ESSAYS ON INTERNATIONAL MIGRATION

by

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Abstract

In recent time efforts are observed in re-evaluating the linkage between economic development and international migration. The thesis can be considered as an attempt to add something to those efforts. In this thesis we mainly analyse the effects of competition among the countries in international labour market and effects of migration on the research activities of firms. As appeared, these two issues so far have not received much attention of economic literature.

We analyse the above mentioned two issues in chapters 4, 5 and 6 of the thesis. Before conducting the main analysis of the thesis, we have explored available data and literature on international migration in chapter 2 and 3. The two chapters were designed to give a global overview of international migration. In chapter 2 we have discussed about international migration using available statistics obtained from secondary sources. The data shows a steady but relatively slow growth rate of world migration since the World War Two. It has however been observed that migration of educated people has increased in recent times. We also have observed that remittances as a percentage of GDP and export are very high in many countries which confirm the importance of remittances. The data also shows that proximity of a wealthy country is an important determinant of international migration destination.

In chapter 3 we have reviewed some issues of international migration. The discussion has covered the issues like the determinants of international migration, performance of migrants and consequences of migration in host country, 'Brain Drain' or 'Brain Gain', migration, remittances and economic development, initiatives of international bodies in international migration. Temporary migration has received special attention in the discussion. Many insights of the research conducted in the thesis have come directly from the reviews conducted in chapter 3.

Chapter 4 and 5 set up models where two countries are engaged in competition with each other in sending people aboard. The competition in international labour market is immensely important in many developing countries. Many countries are highly dependent on the remittances thus competing with other countries in sending people to work abroad. These competitions play an active role in intergovernmental negotiations as the countries require to balance between 'promotion' of overseas employment and 'protection' of migrants. Within economic literature we have not seen efforts to model this competition of labour exporting countries.

Chapter 4 has modelled a situation where two exporting countries send labour to a third country. This chapter assumes unskilled migration as such labour migration is entirely controlled by the respective governments. The governments want to send labour to get remittances in return thus engage in a Cournot-type competition with the other labour exporting country. The importing country on the other hand acts as a Stackelberg leader as it sets up its immigration tax policies by moving first. We have observed that the labour importer uses discriminatory tax policies for the different labour exporting countries to fulfil its national objective. The tax rate is higher for the country with higher labour endowment.

Chapter 5 has adopted a similar model as chapter 4. However the assumption of unskilled migration has been replaced by the assumption of skilled migration. It is thus assumed that migrants do not need governments' assistance to migrate or governments are not in a position to control migration. Thus they use taxes to control migration and maximise national income. In this regard the exporting countries engage in Bertrand type competition with each other in setting emigration tax rate. We have found that skilled migrants should be taxed by the exporting countries to maximise national income. The importing country again resorts to the discriminatory tax policy as obtained in chapter 4. The tax rate is as before higher for the country with higher labour endowment

The analysis of chapter 6 can be linked with the recent literature of 'Brain Drain'. We have assumed a model where two countries are engaged in strategic trade with each other. We have then analysed effects of labour market openness and migration on research and development of countries. It is assumed that the wage rates of one country is higher than the other country's which gives the rationale for migration. With the opening up of labour market and threat of possible migration, wage rates of both skilled people who conduct research and unskilled people who conduct production fall. We have analysed mainly three cases – (1) only labour-importing country conducts R&D, (2) only labour exporting country conducts R&D and (3) both countries conduct R&D simultaneously. The analysis shows that the possibility of migration of only skilled people always increases R&D. It also increases welfare by reducing the price of output. However the migration of unskilled people may not always increase welfare.

We expect that the analysis done in the thesis will be able to provide some guidelines in migration policy making. Firstly we observe no strong coalition among the labour sending countries to manage and control international migration, though labour importing countries are to some extent managing migration jointly. This thesis

along with any possible future work may provide guidance in joint management of international migration by the exporting countries. Secondly, many exporting countries are subsidising skilled migration by providing training and other supports. The thesis is suggesting that labour exporting countries should tax the skilled migrants. In this regard the issue of skilled migration may need re-evaluation. Thirdly, the thesis is pointing towards some possible gains from skilled migration through increased research and development. This position is to some extent at a par with the literature of 'Brain Drain' that pointed towards the beneficial effects of skilled migration.

In summary it appears that we have obtained some interesting results in the analysis done in the thesis. We hope that they will be proved useful in migration policies and will contribute in future progress of both developed and developing countries.

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The remaining errors of the thesis are obviously my responsibility.

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Chapter 1

Introduction

The history of human being and migration is truly indistinguishable. Since the appearance, human being is moving from one place to another place of the earth in search of food, shelter and security. The same trend is continuing in the present world. Viewed in this manner migration appears as an outcome of human decision making process trying to fulfil some objectives. There is nothing surprising or new in the present migration regime that drastically makes it different from the previous migration regimes. However, the present age is sometimes referred as the age of migration. But the volume of migration as observed in the present world is really not unprecedented. As mentioned in Hass (2005) the share of international migrants in the world population underwent a certain increase in the 1990s, but there were periods of drastically equal international migration over the 19th and 20th centuries. The percentage of international migrants in the total world population was at almost similar levels (2.5% – 3%) to those of today. The common perception that the late 20th century and early 21st century are 'the age of migration' is therefore appears incorrect.

What appears unprecedented is the changing patterns of international migration. Now people are moving from all over of the world to all over the world. In the 19th and early 20th century, the world observed mainly North-North or South-South Migration such as Irish and European mass migration to USA or Japanese Migration to South America. But after the World War Two, the world experienced increasing number of people moving from South to North which has changed the demographic profile of North substantially (Hass 2005). In past migration was mainly driven by push factors such as famines, wars etc. but recently we observed active government policies to attract migrants (especially skilled migrants) from other countries. In past centuries such widespread active persuasion was not present.

Migration is now increasingly viewed as linked with issues of economic development. Migration in general provides solutions to two

problems. Firstly migration meets labour shortage of receiving countries which are normally the developed countries of North or rich countries. On the other hand many countries of the world are facing problems like unemployment, high poverty and low investment. Migration though not the only means (Hass 2005, Taylor 2006) provide a solution of this problem through labour outflow and remittances inflow. Migration is therefore receiving attention from governments and international bodies like United Nations, OECD and IOM as a vehicle of fulfilling the development objectives.

The literature of international migration is enormous. They are comprised of theoretical and empirical literatures as well as policy papers published by various government and international bodies. They cover issues like causes and consequence, wage determination, human capital formation and 'Brain Drain', remittances, illegal migration, migrant's right, return migration, migration and trade, international factor mobility, migration cooperation, policy related issues etc. But it seems that within the literature the competition among the countries in international labour market and effects of migration on the research activities of firms have not received much attention. We have addressed these two issues in this thesis.

The competition of the countries in international labour market carries immense importance for many developing countries. Many countries are highly dependent of the remittances. The importance of remittances has resulted in strong competition among the countries in international migration. This competition always plays an active role in the intergovernmental negotiations in international migration. For example IOM report on labour market in Asia (IOM 2003) has several times mentioned about such competition among stakeholders that severely undermines the bargaining power of the countries, as the countries require to balance between 'promotion' of overseas employment and 'protection' of migrants. Reference of such competition also can be often seen in newspaper articles.

In this thesis we propose models incorporating the competition in the international labour market. We analyse the issue in chapter 4 and chapter 5. In chapter 4 we assume that two countries are competing with each other to send migrants to a third country. The chapter considers unskilled migration as

such labour migration is entirely controlled by the respective governments. The governments want to send labour abroad to get remittances in return. As the other country also does the same it gives rise to a Cournot type competition. The labour importing country acts as Stackelberg leader by setting immigration tax policies. We observed that the labour importer uses discriminatory taxes for different labour exporting countries to attain its national objective.

Chapter 5 explores competition in international labour market with the presence of skilled migration. Similar to the chapter 4, the model consists two labour exporting and one labour importing countries. The exporting countries are there not in a position to control migration directly. They use taxes to control migration and maximise national income. Hence the exporting countries compete with each other in setting the emigration tax policies. The result shows that uncontrolled skilled migration does not enhance the income of the exporting countries. The importing country again resorts to the discriminatory taxes as obtained in chapter 4.

The analysis of chapter 6 can be linked with the literature of 'Brain Drain'. This chapter explores the effects of labour market openness and migration on research and development of countries engaged in strategic trade with each other. We have distinguished the migrants in two groups- skilled who conducts research and unskilled who conducts production. The openness and threat of migration reduce the wage rates of both types of labour in labour importing country. We analyse some situations where the openness and possibility of migration can benefit both countries through increased research and development.

Chapter 4, 5 and 6 constitute the main contributions of thesis. The chapter 2 and 3 discuss the available data and literature on international migration. The two chapters were designed to give a global overview of international migration. The starting point of such global overview should be the statistics of international migration. Thus in chapter 2 we have discussed about international migration using the available statistics obtained from secondary sources. We look at the data of world migration since World War Two. In addition it looks at bilateral migration, skilled migration and the

statistics of remittances. Chapter 3 looks at some issues of international migration such as the determinants and consequences of international migration, performance of migrants, 'Brain Drain', migration and economic development, bilateral and multilateral aspects of international migration etc. Temporary migration receives special attention in the discussion. These two chapters are immensely important in our thesis as they play direct roles in formulation of the models and in analysing the results. The chapter 2 and 3 therefore can be regarded as the literature review chapters.

To summarise, we can say that this thesis analyses the effects of competition in international labour market and the effects of international migration on the R&D and economic welfare. The thesis has been organised by presenting the data and literature of international migration in chapter 2 and chapter 3. The chapter 4, 5 and 6 constitute the main contribution of the thesis where the models have been proposed and analysed. In the final chapter we provide the conclusion.

Chapter 2

International Migration: Facts and Figures

1. Introduction

In this chapter we will look at some available statistics on international migration. The main contribution of this thesis is not empirical but this chapter still bear enormous importance as without looking at the data, the study of international migration will be largely incomplete.

Our aim of the literature review chapters is to have an overview of the international migration. The starting point of the overview should be the statistics of international migration. The chapter is therefore aiming to provide an overview of international migration statistics since the Second World War. It has been supplemented by statistics on migration of high skilled people and statistics of remittances inflow as they are highly relevant to present migration regime and our thesis. We will also look at some statistics of bilateral migration. The statistics provided in this chapter are all collected from secondary sources, thus while discussing we will sometimes discuss about the methodologies used by the original collectors. Though the main aim of this chapter is to look at the statistics of international migration, time to time, our observations about the data and international migration situation will also be provided.

2. Overview of World Migration

In this section we will look at the statistics to have an overview of world migration since World War Two. The data on migration can be collected from International organisations like United Nations, International Organisation for Migration (IOM), OECD and other governmental and

international bodies. But they use different methods in collecting and compiling the data. Hence available data on world migration is really comprehensive but suffers from the problem of lack of uniformity. A notable attempt to overcome this problem is the database compiled by Parsons et al. (2007). We will discuss about Parsons et al. dataset in relevant section. But this problem of uniformity of data does not pose a big threat to us as the aim here is mainly to look at some descriptive statistics to have a global overview. Further studies using advanced econometric technique would require higher precision and uniformity.

The data compiled by United Nation's Population Division gives a nice overview of international migration since the Second World War. We have utilised that data set. It has been obtained from the website of Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat titled 'Trends in Total Migrant Stock: The 2005 Revision' (http://esa.un.org/migration). It contains migration statistics of 228 countries or areas. The international migrants' stocks at particular points in time were estimated mostly from population censuses corresponding to the decennial rounds of censuses from 1950 to 2000. In the majority of cases, the censuses gathered information on place of birth of enumerated population and thus allow identification of foreign-born population. However, in some countries information on place of birth was not recorded. Instead, the citizenship (that is, their legal nationality) provided the basis for identification of international migrants.

Table-2.1

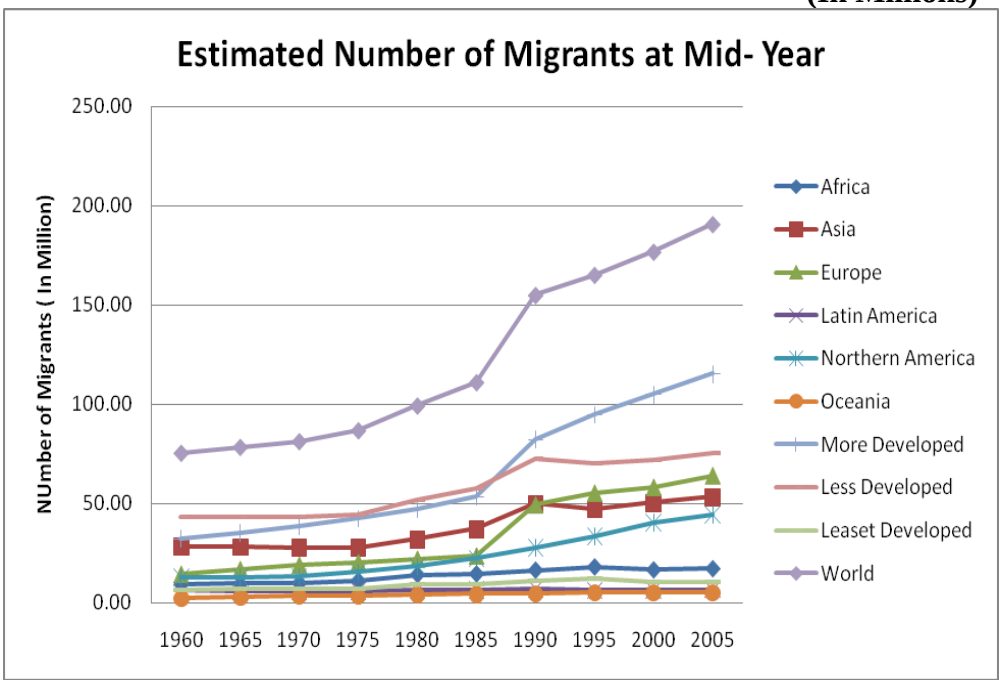
Estimated Number of International Migrants at Mid-Year (Both Sexes)
(In Millions)

Year	Africa	Asia	Europe	Latin America	Northern America	Oceania	More De-veloped	Less De-veloped	Least De-veloped	World
1960	9.1	28.5	14.2	6.0	12.5	2.1	32.3	43.2	6.4	75.5
1965	9.4	28.2	16.7	5.9	12.7	2.6	35.4	43.0	7.0	78.4
1970	9.9	27.8	18.8	5.7	13.0	3.0	38.4	43.0	7.2	81.3
1975	11.0	28.1	20.2	5.7	15.3	3.4	42.5	44.3	6.8	86.8
1980	14.1	32.1	21.9	6.1	18.1	3.8	47.5	51.8	9.1	99.3
1985	14.4	37.2	23.5	6.3	22.1	4.2	53.6	57.4	9.1	111.0
1990	16.4	49.9	49.4	7.0	27.6	4.8	82.4	72.6	11.0	155.0
1995	17.9	47.2	55.3	6.1	33.6	5.1	94.9	70.2	12.2	165.1
2000	16.5	50.3	58.2	6.3	40.4	5.1	105.0	71.7	10.2	176.7
2005	17.1	53.3	64.1	6.6	44.5	5.0	115.4	75.2	10.5	190.6
% change	**87%**	**87%**	**350%**	**10%**	**256%**	**136%**	**257%**	**74%**	**62%**	**153%**
Popu-lation 2005	921.073 (1.86%)	3936.536 (1.35%)	729.421 (8.79%)	556.512 (1.19%)	335.175 (13.28%)	33.559 (14.90%)	1216.55 (9.49%)	5295.726 (1.42%)	761.846 (1.38%)	6512.276 (2.93%)

Source: United Nations Population Division, http://esa.un.org/migration and http://www.un.org/esa/population/unpop.htm

Figure -2.1

Estimated Number of International Migrants at Mid-Year (Both Sexes)
(In Millions)



Source: United Nations Population Division, http://esa.un.org/migration

Table-2.1 and 2.2 and Figure-2.1 and 2.2 have been compiled using the data obtained from the above source. Table-2.1 provides the estimated number of international migrants as of mid-year for each of the years indicated. The table has been later used to make Figure -2.1 to visualise the trend. From the table it can be clearly seen that the numbers of migrants have gradually increased over the time. From the Figure-2.1 we can also observe a potential break in data in the year around 1990. It was not clear from the website of UN as to what extent the break had been caused by disintegration of former USSR and East European countries. Another interesting feature of the data is observable from calculated percentage change from 1960 to 2005. The highest growth on international migrants' stock had been registered in Europe (350%), North America (256%), Oceania (136%) and in developed countries (257%). Again it is not clear as to what extent the growth had been effected by disintegration of former communist blocks. But such disintegration is obviously not the reason for increase of migrants' stock in North America and Oceania. We also have presented the world population data obtained from the Population Division of the United Nations in the last row of Table-2.1. The figure in the parenthesis shows the ratio of migrants to total population. As can be observed from the data at the world level only about 3% of the people are migrants but in Europe, Northern America, Oceania and more developed countries about 10% of people are migrants.

In Table-2.2 we have the statistics of growth rate of migrants' stock over the period of 1960 to 2005 as obtained from the United Nations data set. Again the data has been plotted in Figure-2.2 to visualise the trend of growth of migrants' stock. Figure-2.2 has been separated in two panels to look at continents and countries with income classification differently. As we can see from the Table-2.2 growth rate of stock of migrants in the last decade is higher in Europe and Northern America. Oceania started with a higher migration rate of 3.6 percent in 1960-65 but the growth rate gradually declined and turned negative in recent years. As we can see that the growth rate is higher in more developed (1.9 percent) and less developed countries (1 percent) but low in least developed countries (0.4 percent). Again more developed countries experienced highest growth rate of 10.40 percent during the period of 1985-90.

As the population of developed countries is gradually declining, the rate of growth of migrant population should be in general higher than the population growth of developed countries. Another interesting feature is that the rate of increase of migrants stock is kind of steady over the period and the world average was just about 1 percent. It is demonstrating that the proposition that the world is observing unprecedented migration is not true. As only 3 percent of world's population is migrants, about 1 percent increase in migrants stock, even if the growth rate is higher than the population growth rate, is not substantially going to change the world's demography in near future. However as observed from the data of last row of Table-2.2, population growth rate is much lower than the growth rate of migrants in Europe, Northern America and More Developed countries. Thus migration may induce substantial changes in demographic patterns of those parts of the world.

Table-2.2

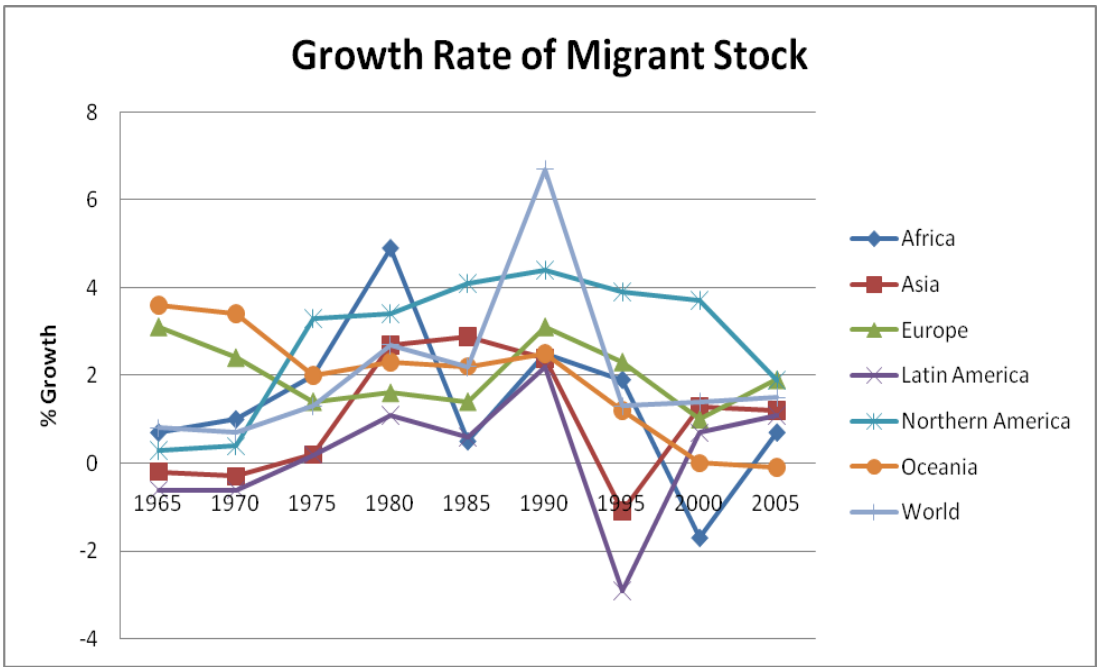
Growth Rate of Migrants' Stock from 1960-2005

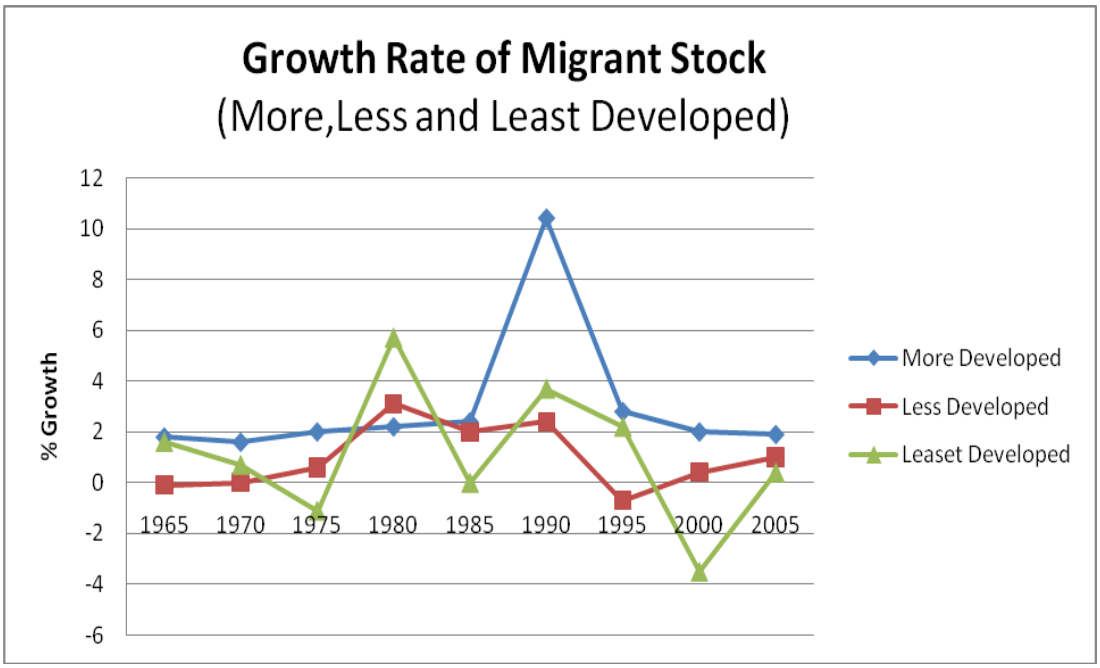
	Africa	Asia	Europe	Latin America	Northern America	Oceania	More Developed	Less Developed	Least Developed	World
1960-65	0.7	-0.2	3.1	-0.6	0.3	3.6	1.8	-0.1	1.6	0.8
1965-70	1	-0.3	2.4	-0.6	0.4	3.4	1.6	0	0.7	0.7
1970-75	2	0.2	1.4	0.2	3.3	2	2	0.6	-1.1	1.3
1975-80	4.9	2.7	1.6	1.1	3.4	2.3	2.2	3.1	5.7	2.7
1980-85	0.5	2.9	1.4	0.6	4.1	2.2	2.4	2	0	2.2
1985-90	2.5	2.4	3.1	2.2	4.4	2.5	10.4	2.4	3.7	6.7
1990-95	1.9	-1.1	2.3	-2.9	3.9	1.2	2.8	-0.7	2.2	1.3
1995-00	-1.7	1.3	1	0.7	3.7	0	2	0.4	-3.5	1.4
2000-05	0.7	1.2	1.9	1.1	1.9	-0.1	1.9	1	0.4	1.5
Pop. Growth (2000-05)	2.34	1.25	0.08	1.31	1.01	1.48	0.36	1.47	2.36	1.26

Source: United Nations Population Division, http://esa.un.org/migration

Figure -2.2

Growth Rate of Migrants' Stock from 1960-2005





Source: United Nations Population Division, http://esa.un.org/migration

3. Regional and Bilateral Migration

The database UN gives a nice overview of worldwide migration but it is not possible to have an outlook of regional and bilateral migration from it. In order to do so we have used Parsons et al. (2007) who built a database of bilateral migrants stock of 226 countries and territories. As noted by them, the lack of comprehensive and reliable data on bilateral flows of migration caused only a few attempts that took a global view of the patterns of international migration between countries and regions. OECD produces detailed stock and flow data on immigrants in OECD and few other countries. The United Nations adopts a global perspective when summarising international migrants' movements but its work provides only total migrants stock in each country. National data sources allow disaggregation but there is problem of comparability from one country to another. The data set of Parsons et al. (2007) tried to overcome these problems by introducing four versions of two origin-destination matrices using mainly the data from the year 2000 round of censuses. The four versions reflect different points of trade-off between the comprehensiveness of coverage and use of the assumption for interpolation to compensate for missing data. The first version simply contains raw data and later versions contain more bilateral entries despite the fact that individual entries are less accurate. Thus as versions progress the data become complete but less accurate.

Even with the inaccuracy, the database allows us to compare country data from both global and regional perspective. It portrays that proximity to regional wealthy country is a powerful determinant of international migration destinations. As a starting point in Table-2.3 we have bilateral migration data for seven South Asian countries. In columns we have statistics of first three host countries for migrants of these countries. For example the second column shows migration from Bangladesh to other countries. The first country in ranking is India where number of migrants is 3805844. India is followed by Pakistan as the second major host country of Bangladeshi migrants where number of migrants is 1508256. The table reveals interesting facts about international migration in particular of South-South migration. The major host

countries for all South Asian countries are not the Northern developed countries but rather the countries of South. Even for India, which is not a Muslim majority country, first two host countries are UAE and Saudi Arabia. It may be argued that for skilled people, Northern developed countries are the major destination countries. But volume of remittances inflow does not just depend on the skills of people working abroad but also on the total number of people working. This statistics gives the notion that South-South and regional migration can be much more important in linking migration to development policy agendas.

Table-2.3

Migration from South Asian Countries to other countries

Source Countries	Bangladesh	India	Sri Lanka	Bhutan	Maldives	Nepal	Pakistan
Host countries	India (3805844)	UAE (1299439)	India (186264)	India (7977)	India (239)	India (651642)	India (1327671)
	Pakistan (1508256)	Saudi Arabia (1045985)	Saudi Arabia (114981	Pakistan (3153)	UK (201)	Pakistan (256125)	Saudi Arabia (661383)
	Saudi Arabia (379207)	USA (1037360)	Canada (91942)	Nepal (426)	Australia (175)	Saudi Arabia (14026)	United Kingdom (322178)

Source: Version_4, Parsons et al. (2007)

http://www.migrationdrc.org/research/typesofmigration/global_migrant_origin_database.html

With the observation from the above table it is expected that similar type of regionalism will be observed in other regions of world. With this view in mind Table-2.4 has been compiled from the Parsons et al. (2007) database. The major sending countries of the table has been obtained by sorting the countries in descending order that have migrants in other countries and then selecting first 16 countries. In the table we only have data of countries which do not fall within the criteria of highly developed or rich countries. Former communist block of East Europe, USSR and Afghanistan also have been excluded. Given that a simple observation of the table shows that migrant population is likely to be concentrated in one or two countries based on regional proximity and social and/or historical ties. About 92 percent of Mexican migrants are living in USA. In Turkey about half of the migrants are

living in Germany. Similar feature is observed in Morocco and Algeria. A large percentage of migrants from Asian countries are residing in Gulf counties especially in Saudi Arabia. For Mali the major host countries are Cote d'Ivoire, Burkina Faso and Guinea. The data again reveals that proximity is an important determinant of migration destination.

Table-2.4

Migration from Major Source Countries to Other Countries

Source Countries	Host Countries					Total Migrants (In Millions)
	1st	2nd	3rd	4th	5th	
Mexico	United States (92.07%)	Pakistan (1.22%)	Kuwait (0.58%)	Germany (0.50%)	Israel (0.47%)	10.14 (100.00%)
India	UAE (14.34%)	Saudi Arabia (11.55%)	USA (11.45%)	Bangladesh (10.58%)	Pakistan (6.69%)	9.06 (100.00%)
Bangladesh	India (55.70%)	Pakistan (22.07%)	Saudi Arabia (5.55%)	Nepal (2.98%)	UK (2.27%)	6.83 (100.00%)
China	Hong Kong (37.69%)	USA (17.31%)	Canada (5.95%)	Malaysia (4.62%)	Japan (4.35%)	5.82 (100.00%)
Pakistan	India (38.75%)	Saudi Arabia (19.30%)	UK (9.40%)	USA (6.70%)	Germany (2.88%)	3.43 (100.00%)
Philippines	USA (42.79%)	Saudi Arabia (11.27%)	Malaysia (9.07%)	Canada (7.05%)	Australia (3.06%)	3.40 (100.00%)
Turkey	Germany (49.88%)	France (6.36%)	Netherland (6.03%)	Austria (4.18%)	Bulgaria (3.07%)	3.02 (100.00%)
Morocco	France (29.29%)	Spain (12.11%)	Germany (11.35%)	Italy (7.26%)	Israel (6.38%)	2.59 (100.00%)
Egypt	Saudi Arabia (46.69%)	Jordan (5.84%)	USA (5.67%)	Palestine (4.76%)	Libya (2.56%)	2.17 (100.00%)
Poland	USA (23.02%)	Germany (14.85%)	Belarus (13.38%)	Canada (8.78%)	France (5.50%)	2.08 (100.00%)
Algeria	France (64.38%)	Germany (10.53%)	Libya (2.61%)	Israel (1.53%)	Serbia and Montenegro (1.52%)	2.07 (100.00%)
Vietnam	USA (49.93%)	Australia (7.71%)	Canada (7.50%)	France (6.08%)	Germany (5.75%)	2.01 (100.00%)
Indonesia	Malaysia (40.59%)	Saudi Arabia (16.19%)	Netherland (9.04%)	Philippines (7.55%)	USA (4.17%)	1.83 (100.00%)
Columbia	Venezuela (36.92%)	USA (31.85%)	Spain (10.59%)	Germany (2.87%)	Ecuador (2.26%)	1.65 (100.00%)
Puerto Rico	USA (90.18%)	Italy (1.93%)	Germany (1.27%)	Pakistan (1.18%)	Kuwait (0.59%)	1.60 (100.00%)
Mali	Cote d'Ivoire (30.82%)	Burkina Fuso (27.74%)	Guinea (10.32%)	Nigeria (5.77%)	Ghana (5.22%)	1.58 (100.00%)

Compiled from: Version_4, Parsons et al. (2007)

http://www.migrationdrc.org/research/typesofmigration/global_migrant_origin_database.html

One should however be careful in interpreting the data set. As can be seen from the table that Bangladesh, Pakistan and India are sharing as large stock of migrants with each other. The three countries in previous time were known as British India which became Independent as India and Pakistan in

1947. Later in 1971 the two parts of Pakistan named East and West become separated. East Pakistan became Bangladesh and West Pakistan became Pakistan. Still a large number of people born in Former East Pakistan (now Bangladesh) are living in Pakistan. A recent newspaper article[1] reported that about 1.2 million people of Bangladeshi ethnicity are living in Karachi of Pakistan. Same is true for people born in Pakistan and living in Bangladesh. To a lesser extent it is in general applicable to the whole Indian Subcontinent. Thus the Indian subcontinent has experienced a similar break up like former communist block of East Europe. It is likely that many other countries of the world have also gone through similar type of transformation in last few decades that changed the number of foreign born population. It may also have some effects on the reports of population censuses. Thus without looking more deeply at the data collection process for individual countries it will be unwise to provide any final comment. Another thing to be noted is that this database may overrate the economic importance of migration in some countries. For example many people born in Pakistan moved to Bangladesh after 1971. Similarly many people born in Bangladesh moved to Pakistan. The same also happened between Bangladesh, Pakistan and India. The economic significance of this migration in term of remittances is very low. Therefore even if the statistics in Table-2.4 is showing that the about 77 percent of Bangladeshi migrants are living in India and Pakistan, these migrants are probably economically less important compared to the migrants (only 5.5%) living in Saudi Arabia.

4. Skilled and Unskilled Migration

Migration of skilled people from developing and developed countries is one highly debated issue of international migration. It is often observed that the developed countries are practising special screening programme only to allow entry of skilled people like engineers or doctors. Migration of high skilled people from developing to developed countries is referred as 'Brain

[1] Faruk Chowdhury's Article, 'Daily Prothom-Alo, date May 14, 2009

Drain'. The size of literature dealing with the Brain Drain issue is quite enormous. We will discuss the literature in next chapter. In this section we will look at some statistics of skilled and unskilled migration in developed countries.

The problem of looking at the data is again the availability of comparable data. Carrington and Detragiache (1998) is one of the first attempts which has been referred by Commander et al. (2002) as a benchmark of empirical analysis of skilled migration in 1990. Carrington and Detragiache attempted to examine the magnitude of skilled migration by estimating migration rates from 61 developing countries to OECD countries for three educational categories (primary, secondary and tertiary) using 1990 U.S. census data, Barro Lee's data set on educational attainment and OECD migration data. They found substantial migration of educated people from Caribbean, Central America and some African and Asian Countries. It was found that individual with little or no education generally have limited access to international migration and migrants tend to be much educated then the rest of the population of the country. Almost for all countries the highest migration rates are for individual with a tertiary education. In some countries migration rate with tertiary education is very high. For example the estimates show that in Gambia 59%, Jamaica 67%, Guyana 77% people with tertiary education have migrated to United States.

Docquier and Marfouk (2006) noted that Carrington and Detragiache (1998) had some severe limitations. Carrington and Detragiache used OECD migration statistics for non-US countries which report limited information on origin of immigrants. They transposed skill structure of U.S. immigrants on the OECD total immigration stock. Relying on OECD statistics produced an average underestimation of 8.9 percent. Docquier and Marfouk constructed their data set using stock data of 192 independent territories (including Vatican City and 191 UN member states) and 39 dependent territories. They count as migrants all working age (25 and over) foreign born individual living in OECD countries. Skilled migrants are those who at least have tertiary level of education wherever they have completed schooling.

In Docquier and Marfouk the set of receiving countries are restricted to OECD countries. They argued that the skill levels of Non-OECD countries are expected to be very low except for South Africa. Focusing on OECD countries, they stated to capture a large number of world educated migration (about 90 percent) but they were aware of the fact that by disregarding Non-OECD countries like Saudi Arabia, United Arab Emirates, Kuwait, Oman, South Africa etc. they probably underestimated Brain Drain for a dozen of countries like Egypt, Sudan, Bangladesh, Pakistan, Swaziland, Namibia etc. In addition as there was no systematic information on age of entry, it was impossible for them to distinguish the emigrants who were educated at the time of entry and who acquired education after settling in receiving countries.

In spite of the stated incompleteness and limitations, the database of Docquier and Marfouk is an important source of information on high skill migration in OECD countries. Table-5.2 of the paper provides an overview of the empirical observations. We have summarised it in Table-2.5 and calculated the last two columns- e and f. As can be seen from the table, total stock of migrant labour forces in OECD in 1990 was 42 millions which rose to 59 millions in 2000. In absolute term there was a 41% increase in migrants stock. On the other hand migrant labour with tertiary education was 12.46 millions in 1990 which rose to 20.40 million in 2000. Migrant labour with tertiary education was 29.80% of total stock of migrants in 1990 which became 34.60% in 2000. Stock of migrants with tertiary education was 64% higher in 2000 compared to 1990. Comparing the stock of migrants with tertiary education as percentage of total stock we see a 4.80% increase from 1990 to 2000. While migrants with secondary education also have increased, migration with less than secondary education has decreased in relative term as seen from the table. Comparably, we observe similar increase in the education level of labour force of the world. On the other hand, both OECD and Non-OECD labour forces with tertiary level of education have increased within this period. It can be said that from the period of 1990 to 2000 the growth of OECD and world's labour forces was biased toward the educated compared to less educated people. Nevertheless migrants still remain as a small fraction of OECD labour force. Total stock of migrants in OECD countries is only 7.87

percent of total OECD labour force which increases to 9.84 in case of tertiary education. Given the ethnic diversity of migrant population, this small fraction of migrants probably has no social and political bargaining power in OECD labour market.

Table-2.5

Migration by Educational Attainment

(In Millions)

	1990		2000		e= (c-a)/a	f=d-b
	A	b	c	D		
Total stock of migrants in OECD countries	41.85	% of stock	59.02	% of stock	41%	
Migrants with tertiary education	12.46	29.80%	20.40	34.60%	64%	4.80%
Secondary education	10.58	25.30%	17.11	29.00%	62%	3.70%
Less than secondary education	18.80	44.90%	21.51	36.40%	14%	-8.50%
World labour force	2568.23	% of labour force	3187.22	% of labour force	24%	
Tertiary education	234.69	9.10%	360.61	11.30%	54%	2.20%
Secondary education	755.10	29.40%	945.84	29.70%	25%	0.30%
Less than secondary education	1578.43	61.50%	1880.78	59.00%	19%	-2.50%
OECD Total labour force	657.72	% of all groups	750.09	% of all groups	14%	
OECD labour force with tertiary education	144.05	21.90%	207.35	27.60%	44%	5.70%
Non-OECD total labour force	1910.51	% of all groups	2437.14	% of all groups	28%	
Non- OECD labour force with tertiary education	90.64	4.70%	153.26	6.30%	69%	1.60%

Source: Table-5.2, Docquier and Marfouk (2006)

5. Migration and Remittances

The last statistics we are going to look at is the statistics of remittances received by the labour sending countries. It is often noted that the remittances is playing an important role in developing countries such as it is now one of the main sources of export earnings (Taylor 2006). In the Table 2.6 we have complied data from World Bank's database "World Development Indicators, December 2008". We have selected first 15 remittances recipient developing

countries of the world according to workers' remittances receipt in 2006. The data is available in current US dollar. We have then calculated per capita remittances dividing the remittances by total population. The last two columns have been calculated dividing remittances respectively by GDP and Export. As can be seen from the table the importance of remittances varies largely. In some countries per capita remittances is quite low such as India, China and Bangladesh, whereas in Lebanon per capita remittances is about 1140 dollars. The remittances as a percentage of GDP and Exports also varies. In Philippines, Morocco, Bangladesh, Lebanon, and El Salvador remittances is respectively about 23 %, 25%, 46%, 85% and 65% of export of goods and services. Remittances as percentage of GDP is not that high but in some countries like Lebanon and El Salvador it is about one fifth of GDP. In Philippines, Bangladesh, Guatemala and Morocco it is about one tenth of GDP. The table is confirming the importance remittances in the economy of many countries.

Table-2.6

Workers' Remittances receipts by Major Receiving countries

(In Millions, current US$)

Country	Workers' remittances, receipts	Total Population	Per capita Remittances	Remittances as % of GDP	Remittances as % of Export
India	25108.88	1109.81	22.62	2.74%	12.41%
Mexico	23742.10	104.22	227.80	2.83%	8.86%
Philippines	12481.00	86.26	144.68	10.62%	22.89%
China	6830.46	1311.80	5.21	0.26%	0.64%
Spain	6068.29	44.12	137.55	0.50%	1.90%
Indonesia	5560.25	223.04	24.93	1.53%	4.91%
Romania	5508.60	21.59	255.17	4.53%	13.32%
Morocco	5454.25	30.50	178.85	8.34%	25.26%
Bangladesh	5417.66	155.99	34.73	8.75%	46.13%
Egypt, Arab Rep.	5329.50	74.17	71.86	4.96%	16.56%
Pakistan	5113.00	159.00	32.16	4.03%	26.35%
Lebanon	4623.00	4.06	1139.99	20.31%	85.82%
Colombia	3889.58	45.56	85.38	2.87%	12.76%
Guatemala	3609.81	13.03	277.07	11.96%	---
El Salvador	3315.69	6.76	490.32	17.78%	65.39%

Source: World Development Indicators, December 2008

6. Conclusions

In this chapter we have explored the statistics of international migration. At first we explored the data of the world migration and found that the world is experiencing a steady increase of stock of migration. But the total number of migrants is still not very high given the world population. As expected the rate of growth of migrants stock is higher in the most developed parts of the world. We have also looked at the data on bilateral migration. It appears that regional wealthy countries are the major destinations of migrants all over the world. We then have looked at migration of skilled people and found supports for the hypothesis that migration of skilled people has increased in the last decade. Lastly we have looked at the data of remittances and found that in some countries ratios of remittances to GDP and export are very high. It confirms the importance of remittances in the economy of many countries. These findings of the chapter are truly interesting. They will also guide us in the analysis of the coming chapters.

Chapter 3

The Issues of International Migration

1. Introduction

In this chapter we discuss about some issues of international migration. The chapter serves as a literature review chapter where we discuss about the determinants of international migration, consequences of immigration on host country, 'Brain Drain' or 'Brain Gain', migration and economic development, and global initiatives on linking international migration and economic development.

The discussion of this chapter will give us an overall idea of the literature and issues of international migration. The issues discussed in the international migration literature are just enormous. Concentration on one or two of them may render poor understanding of the true picture of the international migration. The chapter therefore attempts to overcome this problem by extending the scope of discussion. The discussion sometimes may appear not directly linked to the main research conducted in the thesis. But without this discussion the literature review of international migration may appear largely incomplete. We start the chapter by fist discussing about the basic migration theories that analysed the determinants of migration. Then we cover two important topics- the performance of immigrants and consequences of immigration in the host country and the economics on 'Brain Drain'. These two themes are the centrepieces of debate within economic literature and highly relevant to the analysis done in the upcoming chapters. We then discuss about the linkages between international migration, economic development and remittances. The last section reviews the issues linked the initiatives of international bodies and multilateral aspects of international migration. The chapter is mainly a review chapter but our views regarding the issues time to time accompanies the discussion.

2. Determinants of International Migration

A number of papers have analysed the determinants of migration of people within the regions of a country. The literature is largely applicable also for international migration. In this section we will discuss about them. The determinants of migration are more or less an empirical matter and they can substantially vary depending on the characteristics of sending and receiving regions (countries) as well as the attributes of migrants. But most notable and common is probably the wage differential arguments. One of the earliest literature by Ravenstein in 1885 (Greenwood 1997, Arango 2000) also pointed out that the employment and wage opportunities were the major determinants of migration. It had been also mentioned that bad oppressive laws, heavy taxation, unattractive climate, uncongenial social surrounding, slave trade, transportation all produced and producing the currents of migration.

Wage differential model of migration has special implication for developing countries. A few works took wage differential motive of migration as given and proposed models that are highly influential in policy making in developing countries. Here we will mainly concentrate on two highly influential wage differential based models namely Lewis model (1954) and Harris-Todaro model (1971). Lewis model postulated that the internal economic structure of an underdeveloped economy can be sub-divided into two sectors. One is a rural technologically backward agricultural sector and another is a technologically advanced urban manufacturing sector. The producers of manufacturing sector act as profit maximisers, that is employ labour up to the point where marginal product equates wage. The rural sector provides subsistence wage and there is excess supply of labour in that wage such that marginal productivity of labour is nearly zero. This labour has been termed by Lewis as surplus labour. As marginal product is almost zero this surplus labour can be removed from agriculture without sacrificing the agricultural output. Lewis argued that the goal of economic development can be achieved by transferring the surplus labour to the industrial sector by enabling industrial sector to increase production. It is assumed that the wage rate in manufacturing sector is higher than the agricultural sector's wage and

this wage difference can induce labourers of agricultural sector to migrate to industrial sector. With reinvestment of accumulated profit, manufacturing sector can uninterruptedly grow by using the surplus labour until all surplus labour of agriculture is fully exhausted.

Lewis model was a significant advancement in the field of development economics. But urban area based industrialisation policy gradually started to loss the favour as other consequence of such policy started to emerge. It was found that urban area itself had been suffering from unemployment problem. What really appeared surprising was the continuum of rural to urban migration in the presence of urban unemployment. Harris-Todaro model (1971) came with an explanation of this phenomenon. Harris-Todaro model assumed that rural urban migration proceeds in response to the expected wage differential instead of actual wage differential. That is as long as the "probability or ratio of urban employed workers divided by total urban workers" multiplied by urban wage rate is higher than the rural wage rate, rural labourers find it rational to migrate to urban sector to get higher urban expected wage. In the model, urban wage rate is assumed institutionally/politically fixed above the market clearing wage rate. In response to the higher urban fixed wage, rural labourers start to migrate to urban sector but not all of them find employment as the urban producers employ labour only up to the level where marginal product equates the fixed wage rate. But the migrants stay in urban area as urban producers picks labourers randomly from the pull of urban workers comprising permanent urban proletariat and migrant workers. If expected urban wage is still higher than rural wage, more people migrate to urban sector to get higher urban wage even some people in urban sector remained unemployed. With this flow of migration from rural to urban sector urban unemployment increases, urban expected wage falls and the equilibrium in the labour market is reached when urban expected wage become equal to rural wage[1]. Thus urban fixed higher wage results in unemployment in urban sector and consequently the economy

[1] Here we have provided a general idea of the labour market equilibrium in Harris-Todaro economy. The equilibrium can differ depending on the structure of the economy. The equilibrium expected wage rate can be higher, equal or less than the market clearing wage. (See the geometric interpretation of the model given by Corden and Findlay (1975)

produces and consumes less than what it is capable of producing and consuming with full employment. It is assumed that the socio-political situation of less developed countries does not permit reduction of the fixed urban wage rate. Therefore use of subsidy becomes a necessary instrument to increase the employment and output of the economy. The outcome of the subsidy, however, differs depending on the model and the form of subsidy. It is usually found that if subsidy is given to agricultural sector it improves welfare, but if subsidy is given to manufacturing sector it may not improve welfare all the time. The best policy suggestion by Harris-Todaro model is usually uniform subsidy to both sectors.

The original Harris-Todaro model was a closed economy model. Later on economists like Bhagwati and Srinivasan (1974), Corden and Findlay (1975) and Batra and Naqvi (1987) and others reanalysed and restated the model to allow for international trade and wider ranges of policy analysis. Harris-Todaro model is still highly influential in policy making. It had special role in changing the industrialisation paradigm. Earlier the economists were favouring import substituting industrial policy. Urban area based industrialisation policy is now no longer unquestionable. Krugman and Obstfeld (2003, page 266-267) stated that Harris-Todaro model served as a severe blow and consequently changed the paradigm of industrialisation.

The wage differential explanation is broadly applicable to both internal and international migration. But wage differential in reality as noted by Ravenstein does not provide the only reason of migration. Sometime migration fails to occur even in the presence of substantial earning differentials (LaLonde and Topel 1997, pages 805-806). Such as income uncertainty in the receiving country may deter risk-averse persons from immigrating, even if expected earning gains are higher. The cultural ties and cultural differences between source and receiving country add up to the cost of immigration. Therefore ethnic enclaves in receiving country encourage new migration.

Migration can also be explained in term of relative deprivation (Stark 1991, page 86, LaLonde and Topel 1997 page 806). It has been observed that rural to urban migration rates are not highest among the poorest villages,

migration rate are highest where distribution of income size is more unequal, the propensity to migrate from these villages is highest among the most poors. The phenomenon is explained by stating that people derive satisfaction not only from their own well being but also from their relative stands in the community. Immigration may occur as a result of people's willingness to change their relative standing position. In an empirical study, Stark and Taylor (Stark 1991, pages 119-139) estimated the influence of relative deprivation and found significant positive effects of relative deprivation on labour time allocation on Mexico-US migration.

Migration decisions are often made by households of families instead of a single individual member. Hence migration may act as a family/household decision to maximise earnings and diversify risk. For example rural households may diversify the sources of earnings by sending an individual member to work in urban area. The remittances sent by the migrants may be used to introduce new agricultural technology. On the other hand households act as insurers for the individual migrants which hedge them against turbulent urban labour market. Remittances help to establish the claim of a migrant over household's property. Thus continuation of remittances, apart from altruistic reasons, in this regards can explained as an outcome of implicit contract between the individual members and the households (Stark 1991, Pages 216-235).

Empirical works on the determinants of international migration are rare (LaLonde and Topel 1997). The reason for lack of empirical works is that large usable data sets on both individual immigrants and non emigrants are rarely available. Given the unavailability of data set, internal migration studies are regarded as source of information that drives international migration. Using micro-data on individual these studies relate migrants' status to a list of observable personal, family and socio economic characteristics.

Rotte and Volger (1998) tried to find the determinants of migration flow from LDCs to an industrialised country. They used a data set on immigration from 86 countries to Germany. The study confirmed the importance of differences of living standards. It was found that a U-shaped relationship exists between migration and development from which it was

concluded that migration would increase in short and medium term if economic condition of LDCs improves. The political situation had significant negative and network effect had significant positive effects on migration. The effects of distances as expected were negative.

Another work is World Bank (2006) that used the approach developed by Timothy Hatton where migration acts as a form of human capital investment. It has been found that the migration rate is positively correlated with expected income differentials and negatively correlated with the expectations of improved quality of life at home. The significant negative effect of the stock of migrants rejects the commonly referred "network" effect in some countries and suggested instead that the existence of factors such as increased competition in the labour market of the destination country, anti-immigration policy, racial intolerance, and other factors may make migrant stock a poor predictor of future migrant flows. As was expected, distance is negatively correlated with the migration rate in all models.

We will end the section with some comments on return migration. It has been observed some people migrate back to home after some period of time. The explanation of return migration is given by risk spreading motive, location-specific preferences, higher purchasing power of host country's currency at home country, higher return to human capital, higher return to self employment activities. Optimal migration duration may have inverse relation with wage differential as if migration is temporary, then migrants may wish to stay in host country for longer period to earn desired income when wage gap is small (Dustman 2003).

3. Migrants and Host Country

The most important reason for international migration is wage differential and employment opportunity in the country of immigration. A related concern of literature on immigration is the real performance of immigrants and the effects of immigration in economies of host countries. A substantially large and influential literature have discussed this issue. In this

section we will discuss them largely based on the reviews like Borjas (1994), Freiberg and Hunt (1995), LaLonde and Topel (1997), Gaston and Nelson (2007).

3.1. Performance of Immigrants

The performance of immigrants in the host country is eventually an empirical question. Given the substantial income gap between source and host countries, immigration should improve the well being of new immigrants. Another question received considerable attention from literature is how immigrants perform compared to the natives and other immigrants. In this section we will discuss the issues.

As mentioned in Borjas (1994) the studies have pointed out that immigrants start from a lower earning level compared to the natives. But earlier studies (Chiswick 1978 and others) in this regard showed that immigrants experience faster rate of growth of earnings compared to the native thus they catch up and eventually starts to earn more than the natives of similar characteristics (age, years of schooling, marital status etc.). Such as in US at the time of arrival immigrants earn about 17 percent less but because of faster growth rate immigrants overtake natives within 15 years of arrival. To explain the result, it is argued that at the time of arrival, immigrants earn less than natives as they lack the country specific skills (e.g. US requires English proficiency). It is argued that immigrants are more able and highly motivated than natives, that choose to work longer and harder than natives, thus they experience faster growth rate of earnings.

The empirical strategies of the early literature had been challenged by Borjas (1985) by stating that it might be the case that newly arrived immigrants were inherently different from those who migrated 20 years ago. That is there can be intrinsic differences in productivity of migrants' cohorts. Hence current labour market experiences of those how arrived twenty years ago cannot be used to forecast earnings of newly arrived immigrants. The cross section showed that immigrants who had been in US for several decades

had higher wages than natives. For example those who came between 1950 and 1960 earned 19.6 percent higher than natives in 1990, those who arrived between 1985-1989 earned 31.7 percent less. Thus different cohorts experienced different wage growth rates. It was suggested that changes of wage structure and relative skills had caused the differences across different cohorts. Again when comparing the wage convergence between immigrants and ethnically similar natives, evidences showed substantial differences across different immigrant cohorts. It had been found that the relative wage of successive wave of Mexican immigrants declined in 1980 and 1990. The relative wages of other Hispanic and Asian immigrants also fell across successive cohorts. In contrast the relative wages of European and Canadian immigrants rose between 1970 and 1990. In general white immigrants experienced increase and other groups experienced decline in successive cohorts.

The idea of self selection of immigration had been used to explain the decline of relative wages of successive immigrant cohorts arriving in the United States. Borjas (1987) proposed the model of self selection that postulates that immigrants are not selected randomly from the population of source country. The idea is that in order to have immigration taking place we must have the expected earnings in host country higher than that of home country. Different types of immigrants may experience different earning gaps. It can be the case that immigrants' earnings are higher in both source and host countries. In that case it is said the immigrants are positively selected and likely to belong to high skilled group. It can also be the case that in both home and host countries, immigrants' earnings are lower than the average earnings. It is then said that immigrants are negatively selected and are from lower tail of earning distribution. It is also possible that immigrants earn lower than the average in home but end up in upper tail of earning distribution in host country. This has been termed as 'refugee sorting'. The experiences of immigrants thus differ across different cohorts based on how they are selected.

Ladonde and Topel (1997, pages 835-836) however mentioned about further evidences that immigrants do catch up in 10-20 years with ethnically similar natives of similar level of education. But immigrants' earnings do not

approach those of median native. For example earnings of Mexican immigrants approach those of Hispanic natives, but Hispanic natives earn less than the equivalent natives of European ancestry.

There are also few studies examining immigrants' assimilation in other developed countries (LaLonde and Topel page 836). In contrast to Unites States, years spent yield relatively smaller return in countries like Australia, Canada, Germany and United Kingdom. To explain this finding, it had been argued that immigrants of those countries have skills that are more or less similar to the natives. Time spent in receiving country gives incentives to immigrants with significant earning disadvantages, to acquire country specific skills. New immigrants, who can earn as much as natives are likely to have them already, thus do not experience any return by gradually acquiring them further during their stay in receiving countries.

3.2. Impact on Host Country

Another issue received considerable attention in literature is the economic effects of immigration in host country, in particular to wage and employment opportunities of natives of identical characteristics. This is quite a sensitive issue as such economists and policy makers are fairly divided in this respect. The general perception is that immigration increases supply of labour in host country and many of them are willing to work at a lower wage thus it should have a negative effect on wage and employment of native workers. The assumption here is that immigrants are in production perfect substitute to the natives. But as many studies pointed out immigrants can be complement or imperfect substitute, thus can have positive or modest negative effect on the earnings of natives. In this section we will have a brief overview of related literature.

The theoretical predictions of effects of immigration depend on the model used (Freiberg and Hunt 1995 pages 28-30). In the closed economy model immigration lowers the price of factors with which they are perfect substitute, have an ambiguous effect on the price of factors to which they are imperfectly substitute and raise the price of factors to which they are

complement. Such as if immigrants substitute low skilled workers and complement capital then price of low skilled workers will fall and capital will increase. In the open economy model wage rates across countries can differ when countries have very different endowment of factors. In that case migration can force the country to use a more labour intensive mix of products which will lower wage rate. If the migrant receiving country is a large one, then increase of output of labour intensive product may reduce world price which can reduce wage rate further.

This model however can not explain unemployment due to immigration. It can be explained using efficiency wage models in which wage is high above the market clearing rate to give workers incentive not to shirk, as if caught shirking may result in unemployment. Thus equilibrium unemployment is used as workers discipline device. In this model the influx of immigration increases the size of labour force, which allows firms to lower wage and raise employment. But lower wage must be accompanied by a rise in unemployment rate to maintain workers incentive not to shirk. The rise of unemployment rate can be distributed among the native and immigrants.

The empirical literature in this regards is enormous but full of contradictory results (Borjas et al. 2008). Some studies claimed substantial effects of immigration on wage and employment and others reported only negligible impact. The debates and controversies surrounding economic effects of immigration largely result from the methods used in estimation.

The early empirical studies used the so called area approach where large metropolitan areas were held as proxies of closed geographic units where immigration occurs (Freiberg and Hunt 1995, page 30-31). This approach is justified by saying that immigrants are small relative to the overall labour force but they tend to concentrate in major metropolitan cities. Thus the effects of immigration should be felt mainly within those metropolitan cities. For example proportion of immigrants in many cities and the level of wage in those cities can be used to identify the effects of immigration on wage. The empirical literatures based on this approach found only small and negligible effects of immigration on the wage and employment opportunities. For example in USA, Altonji and Card (1991, page 203) in instrumental variable

estimate found that an inflow of immigrants equal to 1 percent of population of standard metropolitan areas of USA reduces average weekly wage by about 1.2 percent. LaLonde and Topel (1991, page 190) also found that immigration reduces the earnings of immigrants and their close substitutes but the effect is not large. For immigrants themselves, a sustained doubling of the rate of new immigrants may reduce the relative earnings of new immigrants by 3 percent but this effect tends to die out as immigrants assimilate to American market.

Borjas (1994, page 1699) criticised the area approach by saying that metropolitan areas are not closed economy. Labour, capital and goods flow in and out of the locality freely. As long as the native workers and firms respond to immigration by moving out of the locality there is no reason to expect correlation between wage of natives and presence of immigrants. In response to the criticisms, recent studies on the effects of immigration are incorporating the issue. Card (2001) again used area approach but incorporated internal migration by natives. He concluded that (page 56) new immigration has not generated any large offsetting outflow of natives and similarly skilled immigrants. As a result the cities experienced a rise in low skilled populations. Card concluded that immigrant inflow effects employment rate of natives but implied effect as a whole is small, even in the bottom of skill distribution only modest employment effect of new immigration was found.

Borjas (2003), instead of local labour market used national level data and found significant effects of immigration on wage of natives. From 1980 to 2000, immigration increased labour supply by 11 percent. This immigration reduced wage of average native workers by 3.2 percent, high school drop out by 8.9 percent and 4.9 percent for college graduates.

The above discussion will give a brief idea about the debates surrounding the wage and employment effects of immigration on natives. The debate is still to be resolved. As stated by Ottaviano and Peri (2008), national data approach (e.g. Borjas 2003) found large negative effects on less educated workers. However cross area approach (e.g. Card 2001) have found small or insignificant effects. Ottaviano and Peri (2008) themselves reworked with national data approach of Borjas by enriching the methodology. They found that the finding of large negative effects of national approach is largely driven

by imprecise estimates of elasticity of substitution between workers of different education level. They found evidence of imperfect substitution between natives and immigrants. However Borjas et al. (2008) reworking with Ottaviano and Peri's study have found that the result depends on the way sample of working persons is constructed. For example finding of immigrant native complementarity disappear just by removing high school students from data. Borjas et al.(2008) suggested that one can not reject the hypothesis that comparable native and immigrants are perfect substitute. Thus the studies are yet to arrive at a general consensus regarding the effects of immigration on the wage of natives of comparable skills.

3.3. Temporary and Contract Workers

Temporary and contractual workers constitute a significant part of today's migration. The processes of determination of wage of such workers and their effects on host country have not been studied much. It can be presumed that wage of such workers are determined through negotiation between host countries (or their agents) and sending countries governments (or their agents) but exact process of such negotiation is rather obscure. In USA or Europe such migration is probably still negligible part of total immigration but in Asia it is the dominant form of labour migration. In Gulf countries, total number of temporary workers can be well above the total population such as in Dubai about 82 percent of the population is foreign born (Benton-Short et al. 2005). Most of them are obviously temporary workers but it is really difficult to confirm how wage rates of such migrants are determined. One example is (IOM 2003) which has several times pointed to the competition among the sending countries, but provided no discussion on exact wage determination process.

The literature of wage determination and effects of immigration as a whole is probably not applicable for temporary /contract labour migration. Before employing foreign workers, employers are normally require to state that such employee is not available within the native labour market. One of the oldest successful contractual labour migration programmes is Canada's

Seasonal Agricultural Programme initiated in 1960s. The reason of the initiation of the programme was the unavailability of agricultural workers in pick seasons even at a high market wage (Verma 2003). The contractual workers are often not allowed to change the job. Thus the question of labour market opportunities is not applicable to them. The wage the contract workers can also differ significantly on the basis of country of origin such as the wage rates of workers in gulf areas. Given this it appears that there is a great need of some empirical researches directed to evaluate wage determination process and effects of temporary workers on the economies of host countries.

4. 'Brain Drain' and 'Brain Gain'

4.1. A Review of the Literature

Since early 1960s, economists are debating about the potential cost or benefit of human migration. The general idea is that those who are migrating to developed countries are the educated/high skilled people of developing countries. For example scientists, doctors, engineers etc. Migration of the highly educated people was regarded as detrimental to the welfare a country, therefore termed as "Brain Drain". The recent literature on human capital formation is however trying to establish that migration opportunity may actually provide incentive to form additional human capital thereby causing Brain Gain in stead of Brain Drain In this section we survey the literature starting from influential paper of Grubel and Scott.

Grubel and Scott (1966) argued against the view that migration is detrimental for those who left behind. They argued that a country loses by emigration of highly skilled individuals is almost always valid when the objective of the country is to increase military or economic power. They referred this concept as outmoded and instead proposed to use the concept of country as a collection of individual whose collective welfare is to be maximised. Most important determinants of human welfare in the long run is

the standard of living- the quantity of goods and services available for consumption thus emigration should be welcomed whenever two conditions are fulfilled that is emigrant improves his own income and his departure does not reduce the income of those remaining behind. If human capital embodied in emigrants is greater than the countries total per capita endowment of human and physical capital then emigration of high skilled people reduces the total income to be distributed among residents of a country. But in market economy where individuals are paid their marginal product, this reduction of income is just a statistical phenomenon which has no effect on the welfare of those remaining behind. Emigrants remove both his contribution of national output and income that gives him a claim of his share so that others income remain unchanged. Given this, any effect that the emigration of highly skilled person is likely to have is through short run adjustment costs or market failures. The short run costs are due to production losses, size of which depends on rate of short run substitutability of other factors of production or skills for those that have emigrated and the speed of replacement of emigrants. The market may fail to adjust in long run if the person possesses special skill which can not be replaced through training. If it is possible to train a doctor than the service of emigrated doctor is lost only for the period required to train another doctor. Thus emigration imposes only short run frictional cost to society which disappears in the long run. It is sometimes argued that public education is a social investment which the emigrants fail to repay. Against this argument they stated that the public expenditure is financed by tax and average burden of financing education falling on the emigrant's generation is not changed by his departure. The emigrant takes along not just his contribution of tax revenue but also his children on whom the share of revenue would have been spent.

In addition of showing that emigration of highly skilled persons reduces welfare of remaining people only in rare circumstance, they also suggested that emigration may actually increase welfare in several ways. Emigrants are known to raise the income level of family through remittances. They can influence the policy of the country of new residence toward the native country. They can give counsel and advice. The potentially largest benefit of people remaining behind may accrue through pure research of

scientists and engineers in foreign country. The product of basic research is a free good available to all when it is published. As conditions of work in new country are better the productivity is high, so native country gains more from scientists emigrating outside.

Berry and Soligo (1969) noted that benefit or loss of emigration is interlinked with ownership of capital. Their analysis includes both static and dynamic analysis of emigration. In both comparative static case and dynamic case emigration is found to cause loss to the remaining population as a whole except where emigrant groups own a relatively high proportion of capital stock or have a relatively high wealth holding propensity and when they leave some of their capital behind them in the home country.

Kenen (1971) conducted standard trade theoretic analysis of emigration. In a one product economy with two factors capital and labour, emigration will have following impacts- total product should fall, marginal product of labour rise and capital decline and average product of labour rise. In a two product closed economy migration of labour reduces production of labour intensive commodity and increases the production of capital intensive commodity. The price of labour intensive product rises, which raises the marginal product of labour and reduced the marginal product of capital. However the gain of labourers can not compensate the loss of owners of capital. In case of two product open economy the result is mixed. If terms of trade is fixed, then is there is no loss or gain of welfare as no redistribution will take place by emigration of a portion of labour. If price is not fixed, then when the country exports labour intensive good, a reduction of production will increase the price and thereby can improve the welfare. On the other hand if source country exports capital intensive commodity, international price of capital intensive commodity reduces and lower is the welfare of remaining population.

Bhagwati and Hamada (1974) marked starting of a new generation of models of emigration known as models with distortion. They reckoned that wage of high skilled individual of a developing country can be higher and fixed above the market clearing wage due to international emulation and associated wage fixation or wage legislation. The wage of the unskilled people

can also be fixed due to "leap-frogging" process that follows the fixation of wage rate by skilled labour. Given this assumption they analysed the effects of migration in a general equilibrium framework. They assumed that the country produces two products, one using high and another using low or unskilled labour. For the labour market equilibrium expected wage of two types of labour must be same. The cost of education is borne by governments and therefore deducted from income equation. When a part of educated labour force can migrate abroad national income always decreases due to higher cost of educating more labour. The supply of educated labour due to higher expected wage can be more or less than the amount of migration. As population decreases, average or per capita income decreases if cost of training of all educated labour is larger than the employment rate of educated labour. National welfare decreases unless reduced unemployment rate in unskilled sector offsets the loss due to decreased per capita income and increased unemployment in skilled sector. Bhagwati and Hamada also analysed the case where cost of education is internalised that is labourers themselves bear the cost of education. It has been found that internalisation of cost of education can improve the income of the country.

Kwok and Leland (1982) argued that the cited cause of migration such as lack of employment opportunities, lower salary, and preference for living abroad is not enough for explaining migration of high skilled people from a booming economy. They argued that asymmetric information as a cause for foreign trained students not to return home after study. They showed that how the decision by an initially small group of graduates not to return home country may eventually cause almost all graduates to remain abroad. They assumed that employers of foreign country can explicitly observe productivity of each foreign trained individual but employers in home cannot. Thus the wage they offer is only the average wage which is not based on individual productivity. As a result workers will return if the wage in abroad is lower than the wage in home. As home producers gather information about productivity from market, return of individuals with lower productivity will lower the average wage. Thus the country loses its most educated individuals abroad which causes Brain Drain.

Miyagiwa (1991) pointed that the literature of Brain Drain is unsatisfactory in two respects. Firstly it typically treats skilled and unskilled labour as two separate factors of production fixed in supply and analyse Brain Drain as a special case in theory of international factor mobility. This approach however ignores the effect of Brain Drain on the process of skill formation. Secondly the literature so far focused on the consequences of brain drain rather than its causes except the paper by Kwok and Leland (1982). The objective of this paper is to emphasis increasing returns to scale in advanced education. The basic idea stem from the observation that productivity of professional work increases with an increase in numbers of similar professionals concentrated in one location. Professional researchers engaged in interaction and communication with one another is more productive than the professionals working alone. Given this background Miyagiwa presented a model of brain drain emphasizing the scale effect of advanced education by assuming an economy endowed with individuals with different level of latent ability. The economy is assumed to produce a single aggregate commodity with labour alone. In the absence of advanced education all individuals remain unskilled regardless of their levels of ability. Acquisition of advanced education enables an individual to perform and earn an income according to his or her ability. The returns to higher education are assumed to increase with number of people receiving education. When students bear the cost of education a rational individual acquires education when the return to higher education is more than the wage of an unskilled individual. The paper then showed that the most gifted individual acquires education even if no one acquires that. He now considers two countries in one of which (America) greater percentage of people takes higher education implying that individual possessing certain number of skills earn more compared to the other country (Taiwan). Thus individuals from one country (Taiwan) have incentives to migrate to America. The inflow of skills in America increases the returns of individuals in America and reduces it in Taiwan. Thus every Taiwanese individual with higher income after migration will migrate to America. The inflow of foreign worker increases national income of America in two ways, first economies of scale raises the income for the Americans who are already

educated. Secondly a higher professional income induces a segment of Americans who were previously uneducated to acquire higher education. In Taiwan, most gifted individuals always gain from migration. The second group of individuals migrate even though the wage after migration is lower than the present wage as migration of the most gifted individual reduces their wage rates at home. The third group does not take education when migration opportunity is possible while they would acquire higher education without migration of gifted individuals. The paper concludes that instead of the traditional view that migration reduces welfare of those who remain behind, it argues that professionals possessing intermediate level ability are actually hurt by Brain Drain.

Recent works on Brain Drain literature are attempting to recognise the beneficial side of human migration through its positive incentives in human capital formation. The main message of the literature is that when migration is possible returns to human capital increases which give incentives to form more human capital. If newly formed capital is more than the amount migrated, we have Brain Gain instead of Brain Drain.

One of the first papers of this literature is Stark et al. (1997). In this paper the economy consists of equally skilled high-skilled and low-skilled workers. The optimal levels of human capital acquired by high skilled and low skilled workers are different. The cost of acquiring human capital is higher for low skilled workers and lower for high skilled workers. Wages are higher in foreign country compared to home country. The home country workers have a preference for home country life style therefore wage received in foreign country is discounted by given rate to compare with home wage. It is assumed that the skill levels of migrants are unknown to foreign employers. Therefore in the first period they offer all migrants the average wage of high skilled and low skilled workers in foreign country. But in the second period individuals skill levels are identified using a screening device and wage is offered accordingly. Given higher average wage in foreign country, all types of workers migrate in first period. But in second period low skilled workers return to home country if the discounted wage of foreign country is lower than the wage of home. High skilled workers remain in foreign country. Migration

results in Brain Gain if optimal level of human capital acquired by low skilled workers is higher compared to the average level of human capital without migration opportunity.

Mountford (1997) showed that when educational decisions are endogenous and if successful emigration is not certainty, Brain Drain may increase productivity. The possibly of migration raises the return of education that leads to increased human capital formation and may out weight brain drain. Additionally migration also has effects on income distribution dynamics. It is assumed that individuals' accumulation of human capital is a function of parents' level of human capital and resources invested in human capital accumulation. Thus, the greater the human capital of parents, the easier is the accumulation of human capital for offspring. The offspring of the parents who remain in home country now tend to acquire higher education and average level of human capital tend to rise in long run. Temporary migration opportunity is beneficial for the economy. But if Brain Drain is continued the economy ends up with low level of human capital.

Stark et al. (2002) proposed a different model but came out with similar conclusion of Stark et al. (1997). They argued that the prospect of migration can induce individuals to form the socially desirable optimum level of human capital. The individuals do not consider positive externalities that human capital confers to production and acquire less human capital than the desirable level. There is a need to subsidise education in order to form socially optimum level of human capital. The paper argued that the prospect of migration may act as a substitute of subsidy by giving incentives to acquire more human capital. A controlled migration policy can be an effective instrument to enhance the level of human capital and increase welfare of the economy. The paper worked with both homogenous and heterogeneous workforces though the results are similar. The paper has assumed that production is a function of the level of individual human capital plus externalities arise from economy wide average level of human capital. Externalities in production arise as individuals acquiring human capital make each other more productive. The paper then derived the chosen level of human capital by workers. When all workers are identical, the chosen level of human

capital by individual workers is same as average level of human capital in the economy. When deciding to form about human capital, individuals do not internalise the economy wide average level as such the equilibrium level of human capital is less than the socially optimum level. It was then showed that in absence of migration, government can use a combination of subsidy and tax policy to achieve the optimum level of human capital.

The paper argued that migration can act as a tool to mitigate inefficiencies arising from human capital externalities. Given the possibility of higher earnings in foreign country, individual workers choose to form more human capital than they choose in absence of possibility of migration. The benefit of home country from migration arises when possibility of migration makes the non-migrants better off. The paper showed that benefit of migration increases up to a unique migration probability. Given that probability, the paper argued that restrictive migration policy by home country can achieve the socially desired optimum level of human capital. On the other hand a liberal migration policy can reduce welfare of workers who stay in home country.

Another paper that forwarded similar proposition is Beine et al. (2001). In addition to proposing a theory, they also tried to provide empirical evidence in support of the theory. The model depicted a small open economy with over lapping generation of two period-lived individuals. In first period, the agents have possibility to allocate a share of their time to education. In second period, they supply a fixed quantity of labour and their productivity depends on their investment in human capital when young. It is assumed that individuals have different abilities to learn. The individual takes both domestic and foreign wage in comparison when deciding about investing in human capital but they all face a fixed probability of migration. The ability of critical agent at which individual is indifferent between working abroad or home is higher when migration probability is low and high when migration probability is low. Then they showed that equilibrium growth rate is directly proportional to the number of educated people who remain home, which they called drain effect. On the other hand growth rate is decreasing function the ability of critical agent which they have called brain effect. Beneficial Brain Drain occurs when brain effects dominated drain effects. After identifying the conditions at which

migration can benefit a country through increased human capital formation, the paper attempted an empirical investigation from a sample of 37 developing countries. The estimation showed positive and significant correlation between migration and wage differentials, strong and significant negative correlation between migration and population size. The estimation depicted a positive relation between human capital accumulation and growth. The variable for migration, depicting drain effect was found insignificant. Though the estimation procedure had serious limitations, they concluded that empirical evidences do not reject theoretical analysis.

There are a few other works but inherent messages are almost similar. Fan and Stark (2007) provided an alternative analysis of educated unemployment problem. The paper showed that given the prospect of migration and getting higher wage in foreign country, individuals can voluntarily remain unemployed in order to have time to search job in foreign country, which may cause "educated unemployment" observed in developing countries. Therefore a developing country may end up with more educated workers despite brain drain and educated unemployment. The paper assumed two countries titled as home (H) and foreign (F). Only educated individuals of H have a chance to migrate to F. In first stage, after graduating from university, the individual participates in a draw that results in probable work in F. In second stage, those who did not win in lottery faces the choices: to work in H or to face another draw. Waiting for another draw frees time for job search. It has been showed that the number of individuals taking university education increases as probability of migration rises but leads to increase in unemployment of university graduates. The paper then showed that the number of university graduates remaining in home country increases up to a unique migration probability. As there are fewer individuals in the country under feasible migration, the average level of human capital is higher with migration. The paper commented that higher average human capital can play a crucial role in determining long-run output growth.

4.2. Criticisms of 'Brain Gain' Literature

In the above review we have discussed about some papers of the literature of Brain Drain. Though there are many concerns about Brain Drain within general public and politicians, in summary, it can be said that the theoretical literature does not necessarily argue against migration, in fact a few of them showed that migration can actually be beneficial for sending country. Nevertheless, the recent literature on beneficial Brain Drain appears too simple with the claim. They do not take into consideration a few common aspects of human migration. They just have classified skills as high or low skills but in reality, different types of jobs require different types of skills. For example, taking mathematics class would require skill in mathematics but working as a chef in restaurant requires skill in preparing different types of dishes. It is not possible for an individual to master all types of skills. In the planned immigration programme foreign countries demand individuals with special skills such as doctors, agriculturalists, chefs, electricians etc. Though some skills are expensive to acquire compared to others, foreign market demand does not depend on the cost of acquiring skill. For example, foreign market may demand more nurses, but the cost of training doctors may be higher. The foreign market may demand some skills that do not have much demand in home country such as language skills. Therefore in order to migrate if individuals want to form more human capital, they may form it in accordance to foreign demand. If they fail to migrate, the acquired human capital may find no use in home. The investment and time spent acquiring additional or new human capital is hence just wasted. A country therefore should be careful in depending on receiving incentives from a foreign country in forming human capital to be used within its territory.

A criticism of new literatures can be found in Schiff (2006) though it to some extent failed to take into consideration the differences in skills as mentioned in the previous paragraph. The argument of the paper can be summarised as follows:

a. Individual/group heterogeneity:

Positive probability of migration increases expected wage of individuals of home country. Thus low ability individuals who previously deterred from investing in education now invest in education. Though more people are obtaining education, average ability level of individuals with migration is lower than no-migration situation. If the ratio of newly educated individuals to total educated individuals is equal or less than migration probability, migration will definitely result in lowering effective human capital stock. Migration may result in Brain Gain only if the ratio is higher than migration probability, though it is not certain.

b. Unskilled migration:

The brain gain literatures show that expected returns of education increase with migration. When both skilled and unskilled labours can migrate expected returns of education fall. Thus when both skilled and unskilled labours can migrate Brain Gain is small.

c. Brain waste and negative Brain Gain:

Foreign workers are often hired to do jobs for which they are overqualified. Some destination countries only hire unskilled workers, irrespective of qualification, but attract both types of workers as unskilled wage of foreign country is higher than skilled wage of home country, which reduces incentives to acquire more education.

d. General equilibrium effects:

An increase in education requires additional fund. Time spent on education means less work and lower income tax revenues. The fiscal authorities can increase tax or reduce educational subsidies or reduce other expenditures. A reduction in other public expenditures involves reduction of health expenditures. Because human capital depends on both education and

health, a reduction in health expenditures may reduce human capital. The new Brain Gain literature assumes that only education has positive externalities. But other sectors of the economy also have externalities. A reduction of other public expenditures constitutes loss of positive externalities thereby reduces the effects of Brain Gain on welfare and growth.

e. Migration probability:

In the literature, it is assumed that the home country controls migration. But except for a few countries like China, migration is controlled by the destination countries. It is also assumed that migration probability is exogenous that is independent of individual's education decision. But most destination countries keep a quota for new immigrants. Thus the migration probability is likely to change with the change in stock of educated people. When migration raises educational expenditure, stock of educated people increases and migration probability falls. The stock will thereby increase at a decreasing rate and become zero in steady-state. On the other hand if migration causes Brain Drain, that is, net increase in human capital is less than the migrated amount, steady state stock is smaller than the initial one. Thus migration may result in lesser Brain Gain than argued by new literature and even can have negative Brain Gain.

4.3. Empirical Works on 'Brain Drain' and 'Brain Gain'

A few papers have attempted to empirically investigate the hypothesis of Brain Drain (Gain). One attempt as mentioned before is Beine et al. (2001). The work is however not quite up to the point in examining Brain Drain (Gain) hypothesis. We have found two recent attempts that have explicitly tried to address this issue. We will discuss them below.

One of the papers are Commander et al. (2004b) that tried to investigate the beneficial Brain Drain hypothesis that skilled migration can be good for sending country through the incentives it creates for training, that increase supply of skilled labour. The study was based on two surveys of

overseas doctors working in UK- a small telephone survey and a larger internet and postal survey. The data is based on the subjective statement of migrant doctors themselves. In summery their result suggested only relatively weak links between migration possibilities and decision to study medicine from which they concluded that the educational channel of beneficial effect of Brain Drain is not particularly plausible. However about 45% doctors interviewed in small survey send remittances to home country. On average remittances were 16% of their incomes in UK. Considerable number of doctors (about 50% also showed intention to return back to country. The result suggests that remittances and return migration are more important then educational incentives for sending country to gain from migration.

Commander et al. (2004a) is another work that tried to address the issue of Brain Drain. This work is based on a dataset of 225 Indian software firms. The data set provides a detailed look at output and skill composition of these firms and their exposure since 1999 to 2002 to the loss of skilled personnel to firms in developed countries. They concluded that the results, on balance, are not generally consistent with an adverse Brain Drain story. In the first place, the software industry has been marked by a variety of types of cross-border mobility, much of them are temporary. Firms in the sample reported that very significant shares of their workforces performed some parts of their works on or off site in developed countries. Further a significant number of those employed have experiences of working in a developed country. Moreover, the share of skilled workers with such experience has tended to be positively associated with current and lagged incidence of skilled migration from the firm. They concluded that it points to the presence of network effects as well as confirming the importance of temporary mobility.

The limiting factor of the two papers is that they are trying to investigate only the impact of the high skilled migration from two sectors- doctors and engineers. As mentioned earlier, considering skills as just high or low skill is a gross mistake that the literature in general seems to suffer. Skills can be severely different from each other. Foreign market can demand any of them plus not all high skills are demanded by foreign country. For example in most countries law profession is considered as respectable and high income

profession but they don't have foreign demand. Another way to look at the issue is that foreign market may demand low skills instead of high skills such as nurses or chefs for restaurant instead of doctors and engineers. Thus according to Brain Gain hypothesis more people in home should be trained in these skills instead of becoming doctors and engineers. Based on this argument it appears that there is a great need of empirical works aimed at identifying the effects of foreign market demanding particular skills, in the skill formation of the country of emigration.

5. Migration, Remittances and Economic Development

Governments and International bodies are recently emphasising on migration and remittances to meet the goal of development. In order to understand the linkage between international migration and economic development we first need to know how fulfilment of the development goals can be facilitated by international migration. In this section we will devote our discussion on this topic. This emphasis of linking migration and remittances to economic development can be observed in a number of recent initiatives of UN, World Bank, IOM and other organisations. Though the development discussion often refers to the gain of developing countries, the developed countries in reality also can receive substantial benefit from international migration. Thus we first discuss it in the context of developed countries and later on discuss in relation to developing countries.

5.1. Developed Countries

5.1.1. Declining Labour Force

Why developed countries recruit migrants from other countries? The question is simple to meet the labour market needs. It is well known that the labour forces of developed countries are declining gradually. As mentioned in

the World Bank (2006), the wage group that supplies the bulk of labour force (15-65 yrs) is expected to peak near 500 millions in 2010 and then fall to around 475 by 2025. In Japan the labour force has already started to shrink. In Europe it has reached the peak in 2007-08. For USA the peak will come around 2015. Thus there will be a great shortage of labour force in those countries in near future. It is needless to say the fall in labour force will be accompanied by a rise in dependency ratio.

5.1.2. Demand for Additional Workforce

Point base immigration system is now a common practice in developed countries. The aim of point based immigration system is to acquire high skilled and wealthy manpower from other parts of the world. While the reason behind high skill is the market demand for such manpower, the reason behind wealthy manpower is capital transfer and exclusion of immigrants from social security benefits to keep entitlements exclusive to natives. In addition immigrants often fulfil the demand of labour in jobs disliked by natives such as cleaning, construction, manufacture, agriculture etc. As mentioned in Verma (2003) the agricultural sector of Canada in sixties felt shortage of labour as domestic workers were unwilling to work in farms in rural areas even at a high market wage rate. The presence of immigrants is probably keeping wage rates of these services within affordable limit.

5.1.3. Enhancing Tax Base

Migrants are probably helping to enhance the tax base of the developed countries. The dependency ratio of the developed countries is rising gradually. Thus there is a need to generate extra revenue to fund the public expenditure such as roads, infrastructure, health services, education etc. A planned migration program can lower the fiscal burden of natives to some extent. (Storesletten 2000) analysed the case where government faces increased fiscal pressure due to ageing of population. He showed that regulated programme

aiming to allow entry of young high/medium skilled can contribute in sustaining the fiscal policies of government.

A common perception in developed countries is that income of immigrants are low thereby their contribution to tax revenue is low. In addition, it is thought that illegal migrants do not pay any tax at all. Thus immigrants are considered as a burden for a country in term of public expenditure. This view is quite faulty. Legal migrants pay income tax according to their wages but are often not eligible for receiving social benefit because of conditions attached to visa documents. Some work permit holders are required to work for a certain period of time (e. g. 5 years) before they can apply for permanent residency and get entitlement to receive public funds. But before this time period they are not legally considered eligible to receive all the benefits as applicable to residents. Even illegal migrants do pay tax; a simple example of it is consumption tax like VAT. Some illegal migrants obtain counterfeit tax identification number to obtain jobs. The tax they pay can effectively be higher than legal workers (Lipman 2006). In addition many people of developed countries receive substantial amount of unemployment benefit. As migrants are usually young, employed and citizens of other countries they are usually excluded from receiving the benefits. But they are subject to payment of same taxes as natives. Thus transfer of benefit from migrants to natives is the most likely the case.

5.2. Developing Countries

There are a number of channels through which international migration can facilitate the fulfilment of development goals of poor developing countries. In many developing countries remittances is an important part of export earnings. The remittances are expected to enhance investment, reduce poverty, improve health and educational expenditure. In addition migration can induce formation of additional human capital. The return migrants can be source of dissemination of knowledge and technology from developed to developed countries. But to what extent international migration is actually fulfilling the objectives is an empirical question. We will briefly discuss some issues below.

5.2.1. Consumption, Investment and Remittances

A common perception in developing countries is that a substantial fraction of income from remittances is used in unproductive things like personal consumption, purchase of land and building residences etc. But it is often not understood that these increased consumptions are really important for the families unable to meet minimum requirements of food and shelter. Thus the importance of remittances to boost up households' standard of living needs to be properly recognised. A recent study has showed that a 10 percent increase in per capita official remittances leads to 3.5 percent decline in the share of people living in poverty (World Bank 2006, page 120-121). Though there is claim that remittances may lead to further inequality but evidences are not so far clear (World Bank 2006).

Furthermore the studies are showing that migration can also spur investment expenditure by households. In Mexico it has been found that households with international migration spent more on investment and less on consumption than other households of same income level. Similarly another study on Egypt showed that households receiving more income from remittances spent more on investment expenditures (Taylor 2006). On the other hand some studies also showed that migration and remittances may have negative effects on investment. In Pakistan migration was found to effect non-farm investment negatively. The result suggests that the factors, such as absence of male members, can be more important than binding resource constraints. Nevertheless the household with return migrants are found to invest substantially higher in non-farm and agricultural lands (Mansuri 2007). Another interesting work is Yang (2008) that studied the effects of exchange rate shocks on Filipino migrants' households during 1997's financial crisis. The income shock due to appreciation of foreign currency was found to have negligible effect on consumption. Instead households have been found to increase educational expenditure, taking children out of labour force, raised work time in self employment and have started capital intensive entrepreneurial activities.

Network effect is perhaps another channel through which migration can enhance investment. Migration creates demand for local products in foreign ethnic market. This demand can enhance investment in production, procurement and processing of those local products in country of origin. In addition wealthy and established migrants are found to invest in business not just in the locality but all over the country of origin. Thus migration and remittances in many ways can spur investment expenditure.

5.2.2. Educational, Health Expenditure and Human Capital

The increased earning through remittances is expected to be used for increased educational and health expenditures. A number of studies have showed that migration and remittances do have positive effects on the level of health and educational expenditures of households (World Bank 2006, Acosta et al. 2007, Mansuri 2007). The effects of migration on endowment of human capital of a country have received extensive attention of theoretical literature. As already discussed there are claims that migration can have positive effects on human capital formation of a country. But the claim is yet to be confirmed by empirical literature. Besides there are some evidences that migration can negatively influence human capital formation by raising the endowment of locally unproductive human capital thus can deprive the country of necessary human capital. McKenzie (2006) has found that migration can negatively influence educational attainment such as it lowers the completed years of education by 1.4 years for boys and 1.7 years for girls. As an explanation it is stated that children aged 16-18 migrate to obtain work thus drop out of schools. With migration, future return to education in home is lower for children who intend to migrate, thus aspirations of education are lower. Moreover, absence of migrating parents results in less supervision and there is a need to undertake household works in place of migrant adults.

The effects of return migration in this regard needs to be studied. In Stark et al. (1997) return migration plays crucial role in enhancing human capital endowment. But the work experiences gained by migrants in a foreign country may not be useful in country of origin or may not add anything above

the experiences of similar types of works at home. This is broadly applicable to all types of professions like doctors, engineers, technicians, teachers etc. It is however possible for these people to introduce new technologies back home using the experiences they have gained such as the use of new medical equipments. Enhanced human capital due to migration may increase a country's ability of leaning from a foreign technology base (Lee 2008). Again sole reliance on foreign experience and externally innovated technologies may hinder the way of development of domestic technologies and professionals.

5.2.3. Migration and Labour Market

Migration may influence the labour market of country of origin in two ways. As already mentioned, migration may increase investment expenditure thereby create additional employment. But the country may experience shortage of manpower specially skilled manpower. The shortage of manpower may result in lower investment (Mansuri 2007) and low educational attainment by children of migrating parents (McKenzie 2006). Remittances may induce people to become less active as indicated by Acosta (2007). But when a country is characterised by large disparity of income and high income region feel shortage of manpower due to international migration, the country may observe internal migration within regions. This is a very interesting issue to explore as internal migration here can be caused by both the shortage of manpower and enhanced capital investment. Empirical studies in this regards is highly desirable.

5.2.4. Macroeconomic Effects of Remittances

Macroeconomic importance of remittances is substantial. In many countries of the world remittances are almost as important as the exports of commodities (see chapter 2). Remittances is found to be a stable source of income of a country. It can be counter cyclical (World Bank 2006) as remittances may increase during hard times like financial crisis, natural

disasters political conflicts as migrants may send additional funds to help their families and friends. Remittances can improve a countries credit worthiness which makes access to international finance easier. Several banks of developing countries such of Kazakstan, Mexico, El Salvador recently have been able to raise external finance by securitisation of remittances.

From the discussion provided in this section the linkages between migration, remittances and economic development should be clear. Migration does not provide solution to all problems and not all the time it has positive effects. However migration is now an indistinguishable element of the world economy. Hence international bodies are emphasising on initiatives to make maximum use of migration and remittances to meet the development needs. We have therefore devoted the following section to discuss about the initiatives of international bodies about international migration and economic development.

6. International Initiatives and Bilateral and Multilateral Aspects of International Migration

International migration is now increasingly viewed as a multilateral phenomenon which involves a large number of countries through traditionally it is viewed as a unilateral or bilateral matter. In this respect special importance is given to the Mode 4 of GATS. In this section we briefly discuss about it. In addition we also discuss about the temporary migration and bilateral migration agreements.

6.1. WTO and Mode 4 of GATS

It is now well recognised that it is not possible to contain the movement of people from one country to another country. Thus it is now regarded that migration should be well managed in order to a stop it becoming a global ‘Bad’ instead of global ‘Good’ and Mode 4 of GATS provides a unique opportunity for more effective management of temporary movement of

workers across borders for the supply of needed services in another country (Katseli 2006). GATS is in fact the only genuine global agreement relating to migration (Hatton 2006, Borde 2007). The aim of GATS or General Agreement for Trade in Services is to regulate services trade and the Mode 4 of GATS covers movement of natural persons. GATS is one outcome of Uruguay round negotiation leading to formation of WTO in 1995. The other two are GATT and TRIPS (Agreements on Trade Related Aspects of Intellectual Property Rights).

GATS defines four ways through which services can be traded, also known as mode of supply and Mode 4 or Movement of Natural Persons is one of them. Other three are Crossborder supply or Mode 4 (Services supplied from one country to another e.g. international telephone calls), Consumption abroad or Mode 2 (Consumers from one country making use of a service in another country e.g. tourism) and Commercial presence or Mode 3 (A company from one country setting up subsidiaries or branches to provide services in another country e.g. a bank from one country setting up operations in another country). It is important to note that the 'Movement of Natural Persons' or Mode 4 does not cover permanent migration or self employed people seeking employment in foreign country staying in foreign country[2].

The progress of Mode 4 in international labour movement is still negligible. The reliable estimates are still unavailable but as appears estimated Mode 4 trade accounts to only about 5 percent of total services trade (Magdeleine 2008). The reason for the slow progress of Mode 4 trade is the unwillingness of countries to open borders for Mode 4 trade. It is argued that Mode 4 is unworkable because it is not flexible enough. International migration requires shared responsibility of both sending and receiving countries (Panizzon 2008). GATS does not impose such positive obligations.

In the recent WTO rounds it had been observed that both developed and developing countries are reluctant to open up their borders for Mode 4 trade (Winters 2005). The developing countries are increasingly seeking

[2] Reader may look at WTO website http://www.wto.org/ and Handbook of Trade in Services edited by Matto et al. (2008). Bossche (2008) gives a detailed discussion of WTO rules and comparison between agreements.

access to developed countries labour market under Mode 4. However trade negotiators and politicians from US and EU argue that Mode 4 is unworkable, particularly for semi-skilled and unskilled service providers, as source countries cannot guarantee return and hence temporariness (Friedman and Ahmed 2008). On the other hand developing countries are also nervous to offer boldly under Mode 4. Along with social and racial concerns, as they also fear resistance of unskilled workers to immigration (Winters 2005). There are also divisions of interests among the developing world which explains why strong coalition is not growing up. For example, commonwealth citizens receive favourable treatments in several temporary migration schemes. Applying MFN clause would increase competition thereby would reduce benefit. For example the Indian doctors in UK (Winters 2005) and Filipino workers in Japan (Friedman and Ahmed 2008).

Hence the progress of Mode 4 negotiation is still not very encouraging, but one should not be disheartened so soon. It took about 40 years to reach a global agreement on goods trade. The idea of trade in services is still very young. Many countries are now willing to enter into bilateral migration agreements to control and manage migration. The bilateral agreements are though substituting Mode 4 to some extent, lessons of future multilateral negotiations can also be learned from them (Friedman and Ahmed 2008). What needed here are some studies aiming to depict the need of multilateral migration management like Mode 4. Only a few attempts this regard has been taken. Further research in the respect is highly desired.

6.2. Temporary Migration and Bilateral Migration Agreements

Temporary migration implies that migrants will stay and work in a country for some prefixed time period and afterwards must return back to home. However the people of receiving countries often fear that temporary migrants can become permanent, gain voting power and may induce change in social, ethnic and cultural characteristics of receiving countries. The fear to

some extent comes from previous experiences with migration such as German Guest Workers' Programme (RUHS 2006).

The western developed countries are recently showing renewed interest for temporary migration programmes. Nevertheless temporary migration programmes are very effectively working for a substantially long period of time in oil rich Middle Eastern countries. After development of oil exports, the countries felt acute shortage of labour force which led to large increase in recruitment of both skilled and unskilled workers from other countries especially Asian countries (Castles and Miller 2009). Asian workers come under short term contract (generally only one or two years). Private agencies were established in the sending countries to recruit labour but some governments actively promoted contracts for their construction companies and workers. Major destination countries in Middle East are Saudi Arabia, Kuwait, Oman, Bahrain, UAE and Qatar. These six countries together formed the Gulf Cooperation Council (GCC) that among other things, addresses the demand for migrant labour as well as to their requirement to control and management of migrant population. They follow a system called Kafala system in which all migrants need sponsorship from a permanent resident of Gulf. The migrants can never become permanent resident no matter how long they stay (Longva 1999).

The migration in gulf is certainly a very good example of effective management of temporary migration programmes but often criticised for its abusive practices (Castles and Millers 2009, page 160, Longva 1999). Migrants are not allowed to bring dependents, change jobs, often segregated into barracks and have to work in harsh weather for very long hours. Many migrants are exploited by agents and brokers who take a substantial amount of fees. The wage offered to the workers varies considerably. For example wages of housemaids in GCC countries are Philippines Dh 1,470 ($400), India Dh 1,100, Sri Lanka Dh 825, Bangladesh 750 (Gulf News 2008a). The wage rates probably reflect relative bargaining power of countries. Asia is the largest source of unskilled labour force thus the competition among Asian countries is also fierce. This is certainly undermining the bargaining power of labour exporting countries as they require finding the balance between promotion and

protection of migrant labour force (IOM 2003). For example recently Philippines raised the minimum wage of housemaid to 400 dollars which caused a 50% drop in demand (Source: Migrants Right 2008). The huge labour supply also enables arbitrary exercise of power by importing countries. Recently one Bangladeshi worker killed a Bahraini citizen after a dispute. In response Bahrain Government stopped recruitment of further labour from Bangladesh and was considering to deport other remaining workers (Source: Gulf News 2008b). Here the excess supply of labour is probably the prime reason that permitting and encouraging a country to take extreme measure of punishing the whole community for the fault of an individual.

In the other parts of the world we can also observe temporary migration programmes but their coverages are small relative to total labour force (OECD 2004, page 22). However they deserve attention as successful examples of migration programmes that ensure temporariness (Friedman and Ahmed 2008). One highly cited programme in this regard is 'Canada's Seasonal Agricultural Workers Programme' (CSAWP) inaugurated in 1966 as a pilot programme between Canada and Jamaica to allow 264 Jamaican agricultural workers to come to Canada temporarily to harvest tobacco in Southern Ontario. The programme was implemented because of inability of Canadian agricultural sector to meet the demand of labour even during the high period of unemployment. Under CSWAP Canada does not process any worker under private contract or any other private means. Canada gives notices to Mexican and Caribbean counter parts about the labour requirement. Mexican and Caribbean counterparts accordingly process it.

CSWAP has incorporated few mechanisms to ensure temporariness of migration. Such as workers are required to stay in grower's property for free and not allowed to change the job without permission. Authorities give preference to married workers that can serve as collateral against non return. Caribbean agreement involves a 25% compulsory saving scheme for each payroll period where the deduction is given back to the workers after returning back to home (Ahmed and Friedman 2008).

Examples of successful temporary migration programmes can be drawn from many other parts of world. For example, Spain Ecuador

agreement to combat illegal migration, Germany-Poland agricultural labour programme (Friedman and Ahmed 2008, OECD 2004). All programmes apparently share a common attribute that is workers who return back is given preference for re-entry thus the incentive to return is higher.

We will end the discussion with some discussions on bilateral migration agreements. The developed countries are now showing renewed interest for entering into bilateral agreement. More than 176 agreements (OECD 2004) are now operating in OECD countries. Considering the other parts of the world the total number of bilateral agreements would be much higher. Preferential trade agreements are not prohibited in WTO but they are rather exceptions then rules. Though they are generally disfavoured by WTO, in recent period the countries are engaging in PTAs with each other, which is against the spirit of multilateralism of WTO.

Bilateral agreement is however better than having no agreement. In Asia receiving countries are reluctant to enter in to bilateral agreements (Go 2006). The most common argument raised by receiving countries for their reluctance to enter into any formal agreement is that foreign workers are subject to the same laws and regulations as nationals, consequently, they do not need any special attention. Moreover, since the terms of employment are negotiated by workers and private employers/agencies, it is held that government intervention is not necessary since it is a private sector business. However the countries are recently moving away from this view and becoming more interested in intergovernmental negotiations in managing migration.

Apparently bilateral agreements are replacing the multilateral migration agreements. But such multilateralism is not achievable in near future as evident from the dismal achievement of Doha round. Hence bilateral agreements can be used as an instrument to temporarily fulfil the needs of both sending and receiving countries. It can also address the issues related to the welfare of migrant workers. As already discussed the lessons of bilateral agreements may pave the way for multilateralism. Though some studies have pointed that bilateralism in migration conflicts with the spirit of multilateralism it is still too early to provide such judgement.

7. Conclusions

In this chapter we have reviewed some issues linked with international migration. International migration has many facets, thus it is difficult for anyone to gain a proper understanding of the issues linked with international migration. This review will help us to overcome this problem to some extent. The review is however by no mean complete and a few topics (such as trade and factor mobility) have not been covered. But nevertheless the review done in this present chapter will guide us in the analysis to be done in the coming chapters of the thesis.

Chapter 4

Optimal Migration policies with Unskilled Labour Migration and Competition for Remittances

1. Introduction

In recent time economists and policy makers are given special attention to remittances for its role in the economies of many countries. Actually in many countries workers remittances receipt are as high one tenth of the Gross Domestic Product[1]. The importance given to remittances is observed in the efforts of developing countries to send people to work abroad. Through their efforts, developing countries are engaging in competition with each other in international labour market. We often find references of such competition in government reports or newspaper articles. There is however little or no discussion in economic literature about competition of countries in international labour market.

Intuitively it suggests that the competition of countries should confer some market power to the labour importing countries. To what extent this is happening is an issue worth further deliberation. Whereas economic literature is almost silent, the discussions available in the publications of various organisations are also in this regard to some extent vague. For example IOM report on labour market in Asia (IOM 2003) references of such competition have been given a number of times (e.g. page 21, 39, 73) without any detailed discussion on the nature of such competition except for mentioning that the competition among stakeholders is severely undermining the bargaining power of the countries as the countries require to balance between 'promotion' of overseas employment and 'protection' of migrants. Most important source to

[1] Philippines 10.62%, Lebanon 20.31%, Guatemala 11.96%, El Salvador 17.78% Source: World Development Indicators 2008, see also Chapter 2

have idea about the competition is perhaps the newspaper articles. Such as when following a demonstration in front of Bangladesh High Commission in mid 2007, Malaysia decided to stop importing workers from Bangladesh, Bangladeshi newspapers published news of deep concern on the possibility of shift of labour market to other less developed Asian countries. These types of articles are published in Bangladeshi newspapers from time to time. Further hints about ongoing competition among stakeholders can be obtained by studying the bilateral migration agreements and/or labour recruitment procedures of contractual/temporary migrant workers. One example is Canada's Seasonal Agricultural Workers Programme which has two different bilateral agreements with Mexico and Caribbean countries for temporary migration of agricultural labour. In 2001, Canada for the first time decided to meet the two counterparts together to negotiate wage related issues but agricultural employers in Canada objected fearing increase of bargaining power of workers (Verma 2003, page 60). Similar tendency is observed in Asia. Here labour importing countries are reluctant to enter into agreements as foreign labour recruitment is regarded as a private matter though the true reason can be easily attributed to the existence of large pools of unskilled labour in Asian countries. As mentioned by Go (2006) bilateral agreement in Asia is rather an exception than rule. Receiving countries in this regard are probably more organised. In Middle East Saudi Arabia, Kuwait, Oman, Bahrain, UAE and Qatar together have formed Gulf Cooperation Council (GCC) that addresses the demand for migrant labour as well as to their requirement to control and manage migrant population. They follow a system called Kafala system in which migrants need sponsorship from a permanent resident of Gulf (Longva 1999). There exists no such coalition of labour sending countries. Recently Philippines raised the minimum wage rate of housemaids to 400 dollars which caused a 50% drop in demand (Source: Migrants Right 2008). As reported, India also attempted to do so. Thus the labour sending countries in Gulf are probably setting their policies unilaterally, which may have adverse effects on the welfare of all labour sending countries.

This chapter develops a model to analyse the effects of competition for remittances in the international labour market. We assume that two countries

are exporting labour to a third country. The two countries act as Cournot-type competitors as they want to maximise their national income by sending labour to the third country. The third country uses tax policy to fulfil its national objective. Hence the third country acts as a Stackelberg leader. We are considering tax as a proxy of various monetary and non monetary barriers/costs involved in migration which is set above the administrative costs in receiving country.

As mentioned before the competition among the sending countries has not attracted attention of the mainstream economic literature. The analysis of migration and remittances in the literature is mainly unilateral or bilateral. A substantial number of studies have tried to identify the determinants of migration and in most concise form reason of migration can be attributed to wage differential between sending and receiving regions. Among other determinants of migration one may state of improvement of standard of living, family reunion, safety and security etc. In the 'New Economics of Migration' migration is similar to a portfolio investment by a family where the risk of depending on single labour market is reduced by diversification. Remittances in this regard is viewed as an outcome of implicit contract of migrants with families staying behind (Stark 1991, Rotte and Volger 1998).

Similar to mainstream migration literature we also regard that the wage differential is the main motive of migration. In the paper, the countries allow international migration for the benefit they receive. The sending countries receive remittances, which increases national income. Thus in principle a sending country will try to send as much labour as possible as long as the benefit of migration is above the cost of migration. However as both the countries try to do it simultaneously the benefit does not depend entirely on a country's willingness to send people abroad. In addition the policies of receiving country also have effects. The policy objectives of receiving country may reflect the interest of special group such as workers or capitalists. Workers may try to keep migration low to have high wage rate. The capitalists may want to import more migrant workers at low wage rate to maximise surplus. These different and conflicting objectives of different stakeholders of migration together determine the benefit of migration for sending and

receiving countries. Our aim will be to look at the different policy stands of countries given potential benefit of migration and competition among stakeholders.

The way we have modelled migration in this chapter has similarity with the migration of unskilled people. One of the differences between skilled and unskilled migration is that unskilled migrants are incapable of migrating directly as can be done by the skilled migrants. Recently unskilled migration is increasingly taking place through inter governmental negotiation. We therefore assume that the outflow of migrants are directly controlled by the sending countries thereby we only deal of the subset of migrants who are relatively unskilled. This way of modelling unskilled migration is limiting the policy variables available to the sending countries. But we can still observe a few interesting results. One of it is the use of discriminatory tax policy by the receiving country on the basis of labour endowment. The results are not surprising but very relevant in providing guidelines in formulating migration policies.

The idea of the competition to some extent came from Chau and Kanbur (2006) that modelled the competition between two Southern countries in labour standard and showed that Northern importing countries can take the benefit away from Southern countries by increasing tax rate. Instead of labour standard, we have assumed that the countries compete by sending labour. It is also to be noted that the structure of the model is similar to the models of strategic trade especially of Brander and Spencer (1985). A few papers have incorporates import tax in Brander-Spencer framework. The paper has some similarities with them. Though strategic trade theory is regarded as very important in the analysis of trade policies, so far no attempt can be observed to use it in analysis of international migration policies. This chapter can be considered as one of the first attempts.

The organisation of the chapter is as follows. In the introductory section we have already introduced the background of the chapter. The second section introduces the model, basic notations and clarifies the mechanism of unskilled labour migration. The third section deals with some comparative statics results. The forth section discusses the determination process of tax

rates of the importing country. The fifth or the last section concludes the chapters.

2. The Model

2.1. Basic Assumptions and Notations

We assume that there are three open economies C , I and U producing two internationally traded goods - X_1 and X_2. Prices of goods are fixed. We select the units in a way that price of one unit of good is equal to 1. Thus relative price of two goods is just 1. Labour endowment is fixed, denoted by $\bar{L}_i$ for country $i \in \{C, I\}$ and $\bar{L}_u$ for country U .

The production functions of good 1 and good 2 are given respectively by $X_{i1} = X_{i1}(L_{i1})$ and $X_{2i} = X_{i2}(L_{i2})$ where $i \in \{C, I, U\}$. The wage should be equal to the marginal products hence without complete specialisation marginal products of two sectors of a country should be equal which also should give the wage rate of the country. Otherwise the labour will migrate from one sector to another within a country. However we assume that the technology and labour endowment of the countries are such that country C and I specialise in the production of good 1 and country U specialises in production of good 2. This assumption will help us to simplify the analysis. But it is also to be noted that in the general equilibrium model with one factor and incomplete specialisation, wage differential at international level is non-existent hence is the incentive for international migration. Thus to have wage differential existing at the international level in an incomplete specialisation setting, we need additional assumption, such as, existence of some kind of dualism which allows wage of unskilled workers to differ across nations. With this assumption it will also be possible for us to extend our model from two goods to more than two goods case.

As we are assuming that country C and I specialise on producing X_1 the wage in country i is given as- $w_i = \frac{\partial X_{i1}}{\partial L_{i1}}$ evaluated at $\bar{L}_i$. Similarly the

wage rate in country U is given as $w_u = \frac{\partial X_{u2}}{\partial L_{u2}}$. We assume that $w_i < w_u$ which initiates migration. We assume that migrants repatriate all the income back to the home country. The national income of the home is then given by the output produced in the sector 1 plus the remittances received. We may assume consumers' preference in a way where the countries always consume both goods. With specialisation the countries should then export the good which they specialise and import the other one. We assume that migration does not change this pattern of comparative advantage. As migration effects the production and consumption of goods in the countries under consideration, it may also change the world price levels and may reverse the pattern of the specialisation and wage differentials as assumed before. As the aim of the analysis is not to evaluate the welfare from trade and/or changes of comparative advantage, we assume fixed price throughout to keep our analysis simple. It should also be mentioned that we are considering a partial equilibrium setting where the world may consists of many countries whereas we are only considering migration between the three countries. But the model can be extended by allowing more sending and receiving countries. It is also possible that the countries under consideration produce more than just two goods and migration and trade may have some consequences in those sectors. To simplify our analysis we are restricting our analysis within just two sectors of the economy. The incorporation of more sectors may change our results substantially.

It will be convenient to assume some specific functional forms of the production functions to facilitate further analysis. Let us assume that production of X_1 in $i \in \{C, I\}$ is depicted by the following function-

$$X_{i1} = a_1 L_{i1} - \frac{b_1}{2} L_{i1}^2$$

where X_{i1} denotes the amount of X_1 produced in $i \in \{C, I\}$, L_{i1} is total amount of labour used in production of X_1, a_1 and b_1 are coefficients. Differentiating with respect to L_{i1}, marginal product of labour in sector X_1 is obtained as $a_1 - b_1 L_{i1}$. Therefore $\mathrm{MP_L}$ varies between a_1 and $a_1 - b_1 \bar{L}_i$.

The production of X_2 is given as-

$$X_{i2} = a_2 L_{i2}$$

where a_2 is the amount of labour required to produce one unit of X_2 and L_{i2} is the amount of labour used for production of X_2. Differentiating with respect to L_{i2}, the MP_L is obtained as a_2. Hence, country $i \in \{C, I\}$ switches labour from X_2 to X_1 if the value of marginal product of labour in X_1 is greater than the value of marginal product of labour in X_2. that is, iff -

$$(a_1 - b_1 L_{i1}) > a_2$$

Or, $$1 > \frac{a_2}{a_1 - b_1 L_{i1}}$$

Let us assume that $1 > \frac{a_2}{a_1 - b_1 \bar{L}_i}$. Thus with trade $i \in \{C, I\}$ necessarily specialises in producing X_1. Without migration the workers of $i \in \{C, I\}$ therefore receives wage $w_i = (a_1 - b_1 \bar{L}_i)$.

On the other hand assume that country U has linear production technology for X_1, which is written as $X_{u1} = a_{u1} L_{u1}$, where L_{u1} is the amount of labour used and a_{u1} is the coefficient. By differentiating with respect to L_{u1}, we get the marginal product of labour as a_{u1}. Production in sector X_2 is defined by the following function-

$$X_{u2} = a_{u2} L_{u2} - \frac{b_{u2}}{2} L_{u2}^2$$

where L_{u2} is the amount of labour used in production of X_2 in U. Again by differentiating with respect to L_{u2} we get the marginal product of labour in country U as $(a_{u2} - b_{u2} L_{u2})$. Thus marginal products varies between a_{u2} and

$\left(a_{u2} - b_{u2}\bar{L}_u\right)$. Country U specialises in production of X_2 iff $\left(a_{u2} - b_{u2}\bar{L}_u\right) > a_{u1}$. Let us assume that, $\left(a_{u2} - b_{u2}\bar{L}_u\right) > a_{u1}$. U therefore specialises in production of X_2 . Without migration, the workers of U receives wage $\bar{w}_u = a_{u2} - b_{u2}\bar{L}_u$.

With migration wage in U is given as $w_u = a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)$. We assume that $w_u > a_{u1}$ throughout as such the country still specialises in production of X_2 after migration. We also have the assumption that $a_{u2} - b_{u2}\bar{L}_u > a_1 - b_1\bar{L}_i$ such that wage received by labour is higher in country U which initiates migration.

Finally we consider the following game- in the first stage country U sets its tax policy. Given the tax policies of U , country C and I compete with each other in sending labour to U .

2.2. Defining Unskilled Migration between Country i and U

In this section we will consider that labour can move from one country to another country. For this purpose the mechanism of such movement is needed to be defined. In this paper we assume that the governments of sending countries control migration thus they act in way that maximises national income. The national income is calculated by adding the output produced within the country with the remittances received. This assumption may seem unlikely at first look but actually largely captures the pattern of unskilled/low skilled labour migration observed in developing countries.

An alternative is to assume free migration, that is, people can move freely without any restriction of sending and receiving countries. In reality this is an exception rather than the rule. Except for a few regions such as 'European Union' people are not allowed to migrate freely to another country. In a few countries people are not even allowed to emigrate freely as governments can directly restrict migration or can use indirect control like non-issuance of passport. Where free migration is possible the present structure is obviously not valid (We explore the possibility in chapter 5).

To migrate without government's assistance the migrants first need the capability of searching jobs by themselves. Unskilled low income workers of most developing countries do not have that capability. For example let us think that a construction project in Middle East needs 100 manual workers. It wants to recruit the workers from a country like India, Bangladesh, Nepal, Pakistan or Philippines. It is possible to recruit skilled (doctors, engineers) workers directly by publishing advertisements in internet and newspapers. But it is not possible to recruit unskilled workers from a poor developing country by just publishing advertisements in that way as the advertisements will not reach the low income people living in rural areas. To overcome this problem the companies recruit workers directly from these countries through recruiting agencies who have agents at grass roots levels.

This recruitment process is now disfavoured by most countries. The employment contracts are often very abusive, the recruiters/agents often take high application fees, give false documents etc. The benefit of migration is often misappropriated by the middle agents. But migration is truly important not just for the migrants and the companies but also for the respective governments. The receiving countries here meet the shortage of manpower, the sending countries in return receives remittances. Hence governments have stepped in to take control of labour recruitment process. Through inter governmental negotiations, governments now set up the rules to govern the migration related issues. The bilateral migration agreements observed worldwide depict direct involvement and interest of governments in this matter. Many countries now express their interest directly to the respective governments. In Canada's Agricultural Workers' Programme, Canada mentions yearly demand to respective government authorities of Mexico and Caribbean countries. In reply Mexican and Caribbean governments facilitate recruitment according to the Canadian requirement (Verma 2003). South Korea since 1994 is recruiting labour from Bangladesh under 'Employment Permit System (EPS)' where workers are recruited only through the respective government bodies (Bangladesh Economic News 2010). Given the above the assumption of government controlled international migration is an appropriate assumption for unskilled migration.

The objective of sending countries is to maximise national income through remittances. Therefore they will allow migration as long as remittances is higher than the marginal product at home. The receiving country fulfils its own objective using migrant labour. The migration in this model takes place between the sending countries and the firms of receiving countries. The government of the receiving countries in reality here often practise quota system. The recent Brain Grain literature is based on this argument. But quota is appropriate mainly for the high skilled migration. Example of quota is HB-1 visa system in USA or recent German Green Card system. Most developed countries now-a-days are also exercising point based migration system for screening high skilled people. In the paper instead we assume that the receiving countries use tax policies to control and receive extra benefit from migration. This will help us to evaluate the effects of competition of sending countries in international migration.

Another argument could be that though even if the governments of sending countries have direct interest, it is the individual migrants who decide whether they want to migrate or not. This argument cannot be ignored. To ensure that we impose condition that the net wage received by the migrants is higher than the wage of country of origin. We clarify it below.

2.3. National Income Equations and Solutions of Migration

We assume following national income equations for sending countries-

$$Y_i = \left(a_1\left(\bar{L}_i - L_{i2}\right) - \frac{b_1}{2}\left(\bar{L}_i - L_{i2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right) - T_i\right)L_{i2} \qquad (4.1)$$

where –

$i \in \{C, I\}$ and $i \neq j$.

Y_i = National income of i.

L_{i2} = Migrants from country i to country U.

L_{j2} = Migrants from country j to country U.

T_i = Tax imposed by country U on migrants of country i.

As can be observed, the above equation has two components. The first part is the output produced within the country. The second part is the remittances send by workers working in U. The remittances are nothing but wage multiplied by total migrant workers. It is also assumed that migrants send the entire wage back to home country. In reality migrants do keep some income in country of immigration, buy properties or make investments. Here we are considering temporary migration and there is no reason for temporary migrants to keep income in the country of immigration. The assumption of full repatriation of income will allow us to capture temporariness of migration as well as will make analysis simpler.

It is also assumed that receiving country imposes tax on the income of migrants. This tax is a proxy of immigration related monetary and non-monetary cost imposed by the country of immigration which is above the administrative cost of allowing immigration. This tax reflects the fact that in many parts of the world, migrants must pay tax but may not receive the benefit in return. Immigration tax is a controversial and debatable issue in the economics of public sector. A common misconception prevailing is that immigrants receive all the benefits but do not pay equal amount of tax which leads to higher amount of tax burden on the natives. Razin and Sadka (2002) has showed that as low income migration grows, median voters may prefer low tax rates in a fear of leakage of tax revenue to low income migrants. This approach of using the concept of median voters is highly questionable. As mentioned by Leibfritz et al. (2003) tax revenue and distribution is a dynamic process. For example young immigrants who are now going to school can be regarded as using up significant amount of public contribution. But when they will grow up they will contribute to public revenue by paying tax. Similarly those who are now paying tax may at a later period of life get higher return through pension. Another study showed that since 1980s the average skill of

immigrants has increased compared to the average skill of native population (Jasso et al. 1998). If it is assumed that immigrants are paid according to the skill levels, the income tax contribution of immigrants should also be higher. Another misconception is that illegal migrants do not pay tax but consume all the public services such as road, transportation, medical services etc. But in reality illegal migrants do pay tax, a simple example of which is consumption tax like VAT. In addition many illegal migrants by cars, houses, do businesses which have significant contribution in tax revenue. Many illegal immigrants obtain counterfeit tax identification numbers and may pay income tax higher than other low income earners (Lipman 2006, 2009). It is not unlikely that some illegal immigrants receive social benefit using counterfeit documents. Thus before providing final comment it must be properly understood whether migrants in reality pay higher or lower tax compared to the benefit they receive in return. Temporary migrants in this regard are likely to be the net losers. Within the short period of stay it is not possible for them to bring family and children, thus they are excluded from receiving the health and schooling benefits received by permanent residents' families. But they are subject to payment of all type of taxes as applicable to permanent residents.

In the model we are considering temporary migration allowing full repatriation of the earnings back to home country. The receiving country as usual imposes tax which is redistributed to the natives. When forming the strategy, the sending countries therefore take the tax rates into consideration. As the price level is fixed, the higher income ensures higher level of welfare for a country. The objective of country i then is to maximise national income with respect to L_{i2} given the tax rates. Both countries assume that other country will keep the number of migrant labour same. Differentiating with respect to L_{i2} and setting the derivatives equal to zero following two reaction functions for country C and I are obtained-

$$(b_1 + 2b_{u2})L_{C2} = -(a_1 - b_1\bar{L}_C) + (a_{u2} - b_{u2}\bar{L}_u) - T_C - b_{u2}L_{I2} \qquad (4.2)$$

$$(b_1 + 2b_{u2})L_{I2} = -(a_1 - b_1\bar{L}_I) + (a_{u2} - b_{u2}\bar{L}_u) - T_I - b_{u2}L_{C2} \qquad (4.3)$$

To check that the income from abroad is higher than the wage at home, let us write the reaction functions as-

$$a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right) - T_i = \left(a_1 - b_1\left(\bar{L}_i - L_{i2}\right)\right) + b_{u2}L_{i2}$$

where $i \in \{C, I\}$ and $i \neq j$. Thus wage received by migrants minus tax is higher than the wage that can be obtained at home. We derive this result as foreign wage minus tax is actually showing the price of migrant labours. It must be higher than the wage or marginal product at the home that is the marginal cost of labour export.

The two equations can be solved for L_{C2} and L_{I2}. The second derivatives are negative as-

$$\frac{\partial^2 Y_i}{\partial L_{i2}^2} = -b_1 - 2b_{u2} < 0$$

And $\dfrac{\partial^2 Y_i}{\partial L_{i2}\partial L_{j2}} = -b_{u2} < 0$ where $i \neq j$

As can be observed, the cross second partial derivatives are smaller than own second partial derivatives in absolute value. Smaller absolute values of cross partial derivatives ensure that the solutions are stable. To obtain the solutions let us write equations (4.2) and (4.3) in matrix form as-

$$\begin{bmatrix} b_1 + 2b_{u2} & b_{u2} \\ b_{u2} & b_1 + 2b_{u2} \end{bmatrix}\begin{bmatrix} L_{C2} \\ L_{I2} \end{bmatrix} = \begin{bmatrix} -\left(a_1 - b_1\bar{L}_C\right) + \left(a_{u2} - b_{u2}\bar{L}_u\right) - T_C \\ -\left(a_1 - b_1\bar{L}_I\right) + \left(a_{u2} - b_{u2}\bar{L}_u\right) - T_I \end{bmatrix}$$

Let Z be the matrix of coefficients. The determinant is $Z = b_1(b_1 + 4b_{u2}) + 3(b_{u2})^2$, thus determinant is positive and inverse exists. Applying Cramer's rule the following solutions are obtained-

$$L_{C2} = Z^{-1}\left(B_C\left(b_1 + 2b_{u2}\right) - B_I b_{u2}\right) \tag{4.4}$$

and,

$$L_{I2} = Z^{-1}\left(B_I\left(b_1 + 2b_{u2}\right) - B_C b_{u2}\right) \tag{4.5}$$

where,

$$B_i = -\left(a_1 - b_1\bar{L}_i\right) + \left(a_{u2} - b_{u2}\bar{L}_u\right) - T_i$$

From the two solutions it is not possible to identify which country exports more labour. It depends on the amount of initial labour endowments and the tax rates. In later sections we shall see how tax rates are imposed by country U.

3. Comparative Statics

In this section we are interested to see how changes in the tax policy of U effects the income and labour export of i. It will be convenient to describe the comparative static results first and then to show how there were derived. The results are described in proposition format.

Proposition 4.1: If tax rate (T_i) for one country increases then labour export from that country decreases but labour export from the other country increases. Total labour export decreases.

Proof:

Assume that only tax rate for country i has been changed. Differentiating the reaction functions of equations (4.2) and (4.3) with respect to T_i we get-

$$(b_1 + 2b_{u2})\frac{\partial L_{i2}}{\partial T_i} + b_{u2}\frac{\partial L_{j2}}{\partial T_i} = -1$$

$$b_{u2}\frac{\partial L_{i2}}{\partial T_i} + (b_1 + 2b_{u2})\frac{\partial L_{j2}}{\partial T_i} = 0$$

From the equations, the solutions obtained are-

$$\frac{\partial L_{i2}}{\partial T_i} = -Z^{-1}(b_1 + 2b_{u2}) < 0$$

and,

$$\frac{\partial L_{j2}}{\partial T_i} = Z^{-1}b_{u2} > 0$$

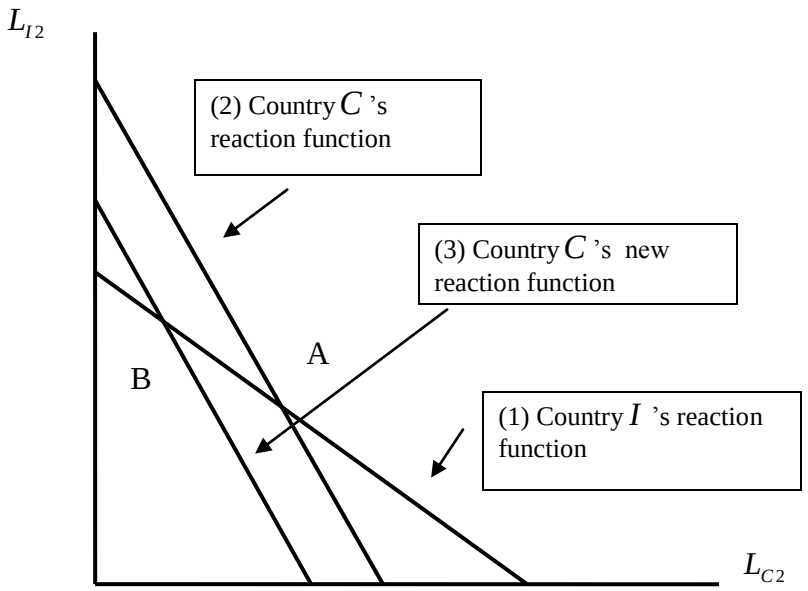
Therefore if the tax rate for a country is increased by U then labour export from that country decreases but labour export from the other country increases. Adding the two we get-

$$\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i} = -Z^{-1}(b_1 + b_{u2}) < 0$$

Thus overall labour export by the two countries decreases. ■

The situation depicted in proposition (4.1) can be expressed using following diagram.

Figure-4.1
Equilibrium Labour Export



In the diagram the country I 's reaction function is given by line (1) and country C 's reaction function is given by line (2). The equilibrium labour supplies by both countries are given by A where the two reaction functions intersect. Now assume that the tax rate for country C has been increased by U. As can be observed from equation (2) it reduces the intercept and shifts the country's reaction function leftward. The new reaction function is indicated as (3). At the new equilibrium B, the labour export from I increases and the labour export from C decreases. But together the labour export decreases. The proposition comes directly from the requirement of the stability of the system. For stability it is required that the labour export should be in absolute value more responsive to change in own tax rate than the change of other countries tax rate.

Proposition 4.2: If U increases the tax rate for a country, national income of that country decreases and income of the other country increases.

Proof:

Assume that the tax rate for country $i = C$ has been increased. The income equation of country C is-

$$Y_C = \left(a_1\left(\bar{L}_C - L_{C2}\right) - \frac{b_1}{2}\left(\bar{L}_C - L_{C2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_C\right)L_{C2}$$

Differentiating with respect to T_C we get-

$$\frac{\partial Y_C}{\partial T_C} = \left(-\left(a_1 - b_1\left(\bar{L}_C - L_{C2}\right)\right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + 2L_{C2} + L_{I2}\right) - T_C\right)\right)\frac{\partial L_{C2}}{\partial T_C} - b_{u2}L_{C2}\frac{\partial L_{I2}}{\partial T_C} - L_{C2}$$

First order condition of equation (4.2) implies that the first term of the expression is zero. Therefore we obtain-

$$\frac{\partial Y_C}{\partial T_C} = -b_{u2}L_{C2}\frac{\partial L_{I2}}{\partial T_C} - L_{C2} < 0$$

For country I the national income equation is-

$$Y_I = \left(a_1\left(\bar{L}_I - L_{I2}\right) - \frac{b_1}{2}\left(\bar{L}_I - L_{I2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_I\right)L_{I2}$$

Differentiating with respect to T_C we get-

$$\frac{\partial Y_I}{\partial T_C} = \left(-\left(a_1 - b_1\left(\bar{L}_I - L_{I2}\right)\right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + 2L_{I2}\right) - T_I\right)\right)\frac{\partial L_{I2}}{\partial T_C} - b_{u2}L_{I2}\frac{\partial L_{C2}}{\partial T_C}$$

As the first term of the expression is equal to zero by first order condition of (4.3), we get-

$$\frac{\partial Y_I}{\partial T_C} = -b_{u2} L_{I2} \frac{\partial L_{C2}}{\partial T_C} > 0$$

Consequently, national income of C decreases and national income of I increases as T_C increases. ■

The proposition is showing how the tax policy followed by country U has effects on the national income of two labour exporting countries. When labour export by C is in equilibrium, marginal increase of tax rate reduces remittances, thereby the national income falls. On the other hand labour export by C falls, thereby labour export and remittances received by I increases.

We may also want to see what happens to the national output of U if U increases the tax rate. To see that note that the national output equation of U is-

$$Y_U = a_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right) - \frac{b_{u2}}{2}\left(\bar{L}_u + L_{i2} + L_{j2}\right)^2 \qquad (4.6)$$

By differentiating with respect to T_i we get-

$$\frac{\partial Y_U}{\partial T_i} = \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right)\right)\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i}\right) < 0$$

We have already found in proposition (4.1) that increased tax rate reduces migrant labour supply. Therefore total output of the country must fall.

4. Determination of Tax Rates

We have until now discussed about the effects of tax policies on labour migration and national income of the sending countries. In this section we turn our attention to the receiving country. It brings us to the first stage of the game where U sets the tax policies foreseeing the labour export of C and I. The tax policy in addition also depends on the national objective of the receiving country. We have seen that imposition of tax rate reduces the national output of U. Then imposition of tax rate must have other reasons. Sometimes presence of strong lobby is regarded as the reason for imposition of import barriers. The same argument can be applicable here for labour import. For example a strong trade union or a lobby of workers may disfavour immigration. The lobby of capitalists may favour immigration. We do not know which force is working in which country. Therefore we are going to analyse the matter assuming few different cases to evaluate how tax policy will be used if one of the cases is applicable to any country. We can consider other tax-transfer policies such that the income of the capitalists may be transferred to the workers through tax. But we are confining ourselves to only three cases to keep the analysis simple and comparable.

Case 1: U **wants to maximise national income.**

Assume that country U aims to maximise the total income of permanent residents. It implies that U maximises the total national output minus the remittances. Thus there is a redistribution of a part of income of the migrants to the residents of U. The objective function in this case is written in following manner-

$$Y_{UN} = \left(a_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - \frac{b_{u2}}{2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)^2 \right) - \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_C\right)L_{C2} - \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_I\right)L_{I2} \qquad \text{……..(4.7)}$$

In the above equation we have deducted the wages remitted by migrants from national output of the country. Here we are interested to know if the country is going to impose positive tax rates or not. Unfortunately the calculation of this equation turns out to be more complicated than it initially appears. However we can express the most important observation by following proposition:

Proposition 4.3: If the receiving country wants to maximise the national income of the residents it may not always impose positive tax rates on migrants.

Proof:

To prove the proposition, let us assume that only the tax rate for country C has been changed. Then differentiating equation (4.7) with respect to T_C and assuming that tax rates are initially zero we obtain-

$$\frac{\partial Y_{UN}}{\partial T_C} = b_{u2}\left(L_{C2} + L_{I2}\right)\left(\frac{\partial L_{C2}}{\partial T_C} + \frac{\partial L_{I2}}{\partial T_C}\right) + L_{C2} \qquad (4.8)$$

Thus the first part of the equation is negative but as L_{C2} is positive the expression can be negative or positive. Thus when tax rates are zero, imposition of positive tax rates do not necessarily increase national income of the residents of U. ■

We may want to calculate the equation (4.8) further to obtain a bit more clear picture. However the calculation does not clearly depict what is happening. But it depends on the size of relative labour import. To see it let us assume $b_1 = b_{u2} = 1$, hence $\frac{\partial Y_{UN}}{\partial T_C} = -\left(L_{C2} + L_{I2}\right)\frac{1}{4} + L_{C2}$. Therefore if $L_{I2} > 3L_{C2}$ then imposition of positive tax on C hurts country U.

The result we have is not unexpected but interestingly it depends largely on the responsiveness of the two countries to changed tax rates. The

income of the residents here is calculated by deducting the wages of migrants and adding the tax revenues to national output. We have seen before that national output falls if tax rate is increased. Additionally as migration decreases, the wage of workers increases. Hence the output minus the wage of migrants falls. The country now nevertheless experiences an increase in the per capita tax revenue. If the increase in tax revenue can compensate the loss of output minus remittances, the national income increases. It is interesting to note that negativity or positivity of the expression depends on the relative magnitude of $\frac{\partial L_{C2}}{\partial T_C}$ and $\frac{\partial L_{I2}}{\partial T_C}$. We already know that the summation of two terms is negative. Imposition of tax rate will result in income loss for U if the gap between them is sufficiently bigger, that is if labour supply from C decreases but the labour supply from I does not increase by that extent. But if the gap between the two is close to zero then imposition of positive tax can be proved beneficial for country U.

Case 2: U wants to maximise the total income of permanent workers.

In this case we assume that U aims to maximise the income of permanent workers. Normally it is thought that permanent workers income that is wage rate is highest when there is no migration and for mainly this reason migration receives objection from the native population. However it is often not rational for a country to completely prohibit migration as it supplies the labour to increase production to meet the necessary requirements. To balance it the country may offer some extra facilities to the permanent workers and a part of it may come from the migrants, especially temporary workers.

Thus here we are pointing to the discriminatory benefit of tax system. As pointed out already migrant workers may face strong discrimination in term of tax benefits. Many countries provide special social security benefits, where foreign workers contribute significantly by paying tax but are not considered eligible to receive benefits in return. One example of it is 500 pounds grant (for job seekers) given by UK government on child birth. This

grant is likely to keep prices of baby products high. Foreign nationals, though paying taxes, are not eligible for the grant but they are purchasing from the same market where prices are artificially high because of the grant. Another benefit of local residents comes through low market prices in sectors where foreign workers work. Foreign unskilled workers mainly work in sectors like agriculture, food processing, cleaning etc. many of these jobs are usually disliked by local population. Foreign workers participation in these sectors helps to keep prices low, thereby makes real income of local workers high.

How participation of foreign workers in food sector is keeping the prices low and its impact on income and poverty level of country of immigration is a very important issue to discuss. It requires further substantial analysis. We will not analyse this issue in this chapter. Here we are only concentrating on the redistributional effects of tax revenue. The result obtained can be stated by following proposition-

Proposition 4.4: The receiving country will impose positive tax rates in order to maximise the income of the permanent labour.

Proof:

The income equation of permanent labour can be written as-

$$Y_{LU} = \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)\overline{L}_u + T_i L_{i2} + T_j L_{j2} \qquad (4.9)$$

As shown in the above equation, U now maximises the summation of wage of permanent workers and tax revenues. By evaluating the derivative when T_is are zero we get-

$$\frac{\partial Y_{LU}}{\partial T_i} = -b_{u2}\overline{L}_u\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i}\right) > 0$$

Thus imposition of tax increases the income of workers when tax rates are zero. Hence the government will impose positive tax in order to maximise income of permanent labour. ■

The result is not surprising. As tax is imposed the migration falls, the wage rate increases. Hence workers enjoy higher wage rate. The permanent workers in addition receive the tax collected from migrants. Therefore the income of workers increases. The most important aspect of this case is that it will allow us to look at the process of imposition of tax rates as it is relatively simple to calculate. To do that we will first calculate the optimal tax rates as done below-

Optimal tax rates

To find the optimal rates of taxes, we differentiate the equation (4.9) with respect to T_C and T_I and set the derivatives equal to zero as-

$$\frac{\partial Y_{LU}}{\partial T_C} = -b_{u2}\bar{L}_u\left(\frac{\partial L_{C2}}{\partial T_C} + \frac{\partial L_{I2}}{\partial T_C}\right) + L_{C2} + T_C\frac{\partial L_{C2}}{\partial T_C} + T_I\frac{\partial L_{I2}}{\partial T_C} = 0 \qquad (4.10)$$

and

$$\frac{\partial Y_{LU}}{\partial T_I} = -b_{u2}\bar{L}_u\left(\frac{\partial L_{C2}}{\partial T_I} + \frac{\partial L_{I2}}{\partial T_I}\right) + L_{I2} + T_C\frac{\partial L_{C2}}{\partial T_I} + T_I\frac{\partial L_{I2}}{\partial T_I} = 0 \qquad (4.11)$$

The second derivatives from equation (4.9) are-

$$\frac{\partial {Y_{LU}}^2}{\partial^2 T_i} = -2Z^{-1}\left(b_1 + 2b_{u2}\right) < 0$$

And,

$$\frac{\partial {Y_{LU}}^2}{\partial T_i \partial T_j} = 2Z^{-1}b_{u2} > 0$$

where- $Z = b_1\left(b_1 + 4b_{u2}\right) + 3\left(b_{u2}\right)^2$

The calculations to get solutions (see appendix) from the above two equations are a bit tedious but we finally get surprisingly simple result that is-

$$T_C = \frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_C\right)\right) \tag{4.12}$$

$$T_I = \frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_I\right)\right) \tag{4.13}$$

T_i s are positive as by assumption $a_{u2} > a_1 - b_1\bar{L}_i$. From the two equations it can be seen that the country with more labour endowment pays more tax, the country endowed with less labour pays less tax. The above solutions and the solutions for labour exports can be expressed by following proposition-

Proposition 4.5: The country with higher labour endowment pays higher tax rate and supplies more labour. The labour supply of a country increases (decreases) if labour endowment of that country increases (decreases) and it decreases (increases) if labour endowment of the other country increases (decreases).

Proof:

We have already shown in equations (4.12) and (4.13) that the country with higher labour endowment pays higher tax rate. By substituting T_C and T_I in equations (4.4) and (4.5) and after necessary calculation we get-

$$L_{C2} - L_{I2} = \frac{1}{2Z}b_1\left(\bar{L}_C - \bar{L}_I\right)\left(b_1 + 3b_{u2}\right) \tag{4.14}$$

If $\bar{L}_C > \bar{L}_I$ then the sign of equation is positive. That is $\bar{L}_C > \bar{L}_I$ implies that country C pays more tax and exports more labour.

The solutions of labour export are given in the appendix. From that it can be seen labour export of a country increases with decrease of other

countries' labour endowment and decreases with the increase of other countries' labour endowment. The labour export increases with the increase of own labour endowment and decreases with the decrease of own labour endowment. ■

There is a very simple intuitive explanation. The workers of labour endowed country receive lower wage in home country. Thus the difference between wages received in U and in own country is higher for the country with higher labour endowment. U can extract higher rent by charging higher tax rate. As labour supply is not perfectly inelastic the country can exercise power when buying labour from international market. Here the relation between labour supply and tax rate is downward slopping, which is like a revenue function of a monopolist. In case of downward slopping demand a monopolist charges higher price on the buyer with lower elasticity of demand. Similar result has also been obtained in our analysis which has been stated below-

Proposition 4.6: The country with higher labour endowment has lower tax elasticity of labour supply. If labour endowment of a country increases (decreases) then the labour supply of the other country becomes more elastic (inelastic).

Proof:

The elasticity is defined as $\eta_{Tii} = \dfrac{\dfrac{\partial L_{i2}}{\partial T_i}}{\dfrac{L_{i2}}{T_i}}$ where η_{Tii} implies own tax elasticity of labour supply of country i. As $\dfrac{\partial L_{i2}}{\partial T_i}$s are same for both countries, the elasticities depend on how the ratio $\dfrac{L_{i2}}{T_i}$ changes with the change of labour endowment. In the appendix we have obtained that-

$$\frac{L_{C2}}{T_C} = \frac{Z^{-1}\left(-b_{u2}\bar{L}_u(b_1+b_{u2}) - \frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_I\right)\right)b_{u2}\right)}{\frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_C\right)\right)} + Z^{-1}\left(b_1 + 2b_{u2}\right)$$

…….. (4.15)

$$\frac{L_{I2}}{T_I} = \frac{Z^{-1}\left(-b_{u2}\bar{L}_u(b_1+b_{u2}) - \frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_C\right)\right)b_{u2}\right)}{\frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_I\right)\right)} + Z^{-1}\left(b_1 + 2b_{u2}\right)$$

…….. (4.16)

The first terms of the expressions are negative, but in total the expressions must be positive because of positivity of tax rates and labour supplies. By deducting (shown in the appendix) them we obtain $\frac{L_{C2}}{T_C} > \frac{L_{I2}}{T_I}$ when $\bar{L}_C > \bar{L}_I$ .Thus, the country with higher labour endowment has lower tax elasticity of labour supply.

By looking at the equation (4.15) we observe that if L_{I2} increases (decreases) then $\frac{L_{C2}}{T_C}$ decreases (increases) and the labour supply become more elastic (inelastic). Similarly by looking at the equation (4.16) we see that if L_{C2} increases (decreases) then $\frac{L_{I2}}{T_I}$ decreases (increases) and the labour supply of country I become more elastic (inelastic). ■

The proposition has very important policy implication. It is known that monopolist varies price until the demand become elastic. Here we observe that when the labour endowment of a country increases, then the labour supply of the other country become more elastic. It implies greater power of the importing country in extracting rent. Thus competition between the countries renders greater power to the labour importer.

Here we may point to the similarity of our model with Brander-Spencer analysis (Brander and Spencer 1985). Brander and Spencer proposed

a similar model where two countries export goods to a third country. They analysed the strategies of setting up of optimum export tax/subsidy of exporting countries. A few papers have extended Brander and Spencer's analysis to include importing country's policy response, such as Gatsios (1990) and Hwang and Mai (1991). In general it has been found that if the importing country practises discriminatory tariff policy, then tariff rate is higher for the most cost efficient exporter. It is not an exception in our model too. Here the most cost efficient sending country (opportunity cost of migration is low) sends more migrants and receive higher tax burden. It may be questioned that if such discriminatory tax policy is observed in reality. As already discussed migrants do pay taxes in many forms. But such taxes should be same for all type of migrants. To find out discriminatory tax rates one needs to look at monetary and non monetary conditions attached to entry and social security benefits. Analysis of such differential tax rates is not readily available. But it is well known that similar to differential tariff regime, the migrants from different countries face different type of entry costs to access the labour market of a host country. Similar to differential tariff regimes, the labour importing countries are now willing to enter into different bilateral migration agreements with different countries (Winters 2005) to target specific skills from specific countries. The agreements obviously set different opportunity costs of migration for workers of different countries. An empirical analysis to compare the entry barriers of immigrants from different countries will be in this regard very useful.

Case 3: U maximises a weighted average of producers' income and earnings of permanent workers, plus weighted tax revenue.

The third case we are going to consider is the situation where the country U wants to maximise a weighted average of workers' and producers' income. As we have already discussed when migration is allowed workers' income is highest when migration accompanies a positive amount of tax. However this tax rate harms the producers as it reduces the producers' surplus.

To resolve the issue government may put weight on the producers' and workers' income when setting up the tax policy plus it may give a weight to decide who is going to receive the tax revenue. We can therefore write the income equation as-

$$\begin{aligned}\pi_U &= (1-\theta)\left(Y_U - \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)\right)\left(\bar{L}_u + L_{C2} + L_{I2}\right)\right) \\ &+ \theta\left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)\right)\bar{L}_u + \omega T_C L_{C2} + \omega T_I L_{I2}\end{aligned} \tag{4.17}$$

where $0 \le \theta \le 1$ is the weight and $\omega \in \max\{\theta, 1-\theta\}$. If θ is equal to 1 then the country only gives importance to the income of workers. If θ is zero the producers receive all the importance in the objective. As Y_U shows the countries' national output, the first term of the equation show the weight given to the producers' surplus. The second term shows the weight given to workers earnings.

After differentiating and necessary calculation we obtain-

$$\frac{\partial \pi_U}{\partial T_C} = (1-\theta) b_{u2} L_{u2} \Phi - \theta b_{u2} \Phi \bar{L}_u + \omega L_{C2} + \omega T_C \frac{\partial L_{C2}}{\partial T_C} + \omega T_I \frac{\partial L_{I2}}{\partial T_C} \tag{4.18}$$

And,

$$\frac{\partial \pi_U}{\partial T_I} = (1-\theta) b_{u2} L_{u2} \Phi - \theta b_{u2} \Phi \bar{L}_u + \omega L_{I2} + \omega T_C \frac{\partial L_{C2}}{\partial T_I} + \omega T_I \frac{\partial L_{I2}}{\partial T_I} \tag{4.19}$$

where, $L_{u2} = \bar{L}_u + L_{C2} + L_{I2}$ and $\Phi = \frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i}$. Note that L_{C2} and L_{I2} are the solutions of labour exports obtained in the first stage, thus to get optimal solutions of tax rates we need to replace them with the solutions obtained in equations (4.4) and (4.5). But the calculations turn out to be very tedious. However it can be seen from equations (4.18) and (4.19) that unlike case 2, imposing tax may not always be welfare improving thus positive solutions may not exist. That is welfare may not increase when tax rates are initially zero. Also imposition of positive tax will necessarily reduce producers' surplus when the objective is to maximise only the producers' surplus. As can

be observed in equations (4.18) or (4.19), ω and θ is then equal to zero. As $\Phi < 0$, producers' surplus reduces with the imposition of tax rate.

The calculations to obtain the solutions of above two equations yields-

$$T_i = M^{-1}\left(-Q_i(1-\theta)b_{u2}(b_1+b_{u2})\Phi - 2\omega Q_i(b_1+2b_{u2}) - 2b_{u2}Q_j + \omega Q_j(1-\theta)b_{u2}(b_1+b_{u2})\Phi\right) \quad \text{.....(4.20)}$$

Where-

$$M = ((1-\theta)b_{u2}(b_1+b_{u2})\Phi)^2(1-\omega^2) + 4\omega(1-\theta)b_{u2}(b_1+b_{u2})\Phi(b_1+3b_{u2}) + 4\omega^2(b_1+2b_{u2})^2 - 4(b_{u2})^2$$

$$Q_i = -(1-\theta)b_{u2}\Psi(b_1+b_{u2})\Phi + (1-2\theta)b_{u2}\bar{L}_{u2}(b_1+b_{u2}) - \omega(a_{u2}-b_{u2}\bar{L}_u)(b_1+b_{u2}) + \omega(a_1-b_1\bar{L}_i)(b_1+2b_{u2}) - \omega(a_1-b_1\bar{L}_j)b_{u2}$$

And,

$$\Psi = 2(a_{u2}-b_{u2}\bar{L}_u) - (a_1-b_1\bar{L}_i) - (a_1-b_1\bar{L}_j)$$

To see which country pays higher tax burden by deducting the solutions of two countries we get-

$$T_i - T_j = (-Q_i + Q_j)\begin{pmatrix}(1-\theta)b_{u2}(b_1+b_{u2})\Phi + 2\omega(b_1+2b_{u2}) - 2b_{u2} \\ +\omega(1-\theta)b_{u2}(b_1+b_{u2})\Phi\end{pmatrix}$$

Or,

$$T_i - T_j = M^{-1}\omega b_1(b_1+3b_{u2})(\bar{L}_C - \bar{L}_I)\begin{pmatrix}(1-\theta)b_{u2}(b_1+b_{u2})\Phi + 2\omega(b_1+2b_{u2}) - 2b_{u2} \\ +\omega(1-\theta)b_{u2}(b_1+b_{u2})\Phi\end{pmatrix}$$

The result obtained is very long and not clear as we have not discussed about the sign of M^{-1} and the last part of the term (in bracket). However the result reduces to that of case 2 if we assume $\theta = 1$. Then we have-

$$M = 4(b_1+2b_{u2})^2 - 4(b_{u2})^2$$

$$T_i = M^{-1}\left(-2Q_i(b_1+2b_{u2}) - 2b_{u2}Q_j\right)$$

And

$$T_i - T_j = M^{-1}b_1(b_1+3b_{u2})(\bar{L}_C - \bar{L}_I)(2(b_1+b_{u2})) = \frac{1}{2}b_1(\bar{L}_C - \bar{L}_I)$$

Therefore we get the same result like case 2 as before that is $T_i > T_j$ if $\bar{L}_i > \bar{L}_j$ that is the country with higher labour endowment pays higher per capita tax rate.

Another point to be noted about the proposition that the country may impose negative tax that is subsidise migration in order to attain the objective. It can certainly be a case when the country wants to maximise the producers' surplus plus tax revenue. The result is discussed in the following proposition-

Preposition 4.7: Country U may subsidise migration in order to maximise the surplus of producers plus tax revenue.

Proof:

We will demonstrate the proposition for a special case when $\theta = 0$ so that only producers' surplus is given weight. Also for simplicity of calculation assume that $b_1 = b_2 = b_{u2} = 1$. Then after doing necessary calculation with equation (4.20) we obtain-

$$T_i = \frac{1}{8}\left(4\left(\left(a_{u2} - \bar{L}_u\right) - \left(a_1 - \bar{L}_i\right)\right) + \bar{L}_i - \bar{L}_j\right) \qquad (4.21)$$

As $\left(a_{u2} - \bar{L}_u\right) > \left(a_1 - \bar{L}_i\right)$ the sign of the expression is always positive when $\bar{L}_i > \bar{L}_j$ or $\bar{L}_i = \bar{L}_j$. Otherwise the sign of the expression can be negative. If the sign is negative then negative tax (subsidy) is the optimal solution.

■

Though in some cases U may subsidise migration, it will still practice discriminatory tax/subsidy regime. The tax/subsidy depends on the relative labour endowments. As can be seen from equation (4.21), if labour endowment of country i increases the tax rate increases or subsidy rate falls. On the other hand if labour endowment of j increases, the tax rate falls or the subsidy rate increases. It then opens the possibility of positive tax rate for a country and subsidy for another country.

5. Conclusions

In this paper we have developed a model where two countries compete for exporting labour to a third country. The concept of competition and cooperation is still a new idea in international migration. International bodies are encouraging and facilitating dialogues between countries in international migration issues. These dialogues may in near future pave the way for a global consensus on migration.

In order to understand how international migration works it is important to realise the interests of different stakeholders of migration. Our paper could be useful to shed some lights on this issue. In our model two countries aim to maximise national income by sending workers to a third country. The third country designs migration policy according to its national objectives. The importing country resorts to discriminatory tax policy in order to maximise income. We have not analysed collusion in this paper but exporting countries may resort to collusion by jointly controlling labour export. But collusion is so far not observed in the activities of labour exporting developing countries. On the other hand importing countries are forming groups to jointly manage and control immigration. Joint management of migrants by Kafala system in Gulf and point based migration system followed by some developed countries can be cited as examples of migration collaboration by importing countries.

International migration serves two fold purposes. It can improve the income and help to reduce poverty level of poor developing countries. In developed countries it is important to fill shortage of manpower. But developed and rich countries restrictive migration policy is limiting the benefit of migration. The developing countries on the other hand only tend to emphasis on remittances and not realising how their unilateral labour export policy is limiting the potential benefit of migration and leading to higher exploitation. The benefit of international migration is a multilateral issue involving both labour exporting and importing countries. Such realisation is required for any future initiative linking migration and economic development.

Appendix

Case 2:

Setting the derivatives equal to zero and after necessary calculations equation (4.10) and (4.11) become-

$$-T_C 2(b_1 + 2b_{u2}) + T_I 2b_{u2} = -a_{u2}(b_1 + b_{u2}) + (a_1 - b_1\bar{L}_C)(b_1 + 2b_{u2}) - (a_1 - b_1\bar{L}_I)b_{u2}$$

$$2T_C b_{u2} - T_I 2(b_1 + 2b_{u2}) = -a_{u2}(b_1 + b_{u2}) + (a_1 - b_1\bar{L}_I)(b_1 + 2b_{u2}) - (a_1 - b_1\bar{L}_C)b_{u2}$$

Solving them using Cramer's rule-

$$\begin{aligned}
&4ZT_C = \\
&2a_{u2}(b_1 + b_{u2})(b_1 + 2b_{u2}) - 2(a_1 - b_1\bar{L}_C)(b_1 + 2b_{u2})^2 + 2(a_1 - b_1\bar{L}_I)(b_1 + 2b_{u2})b_{u2} \\
&+ 2a_{u2}(b_1 + b_{u2})b_{u2} - 2(a_1 - b_1\bar{L}_I)(b_1 + 2b_{u2})b_{u2} + 2(a_1 - b_1\bar{L}_C)(b_{u2})^2 \\
&= 2(a_{u2} - (a_1 - b_1\bar{L}_C))((b_1)^2 + 4b_1 b_{u2} + 3(b_{u2})^2)
\end{aligned}$$

As $Z = (b_1)^2 + 4b_1 b_{u2} + 3(b_{u2})^2$

$$T_C = \frac{1}{2}(a_{u2} - (a_1 - b_1\bar{L}_C))$$

Similarly $T_I = \frac{1}{2}(a_{u2} - (a_1 - b_1\bar{L}_I))$

Now substituting them in equation (4.4) –

$$L_{C2} = Z^{-1}\begin{pmatrix}\left(-\left(a_1 - b_1\bar{L}_C\right)+\left(a_{u2} - b_{u2}\bar{L}_u\right)\right)\left(b_1 + 2b_{u2}\right) - T_C\left(b_1 + 2b_{u2}\right)\\ -\left(-\left(a_1 - b_1\bar{L}_I\right)+\left(a_{u2} - b_{u2}\bar{L}_u\right)\right)b_{u2} + T_I b_{u2}\end{pmatrix}$$

$$= Z^{-1}\begin{pmatrix}\left(a_{u2} - b_{u2}\bar{L}_u\right)\left(b_1 + b_{u2}\right) - \left(\left(a_1 - b_1\bar{L}_C\right)+\frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_C\right)\right)\right)\left(b_1 + 2b_{u2}\right)\\ +\left(\left(a_1 - b_1\bar{L}_I\right)+\frac{1}{2}\left(a_{u2} - \left(a_1 - b_1\bar{L}_I\right)\right)\right)b_{u2}\end{pmatrix}$$

$$= Z^{-1}\begin{pmatrix}\left(a_{u2} - b_{u2}\bar{L}_u\right)\left(b_1 + b_{u2}\right) - \frac{1}{2}\left(a_1 - b_1\bar{L}_C\right)\left(b_1 + 2b_{u2}\right) - \frac{1}{2}a_{u2}\left(b_1 + 2b_{u2}\right)\\ +\frac{1}{2}\left(a_1 - b_1\bar{L}_I\right)b_{u2} + \frac{1}{2}a_{u2}b_{u2}\end{pmatrix}$$

Similarly L_{I2} is obtained from equation (4.5). Deducting them-

$$L_{C2} - L_{I2} = \frac{1}{2Z}b_1\left(\bar{L}_C - \bar{L}_I\right)\left(b_1 + 3b_{u2}\right)$$

Calculation of elasticity

We will only show the calculation of $\frac{L_{C2}}{T_C}$ in detail which as per our previous results-

$$\frac{L_{C2}}{T_C}=\frac{Z^{-1}\left(\begin{array}{l}\left(a_{u2}-b_{u2}\bar{L}_u\right)\left(b_1+b_{u2}\right)-\frac{1}{2}\left(a_1-b_1\bar{L}_C\right)\left(b_1+2b_{u2}\right)-\frac{1}{2}a_{u2}\left(b_1+2b_{u2}\right)\\+\frac{1}{2}\left(a_1-b_1\bar{L}_I\right)b_{u2}+\frac{1}{2}a_{u2}b_{u2}\end{array}\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}$$

$$=\frac{Z^{-1}\left(\begin{array}{l}\left(a_{u2}-b_{u2}\bar{L}_u\right)\left(b_1+b_{u2}\right)+\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)\left(b_1+2b_{u2}\right)\\-\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)\right)b_{u2}-a_{u2}\left(b_1+b_{u2}\right)\end{array}\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}$$

$$=\frac{Z^{-1}\left(\left(a_{u2}-b_{u2}\bar{L}_u\right)\left(b_1+b_{u2}\right)-\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)\right)b_{u2}-a_{u2}\left(b_1+b_{u2}\right)\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}+Z^{-1}\left(b_1+2b_{u2}\right)$$

$$=\frac{Z^{-1}\left(-b_{u2}\bar{L}_u\left(b_1+b_{u2}\right)-\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)\right)b_{u2}\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}+Z^{-1}\left(b_1+2b_{u2}\right)$$

Calculating the ratio for the other country and by deducting we get-

$$\frac{L_{C2}}{T_C}-\frac{L_{I2}}{T_I}=-\frac{Z^{-1}\left(b_{u2}\bar{L}_u\left(b_1+b_{u2}\right)\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}+\frac{Z^{-1}\left(b_{u2}\bar{L}_u\left(b_1+b_{u2}\right)\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)\right)}$$

$$-\frac{Z^{-1}\left(\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)b_{u2}\right)\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)\right)}+\frac{Z^{-1}\left(\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_C\right)b_{u2}\right)\right)}{\frac{1}{2}\left(a_{u2}-\left(a_1-b_1\bar{L}_I\right)\right)}$$

As $\bar{L}_C>\bar{L}_I$ or $T_C>T_I$, the value is positive.

Chapter 5

Optimal Migration Policies with the Presence of Skilled Migration and International Competition

1. Introduction

The recent literature on human capital migration (Mountford 1997, Beine et al. 2001, Stark and Wang 2002) has pointed toward the beneficial effects of skilled migration through the incentive it provides in forming additional skills in the country of emigration. Though the claim does not have overwhelming support (Schiff 2006) it is playing a significant role in modifying the commonly perceived believe about so called 'Brain Drain' where migration is viewed only as a way of channelling the precious human capital from poor countries to the rich developed countries. Though Brain Drain issue is still dominating the mainstream migration literature, the other aspects, specially the remittances sending aspects of migration increasingly receiving more importance from the economists and policy makers as remittances has become a major source of foreign currency receipt in many countries. Some developing countries in this regard are specially emphasising skilled migration as the wage and employment opportunities of skilled people are relatively higher compared to the unskilled people. Hence now a days we observe the endeavour of governments to send both skilled and unskilled people to work abroad. We also notice intergovernmental negations and agreements to control and manage the exit and entry of migrants, employment duration, wage rate, labour right etc. Entry to a foreign country is often contingent upon meeting these conditions fixed in intergovernmental negotiation.

The involvement of governments as described above is now widespread in case of unskilled migration. It is now increasingly becoming difficult for unskilled people to migrate without the involvement of governments. Governments' intervention however is still limited in the

migration of skilled people. Skilled people are actually enjoying a kind of free migration facility similar to that observed in some special zones like European Union or the university graduates of the Caribbean region (Winters 2008, page 535). The reason can be attributed to the fact that recruitment of skilled people directly from a foreign country is possible through advertisement of vacancies in newspapers and internet. Skilled people can look for the vacancies there and make applications. Thus skilled people can easily enter a foreign country for work once the application is accepted and the employers issue the letter of sponsorship. In addition developed countries are now practising high skilled migration programme where migrants with special skills are granted work permit which leads to permanent residency. Most countries at present do not impose or not in a position to impose any exit barrier to the people leaving the country in this manner.

Whereas advertisements published in newspapers and internet is largely inappropriate for recruitment of unskilled people from poor developing countries. This actually is an important feature that makes migration of skilled and unskilled people different. Instead of using advertisements, the employers in past relied on recruiting agencies working at the grassroots levels. Now the countries involved are disfavouring this privately managed recruitment of unskilled migrants and gradually moving toward government controlled migration.

Given the above observation we reckon that skilled and unskilled migrants need to be treated differently. In the previous chapter we have analysed the optimal policies of governments given unskilled migration, remittances and international competition. The policy taken by the sending countries government took the form of controlling the volume of migration. Skilled people are still migrating kind of freely, thus thinking of direct control is inappropriate in case of skilled people. We may nevertheless think about indirect exit barriers such as emigration tax that can be imposed on migrants. We normally do not observe such exit barriers in practice, except for some control over the issuance of passport. Stark and Wang (2002) has referred to such an exit barrier imposed by Chinese Government where not all those who can safely expect to have higher earnings abroad can leave, because the

government does not grant emigration visas or passports liberally. But such barriers now a days are exceptions rather than the rules.

Many countries in reality are promoting skilled migration. We are here questioning this policy. To address the question in this chapter we are modelling migration in a way that people are allowed to move freely from one country to another country. Thus we are working with the subset of world migration where free movement of people is allowed or where people can find job without governments' assistance/negotiation. We are referring to a group that is likely to be high skilled which almost all countries of the world are relatively open in accepting and governments are not in a position to exercise power to stop migration. This subset of world migrants is also likely to be relatively wealthier though not necessarily true in all cases.

Similar to chapter 4 we assume a game where workers from two counties migrate to a third country. As the sending country cannot directly control migration they use tax policies to control migration to maximise national income. The tax should be regarded as various types of monetary and non monetary barriers that can be used by the government of sending countries. The third country foresees the policies of the sending countries and sets it own tax policies given the policies and migration from the sending countries. As in chapter 4, the tax should be considered as various monetary and non-monetary barriers above the administrative costs imposed by the receiving country with the aim to transfer some income of the migrants in its national income account. It is to be noted that we are modelling that the benefit a country receives though migration is the benefit of remittances. Skilled migrants are also regarded as the source of other types of benefits such as investment, human capital formation and business links. Nevertheless remittances is the most tangible and immediate benefit of migration and deserves proper attention.

The modelling here is similar to the literature of strategic trade policy, specially the model proposed in Brander and Spencer (1985) and Brander (1995) where two countries engage in strategic trade to export to a third country. In non-cooperative situation both countries provide positive subsidy to maximise welfare if the goods exported are substitutable. Gatsios (1990)

extended the model by looking at the optimal tax policy of the importing country. He found that the country should practice discriminatory tax policy to maximise welfare where the most efficient producer receives higher tax burden. Contrary to Brander and Spencer (1985) we have found that sending countries should tax the skilled migration and this tax policy improve the welfare of the other sending country. In case of receiving country we see that receiving country uses discriminatory tax policy and tax burden is higher for the country with highest labour endowment. This result is similar to Gatsios (1990) where the efficient producer receives the highest tax burden.

Strategic trade has received considerable attention from economists and is referred extensively in the literature of economic policy making. It is really surprising to see that economic literature paid no such attention to competition among countries in international migration. The reason is probably that in past people migrated from one country to another country mainly for permanent establishment. The linkages between international migration and economic development were evaluated only in the context of the Brain Drain problem. Since 1970s especially after the boom of the oil rich economies in Middle East we can observe the emergence of temporary migration for remittances. Given that remittances constitute a substantial portion of national income of many countries economists have started to emphasis on the importance of remittances in economic development. Competition among the countries for remittances is certainly having effects on the benefits of migration. But still we can only find vague reference of competition in some policy literature without any clarifying discussion. For example in the IOMs publication 'Labour Migration in Asia', references of competition have been provided a number of times without any detailed discussion on the nature of such competition (IOM 2003). We believe that the work of the chapter will be able to fill up this gap of the existing economic literature and will be very useful in the migration policies of developing countries.

The chapter has been organised as follows. In the first introductory chapter we have described the background of the paper. Second section describes the model and identifies the conditions of equilibrium migration or

labour export by sending countries. The third and fourth sections deal respectively with the optimum emigration and immigration taxes. The fifth section is concluding section and also provides policy recommendation based on the analysis of the paper.

2. The Model

2.1. Basic Assumptions and Notations

We adopt a model similar to the model used in chapter 4 where there are three open economies C, I and U producing two internationally traded goods - X_1 and X_2. Prices of goods are fixed. We select the units in a way that price of one unit of good is equal to 1. Thus relative price of two goods is just 1. Labour endowment is fixed, denoted by $\bar{L}_i$ for country $i \in \{C, I\}$ and $\bar{L}_u$ for country U.

The production functions of good 1 and good 2 are given respectively as $X_{i1} = X_{i1}(L_{i1})$ and $X_{2i} = X_{i2}(L_{i2})$ where $i \in \{C, I, U\}$. As in chapter 4 we assume that technologies and labour endowments are such that country C and I specialise in production of good 1 and country U specialises in production of good 2.

As we are assuming that country C and I specialise on producing X_1 the wage in country i is given as- $w_i = \frac{\partial X_{i1}}{\partial L_{i1}}$ evaluated at $\bar{L}_i$. Similarly the wage rate in country U is given as $w_u = \frac{\partial X_{u2}}{\partial L_{u2}}$. We assume that $w_i < w_u$ which initiates migration and migrants repatriate all the income back to the home country. The national income of the home is then given as the output produced in the sector 1 plus the remittances received. We assume consumers' preference such that the countries always consume both goods. Hence without migration C and I should export the good 1 and import good 2. U on the

other hand exports good 2 and import good 1. We assume that migration does not change this pattern of comparative advantage. As migration affects the production and consumption of goods in the countries under consideration, it may also affect the world price level and may reverse the pattern of the specialisation and wage differentials as assumed before. As the aim of the analysis in not to evaluate the welfare from trade and/or changes of comparative advantage, we retain the assumption of fixed price throughout to keep our analysis simple.

Similar to Chapter 4 we assume special functional forms of production functions. Let, production of X_1 in $i \in \{C, I\}$ depicted by the following function-

$$X_{i1} = a_1 L_{i1} - \frac{b_1}{2} L_{i1}^2$$

where X_{i1} denotes the amount of X_1 produced in $i \in \{C, I\}$, L_{i1} is total amount of labour used in production of X_1, a_1 and b_1 are coefficients. Differentiating with respect to L_{i1}, marginal product of labour in sector X_1 is obtained as $a_1 - b_1 L_{i1}$. Therefore MP_L varies between a_1 and $a_1 - b_1 \bar{L}_i$.

The production of X_2 is given as-

$$X_{i2} = a_2 L_{i2}$$

where a_2 is the amount of labour required to produce one unit of X_2 and L_{i2} is the amount of labour used for production of X_2. Differentiating with respect to L_{i2}, the MP_L is obtained as a_2. Hence, country $i \in \{C, I\}$ switches labour from X_2 to X_1 if the value of marginal product of labour in X_1 is greater than the value of marginal product of labour in X_2. that is, iff -

$$(a_1 - b_1 L_{i1}) > a_2$$

Or, $1 > \frac{a_2}{a_1 - b_1 L_{i1}}$.

Let us assume that $1 > \frac{a_2}{a_1 - b_1 \bar{L}_i}$. Thus with trade $i \in \{C, I\}$ necessarily specialises in producing X_1. Without migration the workers of $i \in \{C, I\}$ receive wage-

$$w_i = a_1 - b_1 \bar{L}_i$$

On the other hand assume that country U has linear production technology for X_1, which is written as-

$$X_{u1} = a_{u1} L_{u1}$$

where L_{u1} is the amount of labour used and a_{u1} is the coefficient. By differentiating with respect to L_{u1}, we get the marginal product of labour as a_{u1}. The production in sector X_2 is defined by the following function-

$$X_{u2} = a_{u2} L_{u2} - \frac{b_{u2}}{2} L_{u2}^2$$

where L_{u2} is the amount of labour used in production of X_2 in U. Again by differentiating with respect to L_{u2} we get the marginal product of labour in country U as $(a_{u2} - b_{u2} L_{u2})$. Thus marginal product varies between a_{u2} and $(a_{u2} - b_{u2} \bar{L}_u)$. Country U will thus specialise in production of X_2 iff-

$$(a_{u2} - b_{u2} \bar{L}_u) > a_{u1}$$

Or, $1 > \frac{a_{u1}}{(a_{u2} - b_{u2} \bar{L}_u)}$

Let $\left(a_{u2} - b_{u2}\bar{L}_u\right) > a_{u1}$. Country U therefore specialises in production of X_2. Without migration, the workers of country U receives wage-

$$\bar{w}_u = a_{u2} - b_{u2}\bar{L}_u$$

With migration wage in U is given as $w_u = a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)$. We assume that $w_u > a_{u1}$ throughout as such the country still specialises in production of good X_2 after migration. We also have the assumption that $a_{u2} - b_{u2}\bar{L}_u > a_1 - b_1\bar{L}_i$ such that wage received by labour is higher in country U which initiates migration.

The game we consider can be described as follows. First the importing country that is country U sets it tax policies for migration. Given the tax rates, C and I sets their migration tax policies. Given the tax policies, the migrants of C and I migrate to country U, until the net wage of migration is equal to the home wage.

2.2. Equilibrium Migration between Country *i* and U

In the previous sub-sections we have defined the model and showed the conditions under which country i specialises in production of good X_1 and country U specialises in production of good X_2. In this section we will define the mechanism of migration and find the amount of equilibrium labour export. As already discussed it is assumed that workers are freely allowed to migrate from one country to another country. There is no restriction from both sending and receiving countries on the movement of labour between countries. This is true for migration of both skilled and unskilled labour of some special developed countries such as the countries of European Union. But for migration from developing to developed country it can only be true for the skilled migration.

As mentioned before instead of using direct quantitative restriction, both sending and receiving countries assumed to be using taxes on the income of migrants. Let D_i be the tax imposed by country i on the income of migrants of country i. Let us call it 'domestic' tax for i. Similarly let T_i be the tax imposed by country U on the migrants of country i and call it 'foreign' tax for i. Then following two equations must be satisfied in the migration equilibrium assuming full information, perfect mobility and no travel cost-

$$a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_C - D_C = a_1 - b_1\left(\bar{L}_C - L_{C2}\right) \tag{5.1}$$

$$a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right) - T_I - D_I = a_1 - b_1\left(\bar{L}_I - L_{I2}\right) \tag{5.2}$$

Hence the wage of migrants minus domestic tax and foreign tax must be equal to the wage received by domestic workers. Solving the equations following solutions are obtained-

$$L^*_{C2} = V^{-1}\left(G_C\left(b_1 + b_{u2}\right) - G_I b_{u2}\right) \tag{5.3}$$

and

$$L^*_{I2} = V^{-1}\left(G_I\left(b_1 + b_{u2}\right) - G_C b_{u2}\right) \tag{5.4}$$

where-

$V = b_1\left(b_1 + 2b_{u2}\right)$ and

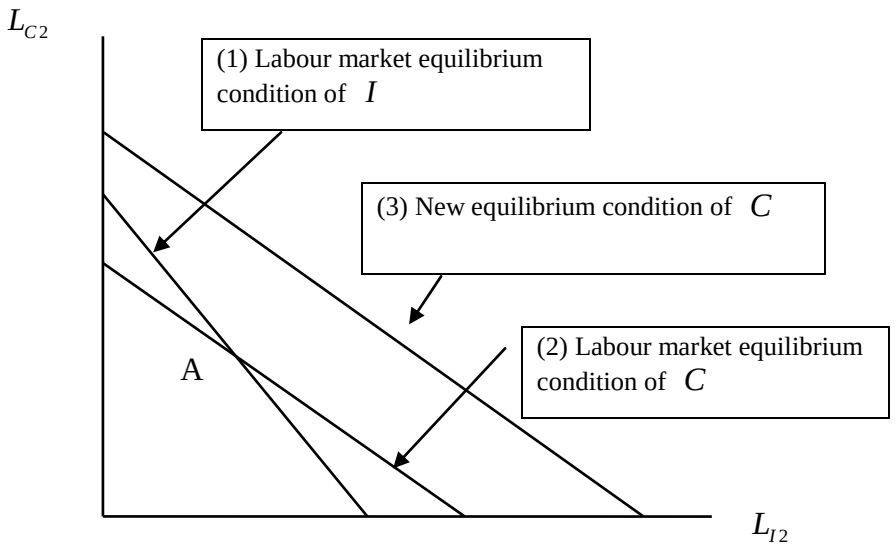
$G_i = -\left(a_1 - b_1\bar{L}_i\right) + \left(a_{u2} - b_{u2}\bar{L}_u\right) - T_i - D_i$

We assume that $G_i > 0$, because to initiate migration the wage rate in U must be higher than the wage rate in i plus the taxes.

We have plotted equation (5.1) and (5.2) in Figure-5.1 to look at the equilibrium more carefully. We have plotted L_{C2} in the vertical and L_{I2} in horizontal axis. The line 1 corresponds to equation (5.2) of country I and line

2 corresponds to equation (5.1) of country C. Two lines have been assumed to intersect at point A.

Figure-5.1
Labour Migration Equilibrium



It is to be noted that a country can affect the other country's labour export by changing its domestic tax rate. As can be seen in the Figure-5.1, by reducing domestic tax rate, country C shifts the line 2 to line 3, where stability requires that country I will cease to have any migration. Nevertheless, it is not the case that reduced tax rate is always associated with net welfare gain for the labour exporting country. The change of tax rates can have beneficial or detrimental effects, which we will analyse in the next sections.

3. Imposition of Domestic Tax

In the previous section we have defined our model and found the equilibrium amount of labour export given the domestic and foreign tax rates. In this section we analyse the imposition of domestic tax rates of the exporting

countries. It can be considered as the second stage of the game. In the first stage the importing country imposes tax rates. Given the tax rates the exporting countries select the tax rates taking in to consideration the possible changes in labour migration. It will be useful to first look at the effects of the domestic tax on the equilibrium labour export. Differentiating equation (5.3) and (5.4) with respect to D_i and after necessary calculation we obtain-

$$\frac{\partial L_{i2}}{\partial D_i} = -V^{-1}\left(b_1 + b_{u2}\right)$$

and,

$$\frac{\partial L_{j2}}{\partial D_i} = V^{-1}\left(b_{u2}\right)$$

By adding we get- $\frac{\partial L_{i2}}{\partial D_i} + \frac{\partial L_{j2}}{\partial D_i} = -V^{-1}\left(b_1\right)$. Thus the labour export of country i decreases but that of j increases. The overall labour export decreases. The above result is obtained as labour migration responses more in absolute value to its own tax rate compared to its response given the change of other country's tax rate. As the country i increases it domestic tax rate, the migrants of i found that income at home is higher than the net income they are receiving by working in U. Hence some migrants pull themselves out from U. As wage rate in U increases, labour migration from j increases. But in total, labour migration decreases.

Given the above result below we state one of the most important results of the chapter-

Proposition 5.1: The countries will impose positive domestic tax to maximise national income.

Proof:

In order to prove the proposition we first need to define the income equation of sending countries. Income equation of country i is written as-

$$Y_i = \left(a_1\left(\overline{L}_i - L_{i2}\right) - \frac{b_1}{2}\left(\overline{L}_i - L_{i2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right) - D_i - T_i\right)L_{i2} + D_i L_{i2}$$

Hence national income is the summation of the output produced at home, the wage remitted by migrants working in U and total amount of domestic tax. It can be seen that domestic tax cancels out from the equation. It is not surprising as workers pay domestic tax to country i for migration, they cannot send that amount again as remittances. We are also assuming full repatriation of remittances by the migrants. Thus the equation becomes-

$$Y_i = \left(a_1\left(\overline{L}_i - L_{i2}\right) - \frac{b_1}{2}\left(\overline{L}_i - L_{i2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right) - T_i\right)L_{i2} \qquad (5.5)$$

By differentiating the income equation of i in equation (5.5) we get-

$$\frac{\partial Y_i}{\partial D_i} = -\left(a_1 - b_1\left(\overline{L}_i - L_{i2}\right)\right)\frac{\partial L_{i2}}{\partial D_i} + \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)\frac{\partial L_{i2}}{\partial D_i} - b_{u2}L_{i2}\frac{\partial L_{i2}}{\partial D_i}$$
$$- b_{u2}L_{i2}\frac{\partial L_{j2}}{\partial D_i} - T_i\frac{\partial L_{i2}}{\partial D_i}$$

Using migration equilibrium condition of equation (5.1) or (5.2)-

$$\frac{\partial Y_i}{\partial D_i} = -V^{-1}\left(D_i\left(b_1 + b_{u2}\right) - b_{u2}L_{i2}b_1\right)$$

Setting $\frac{\partial Y_i}{\partial D_i} = 0$ we get $D_i > 0$, or differently for $D_i = 0$ we have-

$$\frac{\partial Y_i}{\partial D_i} = V^{-1}b_{u2}L_{i2}b_1 > 0$$

Therefore optimal domestic tax is positive.

■

The proposition has substantial implication in the migration policies of poor developing countries. It shows that sending countries can not depend only on labour export to maximise national income. They also need to control it by imposing positive tax. The result can be compared with that of Brander and Spencer (1985) where subsidy acts as a transfer but positive subsidy is required for the profit shifting effects. Here we however see that instead of subsidy the country should tax the migrants. In this paper without tax apparently too many people migrate to U. Tax discourages some people to migrate. Thus wage received by migrants increases and the domestic output increases. Thus national income increases.

We are also interested to know if the positive domestic tax has anything to do with the competition from another country and the positive foreign tax. Let us first assume that country j is inactive or no more in the system such that out of equation (5.1) and (5.2) we have only one equation[1]. The existing equation therefore has no L_{j2} term. Then again differentiating the equation (5.5) we obtain-

$$\frac{\partial Y_i}{\partial D_i} = -\left(a_1 - b_1\left(\bar{L}_i - L_{i2}\right)\right)\frac{\partial L_{i2}}{\partial D_i} + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2}\right)\right)\frac{\partial L_{i2}}{\partial D_i} - b_{u2}L_{i2}\frac{\partial L_{i2}}{\partial D_i} - T_i\frac{\partial L_{i2}}{\partial D_i}$$

Using the migration equilibrium condition stated in footnote 1-

$$\frac{\partial Y_i}{\partial D_i} = -\frac{D_i}{\left(b_1 + b_{u2}\right)} + \frac{b_{u2}L_{i2}}{\left(b_1 + b_{u2}\right)}$$

[1] Equilibrium condition is given as
$a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2}\right) - T_i - D_i = a_1 - b_1\left(\bar{L}_i - L_{i2}\right)$, the solution is-
$$L_{i2} = \frac{-\left(a_1 - b_1\bar{L}_i\right) + \left(a_{u2} - b_{u2}\bar{L}_u\right) - T_i - D_i}{\left(b_1 + b_{u2}\right)}$$

Setting $\frac{\partial Y_i}{\partial D_i} = 0$ we get $D_i > 0$. Therefore optimal domestic tax in no strategic situation is also positive. To see it more clearly note that if $D_i = 0$ then we have-

$$\frac{\partial Y_i}{\partial D_i} = \frac{b_{u2} L_{i2}}{\left(b_1 + b_{u2}\right)} > 0$$

Thus with or without the presence of competition from other exporter the country must pursue the policy of positive domestic tax. Interestingly positive domestic tax has nothing to do with foreign tax being positive. Irrespective of foreign tax rate, the country must pursue positive domestic tax policy. The following proposition however shows that in strategic situation domestic taxes imposed by the countries do have effects on each other.

Proposition 5.2: Marginal increase in domestic tax rate by country i ***will imply increase of income of country*** j.

Proof:

The income equation of j is

$$Y_j = \left(a_1\left(\bar{L}_j - L_{j2}\right) - \frac{b_1}{2}\left(\bar{L}_j - L_{j2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right)\right)L_{j2} - T_j L_{j2} \quad \text{....(5.6)}$$

Differentiating income equation of j in equation (5.6) with respect to D_i and after necessary calculation we get-

$$\frac{\partial Y_j}{\partial D_i} = V^{-1}\left(D_j b_{u2} + b_{u2} L_{i2} b_1\right) > 0$$

Hence the country j experiences an increase in income. ■

This proposition is quite obvious but very interesting. If country i increases domestic tax, it reduces migration from i and thus increases demand in receiving country, increasing wages there. Hence, with same migration, country j should be better off. The migration from j will increase but not that much to bring down the wage rate exactly to the previous level. Thus with higher wage rate and higher migration, j will experience higher income.

Interestingly, the competition among the countries is not really harming each other. The countries have unilateral incentive to impose positive tax but it does not reduce the income of other country but instead increases the income. However if a country decides to follow the policy of subsidising migration or reduce its tax rate, it will be harmful for the other country. As we see, migration subsidy cannot be the optimal policy response of sending countries.

3.1. The Optimum Domestic Tax

As has been discussed, the selection of optimum domestic tax can be considered as the second stage of the game. In the first stage the leader U sets the foreign tax. In the second stage country C and I set domestic tax rates to maximise national income. Thus the game is to be solved using backward induction which involves finding the solutions for optimum domestic tax rates assuming the tax rates of U given. Country i also considers that the other country j will keep the domestic tax unchanged. It means that i maximises following the income equation same as equation (5.5) varying domestic tax D_i.

$$Y_i = \left(a_1\left(\overline{L}_i - L_{i2}\right) - \frac{b_1}{2}\left(\overline{L}_i - L_{i2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)L_{i2} - T_i L_{i2}$$

The L_{i2} s are here function of D_i s and T_i s where $i \in \{C, I\}$. The country i when selecting the domestic tax rate D_i consider that the other country j keeps its domestic tax rate D_j fixed. Hence we get a Bertrand type competition for setting domestic tax rates. We have already seen from proposition (5.1) that i will have positive domestic tax in order to maximise national income irrespective of the domestic tax rate of j. Therefore positive solutions of domestic tax rates exist that satisfy the first order condition of maximisation. Now differentiating the income equation of i with respect to D_i and setting the derivatives equal to zero and using the migration equilibrium condition as stated in equation (5.1) and (5.2) we get following two reaction functions for country C and I (calculations shown in appendix)-

$$-D_C(b_1+b_{u2})(b_1+3b_{u2})+D_I b_{u2}b_{u2} = -b_{u2}(b_1+b_{u2})(w_{DC}-T_C)+b_{u2}b_{u2}(w_{DI}-T_I)$$

and,

$$D_C b_{u2}b_{u2} - D_I(b_1+b_{u2})(b_1+3b_{u2}) = -b_{u2}(b_1+b_{u2})(w_{DI}-T_I)+b_{u2}b_{u2}(w_{DC}-T_C)$$

where-

$$w_{Di} = -(a_1 - b_1\bar{L}_i)+(a_{u2}-b_{u2}\bar{L}_u)$$

The second derivatives are -

$$\frac{\partial^2 Y_i}{\partial D_i^2} = -\frac{(b_1+b_{u2})}{b_1(b_1+2b_{u2})} - \frac{b_{u2}(b_1+b_{u2})}{b_1(b_1+2b_{u2})^2} < 0$$

$$\frac{\partial^2 Y_i}{\partial D_i \partial D_j} = \frac{b_{u2}^2}{b_1(b_1+2b_{u2})^2} > 0$$

Hence the second derivatives have signs as required for stability. Solving the two equations using Cramer's rule we obtain-

$$D_C = H^{-1}((w_{DC}-T_C)A-(w_{DI}-T_I)B) \qquad (5.7)$$

$$D_I = H^{-1}\left(\left(w_{DI} - T_I\right)A - \left(w_{DC} - T_C\right)B\right) \tag{5.8}$$

where

$$H = \left(b_1 + b_{u2}\right)^2\left(b_1 + 3b_{u2}\right)^2 - \left(b_{u2}\right)^4 > 0$$

$$A = b_{u2}\left(\left(b_1 + b_{u2}\right)^2\left(b_1 + 3b_{u2}\right) - {b_{u2}}^3\right) > 0$$

$$B = {b_{u2}}^2\left(b_1 + b_{u2}\right)\left(b_1 + 2b_{u2}\right) > 0$$

The solutions apparently look a bit long, but in reality they are quite simple. We already know from proposition (5.1) that domestic taxes are positive. To look at the solutions a bit more clearly let us assume that $b_1 = b_{u2} = 1$. Then after necessary calculations we get-

$$D_i = \frac{1}{21}\left(5\left(w_{Di} - T_i\right) - 2\left(w_{Dj} - T_j\right)\right) \tag{5.9}$$

Thus in the calculation we have obtained the solutions of second stage of the game for optimal domestic tax rates. Proposition (5.1) implies that $D_i > 0$ is positive. However it is not possible to directly observe it from equation (5.9) as it depends on the values of other parameters namely, a_1, a_{u2}, $\bar{L}_i$'s and $\bar{L}_u$ given $b_1 = b_{u2} = 1$. Nevertheless this simplification will be useful to look at the solutions of foreign tax rates in next section. From equation (5.7) and (5.8) it can nevertheless be seen how changes in foreign tax rates have effects on domestic tax rates. We state it using following proposition.

Proposition 5.3: If foreign tax rate for i increases then the optimal domestic tax rate of i decreases and that of j increases.

Proof:

Differentiating the solutions of D_i from (5.7) or (5.8) with respect to T_i we get-

$$\frac{\partial D_i}{\partial T_i} = -H^{-1}A$$

and,

$$\frac{\partial D_j}{\partial T_i} = H^{-1}B$$

Therefore the optimal domestic tax rate for i decreases and that of j increases.

■

This result is another very important proposition from the policy makers' perspective. If tax for i is increased, then migration from that country decreases. Implying that domestic tax for i is no longer in equilibrium and is higher than the amount required to control migration. Thus, domestic tax rate of i decreases to restore equilibrium. On the other hand as tax increases more people migrate from country j as wage is now higher. Thus domestic tax for j becomes lower than the equilibrium value. Consequently, domestic tax rate of j increases.

It may be of some interest to look at the change in national output of U when the exporting countries impose domestic tax rates. The see it note that the national output equation of U is-

$$Y_U = a_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right) - \frac{b_{u2}}{2}\left(\bar{L}_u + L_{i2} + L_{j2}\right)^2$$

Therefore, $\frac{\partial Y_U}{\partial D_i} = \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{i2} + L_{j2}\right)\right)\left(\frac{\partial L_{i2}}{\partial D_i} + \frac{\partial L_{j2}}{\partial D_i}\right)$. As $\left(\frac{\partial L_{i2}}{\partial D_i} + \frac{\partial L_{j2}}{\partial D_i}\right) < 0$, national output decreases, when the importing countries increases domestic tax rate. Hence it implies that that U will prefer to have no domestic tax imposed by the sending countries.

4. Imposition of Foreign Tax by U

The first stage of the game involves setting of foreign tax by country U. This assumption brings us close to the works like Gatsios (1990) and Hwang and Mai (1991) where the tax policy of importing country was analysed. The reason to adopt similar model is the presence of market power of the rich developed countries. Given the rich countries are powerful; it is often possible for them to move first by setting their own policy objective when allowing migration. The poor countries merely follows the path paved by such policies. Thus in our model the importing country U acts as a Stackelberg leader by setting its policies. The country sets the tax rates contemplating that country C and I will set their domestic taxes to control migration after fixation of foreign tax rate. By foreseeing this U sets up the tax rates to maximise the objective function. Below we are stating some results in propositions-

Proposition 5.4: If U increases the tax rate for i then the labour export of i decreases and that of j increases. The total labour export decreases.

Proof:

To prove the proposition we need to recall the solutions of labour exports in equations (5.3) and (5.4). L_{i2} s are there function of D_i s and T_i s. But D_i s are also function of T_i s. hence by differentiating equation (5.3) and using solutions from equation (5.7), (5.8) and proposition (5.3) we obtain-

$$\frac{\partial L_{i2}}{\partial T_i} = V^{-1}\left(-\left(b_1 + b_{u2}\right) - \frac{\partial D_i}{\partial T_i}\left(b_1 + b_{u2}\right) + \frac{\partial D_j}{\partial T_i} b_{u2} \right)$$
$$= V^{-1}\left(-\left(b_1 + b_{u2}\right) + H^{-1}A\left(b_1 + b_{u2}\right) + H^{-1}Bb_{u2} \right)$$

Similarly from equation (5.4) we obtain-

$$\frac{\partial L_{j2}}{\partial T_i} = V^{-1}\left(-\frac{\partial D_j}{\partial T_i}\left(b_1 + b_{u2}\right) + b_{u2} + \frac{\partial D_i}{\partial T_i} b_{u2} \right) = V^{-1}\left(b_{u2} - H^{-1}B\left(b_1 + b_{u2}\right) - H^{-1}Ab_{u2}\right)$$

By adding these two-

$$\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i} = V^{-1}b_1\left(-1 + H^{-1}A - H^{-1}B\right)$$

In the appendix it has been shown by further calculation that- $\frac{\partial L_{i2}}{\partial T_i} < 0$, $\frac{\partial L_{j2}}{\partial T_j} > 0$ and $\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i} < 0$. ■

The proposition shows that the labour export of country *i* decreases and that of country *j* increases. We have already obtained that a country decreases domestic tax rate if foreign tax rate on own migrants is increased, thereby partially offsets the rate of decrease of migration. On the other hand if other country's foreign tax is increased then the country increases its own domestic tax rate, thereby partially offsets the rate of increase of migration. As the overall labour migration decreases, the imposition of positive tax rates by U decreases the national output of U. Hence maximisation of national output cannot be the reason for positive migration tax. Below we explore the cases where the country may use positive foreign tax rates.

Proposition 5.5: *U* ***may impose positive foreign tax in order to maximise the income of permanent residents.***

Proof:

The objective of the receiving country may be to maximise the income of permanent residents of the country. Thus it will maximise the national output plus tax minus the wage of migrant workers. The objective function is then-

$$Y_U = \left(a_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right) - \frac{b_{u2}}{2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)^2 \right) - \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)L_{i2}$$
$$- \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)L_{j2} + T_i L_{i2} + T_j L_{j2}$$

Thus U aims to maximise the national output plus tax revenue deducting the wage remitted by the migrants. The equation is complicated to work with thus we will evaluate the differentiation when tax rates are initially zero. Thus after differentiating and assuming tax rates are zero we get-

$$\frac{\partial Y_U}{\partial T_i} = b_{u2}\left(L_{i2} + L_{j2}\right)\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i}\right) + L_{i2}$$

Thus the first part of the expression is negative whereas the second part of the expression is positive. If tax is imposed it can increase or decrease the income of residents. Therefore the country may also subsidise migration to increase national income.[2] ■

The proposition shows that the power of importing country is depending on how exporting countries respond to the changed tax rates. This will happen if $\frac{\partial L_{i2}}{\partial T_i}$ and $\frac{\partial L_{j2}}{\partial T_i}$ are very close, then the first term of the above expression become almost zero and the national income of U increases. That is if the migrants of country i are to a large extent replaced by the migrants of country j, then country U will not experience production and tax revenue losses and accordingly the income of residents will increase. This is apparently happening in most developed countries. These countries are highly dependent on foreign labour force, but still maintain a high entry barrier. The reason is probably the existence of large pool of skilled and unskilled workers in the global market who are willing to migrate and work in developed countries.

[2] Assuming $b_1 = b_{u2} = 1$ we obtain $\frac{\partial Y_U}{\partial T_i} = -\frac{2}{7}\left(L_{i2} + L_{j2}\right) + L_{i2}$. Therefore if $L_{i2} = L_{j2}$, the income increases but if $L_{i2} \neq L_{j2}$, income may increase or decrease.

These barriers are effectively increasing the entry cost for foreign labour force. However proposition (5.5) also suggesting that the countries may also practise the policy of subsidising migrants.

We are interested to know the relationship between the labour endowment and tax burden received by a country. To check it we will work with a case where the country *U* wants to maximise the income of its permanent native workers. Not surprisingly, if the country wants to maximise the income permanent workers that is wage plus tax revenue then it imposes positive tax rate. The income of the permanent workers is given as-

$$Y_{LU} = \left(a_{u2} - b_{u2}\left(\overline{L}_u + L_{i2} + L_{j2}\right)\right)\overline{L}_u + T_i L_{i2} + T_j L_{j2}$$

By differentiating we get the following-

$$\frac{\partial Y_{LU}}{\partial T_i} = -b_{u2}\overline{L}_u\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_j}\right) + L_{i2} + T_i\frac{\partial L_{i2}}{\partial T_i} + T_j\frac{\partial L_{j2}}{\partial T_i}$$

When tax rates are initially zero, the value of the derivatives are positive as-

$$\frac{\partial Y_{LU}}{\partial T_i} = -b_{u2}\overline{L}_u\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_j}\right) + L_{i2} > 0$$

As from proposition (5.4) we have $\left(\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_j}\right) < 0$. Hence the country will use positive foreign tax on the migrants. Thus positive solutions of tax rate exist that satisfy the first order condition of maximisation. It is essential to check the second derivatives. By differentiating again with respect to T_i and T_j we see that-

$$\frac{\partial^2 Y_{LU}}{\partial T_i^2} = 2\frac{\partial L_{i2}}{\partial T_i} < 0 \text{ and } \frac{\partial^2 Y_{LU}}{\partial T_i \partial T_j} = 2\frac{\partial L_{i2}}{\partial T_j} > 0$$

The second derivatives have desired signs as required for stability. In order to obtain the solutions of tax rates we need to set the derivatives equal to zero. The solutions of the equations are painstaking as L_{i2} s are functions of D_i s and T_i s. On top of that D_i s are functions of T_i s. Therefore the calculations involve substituting L_{i2} from (5.3) and (5.4) and then substituting D_i s from equation (5.7) and (5.8). Only carrying the calculation for tax rate for country C we get-

$$\begin{aligned} &T_C\left(-2(b_1+b_{u2})+2H^{-1}A(b_1+b_{u2})+2H^{-1}Bb_{u2}\right)+T_I\left(2b_{u2}-2H^{-1}Ab_{u2}-2H^{-1}B(b_1+b_{u2})\right) \\ &= b_{u2}\bar{L}_u b_1\left(-1+H^{-1}(A-B)\right)-w_{DC}(b_1+b_{u2})+H^{-1}\left((w_{DC})A-(w_{DI})B\right)(b_1+b_{u2}) \\ &+w_{DI}b_{u2}-H^{-1}\left((w_{DI})A-(w_{DC})B\right)b_{u2} \end{aligned}$$

where w_{Di}, H, A and B are as defined before. For the solutions we also need to carry out the calculation for country I too and then find the solutions using Cramer's rule. The calculation is going to be tedious and apparently no clear solution is going to come out. We can here resort to simplification as done before assuming $b_1 = b_{u2} = 1$. By carrying out the calculation with simplification we obtain following solutions-

$$T_i = 0.50\bar{L}_u + 0.50w_{Di} \qquad (5.10)$$

and,

$$T_j = 0.50\bar{L}_u + 0.50w_{Dj} \qquad (5.11)$$

We are now in a position to see which country pays higher tax rate and exports more worker; it is given in the following proposition-

Proposition 5.6: The country with higher labour endowment pays higher tax rate and exports more labour compared to the country with lower labour endowment.

Proof:

In order to find which country pays higher tax rate let us subtract equation (5.11) from (5.10). Then we obtain-

$$T_i - T_j = 0.50\left(w_{Di} - w_{Dj}\right) = 0.50\left(\bar{L}_i - \bar{L}_j\right)$$

Therefore the country with higher labour endowment pays higher tax rate. Further the calculation in appendix shows that $L_{i2} > L_{j2}$ if $\bar{L}_i > \bar{L}_j$

■

The wage rate of the country with higher labour endowment is low. Hence the difference between foreign wage and domestic wage is large. The receiving country can exploit this gap by imposing higher tax rate on labour endowed country. The result is to some extent similar to that of Gatsios (1990). When looking at the tax policy of importing country in a third country strategic trade model, he found that importing country has incentive to impose higher tax rates on most efficient producer. In our case, the country with higher labour endowment has lower opportunity cost of migration, and that country faces higher tax burden. It is also interesting to note that (shown in appendix) we obtain $D_i > D_j$ if $\bar{L}_i > \bar{L}_j$. Hence the exporting country should also impose higher tax rate if it is endowed with a large pool of willing migrants.

6. Conclusions

In this paper we have worked with a model to analyse the effects of tax competition of labour sending and receiving countries. We have assumed a

model where two countries export labour to a third country. In addition to receiving extra workers to increase the output of the economy, the third country uses taxes on immigrants in order to fulfil its national objective. The sending countries also impose tax on emigrants to maximise national income. We have assumed that people are free to migrate and work in other countries. Thus the only way governments can control or restrict migration is by using emigration and immigration taxes.

We have first derived equilibrium amount of migration using the labour market equilibrium conditions. Given that foreign wage is higher then the domestic wage people migrate from both sending countries to the third receiving country. As expected, the labour export responds to the opposite directions for the two sending countries. That is if tax rate (domestic or foreign) is increased for one country, the labour export of that country decreases but labour export of the other country increases. We also note that unrestricted migration is not actually maximising the benefit of the sending countries. To maximise the national income, sending countries should also impose positive emigration tax. The result is contrary to the fact that many developing countries are now actually subsidising/encouraging skilled migration. This result to some extent is in line with the idea of 'Bhagwati Tax' (Bhagwati and Dellalfar 1973). Apparently without tax too many people migrate which makes wage earned in abroad low. Emigration tax restricts migration and wage earned by the migrants rises. In analysing how receiving country imposes tax we have noted that to maximise the income of permanent residents, the country may impose positive or negative (subsidy) immigration tax. But if the objective of the country is to maximise the income of permanent workers then it resorts to positive tax. We have found that it imposes different tax rates for different countries. The country with more labour endowment pays more tax. As the wage rate in the country with more labour endowment is low, the earning they receive from migration is initially relatively high. The receiving country uses this gap of earning to enhance its benefit by imposing higher tax rate. This result obtained is consistent with the result of our previous chapter where we assumed that immigration is completely controlled by sending country.

What lessons can we learn for the analysis done in this paper? We assume free migration on the assumption that the countries are not in a position to control the outflow of migration. When considering the developing countries, these migrants mainly belong to the class of skilled/wealthy people. As obtained in the analysis free migration without any domestic barrier does not maximise the welfare of sending countries. This result has some similarity with the works on Brain Drain literature where benefit of migration through human capital formation is obtained only when not all people can migrate. Developing countries here are apparently pursuing incorrect policy. They are providing encouragement to both skilled and unskilled migration. Emigration of skilled people can be promoted when it brings benefit to the country. The governments need to properly evaluate if skilled emigration in reality is bringing benefit to their countries. For example, the skilled migration can bring benefit when skilled people can conduct research and development in the country of immigration that can also be shared by the country of emigration. In addition as suggested by the recent Brain Drain literature skilled migration can provide incentive to form additional human capital. In this case skilled migration can also be promoted. If skilled migration does not bring benefit then it should be discouraged. However the governments of developed countries are apparently pursuing the policy of encouraging /supporting skilled migration without any proper policy evaluation.

The policy recommendation for the developed migrant receivers is that they should pursue discriminatory tax policy. If migration does not response much given the changes of tax rate then they should also impose positive tax rates. In reality developed countries are doing exactly the same. The migrants from developing countries are facing higher barriers but as income gap is very high the barriers are not greatly hindering the willingness of people to immigrate. The barriers can come in the form of visa processing time, high application cost, mandatory health check up, language proficiency requirement etc. In addition to the high application cost, immigrants remain ineligible to receive social benefit for a substantial period of time (e.g 5 years), though they may remain liable to pay taxes for the whole period of time. Because of high

income gap, these barriers have little effects on the immigration from developing country.

The lesson for the developing countries that they should not take the benefit of migration as granted. The policies need to be devised to control the skilled migration and to bring the benefit from it. If outflow of skilled people is not beneficial then the country should increase the exit barrier for the skilled migrants. In this regards the governments can consider taxing the organisations providing immigration services. This will be an immense task given the social-political influence of the groups to be effected by policy changes. Another solution is to ensure the benefit of all parties by mutually beneficial negotiation such that the world acts cooperatively in migration matters. Given the segmentation of the world such negotiation is unlikely to take place in near future.

Appendix

1. Calculation of domestic tax

The national income equation of country C is given as-

$$Y_C = \left(a_1\left(\bar{L}_C - L_{C2}\right) - \frac{b_1}{2}\left(\bar{L}_C - L_{C2}\right)^2 \right) + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)\right)L_{C2} - T_C L_{C2}$$

Differentiating with respect to D_C and setting the derivative zero we get-

$$\frac{\partial Y_C}{\partial D_C} = -\left(a_1 - b_1\left(\bar{L}_C - L_{C2}\right)\right)\frac{\partial L_{C2}}{\partial D_C} + \left(a_{u2} - b_{u2}\left(\bar{L}_u + L_{C2} + L_{I2}\right)\right)\frac{\partial L_{C2}}{\partial D_C} - b_{u2}L_{C2}\frac{\partial L_{C2}}{\partial D_C}$$
$$- b_{u2}L_{C2}\frac{\partial L_{I2}}{\partial D_C} - T_C\frac{\partial L_{C2}}{\partial D_C} = 0$$

Using migration equilibrium condition of equation (5.1)-

$$\frac{\partial Y_C}{\partial D_C} = D_C \frac{\partial L_{C2}}{\partial D_C} - b_{u2} L_{C2} \frac{\partial L_{C2}}{\partial D_C} - b_{u2} L_{C2} \frac{\partial L_{I2}}{\partial D_C} = 0$$

Now using the equation for equilibrium labour migration of (5.3) and (5.4) and as $w_{Di} = -\left(a_1 - b_1 \bar{L}_i\right) + \left(a_{u2} - b_{u2} \bar{L}_u\right)$ we obtain by further calculation the reaction function of country C -

$$-D_C\left(b_1 + b_{u2}\right)\left(b_1 + 3b_{u2}\right) + D_I b_{u2} b_{u2} = -b_{u2}\left(b_1 + b_{u2}\right)\left(w_{DC} - T_C\right) + b_{u2} b_{u2}\left(w_{DI} - T_I\right)$$

Similarly the reaction function of country I can be obtained.

2. Proposition 5.4:

We get-

$$H = \left(b_1 + b_{u2}\right)^2 \left(b_1 + 3b_{u2}\right)^2 - \left(b_{u2}\right)^4 = {b_1}^4 + 8{b_1}^3 b_{u2} + 22{b_1}^2 {b_{u2}}^2 + 24 b_1 {b_{u2}}^3 + 8{b_{u2}}^4$$

$$A = b_{u2}\left(\left(b_1 + b_{u2}\right)\left(b_1 + b_{u2}\right)\left(b_1 + 3b_{u2}\right) - {b_{u2}}^3\right) = {b_1}^3 b_{u2} + 5{b_1}^2 {b_{u2}}^2 + 7 b_1 {b_{u2}}^3 + 2{b_{u2}}^4 > 0$$

$$B = {b_{u2}}^2\left(b_1 + b_{u2}\right)\left(b_1 + 2b_{u2}\right) = {b_1}^2 {b_{u2}}^2 + 3 b_1 {b_{u2}}^3 + 2{b_{u2}}^4$$

Hence

$$H^{-1}A = \frac{{b_1}^3 b_{u2} + 5{b_1}^2 {b_{u2}}^2 + 7 b_1 {b_{u2}}^3 + 2{b_{u2}}^4}{{b_1}^4 + 8{b_1}^3 b_{u2} + 22{b_1}^2 {b_{u2}}^2 + 24 b_1 {b_{u2}}^3 + 8{b_{u2}}^4} < 1$$

$$H^{-1}B = \frac{{b_1}^2 {b_{u2}}^2 + 3 b_1 {b_{u2}}^3 + 2{b_{u2}}^4}{{b_1}^4 + 8{b_1}^3 b_{u2} + 22{b_1}^2 {b_{u2}}^2 + 24 b_1 {b_{u2}}^3 + 8{b_{u2}}^4} < 1$$

Therefore

$$\frac{\partial L_{i2}}{\partial T_i} = V^{-1}\left(-b_1\left(1 - H^{-1}A\right) - b_{u2}\left(1 - H^{-1}A - H^{-1}B\right)\right) < 0$$

By calculation we get-

$$\frac{\partial L_{j2}}{\partial T_i} = V^{-1}\left(b_{u2} - H^{-1}Bb_{u2} - H^{-1}Ab_{u2} - H^{-1}Bb_1\right)$$
$$= V^{-1}\left(\frac{b_1{}^4 b_{u2} + 6b_1{}^3 b_{u2}{}^2 + 13b_1{}^2 b_{u2}{}^3 + 12b_1 b_{u2}{}^4 + 6b_{u2}{}^5}{b_1{}^4 + 8b_1{}^3 b_{u2} + 22b_1{}^2 b_{u2}{}^2 + 24b_1 b_{u2}{}^3 + 8b_{u2}{}^4}\right) > 0$$

And-

$$\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{i2}}{\partial T_j} = V^{-1}b_1\left(-1 + H^{-1}A - H^{-1}B\right)$$

As

$$A - B = b_{u2}\left(\left(b_1 + b_{u2}\right)\left(b_1 + b_{u2}\right)\left(b_1 + 3b_{u2}\right) - b_{u2}{}^3\right) - b_{u2}{}^2\left(b_1 + b_{u2}\right)\left(b_1 + 2b_{u2}\right)$$
$$= b_{u2}\left[\left(\left(b_1{}^2 + 2b_1 b_{u2} + b_{u2}{}^2\right)\left(b_1 + 3b_{u2}\right) - b_{u2}{}^3\right) - b_{u2}\left(b_1{}^2 + 3b_1 b_{u2} + 2b_{u2}{}^2\right)\right]$$
$$= b_{u2}\left[\left(b_1{}^3 + 2b_1{}^2 b_{u2} + b_1 b_{u2}{}^2 + 3b_1{}^2 b_{u2} + 6b_1 b_{u2}{}^2 + 3b_{u2}{}^3 - b_{u2}{}^3\right) - \left(b_1{}^2 b_{u2} + 3b_1 b_{u2}{}^2 + 2b_{u2}{}^3\right)\right]$$
$$= b_{u2}\left[b_1{}^3 + 5b_1{}^2 b_{u2} + 7b_1 b_{u2}{}^2 + 2b_{u2}{}^3 - b_1{}^2 b_{u2} - 3b_1 b_{u2}{}^2 - 2b_{u2}{}^3\right]$$
$$= b_{u2}\left[b_1{}^3 + 4b_1{}^2 b_{u2} + 4b_1 b_{u2}{}^2\right] = b_{u2}b_1{}^3 + 4b_1{}^2 b_{u2}{}^2 + 4b_1 b_{u2}{}^3$$

We get-

$$\frac{\partial L_{i2}}{\partial T_i} + \frac{\partial L_{j2}}{\partial T_i} = V^{-1}b_1\left(-1 + \frac{b_{u2}b_1{}^3 + 4b_1{}^2 b_{u2}{}^2 + 4b_1 b_{u2}{}^3}{b_1{}^4 + 8b_1{}^3 b_{u2} + 22b_1{}^2 b_{u2}{}^2 + 24b_1 b_{u2}{}^3 + 8b_{u2}{}^4}\right) < 0$$

3. Proposition 5.6:

$$L_{C2}^* - L_{I2}^* = V^{-1}\left(G_C\left(b_1 + b_{u2}\right) - G_I b_{u2}\right) - V^{-1}\left(G_I\left(b_1 + b_{u2}\right) - G_C b_{u2}\right)$$
$$= V^{-1}\left(b_1 + 2b_{u2}\right)\left(G_C - G_I\right) = \left(w_{Di} - T_i - D_i - w_{Dj} + T_j + D_j\right)$$
$$= \frac{1}{3}\left(-\left(a_1 - \bar{L}_i\right) + \left(a_{u2} - \bar{L}_u\right) + \left(a_1 - \bar{L}_j\right) - \left(a_{u2} - \bar{L}_u\right)\right)$$
$$= \frac{1}{3}\left(-\left(a_1 - \bar{L}_i\right) + \left(a_1 - \bar{L}_i\right)\right) = \frac{1}{3}\left(\bar{L}_i - \bar{L}_j\right)$$

Also

$$D_i - D_j = \frac{1}{21}\left(5\left(w_{Di} - T_i\right) - 2\left(w_{Dj} - T_j\right)\right) - \frac{1}{21}\left(5\left(w_{Dj} - T_j\right) - 2\left(w_{Di} - T_i\right)\right)$$

$$= \frac{1}{3}\left(0.50w_{Di} - 0.50w_{Dj}\right) = \frac{1}{6}\left(-\left(a_1 - \bar{L}_i\right) + \left(a_{u2} - \bar{L}_u\right) + \left(a_1 - \bar{L}_j\right) - \left(a_{u2} - \bar{L}_u\right)\right)$$

$$= \frac{1}{6}\left(-\left(a_1 - \bar{L}_i\right) + \left(a_1 - \bar{L}_i\right)\right) = \frac{1}{6}\left(\bar{L}_i - \bar{L}_j\right)$$

Chapter 6

Openness of Labour Market, Migration, R&D and Economic Welfare

1. Introduction

Except a few regions, most countries of the world regulate their labour markets unilaterally. The regulatory bodies sometimes design policies with the aim of accepting the inflow of labour from foreign countries. Sometimes the regulatory bodies aim at reducing the inflow of labour from foreign countries. When the labour market is open firms can recruit low cost labour from outside and it may affect the firms' choice of R&D investment. In this chapter we are going to analyse how opening of labour markets affects the R&D choice of firms and consequently changes economic welfare.

Economic literature of migration shows that this openness brings benefit to both the source and host countries. There are also some papers addressing detrimental effects of such migration. From the source countries' point of view the main points of interest of the economic literature have been the beneficial or detrimental effects of migration through 'Brain Drain' or 'Brain Gain' (Stark and Wang 2002, Schiff 2006 for a review). There are also some works showing the beneficial effects of migration on the source countries' population through remittances receipts (World Bank 2006). For the host countries the reason for opening the labour market is mainly the shortage of required labour force. But recently the countries are also recognising the importance of migration in financing fiscal deficits (Storesletten 2000). The economic literature is also concerned about the detrimental effects of openness in the host country. Such as immigration can have negative effects on the employment and wage opportunities of local people.

The migration literature mainly takes the firms' choice of R&D as exogenous and then analyses the effects of increased migration. However

Bretschger (2001) and Lundborg and Seregstrom (2002) within the framework of endogenous growth theory have analysed the firms' choice of R&D given the migration. They both used quality ladder growth models where firms conduct R&D to develop new quality products. In Lundborg and Seregstrom Northern high tech producers compete for producing high-tech high quality product and Southern countries compete for producing low-tech low quality product. Immigration depresses real wage of Northern workers, Northern firms respond by devoting more resources to R&D activities and innovations occur more frequently in each industry. Bretchger (2001) analysed the effects of increased supply of skilled and unskilled labour on R&D and long term development. Increased supply of skilled labour increases the R&D by lowering cost, but the increase in the supply of unskilled labour may unfavourably influence the long term development through the incentive it provides in the expansion of traditional sector compared to the sector that conducts R&D.

In this chapter we have addressed process innovation where firms engage in R&D to reduce the production cost of already developed product. We assume two firms situated in two different countries engage in strategic trade with each other that serves a unified market of the two countries. In addition to production, the firms can conduct labor saving research. Opening up of labour market reduces the wage rate in the country of immigration. We then analyse the changes of equilibrium R&D investment and welfare. The structure we have adopted has similarity with the standard models of R&D rivalry such as Spencer and Brander (1983). The model and analysis done here also has similarity with Marjit and Mukherjee (2008). Recently increasing numbers of firms are outsourcing their production to foreign countries because of availability of cheap labour. Marjit and Mukherjee (2008) analysed the effects of outsourcing on R&D expenditure of firms. They have shown that outsourcing and R&D can be complimentary or substitute, and the relationship depends on factors like market size and skill differentials between the workers. They have shown that under some conditions outsourcing may reduce the R&D investment and therefore may increase the price of product. Instead of

outsourcing in this paper we analyse the effects of openness and migration on firms' choice of R&D.

The key assumption here is that opening up of labour market reduces the wage rate of labour in the country of immigration. It can be justified in the follows way. Firstly it can happen as migration increases the supply of labour. With downward slopping marginal product curve additional labour will then reduce the wage level. In previous two chapters we have analysed such consequences of migration. Secondly, even if labour supply does not increase, openness poses threat of migration to the native labour force. The threat of migration may reduce their bargaining power and thereby may reduce the wage rates. Here it is possible to link our analysis to General Agreement of Trade in Services (GATS) of WTO. The Mode 4 of GATS considers movement of people as a service trade where importing countries make binding commitment for allowing foreign labour service providers to access their labour market. Hence wages of migrants are really the price of labour services procured from abroad. Like any other product it can be procured from any willing seller of a product. It is normal to assume that reservation wage rates in developing countries are lower than the reservation wage rates of developed countries. Therefore we may assume that it is possible to recruit migrant labour from poor developing countries at a lower wage rate compared to the wage rate of natives. This assumption may receive some objections as in some countries minimum wage rate is a binding condition. But we also should note that there is no upper limit of wage rates in these countries. Therefore migration may reduce the high wage rates charged by native people for some particular services.

We have adopted a model of strategic trade between developing and developed countries as we reckon that many Southern countries such as Mexico, China, India and Eastern European countries are competing with the developed countries in the product markets as well as exporting skilled and unskilled labour there. If migration of labour shapes the use of technology in Northern developed countries, it also does so in the Southern labour exporting developing countries. We have thus utilised the framework of strategic trade to

capture the effects of openness of labour market on both developing and developed countries.

It can be argued that the lower wage rate reflects the intrinsic productivity of the labour, that is immigrants and natives are not perfect substitute in production and research. Lundborg and Seregstrom (2002) regarded that North and South experience wage differential as high-tech R&D can only be conducted by the workers of the North. We regard no such productivity difference. In many instances we see direct recruitment of Southern workers by the employers of North. Many high tech firms of Developed countries are operated by immigrant workers. For example Alacron (1999, page 1390) mentioned of a case study of an Indian student working in Oracle corporation where out of 20 engineers 10 were immigrants. He also mentioned of a notion that high tech firms of Silicon Valley are paying the skilled temporary migrants one third less than the payment of U.S. workers. Hence if immigrants earn low wage then it can simply be attributed to the low reservation wage of the immigrants.

One important contribution of the present paper is the analysis of the effects of skilled and unskilled migration differently. Acknowledgement of this difference allows us to link our analysis with the Brain Drain literature and relevant policy issues. The analysis in this chapter is pointing towards the benefit of skilled migration through the channel of increased R&D. We are assuming that native workers are displaced by low cost migrant workers or at least they experience a reduction in the wage rate. Even then they may gain from opening up if it increases output and lowers price level. It should be noted that though we have analysed the effects of openness and migration on output and price, their effects on overall welfare have not been addressed in this chapter as we have restricted ourselves to a partial equilibrium analysis.

The overall structure of the chapter is as follows. We have already provided introduction in the first section. In the second section we introduce the basic model and provide solution of equilibrium R&D. In the third section we analyse the effects of openness on the R&D of the firms by distinguishing the migrants in skilled and unskilled group. The forth section analyses the

similar effects by allowing no skill difference of the migrants. The fifth that is the last section provides concluding remarks.

2. The Basic Assumptions, Equations and Solutions

2.1. The Assumptions and Model

There are two countries 1 and 2 producing commodity Q using labour. The production of Q in each country is controlled by a single firm, which produces it for the home country and trade it to the other country. We will thus use the term firm and country interchangeably. The inverse demand function is given as-

$$p = a - (q_1 + q_2) \tag{6.1}$$

where p is the price of the product, q_i is the amount produced by the firms in country $i = 1,2$.

The production technologies used in the firms are different. In firm 1, λ amount of unskilled labour is required to produce a unit of good. In firm 2, this amount is β. Besides producing, each firm can also conduct labour saving research that reduces the unit labour requirement of production. Hence the firms perform two tasks: R&D and production. We consider that the firms need different types of workers for these activities. The unskilled workers are used in production but the skilled workers are used in R&D. The wage rate for unskilled labour in i is given as w_{ui} and for the skilled labour, it is w_{si}. We assume throughout that $w_{u1} > w_{u2}$ and $w_{s1} > w_{s2}$, that is wage rates are higher in country 1 which gives the incentive for migration. Institutional reasons such as a stronger trade union or low reservation wage can be the reason for wage

difference. In the following analysis, we will define the wage rates of unskilled and skilled workers in country 1 as $\alpha_u w_{u1}$ and $\alpha_s w_{s1}$ where-

$\alpha_u = 1$ if no migration, $\alpha_u = \frac{w_{u2}}{w_{u1}}$ if migration

$\alpha_s = 1$ if no migration, $\alpha_s = \frac{w_{s2}}{w_{s1}}$ if migration.

Hence the wage rates with migration and open labour market are lower than that of the closed labour market. We keep the wage rates of country 2 unchanged while for simplicity assume that wage rates of country 1 become as low as the wage rates of country 2. The assumption regarding the wage of country 2 is not unrealistic. If country 2 is endowed with large pool of labour force then migration of some people would not have much effect on the wage of country 2. In addition we are only considering the possibility of migration thus if no migration takes place then wage rates would remain unchanged. For country 1 the wage rates after migration should be somewhere between the pre-migration wage rates of two country. For simplification, we have taken the assumption that wage rates fall to the level of pre-migration wage rate of country 2. This simplification does not change the qualitative results. Though we know that wage rates, we do not know the types of labour employed in firm 1. They can be native or migrants or both. To simplify the expression, we are defining all situations by migration. We assume that both types of workers of two countries are perfect substitutes. We also assume that no transport cost is associated with trade. There is also no cost of international migration. Some of these assumptions are not fully realistic but they will help us to concentrate on the main issue that is the effects of openness and migration on R&D investments and consumers' welfare.

We consider the following game. At stage 1, the firms determine R&D investments. Conditional on the R&D investments, at stage 2, they take their output decisions like Cournot oligopolists. We solve the game through backward induction.

2.2. Second Stage of the Game

In country 1, the firm's maximisation problem in the second stage can be written as-

$$\underset{q_1}{Max}\ \pi_1 = \left(a - \sum_{i=1,2} q_i - \lambda \alpha_u w_{u1} \right) q_1 \tag{6.2}$$

The first order condition for maximisation yields-

$$\frac{\partial \pi_1}{\partial q_1} = a - 2q_1 - q_2 - \lambda \alpha_u w_{u1} = 0 \tag{6.3}$$

Similarly for the firm 2, we have-

$$\underset{q_2}{\text{Max}}\ \pi_2 = \left(a - \sum_{i=1,2} q_i - \beta w_{u2} \right) q_2 \tag{6.4}$$

Again from the first order condition we obtain-

$$\frac{\partial \pi_2}{\partial q_2} = a - q_1 - 2q_2 - \beta w_{u2} = 0 \tag{6.5}$$

The own and cross second partial derivatives are respectively $\frac{\partial^2 \pi_i}{\partial q_i^{\,2}} = -2 < 0$ and $\frac{\partial^2 \pi_i}{\partial q_i \partial q_j} = -1 < 0$ where $i \in \{1,2\}$ and $i \neq j$. Hence the solutions are stable. Now by solving (6.3) and (6.5), we obtain-

$$q_1^{\,*} = \frac{a - 2\lambda \alpha_u w_{u1} + \beta w_{u2}}{3} \tag{6.6}$$

$$q_2^{\,*} = \frac{a - 2\beta w_{u2} + \lambda \alpha_u w_{u1}}{3} \tag{6.7}$$

Hence the total output and price are given as-

$$Q = q_1^* + q_2^* = \frac{2a - \lambda\alpha_u w_{u1} - \beta w_{u2}}{3} \tag{6.8}$$

$$p^* = a - q_1^* - q_2^* = \frac{a + \lambda\alpha_u w_{u1} + \beta w_{u2}}{3} \tag{6.9}$$

The profit in the second stage by the firms are therefore given as-

$$\pi_1^* = \frac{\left(a - 2\lambda\alpha_u w_{u1} + \beta w_{u2}\right)^2}{9} \tag{6.10}$$

$$\pi_2^* = \frac{\left(a - 2\beta w_{u2} + \lambda\alpha_u w_{u1}\right)^2}{9} \tag{6.11}$$

2.3. First Stage of the Game

Firms in the first stage select the R&D so that the second stage profit net of the R&D cost is maximised. For firm 1 and 2, we get respectively

$$\Pi_1 = \frac{\left(a - 2\lambda(R_1)\alpha_u w_{u1} + \beta(R_2) w_{u2}\right)^2}{9} - c_1(R_1) \tag{6.12}$$

$$\Pi_2 = \frac{\left(a - 2\beta(R_2) w_{u2} + \lambda(R_1)\alpha_u w_{u1}\right)^2}{9} - c_2(R_2) \tag{6.13}$$

where,

R_i = is the level of R&D.

$c_i(R_i)$ = is the cost of R&D of firm i

and $\lambda' < 0,\ \beta' < 0, c_i' > 0$

The first order conditions are-

$$\frac{\partial \Pi_1}{\partial R_1} = -\frac{4}{9}\left(a - 2\lambda\alpha_u w_{u1} + \beta w_{u2}\right)\lambda'\alpha_u w_{u1} = c_1' \qquad (6.14)$$

$$\frac{\partial \Pi_2}{\partial R_2} = -\frac{4}{9}\left(a - 2\beta w_{u2} + \lambda\alpha_u w_{u1}\right)\beta' w_{u2} = c_2' \qquad (6.15)$$

Assume that the second order condition of the maximisation problem is satisfied. In order to simplify the calculation and analysis we may assume an explicit functional form of unit labour requirement, that is-

$$\lambda(R_1) = \theta_1 - b_1 R_1$$
$$\beta(R_2) = \theta_2 - b_2 R_2$$

Hence unit labour requirement falls as the level of R&D increases. In addition we assume that the research cost is given by $c_i(R_i) = \frac{w_{si}(R_i)^{\delta}}{2}$, where $\delta > 0$ and w_{si} is the wage of skilled workers (scientists, engineers) in country i. It shows that in order to have R_i level of R&D the firms need to employ $\frac{(R_i)^{\delta}}{2}$ amount of skilled workers and pay w_{si} to each worker. The shape of the function depends on the value of δ. If it is less than 1 then the cost function is strictly concave. If it is equal to 1 then the function is a straight line. If it is more than 1 then the function is strictly convex, implying that the research cost increases at an increasing rate. For our analysis we will assume that $\delta = 2$ hence cost function is strictly convex. This assumption will simplify the calculation but not unrealistic as we are considering process innovation where aim of the research is to reduce production cost. The cost of the research here can increase at an increasing rate as it gradually becomes harder to reduce production cost.

To capture skilled migration we use the coefficient α_s in firm 1. Therefore, the cost of R&D in firm 1 with $\delta = 2$ is-

$$c_1(R_1) = \frac{\alpha_s w_{s1}(R_1)^2}{2}$$

where $\alpha_s = 1$ if no migration, $\alpha_s = \frac{w_{s2}}{w_{s1}}$ if migration. We can therefore rewrite equations (6.12) and (6.13) as-

$$\Pi_1 = \frac{\left(a - 2\left(\theta_1 - b_1 R_1\right)\alpha_u w_{u1} + \left(\theta_2 - b_2 R_2\right)w_{u2}\right)^2}{9} - \frac{\alpha_s w_{s1} {R_1}^2}{2} \quad (6.16)$$

$$\Pi_2 = \frac{\left(a - 2\left(\theta_2 - b_2 R_2\right)w_{u2} + \left(\theta_1 - b_1 R_1\right)\alpha_u w_{u1}\right)^2}{9} - \frac{w_{s2} {R_2}^2}{2} \quad (6.17)$$

By differentiating equation (6.16) with respect to R_1 and using the first order condition that is setting $\frac{\partial \Pi_1}{\partial R_1} = 0$ we get the following reaction function of firm 1-

$$R_1 = \frac{4b_1 a\alpha_u w_{u1} - 8b_1\theta_1{\alpha_u}^2{w_{u1}}^2 + 4b_1\theta_2 w_{u2}\alpha_u w_{u1}}{9\alpha_s w_{s1} - 8{b_1}^2{\alpha_u}^2{w_{u1}}^2} - \frac{4b_1 b_2 w_{u2}\alpha_u w_{u1}}{9\alpha_s w_{s1} - 8{b_1}^2{\alpha_u}^2{w_{u1}}^2} R_2$$

……..(6.18)

Where $4b_1 a\alpha_u w_{u1} - 8b_1\theta_1{\alpha_u}^2{w_{u1}}^2 + 4b_1\theta_2 w_{u2}\alpha_u w_{u1}$ is negative as $\left(a - 2\theta_1\alpha_{u1}w_{u1} + \theta_2 w_{u2}\right) > 0$. We also assume that $9\alpha_s w_{s1} - 8{b_1}^2{\alpha_u}^2{w_{u1}}^2 > 0$ to ensure $R_1 > 0$ when $R_2 = 0$. The own cross partial derivative is given as-

$$\frac{\partial^2 \Pi_1}{\partial {R_1}^2} = \frac{1}{9}\left(8{b_1}^2{\alpha_u}^2{w_{u1}}^2 - 9\alpha_s w_{s1}\right)$$

As we have assumed before own partial derivative is negative. The cross second partial derivative is given as-

$$\frac{\partial^2 \Pi_1}{\partial R_1 \partial R_2} = -\frac{4}{9} b_1 b_2 \alpha_u w_{u1} w_{u2} < 0$$

Similarly from equation (6.17) by differentiating with respect to R_2 and setting $\frac{\partial \Pi_2}{\partial R_2} = 0$ we obtain-

$$R_2 = \frac{4b_2 a w_{u2} - 8b_2 \theta_2 {w_{u2}}^2 + 4b_2 \theta_1 \alpha_u w_{u1} w_{u2}}{9w_{s2} - 8{b_2}^2 {w_{u2}}^2} - \frac{4b_1 b_2 \alpha_u w_{u1} w_{u2}}{9w_{s2} - 8{b_2}^2 {w_{u2}}^2} R_1 \qquad (6.19)$$

Again $4b_2 a w_{u2} - 8b_2 \theta_2 {w_{u2}}^2 + 4b_2 \theta_1 \alpha_u w_{u1} w_{u2}$ is negative. The second derivatives are-

$$\frac{\partial^2 \Pi_2}{\partial {R_2}^2} = \frac{1}{9}\left(8{b_2}^2 {w_{u2}}^2 - 9w_{s2}\right)$$

$$\frac{\partial^2 \Pi_2}{\partial R_2 \partial R_1} = -\frac{4}{9} b_1 b_2 \alpha_u w_{u1} w_{u2}$$

We again assume that $9w_{s2} - 8{b_2}^2 {w_{u2}}^2 > 0$ to ensure that $R_2 > 0$ when $R_1 = 0$. The equations can be written in matrix form as-

$$\begin{pmatrix} 8{b_1}^2 {\alpha_u}^2 {w_{u1}}^2 - 9\alpha_s w_{s1} & -4b_1 b_2 \alpha_u w_{u1} w_{u2} \\ -4b_1 b_2 \alpha_u w_{u1} w_{u2} & 8{b_2}^2 {w_{u2}}^2 - 9w_{s2} \end{pmatrix} \begin{pmatrix} R_1 \\ R_2 \end{pmatrix} = \begin{pmatrix} -4b_1 a \alpha_u w_{u1} + 8b_1 \theta_1 {\alpha_u}^2 {w_{u1}}^2 - 4b_1 \theta_2 w_{u2} \alpha_u w_{u1} \\ -4b_2 a w_{u2} + 8b_2 \theta_2 {w_{u2}}^2 - 4b_2 \theta_1 \alpha_u w_{u1} w_{u2} \end{pmatrix}$$

The denominator is-

$$\varphi = 48{b_1}^2 {b_2}^2 {\alpha_u}^2 {w_{u1}}^2 {w_{u2}}^2 - 72{b_2}^2 {w_{u2}}^2 \alpha_s w_{s1} - 72{b_1}^2 {\alpha_u}^2 {w_{u1}}^2 w_{s2} + 81\alpha_s w_{s1} w_{s2}$$

Assume that the denominator is positive as required for stability. As the trace of the matrix is negative the equilibrium is stable. The solutions obtained as-

$$R_1^* = \varphi^{-1}\begin{pmatrix} -48b_1 a\alpha_u w_{u1} b_2{}^2 w_{u2}{}^2 + 48b_1\theta_1\alpha_u{}^2 w_{u1}{}^2 b_2{}^2 w_{u2}{}^2 \\ +36b_1 a\alpha_u w_{u1} w_{s2} - 72b_1\theta_1\alpha_u{}^2 w_{u1}{}^2 w_{s2} + 36b_1\theta_2 w_{u2}\alpha_u w_{u1} w_{s2} \end{pmatrix}$$

.....(6.20)

and

$$R_2^* = \varphi^{-1}\begin{pmatrix} -48b_2 a w_{u2} b_1{}^2\alpha_u{}^2 w_{u1}{}^2 + 48b_2\theta_2 w_{u2}{}^2 b_1{}^2\alpha_u{}^2 w_{u1}{}^2 \\ +36b_2 a w_{u2}\alpha_s w_{s1} - 72b_2\theta_2 w_{u2}{}^2\alpha_s w_{s1} + 36b_2\theta_1\alpha_u w_{u1} w_{u2}\alpha_s w_{s1} \end{pmatrix}$$

.....(6.21)

3. Effects of Migration on R&D and Welfare

In this section we are going to analyse the effects of migration on equilibrium R&D of the firms. Since the analysis of innovation by both firms is cumbersome, we first want to see how migration alters the equilibrium outcomes when either firm 1 or firm 2 innovates. Then it will be easy to understand the effects of migration under innovation by both firms, since this situation will be a combination of other two cases. A summary of the results obtained is given below in Table-6.1:

Table-6.1

Summary of the Results (R&D with migration)

Country performing R&D	**Skilled**	**Unskilled**
Country 1	High	*Low if* $a > (<) 2\lambda_{nm}(w_{u1} + w_{u2}) - \beta w_{u2}$
Country 2	No change	Low
Simultaneous R&D (Skills are different)	High	No clear result

3.1. Only Labour Importing Firm 1 Does R&D

Assume that only labour importing firm, i.e., firm 1 does R&D. Hence, R&D of the other firm is assumed fixed. Therefore, the second stage solutions remain as before but in the first stage, we have only equation (6.14) that determines the R&D investment of firm 1. We can state the result in the following proposition-

Proposition 6.1: If only firm 1 does R&D, migration of unskilled people decreases (increases) R&D if $a > (<) 2\lambda_{nm}(w_{u1} + w_{u2}) - \beta w_{u2}$**.**

Proof:

Without migration $\alpha_u = 1$. Therefore equation (6.14) becomes-

$$-\frac{4}{9}(a - 2\lambda w_{u1} + \beta w_{u2})\lambda' w_{u1} = c_1' \qquad (6.22)$$

With migration $\alpha_u = \frac{w_{u2}}{w_{u1}}$. The equation (6.14) becomes-

$$-\frac{4}{9}(a - 2\lambda w_{u2} + \beta w_{u2})\lambda' w_{u2} = c_1' \qquad (6.23)$$

Evaluating the marginal benefit of R&D at no migration equilibrium R&D, the LHS (6.22) $> (<)$ LHS (6.23) if-

$$-\frac{4}{9}(a - 2\lambda_{nm} w_{u1} + \beta w_{u2})\lambda'_{nm} w_{u1} > (<) -\frac{4}{9}(a - 2\lambda_{nm} w_{u2} + \beta w_{u2})\lambda'_{nm} w_{u2}$$

Or, $a > (<) 2\lambda_{nm}(w_{u1} + w_{u2}) - \beta w_{u2}$

Therefore if $a > 2\lambda_{nm}(w_{u1} + w_{u2}) - \beta w_{u2}$ it implies that marginal benefit of R&D is higher in no migration case, hence R&D needs to be reduced with migration. If the opposite of the inequality holds i.e. $a < 2\lambda_{nm}(w_{u1} + w_{u2}) - \beta w_{u2}$ then equilibrium R&D is higher with migration.

■

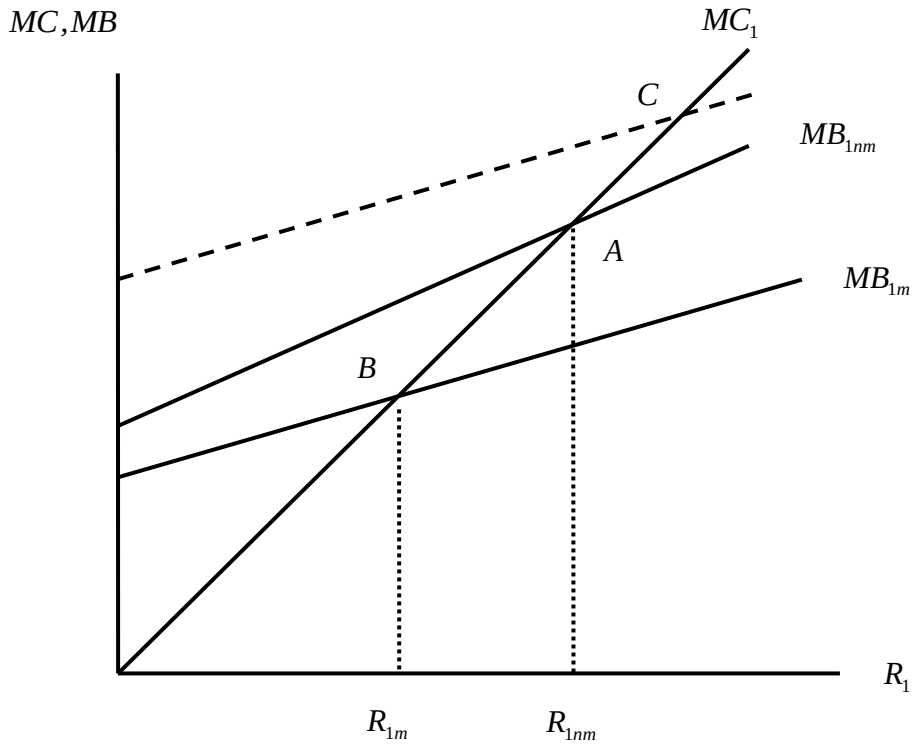
Figure-6.1 has been drawn to facilitate understanding of the situation. To plot we have utilised equation (6.16). In the figure we have shown the intersection of marginal benefit and marginal cost curves that determines equilibrium level of R&D. As we have drawn both marginal benefit and marginal cost curves are positive and upward slopping. The reason is that both total benefit and total cost are convex, that is they increase at an increasing rate with R&D. Marginal cost starts from the original as it is zero without any R&D.

As shown in the diagram, without migration, the marginal benefit is equal to the marginal cost at point A. With migration the slope of marginal benefit curve falls but the intercept may increase or decrease[1]. In the diagram we have drawn three marginal benefit lines. The middle one as we have mentioned shows the situation without migration. The bottom line depicts the situation when marginal benefit shifts down after migration. If marginal benefit shifts down the new equilibrium is given by point B. As we can observe in the diagram, the level of R&D at point A is larger than the level of R&D at point B. Consequently, the R&D investment of firm 1 is lower with migration. The top line illustrates the case when marginal benefit shifts up after migration. As shown in the diagram the new equilibrium when marginal benefit shifts upward is given by point C where equilibrium R&D increases. However in this case it is not certain that R&D will always increase. The

[1] Without migration marginal benefit is given as-
$\frac{4}{9}b_1 w_{u1}(a - 2\theta_1 w_{u1} + \beta w_{u2}) + \frac{8}{9}b_1{}^2 w_{u1}{}^2 R_1$
With migration marginal benefit is given as-
$\frac{4}{9}b_1 w_{u2}(a - 2\theta_1 w_{u2} + \beta w_{u2}) + \frac{8}{9}b_1{}^2 w_{u2}{}^2 R_1$

marginal benefit is now flatter, hence if marginal benefit shifts upward, it may intersect the marginal cost curve in a point where R&D is lower.

Figure-6.1
Equilibrium R&D with Unskilled Migration
(Country 1 does R&D)



The effects we observe are same as the effects of outsourcing on the R&D investment in Marjit and Mukherjee (2008). It is same as the proposition 1 of that paper. The marginal benefit here is given as $-\frac{4}{9}(a-2\alpha_u w_{u1}+\beta w_{u2})\lambda'_{nm}\alpha_u w_{u1}$. Hence wage rate operates in two places, inside the bracket and outside the bracket. If wage rate falls, the term inside the bracket increases, but through the term outside the bracket it exerts negative effect on marginal benefit. The overall effect depends on the multiplication of the two terms. The higher is a the higher is the chance that

lower wage rate implies a lower marginal benefit of R&D. a in the equation stands for market size. Therefore if a is sufficiently large then migration, by supplying workers at a lower wage, reduces R&D. But for a lower a, declining wage rate increases the R&D investment. Therefore migration reduces (increases) R&D in large (small) market.

Proposition 6.2: Migration of unskilled workers increases (decreases) welfare of the consumers if- $\lambda_m w_{u2} < (>) \lambda_{nm} w_{u1}$.

Proof:

The output without migration is given as-

$$Q_{nm} = \frac{2a - \lambda_{nm} w_{u1} - \beta w_{u2}}{3}$$

With migration it is-

$$Q_m = \frac{2a - \lambda_m w_{u2} - \beta w_{u2}}{3}$$

Therefore total output is higher (lower) with migration if-

$$\frac{2a - \lambda_{nm} w_{u1} - \beta w_{u2}}{3} < (>) \frac{2a - \lambda_m w_{u2} - \beta w_{u2}}{3}$$

or, $\lambda_m w_{u2} < (>) \lambda_{nm} w_{u1}$

■

In the above, $\lambda_m w_{u2}$ and $\lambda_{nm} w_{u1}$ respectively stand for total cost of production of one unit of good with migration and without migration. If total cost of producing one unit of output is lower, then it will induce the firm to

increase output to obtain higher profit. With migration, total output and welfare is always higher if R&D is higher as both the unit input requirement and wage rate are lower. However if migration reduces R&D, total output and welfare increases (decreases) if $\lambda_m w_{u2} < (>) \lambda_{nm} w_{u1}$, i.e., if marginal cost of production of one unit good is lower (higher) after migration. Hence, migration can increase welfare even if the input requirement is higher. Such as when wage rate falls by a large amount but input requirement does not increase by that much. Combining with proposition (6.1) we may therefore say that if market size is relatively small, labour market openness, which creates the possibility of migration, may increase welfare by reducing the price level. But if market size is relatively large, migration may increase the price level.

Proposition 6.3: The level of R&D and consumers' welfare is higher with migration of skilled people if only firm 1 does R&D.

Proof:

We will use equation (6.16) to demonstrate the proposition. As only firm 1 conducts R&D the equation can be written as-

$$\Pi_1 = \frac{\left(a - 2\left(\theta_1 - b_1 R_1\right)\alpha_u w_{u1} + \beta w_{u2}\right)^2}{9} - \frac{\alpha_s w_{s1} R_1^{\,2}}{2}$$

Differentiating with respect to R_1 and setting the derivative equal to zero we obtain-

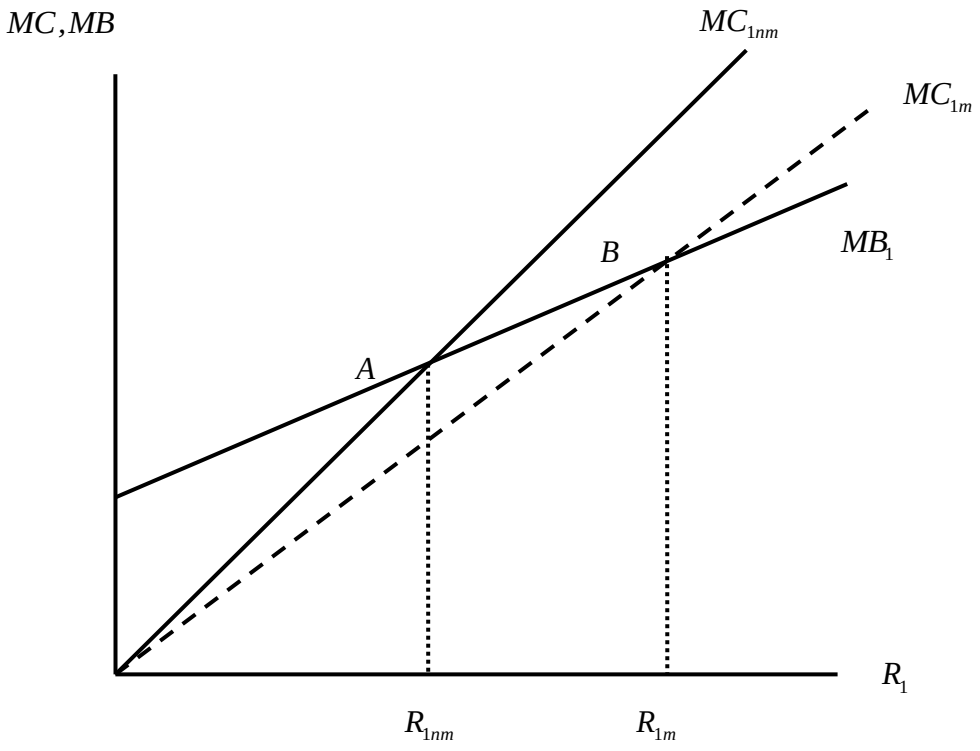
$$R_1 = \frac{4b_1 a w_{u1} - 8b_1 w_{u1}^{\,2}\theta_1 + 4b_1 w_{u1}\beta w_{u2}}{9\alpha_s w_{s1} - 8b_1^{\,2} w_{u1}^{\,2}}$$

The numerator remains unchanged with migration of skilled people. Therefore with migration R&D increases as $9\alpha_s w_{s1} - 8b_1^{\,2} w_{u1}^{\,2} > 0$ and

$w_{s1} > w_{s2}$. The welfare is higher with migration as the input requirement falls with migration i.e. $\lambda_{nm} > \lambda_m$. ■

We can use a diagram like Figure-6.1 to analyse what happens if only skilled people migrate. We have described the situation in Figure-6.2. The migration of skilled people does not change the slope and intercept of the total benefit function as production is conducted by using unskilled labour. Therefore marginal benefit remains the same. But the total cost falls. As marginal cost is always zero with no R&D, the new marginal cost line also starts from the origin. Hence the marginal cost pivot down from the origin after the migration. Now assume that originally without migration we had marginal benefit equal to marginal cost at a point like A. After migration new equilibrium is obtained at point B. At point B the level of R&D is now higher. Therefore migration of skilled people increases R&D if only the labour importing country conducts R&D.

Figure-6.2
Equilibrium R&D with Skilled Migration
(Country 1 does R&D)



We can relate the above arguments with the literature on the economic benefit of international migration and Brain Drain. The analysis done in this section presents a channel of potential cost and benefit of migration. In proposition (6.1) we have seen that unskilled migration changes the production cost and consequently alters the level of R&D of the firm. If market size is larger then unskilled migration may reduce R&D and welfare. This is pointing towards the detrimental effect of unskilled migration in a large market controlled by a single large firm. In this case the firm may want to utilise the advantage presented by low labour cost, as an alternative of putting resources on research and development. This effect is to some extent similar to the effect where firm obtains monopoly right and delays further development of the product to full extraction the benefit out of existing innovation.

However if migration of skilled people takes place, given the level of unskilled wage rate, it is profitable for firm to increase R&D. Consequently welfare also increases. Thus, it points towards a beneficial effect of Brain Drain. Given the limitation of Southern countries in performing research, the migration of skilled people to North is fostering development of products in the North. But both Southern and Northern countries are sharing the beneficial effects of the product development. The development of computer hardware and software can be cited as examples as the products are mainly developed in the developed countries but the benefit of development is shared by the whole world. The result here somehow echoes that of the paper of Grubel and Scott (1966) on international flow of human capital. They mentioned that the largest benefit of people migrating abroad can come through the pure research of scientists and engineers. If the work condition in new country is better the productivity is high, so native country gains more from scientists emigrating outside given the products of basic research are free goods.

3.2. Only Labour Exporting Country Does R&D

In this section we are assuming that only firm 2 conducts R&D. Therefore, at stage 1, only firm 2 determines the R&D investment while firm 1's R&D investment is fixed. It is now immediate that the openness of labour market does not influence R&D directly. It only works by the competition in the product market as firm 1 may now use the low cost labour for production. The effects on the R&D of firm 2 and the welfare are expressed by following proposition-

Proposition 6.4: If only firm 2 conducts R&D then migration of unskilled workers reduces R&D of the firm 2. The consumers' benefit is higher (lower) without migration if $\lambda < (>)(\beta_m - \beta_{nm})\frac{w_{u2}}{(w_{u1} - w_{u2})}$.

Proof:

Without migration we have-

$$-\frac{4}{9}(a - 2\beta w_{u2} + \lambda w_{u1})\beta' w_{u2} = c_2'$$

With migration it is-

$$-\frac{4}{9}(a - 2\beta w_{u2} + \lambda w_{u2})\beta' w_{u2} = c_2'$$

As β' is negative the expressions for marginal benefits are positive. Evaluating the benefits at the equilibrium R&D without migration, we obtain R&D without migration is higher as $w_{u1} > w_{u2}$.

In order to find consumers' welfare we need to compare the output levels. Without migration it is given as-

$$Q_{nm} = \frac{2a - \lambda w_{u1} - \beta_{nm} w_{u2}}{3}$$

With migration-

$$Q_{m} = \frac{2a - \lambda w_{u2} - \beta_{m} w_{u2}}{3}$$

Therefore welfare is higher (lower) without migration if-

$$\frac{2a - \lambda w_{u1} - \beta_{nm} w_{u2}}{3} > (<) \frac{2a - \lambda w_{u2} - \beta_{m} w_{u2}}{3}$$

Or, $\lambda < (>) \frac{w_{u2}(\beta_m - \beta_{nm})}{(w_{u1} - w_{u2})}$

■

The intuitions of the results are as follows. Firm 1 now employs labour at a lower wage rate. Thus, given all other things are equal, it can afford to increase production. It implies that country 2 reduces the production, which in turn implies reduction of labour saving R&D. The output of firm 2 thus is lower. The consumers' welfare depends on the total output produced. Firm 1 now increases the output but firm 2 reduces output. Welfare is higher if firm 1 produces extra output after compensating the reduction of output by firm 2. This condition holds if $\lambda > \frac{w_{u2}(\beta_m - \beta_{nm})}{(w_{u1} - w_{u2})}$. We can see that, the higher is the wage gap, the higher is the chance that welfare is higher. However higher wage gap implies lower R&D by firm 2. Welfare increases if the wage gap is higher but the level of R&D does not change to that extent. However if the wage gap is lower and R&D decreases by a large extent then welfare reduces.

Migration of skilled worker will not have any effect on the R&D expenditure as firm 1 does not perform R&D. Actually there is no rationale for migration of skilled worker if only firm 2 does R&D.

3.3. Simultaneous R&D by Both Countries

In this section we assume that the countries conduct R&D simultaneously. In order to simplify analysis we will utilise the specific functional forms already developed in section 2. We have previously calculated the reaction functions of firms 1 and 2. From the reaction functions, we have calculated equilibrium R&D investments. But the calculations of the effects of migration on equilibrium level of R&D are cumbersome and clear cut results are difficult to obtain. Therefore, in this section the reaction functions will be sometimes plotted to evaluate the effects of migration. To facilitate plotting of the reaction functions, they can be written in the following manner.

$$R_1 = \frac{4b_1 a\alpha_{u1} w_{u1} - 8b_1\theta_1{\alpha_u}^2{w_{u1}}^2 + 4b_1\theta_2 w_{u2}\alpha_u w_{u1}}{9\alpha_s w_{s1} - 8{b_1}^2{\alpha_u}^2{w_{u1}}^2} - \frac{4b_1 b_2\alpha_u w_{u1} w_{u2}}{9\alpha_s w_{s1} - 8{b_1}^2{\alpha_u}^2{w_{u1}}^2} R_2 \quad \text{.....(6.24)}$$

$$R_1 = \frac{4a - 8\theta_2 w_{u2} + 4\theta_1\alpha_u w_{u1}}{4b_1\alpha_u w_{u1}} - \frac{\left(9w_{s2} - 8{b_2}^2{w_{u2}}^2\right)}{4b_1 b_2\alpha_u w_{u1} w_{u2}} {R_2}^2 \quad (6.25)$$

Here both equations have been expressed as a function of R_2. The equation (6.24) comes from the reaction function of firm 1 in equation (6.18). It shows what will be the particular value of the R&D of firm 1 given the R&D of the firm 2. The equation (6.25) is the reaction function of firm 2 which comes from equation (6.19). The way it has been written says what must be the value of R_2 to get a particular value of R_1.

[2] Later we will write it as $R_1 = \frac{4a - 8\theta_2 w_{u2}}{4b_1\alpha_u w_{u1}} + \frac{4\theta_1}{4b_1} - \frac{\left(9w_{s2} - 8{b_2}^2{w_{u2}}^2\right)}{4b_1 b_2\alpha_u w_{u1} w_{u2}} R_2$ to facilitate analysis.

3.3.1. If Only Unskilled Workers Migrate

The first case we analyse is what happens if only unskilled people migrate. Therefore α_s is always equal to 1. However if no migration takes place then $\alpha_u = 1$. Consequently without migration for firm 1-

$$R_1 = \frac{4b_1 a w_{u1} - 8b_1 \theta_1 {w_{u1}}^2 + 4b_1 \theta_2 w_{u2} w_{u1}}{9w_{s1} - 8{b_1}^2 {w_{u1}}^2} - \frac{4b_1 b_2 w_{u1} w_{u2}}{9w_{s1} - 8{b_1}^2 {w_{u1}}^2} R_2$$

If migration takes place then $\alpha_u = \frac{w_{u2}}{w_{u1}}$. Consequently-

$$R_1 = \frac{4b_1 a w_{u2} - 8b_1 \theta_1 {w_{u2}}^2 + 4b_1 \theta_2 w_{u2} w_{u2}}{9w_{s1} - 8{b_1}^2 {w_{u2}}^2} - \frac{4b_1 b_2 w_{u2} w_{u2}}{9w_{s1} - 8{b_1}^2 {w_{u2}}^2} R_2$$

We have $9w_{s1} - 8{b_1}^2 {w_{u2}}^2 > 0$ as required for stability. In addition, for positive output it is required that $(a - 2\theta_1 \alpha_u w_{u1} + \theta_2 w_{u2}) > 0$ implying that $4b_1 a \alpha_u w_{u1} - 8b_1 \theta_1 {\alpha_u}^2 {w_{u1}}^2 + 4b_1 \theta_2 w_{u2} \alpha_u w_{u1} = 4b_1 \alpha_u w_{u1}(a - 2\theta_1 \alpha_u w_{u1} + \theta_2 w_{u2})$, is positive. Hence the intercept term is positive and the slope term is negative. In the intercept term, with migration, the term in bracket is bigger but the term outside is smaller. Therefore when plotting, it is not possible to say if intercept in the R_1 axis with migration increases or decreases. However the intercept in R_2 axis increases[3]. With migration the slope is however definitely flatter[4]. We have plotted the reaction functions of firm 1 without and with migration in Figure-6.3 by denoting (1). The solid line denoted by (1) shows that reaction function without migration and the broken line denoted by (1) shows the

[3] When $R_1 = 0$ without migration $R_2 = \frac{4b_1 a w_{u1} - 8b_1 \theta_1 {w_{u1}}^2 + 4b_1 \theta_2 w_{u2} w_{u1}}{4b_1 b_2 w_{u1} w_{u2}} = \frac{4b_1 a - 8b_1 \theta_1 w_{u1} + 4b_1 \theta_2 w_{u2}}{4b_1 b_2 w_{u2}}$, with migration it is $R_2 = \frac{4b_1 a - 8b_1 \theta_1 w_{u2} + 4b_1 \theta_2 w_{u2}}{4b_1 b_2 w_{u2}}$.

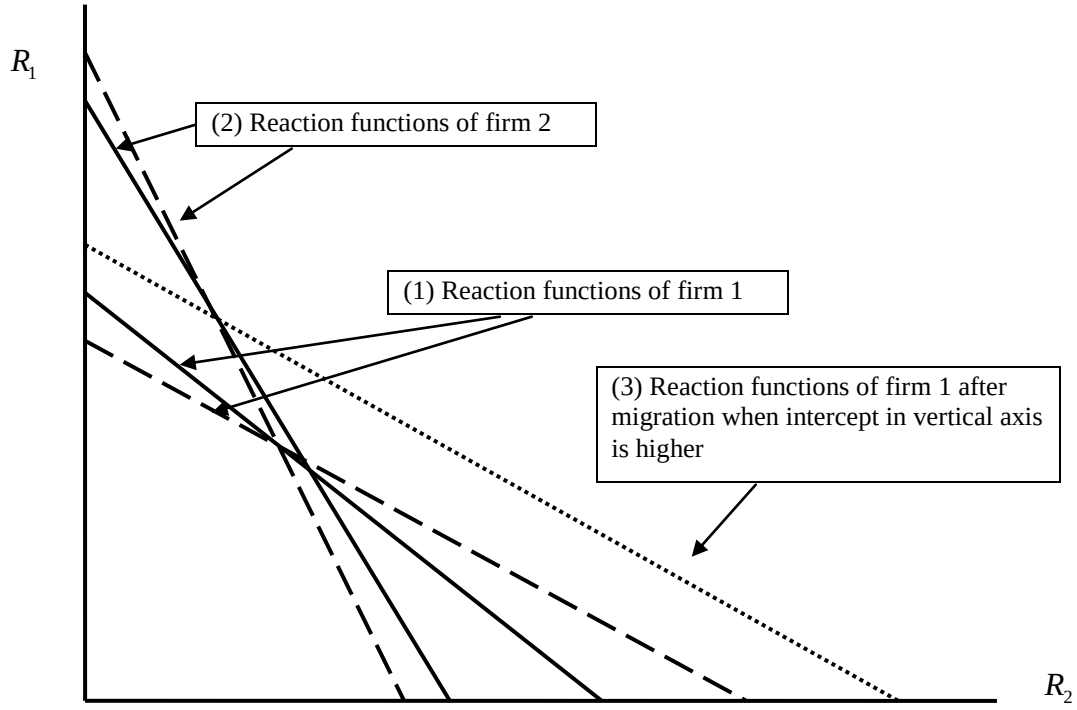
[4] See the appendix for formal derivation.

reaction function with migration. We have assumed that the intercept has decreased (the broken line) but it may also increase. Such a situation is shown by the dotted line denoted as (3). Also note that R_1 of firm 1 has been placed in vertical and R_2 of firm 2 has been placed in horizontal axis.

As can be seen in the diagram, firm 1 may start with a higher R&D and then decreases it as the other country's R&D increases, but the rate of decrease is lower with migration. The shift of intercept in R_1 axis is largely dependent on the value of a, i.e., the market size. As the denominator is higher with migration, to have an upward shift of the intercept, the numerator must also increase and this increase needs to be relatively larger than the increase of denominator. If a is very large then a small fall in wage rate is likely to reduce the numerator by a large extent. If a is not very large the decrease in numerator is likely to be small and may even increase the numerator. That is why we may see higher intercept in R_1 axis with migration[5].

[5] Comparing the numerator of the intercept before and after migration and assuming $b_1 = b_2 = b$ and $\theta_1 = \theta_2 = \theta$ we obtain that the numerator increases with migration if $a < 2\theta w_{u1} + \theta w_{u2}$.

Figure-6.3
Equilibrium R&D with Unskilled Migration
(Simultaneous R&D)



For firm 2, using equation (6.25) if no migration then-

$$R_1 = \frac{4a - 8\theta_2 w_{u2}}{4b_1 w_{u1}} + \frac{4\theta_1}{4b_1} - \frac{\left(9w_{s2} - 8{b_2}^2 {w_{u2}}^2\right)}{4b_1 b_2 w_{u1} w_{u2}} R_2$$

If migration then-

$$R_1 = \frac{4a - 8\theta_2 w_{u2}}{4b_1 w_{u2}} + \frac{4\theta_1}{4b_1} - \frac{\left(9w_{s2} - 8{b_2}^2 {w_{u2}}^2\right)}{4b_1 b_2 w_{u2} w_{u2}} R_2$$

We have plotted the reaction functions of firm 2 in Figure-6.3 by denoting them as (2). The solid line denoted as (2) is the reaction function without migration and the broken line denoted as (2) is the reaction function with migration. The first part must be positive, therefore with migration the

first part increases implying the intercept in R_1 axis increases. The slope is also steeper with migration. The intercept in the R_2 axis however falls with migration as can be directly observed from equation (6.25) assuming $R_1 = 0$.

It is not possible from Figure-6.3 to say if equilibrium R&D will increase or decrease after migration. With migration the cost of production in firm 1 is lower. According to proposition (6.1), if the market size is large then firm 1 in this situation may reduce R&D. But it can also increase the R&D if the market size is relatively small. Firm 2 is now no longer inactive. Hence it can increase or decrease R&D in response to the change of production and R&D of firm 1. As it is difficult to evaluate what happens here we can refer to the proposition (6.1) and (6.2) to look at it a bit more clearly. In proposition (6.1) and (6.2) we have seen that when firm 2 is inactive, with migration if R&D increases, then total output increases. However output of firm 2 falls as can be observed from equation (6.7). Firm 2 then must reduce the R&D as marginal benefit of R&D falls in equation (6.15). Hence equilibrium R&D of firm 2 must fall. On the other hand we have also seen in proposition (6.1) that migration may reduce R&D if market size is relatively large. If total output increases then again the output of firm 2 falls and consequently firm 2 must reduce R&D. But if total output deceases then output and marginal benefit of R&D of firm 2 increases. Hence firm 2 should increase R&D. We may also think what happens if R&D of firm 1 remains the same. According to the previous argument total output increases therefore the output and R&D of firm 2 fall. Consumers' welfare depends on the total output. As output of one firm increases and the other firm decreases the total welfare depends on the relative changes of the outputs of two firms.

3.3.2. If Only Skilled Workers Migrate

If only skilled workers migrate then α_u is always equal to 1.

Proposition 6.5: If only skilled workers migrate then the R&D of firm 1 increases and the R&D of firm 2 decreases.

Proof:

The equilibrium R&D of firm 1 in equation (6.20) is given as-

$$R_1^* = \varphi^{-1}\begin{pmatrix} -48b_1 a\alpha_u w_{u1} b_2{}^2 w_{u2}{}^2 + 48b_1\theta_1\alpha_u{}^2 w_{u1}{}^2 b_2{}^2 w_{u2}{}^2 \\ +36b_1 a\alpha_u w_{u1} w_{s2} - 72b_1\theta_1\alpha_u{}^2 w_{u1}{}^2 w_{s2} + 36b_1\theta_2 w_{u2}\alpha_u w_{u1} w_{s2} \end{pmatrix}$$

where,

$$\varphi = 48b_1{}^2 b_2{}^2\alpha_u{}^2 w_{u1}{}^2 w_{u2}{}^2 - 72b_2{}^2 w_{u2}{}^2\alpha_s w_{s1} - 72b_1{}^2\alpha_u{}^2 w_{u1}{}^2 w_{s2} + 81\alpha_s w_{s1} w_{s2} > 0$$

Therefore only the denominator changes with migration. As $w_{s1} > w_{s2}$ the denominator decreases with migration (see appendix). Hence equilibrium R&D of firm 1 increases with migration.

We can not similarly calculate the R&D of firm 2 from equation (6.21) as the denominator and numerator both change. However in equation (6.15) if marginal benefit if R&D is evaluated at the no migration equilibrium R&D we get $MB_{2nm} > MB_{2m}$ as-

$$\left(-\frac{4}{9}\left(a - 2\beta w_{u2} + \lambda_{nm} w_{u1}\right)\beta' w_{u2}\right) - \left(-\frac{4}{9}\left(a - 2\beta w_{u2} + \lambda_m w_{u1}\right)\beta' w_{u2}\right)$$
$$= -\frac{4}{9}\beta' w_{u2} w_{u1}\left(\lambda_{nm} - \lambda_m\right) > 0$$

In addition by looking at the reaction function of firm 2 in equation (6.19) we see that firm 2 reduces R&D for higher equilibrium R&D of firm 1. Therefore R&D of firm 2 falls with migration of skilled people. ■

The results of the proposition are as we have expected. Firm 1 can now conduct R&D relatively cheaply. Its marginal benefit of R&D is higher than

marginal cost at the previous level of R&D. Hence firm 1 increases R&D. The output increases and price falls. For firm 2 marginal benefit of R&D reduces with migration. Hence firm 2 reduces R&D.

To look at the matter further we have plotted the reaction functions of two firms in Figure-6.4. To see how the R&D changes as the wage rate of skilled people changes assume that all other parameters of equations are same. Therefore assuming $b_1 = b_2 = b$, $\theta_1 = \theta_2 = \theta$ and $w_{u1} = w_{u2} = w_u$ equations (6.18) and (6.19) are rewritten as-

$$R_1 = \frac{4baw_u - 8b\theta w_u^{\,2} + 4b\theta w_u w_u}{9\alpha_s w_{s1} - 8b^2 w_u^{\,2}} - \frac{4bbw_u w_u}{9\alpha_s w_{s1} - 8b^2 w_u^{\,2}} R_2$$

$$R_2 = \frac{4baw_u - 8b\theta w_u^{\,2} + 4b\theta w_u w_u}{9w_{s2} - 8b^2 w_u^{\,2}} - \frac{4bbw_u w_u}{9w_{s2} - 8b^2 w_u^{\,2}} R_1$$

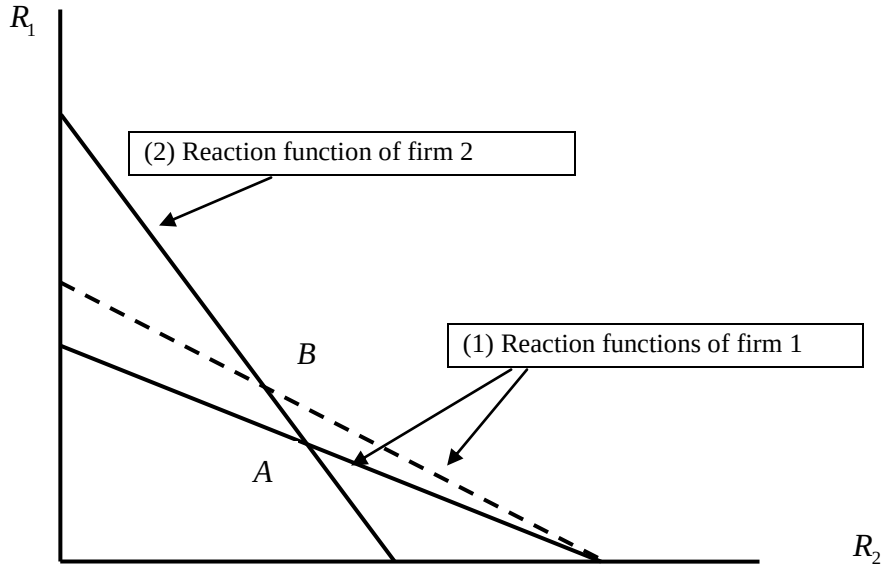
In the Figure-6.4 we have indicated the reaction function of firm 1 using the flatter lines denoted by (1). The flatter broken there line indicates the reaction function of firm 1 with migration. The steeper line denoted by (2) has been used to indicate firm 2. If migration takes place, both firms experience the same wage rate i.e. w_{s2} for the skilled people. Given all other things equal the reaction functions of both firms are exactly the same with migration. Both firms have exactly same R&D. The equilibrium is indicated by point B , where the solid steeper line and the flatter broken line have crossed. Now we want to see if the firm 1 instead faces the wage w_{s1} , how it alters the reaction functions and equilibrium R&D?

By looking at the equations we can see that the reaction function of firm 2 remains unchanged. But firm 1 now has a new reaction function. As $w_{s1} > w_{s2}$, and the numerator and denominator both are negative, the intercept of firm 1 in the vertical axis decreases.

The denominator of the slope term is also higher for firm 1 as $w_{s1} > w_{s2}$. Hence the slope falls in absolute value. The reaction function is therefore flatter, implying that firm 1's reaction to change in the country 2's R&D is

relatively small. Looking further at the equation it can be seen that the intercept term of the firm 1 in the horizontal axis remain unchanged. The new reaction function is given by the solid line indicated as before by (1). The intersection of the reaction functions is now given by A, implying the R&D of firm 1 is lower and that of firm 2 is higher.

Figure-6.4
Equilibrium R&D with Skilled Migration
(Simultaneous R&D)



We have given interpretation of the diagram in opposite order to explicitly describe the effects of migration on the R&D investment. Without migration the firm 1 faces w_{s1} with migration it faces w_{s2}. As we can see the firm 1 increases R&D when facing wage rate w_{s2}. On the other hand firm 2 reduces the R&D. Hence availability of skilled people at a low cost gives advantage to the firm 2. But migration takes the advantage away.

4. If There Is No Skill Difference

This section follows as a special case of the analysis done in previous sections. We assume here that there is no difference between wage rates of skilled and unskilled people. It is actually a simplification of the case where migration of both skilled and unskilled people takes place and both countries conduct R&D simultaneously. We have presented this result as many papers have not taken the difference between skilled and unskilled people into consideration.

Based on the above assume that wage is w_1 in country 1 and it is w_2 in country 2 and $\alpha = \alpha_u = \alpha_s = \frac{w_2}{w_1}$. This can occur in all cases, i.e., innovation by firm 1, innovation by firm 2 and simultaneous innovation by both firms. We will first look at how it alters the result of section 3.1 that is when only firm 1 does innovation. In Figure-6.1 we have seen that the marginal benefit curve of firm 1 shifts with migration. This shift may increase R&D if market size is relatively small and may decrease R&D if market size is relatively large. In Figure- 6.2 we have seen that migration of skilled people shifts the R&D cost curve and increases R&D. The present case is a combination of both figures where both marginal benefit and marginal cost curves shift. Here as marginal cost falls R&D increases. This increase is further enforced if market size is relatively small. However if market size is large it will dampen the positive effect of cost reduction. R&D can even decrease if market size is relatively very large.

Proposition 6.6: If there is no skill difference and if only firm 1 conducts R&D then the R&D investment reduces (increases) with migration if $a > (<) \frac{9\theta_1 - 4\beta w_2 b_1^{\,2}}{4b_1^{\,2}}$.

Proof :

In the appendix we have calculated the equilibrium R&D of firm 1 as-

$$R_1 = \frac{4b_1 a - 8b_1\theta_1\alpha w_1 + 4b_1\beta w_2}{9 - 8{b_1}^2\alpha w_1}$$

Therefore $R_{1nm} > (<) R_{1m}$ if-

$$\frac{4b_1 a - 8b_1\theta_1 w_1 + 4b_1\beta w_2}{9 - 8{b_1}^2 w_1} > (<) \frac{4b_1 a - 8b_1\theta_1 w_2 + 4b_1\beta w_2}{9 - 8{b_1}^2 w_2}$$

$$or, a > (<) \frac{9\theta_1 - 4\beta w_2 {b_1}^2}{4{b_1}^2}$$

■

The similarities of proposition (6.1) and proposition (6.6) are clearly observable. Proposition (6.1) shows that if a is sufficiently large then migration reduces R&D. Similarly in this proposition if a is sufficiently large it reduces R&D. We may compare the critical value of a in the two propositions by further calculation. However the calculation involves different wage rates which are not directly comparable and turns out to be complicated. See appendix for the calculation of a in proposition (6.1).

Proposition 6.7: If there is no skill difference and only firm 2 conducts R&D then equilibrium R&D reduces with migration.

Proof:

In the appendix we have calculated equilibrium R&D of firm 2 as-

$$R_2 = \frac{4ab_2 - 8\theta_2 b_2 w_2 + 4\lambda b_2\alpha w_1}{9 - 4{b_2}^2 w_2}$$

As $w_1 > w_2$, the numerator increases with migration. Therefore $R_{2nm} > R_{2m}$. ■

Hence the result obtained is consistent with the proposition (6.3). Firm 1 does not conduct any R&D. Nonetheless migration reduces the production cost for firm 1, therefore firm 1 increases output and price falls. The marginal benefit of R&D of firm 2 falls. In response firm 2 reduces R&D.

The calculations with simultaneous R&D do not give clear-cut results. Therefore, we plot the reaction functions to get ideas about the effects of migration. From equation (6.20), we get for firm 1 under no migration-

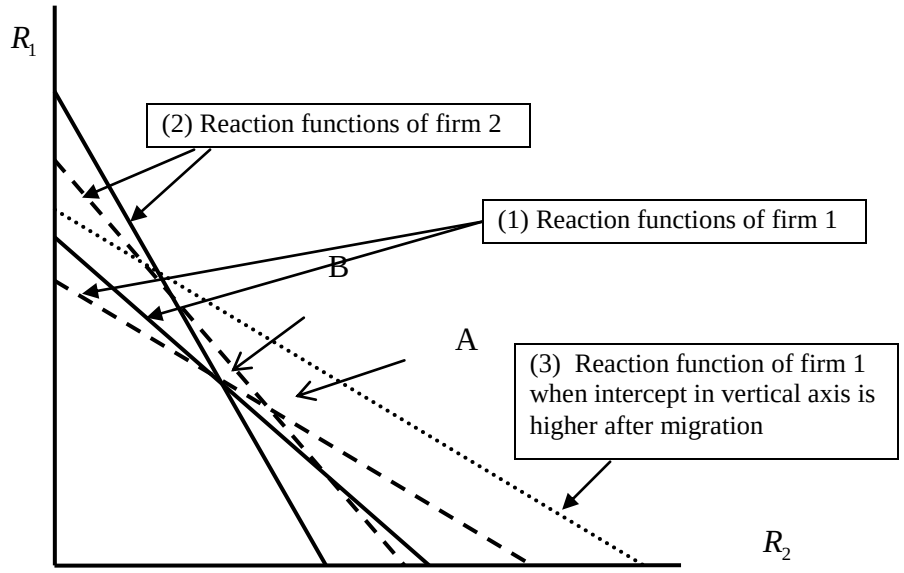
$$R_1 = \frac{4b_1 a + 4b_1\theta_2 w_2 - 8b_1\theta_1 w_1}{9 - 8b_1^{\,2} w_1} - \frac{4b_1 b_2 w_2}{9 - 8b_1^{\,2} w_1} R_2$$

Under migration, we obtain for firm 1-

$$R_1 = \frac{4b_1 a + 4b_1\theta_2 w_2 - 8b_1\theta_1 w_2}{9 - 8b_1^{\,2} w_2} - \frac{4b_1 b_2 w_2}{9 - 8b_1^{\,2} w_2} R_2$$

It can be seen that the slope is flatter in case for migration as the denominator is larger. In the intercept term, the denominator and the numerator both increase with migration. Hence the intercept can be higher or lower after migration. We have plotted the reaction functions in Figure-6.5 by denoting them with (1). As before the solid line is the reaction function without migration. The broken line is the reaction function after migration where we have assumed that the intercept has decreased. But the intercept may also increase as shown by the dotted line denoted by (3). As we have discussed before if market size is relatively small then migration may increase the intercept term. Otherwise it may decrease the intercept term.

Figure-6.5
Equilibrium R&D No Skill difference
(Simultaneous R&D)



For firm 2 if no migration-

$$R_1 = \frac{4a - 8\theta_2 w_2}{4b_1 w_1} + \frac{4\theta_1}{4b_1} - \frac{\left(9 - 8{b_2}^2 w_2\right)}{4b_1 b_2 w_1} R_2$$

If migration-

$$R_1 = \frac{4a - 8\theta_2 w_2}{4b_1 w_2} + \frac{4\theta_1}{4b_1} - \frac{\left(9w_2 - 8{b_2}^2 {w_2}^2\right)}{4b_1 b_2 w_2 w_2} R_2$$

The intercept is given by the first two terms. As the denominator decreases, the intercept increases. The denominator of the slope term also decreases implying steeper slope. In the diagram the reaction functions of firm 2 are indicated by steeper lines denoted by (2).The reaction function without migration is given by the solid line. The reaction function with migration is given by the broken line. The overall change is therefore ambiguous as we can

have intersection in any place. Here as firm 2 increases R&D, firm 1 decreases R&D but the rate is lower with migration. Similarly R&D of firm 2 is lower with migration if firm 1 conducts no R&D. It also reduces R&D with the increase of R&D of firm 1, but the rate is lower with migration. The final equilibrium is not known, but as we have drawn in the diagram, initially the intersection was at A. After migration the intersection is at B. It should also be noted that if market size is relatively smaller resulting in higher intercept for firm 1, then R&D of firm 1 will always increase. From the previous discussion in section 3.3.1 we know that if R&D of firm 1 increases or remains unchanged it will reduce the R&D of firm 2. However if R&D of firm 1 decreases then R&D of firm 2 may increase if total output falls.

5. Conclusions

In the paper we have analysed the effects of openness of labour market and possibility of migration on the level of R&D and consumers' welfare. The analysis has been done within the framework of a strategic trade model where two firms situated in two countries compete in the joint market of the two countries. The R&D is conducted to reduce the production cost and thereby to increase profit which gives rise to R&D rivalry. In order to capture the effects of openness of labour market we assumed that it makes wage rate of skilled and unskilled people lower in the labour importing country. Mainly three types of cases have been analysed. Firstly when only the labour importing country conducts R&D, secondly when only the labour exporting country conducts R&D and thirdly when both countries conduct R&D simultaneously.

The paper is to some extent supporting the recent literatures on the beneficial effects of international labour migration. The literature claims that benefit of international migration can occur though increased incentive on human capital formation. This paper points to another channel that is through the channel of increased R&D. If R&D is higher, production of output can be higher and consequently price can be lower. Migration as we have seen, though not all the time, can increase the level of R&D, increase output and

reduce price level. R&D always increases when we consider possible migration of skilled people. The migration of unskilled people sometime can have negative effects on R&D but can still increase output because of lower production cost.

One important thing to note that not all the countries are capable of conducting high level of R&D though it is possible for them to train the professionals required for conducting R&D. Examples of such professions can be computer engineers, aeronautical engineers, marine engineers, pharmaceutical and chemical engineers etc. Recent Brain Drain literature claims that international migration is beneficial as it gives incentive to acquire these skills. But in reality if these professionals cannot migrate, it is often very difficult for them to find works that fit well with the skills. For example it is possible for many countries to train pharmacists and chemists relatively cheaply, though they do not have a large pharmaceutical sector. The knowledge they can acquire thus is not very useful for their countries and brings little benefit.

In this paper we can see that the abundance of trained people can bring benefit through R&D channel. It these people can migrate and find suitable jobs abroad, they can contribute in production of goods at a relatively lower price that can be imported back by the home country. It can still bring benefit if the labour exporting country has a large production sector but incapable of conducting R&D.

The migration of unskilled people is in general regarded as beneficial for the labour exporting country. But the policy makers of developing countries still maintain the view that migration of skilled people is harmful. As we have discussed it is not true in all cases. For example most developing countries do not have a large hardware production sector. But computer hardware engineers can migrate to Northern developed countries relatively easily. The research and production conducted in North are bringing benefit to the whole world. Thus migration of computer engineers should not be branded as harmful without pointing out towards the alternative uses.

A few things also need to be mentioned before we conclude the chapter. In this chapter we have analysed the non-cooperative behaviours of firms with

simultaneous R&D. The case of sequential game is also worth considering, especially when one country can easily replicate other countries R&D in the later stages. In this regards we may also think about R&D spillover in both cooperative and non cooperative situations (D'aspremont and Jacquemin 1988). As many Southern developing countries are now highly capable of replicating the Northern R&D in short period of time, this case deserves analysing.

Appendix

3.3.1.

Migration in our case reduces the value of α_u. To find out the effect of the change of α_u on the slope we can differentiate the slope term of the reaction function by α_u. Let S be the slope, therefore-

$$\frac{\partial S}{\partial \alpha_u} = -\left(\frac{4b_1 b_2 \alpha_u w_{u1} w_{u2}}{\left(9\alpha_s w_{s1} - 8b_1^{\,2}\alpha_u^{\,2} w_{u1}^{\,2}\right)^2} 16 b_1^{\,2} \alpha_u w_{u1}^{\,2} + \frac{4b_1 b_2 w_{u1} w_{u2}}{\left(9\alpha_s w_{s1} - 8b_1^{\,2}\alpha_u^{\,2} w_{u1}^{\,2}\right)} \right)$$

As $9\alpha_s w_{s1} - 8b_1^{\,2}\alpha_u^{\,2} w_{u1}^{\,2}$ is positive by assumption the slope moves to the opposite direction of the change of α_u. The slope is negative. Hence the slope is steeper if α_u increases. If α_u falls, the slope is flatter. Therefore with migration as α_u falls we get a relatively flatter reaction function.

3.3.2.

We have-

$$\varphi = 48 b_1^{\,2} b_2^{\,2} \alpha_u^{\,2} w_{u1}^{\,2} w_{u2}^{\,2} - 72 b_2^{\,2} w_{u2}^{\,2} \alpha_s w_{s1} - 72 b_1^{\,2} \alpha_u^{\,2} w_{u1}^{\,2} w_{s2} + 81 \alpha_s w_{s1} w_{s2} > 0$$

Here $\alpha_u = 1$. We have $\alpha_s = 1$ if no migration and $\alpha_s = \frac{w_{s2}}{w_{s1}}$ if migration. By subtracting -

$$\varphi_{nm} - \varphi_m = \left(48b_1^{\,2}b_2^{\,2}w_{u1}^{\,2}w_{u2}^{\,2} - 72b_2^{\,2}w_{u2}^{\,2}w_{s1} - 72b_1^{\,2}w_{u1}^{\,2}w_{s2} + 81w_{s1}w_{s2}\right) -$$
$$\left(48b_1^{\,2}b_2^{\,2}w_{u1}^{\,2}w_{u2}^{\,2} - 72b_2^{\,2}w_{u2}^{\,2}w_{s2} - 72b_1^{\,2}w_{u1}^{\,2}w_{s2} + 81w_{s2}w_{s2}\right)$$
$$= \left(-72b_2^{\,2}w_{u2}^{\,2} + 81w_{s2}\right)w_{s1} - \left(-72b_2^{\,2}w_{u2}^{\,2} + 81w_{s2}\right)w_{s2}$$
$$= 9\left(9w_{s2} - 8b_2^{\,2}w_{u2}^{\,2}\right)\left(w_{s1} - w_{s2}\right)$$

As $\left(9w_{s2} - 8b_2^{\,2}w_{u2}^{\,2}\right) > 0$, $9\left(9w_{s2} - 8b_2^{\,2}w_{u2}^{\,2}\right)\left(w_{s1} - w_{s2}\right) > 0$.

Therefore R&D of firm 1 increases as φ falls with migration.

4.

Equilibrium migration if only firm 1 conducts R&D

$$\frac{\partial \Pi_1}{\partial R_1} = \frac{2}{9}\left(a - 2\left(\theta_1 - b_1 R_1\right)\alpha w_1 + \beta w_2\right)2b_1\alpha w_1 - R_1\alpha w_1 = 0$$
$$or, 8b_1^{\,2}\alpha^2 w_1^{\,2}R_1 - 9R_1\alpha w_1 = -4b_1\alpha w_1 a + 8b_1\alpha^2 w_1^{\,2}\theta_1 - 4b_1\alpha w_1\beta w_2$$
$$or, R_1 = \frac{4b_1 a - 8b_1\theta_1\alpha w_1 + 4b_1\beta w_2}{9 - 8b_1^{\,2}\alpha w_1}$$

Therefore,

$$R_{1nm} > (<) R_{1m}$$
$$\frac{4b_1 a - 8b_1\theta_1 w_1 + 4b_1\beta w_2}{9 - 8b_1^{\,2}w_1} > (<) \frac{4b_1 a - 8b_1\theta_1 w_2 + 4b_1\beta w_2}{9 - 8b_1^{\,2}w_2}$$
$$or, -8ab_1^{\,2}w_2 + 16\theta_1 w_1 b_1^{\,2}w_2 - 8\beta w_2 b_1^{\,2}w_2 + 9a - 18\theta_1 w_1 + 9\beta w_2 > (<)$$
$$-8ab_1^{\,2}w_1 + 16\theta_1 w_2 b_1^{\,2}w_1 - 8\beta w_2 b_1^{\,2}w_1 + 9a - 18\theta_1 w_2 + 9\beta w_2$$
$$or, a > (<) \frac{9\theta_1 - 4\beta w_2 b_1^{\,2}}{4b_1^{\,2}}$$

Critical value of a in proposition 6.1-

$$R_{1nm} > (<) R_{1m}$$

$$or, \frac{4b_1 a w_{u1} - 8b_1 {w_{u1}}^2 \theta_1 + 4b_1 w_{u1} \beta w_{u2}}{9w_{s1} - 8{b_1}^2 {w_{u1}}^2} > (<) \frac{4b_1 a w_{u2} - 8b_1 {w_{u2}}^2 \theta_1 + 4b_1 w_{u2} \beta w_{u2}}{9w_{s1} - 8{b_1}^2 {w_{u2}}^2}$$

$$or, a > (<) \frac{-8{b_1}^2 w_{u1} \beta {w_{u2}}^2 + 18\theta_1 w_{s1}(w_{u1} + w_{u2}) - 9\beta w_{u2} w_{s1}}{8{b_1}^2 w_{u1} w_{u2} + 9w_{s1}}$$

Equilibrium migration if only firm 2 conducts R&D

$$\frac{\partial \Pi_2}{\partial R_2} = \frac{2}{9}(a - 2(\theta_2 - b_2 R_2)w_2 + \lambda \alpha w_1) 2b_2 w_2 - R_2 w_2 = 0$$

$$or, 4{b_2}^2 {w_2}^2 R_2 - 9R_2 w_2 = -4ab_2 w_2 + 8b_2 {w_2}^2 \theta_2 - 4\lambda b_2 w_2 \alpha w_1$$

$$or, R_2 = \frac{4ab_2 w_2 - 8b_2 {w_2}^2 \theta_2 + 4\lambda b_2 w_2 \alpha w_1}{9w_2 - 4{b_2}^2 {w_2}^2} = \frac{4ab_2 - 8\theta_2 b_2 w_2 + 4\lambda b_2 \alpha w_1}{9 - 4{b_2}^2 w_2}$$

Chapter 7
Summary and Conclusions

This section is the concluding section of the thesis. In this thesis we have looked at the effects of competitions in international labour market for skilled and unskilled migration and the effects of openness of labour market and international migration on the R&D and consumers' welfare. We believe that the contribution of this thesis would be useful in future policy formulation of developed and developing countries in linking migration and economic development.

We have obtained a few interesting results in this thesis. The chapter 2 and chapter 3 of thesis were mainly literature review chapters. We have tried to provide a broad overview of international migration statistics and literature in those two chapters. Though they formed the basis of the analysis done in the main chapters of the thesis, the review we have done could find some use in different studies to be conducted in future.

The main contribution of the thesis has started from chapter 4. In chapter 4 we have assumed as situation where two countries compete in sending unskilled labour to a third country. We have mainly looked at the policy stance of the third country. It was found that the labour importing country uses different tax rates for the migrants of different countries. The labour exporting country with higher labour endowment exports more labour and receives higher per capita tax burden compared to the other country. This result is consistent with the literature of strategic trade policy. But the analysis of the chapter has very important implication for the migration policies of poor labour exporting countries. The theoretical analyse done here may persuade some countries to empirically investigate the nature of discrimination faced by migrants in international labour market. It may also find some use in international migration negotiation.

Chapter 5 has looked at the migration of skilled people. We have assumed a situation where people can migrate without government's assistance. Similar to chapter 4 here labour from two countries migrate to a

third country. The exporting countries however here compete in setting up emigration tax policy. It has been found that in order to maximise national income the exporting countries should impose positive tax on emigration. The result is opposite of policy stance of many poor developing countries where they subsidise international migration. The findings of the chapter are therefore suggesting to review the policy of subsidising emigration of skilled people. The importing country on the other hand similar to chapter 4 uses discriminatory taxes. The country with higher labour endowment faces higher per capita tax burden.

In chapter 6 we have looked at the effects of opening up of labour market and migration on R&D and consumers' welfare. It has been assumed that two countries are engaged in strategic trade with each other. The wage rate of one country is higher than the other country. If labour market is opened wage rate of the labour importing country falls. We then have analysed how the lower wage rate effects R&D of firms and consumers' welfare in two countries. We have found that migration of skilled people increases R&D and consumers' welfare. But migration of unskilled people does not increase R&D and welfare all the time. The result of the analysis can be linked with the literature of Brain Drain. The recent Brain Drain literature is claiming that migration can benefit the sending country as it gives incentive to form additional human capital. In this chapter we have found an additional channel of possible gain of human capital circulation that is through increased R&D. Many countries of the world are not in a position to conduct R&D though they can train the required personnel to conduct R&D. For example computer hardware engineers, pharmacists, chemists etc. If they can contribute by conducting research in advanced developed countries it eventually benefits everybody. For example computer engineers of Silicon Valley. The developing countries sometimes depict the tendency of branding the migration of skilled labour as harmful. The results of the paper show that before making any judgement we first need to look at the alternative uses of the skills in home country.

In summary, in this thesis we have explored some issues that have not so far received much attention from the economists and policy makers. The

issues explored here are highly relevant to the present international migration regime. We hope that the analysis conducted will further enrich our understanding of international migration. The thesis will be considered successful if it finds some use in future policy making of both developed and developing countries.

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