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International migration, income taxes, public input, remittances and the welfare state

By

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Στην οικογένειά μου



International migration, income taxes, public input, remittances and the welfare state

By Karaviti Panagioti

Abstract

This paper investigates the effect of international migration on wages and welfare in a source country. We construct a general equilibrium model of a labor – exporting (source) country, where we examine separately the case of a one class economy with identical consumers and the case of a two class economy which comprises of two groups of identical individuals, called capitalists and workers. It is assumed that migration is from the class of workers. Within this framework it is shown among other things, that international labour mobility has positive effect on the source country's provision of public input and it may have a positive effect on source country's welfare. The latter effect is contrary to main results of the international migration literature. The analysis provides the sufficient conditions under which these results are obtained.

Keywords: International migration; Taxes; Remittances; Public goods; Wages; Welfare



1. Introduction

The last decades we observed a rapid raise of the international trade in goods and services. According to the data of

Organization for Economic Co – operation and Development (OECD) and as the figure 1.1 presents, the global amount of exports as a fraction of GDP continuously increases. Especially, we can see that within almost two decades exports of OECD countries have been raised from 3,2 % to 7,7 % of GDP, confirming the above tendency.





The raise of international trade that occurred is based on two main reasons. First, technological improvements have led to an increased production and reduction in transportation costs. This unambiguously had a positive impact on international trade. Second, the last 40 years more and more governments comprehend the benefits of free trade and have moved towards adopting increasingly freer trade policies. Timothy J. Hatton (2007: 343) quotes that "…average tariffs in Europe and North America fell from more than 15% in 1950 to about 4 % in 2000…".

On the other hand international labor mobility still remains much more restricted than movement of goods or capital. Data from Eurostat indicate that the last 15 years net migration in EU – 27 as a fraction of the EU – 27 total population has

been risen from 0,139% at 1990 to 0,338% at 2005 (almost twenty times less than the relative percentage of exports over GDP), supporting the aforementioned view, that labour mobility in our era, seems to be more restricted than goods and services. According to the existing literature the theory of factor mobility has established



Source: Eurostat



that finite permanent migration is beneficial for the nationals in the host country but hurts those who left behind in the labor – exporting country, while marginal permanent migration has no welfare effects in either country. If we account for the above results, then source countries should be object to international migration. Nevertheless, it is also observed that host countries also seem to oppose (via their related legislation) the international labor mobility and this point has prompted a strong theoretical and empirical interest.

Rivera – Batiz (1982) has shown that in a source economy that produces traded and non – traded goods the welfare of the remaining residents falls or at best remains the same due to international labor migration. On the other hand, Djajic (1986) and Quibria (1996) extended the Rivera – Batiz model by allowing remittances to the source country. Thus, demonstrate that for a level of remittances greater than a certain critical value the non - emigrant residents' welfare may increase. Gatsios et al. (1999), demonstrate that in a one class economy that produces many traded goods and one non – traded pure public consumption good, financed through income taxes, temporary migration may lower source country's wages and social welfare. Michael and Hatzipanayotou (2001) take one pace further examining a two class model with consumption taxes, tariffs and transfers to demonstrate, among other things, that when the consumption tax revenue in source country is used to financed the provision of an imported but not locally produced (in the sense that domestic production factors are not used) public good, international migration is expected to decrease social welfare in the labor exporting country.

The present paper develops a general equilibrium model of a small labor exporting country producing many traded goods and one non traded public input. We let the economy comprise either identical consumers (one class economy) or two groups of identical workers and capitalists (two class economy). The private goods are freely traded in international markets. The government imposes income taxes in order to finance the production of the public input, and then provides it to the private producers free of charge. We assume that international labor mobility is imperfect, thus wages do not equalize between the source and the rest of the world 'host country'. Within this framework, we examine the effects of "temporary" and "permanent" international migration on government net income tax revenue, on the level of public input provision on wages and on social and groups' welfare. By temporary migration we will consider the case where (at least) part of emigrants' earnings remit to the source country and their utility is considered part of the source's country welfare. By permanent migration we will consider the case where emigrants remit nothing from their income and their utility is considered part of the host country's welfare. The paper shows among others that under reasonable assumptions and contrary to most results of the existing literature, social and groups' (in the case of a two class economy) welfare may be raised due to international labour migration for the non emigrant residents in the presence of a public input regardless of whether or not remittances exist.

2. The model

We consider a small open source economy, which produces (n) private internationally traded goods and one non traded public input (g). Capital (K), labor (L) and other factors are used in the production of all goods. It is assumed that the government provides the public input (g) to local producers at zero cost, for the production of the private traded goods. It is assumed that there is free trade in all private goods. Since commodity trade is free and the economy is a small open economy, the domestic commodity prices equal the world commodity prices.

Labor is imperfectly internationally mobile and the after taxes domestic rate of return to labor differs from the respective world net rate of return. Let w be the source country's rate of return to labour and w^* be the foreign (world) net rate of return. Labor is variable due to international migration. The domestic supply of labor is given by: $L = \overline{L} - L^f = L^P + L^g$, where \overline{L} is the initial fixed endowment of labor, L^f is the number of emigrant workers, L^P is the quantity of labor used in the production of the n private goods and L^g is the quantity of labor used in the production of the public intermediate good. We also assume full employment of all factors, as a result of which $dL = -dL^f$. Capital (K) and all others factors of production are internationally immobile and for the rest of this paper are jointly considered as capital. Thus, supply of capital equals its initial endowment: $K = \overline{K}^{-1}$.

¹ In case of international mobility of capital we have that $K = \overline{K} - K^f$, where K^f may be positive or negative depending on the country's status as a net capital importer or net capital exporter respectively. The existence of other factors allows us to consider cases where labour and capital are complements (i.e. $R_{KL} > 0$).

Technologies in the production of private goods and the public input follow the neoclassical paradigm. Thus, production functions are homogeneous of degree one² and concave to all factors that exhibit diminishing marginal product of all variable factors³. The private sector is assumed to behave competitively, while the public sector is assumed to minimize the production cost of the public input.

We proceed with the description of the one class economy with international migration and then we will describe the model of the two class economy.

In the one class economy R(p, L, g) denotes the maximum value of the private gross domestic product (GDP), where p is the vector of prices of freely traded goods, which is the same with the respective world vector of prices: $p = (1 p_2 p_3 ... p_n)$. Since goods' prices are fixed due to the assumption of a small open economy, they do not affect the analysis and thus are omitted for the rest of the analysis. So, the gross domestic product function is R(L, g). The term $L = \overline{L} - L^f$ is the domestic supply of labour and g is the quantity of public input. The GDP function is assumed to be strictly concave in L and concave in g (i.e. R_{LL} is negative while R_{gg} is not positive). Additionally its partial derivatives with respect to labor, L, and public input, g, (i.e. R_L > 0, R_g > 0) are the marginal revenue products of labor and public input are assumed to be complements in production, that is, an increase in the level of the public input g, leads to an increase in the marginal revenue product of labor (i.e. R_{Lg} > 0). All product and factor markets are competitive and in equilibrium the domestic wage, w, equals its marginal revenue product:

$$w = R_L(L,g) \tag{1}$$

The public sector (government) finances the production of the public input through income taxes on all factors. The government's balanced budget constraint (i.e. B = 0), requires that income tax revenue from the production of private and public goods equals the cost of the public input. Hence the government budget constraint is given by:

$$B = \tau \Big[R(L,g) + gC^{g}(w) \Big] - gC^{g}(w)$$
⁽²⁾

² This assumption means that we have constant returns to scale: f(tK,tL) = tf(K,L)

³ It is worth noting that the homogeneous of degree one functions are widely used in the production theory, Chiang A. (1984). If Q = f(K,L) a production function then the first partial derivatives with respect to each factor would be positive (e.g. $Q_K > 0$, $Q_L > 0$), while the second would be negative (e.g. $Q_{KK} < 0$, $Q_{LL} < 0$)

where τ (≥ 0) is the income tax rate and $C^{g}(w)$ is the unit cost function of the public input⁴. As previously noted, the public input is provided by the government at no cost to the private producers for the production of the traded goods⁵.

Turning to the demand side of the economy there is a representative household. The income – expenditure identity of the one class economy with identical consumers is given by:

$$E(u) = R(L,g) + T \tag{3}$$

where E is the consumers' minimum expenditure function and denotes the minimum expenditure required to achieve a level of utility u, at constant world prices p, while T denotes the emigrant remittances, in case migration is temporary. Following the existing literature (e.g. see Michael, Hatzipanayotou, 2001) we consider that adopting the case of permanent migration, means that emigrants remit nothing from their income and at thus their utility is part of the host country's welfare. On the other hand in case of temporary migration, (at least) part of emigrants' earnings remit to the source country and their utility is considered part of the source's country welfare. In this case and for the remainder of this paper we will regard that emigrants produce in the host country and spend at least a part of their earnings in the source country. Emigrants' remittances are given by:

$$T = aR_L^*(L^*)L^f \tag{4}$$

Asterisks denote the variables of the (rest of the world) host country. We assume that in equilibrium $w^* = R_L^*(L^*)$ is the host country's net wage, namely $w^* = R_L^*(L^*) = (1 - \tau^*)W^*$ and since we have assumed that home (foreign) country is labor exporting (importing) country, we let $(1 - \tau)w < w^*$. The parameter $a \in [0,1]$ denotes the fraction of emigrants' earnings repatriated into the source country⁶, and $L^* = \overline{L}^* + L^f$ is the labor supply in the labor – importing country.

⁵ For instance a possible form of the production function of the private (and traded) goods according to our assumption, could be : $Q(g, K, L) = A(g)K^aL^{1-a}$ (also see Abe,1990), where A(g) is the level of the public input while K^aL^{1-a} is the commonly used Cobb – Douglas production function

⁴ We include the production cost of the public input as a part of the total country's income because it is equal to the sum of the earnings of the factors which are used in public production

⁶ Following the existent literature: a = 0, means that we have permanent migration and thus remittances equal zero, a = 1, means that we have temporary migration where emigrants produce in the host country and spend all their earnings (consume) in the source country

To sum up, the one class model is described by the system of equations (1) - (3). Hence in the one class model we have three equations in three unknowns: the level of the utility (u), the provision of the public input (g) and the domestic wage (w). Within this context we examine the effect of a workers' outflow on social utility, on public input provision and on domestic wages rate.

In case of the two class economy we consider that the small open source country consists of two groups of identical individuals, capitalists, k, and workers, w. A representative capitalist possesses a unit of labour and other factors of production, while a representative worker possesses only a unit of labour. Additionally it is assumed that capitalists do no migrate. All other assumptions of the one class economy hold. Furthermore equation (1), (2) and (4) continue hold whereas the country's expenditure identity in a two – class economy, is given by⁷:

$$L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W}) = R(L,g) + T,$$
(5)

where L^i is the total number of individuals (i = k, w) in the ith group and $L = L^K + L^W$ is the total number of households in the economy. According to the right hand side of equation (5), social welfare in a two class economy depends on the GDP R(L,g), and on remittances, T. Finally in this two class economy, the income – expenditure identity of the class of workers is given by:

$$L^{W}E^{W}(u^{W}) = (1-\tau)L^{W}R_{L}(L,g) + T$$
(6)

Equation (6) denotes that workers' expenditure function depends on the total net wages $(1-\tau)L^{W}R_{I}(L,g)$ and on remittances, T.

To sum up, the two class model can be described by the system of equations (1), (2), (5) and (6). Hence in the two class model we have four equations in four unknowns: the domestic wage (w), the provision of the public input (g), the level of the social utility (W) and the level of the workers utility (u^w) . Within this context we examine the effect of a workers' outflow on domestic wages rate, on public input provision, and on social and classes' utility.

⁷ Equation (5) relatively to the country's expenditure identity in a two – class economy emerges from equation : $L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W}) = (1-\tau)[R(L,g) + gC^{g}(w)] + T$, considering that B = 0 and using equation (2) (see analytically the appendix A)

International migration in a one class economy 3.

The analysis to follow examines the effects of international migration on the provision of the public input, the labor exporting country's wages and the social welfare in a one class economy under temporary and permanent migration. Totally differentiating equations (1) - (3) we obtain⁸:

$$dw = R_{LL}dL + R_{Lg}dg \tag{1'}$$

$$dg = \left[-\frac{\tau R_L - (1 - \tau)gC_w^g W_L}{\tau R_g - (1 - \tau)C^g} \right] dL$$
(2')

$$du = \left[w - \alpha w^* (1 + \mu \eta^*)\right] dL - R_g dg \tag{3'}$$

3.1. Temporary Migration

Differentiating equations (1') - (3') with respect to labour, L, assuming that $dL = -dL^{f}$ and $E_{u} = dE / du = 1$, and after some manipulations⁹ we finally obtain that:

$$\left(dg / dL\right) = -\frac{\tau R_L - (1 - \tau) g C_w^g w_L}{\tau R_g - (1 - \tau) C^g}$$

$$\tag{7}$$

$$\left(dw / dL\right) = w_L = R_{LL} + R_{Lg} \left(dg / dL\right)$$
(8)

$$(du / dL) = w - \alpha w^* (1 + \mu \eta^*) + R_g (dg / dL)$$
(9)

a) The effect of temporary migration on the provision of the public input and on the labor – exporting country's wages

Using equation (7) and considering that B = 0, we obtain the effect of international migration on the provision of the public input in the source country:

$$\frac{dg}{dL} = -\frac{\tau R_L - (1 - \tau)gC_w^g W_L}{\tau R_g - (1 - \tau)C^g} = -[\tau R_L - (1 - \tau)gC_w^g W_L]D^{-1}$$
(7)

The right – hand side of equation (7) is interpreted as the effect that international migration (dL < 0) has on the tax revenues and consequently on the provision of the public input. Where $D = (dB/dg) = \tau R_g - (1-\tau)C^g < 0^{10}$, since all

⁸ For more details see appendix B ⁹ For more details see appendix B

¹⁰ For more details see appendix B

other things being equal, the increase of the level of the public input entails a reduction in government tax revenue, B. Solving equations (7) and (8) simultaneously we obtain the effect of international migration on the public input provision, g, and on domestic wages rate, w. More specifically, solving for (dg / dL) and alternatively for (dw / dL) and after some manipulations¹¹ we finally get that:

$$(dg/dL) = \frac{-\left[\tau R_L - (1-\tau)gC_w^g R_{LL}\right]}{\tau gC_w^g R_{Lg}} < 0$$

$$\tag{10}$$

And finally given that (dg / dL) < 0, we also obtain that (dw / dL) < 0. Relatively to equation (10), the term $-\tau R_L < 0$ is the direct change in the income tax revenue due to international labor migration. It indicates that the reduction of the domestic labor supply in the labor – exporting country leads to a raise in tax revenue, $-\tau R_L dL > 0$ and thus it has positive impact on the provision of the public input. The term $(1-\tau)gC_w^g R_{LL}dL > 0$ is the indirect revenue effect due to emigration induced changes in the unit cost production of the public input and has positive sign. On the other hand $\tau g C_w^g R_{Lg} > 0$ and consequently (dg / dL) is unambiguously negative. Interpreting equation (10) we can say that international labour migration raises the provision of the public input in the source country.

Equation (8) indicates that in the presence of a public input the reduction of the domestic labor supply in the labor – exporting country due to the labor migration, affects directly its wage rate through changes in the marginal revenue product of labor i.e. R_{LL} , and indirectly through the provision of the public input i.e. $R_{Lg}(dg/dL)$. Since $R_{LL} < 0$, the direct effect indicates that a reduction of the domestic labor supply causes a rise in the marginal revenue product of labor and consequently entails a positive effect on the labor - exporting country's wage rate. On the other hand given that R_{Lg} is positive and (dg / dL) < 0 the indirect effect $R_{Lg}(dg / dL) < 0$. So $w_L < 0$ and as a result international migration unambiguously raises the source country's nominal and real¹² wages.

This means that in the presence of a public input, the domestic wage rate of the source country will increase. This result is not in contrast to the standard result of



¹¹ For more details see appendix C ¹² Since we have assumed fixed price level

the neoclassical framework research (see for instance Quibria, 1993), which in a two – good (one traded and one non – traded), two – factors model, requires pure international migration to increase both the nominal and real wages in the source country. Nevertheless, in the presence of the public input ($R_{Lg}dg > 0$) the wage raise is unambiguously greater than that without it.

b) The effect of temporary migration on the labor - exporting country's welfare

Now we examine equation (9) relatively to the source country's welfare:

$$(du / dL) = R_L - \alpha R_L^* (1 + \mu \eta^*) - R_g \frac{\tau R_L - (1 - \tau) g C_w^g w_L}{\tau R_g - (1 - \tau) C^g} \Leftrightarrow (du / dL) = w - \alpha w^* (1 + \mu \eta^*) + R_g (dg / dL)$$
(9)

Where $\eta^* = \frac{dR_L^*}{dL} \frac{L^*}{R_L^*} < 0$, is the elasticity of host country's marginal revenue product and $\mu (= L^f / L^*)$ is the fraction of immigrant workers to total labor supply in the host country.

The right – hand side of equation (9) indicates that international migration affects the labor – exporting country's welfare through an effect on the domestic wages i.e. wdL, an effect on emigrants' remittances i.e. $\alpha w^* (1 + \mu \eta^*) dL$ and an effect on the provision of public input i.e. $R_g dg$.

For a given level of public input provision, the term wdL < 0, since dL < 0, denotes a direct negative effect on welfare due to foregone domestic labour income. The term $-\alpha w^* (1 + \mu \eta^*) dL$ denotes the welfare effects of the change in income earned by emigrants in the host country due to additional migration. This latter term has an ambiguous impact on the source labor – exporting country's welfare. We can see that given w^* , further emigration raises the repatriated wage incomes, i.e. $-\alpha w^* dL > 0$ and consequently affects positively the labor exporting economy's welfare. On the other hand the influx of additional immigrants (workers) in the host country, reduces local wages, i.e. $-\alpha R_{LL}^* L^f dL < 0$ since $R_{LL}^* < 0$, having a negative impact on both repatriated wage incomes and welfare.



To highlight this result we distinguish two cases. First, we assume that the absolute value of the elasticity of the foreign marginal revenue product with respect to labour η^* multiplied by the fraction μ is more than one and consequently $-\alpha w^* (1 + \mu \eta^*) dL < 0$. Then given the necessary condition (dg / dL) < 0, the sufficient condition for emigration to raise the non emigrants' welfare is that

$$w - \alpha w^* (1 + \mu \eta^*) < \left| R_g \left(dg / dL \right) \right| \tag{9a}$$

According to the above expression there is a welfare improvement for the non emigrant residents since the gains from the increasing public input due to labour mobility (dL < 0) compensates the losses from lower wages and remittances $([w-\alpha w^*(1+\mu\eta^*)]dL < 0).$

Second, and contrary to the previous case we assume that the absolute value of the elasticity of the foreign marginal revenue product with respect to labour η^* multiplied by the fraction μ is less than one and consequently $-\alpha w^* (1 + \mu \eta^*) dL > 0$. This practically means that host country's wages, w^* , are not decreased too much due to immigrants' influx. As a result, host country's wages remain high and the emigrants' remittances multiplied with the number of emigrants, L^f , are more than previously, having in this way a positive impact on source country's welfare. We conclude that given the necessary condition (dg / dL) < 0, the sufficient condition for emigration to raise the non emigrants' welfare is that

$$w < \left|-\alpha w^*(1+\mu\eta^*) + R_g\left(dg / dL\right)\right| \tag{9b}$$

According to the above expression there is a welfare improvement for the non emigrant residents since the losses from lower wages (wdL < 0) are smaller than the gains from the positive impact of the remittances plus the raise of the public input provision due to labour mobility (dL < 0).

We could additionally take into consideration the special case where $|\eta^*| = 0$. This means that international migration do not affect at all, host country's wages. In this extreme case and given that (dg / dL) < 0, the sufficient condition for emigration to raise the non emigrants' welfare is that $w < |-\alpha w^* + R_g (dg / dL)|$.



Proposition 1. Consider a small labor – exporting country where there are income remittances and where income taxes finance the provision of a public input. Then temporary migration unambiguously increases the provision of the public input, while country's nominal wage not only increases but it also emerges that this rise in the presence of the public input is greater than that without it. Finally social welfare increases if the absolute value of the elasticity of the foreign marginal revenue product with respect to labour η^* multiplied by the fraction μ is more than one and the total losses from lower wages and remittances are smaller than the gains from the public input provision, or if the absolute value of the elasticity of the foreign marginal revenue product with respect to labour η^* multiplied by the fraction μ is less than one and the total losses from lower wages are smaller than the gains from the public input provision and remittances.

We are now able to compare our previously obtained results $(du/dL) = w - \alpha w^* (1 + \mu \eta^*) + R_g (dg/dL)$, initially with those of the literature on migration with the provision of a public consumption good and second on migration without the provision of public good (or input in our case) at all.

Comparing the provision of a public input to the case of the provision of a public consumption good (see for instance Gatsios et al, 1999) it emerges that the effect of international migration on the welfare in a one class static model is more straightforward. Specifically, in the case of a public input, one additional unit of public input leads to a rise the country's value of privately produced goods by the increment of the marginal product of g, i.e. $R_g > 0$. On the other hand, in case of a public good, the production of an additional unit of public good leads to a fall the country's value of privately produced goods by the reduction of the marginal product of g, i.e. $R_{o} < 0$. The reason that in case of a public input we end up with clearer results is that contrary to the case of public consumption good, in case of public input, international migration unambiguously increases both public input provision and the domestic wage rates allowing the welfare to depend only on the elasticity of host country's marginal revenue product $(\eta^*)^{13}$.

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¹³ Gatsios et al (1999) using a similar analysis with a public consumption good, they let the welfare effect of international migration besides η^* to depends also on other factors like whether the public good is over or undersupplied and on the induced changes in its unit cost of production. MIKO

Lastly, comparing our results with those of the literature without the provision of public good or public input, we conclude the following. We initially can easily denote that equation (9) is consistent with pure neoclassical theory. For this reason we assume that taxes (both domestic and foreign) are zero, there is not provision of public good (i.e. $\tau = \tau^* = g = dg = 0$), α equals to one¹⁴ and that L^f is initially zero. Then equation (9) becomes: $(du / dL) = w - w^* < 0$. The later equation is consistent with pure neoclassical theory. For this reason we assume that equation (9) becomes: $(du / dL) = w - w^* < 0$. The later equation is consistent with pure neoclassical theory. This welfare reduction equals to the host country's wage, w^* , that emigrants earn in the host country. Second, the contribution of this paper is the welfare effect of the public input in the presence of international migration as it is denoted in the 3rd R.H.S. term of equation (9), i.e. $R_g(dg / dL)$. This latter term has an unambiguously positive effect on social welfare of the source country.

3.2 Permanent international migration

In case of permanent migration emigrants do not have any incentive to remit any of their earnings back to the source country, while their utility is considered part of the social welfare of the host country. Equations (8) and (10) again capture respectively the level of the source country's wage and the effect of the provision of the public input, under permanent migration in a one class economy. Using equation (9) and since $\alpha = 0$ we obtain that:

$$(du / dL) = w + R_{\sigma} (dg / dL), \tag{10}$$

instead of equation (9) in case of temporary migration. These two equations (i.e. eq. (9) and eq. (10)) differ only by the term of remittances. This means that possible changes in w^* due to L^* do no affect the source country's welfare in the case of permanent migration. As a result the effect of labour migration on the foreign wages, w^* is indifferent from the source country's perspective.

The right hand side of equation (10) denotes that despite the absence of emigrants' remittances the social welfare of the labor – exporting country remains ambiguous, since wdL < 0 due to labor migration and $R_{e}(dg/dL)dL > 0$.

¹⁴ Under this assumption and following the existing literature we mean that we have temporary migration where emigrants produce in the host country and consume in the source country

Nevertheless given that (dg / dL) is negative, then a necessary and sufficient condition for emigration to raise social welfare in a one class economy is that

$$w < \left| R_g \left(dg \,/\, dL \right) \right| \tag{10a}$$

If the above expression holds, we obtain that (du / dL) is negative, and consequently that labor migration is beneficial for the non emigrant residents of the labor – exporting country under the existence of the public input.

Proposition 2. In the presence of income taxes and public production of an intermediate input in a one – class economy and without emigrants' remittances, permanent labor migration increases social welfare if the losses from the lower wages are fewer than the gains from the public intermediate good provision.

Comparing now equation (9) from temporary migration to equation (10) from permanent migration, via inequations (9a), (9b) and (10a), we can conclude that if, in case of temporary migration, the absolute value of the elasticity of the foreign marginal revenue product with respect to labour, η^* , multiplied by the fraction μ is more than one (i.e. $|\mu\eta^*| > 1$) and consequently social welfare is improved if $w - \alpha w^* (1 + \mu \eta^*) < |R_g (dg / dL)|$, then ceteris paribus temporary migration is more possible to worsen social welfare rather than permanent migration, since this welfare improvement is succeeded if the expression $w < |R_{g}(dg/dL)|$, holds. If on the other hand the absolute value of the elasticity of the foreign marginal revenue product with respect to labour, η^* , multiplied by the fraction μ is less than one (i.e. $|\mu\eta^*| < 1$) and if consequently welfare is improved the social expression $w < |-\alpha w^*(1 + \mu \eta^*) + R_g(dg/dL)|$ holds, then ceteris paribus, temporary labour migration is more possible to improve social welfare rather than permanent migration, since it is required as previously stated, $w < |R_g(dg / dL)|$.

Here among others and contrary to the existing literature¹⁵, we observe that even without emigrants' remittances, i.e. $\alpha = 0$, the existence of the production of the public input may leads to a social and classes' welfare improvement.

¹⁵ Djajic (1986) and Quibria (1996) extended the Rivera – Batiz model by allowing remittances to the source country and denote that in the presence of emigrants' remittances, international migration may lead in a welfare improvement, those who left behind

Lemma 1. It emerges that if the absolute value of the elasticity of the foreign marginal revenue product with respect to labour, η^* , multiplied by the fraction μ is less than one, then temporary migration is preferable than permanent migration and inversely.

4. International migration in a two – class model

Equations (8) and (10) again capture respectively the effect of the source country's wage and the public input provision level in a two class economy. As a result the analysis to follow examines the effects of international migration on the social and groups' welfare in a two class economy under temporary and permanent migration. The two class model is described by equations (1), (2), (5) and (6) as previously stated and here repeated for analytical convenience. Namely:

$$w = R_L(L,g) \tag{1}$$

$$B = \tau \Big[R(L,g) + gC^{g}(w) \Big] - gC^{g}(w)$$
⁽²⁾

$$L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W}) = R(L,g) + T$$
(5)

$$L^{W}E^{W}(u^{W}) = (1-\tau)L^{W}R_{L}(L,g) + T$$
(6)

4.1. Temporary Migration

In what follows we investigate how temporary migration affects on both social and classes' welfare in a two class economy.

The effect of temporary migration on groups' and social welfare

Totally differentiating equation (5), equation (6) and by considering that $dL = -dL^{f}$ and after some manipulations, we obtain the following results:

$$(dW / dL) = \tau w - (T / L^{w}) + R_{g} (dg / dL) - \alpha w^{*} (1 + \mu \eta^{*})$$
(13)

$$L^{w}(du^{w}/dL) = -(T/L^{w}) + (1-\tau)L^{w}(dw/dL) - \alpha w^{*}(1+\mu\eta^{*})$$
(14)

$$L^{k}(du^{k} / dL) = \tau w + R_{g}(dg / dL) - (1 - \tau)L^{w}(dw / dL),$$
(15)

where $dW = L^k E_u^k du^k + L^w E_u^w du^w$ and it is the weighted sum of changes in the utility of all the residents in the source country. Thus, we call dW the change in social welfare. Here we also assume that the marginal utility of income for all households equals to one, i.e. $E_u^k = E_u^w = 1$.

Equation (13) indicates the effect of international migration on the social welfare of a labour exporting economy, where due to emigration, dL < 0. The first term, i.e. $\tau w dL < 0$, denotes the negative impact that international migration has on the tax revenue from labour income due to the reduction of labour force in the source country. The second term i.e. $-(T/L^w)dL > 0$ indicates that for a given level of remittances¹⁶ per worker, emigration affects positively the labor exporting economy's welfare. The third term i.e. $R_{g}dg > 0$ is the effect of international migration on the provision of public input. Finally, the forth term, i.e. $-\alpha w^*(1+\mu\eta^*)dL$, indicates the effect that the change of the host country's wages w^{*}, due to labor migration, has on the source country's welfare through remittances. This third term of equation (13) may either be positive or negative depending on the elasticity of host country's marginal revenue product (η^*) multiplied by the fraction μ . Here, following the same to the third chapter procedure, we distinguish two cases. First, if the absolute value of the elasticity of the foreign marginal revenue product with respect to labour, η^* , multiplied by the fraction μ is less than one, then $-\alpha w^*(1+\mu\eta^*)dL > 0$, namely remittances have a positive impact on source country's welfare. In this case a necessary and sufficient condition for emigration to improve source country's welfare is that

$$\tau w < \left| \left(T / L^{w} \right) + R_{g} \left(dg / dL \right) - \alpha w^{*} \left(1 + \mu \eta^{*} \right) \right|$$
(13a)

Second, if the absolute value of the elasticity of the foreign marginal revenue product with respect to labour, η^* , multiplied by the fraction μ is more than one, then $-\alpha w^* (1 + \mu \eta^*) dL < 0$, namely remittances have a negative impact on source country's welfare due to labor migration. In this case a necessary and sufficient condition for emigration to improve source country's welfare is that

$$\tau w - \alpha w^* (1 + \mu \eta^*) < \left| (T / L^w) + R_g \left(dg / dL \right) \right|$$
(13b)

¹⁶ This means that ceteris paribus and for a given w^{*}, remittances have a positive impact on the labor exporting country's welfare.

Equation (14) indicates the effect of international migration on the welfare of non – emigrants workers in the labour exporting economy, where due to emigration dL < 0. In this case the final result would also be ambiguous since $-(T/L^w)dL > 0$ and $(1-\tau)L^ww_L dL > 0$, denoting the positive impact that labour migration has on the non emigrants workers' welfare through the change of the total net income, while $-\alpha w^*(1+\mu\eta^*)$ may be positive or negative. More specifically, this latter term i.e. $-\alpha w^*(1+\mu\eta^*)dL$, is positive if, as and previously stated, $|\mu\eta^*| < 1$ and negative if $|\mu\eta^*| > 1$. In case that $|\mu\eta^*| < 1$, then equation (14) is unambiguously negative, that means labor migration improves the non emigrant workers' welfare. If on the other hand $|\mu\eta^*| > 1$, then a necessary and sufficient condition for labor migration to improve the non emigrant workers' welfare is that

$$-\alpha w^{*}(1+\mu\eta^{*}) < \left| -(T/L^{w}) + (1-\tau)L^{w}w_{L} \right|$$
(14a)

Equation (15) indicates the effect of international migration on the welfare of capitalists in the labour exporting economy, where due to emigration dL < 0. Equation (15) emerges deducting non emigrants' welfare from social welfare. According to it, capitalists' welfare is ambiguous. The existence of the public input improves capitalists' welfare since $R_g dg > 0$. On the other hand the lower tax revenue from labour income due to the reduction of labour force in the source country $\tau w dL < 0$, that finances the public input provision, has a negative impact on capitalists welfare. The raise of the workers' wages has also the same negative impact on capitalists welfare, $-(1-\tau)L^w w_L dL < 0$. Consequently, a necessary and sufficient condition for labour migration to improve the capitalists' welfare is that

$$\tau w - (1 - \tau) L^{w} w_{L} < \left| R_{g} \left(dg / dL \right) \right|$$
(15a)

Proposition 3. Consider a two – class small labor exporting country where there are income remittances and where income taxes finance the provision of a public input. If $|\mu\eta^*| > 1$ and $\tau w - \alpha w^*(1 + \mu\eta^*) < |(T/L^w) + R_g(dg/dL)|$, or if $|\mu\eta^*| < 1$ and $\tau w < |(T/L^w) + R_g(dg/dL) - \alpha w^*(1 + \mu\eta^*)|$, then temporary migration increases social welfare. On the other hand when $|\mu\eta^*| < 1$, or when $|\mu\eta^*| > 1$ and

 $-\alpha w^*(1+\mu\eta^*) < \left| -(T/L^w) + (1-\tau)L^w w_L \right|, \text{ then non emigrants workers improve their welfare. Finally, capitalists improve their welfare if the expression <math display="block">\tau w - (1-\tau)L^w w_L < \left| R_g \left(dg/dL \right) \right|, \text{ holds.}$

Comparing the results from the one and two class model, we initially observe that in both models international migration may lead to an improvement of social welfare and this is achieved under certain conditions. Furthermore, comparing the conditions (9a) and (9b) under which we achieve social welfare improvement from the one class model to the respective conditions (13a) and (13b) from the two class model, it emerges that is easier the "adverse" to the existing literature results to be denoted in the two class model. More specifically, since $w > \tau w$ and $(T/L^w) > 0$, it emerges that irrelatively to the absolute value of the elasticity of host country's marginal revenue product (η^*) multiplied by the fraction μ , the improvement of the social welfare is easier to be achieved in the two rather than the one class model.

4.2. Permanent Migration

 $\tau w < |R_g(dg/dL)|$

In case of permanent migration we assume that emigrants do not have any incentive to remit any of their earnings back to the source country, while their utility is considered part of the social welfare of the host country. In this case equations (13), (14) and (15) that denote the source country's social, workers' and capitalists' welfare respectively, since $\alpha = 0$ become:

$$(dW / dL) = \tau w + R_g \left(dg / dL \right) \tag{16}$$

$$L^{w}(du^{w} / dL) = (1 - \tau)L^{w}(dw / dL)$$
(17)

$$L^{k}\left(du^{k} / dL\right) = \tau w + R_{g}\left(dg / dL\right) - (1 - \tau)L^{w}\left(dw / dL\right)$$
(18)

Equation (16) denotes the effect of international labor migration on social welfare in case of permanent migration. Since $\tau w > 0$ and $R_g (dg/dL) < 0$, emerges that international labor migration has an ambiguous effect on source country's welfare. In this case a necessary and sufficient condition for emigration to improve source country's welfare is that



Equation (17) indicates the effect of international labor migration on workers' welfare in case of permanent migration. According to it, the change in the workers' welfare depends on the net total change of the wages in the source economy that is positive since $w_L dL > 0$. As a result $(du^w / dL) < 0$. So, non emigrant workers' welfare is unambiguously improved due to international labor migration.

Equation (18) indicates the effect of international labor migration on capitalists' welfare in case of permanent migration. According to it, labour migration has an also ambiguous effect on capitalists' welfare. In a similar to the temporary migration analysis way, the provision of the public input has a positive impact on capitalists' welfare, since $R_g dg > 0$. On the other hand the lower tax revenue from labour income due to the reduction of labour force in the source country $\tau w dL < 0$, that finances the public input provision and the raise of workers' wages $-(1-\tau)L^w w_L dL < 0$ have a negative impact on capitalists welfare. Consequently, a necessary and sufficient condition for labor migration to improve the capitalists' welfare is that

$$\tau w - (1 - \tau) L^w w_L < \left| R_g \left(dg / dL \right) \right| \tag{18a}$$

Proposition 4. In the presence of income taxes, public production of an intermediate input in a two – class economy and under the condition of permanent migration, the effect of labor migration on the workers' welfare is positive, while on the capitalists' and the social welfare is ambiguous.

Comparing now the results that we have obtained from the case of temporary and permanent migration in a two class model, it emerges similarly to the case of the one class model, that if $|\mu\eta^*| < 1$, then temporary migration is unambiguously more preferable rather than permanent migration and inversely.

As in case of the permanent migration in a one class model, and here as well among others and contrary to the existing literature (see Djajic,1986 and Quibria, 1996), we observe that even without emigrants' remittances, i.e. $\alpha = 0$, the existence of the production of the public input may leads to a social and classes' welfare improvement.



5. The welfare effects of international migration in a Heckscher – Ohlin model

The existence of this chapter serves our target to obtain clearer results relatively to the public input provision, and the effects of international migration on group and social welfare incorporating our model, which entails income taxes, remittances and public input provision, in the Heckscher – Ohlin model.

In a framework like this¹⁷, factors' rewards are independent of their endowments and are affected only by the commodities' prices. But since the source country in our model is a small open economy, commodities prices are considered as fixed (exogenously determined) from its perspective. Consequently we will reexamine our previously obtained results under the condition that: $R_{LL} = R_{gg} = R_{Lg} = R_{LK} = R_{KK} = R_{Kg} = 0$.

5.1. Temporary Migration

a) Public input

Using equation (8) and taking in account that $w_L = 0$, we obtain that:

$$(dg/dL) = -(\tau w/D), \tag{19}$$

In this case (dg/dL) is unambiguously positive since $-\tau w < 0$ and also $D = (dB/dg) = \tau R_g - (1-\tau)C^g < 0$. Equation (19) denotes that within a Heckscher – Ohlin framework the reduction of the labor force of the source country unambiguously leads us to a lower level of public input provision.

b) Welfare

Using equation (13) and taking into consideration that in this case $R_{LL}^* = w_L = 0$, we obtain that:

$$(dW/dL) = \tau w - (T/L^{w}) + R_g (dg/dL) - \alpha w^{*}$$
⁽²⁰⁾

¹⁷ We talk about a two intersectorally mobile factors Labor and Capital that are used in the production of the two commodities. Also is assumed that labor is imperfectly international mobile while capital is internationally immobile.

Equation (20) denotes the effect of the international labour migration on the social welfare. Examining the right hand side of equation (20) term by term in case of temporary migration and taking into account that dL < 0 due to labor migration we can see that: $\tau w > 0$, $-(T/L^w) < 0$, $R_g (dg/dL) > 0$ and $-\alpha w^* < 0$. Consequently in this case, international labour migration will have a positive impact on source country's welfare only if the next expression holds

$$\tau w + R_g \left(dg / dL \right) < \left| \left(T / L^w \right) - \alpha w^* \right|$$
(20a)

Using equation (14) and taking into consideration that in this case $R_{LL}^* = w_L = 0$, we obtain that:

$$L^{w}(du^{w} / dL) = -(T / L^{w}) - \alpha w^{*}$$
(21)

Equation (21) indicates the effect of international migration on the non emigrant workers' welfare. Since both terms of the right hand side of equation (21) are negative, it emerges that international migration has an unambiguously positive impact on the non emigrant workers' welfare.

Finally, using equation (15) and taking into consideration that in this case $R_{LL}^* = w_L = 0$, we obtain that:

$$L^{k}(du^{k} / dL) = \tau w + R_{o}(dg / dL)$$
⁽²²⁾

Equation (22) denotes the effect of international migration on the capitalists' welfare. Since both terms of the right hand side of equation (22) are negative, it emerges that international migration has an unambiguously negative impact on the capitalists' welfare.

5.2. Permanent Migration

Nevertheless in case of permanent migration, where $\alpha = 0$, and taking into account that from the source country's perspective dL < 0 due to labor migration, equations (13) – (15) become respectively:

$$(dW / dL) = \tau w + R_{\rho} (dg / dL)$$
⁽²³⁾

$$L^{w}(du^{w}/dL) = 0 \tag{24}$$

$$L^{k}(du^{k} / dL) = \tau w + R_{g}(dg / dL)$$

Equation (23) informs us that in case of permanent migration and since $\tau w > 0$, $R_g (dg / dL) > 0$, social welfare falls due to international migration. This welfare reduction is equal to the one which the capitalists are being burdened and is indicated by equation (25). Consequently, non emigrant workers' welfare remain unchanged as equation (24) denotes.

Proposition 5. In a Heckscher – Ohlin small open source economy and in the presence of public intermediate good that is financed through income taxes, the effect of labor migration on the provision of public input would be unambiguously negative. Social welfare may be improved in case of temporary migration but unambiguously falls in case of permanent migration due to international migration. Workers' welfare is improved in case of temporary migration while does not change in case of permanent migration. Finally, capitalists' welfare reduces either in case of temporary or permanent migration.

Concluding remarks

The present study investigates the effects of international labor migration from the source country's perspective. For this reason we construct a general equilibrium model of a small open economy that produces i) many private and traded goods using public intermediate good, g, labor, L, capital, K, and other factors and ii) one public intermediate (and non traded) good, g, using labor, L, capital, K, and other factors of production. We examine two different main cases. First, a one class economy of identical consumers and second, a two class economy comprises two groups of identical workers, w, and capitalists, k. Labor is imperfectly international mobile while capital is internationally immobile. Migrants are from the class of workers. In our analysis and according to the type of migration, we furthermore distinguish each of the two above cases into two sub cases: i) temporary migration, in the sense that immigrants produce in the host country and remit part of their net earnings in the source country and ii) permanent migration, in the sense that emigrants do not remit any of their net income in the host country to the source country. In each case the source country's government imposes income taxes, which spends in the production of the public input.

Within this framework we wind up to some contrary to the existing literature results. These major results of this paper are summarized in its propositions. More

specifically, in a one class model, where income taxes finances the provision of public input and under the presence of emigrants' remittances stems that international migration has an unambiguously positive impact on public input provision and on labour exporting country's wages. Furthermore and relatively to the source country's wages, it emerges that in the presence of the public input ($R_{Lg} dg > 0$) the wages' raise is unambiguously greater than that without it. Now about the welfare state, it emerges that international migration in the existence of a public input provision may lead to an improvement of the social welfare in case of temporary or even permanent migration. In each case the necessary and sufficient conditions, in order to obtain a welfare improvement, are given. Finally, comparing temporary Vs permanent migration it also stems when under certain conditions the one or the other form of labor mobility is preferable for the economy.

In a two class model and under the same to the one class model assumptions, emerges that international migration may lead to an improvement of social, non emigrant workers and capitalists welfare either in case of temporary or permanent migration. And here also stems that under certain conditions, temporary migration is preferable from labour exporting country's perspective and inversely. The analysis also uses the Heckscher – Ohlin model as a special case in order to examine the effect of international migration on public input provision, and on group and social welfare in the labour exporting country.

The under consideration model is absolutely possible to be used as a base for future extensions. First, in this model we assume a homogeneous capital. It would be interesting to examine the effects of international migration in a model like the one of this paper under the assumption of capital heterogeneity. In this case we would have the chance to work in a specific factors' model. Second, we can assume that the same production process gives as two and not one output. For instance, the public production gives as the public input which has a positive impact in private production and consequently in social welfare but simultaneously gives and one product that is considered as a bad (and not as a good), like the pollution, which has a negative impact in social welfare. Third, in this paper is assumed that capital is internationally immobile. It would be also interesting to examine the present model and compare the obtained results from a one and a two class model in the existence of public input provision and capital mobility.

Appendix A. Country's income expenditure function

Using equation (2): $B = \tau [R(L, g) + gC^{g}(w)] - gC^{g}(w)$ under the assumption that B = 0, equation (5) is becoming:

$$L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W}) = (1-\tau)[R(L,g) + gC^{g}(w)] + T =$$

= $(1-\tau)[R(L,g) + \frac{\tau}{(1-\tau)}R(L,g)] + T =$
= $(1-\tau)R(L,g) + \frac{(1-\tau)\tau}{(1-\tau)}R(L,g) + T =$
= $(1-\tau)R(L,g) + \tau R(L,g) + T =$
= $R(L,g) + T$ (A.1)

Appendix B. One – class model's set up

In this case our model can be described by the below three basic types:

$$w = R_L(L,g) \tag{1}$$

$$B = \tau \Big[R(L,g) + gC^{g}(w) \Big] - gC^{g}(w)$$
⁽²⁾

$$E(u) = R(L,g) + T \tag{3}$$

Where $T = aR_L^*(L^*)L^f$

Totally differentiating equation (3) and taking into account that $E_u = dE / du = 1$, $dL = -dL^f$, we take that:

$$E_{u}du = R_{L}dL + R_{g}dg - \alpha R_{L}^{*}dL - \alpha R_{LL}^{*}L^{f}dL \Leftrightarrow$$

$$\Leftrightarrow du = R_{L}dL + R_{g}dg - \alpha R_{L}^{*}dL - \alpha R_{LL}^{*}L^{f}dL \Leftrightarrow$$

$$\Leftrightarrow du = R_{L}dL - \alpha (R_{L}^{*} + R_{LL}^{*}L^{f})dL + R_{g}dg \Leftrightarrow$$

$$\Leftrightarrow du - R_{g}dg = \left[R_{L} - \alpha R_{L}^{*} (1 + \mu \eta^{*}) \right] dL$$
(B.1)

Where $\eta^* = \frac{dR_L^*}{dL} \frac{L^*}{R_L^*} < 0$, is the host country's marginal revenue product and $\mu(= L^f / L^*)$ is the fraction of immigrant workers to total labor supply in the host country.

Totally differentiating equation (2) and taking into account that $B = 0 \Leftrightarrow dB = 0$ we obtain that:

$$dB = (R + gC^{g})d\tau + \tau R_{L}dL + \tau R_{g}dg + \tau C^{g}dg + \tau gC_{w}^{g}\frac{dw}{dL}dL - C^{g}dg - gC_{w}^{g}\frac{dw}{dL}dL \Leftrightarrow$$

$$dB = (R + gC^{g})d\tau + \tau R_{L}dL - (1 - \tau)gC_{w}^{g}w_{L}dL + \tau R_{g}dg - (1 - \tau)C^{g}dg \Leftrightarrow$$

$$[\tau R_{g} - (1 - \tau)C^{g}]dg = -[\tau R_{L} - (1 - \tau)gC_{w}^{g}w_{L}]dL - (R + gC^{g})d\tau$$
(B.2)

Using (B.1) - (B.2) we are able to construct the below linear equation system that will give as the results that are required in order to see the economic consequences of the international labor migration in our model:

$$\begin{bmatrix} 1 & -R_g \\ 0 & \tau R_g - (1-\tau)C^g \end{bmatrix} \begin{bmatrix} du \\ dg \end{bmatrix} = \begin{bmatrix} R_L - \alpha R_L^*(1+\eta) \\ -\tau R_L + (1-\tau)gC_w^g W_L \end{bmatrix} dL + \begin{bmatrix} 0 \\ -R - gC^g \end{bmatrix} d\tau$$
(B.3)

Now let $\Theta = \begin{bmatrix} 1 & -R_g \\ 0 & \tau R_g - (1 - \tau)C^g \end{bmatrix}$. We need to calculate its inverse (Θ^{-1}) , if

of course this exists, in order to continue our analysis. We observe from Θ that:

✓ Θ is a 2X2 matrix (necessary but not efficient condition)

$$\checkmark |D| = \begin{vmatrix} 1 & -R_g \\ 0 & \tau R_g - (1-\tau)C^g \end{vmatrix} \Leftrightarrow |D| = \tau R_g - (1-\tau)C^g, \text{ that we assume is not zero}$$

 $(|D| \neq 0 \Leftrightarrow \tau R_g \neq (1-\tau)C^g)$, in order to exist the inverse matrix. We also have to note that differentiating equation (2) with respect to the level of public input, g, we take that:

$$\frac{dB}{dg} = \tau R_g + \tau C^g - C^g = \tau R_g - (1 - \tau)C^g = \left|D\right|$$

And since all others equal $\frac{dB}{dg} < 0 \Leftrightarrow |D| < 0$.

 $\checkmark \quad \text{The cofactor matrix } C = \begin{bmatrix} \tau R_g - (1 - \tau) C^g & 0 \\ R_g & 1 \end{bmatrix}$

$$\checkmark \text{ And } adjC = C' = \begin{bmatrix} \tau R_g - (1 - \tau)C^g & R_g \\ 0 & 1 \end{bmatrix}$$

 \checkmark And finally the inverse is



$$\Theta^{-1} = \frac{1}{|D|} adjC \Leftrightarrow \Theta^{-1} = \begin{bmatrix} 1 & \frac{R_g}{\tau R_g - (1 - \tau)C^g} \\ 0 & \frac{1}{\tau R_g - (1 - \tau)C^g} \end{bmatrix}$$
(B.4)

Using now equation (B.3) and (B.4) and assuming that the income tax rate is constant, (i.e. $d\tau = 0$), we take that:

$$\begin{bmatrix} 1 & -R_{g} \\ 0 & \tau R_{g} - (1 - \tau)C^{g} \end{bmatrix} \begin{bmatrix} du \\ dg \end{bmatrix} = \begin{bmatrix} R_{L} - \alpha R_{L}^{*}(1 + \eta) \\ -\tau R_{L} + (1 - \tau)gC_{w}^{g}W_{L} \end{bmatrix} dL \Leftrightarrow$$

$$\begin{bmatrix} du \\ dg \end{bmatrix} = \Theta^{-1} \begin{bmatrix} R_{L} - \alpha R_{L}^{*}(1 + \eta) \\ -\tau R_{L} + (1 - \tau)gC_{w}^{g}W_{L} \end{bmatrix} dL \Leftrightarrow$$

$$\begin{bmatrix} du \\ dg \end{bmatrix} = \begin{bmatrix} R_{L} - \alpha R_{L}^{*}(1 + \eta) - R_{g} \frac{\tau R_{L} - (1 - \tau)gC_{w}^{g}W_{L}}{\tau R_{g} - (1 - \tau)C^{g}} \\ -\frac{\tau R_{L} - (1 - \tau)gC_{w}^{g}W_{L}}{\tau R_{g} - (1 - \tau)C^{g}} \end{bmatrix} dL$$
(B.5)

Appendix C. Solving the indetermination between equations (8) and (9).

Using equation (8) and given equation (9) we obtain that:

$$(dg / dL) = -\left[\tau R_L - (1 - \tau)gC_w^g W_L\right] D^{-1} \stackrel{(9)}{\Longrightarrow}$$

$$(dg / dL) = -\left[\tau R_L - (1 - \tau)gC_w^g (R_{LL} + R_{Lg} \frac{dg}{dL})\right] D^{-1} \Rightarrow$$

$$(dg / dL) = -\left[\tau R_L - (1 - \tau)gC_w^g R_{LL}\right] D^{-1} + \left[(1 - \tau)gC_w^g R_{Lg} \frac{dg}{dL}\right] D^{-1} \Rightarrow$$

$$(dg / dL) = \frac{-\left[\tau R_L - (1 - \tau)gC_w^g R_{LL}\right]}{\tau gC_w^g R_{Lg}} < 0$$

Appendix D. Two – class model set up

In this case our model can efficiently be described by the below four basic types:

$$w = R_L(L,g)$$



$$B = \tau \Big[R(L,g) + gC^{g}(w) \Big] - gC^{g}(w)$$
⁽²⁾

$$L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W}) = R(L,g) + T$$
(5)

$$L^{W}E^{W}(u^{W}) = (1-\tau)L^{W}R_{L}(L,g) + T$$
(6)

Where $T = aR_L^*(L^*)L^f$

Totally differentiating equation (5) and taking into consideration that: (i) $dL = -dL^{f}, dL^{*} = dL^{f}$, (ii) immigrants come from the class of workers, i.e. $dL = dL^{w}$ (iii) $W = L^{K}E^{K}(u^{K}) + L^{W}E^{W}(u^{W})$, (iv) $E^{w} = (1 - \tau)R_{L} + (T/L^{w})$ and additionally assume that $E_{u}^{w} = (dE^{w}/du^{w}) = E_{u}^{k}(dE^{k}/du^{k}) = 1$, which means that one unit increase of income leads to one unit increase of welfare in each worker or capitalist, we get :

$$L^{k}E_{u}^{k}du^{k} + E^{w}dL + L^{w}E_{u}^{w}du^{w} = R_{L}dL + R_{g}dg - \alpha(R_{L}^{*} + R_{LL}^{*}L^{f})dL \Leftrightarrow$$

$$dW = L^{k}du^{k} + L^{w}du^{w} = -E^{w}dL + R_{L}dL + R_{g}dg - \alpha R_{L}^{*}(1 + \mu\eta^{*})dL \Leftrightarrow$$

$$dW = -(E^{w} - R_{L})dL + R_{g}dg - \alpha w^{*}(1 + \mu\eta^{*})dL \Leftrightarrow$$

$$dW = \tau R_{L}dL - (T / L^{w})dL + R_{g}dg - \alpha w^{*}(1 + \mu\eta^{*})dL \qquad (D.1)$$

Where $dW = L^k E_u^k du^k + L^w E_u^w du^w$ and it is the weighted sum of changes in the utility of all the residents in the source country. Thus we call dW the change in social welfare.

Similarly, totally differentiating equation (6) and taking into account that $E_u^w = (dE^w / du^w) = 1$, we obtain:

$$E^{w}(u^{w})dL + L^{w}E^{w}_{u}du^{w} = (1-\tau)R_{L}dL + (1-\tau)L^{w}\left[R_{LL}dL + R_{Lg}dg\right] - \alpha\left[R^{*}_{L} + R^{*}_{LL}L^{f}\right]dL \Leftrightarrow$$

$$L^{w}du^{w} = -\left[E^{w} - (1-\tau)R_{L}\right]dL + (1-\tau)L^{w}\left(R_{LL}dL + R_{Lg}dg\right) - \alpha R^{*}_{L}\left(1+\mu\eta\right)^{*}dL \Leftrightarrow$$

$$L^{w}du^{w} = -\left(T/L^{w}\right)dL + (1-\tau)L^{w}dw - \alpha w^{*}\left(1+\mu\eta^{*}\right)dL$$
(D.2)

Finally substituting equation (D.2) in equation (D.1) and solving for $L^k du^k$ or alternatively, deducting equation (D.2) from equation (D.1) we get the change of the capitalists utility:

$$L^{k}du^{k} + L^{w}du^{w} = \tau R_{L}dL - (T / L^{w})dL + R_{g}dg - \alpha w^{*}(1 + \mu \eta^{*})dL \Leftrightarrow$$

$$L^{k}du^{k} = \tau R_{L}dL - (T / L^{w})dL + R_{g}dg - \alpha w^{*}(1 + \mu \eta^{*})dL - L^{w}du^{w} \Leftrightarrow$$

$$L^{k}du^{k} = \tau R_{L}dL + R_{g}dg - (1 - \tau)L^{w}dw$$



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