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IMMIGRATION VERSUS OUTSOURCING:

A DEVELOPING COUNTRY'S VIEW

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This paper provides a comparative study between temporary immigration policy and product outsourcing process, from the low-income developing country's point of view, which is supply side constrained by the availability of skilled labour. A two-country general equilibrium model establishes an inverse relationship between temporary immigration quota and product outsourcing. Though temporary immigration quota enhances world welfare and the developed country welfare, its impact on welfare level of the developing country is uncertain. In the empirical part, a panel data analysis shows that real consumption level of a set of developing countries increases with an increase in product outsourcing, given an inverse relationship between product outsourcing and temporary immigration policy.

Keywords: Immigration, Outsourcing, Intermediate Input, Consumption, Panel Analysis
JEL classification: C23, E20, F2, F12, F22

1. INTRODUCTION

Conventionally international trade between a developed and a developing country, from a theoretical perspective, is based on the difference in relative factor endowments among them. International trade helps utilise the abundant factor. Internationally trading countries gain from relative factor abundance and lower relative price of factor inputs. For instance, a relative labour abundant developing country use the abundant factor and the gains from trade follow from lower relative factor price of labour. In recent times, trade in intermediate goods and factor inputs have assumed significance along with conventional merchandise trade in final goods. For a relatively capital abundant country, with regards to trade in factors inputs, the policy options are between import of low-priced foreign labour and export of domestic capital. It has been theoretically

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established, *a la* Ramaswami (1968), that importation of low-priced foreign labour is a better option than exportation of domestic capital for capital abundant developed countries. Now the question is, "*What is the choice for a labour abundant country: exportation of domestic labour or importation of foreign capital?*" This paper investigates into the relationship between exports of domestic labour, that is, temporary migration, and product outsourcing from the perspective of a developing country.

Migration and outsourcing are the two manifestations of trade in factor inputs: while migration includes cross-border movement of natural persons, international outsourcing[1] involves cross-border movement of capital. Both immigration and international outsourcing increase cost-efficiency of the global production system (Murat and Paba, 2003). The labour-intensive part of the production process is reallocated from the developed country to the labour abundant developing country; the developing countries, engaged in such outsourcing contract, become a part of the globally integrated production chain.[2] For instance, a growing outsourcing demand is directed towards India from different capital abundant countries including the USA. There are two types of outsourcing; product outsourcing and service outsourcing. Globally while product outsourcing takes place in engineering, automobile, textile, and chemical industries (Dubey, 2003),[3] service outsourcing takes place in communication, information technology and information technology enabled sectors. The developing countries, through outsourcing not only expand their market for intermediate products, but also benefit from employment generation, profit maximisation, quality up-gradation, capacity utilisation skill-improvisation and technology transfer.

Immigration is another way by which the pool of high-skilled labour in developing countries is being used by developed countries. Temporary immigration refers to the temporary movement of persons from one country to another to provide on-site services, when immigrants do not get the right to dwell permanently in the host country. Developed countries encourage such temporary immigration on account of lower wages of skilled workers from developing countries. Employers in developed countries also

[1] Outsourcing can also be between formal and informal sectors within the domestic boundary of a developing country. Maiti and Marjit (2011) develop a theoretical model showing that the choice of informal sector subcontracting and in-house R&D investment appears to be alternative options to the firm to bypass expensive labour in the formal sector given that the formal sector wage is higher than that of informal sector. The paper theoretically shows that R&D expenditure and labour productivity of formal sector depend on the wage rate of the informal sector.

[2] Sanyal (1983) provides a framework to analyse a country's specialisation pattern along the vertical production spectrum of a good. Sanyal and Jones (1982) further show that trade in middle products increases the availability of inputs in the production of final consumption goods.

[3] Dubey (2003) provides evidence using Confederation of Indian Industry (CII) sources that India is estimated to receive $ 10 billion worth outsourcing order in manufacturing sector by 2007, which is expected to increase by US $ 50 billions by 2015.

prefer temporary immigrants over permanent ones on account of the lengthy process involved in permanent immigration. Temporary immigration process not only provides flexibility in the production process, but also allows such migrants from developing countries to earn higher wages than their counterparts in the home country.[4]

Most of the existing literature discusses immigration and outsourcing independently, studying separately the impact of these two on labour market. Cohen-Goldner and Pasermann (2004), D'Amuri, Ottaviano and Peri (2008), Dustmann, Fabbri and Preston (2005), Jean and Jimenez (2007), Longhi, Nijkamp and Poot (2006), Robertson (2008), Tu (2010) and Wadsworth and De Coulon (2008) show that immigration, in general, has no adverse effect on wage and employment level of developed countries in the long run. However, as Cohen-Goldner and Pasermann (2004) and Jean and Jimenez (2007) show, there can be some short term adverse effects of immigration on the host country's wage level. Longhi, Nijkamp and Poot (2006) find that loss of employment opportunities in host countries on account of large immigration influx is negligible, but the intensity of such negative effect varies across countries and gender. There were many other factors like anticompetitive product market regulations, stringent employment protection legislation and high average replacement rate of unemployment benefits, which aggravate such effects (Jean and Jimenez, 2007). The results of these studies imply that host country workers and migrant workers are imperfect substitutes. In contrast, D'Amuri, Ottaviano and Peri (2008) show that as new and old immigrants are perfect substitute to each other in the context of West Germany, immigration leads to reduction in employment opportunity and wage level of previous immigrants. Wadsworth and De Coulon (2008) highlight that relaxation of immigration quota, by the developed countries, reduces the international wage difference.

There is a debate on the labour market effect of outsourcing.[5] Arndt (2002), Bandyopadhyay, Marjit and Yang (2010) and Koskela and Stenbacka (2007) show that despite labour market imperfections outsourcing increases the aggregate employment of the host country. On the other hand, Egger and Kreickemeir (2008) and Hijzen, Görg and Hine (2004) show that international outsourcing reduces the demand for host country workers. In specific, Hijzen, Görg and Hine (2004) find that outsourcing reduces the demand for low-skilled host country workers, whereas Koskela and Stenbacka (2007) show that outsourcing increases the demand for low skilled workers but reduces that for high skilled workers in developed countries. Bandyopadhyay, Marjit and Yang

[4] This H-1B visa issued by U.S. Government can be taken as a measure of temporary immigrants (Jansen and Piermartini, 2005; Bandyopadhyay and Wall, 2005). India is one of the important source countries of the H-1B migrants. In 2000, according to U.S census, India sent 124,647 H-1B migrants to the U.S. Among the developing countries, China and Pakistan are also two major senders of the H-1B migrants to the US.

[5] There exist a wide range of studies delving into other aspects of impact of outsourcing. For instance, Li (2008) empirically shows that outsourcing narrows the technological gap between firms of host countries and developing countries.

(2010) theoretically show that an outsourcing tax has two opposite effects on host country employment level. While substitution effect of outsourcing tax increases domestic employment, its output effect on account of loss in international competitiveness reduces the domestic employment. However, they found that output effect was stronger than substitution effect in most of the cases. Even though most of the above-mentioned studies analyse the labour market effect of outsourcing from the perspective of developed countries, Arora and Chakrabarti (2004), Engman (2007) and Khalifa and Mengova (2010) discuss the phenomenon of outsourcing from a developing country perspective. While Engman (2007) discusses various supply constraints to outsourcing of Business Process Services (BPS) and Information Technology Services (ITS) in four emerging economies like China, Czech Republic, India and Philippines, Arora and Chakraborty (2004) show that outsourcing raises the wage difference between skilled and unskilled workers in Indian manufacturing. Khalifa and Mengova (2010) theoretically explain that there is a threshold level of skill abundance in developing countries, beyond which outsourcing increases wage inequality. However, empirical estimates for 29 developing countries over the time period 1982-2000 show variations in result: while outsourcing reduces wage inequality below the threshold level of skill abundance, it has no effect on wage inequality above that level.

The existing literature shows that temporary immigration is a substitute of outsourcing (Bandyopadhyay and Wall, 2005; Engman, 2007; Murat and Paba, 2003; and Navaretti, Bertola and Sembenelli, 2008). An increase in the temporary immigration quota – implying the reduction in the outsourcing demand – by a developed country's government has a positive impact on her own national income (Bandyopadhyay and Wall, 2005). Being the complementary factor to domestic labour, temporary immigration increases the domestic wage level and domestic employment level of the developed country (Jones, 2005). Temporary immigration policy is thus a better option for a developed country. However, the outcome can be different for any developing country. While temporary immigration generates only labour demand, outsourcing generates demand for labour as well as other factor inputs in a developing country. On the other hand, in a developed country, with higher productivity of immigrants in the presence of good quality infrastructure, better working environment, etc., the outsourcing demand declines. As a result, derived labour demand by the outsourcing firms in the developing country decreases. An increase in temporary immigration quota is thus expected to have an indirect negative impact on the labour market of a developing country.

On the basis of the above issues that emerge from the existing literature, this paper analyses the impact of immigration and outsourcing on welfare of developing countries. In this context we should mention that Bandyopadhyay and Wall (2005) discuss about the relationship between service outsourcing and temporary immigration,[6] while this

[6] Khalifa and Mengova (2010) also consider service outsourcing measured by the amount of FDI directed

paper analyses the relationship between product outsourcing and temporary immigration. In fact, in this paper the main emphasis is on developing country, while Bandyopadhyay and Wall (2005) focus on developed country.

Theoretical as well as empirical analyses have been done in the paper. The results show that temporary immigration policy of the developed countries significantly reduces the product outsourcing. The product outsourcing is better for the low-income countries than the temporary migration. Second and third sections of the paper contain theoretical and empirical analyses respectively. The last part summarises the major findings of this paper with some policy implications. In this paper, 'immigration' and 'temporary immigration' are synonymous, and 'outsourcing' and 'product outsourcing' are also used interchangeably to indicate the same meaning.

2. THEORETICAL ANALYSIS

2.1. Model Description

A simple two country general equilibrium model, without any skill variation and technological differences across the country, is adopted to illustrate the 'immigration versus outsourcing' debate. The model uses a modified version (as highlighted in the appropriate places) of a general equilibrium structure proposed in Bandyopadhyay and Wall (2005). Usually general equilibrium framework provides wider scope to analyse welfare by considering the demand and the supply side forces and their joint interaction on all factor inputs as well as final consumption good markets. This paper not only addresses the welfare issue with respect to the migration versus outsourcing debate from the aggregate perspective (world output level), but also from the distributive perspective (allocation of world output between developed and developing countries in terms of their respective national incomes).

The world economy is assumed to be divided into a developed economy (known as foreign country) and a developing economy (known as domestic country). Here the production function is of neoclassical type, exhibiting positive but diminishing marginal productivity of factor inputs and constant returns to scale. The firm in the foreign country produces single final consumption good (Q) by using foreign labour (N) and an intermediate input (I). The neoclassical type production process for the final consumption good is given by,

$$Q = Q(I, N), \tag{1}$$

from the developed to the developing country.

where Q_I, $Q_N > 0$; Q_{II}, $Q_{NN} < 0$;[7] $Q_{IN} = Q_{NI} > 0$.

The foreign firm produces part or whole of her intermediate input requirement (I_F) using foreign capital (K_I) and temporary immigrant workers (*n*) from the domestic country. The foreign firm's production function for the intermediate input is given by,

$$I_F = F(K_I, n), \tag{2}$$

where F_{KI}, $F_n > 0$; F_{KIKI}, $F_{nn} < 0$; $F_{KIn} = F_{nKI} > 0$.

Alternatively, the foreign firm can outsource the part or the whole of her intermediate input requirement (I_D) to the domestic country,[8] where the representative domestic firm produces it using domestic capital (K_O) and domestic labour (L_O). Domestic firm's production function of the outsourced intermediate input is given by,

$$I_D = F(K_O, L_O), \tag{3}$$

where F_{KO}, $F_{LO} > 0$; F_{KOKO}, $F_{LOLO} < 0$; $F_{KOLO} = F_{LOKO} > 0$.

Production of total intermediate good (I) is given by,

$$I = I_F + I_D. \tag{4}$$

Apparently there is no technical difference in producing I_F and I_D across the countries. The temporary immigrants have higher productivity than the domestic workers (so $F_n > F_{LO}$) on account of larger stock of capital and better quality infrastructure in the foreign country. As a result, in the competitive environment, immigrants earn higher wage than the domestic workers, employed in the domestic outsourcing sector. This wage difference ensures migration from domestic to the foreign country.

The profit function for the representative foreign firm is given by,

$$\Pi_F = Q(I_D + F(K_I, n), N) - r_k K_I - P_I I_D - W_N N - W_I n,$$

[7] Here subscript denotes the marginal product of that factor input.

[8] The intermediate good is either outsourced or produced by immigrant workers. As a result, developed country workers are indirectly complement to the immigrant workers and outsourcing. This is unlike Bandyopadhyay and Wall (2005), where developed country workers, immigrants and outsourced workers are substitutes to each other.

where P_I = price of outsourced product, W_N = wage of the foreign worker, r_k = rent of the foreign capital and W_I = wage of the immigrants. To simplify the model, final consumption good is treated as numéraire. Therefore all the prices are expressed in terms of final consumption good (Q).

Hence, the optimisation problem can be stated as

Maximise $\Pi_F = P_Q Q(I_D + F(K_I, n), N) - r_k K_I - P_I I_D - W_N N - W_I n$,

where $I_D, N, K_I, n > 0$.

The profit maximisation conditions lead to

$$Q_I = P_I, \tag{5}$$

$$Q_I F_{KI} = r_k, \tag{6}$$

$$Q_I F_n = W_I, \tag{7}$$

$$Q_N = W_N. \tag{8}$$

These conditions give the foreign firm's optimum demand for intermediate input (I^d), foreign capital (K_I^d), foreign labour (N^d), and temporary immigrant workers (n^d).The factor prices are determined assuming full employment and perfect competition, and the return (price) to a factor is the value of the marginal product of that factor in production.

Foreign labour supply is fixed at N_F and in equilibrium

$$N_F = N^d. \tag{9}$$

Similarly, the equilibrium condition for foreign capital in short run is given by,

$$K_F = K_I^d. \tag{10}$$

On the other hand, in the immigration market, given social and political factors related to temporary immigration quota, the foreign country often restricts the number of temporary immigrants. In this model temporary immigration quota is considered to be exogenous being decided at n^*. The equilibrium condition in the immigration market is

$$n^* = n^d . \tag{11}$$

In the intermediate goods market, there are two sources of supply – the foreign country firm being producing a part of her intermediate input requirement *(I_F)* and the rest is outsourced from the domestic country firm. The foreign firm's supply of intermediate good is given by

$$I_F^S = F(K_F, n^*) . \tag{12}$$

The representative domestic firm, unlike Bandyopadhyay and Wall (2005), produces only the outsourced intermediate input and no final consumption good. All available domestic factor inputs are involved in the production of outsourced intermediate input. Suppose K_D and L_D are the total capital and labour endowment of the domestic country respectively. In the presence of high wage in the foreign country, some domestic workers (say n^*) migrate temporarily to the foreign country. The supply of intermediate goods by the domestic country firm is as,

$$I_D^S = F(K_D, L_D - n^*) . \tag{13}$$

Equations (12) and (13) give the total supply of the intermediate input (I^S).

$$I^S = I^S(K_F, n^*, K_D, L_D).^{9} \tag{14}$$

The equilibrium condition for the intermediate input market is,

$$I^d = I^S . \tag{15}$$

Equations (12), (13), (14) and (15) give the equilibrium I_F^*, I_D^*, I^* and P_I^* as the function of L_D, K_D, n^*, and K_F.

The profit function for the representative domestic firm is,

$$\Pi_D = P_I I_D - wL_O - rK_O ,$$

[9] The supply of the intermediate input is independent of P_I, rather is determined by the capital endowment of both the countries and the labour allocation of the domestic country (since the possibility of the foreign workers, to be engaged in the production of the intermediate input is ruled out).

where $w =$ wage of the domestic workers, involved in the domestic outsourcing sector and $r =$ domestic rental.

Hence the optimisation problem of the domestic country firm is

Maximise $\Pi_D = P_I F(K_O, L_O) - wL_O - rK_O$. $(K_O, L_O > 0)$

Profit maximisation conditions lead to,

$$P_I F_{LO} = w, \tag{16}$$

$$P_I F_{KO} = r. \tag{17}$$

These equilibrium conditions, along with full employment assumption, give the optimum demand for domestic labour (L_O^d) and domestic capital (K_O^d) of the domestic outsourced sector. This is given by

$$L_O^d = L_D - n^*, \tag{18}$$

$$K_O^d = K_D. \tag{19}$$

Equations (9), (10), (11), (18) and (19) give the equilibrium W_N^*, r_k^*, W_I^*, w^* and r^* as functions of L_D, K_D, n^*, K_F, and N_F.

Equilibrium final consumption good production can thus be restated as,

$$Q^* = Q^*(L_D, K_D, n^*, K_F, N_F).$$

2.2. Welfare of Individual Countries

Real or actual consumption level of any economy can be considered as a good representative measure of the welfare level of that economy at the aggregate level. With no saving and taxation, the national consumption is equivalent to the national income, which consists of the aggregate income of that country's factor inputs either employed within the country or outside the country. The national income of the foreign country (Y_F*) is,

$$Y_F^* = W_N^* N_F + r_k^* K_F.$$

Under perfect competition, production function exhibiting CRS and applying product exhaustion theorem we get,

$$Y_F^* = W_N^* N_F + P_I^* I_F^* - W_I^* n^* . \tag{20}$$

The national consumption of the foreign country is given by,

$$C_F^* = Y_F^* = W_N^* N_F + P_I^* I_F^* - W_I^* n^* . \tag{21}$$

On the other hand, national income of the domestic country (Y_D^*), which includes income of the emigrants in addition to the income of workers and capital employed in the domestic country firm, is given by

$$Y_D^* = r^* K_D + w^* (L_D - n^*) + W_I^* n^* .$$

Under competition, production function exhibiting CRS and applying product exhaustion theorem we get,

$$Y_D^* = P_I^* I_D^* + W_I^* n^* . \tag{22}$$

The national consumption of the domestic country is given by,

$$C_D^* = Y_D^* = P_I^* I_D^* + W_I^* n^* . \tag{23}$$

Global welfare level is measured by the total production of final consumption good (Q^*), since the total final consumption good produced is consumed by the labour employed in both the countries. Q^* is distributed between the developed and developing economies as their respective national income or national consumption (in the absence of saving and taxation).

$$Q^* = Y_F^* + Y_D^* . \tag{24}$$

or, $Q^* = C_F^* + C_D^* .$[10] (25)

The solution set can be interpreted as the reduced form equations, since all endogenous variables are expressed in terms of exogenous variables, n^*, L_D, K_D, K_F, and N_F.

[10] In a simple two-economy model, it can be interpreted that the total world welfare is the sum of the individual country's welfare.

2.3. Comparative Static

Consider a change in the immigration policy of the developed country. This change will affect all the factor input markets, final consumption good market, and welfare level of both the economies in the two country general equilibrium model.

Proposition 1: *An increase in the temporary immigration quota increases total production as well as the demand for intermediate input (I^*), but reduces the equilibrium price of the intermediate input (P_I^*).*

With an increase in the temporary immigration quota, domestic workers migrate to the foreign country, since $W_I^* > w^*$. As a result the production of the outsourcing sector is reduced by F_{LO} amount per emigrant, since this is supply determined equilibrium. This reduces the supply of the outsourced intermediate input by the domestic country. So there exists an inverse relation between immigration quota and the outsourced intermediate input. In the present paper supply side constraints determine the inverse relationship between immigration and outsourcing, while Bandyopadhyay and Wall (2005) show that demand side factors determine this inverse relationship.[11] On the other hand, production of the intermediate input in the foreign country is increased by F_n amount per emigrant. As $F_n > F_{LO}$, so there is a net increase in productivity by $(F_n - F_{LO})$ amount per emigrant. Therefore total production of the intermediate input is increased by $(F_n - F_{LO})$ per emigrant. As a result, the equilibrium demand for intermediate input increases by $(F_n - F_{LO})dn^*$[12], since there is full-employment in the intermediate input market. Therefore, $dI^*/dn^* = F_n - F_{LO} > 0$. While the demand for the intermediate input remains unchanged, the supply of the intermediate input increases on account of an increase in n^*. Therefore the equilibrium price of the intermediate input falls. Differentiating Equation (5) with respect to n^* gives,

$$dP_I^*/dn^* = Q_{II}(F_n - F_{LO}).$$

Since $Q_{II} < 0$, and $(F_n - F_{LO}) > 0$, $dP_I^*/dn^* < 0$.

Proposition 2: *An increase in the temporary immigration quota reduces the wage of the immigrants.*

[11] Bandyopadhyay and Wall (2005) model is demand determined, while our model is supply determined.

[12] dn^* = change in the immigration quota.

The supply of the temporary immigrant workers increases with the relaxation of immigration policy of the foreign government. On the other hand, an increase in the immigration quota reduces the equilibrium price of the intermediate input. The value of marginal physical product for immigrant workers[13] (or demand for immigrant workers) falls resulting in the fall of the equilibrium wage of the immigrant. Differentiating Equation (8) with respect to n^* we obtain,

$$dW_N / dn^* = Q_{NI}(F_n - F_{LO}).$$

Since $(F_n - F_{LO}) > 0$ and $Q_{NI} > 0$, $dW_N / dn^* > 0$.

Proposition 3: *Even though an increase in temporary immigration quota increases foreign worker's wage, the impact on equilibrium rental of foreign capital is ambiguous.*

An increase in immigration quota raises the equilibrium demand for the intermediate input in the production of final consumption good. This increases the productivity of foreign workers in the final consumption good production, due to the complementary relationship between two factor inputs. Therefore the value of the marginal physical product of foreign workers (or the demand for the foreign workers) increases. Given the fixed supply of the foreign workers at N_F, the equilibrium foreign wage increases. This result contradicts with Bandyopadhyay and Wall (2005) which show that foreign wage decreases with an increase in immigration quota. Differentiating Equation (7) with respect to n^* gives,

$$dW_I^* / dn^* = Q_{II}\{-F_{LO} + F_n\}F_n + Q_I F_{nn}.$$

Since $(F_n - F_{LO}) > 0$ and Q_{II}, $F_{nn} < 0$, $dW_I^* / dn^* < 0$.

Foreign capital is only used in the production of intermediate input by the foreign firm. With an increase in the temporary immigration quota, the equilibrium price of intermediate input falls. This fall in price reduces the value of marginal physical product of foreign capital.[14] On the other hand, productivity of foreign capital increases on account of the increasing use of complementary factor input 'temporary immigrants' in the production process. The combined effect of these two opposite forces may increase, decrease or may not change the demand for foreign capital. Given the fixed supply of

[13] The value of marginal physical product of a factor input can be interpreted as the demand of that factor input, in the presence of the perfect competition in final consumption good market.

[14] Value of marginal physical product of foreign capital= $P_I F_{KI}$.

foreign capital at K_F, the equilibrium rental on foreign capital may increase, decrease or remain unchanged. This result is also in contrast with Bandyopadhyay and Wall (2005), even though in both the models capital and immigrant workers are complementary factors of production. Differentiating Equation (6) with respect to n^* gives,

$$dr_k^* / dn^* = Q_I F_{Kin} + Q_{II}(F_n - F_{LO})F_{KI} .$$

Since $Q_{II} < 0$, $(F_n - F_{LO}) > 0$ and $F_{KIn} > 0$, $dr_k^* / dn^* \gtrless 0$.

Proposition 4: *An increase in temporary immigration quota has uncertain impact on the wage rate of the domestic workers, but it definitely reduces the equilibrium rental on domestic capital involved in domestic outsourcing sector.*

The equilibrium price of intermediate input reduces with an increase in n^*. This reduces the value of marginal physical product[15] (or derived demand) of domestic workers. On the other side, the supply of labour to the domestic outsourcing sector falls as the domestic workers migrate to the foreign country. The equilibrium domestic wage may thus increase, decrease or remain unchanged, unlike Bandyopadhyay and Wall (2005) showing a rise in immigration quota raises domestic wage. Differentiating Equation (16) with respect to n^* gives,

$$d(w^*) / dn^* = F_{LO} Q_{II}[F_n - F_{LO}] - P_I^* F_{LOLO} .$$

Since $(F_n - F_{LO}) > 0$ and Q_{II}, $F_{LOLO} < 0$, $d(w^*) / dn^* \gtrless 0$.

An increase in immigration quota reduces the labour availability to the domestic outsourcing sector. As a result, the productivity of the complementary factor, domestic capital, also reduces. However, the price of intermediate input falls. These two effects jointly reduce the value of marginal physical product of domestic capital leading to a fall in equilibrium domestic rental in the face of a fixed supply of domestic capital at K_D. Differentiating Equation (17) with respect to n^* gives,

[15] Value of marginal physical product of domestic workers= $P_I F_{LO}$, and Value of marginal physical product of domestic capital= $P_I F_{KO}$. These can be interpreted as the respective demand of the domestic labour and domestic capital.

$d(r^*)/dn^* = F_{KO}Q_{II}[F_n - F_{LO}] - P_I^* F_{KOLO}$.

Since $Q_{II} < 0$, F_{KO}, $(F_n - F_{LO}) > 0$ and $F_{KOLO} > 0$, $d(r^*)/dn^* < 0$.

Lemma: *The wage difference between temporary immigrants and domestic workers falls on account of an increase in temporary immigration quota.*

An increase in immigration quota reduces marginal productivity of the immigrants, but increases that of the domestic workers. The equilibrium price of the intermediate input also falls. This reduces the absolute difference between the value of marginal physical product of immigrants and domestic workers, even in the face of an uncertain change in equilibrium domestic wage, given fall in the immigrants' wage. Absolute wage gap between immigrants and domestic workers is measured by $(W_I^* - w^*)$.

Now $(W_I^* - w^*) = P_I(F_n - F_{LO})$.

After differentiating the above equation with respect to n^* we obtain,

$$d(W_I^* - w^*)/dn^* = Q_{II}(F_n - F_{LO})^2 + P_I(F_{nn} + F_{LOLO}). \quad (26)$$

Since Q_{II}, F_{nn}, $F_{LOLO} < 0$, $(F_n - F_{LO}) > 0$, $d(W_I^* - w^*)/dn^* < 0$.

Proposition 5: *An increase in temporary immigration quota increases world welfare (measured in terms of final consumption good production).*

In the region where $F_n > F_{LO}$, an increase in temporary immigration quota increases the total production as well as consumption (in the absence of saving and taxation) of the final consumption good. Once the world reaches $F_n = F_{LO}$, there will be no further immigration from the domestic country to the foreign country. The wage difference will also disappear at $F_n = F_{LO}$. The production of the final consumption good is maximised at $F_n = F_{LO}$.

Differentiating twice $Q^* = Q(I^*, N_F)$ with respect to n^* we obtain,

$$dQ^*/dn^* = Q_I[F_n - F_{LO}]. \quad (27)$$

$$d^2Q^*/dn^{*2} = Q_{II}[F_n - F_{LO}]^2 + Q_I[F_{nn} + F_{LOLO}].$$

With $(F_n - F_{LO}) > 0$, $dQ^*/dn^* > 0$ and $d^2Q^*/dn^{*2} < 0$. This shows that the Q^* curve is positively sloped and concave to the origin.

Proposition 6: *The foreign national income (measured in terms of final consumption good) increases due to an increase in temporary immigration quota.*

The foreign national income has two components: total wage income earned by foreign workers and total rent income earned by foreign capital owners. With an increase in immigration quota, equilibrium foreign wage increases, but equilibrium foreign rental may increase, decrease or remain unchanged. The first effect is a dominating one, which outweighs the second effect. Differentiating Equation (20) with respect to n^* gives,

$$dY_F^*/dn^* = -Q_{II}[F_n - F_{LO}][I_D^* + n^* F_n] - n^* Q_I F_{nn}. \tag{28}$$

Since $(F_n - F_{LO}) > 0$, and Q_{II}, $F_{nn} < 0$, $dY_F^*/dn^* > 0$. Equation (28) shows that the foreign national income is a monotonically increasing function of n^* provided that $F_n > F_{LO}$.

Lemma: *Since* $C_F^* = Y_F^*, dC_F^*/dn^* = dY_F^*/dn^* > 0$ *according as* $F_n > F_{LO}$.

Proposition 7: *An increase in* n^* *has uncertain impact on the domestic national income (measured in terms of final consumption good) and domestic national consumption level.*

Domestic national income comprises of the value of the total outsourcing product $(P_I^* I_D^*)$ [16] produced in the domestic country and total wage earning by the immigrants in the foreign country $(W_I^* n^*)$. With an increase in the immigration quota, the equilibrium supply of outsourced intermediate input as well as the equilibrium price of the intermediate input falls. As a result, $P_I^* I_D^*$ decreases. On the other hand, relaxation of foreign immigration policy definitely reduces the equilibrium wage of immigrants (W_I^*). The total wage earned by the immigrants $(W_I^* n^*)$ may increase, decrease or remain unchanged. The total wage earning by the immigrants would fall, provided the own wage elasticity of the immigrants is greater than one. In this situation, temporary

[16] $P_I^* I_D^*$ consists of domestic wage component and domestic rental component; with the increase in n^*, domestic rental increases but domestic wage component may increase, decrease or remain unchanged.

immigration quota and domestic national income are inversely related. Otherwise, the impact of an increase in the immigration quota on the domestic national income is uncertain.

Differentiating Equation 22 with respect to n^* we obtain,

$$dY_D^*/dn^* = [F_n - F_{LO}][I_D^* + Q_{II} + P_I^* + n^* Q_{II} F_n] + n^* Q_I F_{nn}. \quad (29)$$

Since $(F_n - F_{LO}) > 0$ and Q_{II}, $F_{nn} < 0$, $dY_D^*/dn^* \gtreqless 0$.

Lemma: *Since* $C_D^* = Y_D^*$, $dC_D^*/dn^* = dY_D^*/dn^* \gtreqless 0$ *according as* $F_n > F_{LO}$.

In this model, rise in immigration quota increases world welfare and developed country welfare. However it may reduce developing country welfare. Bandyopadhyay and Wall (2005) show that national income of the developed country monotonically increases with immigration quota, but in the presence of monopsony power of developed country in international labour market, national income of the developed country may fall with rise in immigration quota. In our model, there is no such possibility. It also needs to be mentioned that Bandyopadhyay and Wall (2005) do not analyse the impact of rise in immigration quota on developing country welfare.

3. EMPIRICAL ANALYSIS

The theoretical model, detailed out in the earlier section, has established an inverse relationship between temporary immigration and product outsourcing. However, the impact of an increase in the temporary immigration quota on the welfare level of the developing country remains ambiguous. These propositions encourage us to do an empirical analysis to determine the nature of impact of temporary immigration and product outsourcing on welfare of developing economies. For this purpose, three reduced form equations, derived in the theoretical model (after some modification), are estimated. The empirical analysis is carried out in a partial equilibrium framework even though applied general equilibrium welfare calculation is a possibility.

3.1. Estimating Model

The whole empirical analysis is divided into three stages; in stage I, we estimate

relation between the real product outsourcing (VA_O)[17] and temporary immigration quota (n). The sign of $d(VA_O)/dn$ at the mean value of regressor (n) will show the relationship between product outsourcing and temporary immigration; in stage II, relation between income of the immigrants ($W_I^* n^*$) and the number of immigration quota (n^*) is estimated. The sign of $d(W_I^* n^*$ [18]$)/dn^*$ shows the nature of the relationship between income of the immigrant workers of i^{th} country and the total number of immigrants; and in stage III, the impact of the real value of the product outsourcing on the real consumption level (which is a representative measure of the welfare level) of a low-income country is estimated.

In the general equilibrium model, the developing country has only one sector; the outsourcing sector. Domestic labour and domestic capital are engaged in the outsourcing sector. Domestic labour has the option to migrate to the developed country. There are many sectors in the developing country, which contribute to national income. For instance if we assume that there are three sectors in a developing country, namely agriculture, transport and communication, non-outsourced manufacturing sectors apart from outsourced manufacturing sector. The national income equation for the developing country is given by,

$$Y_D^* = VA_A + VA_T + VA_{NOM} + VA_O + W_I n \,,$$

where $VA_A =$ value added by agriculture sector, $VA_T =$ value added by transportation and communication sector, $VA_{NOM} =$ value added by non-outsourced manufacturing sector, $VA_O =$ value added by outsourced sector and $W_I n^* =$ income of the immigrant workers.

Consumption level (C_D) of the developing country can be considered as the proxy for the country's welfare.[19] In the theoretical model, consumption was equivalent to

[17] $VA_O(n)_{it}$ = real value of product outsourced to i^{th} country by a developed country in period t, n_{it}= number of people temporarily migrated from the i^{th} county to the same developed country in t^{th} year.

[18] $(W_I^* n^*)_{it}$ = the current transfers by migrant workers and wages and salaries earned by nonresident workers to i^{th} country from abroad in period t.

[19] In the absence of savings, consumption is equivalent to income. Therefore no problem occurs. But in reality there are savings and dis-savings, so there is a choice between consumption and income for the measurement of welfare. In the industrialised countries (like U.S.A), income data is considered as a proxy measure of welfare. On the other hand, in less developed countries (like Asian countries), where data on wealth is not available, consumption is a better choice than income for welfare measurement. Apart from this, consumption also provides more stable measure of welfare than income. Deaton (1980), Deaton and Zaidi (1999), Pradhan (2001), and others are in favour of consumption as a measure of welfare. Among them,

national income in absence of saving and taxation. Here a linear consumption function is used for the purpose.

$$C_D^* = \alpha_0 + \alpha_A(VA_A) + \alpha_T(VA_T) + \alpha_{NOM}(VA_{NOM}) + \alpha_{OUT}(VA_O) + \alpha_I(W_I n)\,.$$

In this equation, consumption is made to depend on value-added in different sectors. The estimating equation will thus be

$$C_D^* = \alpha_0 + \alpha_A(VA_A) + \alpha_T(VA_T) + \alpha_{NOM}(VA_{NOM}) + \alpha_{OUT}(VA_O) + \alpha_I(W_I n) + e\,, \quad (30)$$

where $e =$ error term.

Partial differentiation of Equation (30) with respect to VA_O gives,

$$\left(\frac{\partial C_D^*}{\partial VA_O}\right) = \alpha_{OUT}\,.$$

The sign of α_{OUT} determines the partial effect of real value of outsourcing on the domestic consumption level, whereas total effect of real value of outsourcing on the domestic consumption level is measured by $\frac{dC_D^*}{dVA_O}$.

Total differentiation of Equation (30) with respect to VA_O gives,

$$\left(\frac{dC_D^*}{dVA_O}\right) = \alpha_{OUT} + \alpha_I\left(\frac{d(W_I n)}{dn}\right)\left(\frac{dn}{d(VA_O)}\right). \quad (31)$$

The sign of $\frac{dC_D^*}{dVA_O}$ depends on the relative signs of α_{OUT}, α_I, $\frac{dW_I n}{dn}$ and $\frac{dVA_O}{dn}$. Given the signs of $\frac{dVA_O}{dn}$ and $\frac{dW_I n}{dn}$, α_{OUT}, α_I will be estimated from the Equation (30).

3.2. Methodology and Data

Deaton (1980, 1999) strongly supported consumption measure since consumption is the basis of other measures of welfare. In fact, Living Standard Measurement Study (LSMS) surveys are in favour of consumption measurement.

The Equation (30) is estimated in a multi-country framework. U.S.A. is considered here as the foreign country and seven low-income countries (Bangladesh, Ghana, Haiti, Kenya, Myanmar, Nepal and Senegal)[20] are considered as domestic countries. Panel Data Analysis is used to estimate Equation (30).

3.2.1. Panel Data Analysis

Here we have 7 less developed countries (cross-sectional units) indexed by $i = 1,2,...,7$ for the time period 1997 to 2009,[21] indexed by $t = 1997,1998,...,2009$. The linear relationship, given by the Equation (30), for i^{th} country in t^{th} period can be written as

$$(C_D^*)_{it} = \alpha_{0t} + \alpha_A (VA_A)_{it} + \alpha_T (VA_T)_{it} + \alpha_{NOM} (VA_{NOM})_{it} + \alpha_{OUT} (VA_O)_{it} + \alpha_I (W_I n)_{it} + e_{it}.$$

There are two tests, used for appropriate model selection. Lagrange multiplier test helps to distinguish between simple pooled regression and random effect model, while Hausman's specification test helps to distinguish between fixed effect model[22] and random effect model.

The description of the data used in the estimation of the econometric model is provided in what follows.

Current value of product outsourcing (VA_O): Data on imports of goods (HS-9802) into U.S.A is considered as the statistical information on product outsourcing of the importing country (Swenson, 2005).[23] United States International Trade Commission

[20] Here India, Pakistan and Vietnam are excluded from the country set. Data on the immigrants' income of Vietnam is not available for some years. Scatter diagram shows that the patterns of data for India and Pakistan are different from the rest of seven countries. In these two countries, temporary immigration quota and product outsourcing (in current US$) are positively related. In our theoretical model, supply side constraint determines the inverse relationship between immigration quota and product outsourcing. With the rise in immigration quota, labour availability to the domestic outsourcing sector decreases. This reduces the production of domestic outsourcing sector. India and Pakistan are two major senders of h1b visa. The supply side constraint may not be valid for these two countries, as they have surplus.

[21] No H-1B visa was issued by U.S.A government in 2001, due to the terrorist attack on the Twin Tower. Therefore 2001 is not included in the analysis.

[22] Here fixed effect model is estimated with time dummy instead of cross-section dummy. As our theoretical model is fixed endowment model, and immigration policy of U.S.A. changes over time, fixed effect model with time dummy gives more meaningful result.

[23] In some studies, FDI is considered as the proxy measure of service outsourcing (Khalifa and Mengova, 2010).

(USITC) reports the time series data on HS-9802. For our study, the cif import value under HS-9802 is considered. The unit of measurement is in current US $. This is referred to as the offshore assembly programme (OAP). Under OAP, exporters of the foreign country enjoy the tariff benefits, if their exported products contain parts, components or materials made in the U.S.A. There is no tariff on the part of the value added produced within the U.S.A. The dutiable OAP import, as a result, is the value added produced abroad and hence, is a part of product being outsourced.

Under HS-9802 product group there are six tariff lines, which are stated as follows:

- 98020020: Photographic films and dry plates manufactured in U.S.(except commercial motion-picture film) and exposed abroad, whether developed or not,
- 98020040: Articles returned to the U.S. after having been exported for repairs or alterations, made pursuant to a warranty,
- 98020050: Articles returned to the U.S. after having been exported for repairs or alterations, nes,
- 98020060: U.S. articles of specific metals exported for further processing and returned for further processing,
- 98020080: U.S. articles assembled abroad, which have not lost their physical identity or have not advanced in value or improved in condition abroad,
- 98020090: Textile and apparel goods, assembled in Mexico in which all fabric components were wholly formed and cut in the United States, etc.

The data on these are electronically documented for 154 countries, including high income, upper middle income, lower middle income and low income group, over the period 1989 to 2009. The data considered here are only a part of total outsourcing activity. In fact, this dataset does not include the service outsourcing (software outsourcing).

GDP deflator: GDP deflator (base year 2005=100) is used to convert the current value of product outsourcing in US $ into constant price estimates. These data are collected from the official web page of United Nations Statistics Division. Using GDP deflator, product outsourcing by i^{th} country to a developed country in real terms is arrived at.

Temporary immigration quota (n_{it}): H-1B issued by U.S.A Government in a year, categorised by country of birth, is considered as a measure of temporary immigration quota. However, no H-1B visa was issued by U.S.A government in 2001. U.S. Department of Homeland Security provides with this data.

The real consumption data of i^{th} *country in period t* $(C_D^*)_{it}$: The consumption expenditure data at constant price are collected from the official web page of United Nations Statistics Division.

Value added by agriculture sector of i^{th} country in period t $(VA_A)_{it}$: The data on value added by agriculture sector at constant price are collected from the official web page of United Nations Statistics Division.

Value added by transportation and communication sector of i^{th} country in period t $(VA_T)_{it}$: The data on value added by transportation and communication sector at constant price are collected from the official web page of United Nations Statistics Division.

Value added by non-outsourced manufacturing sector of i^{th} country in period t $(VA_{NOM})_{it}$: The data on value added by non-outsourced manufacturing sector at constant price are obtained by subtracting the value of product outsourcing from the value added by manufacturing sector.

Income of the immigrant workers in t^{th} period $(W_1 n)_{it}$: Income of immigrant workers includes workers' remittances, compensation of employees, and migrants' transfers. The data on these variables available in current U.S. dollars are deflated by GDP deflator to arrive at real income of the immigrant workers.

4. ESTIMATION RESULTS

4.1. Stage I Estimation

The empirical estimation is carried out to find the impact of real product outsourcing on welfare of developing countries from where intermediate products are being outsourced by developed country U.S.A. In doing so, it is necessary to arrive at the estimates of the relations between real product outsourcing and temporary immigration quota. In order to estimate the relation between real product outsourcing and temporary immigration quota, a simple pooled regression is carried out on the data of 7 low-income countries over the time period 1997 to 2009. The bivariate equation estimates real product outsourcing (VA_O) as the dependent variable and temporary immigration (n) as the explanatory variable. The results are shown in Table 1.

The results show that the inverse function is most appropriate for describing the relationship between real product outsourcing and the temporary immigration quota, since $R^2 (= 0.164)$ is highest for inverse form. In fact F statistic also indicates that only logarithmic function and inverse function are appropriate to describe the relationship between real product outsourcing and the temporary immigration quota. In both the functions, real product outsourcing is inversely related with immigration quota. We also estimate linear function, quadratic function, cubic function, and quartic (4^{th} order)

function.[24] However, none of these is appropriate. We choose inverse function between logarithmic and inverse functions, since R^2 is highest for this functional form.

The estimated inverse functional form can be written as,

$$VA_O = 37.1855 + (9133.57)(1/n).$$

$d(VA_O)dn\big|_{n=\bar{n}} = -(9133.57)(1/\bar{n})^2$, where $\bar{n}$ = mean value of n.

Therefore, $d(VA_O)dn_{at\ n=265} = -(9133.57)(1/265)^2 = -0.13$; mean n=265.

Table 1. Relationship between Real Value of Product Outsourcing and Temporary Immigration Policy across Low-income Countries

(Dependent variable= VA_O ; Independent Variable=n)

Functional Form	Linear	Quadratic	Cubic	Quartic (4^{th} order)	Logarithmic	**Inverse**
R^2	0.027	0.029	0.032	0.043	0.057	**0.164**
D.O.F	82	81	80	79	82	**82**
F	2.3	1.20	0.87	0.892	4.99**	**16.08*** **
Significance Level	0.133	0.307	0.461	0.473	0.028	**0.000**
β_0	222.741***	241.231***	274.556**	350.18***	547.586***	**37.1855**
	(0.000)	(0.003)	(0.011)	(0.009)	(0.003)	**(0.453)**
β_1	-0.2381	-0.4351	-1.0202	-3.00	-77.809**	**9133.57*** **
	(0.133)	(0.463)	(0.451)	(0.22)	(0.028)	**(0.000)**
β_2		0.0002	0.0020	1.305E-02		
		(0.730)	(0.591)	(0.275)		
β_3			-1.E-06	22.119E-05		
			(0.630)	(0.303)		
β_4				1.105E-08		
				(0.33)		

Notes: Figures in bracket indicate the significance level. * indicates significant at 10 percent level, ** indicates significant at 5 percent level and *** indicates significant at 1 percent level.

The sign of $\{d(VA_O)dn_{n=265}\}$ shows that there is an inverse relation between real

[24] Quintic function (5^{th} order) can not be estimated, since one variable is dropped due to multicollinearity. Here, compound function, power function, *S* function, growth function, exponential function and logistic function cannot be estimated due to the presence of non-positive values of dependent variables.

product outsourcing and the number of temporary migrants in developing countries at the mean value of regressor (n).

The results show that if a developed country (say, the U.S.A) increases temporary immigration quota for low income countries, then the product outsourcing from that low income country decreases. Shortage of specialised labour (involved in outsourcing sector and in migration process) of these low-income countries may cause this.[25]

4.2. Stage II Estimation

In order to estimate the relationship between total wage income earned by immigrants and temporary immigration quota, a simple pooled regression is run on the data of seven low-income countries over the time period 1997 to 2009. The result for the appropriate model selection is given in Table 2.

***Selection of the appropriate functional form*:** When the number of the regressor increases, then the justification of introduction of the new variables can be checked through F test.

Null Hypothesis; H_0 : Coefficients of new regressors = 0.

Alternative Hypothesis; H_A : Coefficients of new regressors ≠ 0.

Test statistic is, $F(q, n-k) = (R^2_{NEW} - R^2_{OLD}/q)/(1 - R^2_{OLD}/n-k)$,

where, q=number of new regressors, n=number of observations, k=number of parameter in the new model. Under null hypothesis, test statistic follows F distribution with degrees of freedom (q, n - k).

The results show that the quartic function (4th order)[26] is a significant improvement over linear, quadratic and cubic functions. Table 2 shows that quartic function is most appropriate for describing the relationship between total wage income earned by immigrants and temporary immigration quota.

[25] There are two problems regarding empirical analysis. There is unavailability of data on the product outsourcing and on the temporary immigration quota. Number of H-1B visa, issued by U.S.A government, is considered as the measure of the temporary immigration quota. But the sector wise classification of H-1B visa is not available for all years. This makes it difficult to get the sector wise scenario. So in the empirical part, aggregate level relationship between the temporary immigration policy and the real value of product outsourcing is analysed. Second problem is that there is a non-linear relationship between these two variables. Therefore, the inverse relationship (measured by the slope of the inverse function) between two variables is estimated at the mean value of the regressor.

[26] Quintic function (5th order) can not be estimated, since one variable is dropped due to multicollinearity.

Table 2. Appropriate Model Selection for Seven Low-Income Countries

Test	Hypothesis	Test Statistic	Value	Comment
Linear vs. Quadratic	H_0: β_2 =0	F (1, 80)	8.66***	H_0 is rejected. So quadratic function is better than linear function.
Linear vs. Cubic	H_0: β_2 =β_3=0	F (2, 79)	4.47**	H_0 is rejected. So cubic function is better than linear function.
Linear vs. Quartic	H_0: β_2 =β_3 =β_4=0	F (3, 78)	4.91**	H_0 is rejected. So quartic function is better than linear function
Quadratic vs. Cubic	H_0: β_3 =0	F (1, 79)	0.43	H_0 is accepted. So quadratic function is better than cubic function
Quadratic Vs. Quartic	H_0: β_3 =β_4 =0	F (2, 78)	3.53*	H_0 is rejected. So quartic function is better than quadratic function
Cubic vs. Quartic	H_0: β_4 =0	F (1, 78)	6.72**	H_0 is rejected. So quartic function is better than cubic function

Notes: * H_0 is rejected at 10% significance level; ** H_0 is rejected at 5% significance level; *** H_0 is rejected at 1% significance level

The results, given in Table 3, show that $R^2 (= 0.326)$ is highest for quartic function with a F-statistic of 9.42 being significant at 1 percent level. The estimated relation between the two variables at the mean value of the regressor (n) for the quartic equation is given by,

$$(W_I n) = \beta_0 + \beta_1 n + \beta_2 n^2 + \beta_3 n^3 + \beta_4 n^4 + E ,$$

where E= random error term.

$$d(W_I n)/dn\big|_{n=\bar{n}} = \beta_1 + 2\beta_2(\bar{n}) + 3\beta_3(\bar{n})^2 + 4\beta_4(\bar{n})^3 ,$$

$$d(W_I n)/dn\big|_{n=265} = \beta_1 + 2\beta_2(265) + 3\beta_3(265)^2 + 4\beta_4(265)^3 = 100881.16 ,$$

where $\beta_1 = -132432.50$, $\beta_2 = 1082.64$, $\beta_3 = -1.9958$ and $\beta_4 = 0.0011$.

Table 3. Relationship between Real Immigrants Income from Abroad and Temporary Immigration Policy for 7 Low-Income Countries
(Dependent variable=$W_I n$; Independent Variable=n)

Functional Form	R^2	D.O.F	F	β_0	β_1	β_2	β_3	β_4
Linear	0.169	81	16.50***	4027274.35*	24721.61***			
			(0.000)	(0.084)	(0.000)			
Quadratic	0.259	80	14.00***	-2189869.06	89942.05***	-78.87**		
			(0.000)	(0.461)	(0.000)	(0.003)		
Cubic	0.263	79	9.38***	-610238.40	62748.13	2.675	-0.0612	
			(0.000)	(0.878)	(0.212)	(0.985)	(0.546)	
Quartic	**0.326**	**78**	**9.42*** **	**7023371.50**	**-132432.50**	**1082.64** **	**-1.9958*** **	**0.0011*** **
(4^{th} order)			**(0.000)**	**(0.142)**	**(0.131)**	**(0.012)**	**(0.007)**	**(0.009)**
Logarithmic	0.184	81	18.32***	-18962210.37***	5909282.40***			
			(0.000)	(0.009)	(0.000)			
Inverse	0.067	81	5.83**	13915145.13***	-253556965.37**			
			(0.018)	(0.000)	(0.018)			
Compound	0.240	81	25.56	2245121.10***	1.0026***			
			(0.000)	(0.000)	(0.000)			
Power	0.212	81	21.78	280306.74	0.5524***			
			(0.000)	(0.101)	(0.000)			
S-curve	0.044	81	3.75*	15.54***	-17.9494*			
			(0.056)	(0.000)	(0.056)			
Growth	0.240	81	25.56***	14.62***	0.0026***			
			(0.000)	(0.000)	(0.000)			
Exponential	0.240	81	25.56***	2245121.10***	0.0026***			
			(0.000)	(0.000)	(0.000)			
Logistic	0.240	81	25.56***	4.45***	0.9974***			
			(0.000)	(0.000)	(0.000)			

Notes: Figures in bracket indicate the significance level. * indicates significant at 10 percent level, ** indicates significant at 5 percent level and *** indicates significant at 1 percent level.

The above results also show that the income of immigrant workers from abroad and immigration quota are directly related in quartic functional forms.

4.3. Stage III Estimation

The impact of real product outsourcing on welfare of low-income countries is estimated using Equation (30). Here real consumption is used as a measure of developing country welfare. The five explanatory variables, as in Equation (30), are value added by agriculture, value added by transport and communication, value added

by non-outsourced manufacturing sector, value added by outsourcing sector and the income of the immigrants from the abroad. Panel data method is used for the purpose. For the purpose of this estimation, the results of the earlier two estimates are taken into account.

The results of the empirical exercise are presented in Table 4. The results show that all the explanatory variables, except the income of the immigrants from the abroad, have positive effect on real consumption level in all three models. However, the coefficient of value added by outsourcing sector is statistically significant (at 1% level) only in random effect model. On the other hand, income of the immigrants from abroad has negative impact on real consumption in all three models. This indicates that immigrants may spend their income on foreign consumption instead of domestic consumption. The coefficients of income of the immigrants are statistically significant (at 1% level) in pooled regression model and fixed effect model. However, as the estimated coefficient corresponding to value added by outsourcing sector is greater than unity so the increase in domestic consumption will be greater than the increase in value added by outsourcing sector.

Comparing three models, it is noted that the total effect of value added by outsourcing on real consumption (dC_D^*/dVA_O) is positive in all three models. From Equation (31), we have $(dC_D^*/dVA_O) = \alpha_{OUT} + \alpha_I (d(W_I n)/dn)(dn/d(VA_O))$.

Stage I and Stage II estimations give that $d(VA_O)/dn|\bar{n} < 0$ and $d(W_I n)/dn|\bar{n} > 0$ respectively. Panel data estimation gives that $\alpha_{OUT} > 0$ and $\alpha_I < 0$ in all three models.

In Pooled Regression Model, $(dC_D^*/dVA_O) = 81092062.88$.

In Fixed Effect Model, $(dC_D^*/dVA_O) = 107841742.88$.

In Random Effect Model, $(dC_D^*/dVA_O) = 5874227.02$.

It is noted that total effect of value added by outsourcing on real consumption is positive irrespective of model specification. In fact, the partial effect of value added by outsourcing on real consumption $(\partial C_D^*/\partial VA_O)$ is also positive in all three models; however it is statistically significant only in random effect model. These results show that given the negative impact of temporary immigration quota on real product outsourcing, real consumption in developing countries increases with rise in real product outsourcing. The partial as well as total effects of real product outsourcing on welfare of developing countries are thus positive.

Lagrange Multiplier test and Hausman test show that fixed effect model with time specific dummy is suitable for this analysis. Choice of fixed effect model implies that immigration policy of developed country (here USA) over the years, year wise labour endowment of developing countries and other time specific factors influence the real consumption of developing countries, apart from other explicit factors, like value added by agriculture, value added by transport and communication, value added by

non-outsourced manufacturing sector, value added by outsourcing sector and income of the immigrants. The cross-sectional movement is more important than time-specific movement of the data.

Table 4. Panel Data Analysis for Seven Low Income Countries over the Period 1997-2009

Dependent variable: logC_D	Pooled Regression Model		Fixed Effect Model		Random Effects Model	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
VA_A	0.43**	0.05	0.33	0.18	1.53***	0.00
VA_T	2.96***	0.00	2.58***	0.00	2.73***	0.00
VA_{NOM}	2.71***	0.00	3.22***	0.00	1.41***	0.00
VA_O	92251.49	0.87	209305.25	0.74	1117292.32**	0.06
W_Pn	-104.38***	0.00	-138.70***	0.00	-6.13	0.86
Constant	3360314157***	0.00	-	-	-	-
D.O.F	78		67		-	
Adjusted R^2	0.98		0.98		-	
Lagrange Multiplier Test = 5.56 (1 df, prob value = 0.02)						
(High values of LM favour FEM/REM over CR model)						
Fixed vs. Random Effects (Hausman) = 41.44 (5 df, prob value = 0.00)						
(High (low) values of H favour FEM (REM))						

Note: * indicates significant at 10 percent level, ** indicates significant at 5 percent level and *** indicates significant at 1 percent level.

The results, as presented in Table 5, provide the value of time specific fixed effect for the period 1997-2009. Here all the estimated time specific effects are positive implying that actual real consumption is higher than the one predicted by the other explanatory variables.

Apparently, the results hold in the time specific fixed effect model, but a higher level of disaggregation will throw more light on the subject, although problems relating to estimation like multicollinearity and heteroscedasticity are likely to compound.

Table 5. Country Specific Fixed Effect Coefficient of Panel Data Analysis

Year	Fixed Effect Coefficient	*t*-ratio
1997	3150055267.89	3.56
1998	3142889492.73	3.63
1999	3200969758.33	3.64
2000	3213814369.84	3.65
2002	3699997828.48	4.00
2003	3819495263.76	4.14

2004	3679052101.36	3.95
2005	3681299477.02	3.83
2006	3839421008.46	3.83
2007	3871977994.61	3.81
2008	4165407508.68	3.85
2009	4558335168.37	3.99

5. CONCLUSIONS

The theoretical analysis in this paper establishes an inverse relationship between the temporary immigration quota and the product outsourcing, given a supply side constraint in terms of availability of skilled labour to be employed in the outsourced sector. Temporary immigration enhances the welfare of developed countries as well as for the world. However, the impact on welfare of developing countries is ambiguous. Since the theoretical model fails to explain the effect of temporary immigration policy on the welfare of developing countries with certainty, an empirical analysis has been done to find the actual relationship between these two. Empirical results establish a significant inverse relationship between temporary immigration and product outsourcing. A panel data estimate shows that real product outsourcing in a developing country has a positive influence on the country's welfare. In a multi-country framework, on the contrary, temporary immigration is thus not welfare enhancing for developing countries. It thus becomes evident that these countries need to frame their policies in such a way that helps to obtain outsourcing contract and reduce emigration. For the growth of the outsourcing sector, development of infrastructure becomes a necessity. While improvement of infrastructure not only helps outsourcing market to expand, but it also provides incentives to domestic workers not to emigrate.

REFERENCES

Arndt, S.W. (1997), "Globalization and the Open Economy," *North American Journal of Economics and Finance*, 8(1), 71-79.

Arora, S.S., and A. Chakrabarti (2004), "Importing Jobs? The Impact of Global Outsourcing on Wages in Indian Manufacturing," *Indian Journal of Economics and Business*, Special Issue, 137-152.

Bandyopadhyay, S., S. Marjit, and L. Yang (2010), "An Evaluation of the Employment Effects of Barriers to Outsourcing," Working Paper, 2010-030A, St. Louis: Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/wp/2010/2010-030.pdf).

Bandyopadhyay, S., and H.J. Wall (2005), "Immigration and Outsourcing: A General

Equilibrium Analysis," FRB of St. Louis Working Paper, 2005-058C, West Virginia University and IZA, Bonn.

Cohen-Goldner, S., and D. Paserman (2004), "The Dynamic Impact of Immigration on Natives' Labour Market Outcomes: Evidence from Israel," CEPR Discussion Papers, 4640.

D'Amuri, F., G.I.P. Ottaviano, and G. Peri (2008), "The Labour Market Impact of Immigration in Western Germany in the 1990's," CEPR Discussion Papers, 6736.

Deaton, A.S. (1980), "The Measurement Of Welfare: Theory And Practical Guidelines," LSMS Working Paper, 7, The World Bank, Washington, D.C.

Deaton, A.S., and S. Zaidi (2002), *Guidelines for Constructing Consumption Aggregates for Welfare Analysis*, The World Bank, Washington, D.C.

Dueby, R. (2003), "Global Outsourcing: The India Story So Far," *Business World*, 12, 30-44.

Dustmann, C., F. Fabbri, and I. Preston (2005), "The Impact of Immigration on the British Labour Market," *The Economic Journal*, 115(507), F324-F341.

Egger, H., and U. Kreickemeier (2008), "International Fragmentation: Boon or Bane for Domestic Employment?" *European Economic Review*, 52(1), 116-132.

Engman, M. (2007), "Expanding International Supply Chains: The Role of Emerging Economies in Providing It and Business Process Services," OECD Trade Policy Working Papers, 52.

Hijzen, A., H. Görg, and R.C. Hine (2004), "International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom," IZA Discussion Paper, 1249.

Jansen, M., and R. Piermartini (2005), "The Impact of Mode 4 Liberalisation on Bilateral Trade Flows," Centre for Economic Policy Research Staff Working Paper, 5382, Geneva.

Jean, S., and M. Jimenez (2007), "The Unemployment Impact of Immigration in OECD Countries," OECD Economics Department Working Papers, 563.

Jones, R.W. (1965), "The Structure of Simple General Equilibrium Models," *The Journal of Political Economy*, 73(6), 557-572.

_____ (2005), "Immigration vs. Outsourcing: Effects on Labour Market," *International Review of Economics and Finance*, 14(2), 105-114.

Khalifa, S., and E. Mengova (2010), "Offshoring and Wage Inequality in Developing Countries," *Journal of Economic Development*, 35(3), 1-42.

Koskela, E., and R. Stenbacka (2007), "Equilibrium Unemployment with Outsourcing and Wage Solidarity under Labour Market Imperfections," CESifo Working Paper, 1988.

Longhi, S., P. Nijkamp, and J. Poot (2006), "The Fallacy of 'Job Robbing': A Meta-Analysis of Estimates of the Effect of Immigration on Employment," Tinbergen Institute Discussion Papers, 06-050/3.

Maiti, D., and S. Marjit (2011), "Subcontracting, R&D and Labour Productivity: A Theoretical Explanation," Journal of Economic Development, 36(3), 1-24.

Murat, M., and S. Paba (2003), "International Migration, Outsourcing, and Italian

Industrial Districts," presented at the Conference on 'Clusters, Industrial Districts and Firms: The Challenge of Globalization,' September 12-13, Modena, Italy.

Navaretti, G.B., G. Bertola, and A. Sembenelli (2008), "Offshoring and Immigrant Employment: Firm-level Theory and Evidence," CEPR Discussion Paper, 6743 (www.cepr.org/pubs/dps/DP6743.asp).

Ramaswami, V.K. (1968), "International Factor Movement and National Advantage," *Econometrica*, 35(139), 309-310.

Robertson, P.E. (2008), "The Biggest Loser: Education and Skilled Immigration in Australia," *Agenda: A Journal of Policy Analysis and Reform*, 15(1), 85-95.

Sanyal, K.K. (1983), "Vertical Specialization in a Ricardian Model with a Continuum of Stages of Production," *Economica*, 50(19), 71-78.

Sanyal, K.K., and R.W. Jones (1982), "The Theory of Trade in Middle Products," *The American Economic Review*, 72(1), 16-31.

Swenson, L.D. (2005), "Overseas Assembly and Country Sourcing Choice," *Journal of International Economics*, 66(1), 107-130.

Tu, J. (2007), "The Impact of Immigration on the Labour Market Outcomes of Native-born Canadians," IZA Discussion Paper, 5129.

United Nations Statistics Division (2011), *National Accounts Main Aggregates Database* (http://unstats.un.org/unsd/snaama/dnllist.asp).

United States International Trade Commission (USITC), *Interactive Tariff and Trade Data Web,* Version 3.1.0 (http://www.usitc.gov/).

U.S. Department of States (2000-2011), *Report of the Visa Office* (http://travel.state.gov/visa/frvi/ statistics/statistics_1476.html).

Wadsworth, J., and A. De Coulon (2008), "On the Relative Gains to Immigration: A Comparison of the Labour Market Position of Indians in the USA, the UK and India," Centre for Economic Performance Discussion Papers, DP0851.

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