it (Darlington, 1990; Azman et al. 2010). In order to alleviate this problem, the interaction term is orthogonalized by using the following two-step procedure suggested by Burill (2007): First, the interaction terms, say for example, $_{FL*LP}$ is regressed on the *LF, and LP* variables. Second, residuals from this regression in the first step are used to represent the interaction term. Thus, according to this information, Equation 8 becomes:

$$UN_t = \beta_0 + \beta_1 FL_t + \beta_2 LMR_t + \beta_3 LP_t + \beta_4 OP + \beta_5 (FL * CH) + \varepsilon_t \quad (9)$$

Where, all variables are as previously defined and CH refers to each of total output per work (LP) and openness (OP).

4.2 The estimation procedures

In the present study, the ARDL test for co-integration proposed by Pesaran and Pesaran (1997) is employed for the following certain econometric advantages, which are: 1) Endogeneity problem and inability to test hypotheses on the estimated coefficients in the long run associated with the Engle Granger method are avoided. 2) The long and short run parameters of the model are simultaneously estimated. 3) All variables are assumed to be endogenous. 4) The econometric methodology relieved the burden of pre-testing of unit roots; it is applicable whether the underlying variables are I(0), I(1), or fractionally integrated. 5)

2 For recent examples see Alberto et al. (2000), Elias and Peter (2000) or Francisco and Antonio (2004).

Moreover, with the ARDL, and to avoid collinearity problem between the variables, it is possible that different variables have different lag length of the maximum number of lags selected. Finally, the ARDL procedure only employs a single reduced form equation, while the conventional cointegration procedures estimate the long run relationship within a context of system equations (Oztutk and Acaravic 2011).[5]

The first step in the ARDL is to test for the existence of a long run relationship between the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables[3]. According to Pesaran and Pesaran (1997) and Pesaran et al. (2001), as summarized in Choong et al. (2005), the augmented ARDL (p, q_1, q_2, q_3,….q_k) model can be expressed in the following form:

$$\varphi(L,P)y_t = C_0 + \sum_{i=l}^{k}\varphi_i(l,q_i)x_{it} + \gamma_t w_t + \varepsilon_t, t = 1,2,3\ldots\ldots\ldots\ldots\ldots n \tag{10}$$

where, y is the dependent variable, C_0 is a (K+1)-vector of intercept, x are the independent variables, L is lag operator, and wt is the a (K+1) vector of deterministic variables including intercept terms, dummy variables, time trends and other exogenous variables with fixed lags. The (conditional) unrestricted ECM version of the selected ARDL model can be obtained by rewriting Eq. (3) in terms of the lagged levels and first difference of y_t,x_{1t},x_{2t},……x_{kn} and w_t as follows:

$$\Delta y_t = C_0 + C_1 t + \theta_{xy} z_{t-1} + \sum_{i=1}^{p-1}\varnothing_i \Delta y_{t-1} + \sum_{i=0}^{p-1}\vartheta_i \Delta x_{t-1} + \lambda_t w_t + \epsilon_t \tag{11}$$

Where Δ is the first difference operator, t is the trend, the coefficient ϑ expresses the short run dynamics of the model's convergence to equilibrium and $z_t = (y_t, x_t)$. Similarly, based on equation (1 and 2), the conditional VECM of interest can be specified as:

$$\begin{aligned}\Delta UN_t = a_1 + \sum_{i=1}^{p}\beta_1 \Delta UN_{t-i} + \sum_{i=0}^{p}\beta_2 \Delta FL_{t-i} + \sum_{i=0}^{p}\beta_3 \Delta LMR_{t-1} + \sum_{i=0}^{p}\beta_4 \Delta LP_{t-i} + \sum_{i=0}^{p}\beta_5 \Delta OP_{t-i} + \sum_{i=0}^{p}\beta_6 \Delta (FL*CH)_{t-1} \\ + \delta_1 UN_{t-1} + \delta_2 FL_{t-1} + \delta_3 LMR_{t-1} + \delta_4 LP_{t-1} + \delta_5 OP_{t-1} + \delta_6 (FL*CH)_{t-1} + \omega_{it}\end{aligned} \tag{12}$$

Where all the variables are as previously defined, Δ is the first difference operator, p is optimal lag length, the residuals ω_{it} are assumed to be normally distributed and white noise. The H_o of no cointegration in equation 7 is that δ_i=0. The F-test has a non-standard distribution, which depends on (i) whether variables included

3. This test is well known as bounds test

in the model are *I*(0) or *I*(1), (ii) the number of repressors, and (iii) whether the model contains an intercept *and*/or a trend. Given a relatively small sample size in this study, i.e. 51 observations, the critical values used are as reported by Pesaran and Pesaran (1997). The test involves asymptotic critical value bounds depending whether the variables are *I* (0) or *I* (1), or a mixture of both. Two sets of critical values are generated in which one set refers to the *I* (1) series; and the other to the *I* (0) series.

If the F-test statistics exceed their respective upper critical values, we can conclude that there is evidence of a long run relationship between the variables regardless of the order of integration of the variables. If the test statistic is below the lower critical value, we cannot reject the null hypothesis of no cointegration. If it lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying repressors. In the case where the F-statistic falls between the lower bound and the upper bound critical value, it is recommended to consider the t-test corresponding ECT_{-1}, if it is significant, this suggests the existence of cointegration among the variables (see Bannerjee et al. 1998, Mosayeb and Mohammad 2009). The second step is run only if a long run relationship is found in the first step (Marashdeh 2005). The existence of the cointegration relationship implies that the selected explanatory variables are the long run forcing variables for the dependent variables (Pesaran and Pesaran 1997). For the first model, the existence of this relationship in equation 7 indicates the need to estimate the following long run relationship:

$$UN_t = a_1 + \sum_{i=1}^{p} \alpha_1 UN_{\text{illegible}} + \sum_{i=0}^{p} \alpha_2 FL_{-} + \sum_{i=0}^{p} \alpha_3 LMR_{-} + \sum_{i=0}^{p} \alpha_4 LP_{-} + \sum_{i=0}^{p} \alpha_5 OP_{-} + \sum_{i=0}^{p} \alpha_6 (FL * CH)_{-} + \omega \tag{13}$$

In the third and final step, we obtained the short run dynamic parameters by estimating an error correction model (ECM) associated with the long run estimates for each equation. Thus, for the first model, the ECM specification takes the following form:

$$\Delta UN_t = \phi_1 + \sum_{i=1}^{p} \gamma_1 \Delta UN_{t-i} + \sum_{i=0}^{p} \gamma_2 \Delta FL_{t-i} + \sum_{i=0}^{p} \gamma_3 \Delta LMR_{t-i} + \sum_{i=0}^{p} \gamma_4 \Delta LP_{t-i} + \sum_{i=0}^{p} \gamma_5 \Delta OP_{t-i} + \sum_{i=0}^{p} \gamma_6 \Delta (FL * \ln CH)_{t-i}$$
$$+\theta_1 ECT_{t-1} + \upsilon_{1t} \tag{14}$$

Where g, is a short run dynamic coefficient of the model's convergence to equilibrium and q is the speed of adjustment. Furthermore, the significance of the ECM_{t-1} suggests a causality relationship in at least one direction.

5. EMPIRICAL RESULTS

5.1 Unit root test

To ensure that no variable is *I*(2), we first examined the order of the cointegration for each of the variables. Since the plotted figure of unemployment rate shows that it is not exhibit a trend, the unit root tests are performed at level and at first difference considering intercept only. The data series is tested for the stationarity (i.e. order of integration) using the Augmented Dickey Fuller (ADF, 1979) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992).[7] The results of these tests at the level and at first difference are described in Table 2. The results of both unit root tests confirmed each other and suggested that all the variables are integrated in order one [*I*(1)]. Thus, the results of the unit root test affirmed the need to test for cointegration among these variables. The second step is to test whether there is a long run relationship between the variables.

Table 2
Unit root tests

The Variables	*At level*		*At first difference*	
	ADF	*KPSS*	*ADF*	*KPSS*
UN	-1.22 [0.65]	0.37*	-3.43*** [0.02]	0.13
FL	0.04 [0.96]	0.60**	-4.27*** [0.002]	0.15
LMR	-1.87 [0.34]	0.36*	-3.32*** [0.02]	0.15
OP	-1.55 [0.50]	0.47**	-3.85*** [0.006]	0.10
LP	-0.50 [0.88]	0.71***	-7.40*** [0.000]	0.06

Notes:

[1]In KPSS tests, the null hypothesis is that the variable is stationary, which is exactly opposite in the ADF test.

[2]The Asymptotic critical values for the Kwiatkowski-Phillips-Schmidt-Shin test statistic are equal to 0.73, 0.46 and 0.35 at 1%, 5% and 10% significance level, respectively.

[3]The critical value for, t-statistic for ADF are -3.58, -2.93 and -2.60 at 1%, 5% and 10% significance level, respectively.

[4](*), (**), (***) in (ADF) denote rejection of the null of non-stationary of the variable at 10% , 5% and 1% significance level, respectively.

[5](*), (**), (***) in (KPSS) denote rejection of the null of the stationary of the variable at 10%, 5% and 1% significance level, respectively.

5.2 Cointegration Test

The first step is to apply the bound test on Equation 12 and compute the F-statistic for the joint significance of the coefficients of the lagged levels of the variables. Table 3 presents the results of the F-statistic. Recall that we have selected the optimal order of lags for the models based on Schwarz-Bayessian information criteria (SBI), as suggested by Pesaran et al. (2001). However, the Akaike information criteria (AIC) confirmed the optimal lags selected by SBC (the AIC results are not reported here, but are available upon request). Therefore, based on the conclusion made on the results of the F-statistic in Table 3, it is clear that a long run relationship exists in specification 1 and 2. More specifically, the F-statistic test detects a long run relationship in specification 1 and 2 at maximum lag length 3 for each. Accordingly, from the table above it is possible to conclude that the variables FL, LP, LMR, OP and (FL*LP) are long run forcing variables for unemployment rate in Malaysia during the period 1982-2012.

Table 3
F statistic test

No.	*Specification*	*Maximum Lag length*			*Conclusion*
		1	*2*	*3*	
1	UN/(FL,LMR,LP,OP)	3.22	3.31	4.56*	Cointegration at lag 3
2	UN/(FL,LMR,LP,OP,[FL*LP[)	2.88	4.33	9.32*	Cointegration at lag 3
3	UN/(FL,LMR,LP,OP,[FL*OP])	2.81	2.14	2.22	No Cointegration

Notes:

[1]First letter outside the brackets indicate to the dependent variables.

[2]The lower - upper critical value for the F test(with intercept and no trend) with five variables (k=4) are (4.28-5.84)and (3.06-4.22) at 99.5%, and 99% confidence level respectively . For (k=4) are (4.13-5.76)and (2.92-4.19) at 99.5%, and 99% confidence level respectively

[3]The critical value obtained from Narayan (2005).

[4] (*) and (**) denote significant at 99% and 95.5% level, respectively.

5.3 Long Run Analysis

Based on the results of the F- statistic presented in Table 3, in this section, we analyse the long-run relationship between the variables for our model. Table 4 shows the long run direct impact of foreign labour on unemployment rate (specification 1) and the indirect impact (specification 2). Interestingly, the results showed that while the direct impact of foreign workers on unemployment rate in the long run appeared positive and statistically significant at 1%, it turned out to be negative but relatively less significant (i.e. at 10%) when we added the indirect effect. A 10 percent increase in the share of foreign labour in the total labour force in the long run, is expected to reduce the unemployment rate of the natives by 2.3 percent. The magnitude of the impact was limited, which is consistent with previous findings. In addition, the coefficient of the interaction term that manifests the indirect channel appeared to be negative and statistically significant, but its magnitude was very small. The significance of this term implied that foreign workers influence unemployment rate through their effect in the total output per native worker.

We can interpret these findings as follows; as mentioned previously, majority of the foreign workers who flow into Malaysia are low skilled workers (not only for Malaysia, but this is a common feature of the immigrants). In contrast, in the Malaysian economy, majority of its labour force possesses higher or medium skills. The influx of these low skilled immigrant workers will complement higher skilled native workers in the economic activities. As in the standard concept of comparative advantage, this will lead to specialization and improved production, and labour productivity or total output per worker for high skilled workers will increase. Consequently, wages for high skilled workers (who are the natives) will increase and this will be reflected in the higher demand for native labour. Thus, decrease in natives' unemployment rate. These findings are consistent with findings and theoretical frameworks of Peri and Sparber (2009) and Peri (2010).

The coefficient of each, the LP and OP variables, has the expected sign. An increase in productivity leads to a decrease in the cost of production and lower prices of products. These lower prices could boost the aggregate demand leading to decrease in unemployment. For openness, several studies have pointed out on the negative correlation between trade and unemployment (Matusz (1996, Felbermayr et al. (2008), Dutt et al. 2009)[4]. For instance, Dutt et al. (2009) claimed that (based on Recardian model) trade will increase marginal productivity of labour in the export sector due to increase in the domestic relative price of the goods produced by this sector. The model assumes that trade will lead to complete specialization,

4 For more information on the theoretical models that link unemployment rate with trade policies see, for example, Dutt et al. (2009) and Hasan et al. (2012)

in which the marginal productivity of labour in the import-competing sector will experience a decline and fail to survive trade liberalization. However, the marginal product of labour for the overall economy continues to increase due to efficiency, encouraging greater investment, and thus resulting in more job opportunities and less unemployment.

Table 4
The long run coefficients - dependent variable is unemployment rate (UN)

Explanatory variable	*Specification (1)* *ARDL (3,0,0,0,0)*	*Specification (1)* *ARDL (3,0,3,1,2,3)*
FL	0.15*** [3.82]	-0.23* [1.98]
LP	-0.00002*** [5.75]	-0.0005* [1.85]
LMR	-0.47 [0.28]	-0.73 [0.87]
OP	-0.02*** [2.80]	-0.07*** [3.73]
(FL*LP)	–	-0.00003*** [3.46]
Constant	14.74*** [3.61]	17.53** [2.20]
Diagnosis Tests		
Serial Correlation	0.46 (0.51)	1.23 (0.28)
Functional Form	2.41 (0.11)	0.04 (0.34)
Normality	1.50 (0.47)	0.44 (0.80)
Hetero-Cedasticity	0.02 (0.89)	0.22 (0.64)
CUSUM	Stable	Stable
CUSUMSQ	Stable	Stable

Notes:

[1]Serial correlation is F- statistics of Breusch-Godfrey serial correlation LM test. B: Functional form is F- statistics of Ramsey's RESET test using the square of the fitted values. Normality is LM – statistics of skewness and kurtosis of residuals for normality test. Heteroskedasticity is F- statistics of white Heteroskedasticity test. CUSUM; Cumulative Sum of Recursive Residuals is the stability test of the long run coefficients together with the short run dynamics based on Pesaran and Pesaran (1997). CUSUMSQ; Cumulative Sum of Squares of Recursive Residuals is the stability test of the long run coefficients together with the short run dynamics based on Pesaran and Pesaran (1997).

[2]The absolute value for t-statistic in [ ] & prob for F-statistic in ()

[3] (***), (**) and (*) denote significant at 1%, 5% and 10% level respectively

Lastly, the results of the diagnosis test suggested that each model had passed all the selected tests. Specifically, the normality test cannot reject the null hypothesis. This means that the estimated residuals are normally distributed and the standard statistical inferences (i.e. t-statistic, F-statistic, and R-squares) are valid. Moreover, the results of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) plots also indicated that the regression coefficients are generally stable over the sample period. In fact, the results of the CUSUM) and (CUSUMQ) also confirmed the robustness of this analysis.

In the adjustment period, i.e. short run, as shown in Table 5, once again, while the direct impact of foreign workers on unemployment rate in the long run appears to be positive and statistically significant at 1%, it is negative and statistically significant at 5%. Most importantly, although the coefficient of; foreign labour, and output per worker, influences unemployment positively, when they interact together they influence unemployment rate negatively. More specifically, in contrast to the long run, in the short run, the lag coefficient of the interaction term appeared to be positive and statistically significant, but its magnitude was very small. This is because the increase in total output per native worker as a result of the complementary process following to the entry of foreign workers requires longer time (i.e. not captured in short time frame). In this respect Borjas (2003) argued that the mobility or degree of substitution / complementary between workers depends largely on their skills especially in the short run, suggesting that the mobility of the worker may be limited in the short run. Nevertheless, the negative sign of the FL coefficient may be due to the segmentation of Malaysian labour market (Abdul-Aziz 2001, Narayanan and Lai 2005). Due to this segmentation, immigrant workers will fill the unwanted jobs by natives without facing any competition from the local workers. Those jobs are complementary; where new employment opportunities for the natives will emerge in the primary sector, and thus native's unemployment rate decreases.

Table 5
The short run coefficients - dependent variable is changes unemployment rate (UN)

Explanatory variable	*Specification (1) ARDL(3,0,0,0,0)*	*Specification (1) ARDL(3,0,3,1,2,3)*
ECT-1	-0.80*** [4.62]	-0.71*** [6.75]
ΔUN_1	0.35*** [2.94]	0.21* [1.73]
ΔUN_2	0.41** [2.61]	0.70*** [4.60]
ΔFL	0.12*** [3.16]	-0.17** [2.16]
ΔLP	-0.00002*** [3.45]	-0.00002*** [3.97]
ΔLP_1	–	-0.00001*** [3.70]
ΔLP_2	–	-0.00003*** [3.69]
ΔLMR	-0.37 [0.24]	0.007 [0.01]
ΔLMR_1	-	-1.96*** [3.06]
ΔOP	-0.02** [2.73]	-0.03*** [3.30]
$\Delta(FL*LP)$	–	-0.00002 [0.58]
$\Delta(FL*LP)_1$	–	0.00003*** [4.13]
$\Delta(FL*LP)_2$	–	0.00002*** [4.20]
Δ Constant	11.79*** [3.62]	12.38** [2.30]
R^2	0.71	0.93
R^{-2}	0.60	0.80
F	6.25*** (0.000)	9.60*** (0.000)

Notes:

[1] The absolute value for t-statistic in [ ] & prob for F-statistic in ().

[2] (***), (**) and (*) denote significant at 1%, 5% and 10% level respectively

The most interesting finding is related to the response of unemployment to labour market regulation in the short run. The results showed that in the short run, labour market regulations seem to be the most influential factor to unemployment. A 10 percent improvement in the lagged labour market regulation is likely to reduce current unemployment rate by nearly 20 percent, as compared to only 1.7 percent if the share of foreign labour in the total labour force were to increase by the same amount. This finding implied that unemployment rate in the country responds more to the reform of labour market regulations in the short run as compared to the changes in the share of foreign workers in the labour force.

Table 5 shows that in each specification, the adjustment coefficient (ECT_{-1}) has favourable sign and magnitude as well as being statistically significant at 1 percent. These indicate the existence of long run relationship between the variables. This means that the selected explanatory variables in each specification are long run forcing variables for native's unemployment rate. In other words, if native's unemployment rate deviates from its long run equilibrium path because of certain shocks in the current year, all the chosen explanatory variables will interact and correct on average, more than 71 percent of this disequilibrium in the following year.

Given the difference between causation and the correlation (see Granger 1981), it is also possible to interpret the results in Table 5 as short or temporary causality relationship. Accordingly, in the short run, the flow of foreign workers will Granger cause native's unemployment rate. In other words, foreign labour provides useful information to predict the future rate of native's unemployment.

Recall that, we re-estimated both specifications using, first, the share of foreign workers in the total employment and second, we estimated both models by utilizing Akaike information criteria (AIC). However, our results remained the same in general, and that of foreign labour in particular (which provided results of robust properties). To further check on the robustness, we employed the innovation accounting technique in the context of unrestricted VAR approach (Shan 2002). In the following section, and to safe space, we will report and discuss the results of the second model, but the results of the first one are available upon request.

5.4 Innovation Accounting Analysis

The innovation accounting analysis includes two types of statistical methods that provided this study with its robust feature. The two methods are the forecast error variance decomposition (thereafter, FEVD) and impulse response function (thereafter, IRF). In practice, the FEVD and IRF are both employed in the VAR framework. According to Enders (1995), the FEVD analysis allows inference over the proportion of the movement in a time-series (due to its own shocks versus shocks

to other variables in the system). This allows the classification of the variance of the forecast error for each variable into components; and these components can be attributed to each of the explanatory variables in the system. As such, in our study the utilization of FEVD analysis will help us to classify the variance of the forecast error for UN into components that can be attributed to each of the explanatory variables, particularly, foreigners. For instance, if the results of the FEVD show that the foreign workers explain relatively more in the variance of forecast error for UN, then it is implied that FL causes unemployment rate of native workers. Most importantly, the FEVD analysis also explains the relative importance and contribution of each explanatory variable to the UN. This will assist the policy makers with their effort in keeping the native's unemployment rate low and to focus on factors that relatively have more influence (compared to other variables) on native's unemployment, particularly, the foreign worker's variable.

The IRF analysis determines how each endogenous variable reacts over time to a shock in that variable and in every other endogenous variable in the VAR. For instance, if IRF shows that there are strong and longer responses of UN to shock in the FL, it implies the existence of causality relationship running from FL to UN. The VAR model takes the following form

$$Y_t = A_0 + \sum_{i=1}^{L} A_i Y_{t-1} + \ni_t \quad (15)$$

Where, y is the all the variables in the model including the dependent variables (i.e. UN), L is lag operator, A_1-A_l is the six by six matrices of coefficients and A_0 is an identity matrix. The optimal lags (L) will be selected through either AIC or SBC.

Table 6
Variance Decomposition of DUN- five-year error variance (%)

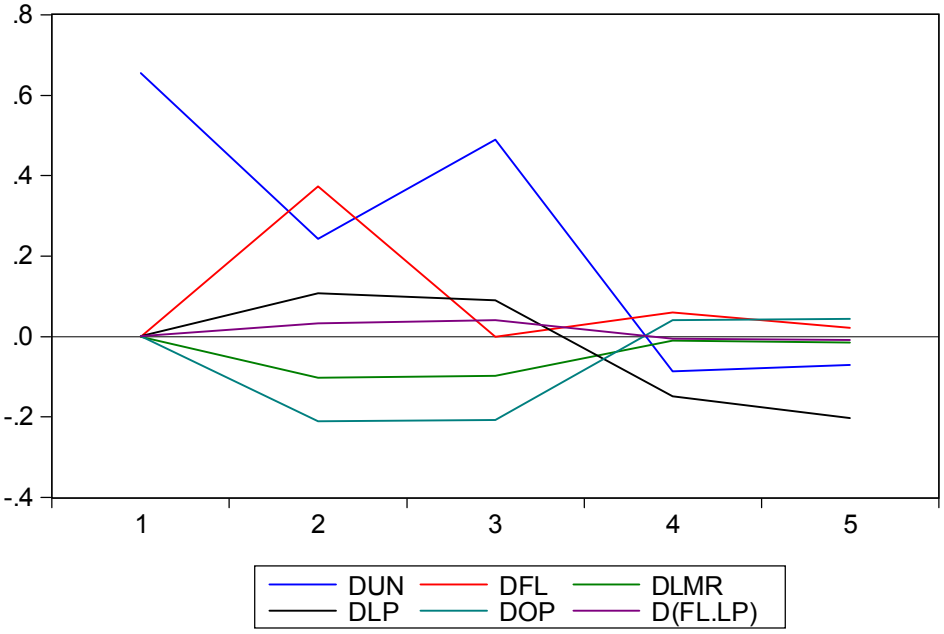
Period	*S.E.*	*DUN*	*DFL*	*DLMR*	*DLP*	*DOP*	*D(FL.LP)*
1	0.654414	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.833071	70.15067	20.09160	1.539375	1.643911	6.425662	0.148781
3	0.998171	72.92445	13.99486	2.042807	1.940285	8.827022	0.270571
4	1.015730	71.17046	13.86854	1.983482	4.036226	8.677298	0.263995
5	1.039605	68.41151	13.27948	1.914881	7.677421	8.458953	0.257760

Notes:
[1]The Variance Decomposition of DUN is estimated using the Choleski- decomposition methods

The results of the FEVD reported in Table 6 suggested that for the case of Malaysia, innovation in native's unemployment rate attributed to its own past

values and shock in the share of foreign workers decreases over time. However, the influence of FL on UN diminishes over time. These findings are consistent with the ARDL analysis which suggested that the impacts of foreign labour in the short run are relatively larger than its effect in the long run. In comparison to the rest of the explanatory variables, foreign labour explains relatively large proportion of the forecast error variance for the native's unemployment rate. In addition, UN explains the preponderance of its own past values (forecast error variances), which implies that current UN can influence its future trend or exhibits a strong lag effect[5]. Thereafter, the present study proceeded to impulse responses function analysis and the results of the response of UN to shocks in the rests of the variables are plotted in Figure 6. As suggested earlier, a graphic illustration of impulse response functions can provide an intuitive insight into the existing dynamic relationships because it will present the response of a variable to an unexpected shock in another over a certain time horizon.

Figure 6: Impulse Responses Function



In response to innovation that comes from foreign labour in the form of gradual increase in their share in the total labour force, native's unemployment

5 Also, same results, not reported, are observed in the case of foreign labour (i.e. foreign labour explains the preponderance of its own past values (forecast error variances)).

rate responded negatively. The negative responses of UN to innovation that come from foreign labour will continue up to four years (i.e. four lags); thereafter, both variables will maintain a stable flow at a neutral level in the long-run. Given the concept of causality, the findings imply that FL is Granger cause native's unemployment rate. These findings confirm the earlier findings on the existence of temporary unidirectional causality relationship running from foreign labour to native's unemployment rate.

6. CONCLUSION

The flow and mobility of labour across countries and region have motivated numerous studies to investigate the economic impact of such events. The general perception is that (supported by several empirical studies based on the experience of some countries) foreign workers affect the host country's labour market negatively. Since there is no specific theoretical model to evaluate the direct impacts of foreign labour, past empirical studies tend to predict such impacts through different ways. In other words, foreign labour is likely to affect labour market of the host country indirectly through several channels. In addition, such effects are likely to vary over time, and across sub-sectors within an economy. However, the characteristics of the immigrants, and complementary or substitutability relationship between native and foreign workers remains the main determinants of the effect of foreign workers on the host country labour's market.

We believe that capturing the foreign workers' effect depends largely on the specification and modelling of the indirect effect. Controlling the factors that represent the indirect impact in a regression analysis is likely to yield an inaccurate estimate. To examine the validity of this assumption, in the present study we had constructed two models. In the first, it shows the direct effect of foreign worker by regressing foreign workers (% labour force) with other proxies that represent labour productivity, openness and labour market regulation on native's unemployment rate. In the second model and to capture the indirect impact, we created an interaction term between foreign workers and each of native's labour productivity and openness of the economy, and re- examined the foreign effect. We used data on native's unemployment rate, share of foreign labour in the labour force, total output per native worker, labour market regulation and openness for Malaysian economy during the period between 1982 and 2012. Malaysia was selected due to the fact that this economy has been experiencing huge inflow of foreign labour since 1980s; in which the growth rate in the number for foreign workers exceeds the growth rate of labour force, and employment.

Through the employment of the ARDL technique, the results show that: for the first model, foreign workers appear to have statistically negative impact on

native unemployment, both in the short and long run. Interestingly, for the second model, where the only variable is foreign labour, its interaction with total output per native worker appears to have statistically positive influence over native unemployment, both in short and long run. To check on robustness, first, we re-estimated our model in the context of unrestricted VAR approach; and once again we re-estimated our model by using the share of foreign labour on employment. In both cases, our main finding remains the same. This finding implies that in modelling the impact of foreign workers on labour market's outcome, the indirect impact of foreign workers should be considered.

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