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Essays on Determinants and Effects of Labour Mobility

by

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ABSTRACT

FACULTY OF LAW, ARTS & SOCIAL SCIENCES

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ESSAYS ON DETERMINANTS AND EFFECTS OF LABOUR MOBILITY

By Emanuela Lotti

In this thesis we study the determinants and the economic effects of labour mobility in economic environments characterised by trading frictions, entry costs and credit constraints. People move to a different sector, or to a different geographical area, to improve their socioeconomic conditions. The focus is on the impact of mobility on inequality, unemployment and productivity.

Chapter 2 describes a framework to analyse the extension of the formal sector and income dispersion. We borrow a stochastic job matching model and we introduce a stage which determines the size of the modern market. People may choose between a safe return (traditional sector) and a higher expected return in a market with imperfect matching (modern sector). The participation to a market activity and ex-post match heterogeneity interact and affect the productivity as well as the variability of incomes in the economy.

In chapter 3 we consider the effect of remittances on the unemployment rate of the labour exporting country. Remittances have two opposing effects on the labour market. First they raise the income of the unemployed members back home. This causes the unemployment rate to rise. The second effect is on investment in the source country. Since it is likely that many firms in labour exporting countries are credit constrained, remittances available for investment will then relax these constraints and increase the level of the capital stock. The effect is to reduce the unemployment rate. If the `investment effect' outweighs the `search income' effect, then remittances will reduce the unemployment rate. The chapter contains also an empirical section to support the predictions of the theoretical analysis.

Chapter 4 builds upon the previous chapter by endogenizing the migration choice. We show that if there are no credit constraints in the economy, unemployment is a positive function of the proportion of migrants. Remittances increase the unemployment income of stayers and this has the effect of decreasing the labour force participation. However, if there are credit constraints the relation between unemployment and migration is not obvious and multiple equilibria can arise.

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Definitions

Chapter 2

Definitions of variables from chapter 2 follow:

$d =$ fixed return in the traditional sector

$U_E =$ unmatched entrepreneurs

$U_T =$ unmatched technicians

$\alpha =$ propensity to co-operate

$F(\alpha) =$ distribution function of co-operation attitudes

$G(\varepsilon) =$ distribution function of match productivity

$\lambda =$ degree of the matching function

$\varepsilon_R =$ reservation productivity

$q_T =$ arrival rate for technicians

$q_E =$ arrival rate for entrepreneurs

$V_{U_E} =$ discounted expected value of a vacancy

$V_{U_T} =$ discounted expected value of unemployment

$V_{M_E} =$ discounted expected value of a filled vacancy (matched entrepreneur)

$V_{M_T} =$ discounted expected value of employment (matched technician)

$r =$ interest rate

$p(\varepsilon) =$ remuneration to the technician

$y(\varepsilon) =$ match productivity

$s =$ exogenous destruction rate

$b =$ unemployment income

$c =$ cost of posting a vacancy

$D =$ present discounted value in the traditional sector

$k =$ entry cost

$K =$ present discounted entry cost

$\beta =$ bargaining power of the technician

$1 - \beta =$ bargaining power of the entrepreneur

$p_R =$ reservation wage

$\theta =$ labour market tightness

$\varepsilon^e = E(\varepsilon \geqslant \varepsilon_R) =$ conditional mean of productivity

Chapter 3

Definitions of variables from chapter 3 follow:

$p =$ productivity of the match

$y =$ output

$\delta =$ depreciation rate

$r =$ interest rate

$c =$ recruitment cost

$z =$ remittance flow

$\bar{z} =$ domestic support for unemployed

$z' =$ unemployment income of recipient family

$z =$ average unemployment income

$q(\theta) =$ arrival rate for firms

$\theta q(\theta) =$ arrival rate for workers

$w^{nm} =$ wage for non remittance recipient

$w^m =$ wage for remittance recipient

$\lambda =$ exogenous job destruction rate

$\bar{F} =$ expected income of a filled vacancy

F^{nm} = expected income of assuming a non remittance recipient

F^{m} = expected income of assuming a remittance recipient

V = expected income of a vacancy

U^{m} = market value of remittance recipient unemployed

U^{nm} = market value of non remittance recipient unemployed

E^{m} = market value of remittance recipient employed

E^{nm} = market value of non remittance recipient employed

α = proportion of migrants

β = bargaining power of workers

w = expected income

Chapter 4

Definitions of variables for chapter 4 follow:

w_s = high skilled wage at home

$G(m)$ = congestion costs increasing in m

m = proportion of migrants

y = income for high skilled

x = income for low skilled

e = weight for high skilled member of the family

$1-e$ = weight for low skilled member of the family

U^{F} = utility of the family

t = tax rate

$\theta q(\theta)$ = probability for the low skilled unemployed of finding a job

$q(\theta)$ = probability for the vacant firm of finding a worker

τ = exogenous remittance transfer

w_0 = high skilled wage abroad

w^{m} = wage for recipient low skilled unemployed

w^{nm} = wage for non recipient low skilled unemployed

$j =$ matching function

$\theta =$ labour market tightness

$k =$ capital stock

$r =$ interest rate

$\delta =$ depreciation rate

$w^e =$ average wage

$\pi =$ expected profits

$\tau^e =$ expected unemployment income

$d =$ domestic support

$U^{mF} =$ utility of remittance recipient family

$U^{nmF} =$ utility of non remittance recipient family

Chapter 1

Introduction

The decisions to move to a higher rewarding sector, to invest in human capital and to work in a particular geographical space, respond to an innate tendency of people to improve the socioeconomic conditions for themselves and their families. This is the main motivation of mobility, with consequences in terms of allocation of resources in the economy under analysis. While there has undoubtedly been an increase in people's mobility, the overall picture that emerges is not necessarily one where everybody benefits from these movements. Labour mobility, both sectorial and spatial, can affect the dispersion of incomes with a possible increase in inequality. Similarly, international geographical mobility can have a detrimental effect on natives of the destination country and on people left behind[1].

This thesis consists of three essays in which we develop the theme of labour mobility in economic environments characterised by trading frictions. The different models presented are meant to represent different situations in which we apply the same economic tool. In a nutshell, the common denominator of the essays presented in this thesis is the existence of a choice made by the individuals in an environment characterised by imperfections in the search process. It is indeed the

[1] With regard to the recent EU Enlargement, these effects can be particularly relevant. It follows the decision of the European Commission to suspend the free movements of workers at least for the first 5 years after accession (transitional period).

acknowledgement of uncertainty in the trading process that justifies the use of a search-matching framework to develop and organize our results on the occupational and migration choices of rational economic agents. The search-matching approach is a useful tool for discussing many phenomena, in particular labour market issues. For a theoretical discussion, please refer to Pissarides (2000). Estimations of the empirical matching function include: Blanchard and Diamond (1989), Anderson and Burgess (2000), and Pissarides (1986). The approach adopted in this work is in line with a series of models, McKenna (1987), Ortega (2000) and Monfort and Ottaviano (2002), that use search theory to analyse the impact of labour mobility on market activity.

The supply and demand theoretical framework in a market without frictions is not able to take into account important phenomena such as inflows and outflows from unemployment, the duration of unemployment and the distribution of wages. In our first paper we look at the impact of various policies on labour market participation through job creation, and the use of a search matching model helps us in understanding the decision of entrepreneurs to open new vacancies. Furthermore, we are concerned with the following questions. Why do unmatched workers choose to remain unemployed? How can apparently similar agents end up with different wages? How is the size of the formal market affected? Again we believe that the theoretical framework we use can clarify these points (Rogerson et al.,2004). In the third and fourth chapter, we look at the impact of remittances and migration on the labour market of the sending economy. A search-matching framework can clarify the impact of remittances on wages of recipient and non recipient workers. In particular, we show that the wages of recipients and non recipients are related and that the impact on job creation is ambiguous and depends on the way remittances are used. We do not model explicitly the saving decisions of recipients because the introduction of savings in the standard job search model will make the analysis difficult to treat analitically (Maidorn, 2002). While we think this could be an important extension of our story, we prefer to keep the analysis as simple as possible.

The work is organised around two main blocks: the determinants of labour mobility and its effects in terms of the main economic variables. In particular, we emphasize the effects on inequality, unemployment and productivity. In the first part of the thesis, we examine the occupational choice of individuals, while chapter 3 and 4 look at the phenomenon of mobility from a geographical point of view.

In what follows we briefly summarise the content of each chapter, and we discuss the contribution of each work to the debate on workers' mobility. A detailed survey on the related literature is developed at the beginning of each chapter. The contribution of Stephen Drinkwater is in the empirical section in chapter 3, while Paul Levine contributes in section 3.3.2 and appendix B.4.

In chapter 2 we consider the links between size of the formal sector, technology and institutions, as well as the role of labour force participation as the driving force to account for productivity and income dispersion. Under particular assumptions on the returns to scale of the matching technology, the work describes a framework to study the inequality between groups of different educational level and the within group inequality, namely inequality among individuals of similar educational level.

The literature on the measurement of inequality in economics has been concentrated on inequality of incomes as the primary focus of attention. This is equivalent to treating everyone's incomes symmetrically. The famous economist and philosopher Amartya Sen (Sen, 1995) argues that innate differences among individuals play a key role in assessing inequality:

> equal incomes can still leave much inequality in our ability to do what value doing. A disabled person cannot function in the way an able-bodied person can, even if both have exactly the same income. *Amartya Sen*

We are aware there are interpersonal diversities. However, we believe that addressing the question of inequality by initially concentrating on income distribution is a necessary starting point in every work on inequality. Common sense suggests that we concentrate on the most important aspects of diversity, and we think educational

level is an easily and observable variable to anchor the discussion.

We model the decision to invest in training and participate to a market activity in the modern sector. In particular, we borrow a stochastic job matching model and we introduce a stage which determines the size of the markets in which the agent operates. The basic idea is that people may choose between a safe return (private project in the traditional sector) and a higher expected return in a market with imperfect matching (joint project in the modern sector). We build our discussion around three blocks:

1. there are frictions in the process of finding a partner;

2. individuals' occupational choice, which depends on technological and institutional factors, affects the size of the market;

3. inequality has two components of comparable importance: inequality due to differences in fixed individual characteristics and inequality due to "bad luck" in the meeting process (Aghion et al., 2002)

We show that the propensity to enter the formal sector and ex-post match heterogeneity interact and affect the productivity as well as the variability of incomes in the economy. Individuals choose their occupations depending on their attitudes to participate in

the uncertain (market) activity, which is assumed different among agents and economies (cultural differences). Joining the modern sector allows more productive projects, but at the same time individuals may not be able to find a suitable partner. Moreover, the partnership can collapse and individuals need to engage in a new search process. We find that technology and institutions affect the participation in the modern sector. Our results depend on the assumption of returns to scale in the matching technology. If we assume constant returns to scale in the matching technology, a decrease in entry or training costs should be associated with a larger modern sector. It should also determine an increase in the average productivity in the economy. There are no effects in terms of income dispersion. However, if there

are increasing returns to scale, a decrease in entry costs is associated to an increase in inequality between traditional and modern sectors and a decrease in inequality within the modern sector. Under decreasing returns to scale, we obtain opposite results.

Chapter 3 and 4 focus on the determinants and effects of geographical labour mobility. It is a common view that the enlargement of the European Union increases labour mobility across borders, and this has led to a renew interest in the welfare effects of migration. These considerations develop along different lines. First, the flow of people from poor to prosperous areas affects the utility of natives, namely people living in the receiving country. Second, it increases the economic opportunities of migrants. Third, geographical labour mobility has an impact on people left behind. We concentrate on this third point and examine the effects of non economic transfers (remittances) to a market activity. In particular, we look at the effects of remittances on the labour market of the home economy. Chapter 3 develops the analysis assuming an exogenous migration choice. Chapter 4 builds upon the previous chapter by making international migration endogenous and, once abroad, we assume that altruism is the only reason to remit. As Rapoport and Docquier (2004) report

> remittances impinge on households decision in terms of labour supply, investment, education, migration, occupational choice, fertility with potentially important aggregate effects.

In spite of the importance of remittances, as revealed by several statistics on labour exporting countries, they have received relatively little attention among theoretical economists. Official estimates put global remittances at around $80 bn in 2002 but the total amount, which includes flows through unofficial channels, is far greater than this. Even the official level of remittances great exceed the amount received in overseas aid by developing country. A series of works have recently focused on the implications of remittances, but they mainly emphasise a particular aspect of the international transfers. Our works look at different effects of remittances. One

of the most obvious effect that migration should have on the labour market in the sending economy is that migration should decrease the labour force participation by increasing the unemployment income of remittance recipient stayers (Zachariah et al., 2001). At the same time, firms in developing countries often cite credit constraints as a major obstacle to business. Batra et al. (2002) describe a survey of more than 10,000 firms in 80 countries, carried out between late 1999 and mid 2000 on the types of constraints they faced. From the survey, it appears that 50% of firms in all developing regions cited financing as a serious constraints. As is to be expected, remittances can relax the credit constraints faced by the firms.

The basic idea of our work is simple. Remittances from migrants to their families have two opposing effects on the labour market of the source country. First they raise the income of the unemployed members back home. If we assume that wage income is taxed at a higher rate than income received by the unemployed, this will reduce the difference between the income of the employed and unemployed in the source country. According to standard matching models of unemployment this causes the unemployment rate to rise. The second effect is on investment in the source country. Since it is likely that many firms in labour exporting countries are credit constrained, remittances available for investment will then relax these constraints and increase the level of the capital stock. This will have the effect to decrease the unemployment rate. If the 'investment effect' outweighs the 'search income' effect, then remittances will reduce the unemployment rate.

In chapter 3 we develop this intuition in a dynamic labour-matching model and we present some empirical evidence to support our idea. The relationship between remittances and unemployment is tested using data from a panel of developing countries. The influence of remittances on investment is also tested econometrically. The analysis has been conducted at an aggregate level such as providing an overall perspective on the effect of remittances. The empirical analysis suggests that remittances have a small negative effect on unemployment, but a positive and significant effect on investment, although the effect is not as strong after controlling

for endogeneity.

In chapter 4 we build upon the previous chapter and we endogenise the migration decision of individuals even if we limit the presence of frictions within a static matching framework. Dealing with a static analysis helps us to concentrate on the links between migration, remittances and unemployment in the labour exporting country.

We model migration as a family choice and we show that repatriated savings have an important role in the development process of the labour exporting country. Migration decision is taken for the interest of the family. We assume that high skilled workers have a higher propensity to migrate. This assumption is coherent with the empirical evidence on migration and human capital which shows that individuals with a higher educational level are more likely to migrate (Drinkwater, 2003).

We consider an example that shows that if there are no credit constraints in the economy, unemployment is a positive function of the proportion of migrants. Remittances increase the unemployment income of stayers and this has the effect of increasing their reservation wage. However, if there are credit constraints the relation between unemployment and migration is not obvious. On the one hand, migration increases the outside option for unemployed stayers. On the other hand, it relaxes the credit constraints with positive effects on final output and labour demand. If firms are not able to expand production at its optimal level, multiple equilibria can arise. The presence of multiple equilibria, under credit constraints, is explained by the interaction between the search income and the investment effect. Unfortunately, equilibria can not be Pareto ranked since credit constraints, wages and unemployment rate move in different directions. However, we can say that the equilibrium with a higher level of migration is characterized by a higher wage due to, both, the release of credit constraints and the increase in unemployment income. We also show that, contrary to the findings of the brain drain literature, migration of high skilled can be beneficial through the release of credit constraints, and increases the productivity of the home economy.

Chapter 5 contains concluding remarks and outlines future directions of research.

Part I

Labour Mobility and Occupational Choice

Chapter 2

Search frictions, entry costs and formal markets

2.1 Introduction

The increasing demand in specific abilities represents an important opportunity for people to undertake more productive projects. While the rise of partnerships enhances the exchange of ideas generating opportunities for people to become more specialized and productive in a growing modern sector, there is a concern that certain traditional sectors are missing that chance. We claim that in a world with friction in the agents' search process and heterogeneity in match productivity, the decision to work in an informal sector (i.e. home production) or in a formal sector (modern labour market) may influence both income dispersion and average productivity of the economy. We refer to the activity in the informal (traditional) sector as an individual project, while the activity in the formal (modern) sector (market activity) is a joint project combining a worker and a firm.

The low level of labour force participation in developing countries has attracted great attention and created an interesting debate on finding specific policies that may rise employment rates. A possible explanation of such limited labour participation is perhaps offered by the presence of barriers to entry in the modern sector and

individuals perception of uncertainty related to the market activity. Rigidities in the market activity are also a deterrent for entering the modern sector. Our model can offer a possible explanation of the relatively high proportion of resources trapped in the informal sector in developing countries. While 17 per cent of the labour force in OECD countries "work" in informal activities, this figures more than double in developing countries (Ihrig and Moe, 2000) and (Gerxhani, 1999). We think that a model of job creation within a stochastic matching framework can capture this point [1]. At the same time, this work can relate to a series of issues interesting for developed countries. For example it can contribute to the debate on the female employment rate in OECD countries (Garibaldi and Wasmer, 2003). There has been an increasing interest in finding specific policies that can have a positive impact on female labour market participation. As clarified in Garibaldi and Wasmer (2003), the substitution of household production to market production would have a positive impact on, both, employment rate and the size of official GDP in OECD countries. We show that the reduction of barriers to entry, which often characterizes women participation choice, can have a positive impact on the variables of interest. Developments in the UK employment rate, accompanied by a relatively stable inactivity rate, have also attracted interest on the joint behaviour of unemployment and inactivity rate (Brigden and Thomas, 2003). The authors offer an explanation of the joint behaviour of unemployment and inactivity rate within a search matching model where wage offers made to the unemployed and the inactive are interdependent. This is derived from the assumption that inactive (i.e. students) can still find a job even if at a lower rate compared to unemployed. In our model we exclude this possibility since our focus is on the impact of various policies/shocks on the participation rate and income distribution. Finally, we think this work can also help explaining the increase in the formal sector which has characterized some OECD countries (i.e.

[1]The focus is on job acceptance, namely on which job matches are accepted and which are rejected. The introduction of endogenous job destruction could create additional impacts of policies/shocks on the inactivity rate. At the moment this is not present in our model since we intend to focus on the impact of job creation on the participation rate.

USA). Reduction in entry costs on one side and better labour market conditions on the other, contributed to the rise of the modern (formal) sector.

To a limited extend (i.e. in case of non-constant returns in the matching technology) the model looks at the impact of entry barriers and technological progress on income dispersion in developed countries. For example, periods of increasing returns to college (US and UK of the 1980's) can be explained by labour markets characterized by increasing returns in the matching technology and reduction in entry barriers. The conventional view is that the increase in inequality is the result of technological factors (i.e. increase of the degree of mismatch in the economy) and institutional characteristics (i.e. unemployment benefits) [2]. Keeping this conventional explanation of inequality, our model focuses on the role of labour force participation as the driving force to account for productivity and income dispersion.

Search-theoretic models can be used to formalize the role of institutional and technological factors in the degree of participation to the formal sector. We consider the match between two individuals linked by a buyer and supplier relationship. The framework allows us to address distribution issues in an economy where individuals have the possibility to choose between a traditional and a modern sector.

We concentrate on the main empirical evidence only to anchor the theoretical discussion. This is organized around three trends, dealing respectively with college premium, residual and overall inequality. In the past three decades there has been a remarkable increase in the overall wage inequality (Gottschalk and Smeeding, 1997); returns to college rose very sharply in the US of the 1980's (Bound and Johnson, 1992) ; and we witnessed an increase in residual inequality, that is inequality which is not accounted for by the between groups changes (Rubinstein and Tsiddon, 1999). A final piece of evidence we would like to highlight is the diversity of experiences in a number of developed countries. For example, Atkinson (1996) comments upon

[2]Burgess et al. (1999) offers an alternative explanation of the increase in income dispersion. They look at and quantify the impact of labour reallocation on earning dispersion. In particular, they investigate the impact, on within-group inequality, of the changing allocation of workers to jobs.

the changes in the wage structure in US and UK. In contrast, the results for Canada are ambiguous (Baker and Solon, 1999) and (Atkinson, 1996). Finally, the Gini coefficient for many European countries remained roughly constant or decreased. Aghion et al. (1999) argues: "the US and UK are the only countries experiencing a large and simultaneous increase in the returns to both experience and education, as well as within group inequality". The different experience of many industrialized countries should not come as a surprise. The evidence points to institutions as an unavoidable factor to anchor the theoretical discussion on income dispersion.

In our economy, individuals decide to be self-employed in the traditional sector or they offer their own ability to other individuals with managerial ability (entrepreneurs). Similarly, we can think of a worker who decides to work in a traditional or in a modern sector.

The basic idea, which appears in various guises, is that people may choose between a safe return (private project) and a higher expected return due to the synergies between the two agents in a market with imperfect matching (joint project). Given a distribution of willingness to enter the modern sector, risk-neutral agents enter the joint projects' (formal) market until expected returns in the traditional and modern sectors are equalized. The corresponding equilibrium is the result of a balance of forces that push in different directions. Indeed, institutional and technological factors such as entry costs, search costs and matching technology affect the number of people that decide to enter the market activity with possible effects in terms of average productivity and dispersion of projects' values. In order to enter the joint projects market, individuals sustain a sunk cost (i.e. training cost). The sunk costs may influence the equilibrium outcome since it affects individuals' decision to enter the risky market. Differently from other papers where individuals can choose the side of the market in which they want to operate, we keep it fixed, but we allow individuals the choice between operating in a traditional sector with lower but safer returns or enter a formal, modern sector and look for a partnership. The main idea is that a worker (type t) decides to participate to the trading process until the

entrance in the new market fully compensate the opportunity cost of giving a safe return up and sustain the sunk cost. In order to concentrate on participation to the formal sector, we assume homogeneity and free entry on the demand side. There are two key, though reasonable, assumptions which drive the inference of the model. The first is "exogenous distributions" reflecting differential willingness to undertake a joint project for workers. A higher value of α synthesises a higher propensity to enter the formal sector while individuals with a low value of α will always prefer the safe job. This reflects in part considerations concerning personal and familiar conditions, initial wealth endowments, access to information and location, and every other unobserved variables which may affect the choice between the two sectors. The second is "skill assignment". Workers and entrepreneurs (firms) differ in their specific ability, but there is no *a priori* superiority or inferiority among them . Each worker and each entrepreneur is endowed with a specific type of knowledge. We can imagine that the specific type of knowledge is an expression of individual's primary field of expertise (Berliant et al., 2000). Given agents' heterogeneity, matches have different values generating a distribution of individual's incomes[3].

In terms of the search-matching literature, we review what has been accomplished in the standard matching framework and we will add the occupational choice stage in a dynamic framework in which individuals in the supply side of the market have different propensity to enter the innovative market. Moreover they have to sustain entry costs if they decide to enter it. Match destruction is exogenous but stochastic and we will show the properties of the model under constant and non constant returns to scale in the matching technology. This will allow us to evaluate the impact of technology and institutional factors on participation decision, income dispersion and average productivity.

We put together Pissarides' models on labour force participation and on stochastic job matching (Pissarides, 2000) to gain some insights on the size of the formal sector in LDC and in OECD countries and on the links between occupational choice

[3]It is worth mentioning that individuals are homogeneous in the informal sector, but heterogeneous if they decide to undertake the formal activity.

and income dispersion. We concentrate on the constant returns assumption in the matching technology and then show what happens in the case of increasing and decreasing returns cases[4]. We believe the choice of a job matching model represents a useful way to characterize our two sectors, namely the traditional sector (home production) with no frictions and a modern sector (market activity) where the search of a partner (i.e. an employer) is required. The market activity is characterized by frictions and rigidities. This is certainly true for explaining different phenomena in industrialized countries, where the use of a search-matching approach is clearly recognized. Moreover, we think that frictions and rigidities are even more important in LDC and for this reason we think the model can offer a unifying framework to analyse formal and informal markets in, both, developing and industrialized countries.

We believe, the model has an independent interest as it shows the role of technology and institutions in the trade-off between interacting with a partner or giving it up and entering the traditional sector [5]. The innovative sector requires the affinity between partners' skills (exchange of knowledge). In terms of policy recommendations, agents need incentives to give up a low and safe return and enter the more productive market. Finally, the use of a search-matching model offers the possibility to study the links between the size of the formal sector and income dispersion, as well as average productivity, in the modern sector [6].

[4]Several contributions have, in different context, tried to assess the nature of returns to scale and it is, at first glance, difficult to have a clear-cut idea of what the returns in matching might be.

[5]The basic idea is that training costs in the innovative sector are higher than the one individuals incur in the traditional sector .

[6]At the moment this is only true in the case of non-constant returns in the matching technology. However, by allowing different kind of occupational choice the links can also be analysed in a model with constant returns to scale in the matching technology (Fonseca et al., 2001).

2.2 The background: Occupational Choice and Matching

As the search theory suggests, if there is friction in the agents' search process, agents may not find their most suitable partner. They must spend time and energy to find acceptable matches. Individuals may choose between different alternatives:

1. be in a frictionless market and earn a safe return;
2. enter the market with friction and being involved in the search process;
3. choose the side of the market in which they want to operate (i.e. choice between enter as an entrepreneur or as a worker).

In the standard model, infinite living agents start a trading process. They maximize their pay-offs under rational expectations given the stochastic process that breaks up partnership and the one that leads to the formation of new matches. The process that changes the state from unmatched to matched is Poisson with rate that depends on the matching technology and the number of agents on both sides of the market. The number of traders in the market with friction (i.e. workers) does not depend on any ex-ante individuals' choice. There is a given number of workers and vacancies form until the expected profits are equal to zero (zero profit condition).

Endogenous labour participation has been introduced by a series of works which highlight the option, for workers, to be in or out the labour force. McKenna (1987) models labour force participation in a three states model of matching in a context where the productivity is the same in every match. Under the constant returns to scale assumption, the size of the labour force does not affect the equilibrium since the dimension of the market is not relevant. The variable driving the results is the tightness of the market which adjusts according to the free-entry condition. The independence of equilibrium values on the number of traders in the constant returns case suggests that, under non constant returns in the matching technology, agents' occupational choice affects the equilibrium conditions. We first keep the assumption

of constant returns to scale, but we develop the analysis in an economic environment where the productivity of the match is stochastic[7]. Then, we extend the analysis to the case of non constant returns to scale in the matching technology.

As in Garibaldi and Wasmer (2001), the activity in the traditional sector (home production) is an individual project, while the activity in the modern sector (market activity) is a joint project combining a technician (worker) and an entrepreneur (firm). Compared to their model, where the flows between activity and inactivity are driven by individual shocks, in our framework the flows depend on technological and institutional factors. Compared to Garibaldi and Wasmer theory which builds on, both, entry and exit flows from the labour market, we limit the analysis to a theory in which individuals decide their participation to the labour market by focusing on job creation. Moreover, Garibaldi and Wasmer (2001) build on, both, macro factors and individual shocks while we look at the impact of macro variables and institutional changes on labour force participation. This is in some way restrictive, but our aim is to build a theory that analyses labour force participation, productivity and income distribution and we think that the focus on job creation can offer useful insights on these issues.

Our work is also similar to Sato (2000) in the way they both show the link between the dimension of the market and the outcome in the labour market with friction in a world with heterogeneity in the match outcome. However, while Sato's focuses on the spatial aspects and investigates the dimension of the city, we look at the occupational choice of individuals. Moreover, Sato constructs a search-theoretic framework and shows that in the scale efficient case agglomeration economies exists and justifies the formation of a city, while we look at the constant returns case and compare it with the case of non constant returns in the matching technology.

Previously, we described a framework where individuals choose between being 'in' or 'out' of a market with friction. An alternative extension consider an economy of infinite-living agents in which a new stage is introduced. This approach has

[7]Stochastic job matching.

been suggested by Fonseca et al. (2001). During this stage agents decide to be entrepreneurs or workers on the basis of their expected pay-offs. It is a search equilibrium model where job creation is done by market participants. In contrast with the previous approaches, the occupational choice affects the division of the population in these two categories. Clearly, under this new framework, the occupational choice affects the equilibrium also under constant returns to scale in the matching technology. This model has been developed in a deterministic framework. When agents on both sides meet, the productivity of the match is identical. The authors show that higher set-up costs discourage 'entrepreneurship' and employment settles at a lower level. Now all individuals are involved in the market with friction. The main difference with the basic approach is that market participants can choose to be in the market as worker or as entrepreneur.

It is worth noting that other lines of research address the analysis concerning individuals' choice to enter the market with friction. We are referring to a variety of models where the static approach to the matching theory has emerged. Those models mainly focus on the trade-off between investing time in education or work from the beginning in a low skill sector. They concentrate on a two-periods economy with a fixed number of workers. The interactions between agents' participation on both side of the market creates an externality that sums to the trading externality that characterized search models. Snower (1996), Monfort and Ottaviano (2002) show the existence of two reinforcing externalities: a vacancy supply and a training externalities in a two-periods model where workers divide into unskilled and skilled. At the beginning of the first period each agent decides whether to acquire training to enter the market with frictions. On the other side of the market, firms enter the innovative sector until the zero-profit condition is satisfied. Since it takes one period to acquire a specific skill, each skilled worker works for only one period. This means that the aggregate skilled searchers is equal to the number of skilled in the economy and the aggregate number of vacancies is equal to the number of jobs. The matching technology is static; the number of participants on both side of the

market directly affects the probability of matching for both workers and firms. The training costs sustained by individuals affects the equilibrium number of matches in the economy. All individuals are initially low skill. If they choose to sacrifice a unit of their potential working time to enhance their human capital, they become high skill and they can compete with other skilled in the "new" sector. The use of the two periods model is in same way attractive, describing in an intuitive way the trade-off between a lower but safer return (low skilled sector) and a risky investment (high skilled sector). However, dealing with a dynamic matching framework allows us to answer different questions. Individuals decision to enter the "innovative" sector depends on the expected present discounted pay-offs in the two sectors. Variables like the interest rate and the duration of unemployment [8] play an important role in the analysis we are interested in. Moreover, by dealing with a stochastic framework, we can address interesting questions concerning economy's average productivity, income dispersion and compare the results with the basic standard model of search and matching.

2.3 The Model

2.3.1 Matching Framework

The economy consists of a continuum of infinitely-lived individuals with technical ability with mass 'n' and a continuum of entrepreneurs with mass N. We call them, respectively, type t and type e individuals. Type t individuals are free to work in the friction-less world and earn a fixed return d each period or sustain entry (training) costs and enter the 'innovative' market. The entrance in the modern (joint project) sector requires the search for a partner with a complementary ability (i.e. firm).

As in the standard labour market search framework, we assume a buyer-supplier

[8] Public opinion sees the nature of unemployment explained mainly by outflow variables like the duration of unemployment. However, Burgess and Turon (2000) challenge this view and argue that unemployment in Britain has been recently driven by inflow shocks.

relationship. The firm, type e, buys a service from the 'technician', type t. The firm formed by the entrepreneur is a unit of collaboration that can either be filled by a type t or be unfilled and thus unproductive. The productivity of the match results from the complementarities between the two partners. The allocation of joint projects takes place according to a process of search and matching, with the frictions summarized in an aggregate matching function:

$$m = m\left(U_E; U_T, \right)$$

where U_E are the unmatched entrepreneurs and U_T are the unmatched technicians.

Individuals decide whether to enter the modern sector using their specific ability on the basis of their expected pay-offs. Each individual is born with an α and carries it for the rest of his life. For matters of simplicity we initially assume α is equal for all type e individuals, while a type t's α is critical in the decision whether to enter the modern market or the more traditional frictionless market. The main idea is that type t individuals have the possibility to choose between two opportunities, be technicians and sustain the training cost or be self-employed in the friction-less market, while type e individuals (entrepreneurs) can only work in the innovative sector. They prefer to wait until there is a profitable opportunity[9]. This means that the steady-state will be characterized by : unmatched technicians, matched technicians, self-employed technicians, matched and unmatched managers, idle managers. The distribution of α is given by the cumulative distribution function $F(\alpha)$ with support in $[0; 1]$. A part from their propensity to enter the formal market, individuals differ in terms of the specific ability in their field (technical or managerial). Given the different productivity of the matches, we need to distinguish between meetings and matches (only a subset of meetings results in matches). The value of the project depends on the complementarity of the partnership. If the productivity of a partnership is not good enough, individuals prefer to carry on the searching process. This means that the probability for an individual to be matched depends on both the contact rate and the productivity of the match. We base our analysis on the

[9]The value of managers' individual project is equal to zero for everybody.

model of Mortensen and Pissarides (1994) and assume ex-post heterogeneity of the matches. This kind of models are known in the literature as stochastic job matching models.[10]. During the production stage, the partnerships produce

$$y(\varepsilon) = A\bar{y} + \varepsilon$$

where A is a scaling factor capturing the overall technology gap between the two sectors and $\bar{y}$ is a productivity value equal for every match. The productivity of the match is randomly defined and governed by the distribution function $G(\varepsilon)$: with ε known to both partners when they make the contact. They start at some randomly drawn productivity ε and remain there until match destruction. The random variable for productivity (i.e. synergy) in the modern sector is independent from the 'cooperation' variable. We think this is quite a reasonable assumption since the quality of the match depends on the synergies between the two partners (firm and worker) and not on the specific quality of each partner. *"Two vacant jobs may look the same to a worker before he searches the firms offering them; two workers may look the same to a firm before it screens them. But when the jobs and workers are brought together, one pair may be more productive than the other"* (Pissarides, 2000). During the participation decision, workers do not know their partners and the productivity of the match. If lucky they will meet a suitable firm. Firms and workers are ex-ante homogeneous in terms of productivity and the propensity to enter the modern sector can realistically depend on familiar and social conditions exogenous to the analysis [11].

[10]Models of endogenous job destruction and models of stochastic job matching assume the arrival of a negative shock which affects match productivity. In the endogenous destruction case, matches start at the highest available technology then, over time, the profitability of the match decreases. When it generates a negative surplus, the match is destroyed. In the stochastic matching framework the shock is at the initial time (i.e. the productivity of a partnership is a drawing from a known probability distribution). In two words, endogenous job destruction models focus on and endogenize, as the word suggests, the destruction of matches, while stochastic matching models focus on job creation since just the profitable meetings end up in matches.

[11]This can be a model of horizontal heterogeneity and not one of vertical heterogeneity. Please refer to section 2.1 of this thesis and Marimon-Zilibotti (1997) for further details.

The arrival of contacts is governed by a homogeneous matching function of degree λ. An increase in either U_E or U_T raises the number of contacts, since the chances of a random meeting improve. Such contacts arrive at the rate of $\frac{m(U_E;U_T)}{U_E}$ and $\frac{m(U_E;U_T)}{U_T}$ for entrepreneurs and technicians, respectively. The matching function is differentiable and increasing in its arguments: $\frac{\partial m(U_E;U_T)}{\partial U_T} > 0; \frac{\partial m(U_E;U_T)}{\partial U_E} > 0$, and $\frac{\partial (m/U_E)}{U_E} < 0$ $\frac{\partial (m/U_E)}{U_T} > 0$. [12]. If $\lambda = 1$, the size of the formal sector is not relevant (constant returns to scale in the "technology of search") while, if $\lambda > 1$ (i.e. increasing returns to scale) or $\lambda < 1$ the occupational choice affects the equilibrium.

Given the arrival of contacts, the individual transitions from an unmatched to a matched state are:

$$q_T = \left[(1 - G(\varepsilon_R)) \frac{m(U_T; U_E)}{U^T} \right]$$

and

$$q_E = \left[(1 - G(\varepsilon_R)) \frac{m(U_T; U_E)}{U_E} \right]$$

where ε_R is the reservation productivity for workers (technicians) and entrepreneurs. Firstly, we concentrate on the constant returns to scale case. We denote the discounted value of a vacancy by V_{U_E}, of a filled vacancy by V_{M_E}, of being an unmatched and a matched technician , respectively V_{U_T} and V_{M_T}. Then, the value of the match for an unmatched technician and entrepreneur depends on the reservation productivity of the match which affects the average productivity of the economy. With a perfect capital market, and in the steady-state, the present-discounted values satisfies the following Bellman equations:

$$rV_{M_T}(\varepsilon) = p(\varepsilon) + s\left[V_{U_T} - V_{M_T}(\varepsilon)\right] \tag{2.1}$$

$$rV_{U_T} = b + \theta q(\theta) \Pr(\varepsilon \geq \varepsilon_R) \left[V^e_{M_T}(\varepsilon) - V_{U_T}\right] \tag{2.2}$$

[12] On the same side of the market there is a congestion effect (i.e. the contact rate decreases with that type's participation), while the two sides of the market are complements.

$$rV_{M_E}(\varepsilon) = y(\varepsilon) - p(\varepsilon) + s\left[V_{U_E} - V_{M_E}(\varepsilon)\right] \tag{2.3}$$

$$rV_{U_E} = -c + q(\theta)\Pr(\varepsilon \geq \varepsilon_R)\left\{\left[V^e_{M_E}(\varepsilon) - V_{U_E}\right]\right\} \tag{2.4}$$

where $y(\varepsilon)$ is the match productivity, $p(\varepsilon)$ is the wage (price of the services offered by the technician), with b equal to the unemployment income[13], c equal to the cost of posting a vacancy and θ the labour market tightness. Finally s is the exogenous destruction rate for partnerships. The discounted values of being unemployed and of a vacancy depend on, $V^e_{M_T}$ and $V^e_{M_E}$, respectively, that is on the expected discounted values in the matched states.

2.3.2 The Choice of Occupation

The number of participants to the modern market is endogenously determined. We assume the agents consume what they produce. The timing of events is as follows. First, type t agents choose whether to join the friction market or not, then type e individuals decide to open vacancies and finally both side of the markets engage in search. As specified in the previous section, V_{U_T} is the present discounted value of income of an unmatched technician (worker). D is the corresponding present-

[13] b can have different interpretations in function of the economy we have in mind. Our aim is to try to offer a theory which is able to account for the differences in size of the informal and formal sectors in developing and developed countries. When we apply the model to a developing economy, b is often small if not negative. World Labour Report (ILO, 2000) claims that most of world lacks unemployment insurance. In this sense, we would like to highlight the possible positive role of unemployment benefits which can make the participation to the formal sector more attractive. In OECD countries, b clearly represents an income support which offers an income in periods of unemployment (unemployment benefits). While b can be interpreted as a policy variable in industrialized countries, it can have a wider interpretation in the case of developing countries. In particular, it can include the network support offered by relatives and friends to the individual that decides to undertake the market activity. As far as the informal sector is concerned, d can be interpreted as a benefit that individuals will give up to participate to the formal sector (leisure time, flexibility, etc.)

discounted value in the traditional sector equal for all type t individuals. It is a perfectly competitive sector in which $n - T = L$ individuals operate.

In order to enter the modern market, technicians incur, each period, a sunk cost equal to k. They enter the joint projects market until:

$$\alpha V_{U_T} - K \geq D. \tag{2.5}$$

When they enter the modern sector, they accept a match with an entrepreneur if the expected return from searching is equal to the expected return of being part of the partnership. Since all technicians are alike during search, they will all choose the same reservation price.

The choice of occupation for type t individuals is governed by a reservation value α^*. This means that the cut-off value of α is equal to

$$\alpha^* = \frac{D + K}{V_{U_T}} \tag{2.6}$$

Given the c.d.f. of α, $F(\alpha)$, a fraction $nF(\alpha^*)$ of type t population produce and consume in the frictionless market and a complementary fraction $n(1 - F(\alpha)) = T$ are technicians entering the modern sector and looking for a partner. As in the standard model, entrepreneurs enter the joint projects market until the expected payoff is equal to zero (free entry condition).

Under constant returns to scale in the matching technology, V_{U_T} does not depend on the number of participants in the market. On the contrary, if we assume scale economies or diseconomies in the matching technology, the expected value of being unemployed is affected by variations in the reservation productivity.

2.3.3 Bargaining

Suppose that type e and type t individuals meet and discover that their partnership productivity is $A\ \bar{y}+\varepsilon$.

Initially, we assume that both technicians and entrepreneurs know the value

of their joint productivity only after the meeting[14]. Given the existence of quasi-rents determined by search costs in the economy, the "market price" is not unique. However, it is most commonly assumed that rents are divided in function of partners' bargaining power [15].

The value of the project is shared to maximize

$$\left(V_{M_T}(\varepsilon) - V_{U_T}\right)^{\beta} \left(V_{M_E}(\varepsilon) - V_{U_E}\right)^{1-\beta}$$

where β is the bargaining power of the workers and $1-\beta$ the bargaining power of the entrepreneurs. To satisfy individual rationality, the share received by each partner must exceed the forgone option of continued search.

The solution to the following maximization problem is the price the worker receives for his services:

$$\max_{p} \left[V_{M_T}(\varepsilon) - V_{U_T}\right]^{\beta} \left[V_{M_E}(\varepsilon) - V_{U_E}\right]^{1-\beta}$$

We obtain

$$p(\varepsilon) = \beta y(\varepsilon) + (1-\beta) p_R \tag{2.7}$$

where p_R is the reservation price that workers (technicians) are willing to accept[16]. Since the individual α does not affect the value of the productivity of the match, all individuals are ex-ante homogeneous in terms of productivity[17]. This means that the reservation price will be the same for all.

$$p_R = p(\varepsilon_R) = r\left[V_{M_T}(\varepsilon_R)\right] = r\left[V_{U_T}\right] = Ay + \varepsilon_R \tag{2.8}$$

[14]A worker with high propensity to enter the formal market can meet an unsuitable partner and the productivity of the match can be very low.

[15]The match surplus sharing rule has been interpreted as the solution to a strategic bargaining game.

[16]Please refer to appendix A.1 for the derivation.

[17]α is a non-economic variable affecting individuals' decision to participate in the formal market. It is the result of individual characteristics as well as personal experience. For this reason it is a different one for every agent in the same economy. At the same time, two economies can have different distributions of α due to historical facts and different cultural traditions.

In fact, once the contact is made, agents observe the productivity of the match and decide to trade if $V_{M_T}(\varepsilon) \geq V_{U_T}$.

To obtain the reservation price in function of average productivity, unemployment income, tightness of the market and partnership destruction rate, we follow Pissarides (2000) showing that $\frac{\partial V_{M_T}}{\partial p} > 0$ and that the expected discounted value of being unmatched is not related to a specific price. In this case, there exists a reservation price that makes the worker indifferent between accepting the match or keep searching. Workers' reservation price must cover the permanent income of the unmatched agent and the sunk cost paid to be in the market. We obtain[18]

$$p(\varepsilon_R) = \frac{(r+s)\,b + \theta q(\theta) \Pr(\varepsilon \geq \varepsilon_R)\, p(\varepsilon^e)}{\theta q(\theta) \Pr(\varepsilon \geq \varepsilon_R) + r + s} \tag{2.9}$$

where $p(\varepsilon^e)$ is the conditional mean of the remuneration rate for workers.

On the other side of the market, entrepreneurs choose the level of standard productivity. As shown in Pissarides (2000), if the number of unmatched entrepreneurs is allowed to vary optimally when they are deciding whether to accept or reject a partner, the reservation productivity for managers is equal to the reservation productivity chosen by workers.[19] The marginal worker just covers the cost of his services. In order to determine the remuneration for technicians as a function of the tightness of the market, productivity and technicians' option value, we need to introduce the free entry condition for entrepreneurs. Entrepreneurs (firms) create partnerships until the expected profit from a new match covers costs for the average relationship.

[18] Derivation of (2.9) is given in appendix A.2.

[19] From the bargaining stage

$$V_{M_T}(\varepsilon) - V_{U_T} = \frac{\beta}{1-\beta}\left[V_{M_E}(\varepsilon) - V_{U_E}\right]$$

It follows that a worker will accept a job if $V_{M_T}(\varepsilon) \geq V_{U_T}$ and firms accept hiring a worker if $V_{M_E}(\varepsilon) \geq V_{U_E}$, that is if $V_{M_E}(\varepsilon) \geq 0$. From the bargaining formula it appears that the relation that gives the reservation productivity for workers $V_{M_T}(\varepsilon) = V_{U_T}$ and the one for firms $V_{M_E}(\varepsilon) = 0$ are compatible and satisfied for the same reservation productivity ε_R.

In the increasing returns case ($\lambda > 1$) , the process that changes the state from unmatched to matched depends on the size of the market (i.e. number of technicians that decide to enter the market with frictions). In this case, we need to express the contact rate as : $\frac{m(U_T;U_E)}{U_T}$ and $\frac{m(U_T;U_E)}{U_E}$. If the contact rate increases, individuals wait longer to obtain a better match. If the size of the market increases, the equilibrium is reached at a higher productivity with positive effects in terms of income distribution[20] and average productivity of the economy. Conversely, in the case of decreasing returns ($\lambda < 1$) individuals are less patient. If the size of the market increases, the equilibrium is reached at a lower reservation productivity, with negative effects in terms of income distribution and average productivity.

2.3.4 Equilibrium

A steady-state search equilibrium with occupational choice is a tuple $[U_E, U_T, \varepsilon_R, T]$ that satisfies the following conditions

(i) equilibrium conditions for entrepreneurs: $V_{U_E} = 0$;

(ii) a reservation rule $p^* = p(\varepsilon_R)$

(iii) a steady state condition : $\Pr(\varepsilon \geq \varepsilon_R)\, m(U_T; U_E) = s(T - U_T)$

(iv) entry condition for technicians: $\alpha^* = \frac{D+K}{V_{T_u}}$

To organize the study of the equilibrium outcomes of the model, it is necessary to distinguish between two alternative scenarios, namely constant and non-constant returns in the matching technology. As it will become clear in a shortwhile, the behaviour of the equilibrium differs from one case to the other and we try to exploit such differences to bring about a number of insights on what determining income dispersion and average productivity in different economies. The first step of the outlined project, namely the characterization of the equilibrium in the case of constant returns, is developed in this section.

The existence of equilibrium in the constant returns to scale is determined by

[20]This is true only for the modern economy. Income inequality between modern and traditional sector increases due to the increase of average productivity in the modern sector.

the solution of the above expressions in terms of θ , the "tightness" of the market.

We will first find the locus of pairs $\left(\varepsilon_R \text{ and } \theta = \frac{U_E}{U_T}\right)$ which are consistent with the optimal "choice" of both technicians and entrepreneurs. From the zero profit condition for entrepreneurs, we obtain: [21] $Ay + \varepsilon_R = b + \frac{\beta}{1-\beta}\theta c$

The partnership creation equation is obtained by plugging the free-entry assumption (i) into the formula expressing the expected profit from a new match:

$$V_{M_E}^e = \frac{c}{q(\theta)\Pr(\varepsilon \geq \varepsilon_R)}$$

We obtain

$$Ay + \varepsilon^e - p^e - (r+s)\frac{c}{q(\theta)\Pr(\varepsilon \geq \varepsilon_R)} = 0 \tag{2.10}$$

From the bargaining stage, we obtain the wage as a function of β, b, ε and θ[22] :

$$p(\varepsilon) = (1-\beta)b + \beta[y(\varepsilon) + \theta c] \tag{2.11}$$

Plugging (2.11) into (2.10) we obtain:

$$(1-\beta)[(Ay + \varepsilon^e) - b] - \beta c\theta - \frac{(r+s)c}{q(\theta)\Pr(\varepsilon \geq \varepsilon_R)} = 0 \tag{2.12}$$

The system can be solved in a recursive way. It does not depend on ε_R since the effects of a variation in ε_R on average productivity offset the one of the variation on reservation productivity on the probability of the match. This means that given the interest rate and all the other parameters included in the analysis, the creation condition can be solved uniquely for θ. The steady-state condition (iii) determines the number of unmatched technicians (it corresponds to the Beveridge curve).

$$u_T = \frac{U_T}{T} = \frac{s}{s + \theta q(\theta)\Pr(\varepsilon \geq \varepsilon_R)}$$

[21] See Appendix A.3 for the derivation.

[22] See Appendix A.4 for the derivation.

Finally, once we solve for the equilibrium values of θ, the number of participants in the market with frictions (i.e. the size of the market) will be a function of the parameters of the economy[23].

$$\alpha^* = \frac{r(K+D)}{Ay + \varepsilon_R} = \frac{r(K+D)}{b + \frac{\beta}{1-\beta}\theta c}$$

and

$$T = n\left[1 - F(\alpha^*)\right]$$

2.3.5 Comparative Statics

Variation in entry costs for workers does not affect the equilibrium values of the economy. However, since $\frac{\partial \alpha^*}{\partial K} > 0$, a decrease in entry costs determines a decrease of α^* and more technicians enter the modern sector. This will determine an in-

[23]The equilibrium obtained depends on the assumption that the productivity of the match and the participation attitude are independent. We have previously justified this assumption. If, instead, we decide to assume ex-ante differences between workers (i.e. vertical heterogeneity and different abilities among workers), then the output in the formal sector will be a function of the propensity to enter that sector. In particular, individuals with a higher propensity to undertake a market activity are also more productive in that sector. This is a model of self-selection and if we further assume that firms can discriminate the abilities, we will end up with a fragmented market where a vacancy is open for each ability/skill. When opening a new vacancy, the firm specifies the skill requirements. In this case: $w = w(\alpha)$ with $\frac{\partial w}{\partial \alpha} \geq 0$. The main difference with the previous framework is that now individuals and firms are aware of the productivity of their match and only individuals with higher ability/skill will enter the market activity. In particular, workers will enter the modern sector only if

$$U(\alpha) \geq D + K$$

with

$$rU(\alpha) = b + \frac{\beta}{1-\beta}\theta(\alpha)\, c$$

A decrease in entry costs will increase the size of the modern sector and also individuals with lower ability will find participation to the formal sector convenient. As a result, the average productivity in the modern sector decreases. For more details on segmented markets please refer to Mortensen and Pissarides (1999).

crease in the dimension of the formal sector with positive effects in terms of average productivity of the economy[24].

As clarified in the previous section, entry costs affect the size of the market. Under constant returns in the matching technology, average productivity in the innovative market does not change. However, the average productivity of the whole economy will be positively affected.

Under constant returns in the matching technology, the dimension of the joint projects market is not a variable in the equations defining the equilibrium. The "tightness" of the market, θ, is determined by profit maximization, so the same equilibrium conditions of the standard model give the solutions for all the unknowns, except for the size of the modern sector. The reservation productivity is not affected by individuals' occupational choice. A decrease in entry costs determines an increase in the number of people undertaking the market activity (the cut-off point α^*decreases). The results are: a higher average income in the economy since more individuals choose the modern market characterised by frictions. However, the performance of the modern market is not affected since the reservation productivity is independent from the size of the market.

Similarly, an exogenous increase in technological progress determines an increase in the size of the market (i.e. $\frac{\partial \alpha^*}{\partial A} < 0$). The intuition is clear: technological progress affects the modern sector. An increase in the productivity in the joint projects sector will necessary affect individuals' occupational choice. Under constant returns in the matching technology, more individuals enter the formal sector with positive effect in terms of average productivity. The average income of the economy increases for two reasons: the increase in A and the decision of more individuals to enter the market with frictions. However, given the assumption of constant returns, the performance

[24]The joint projects (modern sector) are on average more productive than the private projects (traditional sector). On the contrary, if there are ex-ante differences between workers, as clarified in the previous footnote, the overall effect of entry costs on average productivity is ambiguous. On the one hand, the average productivity in the modern sector decreases since less able workers enter the market activity. On the other hand more people in general enter the more productive sector.

of the modern sector is not affected.

Finally, the simple theoretical framework suggested in this work, allows us to make clear comparisons between two economies with different training and start-up costs or different distribution of propensity to undertake a market activity. Assume two economies A and B with $F_A(\alpha) \leq F_B(\alpha)$. Everything else equal, we obtain two different cut-off values for α. Under constant returns in the matching technology, the higher propensity to labour participation of region A does not affect the average productivity of the formal sector. However, when the size of the market positively affect individuals' contact rates, economy A performs better. Returns to scale in the matching technology affect both the expected value of the projects and income dispersion of the economy.

2.3.6 Equilibrium under non-constant returns

The previous section mainly dealt with the characterization of the steady-state equilibrium under constant returns in the matching technology. Under non-constant returns in the matching technology, the size of the market affects individuals' choice of reservation productivity. In this section, we briefly outline the case of non-constant returns and compare it with the one of constant returns to scale in the matching technology.

In our framework, an increase in the number of participants in the market determines an increase in the labour force participation and this can affect the average productivity of the economy.

In the case of increasing returns, the process that changes the state from unmatched to matched depends on the size of the market (number of individuals that decide to enter the market with frictions). If the contact rate increases, individuals wait longer to obtain a better match. Once entry costs decrease, the equilibrium is reached at a higher size of the market with positive effects in terms of average productivity (conditional mean) of the modern sector.

The effects on income dispersion are ambiguous: on the one hand, more people

enter the formal sector. On the other hand, there is a variation of the range of acceptable value in the market activity. In particular, the reservation productivity ε_R increases and the income dispersion in the modern sector decreases, while the inequality between modern and traditional sector increases.

In the case of decreasing returns in the matching technology, an increase in the number of participants in the market determines an increase in congestion costs. In this case, technicians (workers) wait less to find a suitable partner and a decrease in entry costs will have a negative effect on the average productivity (conditional mean) of the modern sector.

Under constant returns, the existence and uniqueness of equilibrium are easy to show. In fact, in the case of constant returns, the occupational choice have no effect on the equilibrium condition and the stochastic job matching model can be solved in a recursive way (Pissarides, 2000). However, under the assumptions of increasing and decreasing returns to scale, the existence and uniqueness of the equilibrium need to be verified. We outline here a sketch of the proof. We proceed in the following steps:

1. show uniqueness of the equilibrium;

2. show existence.

First of all, we are interested in the slope of the Beveridge curve and the one of the free-entry curve for a given value of α. If they meet only once, then we can argue that if the equilibrium exists then it is unique. Second, we consider the occupational choice relation. It compares the expected income for a technicians in the traditional and in the modern sector.

Under non constant returns, the Beveridge curve gives a negative relation between unemployment and vacancies, as in the standard model of matching. Similarly, the steady-state condition gives a positive relation between unemployment and vacancies. This guarantees the uniqueness of the equilibrium [25].

[25] For example, if we consider the increasing returns case and differentiate the free-entry and the

In order to show the existence of the equilibrium, we need to verify that the relations which show the expected incomes in the traditional and modern sectors meet at least once. The relation that expresses the income in the traditional sector is not affected by α, so it is a horizontal line with intercept given by the opportunity cost to enter the modern sector. In the case of increasing returns in the matching technology, the expected income in the modern sector is first increasing, since the greater number of technicians has a positive effect on the average income, then decreasing since the effect of a lower α dominates. In this case, the condition for the existence is:

$$max\left\{\alpha V_{U_T}\right\} > k + d$$

the maximum of the the expected income flow in the modern sector must be greater than the income flow in the traditional sector.

In the case of decreasing returns instead, the condition to be satisfied is different. In this case, the net expected income in the modern sector is a decreasing function of the number of participants. An equilibrium exists if, for $\alpha = 1$, the expected income flow in the modern sector is greater than the expected income flow in the traditional sector:

$$V_{U_T} > k + d$$

.

2.4 Conclusions

This work discusses the link between entry barriers and technological progress on one side, and the size of the formal (modern) sector on the other, with special emphasis given to the differences between developing and developed countries. To a limited extend, we also look at the impact on income dispersion.

steady-state relation we obtain that $\frac{dU_T}{dU_E} < 0$ in the steady-state relation and $\frac{dU_T}{dU_E} > 0$ in the free entry condition.

Individuals' decision to participate in the market activity (formal sector) is *per se* relevant. This decision affects the size of the modern (i.e. with friction) sector. Technological progress and institutions affect the cut-off value for the marginal agent, namely the individual that is indifferent between the two sectors. While the rise of the modern (formal) sector in OECD countries enhance the development of new ideas, generating better and more productive opportunities, there is a concern that individuals in most part of the world are missing that chance. The limited amount of resources invested in the formal sector in developing countries can, in part, be explained by the presence of high barriers to entry and the imperfections of the market activity. Clearly, the decision to enter a market activity can be seen as undertaking an investment with a certain margin of uncertainty. Individuals that choose to enter the market activity face two main uncertain events: there is a positive probability of being unmatched and a positive destruction rate of the project. Moreover, individuals need to find a suitable partner. The effects on average productivity and income dispersion naturally follow. The main contribution of this chapter is the introduction of a pre-matching stage in a stochastic matching framework. The main result, namely the effects of entry barriers and of other macroeconomic variables on the size of the formal sector, can be obtained also in a model of deterministic matching. However, we choose a stochastic matching framework since we want to look at the impact on income dispersion as well. In particular, we show that, under the assumption of non-constant returns in the matching technology, the occupational choice also affects the performance of the modern sector. In the case of increasing returns in the matching technology, low barriers to entry and low rigidities imply a higher average productivity in the modern sector and lower income dispersion [26].

[26] Marimon and Zilibotti (1997) obtain a similar result by varying the benefits received when unemployed. In particular, they show that an increase in unemployment income, makes workers wait longer to find a good job and the longer searching time has a positive impact on average productivity and income dispersion. Despite these positive effects, an increase in unemployment benefits has a negative impact on unemployment. We show that under increasing returns in the matching technology, larger formal markets perform better and an increase in average productivity, as well

In general, economies where entry costs are not very high should be characterized by a large "modern" sector with effects that depend on the returns to scale in the matching technology. We think the occupational choice approach, together with a stochastic matching framework, represent a valid base to account for the size of the formal and informal sectors. It can also offer a starting point for a discussion on, both, inequality between groups (i.e. modern and traditional sector) and within group inequality (the occupational choice may affect the reservation productivity in the modern market). [27]

as a decrease in income dispersion is the result of, both, policy variables like the unemployment income and other variables which affect the decision to enter the formal sector (barriers to entry).

[27] At the moment, our results on income dispersion depend on the assumption of non-constant returns in the matching technology and on the independence between the distribution of willingness to enter the formal sector and the match productivity distribution. If we allow market participants the choice between being a worker or an entrepreneur (Fonseca et al., 2001), we would obtain similar results also under constant returns to scale. We leave this analysis for future research.

Part II

Labour Mobility and Migration

Chapter 3

The Labour Market Effects of Remittances

3.1 Introduction

Economic analysis of the effects of remittances has become an important issue recently because of the rapid growth of this form of financial flow. Official estimates put global remittances at around $80bn in 2002, but the total amount, which includes flows through unofficial channels, is thought to be far greater than this. Even the official level of remittances greatly exceeds the amount received in overseas aid by developing country. Remittances are particularly important to some countries with remittances in our sample of 20 lower and middle income countries equal to 3.5% of GDP.

The purpose of this paper is to shed light on the relationship between remittances from international migration and imperfections in the labour and capital markets of the sending countries. Different forces can affect the way labour markets perform, especially when migration occurs between countries at different stages of development. Migration can affect the labour market of the origin country through at least two channels. First, migration opportunities can influence the education decision of both migrants and stayers (Stark et al., 1998). Second, when migrants remit part

of their earning to their families, they can affect the consumption, investment and employment decisions of stayers. The latter is the focus of this paper.

The basic idea of the paper is that migration opportunities can have two opposing effects on the source country's labour market. First, remittances from migrants to their family raise the income of the unemployed individuals back home. As a consequence the outside option for the unemployed improves causing the unemployment rate to *increase*. But suppose some remittances are invested. The net effect of remittances in the labour market of the home country is then far from obvious. In particular, we show that when firms are financially constrained, remittances can *decrease* the unemployment rate in the home labour market [1].

Firms in developing country often cite credit constraints as a major obstacles to business. Batra et al. (2002) describe a survey of more than 10,000 firms in 80 countries, carried out between late 1999 and mid 2000 on the types of constraints they faced. They report *"firms in Central and Eastern Europe are most likely to identify financing as a serious constraint, followed by those in CIS (former Soviet Union) countries, and then those in Africa, South Asia, and Latin America"*(p. vi). The constraint is particularly important for small and medium size firms. The authors add *"It is not surprising that whereas 50 per cent of firms in all developing regions cited financing as a serious constraints, only 40 per cent of firms in OECD countries found it to be so"*. Clearly the lack of funds for investment influences the process of economic development, and remittances are a possible way of relaxing these constraints.[2] We therefore develop a dynamic labour matching model

[1] We are aware that unemployment in LDC is not the best measure to take into account the employment conditions in these economies. The inactivity rate could offer a better picture of the situation. In this chapter we do a partial analysis of the phenomenon and look at the unemployment rate keeping the participation decision of individuals as given. In chapter 2 we offered a possible analysis of the participation decision to the market activity in developing countries.

[2] Foreign direct investment (FDI) is another possible way of relaxing credit constraints. However FDI may not necessarily raise capital in the host country. Harrison and MacMillan (2001), using firm level data from the Ivory Coast, show that borrowing by foreign firms can have a negative effect on the credit constraints of domestic firms. In particular, they show that borrowing by

with capital and credit constraints. This gives us a useful theoretical framework to discriminate between the 'productive' and 'unproductive' uses of remittances [3].

The paper is organized in the following way. Section 3.2 provides an overview of the existing theoretical and empirical literature on the effects of migration on the welfare of stayers. Section 3.3 introduces the basic model in which we explore the effect of remittances on labour markets where firms' level of investments is sub-optimal owing to credit constraints. Section 3.4 provides an empirical analysis of the relationship between remittances and unemployment as well as with investment and section 3.5 concludes.

3.2 Related Literature

A large literature has developed in recent years concerning the impact of international migration on both the home and host countries. Apart from a few exceptions (e.g. Davis and Weinstein, 2002), the general perception is that migration enhances the welfare of people living in the host country even if distributional effects can be important. For example, Borjas (1995) summarises this literature and reports that immigration increases national income but only results in a small negative impact on native wages and employment.

However, the analysis of the effects of migration is far from complete if we do not take into account the effects of migration on the home (sending country's) labour market. Given that it is often the most skilled individuals who migrate, the most obvious effect of migration from Less Developed Countries (LDCs) is that a brain

foreign firms exacerbates the credit constraints of domestic firms.

[3] As clarified in the first chapter, we do not model the saving and investment decision of recipient households. This is clearly a limitation of our analysis. Despite this limitation, we think that the use of a search-matching model can offer useful insights on the dual role of remittances. Most of the theoretical literature reviewed in the following section concentrates only on the positive or the negative role of remittances while the evidence generally point to ambiguous effects on the performance of the source economy. Our approach takes into account both effects and from this respect is in line with the empirical evidence.

drain could negatively affect the labour market of the labour exporting country, although more recent studies argue that the brain drain need not harm LDCs (Stark et al., 1997 ; 1998 ; Beine et al., 2001). For the remainder of this section, however, we will focus on literature that examines the effects of remittances.

First we relate our theoretical model to what has been found empirically. Income from remittances or from return migrants[4] can be spent on durable and non-durable goods or can be used in a productive way through direct investment in a project or through savings channeled from the banking system. A number of studies have examined one or other or both of these two effects.

Funkhauser (1992) notes that migration and remittances can have two effects on participation decisions on the home country's labour market. The loss of the migrant worker may mean that other household members, in particular females, enter the labour market. However, the receipt of remittances could reduce participation rates because of the income effect. He further suggests that high levels of remittance flows into local labour markets may increase aggregate demand and hence the demand for labour. Using data from El Salvador, he finds that remittances have a negative and significant influence on the labour force participation of both males and females. However, he finds that the loss of migrants does not have a significant effect on local labour markets. For females the positive but small effect of the local labour market is enough to outweigh the negative remittance effect, but for males, the negative income effect from remittances dominates all other effects.

Further evidence that remittances act in a similar way to welfare payments is provided by Zachariah et al. (2001). They report that the worker-population ratio was 55% amongst non-migrant households in Kerala, India but only 32% in households with an emigrant. They suggest that this finding may be caused by

[4]As clarified in Rapoport and Docquier (2004): "At a macro level, there are only minor differences between remittances stricto sensu and repatriated savings upon return..... . The relevant questions are: How much income earned abroad is repatriated? And are the amounts repatriated being used for investment or consumption?" Therefore, we use the term "remittances" to cover both sources of income.

employment seekers from emigrant households being more selective with regards to their job match. Furthermore, they report unemployment rates of 21% and 8% for emigrant and non-emigrant households respectively. They conclude their section on the effect of migration on employment and unemployment with the comment *"because unemployed persons belonging to emigrant households enjoy the financial support of the emigrant members, they are not in any hurry to get employed"* (p. 55).

The idea that unemployment benefits act as a safety net for the unemployed worker is theoretically explained in Marimon and Zilibotti (1997). They develop an equilibrium search matching model with two-sided and ex ante heterogeneity to obtain a distribution of match productivities. An increase in unemployment benefits acts as a safety net and the unemployed wait longer for better matches. They find that in an economy with higher unemployment benefits there will be a higher unemployment rate but also a better allocation of skills to jobs.

Regarding the non-productive versus productive use of remittances, Durand et al. (1996) report that 10% of their sample of Mexican migrants to the US who reported that they sent remittances or brought savings back with them spent at least some of the saved/remitted money (i.e. migradollars) productively. 14% reported that they spent some of their migradollars on housing and the remaining 76% reported that they spent the migradollars only on consumption. Glytsos (1993) estimates that only 4% of the estimated 14 billion drachmas sent migrant remittances to Greece in 1971 was invested in machinery and another 4% was invested in small shops, compared with 63% on consumption, 22% on housing and 7% on land. Using input-output analysis, he estimates that the multiplier effect associated with migrant remittances is 1.7 and this is found to vary between industries. The author also estimates the potential employment and capital effects of remittances amounted to around 74,000 new non-agricultural and non-public sector jobs and 8% of installed manufacturing capacity.

Adams (1998) also finds that external remittances have an important impact on

the accumulation of rural assets using Pakistani data and argues that the marginal propensity to invest transitory income is higher than it is for labour income[5]. Rozelle et al. (1999) find that remittances help to loosen the constraints on crop production in rural China and also stimulate productivity. Furthermore, given that many LDCs are likely to face capital and liquidity constraints, these constraints can be eased as a result of the savings that are deposited by migrants or their families. Therefore despite the fact that only a small proportion of remittances may be invested directly by migrants or their families, remittances can be channeled into productive uses by the banking system.

Kule et al. (2002), summarise the results of two surveys carried out in Albania in 1998. The first of these was completed by around 1500 individuals about their migration experience (of whom just under a half had migrated), whilst the second contained questions which were directed towards firms. Both of these surveys contained information on remittances. The information provided in the first of the surveys suggested that over 50% of the remittance sent to Albania were used for consumption, 16% were saved in a bank, 7% were invested both in financial institutions and in property, and over 7% invested in business. The survey of firms indicates that around 17% of the capital required to establish a business came from remittances. This evidence suggests that remittances can been seen as a way to overcome credit-constraints in the source economy [6].

Leon-Ledesma and Piracha (2001) also adopt a positive view of the relationship between remittances and development by modeling the effects of short term migration on labour productivity. Remittances can be channeled into investments and increase productivity in the home economy. The authors study the impact of migration and remittances on the employment performance of Central and Eastern

[5]He also finds that remittances from international migration have a much larger impact on the accumulation of physical assets (irrigated and rain-fed land) than remittances from internal migration.

[6]There is also evidence to indicate that remittances increase human as well as physical capital levels (Cox Edwards and Ureta, 2003; Lopez Cordova, 2004).

European Countries and claim that the main sources of the migrant' savings from overseas are used productively in the home country.

Of course, the impact of remittances is not confined to the labour market. The positive impact on consumption in the source country may increase the dependency and also have a negative impact on the income inequality in the home country. Furthermore, if the majority of the money that is sent back is spent on goods and services, then remittances could cause inflation which could led to excessive wage claims. Then, as pointed out in Rapoport and Docquier (2004), the effect of remittances on GDP depends on the assumption made in terms of capital mobility and exchange rate regime. In particular, if we assume perfect capital mobility and completely flexible exchange rate, then remittances will have an impact only on the exchange rate (appreciation), while in the case of a pure fixed exchange rate regime there can be an impact on GDP. International trade theory pointed out a possible negative impact of remittances for developing countries. This international transfer can generate appreciation of the currency and deteriorate the terms of trade of developing countries. McCormick and Wahba (2000) present a theoretical framework on the impact of remittances on the relative price of non-traded goods (real exchange rate and 'Dutch desease' syndrome). International transfers in the form of remittances can also have an impact on the growth rate of developing countries. A detailed discussion on this point can be found in Rapoport and Docquier (2004).

Finally, this issue can also be related to the literature that explores the role of foreign aid as an instrument for financing investment[7]. The theoretical literature and

[7]Foreign aid and remittances are both redistributive mechanisms which try to decrease the drastic income inequality between rich and poor world. Foreign aid can be defined as international transfers through loans, grants, goods, etc, either directly from one country to another or indirectly through a multilateral assistance agency like the World Bank. Compared to foreign aid, remittances are a redistributive force that places money directly in the hands of households. They are individual transfers which do not require Government contracts. Our framework can be useful to understand the impact of foreign aid on labour markets. This can be certainly the case in economies where the Government distributes international money to unemployed (increase in search income) and to credit constrained firms (increase in capital and investment).

the empirical evidence show as that the links between aid and investments are quite complex. On the one hand, foreign aid finances investment in public infrastructure which can have a positive effect on private investments (Chatterjee and Turnovsky, 2002). On the other hand, aid can have an adverse impact on domestic savings and investment (Cassen, 1986). Dollar and Easterly (1999), in a study on African countries on the links between aid, investment and growth, find that only 8 countries show a positive and significant relationship between aid and investment, while there is a negative and significant relationship in 12 countries.

To the best of our knowledge, the literature on matching theory has been silent until now on the role of migration opportunities on the labour market performance of the home country. In section 3.3 we build on Pissarides' basic model with capital. Pissarides (2000) assumes perfect capital markets and shows that the standard unemployment model is unaffected by the introduction of capital. Firms choose the optimal level of investment and the introduction of new savings in the economy does not have any effect on the output produced by each firm. The introduction of credit constraints generates new effects and creates a link between the literature on matching theory and the one that investigates the effects of remittances on labour exporting counties.

3.3 The Model: Remittances with Credit-Constrained Firms

3.3.1 The Basic Model with Capital Stock

Consider a worker living in a country characterized by unemployment owing to search frictions in the labour market. He has the option to migrate and earn a safe return abroad which we assume is given. We do not model the migration decision of individuals and we assume that a fixed proportion of individuals migrate and remit

back home[8]. These savings are used by the return migrant to increase his expected lifetime utility in his own country. Alternatively, we can think of a permanent migrant who remits his savings to the members of the family that decide to stay in the home country[9].

In a world with frictions it takes time to find a job. Trade is a decentralized economic activity and coordination failures together with imperfect information are essential elements of the trading process. The technology of meeting is summarized by a matching function which gives the number of matches in the economy as a function of inputs (i.e. the number of buyers and sellers). Matching functions reflect the fact that trading partners are not fully informed of each others' existence, because of horizontal heterogeneity in location, sectors of activity, type of skills, etc. Rationing arises in a world where individuals are imperfectly aware of their economic opportunities, from the stochastic nature of the matching process between partners.

The number of job meetings and matches is synthesized by the following matching function[10]: $m(u;v)$ where u is the unemployment rate and v the vacancy rate. This function is assumed increasing in both arguments and concave. For simplicity, we assume that the dimension of the market does not affect its performance, namely the function is homogeneous of degree one. Under this assumption, the probability of finding a match will be a function only of the ratio of unemployment to vacancies (i.e. the 'tightness' of the market), $\theta = \frac{v}{u}$. Given the arrival of contacts, the individual transitions from an unmatched to a matched states are $q = \frac{m(u,v)}{v} = q(\theta)$ for firms and $\theta q(\theta)$ for workers, with $q'(\theta) < 0$.

The model includes Bellman equations for the asset values of vacant and non-vacant firms, employed and unemployed workers. The firm opens a vacancy, sustains

[8]It is beyond the scope of this paper to model the migration decision. In fact, the evidence shows that part of the income earned abroad is repatriated in the home economy and that the decision to remit is driven by different motives. See Rapoport and Docquier (2004) for a detailed survey on the motives to remit.

[9]See the previous section for the definition of repatriated income earned abroad.

[10]The matching function is a technical device that captures the frictions of the economy. It is possible to derive it from particular specifications of the meeting process.

search costs c, and job creation takes place when the complementary partners meet and agree to a way to share the rents. Let F^m be the present-discounted value of expected profit from a job filled by a worker from a remittance recipient family. Similarly define F^{nm} as the asset value of a job filled by a worker from a 'non-migrant' family. Let V be the asset value for the vacant firm. Introducing capital into the model, we follow Pissarides (2000) and let k be the capital stock per efficiency unit of labour. Then, given the wage bargaining process specified below, the value function for each job type is given by:

$$rF^i = pf(k) - pk(r+\delta) - w^i + \lambda(V - F^i)\ ;\ i = m, nm \tag{3.1}$$

where $f(k)$ is the output produced by a firm, which uses k capital and a worker, w^m is the wage for a worker from a 'migrant family', w^{nm} is is the wage for a worker from a 'non-migrant family', λ is the exogenous destruction rate of jobs and p is a productivity parameter. The capital is lent at the market interest rate r, which is the discount rate used to calculate asset values, and it is subject to the depreciation rate δ.

When the vacancy is open but the job is not filled, the firm does not hire capital and its asset value in the steady-state, V, satisfies the following Bellman equation:

$$rV = -c + q(\theta)\left[\bar{F} - V\right] \tag{3.2}$$

where c represents the recruitment cost and $\bar{F}$ is the average value of a filled vacancy. The expected value of a filled job depends on the proportion of 'migrants' and 'non-migrants' in the population:

$$\bar{F} = \alpha F^m + (1-\alpha) F^{nm} \tag{3.3}$$

where α represents the proportion of 'migrants' in the economy. If the firm has free access to financial markets offering finance at the interest rate r, then the maximization of F w.r.t k gives the standard result:

$$f'(k) = r + \delta \tag{3.4}$$

Let $\bar{z}$ denote the domestic support for the unemployed and $\tilde{z}$ denote income from remittances. Then $z^m = (\bar{z} + \tilde{z})$ and $z^{nm} = \bar{z}$ are the unemployment incomes for the worker in a migrant and non-migrant family respectively. The remaining value functions which summarize unemployed and employed workers' asset values are then respectively

$$rU^i = z^i + \theta q(\theta)\left[E^i - U^i\right] \tag{3.5}$$

$$rE^i = w^i + \tilde{z}^i\left(1 - t^i\right) + \lambda\left[U^i - E^i\right] \tag{3.6}$$

for a worker in a family of type $i = m, nm$, where t^i is the taxation rate[11]. (3.5) says that the asset value of unemployed worker of type i depends on the unemployment income and the probability of finding a job, $\theta q(\theta)$. (3.6) says that the asset value of employed worker of type i depends on the employment income, remittances and the exogenous probability of losing a job, λ.

As in Ortega (2000), we assume that firms are not able to discriminate *ex ante* between an unemployed migrant and non-migrant since only information concerning

[11]Taxation is zero up to a threshold income and, for simplicity, we assume that unemployment income, non-recipient wages and recipient wages without remittances are below this threshold value. For this reason, only income exceeding $w + \tilde{z}$ will be taxed. In our case, only remittances of employed will be taxed at a rate $t > 0$. We believe that a progressive taxation system is a quite reasonable assumption and we can also assume that wages are taxed as well, but this will not affect our results. What is relevant for our result is that remittances of employed workers are taxed at a higher rate than remittances of unemployed and this is quite reasonable under two assumptions: progressive taxation system and formal (legal) remittances. We can also obtain the same result by assuming that unemployed receive more remittances than employed. This is quite realistic if we have in mind one of the main roles of remittances. In particular, if remittances represent a form of support for those left behind, they should increase when the income of stayers decreases. Finally, the results obtained in the model with risk-neutral individuals are also similar to the ones obtained in case of risk-averse workers and no taxation. We will present this extension in the appendix B.4. The role of taxation in our model is dual. First, it affects the outside option of unemployed. Second, it allows us to model the decrease of credit constraints without introducing financial intermediation. Compared to the analysis with risk-averse workers, it allows us to obtain a simple analytical solution for wages of recipients and non-recipients workers and for the search income and the investment effect.

the average characteristics of workers is available when the vacancy is opened.[12] This implies that firms will open the same vacancy for the non-recipient and recipient unemployed. In the home economy, households will bargain over two different wages and the wage for workers with migrants in the family will be higher than that of workers in non-migrant families since they have a higher 'threat point'.

In equilibrium all firms enter the market until the asset value from a vacant job, V, is zero. By manipulating the two Bellman equations for the firms and the zero profit assumptions, we can determine the *job creation curve* JC:

$$p[f(k) - (r+\delta)k] - w^i - \frac{(\lambda + r)pc}{q(\theta)} = 0\,;\;\; i = nm, m \tag{3.7}$$

Aggregating over $i = nm, m$, (3.7) applies to the average wage $w = \alpha w^m + (1-\alpha)w^{nm}$ as well. Since $q'(\theta) < 0$, the JC curve (3.7) is *downward sloping* in (w, θ) space as in figure D.7.

During the bargaining stage, the partners agree on a way to share the rents. Wages are determined as the solution to a Nash bargaining problem. Given that the firm surplus is equal to $F^i - V$ and the worker surplus is $E^i - U^i$, the wage is contracted by following the maximization problem:

$$w^i = \arg\max \left[E^i - U^i\right]^{\beta} \left[F^i - V^i\right]^{1-\beta}\;;\;\; i = nm, m \tag{3.8}$$

where $0 \leq \beta \leq 1$ is the bargaining power of workers. By solving the maximization problem, we obtain:

$$w^i = (1-\beta)\, s^i \left[\frac{r+\lambda}{r+\lambda+\beta\theta q(\theta)}\right] + \beta y \left[\frac{\theta q(\theta) + r + \lambda}{r+\lambda+\beta\theta q(\theta)}\right] \quad i = nm, m \tag{3.9}$$

where $s^m = \bar{z} + \tilde{z}t$, $s^{nm} = \bar{z}$ [13]. The pre-tax income of the remittance recipient,whilst searching is $\bar{z} + \tilde{z}$ and the pre-tax income whilst employed is $w + \tilde{z}$. We assume a progressive taxation system; taxation is zero up to a threshold income and we also assume that unemployment income with remittances and employment income without remittances are smaller than this threshold value. Given this taxation

[12] Alternatively, we can assume that firms cannot open different vacancies for recipients and non recipients.

[13] Please refer to appendix B.1 for the derivation.

regime, this implies that, when employed, the recipient sees his remittances taxed at a rate t . With these assumptions, the effect of the migration fund is simply to raise the search income of recipient to $s^m = \bar{z} + \tilde{z}t$.

Similarly, by using (3.3), we can obtain the wage of recipient (non-recipient) worker in function of the wage of non-recipient (recipient) worker. In particular, we have

$$w^{nm} = (1-\beta)\,\bar{z} + \beta y + \frac{\beta}{1-\alpha}\theta\left[c - \alpha q(\theta)\frac{y - w^m}{r+\lambda}\right] \tag{3.10}$$

and

$$w^m = (1-\beta)\,(\bar{z} + \tilde{z}t) + \beta y + \frac{\beta}{\alpha}\theta\left[c - (1-\alpha)\,q(\theta)\frac{y - w^{nm}}{r+\lambda}\right] \tag{3.11}$$

The terms in the square bracquets show the cost saving which firms make on average over having vacancy filled or having it unfilled. As clarified in Bridgen-Thomas (2003) in a matching model of low and high search costs individuals, the gain of the match syntesized in the wage equation takes into account the possibility that the firm can recruit a worker of different type. For example, in the wage equation of the recipient worker we need to substract the capitalized value of matching with a non recipient. Firms bear a positive search cost by keeping the job unfilled and they are not sure if the next candidate will be a worker of different type. For this reason they also accept a worker with a higher outside option. At the same time, the wage for the recipient is affected by the proportion of non recipients in the economy since this will increase the probability for the firm to meet a non recipient worker.

The average wage w in the source economy is then

$$w = (1-\beta)\,z + \beta p\,(f(k) - (r+\delta))k + \theta c) \tag{3.12}$$

where $z = \alpha\,(\bar{z} + \tilde{z}t) + (1-\alpha)\,\tilde{z}$. (3.12) is the average *wage curve* (WC) and it is *upward sloping* in (w, θ) space, as in figure D.7 [14]. From now on we look at the impact of remittances on job creation and unemployment. For this reason, as clarified before, we subsitute the average wage in the job creation relation.

[14] For a derivation refer to the appendix B.1.

Substituting the WC curve (3.12) into the JC curve (3.7) we arrive at

$$pc\left(\beta\theta + \frac{(r+\lambda)}{q(\theta)}\right) = (1-\beta)(y(k)-z) \tag{3.13}$$

where $y(k) = p[f(k) - (r+\delta)k]$ is the value of output net of capital costs. (3.13) gives the equilibrium value of θ given capital stock k.

To complete the matching model with capital, the evolution of unemployment is given by

$$\dot{u} = \lambda(1-u) - \theta q(\theta) u \tag{3.14}$$

In the steady state $\dot{u} = 0$ and we arrive at the *Beveridge Curve* (BC):

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{3.15}$$

Four equations (3.4), (3.12), (3.13) and (3.15) give steady-state values for k, w, θ and u. The wage rate for migrants and non-migrants is obtained from (3.9). The definition $\theta = \frac{v}{u}$ (the 'labour market tightness' parameter) gives the vacancy rate and completes the description of the steady-state equilibrium.

3.3.2 Credit Market Imperfections

Without some constraint on the ability to raise finance for investment, remittances can affect the unemployment income, but they would have no effect on the capital stock. Firms would choose the optimal level of capital stock (per efficiency unit of labour) at $k = k^*$ given by (3.4). However, as discussed in the introduction, the lack of formal channels to obtain credit that characterizes many developing and transitional countries can generate financial constraints for firms. We therefore assume that firms cannot raise sufficient finance to pay for their optimal choice of capital. With credit constraints $k < k^*$, remittances now play a dual role. First, they relax the constraints and enable the firm to get closer to its optimal capital stock. In figure D.7, this causes the WC to swivel in an anti-clockwise direction and the JC curve shifts out. The net effect is to *increase* $\theta = \frac{v}{u}$. In figure D.8, in (u, v) space, the JC curve swivels in an anti-clockwise direction causing v to rise and u

to fall. To see this 'investment effect' algebraically, we differentiate the equilibrium condition (3.13) with respect to k to obtain

$$\frac{d\theta}{dk} = \frac{(1-\beta)[f'(k)-(r+\delta)]}{pc(\beta-(r+\lambda)q(\theta)^{-2}q'(\theta))} > 0 \tag{3.16}$$

since $q'(\theta) < 0$ and $f'(k) > r+\delta$ when $k < k^*$.

The second effect of remittances is to raise the search income (z). The 'search income effect' moves in the opposite direction since:

$$\frac{d\theta}{dz} = \frac{-(1-\beta)}{pc(\beta-(r+\lambda)q(\theta)^{-2}q'(\theta))} < 0 \tag{3.17}$$

Thus in figure D.9 an increase in z determined by an increase in remittances rotates the WC curve in an anti-clockwise direction with the effect of increasing the wage and *decreasing* θ. In figure D.10. the JC curve in the unemployment-vacancy space swivels in a clockwise direction as the unemployment income increases. The effect is a reduction in vacancies and an increase in the unemployment rate.

Suppose that variables θ, k and z refer to a post-migration state with remittances and in the pre-migration state without remittances they take values $\bar{\theta}$, $\bar{k}$ and $\bar{z}$. Then from the equilibrium relation (3.13), $\bar{\theta} < \theta$ and the investment effect outweighs the search income effect causing the unemployment rate to fall, iff the following condition applies:

$$y(k) - y(\bar{k}) \equiv f(k) - f(\bar{k}) - (r+\delta)(k-\bar{k}) > z - \bar{z} = \alpha\tilde{z}t \tag{3.18}$$

(3.18) is then the necessary and sufficient condition for remittances from migration to cause the unemployment rate to fall. The left-hand-side of (3.18) is the investment effect from relaxing credit constraints and allowing the capital stock to rise above its constrained pre-migration level. The right-hand-side is the search income effect from providing the unemployed worker in migrant family with a higher outside option in the bargaining process.

The model is completed by relating the income of the average unemployed worker in the source country, z, to its earnings and the 'funding gap' $\left(k^* - \bar{k}\right)$ which is a measure of the degree to which the sending country is credit constrained. We now

have an average tax stream in the economy equal to $(1-u)\,\tilde{z}\alpha t$. A possible use of this tax stream is to provide transfers to firms in the form of tax deductions or subsidies so easing their credit constraints. Then in a steady state, per capita capital stock rises by $(1-u)\,\tilde{z}\alpha t/\delta = \bar{k}$, say[15] until such a point where $k = k^*$. The complete model with migration now consists of the job creation curve, the wage curve , the Beveridge curve and capital stock given by:

$$\begin{aligned} k &= \bar{k} + (1-u)\,\tilde{z}\alpha t/\delta = \bar{k} + \tilde{k}, \quad \text{if } \bar{k} + \tilde{k} \leq k^* \\ &= k^*, \qquad\qquad \text{if } \bar{k} + \tilde{k} \geq k^* \end{aligned} \tag{3.19}$$

The analysis above treats the pre-migration income for the unemployed, $(\bar{z})$, as independent of the wage rate. However, one might expect $\bar{z}$ to depend on the wage rate through, for example, some indexed unemployment support. If we assume a proportional relationship then we rewrite the income of the unemployed as domestic support plus remittances; i.e., $z = \rho w + \tilde{z}$ with $\rho w + \tilde{z} < w$ and the replacement ratio $(0 < \rho < 1)$. Then, if we take into account the proportion of migrants and the taxation rate, the intersection of the WC and JC curves becomes:

$$pc\left(\beta\theta + \frac{(r+\lambda)[1-\rho(1-\beta)]}{q(\theta)}\right) = (1-\beta)[(1-\rho)y(k) - z] \tag{3.20}$$

with (3.18) now becoming:

$$(1-\rho)[y(k) - y(\bar{k})] > \tilde{z}t\alpha \tag{3.21}$$

The left-hand-side of (3.21) rises as the credit constraint becomes more severe $(k - \bar{k}$ increases) and/or the replacement ratio, ρ, decreases. The right-hand side rises as the proportion of migrants and/or the tax rate, t, increases. We can now summarise our results as a proposition:

Proposition

Remittances have two opposite effects on the unemployment rate: First,

[15] Using $\dot{k} = -\delta k + i$ where i is investment.

they increase the search income and the unemployment rate rises. Second, they relax the credit constraint facing firms, raising the capital stock towards its optimal level and reducing the unemployment rate. When remittance income is sufficiently high, the optimal capital stock is reached and any further increase only has the first search income effect. The condition for the investment effect to dominate is given by (3.21), assuming domestic unemployment income is indexed to the wage, and this is more likely to hold if the credit constraint is severe and/or domestic unemployment support is low.

Figures D.1 to D.6 illustrate this proposition and the workings of our model. In these simulations we assume the second formulation above, $z = \rho w + \alpha t \tilde{z}$, where tax receipts from remittances to the employed are set equal to $\xi \rho w$ and we allow the parameter ξ to increase from zero (no remittances as in the pre-migration state). We assumed the credit ceiling to be $\bar{k} = \eta k^*$, where $\eta \in (0, 1)$. Thus a low η signifies a severe credit constraint, whilst η close to unity is a modest credit constraint. Details of the functional forms employed, the calibration and the parameter values are given in Appendix B.

Figures D.1, D.2 and D.3 give results for a very severe credit constraint, $\eta = 0.1$. Figure D.1 shows the 'capital shortfall', $k^* - k$, falling as ξ increases. For $\xi \leq 1$, remittances are never sufficient to ease the credit constraint entirely. Figure D.2 shows the left-hand-side and right-hand-side of (3.21) as ξ increases. According to the proposition, the unemployment rate with remittances lies below that without remittances if $\xi < 0.75$. Figure D.3 plots the labour market tightness parameter $\theta = \frac{v}{u}$ and the unemployment rate u, both as proportions. Thus unemployment falls until approximately $\xi = 0.3$, the point at which the difference between the left-hand-side and the right-hand-side of (3.21) is maximized. The unemployment rate then falls until around $\xi = 0.75$ when condition (3.21) is no longer satisfied. Beyond $\xi = 0.75$, migration with remittances causes unemployment to increase

above its pre-migration level. Figures D.4 to D.6 give comparable results for a more moderate credit constraint, ($\eta = 0.5$). Figure D.4 shows the 'credit shortfall', falling as ξ increases until at around $\xi = 0.7$ and remittances are sufficient to eliminate the credit constraint. From figure D.5 we see that (3.21) is never satisfied and from figure D.6, migration with remittances causes unemployment to rise monotonically from its pre-migration level.

3.4 Empirical Analysis

3.4.1 Data

In order to test the theoretical model of the effect of remittances on the unemployment rate of the home country, aggregate data have been collected for those countries where remittances constitute an important part of the economy. More specifically, countries were selected if remittances were at least 1 per cent of GDP during the sample period, which begins in 1976 and finishes in 2003. Inclusion within the sample also required an adequate number of observations on unemployment and the other covariates to be included in the econometric models. As a result of these restrictions we are left with 19 countries. However, given the lack of complete data on remittances, unemployment and the other explanatory variables for some countries, we have an unbalanced panel[16].

Before estimating econometric models of unemployment, it is useful to observe the importance of remittances to the countries contained in the dataset and the extent to which these countries have suffered from unemployment. Table D.2 therefore reports some descriptive statistics on remittances and unemployment for the countries in the sample. Remittances are most important to Egypt, the Dominican Republic, Morocco, Portugal, Sri Lanka and Honduras, where they were equivalent to more than 6 per cent of GDP over the sample period. However, there has been a general increase in the importance of remittances to developing countries over time.

[16]Further details of the dataset can be found in the data appendix.

This is illustrated by the average level of remittances as a percentage of GDP rising to 4.72 per cent since 2000, compared to an average of 3.78 per cent over the whole sample period. Unemployment also varies across the countries in the sample, with Jamaica experiencing average unemployment rates in excess of 25 per cent between 1976 and 1985 and average rates of at least 15 per cent in Barbados, the Dominican Republic and Morocco. In contrast, the average unemployment rate was 5per cent or less in Mexico and Pakistan[17].

Given that one of the predictions from the theoretical analysis was that remittances should increase investment levels in credit constrained economies, econometric models which investigate the impact that remittances have on investment are also estimated. Therefore, Table D.2 reports the average level of investment for the countries in the sample, together with the average levels of remittances given that the sample period differs for some countries from the unemployment models as a result of data availability[18]. Gross Capital Formation as a percentage of GDP is found to range from an average of 16 per cent in Barbados to almost 30 per cent in Nicaragua, although most countries are clustered between 21 and 25 per cent.

3.4.2 Econometric Model

Because of the opposing effects that remittances are expected to have on the source country's labour market, as shown in previous sections, and the need to control for other influences on unemployment, it is necessary to test this relationship by estimating an econometric model.

[17]Underemployment is also a major issue in many developing countries because their labour markets tend not to be efficient and they usually have large informal sectors. For an analysis of underemployment in Trinidad and Tobago see Gorg and Strobl (2003). However, the underemployment rates they present for the four countries in our sample that feature in their international comparison in Table D.2 (Ecuador, Mexico, Paraguay and Turkey) suggest that the problem is relatively small in these countries.

[18]The investment variable used here is Gross Capital Formation as a percentage of GDP, which is very similar to the Gross Domestic Investment variable created by Easterly and Sewadeh (2001) since the correlation coefficient between these two measures is in excess of 0.95.

Ideally, we would like to look at the effect of remittances on job creation and the searching time for individuals. Given data limitations [19], we test the theoretical model in a less direct way. The analysis consists of two steps. Firstly, we look at the impact of remittance on the unemployment rate. Secondly, we concentrate on the impact of remittances on investment. The model predicts ambiguous results in terms of unemployment due to the presence of the search income and investment effects. At the same time, it clearly predicts a positive impact of overseas remittances on investment. The impact should be stronger in economies where credit constraints are particularly binding [20]. We think, the following exercise suggests new variables which can affect the unemployment and the investment rates in developing countries.

The following equation represents the general form of the model to be estimated:

$$u_{it} = x_{it}^{'}\beta + \delta r_{it} + \varepsilon_{it} \quad i = 1, 2..n; \quad t = 1, 2...T$$

where u_{it} denotes the unemployment rate in country i in period t and r_{it} the amount that country i receives in remittances (as a proportion of GDP) in period t. x_{it} is a vector of regressors that represents other factors that are expected to influence the unemployment rate. The parameters and will initially be estimated using fixed effects models. However, because of the potential endogenous nature of the explanatory variables, Generalised Method of Moment (GMM) Models will also be estimated.

Data limitations severely constrain the explanatory variables that can be included in the econometric models. For example, few if any of the countries have information on the types of institutions (e.g. union density, centralisation of wage

[19] Similarly, Bartelsman et al. 2005 highlight the difficulty of having comparable firm-level data on job creation and job destruction.

[20] Nevertheless, we decide to remove results for the highly constrained variable, which was present in a previous version of this paper, since the World Business Environmental Survey (WBES), from which we took the dummy variable for highly constrained countries, was not undertaken in all of the countries in our sample and this reduced the number of degree of freedom of our previous specification.

bargaining, tax wedges, employment protection, duration of benefits and replacement rates) that have been examined by recent studies of OECD unemployment (Blanchard and Wolfers, 2000; Nickell and Nunziata, 2002). Given these restrictions and the fact that countries in the sample are less developed than those in the OECD, more dated studies of OECD unemployment, which focus more on demand and supply factors i.e. the influence of economic shocks, as well as studies that analyse unemployment in individual developing countries have been used to inform which explanatory variables to include.

Bruno (1986) estimates a reduced form equation for unemployment, which is expressed as a function of the real wage gap and aggregate demand factors, namely the real money stock and the government fiscal deficit. Contractionary monetary or fiscal policies, to reduce inflation, will shift the aggregate demand curve inwards. For example, Bruno (1986) argues that a restrictive monetary policy, such as those followed by several OECD governments in the early 1980s, should cause unemployment to rise. He includes two lags for each of the explanatory variables and estimates a pooled model in first differences for 8 countries for the period 1962-1982. He finds that the lagged first difference of the real money supply has a negative and significant effect on unemployment but the difference lagged two periods is not significant (although it is positive). The lagged differences for real wages have a positive and significant influence on unemployment, whereas increases in the government deficit cause unemployment to fall.

McCullum (1986) also includes aggregate demand factors in his model of unemployment in 14 OECD countries between 1980 and 1984. The variables he uses are the percentage change in the narrowly defined money supply deflated by the GNP deflator minus the trend growth in the real money supply in the preceding period and the cyclically adjusted government budget balance as a percentage of GNP. He finds that the fiscal and monetary multipliers have their expected effects and estimates that a 1 per cent increase in real money supply causes a 0.18 per cent increase in output a year later. Nickell et al. (2005) also include money supply shocks in

their model of unemployment in 20 OECD countries between 1961 and 1995.

Marquez and Pages (1997) estimate the effect of trade liberalisation on unemployment using a panel of 18 Latin American and Caribbean countries which have at least 15 observations with complete information. Trade liberalisation is captured by four variables: openness, tariffs, the black market premium and a trade reform index. Of these, they only find that the trade reform policies exert a significant influence and its effect is to increase unemployment but they also suggest that movements in and out of employment dominate the unemployment effects of the reduction in protection. McCallum (1986) also multiplies each of the explanatory variables in his model by the ratio of imports of goods and services to GNP for each country minus the mean value for all countries to indicate how much the estimated parameters are influenced by openness.

3.4.3 Results for Unemployment

Table D.3 presents estimates of the determinants of unemployment in developing countries. Two specifications of each model are estimated. The first specification captures the influence of openness, monetary and fiscal polices, as well as remittances and lagged unemployment, the latter is included in each of the models estimated by Nickell et al. (2005) [21]. A second specification includes more dynamics, in particular it adds the lagged values of the other explanatory variables.

However, given that it could be argued that the lagged dependent variable and the other explanatory variables are endogenous, implying that the fixed effects estimates may be inconsistent, GMM models of unemployment are also estimated for each of the specifications. These models are estimated in first-differences and in the absence of second-order serial correlation in the residuals, values of the en-

[21] Ideally we would also like to include some measure of wages, as Bruno (1986) does. However, wage data are not readily available for many developing economies, which means that it is not possible to control for wages. A Regression Error Specification Test (RESET) on this specification using a pooled model produced a F-statistic of 0.14, with an associated p-value of 0.87, which implies the null hypothesis that the model is correctly specified could not be rejected.

dogenous variables lagged two or more periods are valid instruments (Arellano and Bond, 1991). Thus the set of instruments consists of the second and third lag of all explanatory variables.

The coefficients attached to the remittances variables are negative and insignificant in both of the specifications. When the lag of remittances is included, the coefficient attached to the level of remittances is reduced but the coefficient on the lag becomes positive in the GMM model, although it remains insignificant. The coefficient attached to the lagged unemployment term is positive and also highly significant, even after it has been instrumented. These coefficient attached to the lagged dependent variable is in excess of 0.7 in the fixed effects models, which is of similar magnitude to the Generalised Least Squares estimates obtained by Nickell et al. (2005) for OECD countries. In the each of the specifications, the coefficient attached to the money supply variable is positive, which is contrary to expectations and to the findings of Bruno (1986), but it is not significantly different from zero. The coefficients on the other explanatory variables also tend not to reach the commonly used levels of significance, although more open economies display a significantly lower unemployment rate in the first specification using the fixed effects estimator.

3.4.4 Results for Investment

To further examine the effect that remittances have on relaxing credit constraints, Table D.4 reports panel data estimates for the determinants of Gross Capital Formation as a percentage of GDP. Knack and Keefer (1997) use a similar dependent variable to examine the effect that social capital has on economic performance in 29 countries. Three specifications are estimated, the first of which includes remittances and the other control variables, the real interest rate and aid, in levels. The former variable is included as it broadly represents the real costs of new borrowing to a firm. In the second specification, the lagged dependent variable is added. The lagged values of the other explanatory variables are then added to the final

specification.

In specification 1, the effect of the current level of remittances on investment is particularly strong, which appears to provide strong support for the hypothesis that remittances ease credit constraints in developing countries. However, adding the lagged dependent variable, which exerts a powerful influence reduces the impact of remittances suggesting some correlation between these variables, although remittances still have a significant influence at around the 1 per cent level. The fit of the model also increases quite considerably after the lagged dependent variable is added[22]. Estimating the model by GMM rather than by fixed effects further reduces the impact of remittances and the coefficient attached to this variable becomes insignificant. Adding the dynamic effects produces a positive and significant coefficient on the level of remittances but a negative impact for the lag of remittances, which is also significant at the 5 per cent level in the GMM model. Higher interest rates reduce investment levels but this effect is not significant. Similarly, there is no clear relationship between aid and investment.

3.5 Conclusions

Given that the remittances that accrue from international migration are becoming an ever increasing and important aspect of the global economy, it is important to examine the impact of such flows. In this paper, the focus has been placed on the effect that remittances have on the source economy, in particular what impact they have on unemployment. It is argued that remittances can have two opposing effects on unemployment in the labour exporting country. Firstly, unemployment could be raised if remittances are seen by their recipients as providing some sort of welfare payment. Secondly, remittances could reduce credit constraints in developing economies and hence encourage firms to increase their investment levels. The over-

[22]A RESET on this specification using a pooled model produced a F-statistic of 0.73, with an associated p-value of 0.48, which implies the null hypothesis that the model is correctly specified could not be rejected.

all effect on unemployment will depend on which of these effects dominates. The relationship between remittances and unemployment was tested using data from a panel of developing economies. It was found that remittances have negative but insignificant effect on unemployment, thus suggesting that the investment and search income effects of remittances have partially offsetting influences. The effect of remittances on investment was also tested econometrically and the results indicate that there is a stronger relationship between investment and remittances. In particular, an increase in remittances causes a positive and significant rise in a country's investment levels in the fixed effects models, although the effect is not as strong after controlling for endogeneity [23].

The analysis in this paper has been conducted at an aggregate level, both in terms of the theory and empirics. This has a number of advantages such as providing an overall perspective on the effects of remittances. However, to gain a better understanding of the links between remittances, the decision to work and investment, it is necessary to examine these relationships at a more disaggregated level. For example, performing the theoretical analysis at the household level and examining microdata would provide further insights into these important issues, which could be used to inform on the likely impact of particular development policies.

[23] Overall, we find that our evidence is, in part, consistent with the theoretical predictions of our model. In particular, we find that the effects of remittances on unemployment is insignificant confirming the ambiguity due to the net effect on the unemployment rate of job creation and longer searching periods for unemployed. The results for the impact of remittances on investment suggests that the endogeneity problem is an important issue that affects most of the empirical work on remittances and migration.

Chapter 4

High Skilled Migration, Remittances and Labour Market

4.1 Introduction

It is a common view that the Enlargement of the European Union will affect the location decision of individuals. The prospect of increased labour mobility across the EU has led to a renewed interest in the welfare effects of migration. In general, it is possible to argue that migration, and the related welfare considerations, have more than one face. First, the flow of people from poor to prosperous areas affects the utility of natives. Second, it increases the economic opportunities for migrants. Third, geographical labour mobility has an impact on those people who stay. Once we recognize that migration has an impact on the economic conditions of natives, migrants and stayers, it is important to understand the determinants of the phenomenon itself. Individuals move and look for better opportunities. This is the main motivation for mobility. At the same time, emigrant workers care of those left behind. Remittances are an important part of GNP in many less developed countries and its importance is also recognized for the case of transitional economies. Altruism is at the heart of remittance behaviour and, as emphasized in Rapoport and Docquier (2004), *"remittances impinge on households' decision*

in terms of labour supply, investment, education, migration, occupational choice, fertility, ..with potentially important aggregate effects".

The aim of this paper is to explore the effects of migration opportunities and remittances in a small less developed economy, where migration choice is endogenous and migrants have an altruistic inclination to remit. As unemployment in less developed economies is often described by a 2-digit number, we model migration and remittances in a model with imperfections in the labour market. We propose a theoretical framework to assess the welfare effects of the remaining residents by linking together unemployment in the source economy, migration of heterogeneous workers and remittances. The model offers insights of the determinants and effects of free movements on the development of the home economy. In this work, we focus on the effects of migration opportunities on the employment condition of the small, less developed economy and we show that migration of high skilled have ambiguous effects on the development of the home economy.

In general, the reasons for workers mobility can be synthesized into pull and push factors that promote and limit the choice of individuals to locate in a more developed region. We concentrate on the economic aspect of the phenomenon: people look for better earnings prospects. The equilibrium is reached when benefits equal costs of migration.

The basic idea of this work is that migration is a family decision and repatriated savings can have an important role in the development process of the source country. Firms in developing and transition countries are likely to identify financing as a serious constraint for their business (Batra et al. 2002). Indeed, the productive use of the transfers between migrants and stayers can have a role in contrasting imperfections in capital and labour markets of the less developed economy (Drinkwater et al., 2003). As clarified in Chami et al. (2003) *"It is highly desirable to link the causes of remittances to particular effects..".* In fact, the analysis of the effects of remittances on the development of the source country requires a clear understanding of the location decision of households. We build upon Drinkwater et al. (2003)

(chapter 3 of this thesis) by making international migration endogenous and once abroad we assume that altruism is the main cause of remittances behaviour.

This chapter is organised in the following way. Section 4.2 compares the present work with related previous literature. Section 4.3 outlines the model, and section 4.4 synthesizes the main results of the work.

4.2 Related Literature

A fragmented literature documents the determinants of migration flows. The seminal work by Harris-Todaro (1970), and related studies, treats migration (rural-urban migration in the specific case) as an economic cost/benefit analysis. Individuals migrate until the expected incomes are equalized. Migration is understood as an incentive to equalize the unequal spatial distribution in earnings. The potential migrant faces incentives to leave the family behind and look for more profitable opportunities abroad. In common with the standard neoclassical view, migration is conceived as an individual cost/benefit analysis and remittances do not play any relevant role. Similarly, the New Economics of Labour Migration (Bloom and Stark, 1985) explains labour mobility in terms of a cost/benefit analyisis, this time at the household level. Within this approach, the migration decision is taken *for the interest of the family* and the utility of the family, together with repatriated savings, are at the centre of the migration process. Migration thereby acquires new dimensions; it can be seen as a way to overcome imperfections in the capital and labour markets of the home economy, but also as a possible disincentive for labour participation.

An emerging literature on migration choice explains geographical mobility of the workforce taking into account migrants networks and herd effects (i.e. Gang et al., 2002)[1] while Chen et al. (2003) proposes a new dimension to the theory of migration. Motivated by the recent dependent-oriented migration flows from Hong Kong and Taiwan, the authors develop a general model of migration under

[1]These extra effects are not part of the model presented in the following section. However, the possibility to include them would enrich the analysis.

uncertainty. Compared to the New Economics of Labour Migration, their theoretical framework provides a coherent explanation of both breadwinner-oriented migration and dependent-oriented migration. The final decision is a function of expected incomes, country risks and market correlations.

Although interesting, these new developments in migration theory are not part of this model. In fact, we keep the main structure of the migration process given by the New Economics of Labour Migration and we model migration as a way to improve the economic conditions of the family [2].

Remittances and migration are often treated in an unified way, but sometimes this is not the case. Migrants have different reasons to remit. Durand et al. (1996) show that remittance behaviour is in part explained by unobserved (i.e cultural) characteristics. Keeping this in mind, we borrow the family decision approach and assume that, when abroad, individuals repatriate a given amount of savings which is often determined by the social and the cultural characteristics of the migrants [3].

As clarified in Chami et al. (2003), it is important to show how remittances (non market transfers) interact with market activity. The family members that stay in the home country participate in the local labour market and, although each recipient is a price taker, remittances have an effect on the final outcome. Then, the immigrant decision to migrate depends on the realization of wages and unemployment confirming the altruistic nature of the transfer.

This work strongly builds upon Drinkwater et al. (2003), namely chapter 3 of this thesis, and Ortega (2000). As in Ortega (2000), we model migration decision in a labour matching economy even if we limit the analysis to a static framework, but we focus on the effects of migration in the source economy [4] and we model migration as a family decision. We also study workers mobility in a richer framework which includes congestion costs on one side and remittances effect on the other. Drinkwater el al.

[2]Please refer to section 4.2.1 for a more detailed analysis of migration forces.

[3]Please refer to Rapoport and Docquier (2004) for a detailed analysis of the motivations to remit.

[4]Ortega (2000) looks at the impact of migration on the labour market of the host economy.

(2003), in a model with exogenous migration, investigates the effect of remittance on the labour market of the source economy. We extend the model by endogenizing individuals decision to migrate.

This work is also close to Epifani and Gancia (2002) where migration and unemployment are explained through a core-periphery model with frictions in the labour market. In common with this paper, we introduce imperfections in the job market in a model of migration but, we limit the analysis to a static, one sector, framework and we model migration as a family decision process. McCormick-Wahba (2000) also model a general equilibrium economy with endogenous migration. We can consider their model complementary to our work. They introduce remittances in a two-sectors economy with unemployment. The presence of a general equilibrium framework allows the authors to draw some conclusions in terms of the effect of migration on the exchange rate of the small country and of the way resources are allocated. On the other hand, we introduce frictions and credit constraints in the labour market and focus the attention on the effects of remittances to the unemployment rate of the labour exporting country.

Traditionally, labour economists have used the infinite-living agents version of the matching approach, within the search theory literature, to explore the effects of "frictions" on the labour market (Pissarides, 2000). Other lines of research address the analysis of labour market with frictions. We refer to a variety of models where the static approach to the matching theory has emerged. Under this assumption, the aggregated number of searchers is equal to the number of workers in the economy and the number of participants on both sides of the market directly affects the probability of matching for both firms and workers. Snower (1996) concentrates on the education decision of workers while firms may generate *bad* or *good* jobs. Monfort and Ottaviano (2002) extend Snower's analysis adding a spacial dimension to the education decision of workers, while Sato (2000) constructs a two-sector model to investigate the links between migration and optimal policies. We also model the presence of frictions in the home labour market, within a static matching framework.

Dealing with a static analysis help us to concentrate on the links between migration, remittances and unemployment in the labour exporting country.

4.2.1 Models with Endogenous Migration

In this section we would like to highlight various approaches used by the literature on migration to model the location decision of individuals and households. We refer to some of the papers mentioned above and then compare them with ours. In the literature on migration, there are various approaches that endogenize the location choice of individuals. Individuals migrate until the expected incomes at home and abroad are equalized. The standard theory of rural-urban migration (Harris-Todaro, 1970) and related studies, assume that city wages are set institutionally and for this reason above their competitive value. This imperfection creates unemployment, and urban unemployment rate acts as an equilibrating force on migration. In general, this series of studies which view migration as an investment, incorporate a basic mechanism which decreases wages abroad and/or improves economic perspectives at home when migration increases. McCormick and Wahba (2000) combine this approach within a general equilibrium framework characterized by two sectors and an exogenous proportion of skilled and unskilled workers. An increase in skilled migration has a positive impact on the probability, for highly skilled, of finding a formal job at home. This is the case since high skilled workers compete for a limited number of formal jobs and migration releases some job opportunities. At the same time, remittances have an impact on the price of non-traded goods (terms of trade).

In general we can distinguish two equivalent approaches that act as equilibrating forces in models with endogenous migration. It is possible to assume some kind of agents heterogeneity and/or assume the presence of congestion costs in the receiving economy. For example, Docquier and Rapaport (2004) present a stylized word populated by two-period lived individuals which compare their utility under two investment choices: education and migration. Migration is costly and only individuals with high ability have an interest in investing in migration (and education). This

basic idea can be extended in different ways. For example, the authors introduce liquidity constraints and uncertainty which modifies the costs and benefits of migration. The impact of this extensions is to affect the marginal ability, namely the proportion of individuals that migrate.

A different strand of the literature endogenizes migration within a search-matching framework. In Ortega (2000), workers migrate to a country with better structural characteristics in the labour market. In presence of those structural differences all the unemployed decide to move and exploit better employment opportunities abroad. In search matching models, migration does not normally have any impact on the labour market conditions of the home economy since the number of jobs created, and wages, are not affected.[5] At the same time, Ortega (2000) shows that the probability of finding a job abroad increases with migration because migrants create a boost in the labour demand abroad. Monfort and Ottaviano (2002) and Epifani and Gancia (2004) combine migration and frictions in the labour market within a core-periphery framework. Migration is not the result of structural and technological differences between regions, but derives from transportation costs and plant-level increasing returns (Fujita, Krugman and Venables, 1999). For example, Monfort and Ottaviano (2002) model labour market frictions where the search efficacy of workers and firms depends on their respective locations. On the one hand, agents are attracted to a particular region because of higher returns to training (higher probabibility to find a good job) and firms are attracted because the region offers higher probability to fill a vacancy. This creates two reinforcing local externalities (centripetal force).On the other hand, congestion costs due to competitive pressure reduces the expected returns from posting a vacancy so that migration, and agglomeration in this case, stops at some point. In Sato (2002), as in many studies on this area, migration occurs so as to equate the expected indirect utility between sectors. Wage disparity between rural and urban areas derive from frictions in the labour market and migration to the urban area is, in a certain sense, very similar

[5]This is due to the assumption of constant returns to scale in the matching technology.

to the one explained in the seminal work of Harris and Todaro (1970).

Our work follows the literature that endogenize migration in search-matching models characterized by frictions in the labour market. Frictions create unemployment in the home economy and the impact of migration and remittances on one side and congestion costs on the other act as equilibrating forces. We consider two different scenario. In a scenario where firms can invest at their optimal level, migration increases the utility of the migrant family, but this improvement is then compensated by increasing congestion costs in the foreign country. In the second scenario, firms are initially credit constrained and the remittances effect is ambiguous. From this ambiguity derives the possibility of multiple equilibria. In our framework, a decrease in the probability of finding a job makes migration more appealing. This is the case since households do not take into account the impact of their decision on aggregate variables for low skilled (i.e. probability of finding a job and wages at home). Compared to Ortega, we also assume that high skilled migration has no direct impact on the labour market for low skilled [6]. Contrary to Ortega (2000), we assume that migration affects the labour market for low skilled through the remittance effect with ambiguous impact on the expected utility of the family. Limits to migration derive from congestion costs in the receiving economy.

4.3 A Model with Migration and Imperfections in the Labour Market

4.3.1 Workers

We study the determinants and the effects of migration and remittances in a model with imperfections in the job market. The home labour market is composed by a heterogeneous labour force; low skilled workers face frictions in the labour market, while high skilled are able to find a job and earn a given wage, w_s. We assume that

[6] For simplicity, we do not model the labour market of high skilled and we assume that they can always find a job at home at a given wage

migrant workers find a job abroad and receive a wage proportional to their abilities. This is equivalent to assuming increasing congestion costs in the receiving economy $G(m)$ with $\frac{\partial G}{\partial m} \geq 0$. Alternatively, we can think that high ability workers have low migration costs (high ability to adapt to the foreign market). This implies that only individuals with high ability migrates and that m gives also the proportion of migrants which, by construction, corresponds to high skilled workers. The other important assumption which drives the result of the model is the composition of each household, which mirrors the composition of the economy. We assume that each atomistic family is made up of a low and a high skilled worker.

With these assumptions, the economy consists of a continuum of identical nuclear families, each composed by a potential migrant and by a stayer. We assume two stages. In a first stage, the migration choice takes place and in a second stage individuals enter the home or the foreign labour market. Let us assume that y is the income of the high skilled worker, while x is the expected income for the low skilled. Then, each household has an utility function of the form:

$$U^F = ey + (1 - e)\, x \tag{4.1}$$

where e and $1 - e$ are the weights for, respectively, the potential migrant (skilled) and the stayer (unskilled).

The utility of the family depends on the expected income of each member which is affected by the location decision. Assume the following; taxation is zero up to a threshold income, then the government taxes the income derived from remittances at a rate t. Since unemployment income with remittances is smaller than this threshold value, and also the wage of recipients and non recipients, then only remittances received during employment are taxed [7].

[7] As clarified in chapter 3 this is consistent with a progressive taxation system in which t is zero up to a threshold value and then become positive. What is relevant for our result is that employed are taxed at a higher rate than unemployed. In the appendix C.1 we present the case where taxes applied to the overall income.

As specified elsewhere, we also assume that only high skilled can have an incentive to migrate and if $[1-\theta q(\theta)]$ and $\theta q(\theta)$ are the probabilities, respectively, of being unemployed and of finding a job [8], the expected incomes for the two members of the family are:

y with migr. =	w_0−G(m) -τ
y without migr. =	w_s

x with migr. =	$\tau[1-\theta q(\theta)]+(w^m+\tau(1-t))\theta q(\theta)$
x without migr. =	$w^{nm}\theta q(\theta)$

The high skilled earns $w_0 - G(m)$ when abroad and pay remittances τ which are taxed by the Government at a rate t. When at home, high skilled earn the same wage w_s. Similarly, x is the income of the low skilled worker which is affected by the migration decision of the skilled member of the family[9]. When the partner migrates, the stayer receives remittances which reinforce his outside option in the wage bargaining process.

Each period a family in the small economy chooses whether to send a member abroad or not. The location decision is affected by the employment conditions in the two economies (i.e wage differentials and probability of finding a job), the relative cost of living and idiosyncratic characteristics, namely the ability to perform abroad. We assume, for simplicity, that individuals' abilities also determine the ability to work abroad such that the two distribution coincide[10]. Since we are interested in the effects of remittances on home labour market, we assume that, once at home, a high

[8]These two probabilities are endogenous and they will be defined in the following section.

[9]This assumption can be justified in two different ways. First, migration can be too costly for individuals with low ability. Second, we can look at this assumption as a way to study the policy implications of the introduction of quota, which limit unskilled migration.

[10]An individual with high ability can easily adjust to a different environment and will also perform better abroad.

skilled worker produces w_s which is equal for all high skilled while abroad they earn a net salary proportional to their abilities. This idea is equivalent to our framework characterized by migration costs lower for high ability workers. We believe that this is a quite reasonable assumption considering that it is often argued that, in LDCs , there is little reward for individuals endowed with high ability.

4.3.2 Firms: Production and Wages

In the labour market for low skilled workers there is a continuum of firms which enter the market until the expected return to open a vacancy is equal to zero. The technology requires one unit of labour and k units of capital to produce $f(k)$ units of good. Each firm bears a cost, c, to open a vacancy. This is the search cost of labour recruitment for a low skilled worker. When the vacancy is open, but the job is not filled, the firm does not hire capital. The number of job matches is synthesized by the following matching functions:

$$j = j(u; v)$$

where u and v are, respectively, the unemployment and the vacancy rate[11]. Given the number of low killed workers, the probability for a worker to find a job is $\theta q(\theta)$ and for a firm to find an unemployed is $q(\theta)$, with $\theta = \frac{v}{u}$ the tightness of the market.

Low skilled maximize their pay-offs under rational expectations and accept a job if the net wage is higher than the outside option.

Following Ortega (2000), we assume that only information concerning the average characteristics of workers is available when the vacancy is opened. This implies that firms open the same vacancy for the unemployed with and without remittances. Introducing the capital into the model, we follow Pissarides (2000) and let k be the capital stock per efficiency unit of labour.

Firms post vacancies and search for a worker. When searching, the firm bears a cost c for labour recruitment. When matched with a worker, a firm produces

[11]The matching function is assumed increasing in both arguments and concave. Following Pissarides (2000), we assume it is homogeneous of degree one (constant returns to scale).

$y = f(k)$ where k is the capital used per worker and pays $w_i = w^m$ for the recipient worker and $w_i = w^{nm}$ for the unemployed that does not receive remittances [12]. The capital is lent at the market interest rate r and it is subject to the depreciation rate δ. When the vacancy is open but the job is not filled, the firm does not hire capital. The expected profits for the firm are:

$$\pi = q(\theta)\left[f(k) - (r+\delta)k - w^e\right] - c \tag{4.2}$$

where w^e is the average wage in the economy.

The maximization of profits for the firm w.r.t. k gives the standard result:

$$f'(k) = r + \delta \tag{4.3}$$

Finally, $\tau^e = m\tau + (1-m)d$ is the expected unemployment income where τ is the exogenous level of remittances, d corresponds to the domestic support [13]and m is the proportion of migrants in the economy. Clearly, the expected unemployment income increases when migration, m, is higher.

In the skilled sector we assume the following technology: one high skilled worker earns $w_s \geqslant w_0$. For simplicity, we do not model frictions in the labour market for high skilled and, as specified in previous sections of this paper, we assume that all high skilled at home find a job and earn the same salary.

Credit Constraints

Without some constraint on the ability to raise finance for investment, remittances would affect the unemployment income, but they would have no effect on the capital stock. Firms would choose the optimal level of capital stock (per efficiency unit of labour) at $k = k^*$ given by (4.3).

If capital markets are perfect, variations in the amount of remittances positively affect the unemployment rate in the home country since they increase the option

[12]In this static framework there is no interest for the firm to wait another period to find a cheaper worker.

[13]We assume d=0 throughout.

value for unemployed. In a similar way, the increase in remittances determines higher wages.

We believe that lack of formal channels to obtain credit characterizes many developing and CEEC's countries. This can generate financial constraints on the production site. We therefore assume that, for reasons lying outside the model, firms in the developing countries cannot raise finance up to their optimal choice of capital. With credit constraints $k < k^*$, remittances now play a dual role. First, they relax the constraints and enable the firm in the traditional sector to get closer to its optimal capital stock. Second, they increase the unemployed income of those left behind. The mechanism which discriminate unproductive and productive usage of remittances is as the one specified in Drinkwater el al. (2003), but we apply it to a static matching with endogenous migration. Extra income to employed workers is taxed at a rate t and uniformly distributed by the state to firms with financial constraints. The average tax stream in the economy is equal to $(1-u)\,\tau mt$.

4.3.3 Equilibrium

Labour Market equilibrium for low skilled All firms enter the market until the expected value of opening a vacancy is zero, $\pi = 0$, and the *job creation curve* JC for our economy is:

$$q(\theta)\left[f(k) - (r+\delta)\,k - w^e\right] = c \tag{4.4}$$

where w^e is the expected wage in the economy.

During the bargaining stage, the wage is contracted by following the maximization problem:

$$w^i = \arg\max \left(w^i - \tau t^i\right)^{\beta} \left[f(k) - (r+\delta)\,k - w^i\right]^{1-\beta} \tag{4.5}$$

where $0 \leq \beta \leq 1$ is the bargaining power of workers and $t^i = 0$ for the worker that does not receive remittances. By solving the maximization problem, we obtain:

$$w^{nm} = \beta\left[f(k) - (r+\delta)\,k\right] \tag{4.6}$$

for the worker who does not receive remittances and

$$w^m = (1-\beta)\tau t + \beta\left(f(k) - (r+\delta)k\right) \tag{4.7}$$

for the recipient worker. Finally, the average wage in the economy is:

$$w^e = (1-\beta)\tau m t + \beta\left(f(k) - (r+\delta)k\right) \tag{4.8}$$

The *job creation curve* JC is completed by substituting the average *wage curve* WC in the job creation condition:

$$(1-\beta)(y - \tau m t) = \frac{c}{q(\theta)} \tag{4.9}$$

where y= $\left(f(k) - (r+\delta)k\right)$

Labour Market equilibrium for high skilled As far as the labour market equilibrium for high skilled is concerned, all high skilled in the home economy find a job at the wage w_s.

Migration Skilled workers with high ability may prefer to migrate and remit part of their income back home. The skilled worker migrates if the utility of the family under migration is greater than the utility of the family without migration:

$$U^{mF}(w_0 - \tau - G(m)) > U^{nmF}(w_s) \tag{4.10}$$

As a consequence, the propensity to migrate declines the higher the share of the population (high skilled) which already live abroad. In fact, the income differential tends to decrease as a consequence of migration. The migration equilibrium becomes:

$$(w_0 - \tau) + \frac{1-e}{e}\tau\left[\theta q(\theta)((1-\beta)t + (1-t)) + (1-\theta q(\theta))\right] - G(m) = w_s \tag{4.11}$$

From (4.11) we can already notice that a decrease in the probability of being employed increases the expected utility of migration. This is the case since households do not take into account the impact of their decision on the market activity in the home economy (employment probability and wage in our model), while an increase in unemployment will have a positive effect on the amount of remittances received. For this reason, since β and t are, both, less than one, the remittance effect, which operates through variations in the unemployment rate, is the main effect of our analysis. The way remittances are taxed is fundamental for our results, though our model is robust to different taxation systems. In particular, it is possible to show that what is important is that employment income (wage plus remittances) is taxed at a higher rate than unemployment income and we believe this is a quite reasonable assumption [14].

4.3.4 Summary of the Model

The model can be summarized by the following relations:

$$\mathrm{w}^{nm} = \beta \left[f\left(k\right) - \left(r + \delta\right) k \right]$$

$$\mathrm{w}^{m} = \left(1 - \beta\right) \tau t + \beta \left(f(k) - \left(r + \delta\right) \right) k)$$

$$\left(1 - \beta\right) \left(y - \tau m t\right) = \frac{c}{q(\theta)}$$

$$\mathrm{f}'\left(k\right) = r + \delta$$

$$\left(w_0 - \tau\right) + \frac{1-e}{e} \tau \left[\theta q\left(\theta\right) \left(\left(1 - \beta\right) t + \left(1 - t\right) \right) + \left(1 - \theta q\left(\theta\right)\right) \right] - G\left(m\right) = w_s$$

This gives us 5 equations in the unknown: θ, w^m , w^{nm}, k and m.

[14] An example of a different taxation structure is presented in the appendix C.1. Please refer also to chapter 3 for further details on the assumption of the taxation structure

4.3.5 Analysis of a Special Case

For simplicity, we follow Ortega (2000) in assuming a Cobb-Douglas matching function:

$$j = u^{\alpha} v^{1-\alpha}$$

Under this assumption, the probability for a worker to meet a vacancy will be $\theta q(\theta) = \theta^{1-\alpha}$ and the probability for a vacancy to meet an unemployed $q(\theta) = \theta^{-\alpha}$.

We can now express the *labour market tightness* in function of the number of migrants:

$$-c\theta^{\alpha} + (1-\beta)(y(k) - (r+\delta)k - \tau mt) = 0$$

The only solution of this equation is:

$$\theta^{*} = \left(\frac{(1-\beta)(y(k) - (r+\delta)k - \tau mt)}{c} \right)^{\frac{1}{\alpha}} \tag{4.12}$$

Following Drinkwater et al. (2003), if there are credit constraints in the source economy, remittances from migrants to their families have two opposing effects in the labour market. First they raise the income of the unemployed members back home. If we assume that wage income is taxed at a higher rate than income received by the unemployed, this will increase the outside option for the unemployed and according to standard matching models of unemployment this 'search income' effect causes the unemployment rate to rise. Second, they have an effect on investment in the source country. Remittances available for investments will relax the credit constraints and increase the level of capital stock. According to standard matching models of unemployment this causes the unemployment rate to decrease.

If there are no credit constraints in the economy, θ^{*} is a negative function of the proportion of migrants. Compared to Ortega (2000), who looks at the impact of migration on the receiving country, the impact on θ is of opposite sign.

The intuition is the following: an increase in high skilled migration is seen as an increase in unemployment income for stayers which has the standard effect of

increasing the outside option for low skilled unemployed. If there are credit constraints, the relation between θ and m is not obvious. On the one hand, migration increases the unemployment outside option (income) for stayers, on the other hand it release the credit constraints with positive effects on final output. Moreover, when $t = 0$ the outside option for the unemployment does not change and, both, the 'search income' and the 'investment' effects are zero [15].

The necessary and sufficient condition for the existence of at least one stable migration equilibrium is that:

$$\max\left\{w_0 - \tau + \frac{1-e}{e}\tau\theta q(\theta)\left((1-\beta)t + (1-t) - 1\right) + \frac{1-e}{e}\tau - G(m)\right\} > w_s \tag{4.13}$$

while there are multiple equilibria if credit constraints are particularly strong and, for $m = 0$, that is $G(m) = 0$

$$w_0 - \tau + \frac{1-e}{e}\tau(\theta q(\theta)\left((1-\beta)t + (1-t) - 1\right) + \frac{1-e}{e}\tau > w_s \tag{4.14}$$

In the absence of credit constraints, the expected income of the 'migrant' family is represented by the one-peaked curve in figure D.11. The stable market equilibrium is reached at a point where the marginal high skilled worker is indifferent between migrate and stay at home and when there is no incentive to migrate:

$$\left\{w_0 - \tau + \frac{1-e}{e}\tau\theta q(\theta)\left((1-\beta)t + (1-t) - 1\right) + \frac{1-e}{e}\tau - G(m^*)\right\} = w_s \tag{4.15}$$

An increase in the level of migration determines two effects. Firstly, the migration decision of the extra migrant affects the level of remittances in the economy. Secondly, it increases the costs of migration.

We can consider two different scenarios. In the first scenario firms are able to expand production at its optimal level, in the second scenario, instead, there are credit constraints and the level of production may not be optimal. In a framework without credit constraints, at low levels of migration, remittances determine an

[15] As highlight in the previous chapter, and elsewhere in this chapter, the model is robust to various modifications

increase in the utility of the migrant family since migration has a positive effect on unemployment income[16]. At a level of migration that maximized the utility of the migrant family, migration costs outweighs the remittance effect which produces a decrease in the utility of the migrant family. The stable equilibrium is given at the point where $U^{mF} = U^{nmF}$, namely when the extra family is indifferent between sending or not sending a member abroad. Moreover, for the equilibrium to be stable, there is no incentive to migrate. This can be expressed by the following condition: $\frac{\partial U^{mF}}{\partial m} \leq 0$. This is shown in figure D.11.

To sum up, if there are no credit constraints, the search income effect determines a decrease in the labour market tightness (increase in the unemployment rate)[17]. First, the remittances effect dominates and the positive effect on unemployment increases the unemployment income of the family. Then the congestion costs offset the remittances effect and the expected utility of the migrant family starts decreasing.

In the second scenario, firms face credit constraints and remittances for the employed, unskilled worker are taxed to finance the market imperfections. Now multiple equilibria can arise. When credit constraints are binding, the remittance effect and the congestion costs both decrease the utility of the migrant family[18]

In the presence of credit constraints two stable equilibria can arise. As shown in figure D.12, if credit constraints are particularly strong, the remittances effect will be negative (decrease in the unemployment income) and the expected utility of the family decreases. In a second stage, the search income effect dominates the investment effect and unemployment starts increasing. Now the remittance effect will be positive and the expected utility of the family increases. After a certain point, the congestion costs dominate the remittance effect and the expected utility

[16]The unemployment income derived from remittances is not taxed by the government.

[17]The remittances effect is positive since $0 < \beta < 1$ and $t < 1$

[18]This happens because the extra migrant decreases the unemployment income of the stayer households. The different way unemployment and employment income from remittances are taxed plays an important role in determining the mechanism of the model.

starts decreasing again. The two relations meet three times determining equilibria: m_1, m_2 and m_3. While we have not introduced the dynamic version of the model, the equilibrium m_2 is probably unstable. In fact, at a level of migration just above m_2 the utility of the migrant family increases and this creates an incentive for further migration. Following a similar reasoning, equilibria m_1 and m_3 are likely to be stable. The stable equilibria are at a point where the expected utility of the family with migration meets the utility of the non migrant family with a negative slope. The presence of multiple equilibria, when we assume credit constrains, is explained by the interactions between the search income, the investment effect and their impact on the remittance effect. When the latter dominates, the utility of the family is negatively affected by migration since the expected unemployment income decreases.

In a framework with credit constrains it is difficult to draw conclusions in terms of welfare. In fact, the implications for a welfare analysis are not directly measurable and equilibria cannot be clearly ranked according to Pareto's optimality criterion. Credit constrains, wages and unemployment rate move in different directions and the magnitude of the effects of these movements depends on the specific values of the parameters. On the one hand, equilibrium m_1 is characterized by credit constrains which have been completely released in equilibrium m_3. On the other hand, the performance of the labour market in the two equilibria is not clear. Equilibrium m_3 is characterized by a higher average wage due to, both, the release of credit constrains and the increase in unemployment income. By moving from m_1 to m_3 , the employment rate , as a consequence, can increase or decrease.

4.4 Conclusions

Given the important role of remittances in transition and developing countries, it is important to analyse international migration and the impact of migration transfers in the source country. We discuss a joint analysis of the family migration decision and use of remittances in a scenario with and without credit constrains and we show that,

under certain conditions, credit constrains lead to the existence of a multiplicity of equilibria. The most important implications of the multiplicity of equilibria is that if, for a shock, the economy moves from equilibrium m_1 characterized by a low level of migration, then, once the shock disappears, the economy may not return to the original equilibrium. In this chapter we also show how the migration of high skilled worker, (i.e. brain drain in the literature) can actually release credit constrains and increase the productivity of the home economy.

Chapter 5

Concluding Remarks

Labour mobility can have important effects on many economic variables. This is particularly true in a world characterized by frictions in the trading process. Individuals move between different sectors and various geographical areas. These movements have a substantial impact on many macroeconomic variables. The acknowledgement of these effects has been the main motivation of this work.

We also think it is desirable to link the effects of labour mobility to its main determinants. We have shown two examples in which we described the decision of individuals to move and look for better opportunities. The analysis then concentrates on the effects of mobility. In other words, the economic problems we have studied include a pre-matching stage in which individuals take decisions concerning their mobility in economic environments characterised by training costs and credit constraints.

We believe the findings in this thesis support the idea that labour mobility can have an impact on the process of development of a country. They can also offer some points of discussion to various issues in developed countries. We are aware that the models presented in this thesis are based on some strong assumptions. In particular, the assumption on the taxation structure drives most of our results in chapters 3 and 4. Nevertheless, we think this assumption offers a useful simplification to obtain interesting analytical results. We then show how we can obtain similar results

by making different assumptions. Similarly, we find that the adoption of search matching models gives us a useful framework to deal with the issues of interest. At the same time, it can limit the analysis of other important phenomena. Finally, we would like to spend few lines on the empirical approach adopted in chapter 3. We first show a numerical example of our theoretical model, by assigning different values to our parameters. Then we try to offer empirical evidence which can support our theoretical findings. Unfortunately, given to data limitations, we test a model in a less direct way. At the same time, the empirical analysis suggests new variables which affect the unemployment and the investment rate in developing countries. In particular, we look at the net impact of remittances.

In chapter 2 we have examined the choice of individuals to move to a more rewarding, but "risky", sector or give it up and choose a lower, but safer, return. This can offer an explanation of the difference in size between formal and informal sectors in OECD and in developing countries. The economic environment can affect this decision in different ways. First, technology and institutions have an impact on the barriers between traditional and modern sectors. Second, the propensity of people to participate in a market activity in the modern sector is affected by familiar and sociological factors which are assumed as given in our model. It would be interesting to allow for endogenous job destruction as in Garibaldi and Wasmer (2001). Alternatively, it would be interesting to extend the setting of the model in a geographical framework and introduce spatial aspects in the analysis. For example, as suggested in the analysis of Gaspar and Glaeser (1998), we can assume that individuals can start individual and joint projects in the city or in the hinterland. Of course, cities will have a comparative advantage for the joint projects, given the lower cost of face-to-face communication. This extension should be able to offer useful insights in terms of inequality between sectors and also in terms of income dispersion between city and rural area.

The analysis on the effects of remittances contained in chapters 3 and 4 could be extended in several directions. It is shown to what extent migration and remittances

affect the labour market conditions in the sending economy. The results on the unemployment rate are ambiguous, given the interaction between search income and investment effects. However, the results on wages are always positive.

In chapter 3 we looked at the effects of remittances in a dynamic labour matching model with exogenous migration. We then gave some evidence at the aggregated level to support our analysis. This work can be extended by examining the relationship between remittances, unemployment and investment at a more disaggregated level. From a theoretical point of view it would be interesting to introduce a pre-stage in which remittance choice is endogenously determined. The extension with endogenous migration was introduced in chapter 4.

Chapter 4 shows the effects of remittances in a model with endogenous migration. We are aware that the model can be extended in many ways. In particular, the analysis in this chapter has been conducted by assuming a static matching. An obvious extension would be the introduction of dynamic matching to gain further insights into the links between remittances and unemployment (e.g. duration of unemployment). We can also introduce two sectors. For example, as in McCormick and Wahba (2001), we can introduce a traditional sector that produces non exportable goods and a modern exporting sector. The extension to a general equilibrium framework will allow us to obtain interesting results with respect to the terms of trade between the small developing country and the rest of the world. We would like to produce analytical results. However, we would rely on numerical results when an analytical solution is not possible. In appendix C.2, we present a sketch for a possible extension of the research in chapters 3 and 4. We endogenize human capital investment and look at the link between remittances on one side and externalities between human and physical capital investments on the other.

While we cannot do justice to all the implications of labour mobility, we think we have produced some interesting examples on how labour mobility can have an impact on the macroeconomy of developing and developed countries. If governments can regulate the mobility in a way that acknowledges the impact on income disper-

sion, productivity and employment rate, they can offer a long term solution to the development process of many countries. We do not expect to have an answer to this question, but we hope that this work has at least conveyed useful insights to the debate on labour mobility and some interesting points of discussion.

Appendix A

Derivations for Chapter 2

A.1 Wage bargaining

$$\beta \ln \left[V_{M_T}(\varepsilon) - V_{U_T}\right] + (1-\beta) \ln \left[V_{M_E}(\varepsilon) - V_{U_E}\right] \tag{A.1}$$

$$f.o.c. \quad \frac{\beta}{V_{M_T}(\varepsilon) - V_{U_T}} V'_{M_T}(\varepsilon) + \frac{1-\beta}{V_{M_E}(\varepsilon) - V_{U_E}} V'_{M_E}(\varepsilon) = 0 \tag{A.2}$$

with $V_{U_E} = 0$ in equilibrium.

We can then write:

$$(1-\beta)\left[V_{M_T}(\varepsilon) - V_{U_T}\right] = \beta \left[V_{M_E}(\varepsilon) - V_{U_E}\right]$$

Then, from

$$V_{M_T}(\varepsilon) - V_{U_T} = \frac{p(\varepsilon) - r V_{U_T}}{r+s} \tag{A.3}$$

and from

$$V_{M_E}(\varepsilon) - V_{U_E} = \frac{y(\varepsilon) - p(\varepsilon) - r V_{U_E}}{r+s} \tag{A.4}$$

we can write:

$$p(\varepsilon) - r V_{U_T} = \beta \left[y(\varepsilon) - p(\varepsilon) - r V_{U_E} + p(\varepsilon) - r V_{U_T}\right] \tag{A.5}$$

$$p(\varepsilon) = (1-\beta) r V_{U_T} + \beta y(\varepsilon) \tag{A.6}$$

or

$$p(\varepsilon) = rV_{U_T} + \beta(y(\varepsilon) - rV_{U_T}) \tag{A.7}$$

As clarified in Pissarides (2000), we can then easily verify that:

$$p_R = rV_{U_T}$$

$$V_{U_T} = V_{M_T}(p_R)$$

Workers receive their reservation wage

$$p_R = rV_{U_T}$$

plus a fraction β of the surplus created by the job match.

If we rearrange the terms, equation 2.7 follows.

A.2 Derivation of the Reservation Wage

$$rV_{U_T} = b + \theta q(\theta)(\Pr \varepsilon \geq \varepsilon_R)(V^e_{M_T} - V_{U_T})$$

since

$$V^e_{M_T} = \frac{p(\varepsilon^e) + sV_{U_T}}{r+s}$$

$$rV_{U_T} = b + \theta q(\theta)(\Pr \varepsilon \geq \varepsilon_R)\left[\frac{p(\varepsilon^e + sV_{U_T})}{r+s} - V_{U_T}\right]$$

$$rV_{U_T} = b + \theta q(\theta)(\Pr \varepsilon \geq \varepsilon_R)\frac{p(\varepsilon^e) - rV_{U_T}}{r+s}$$

$$p(\varepsilon_R) = \frac{(r+s)b + \theta q(\theta)(\Pr \varepsilon \geq \varepsilon_R)p(\varepsilon^e)}{\theta q(\theta)(\Pr \varepsilon \geq \varepsilon_R) + r + s}$$

A.3 Derivation of the Reservation Productivity

$$y(\varepsilon) - p(\varepsilon) = 0$$

$$Ay + \varepsilon_R - (1-\beta)b - \beta[Ay + \varepsilon_R + \theta c] = 0$$

$$\varepsilon_R(1-\beta) = Ay(1-\beta) + (1-\beta)b + \beta\theta c$$

$$Ay + \varepsilon_R = b + \frac{\beta}{1-\beta}\theta c$$

A.4 Wage Setting

$(V_{M_T} - V_{U_T}) = \frac{\beta}{1-\beta}(V_{M_E} - V_{U_E})$

From (2.1) – (2.4) :

$(V_{M_T} - V_{U_T}) = \frac{p(\varepsilon)-b}{r+s+\theta q(\theta)\Pr(\varepsilon \geq \varepsilon_R)}$ and $V_{M_E} = \frac{y(\varepsilon)-p(\varepsilon)}{r+s}$

It follows:

$$\frac{p(\varepsilon) - b}{r + s + \theta q(\theta)\Pr(\varepsilon \geq \varepsilon_R)} = \frac{\beta}{1-\beta}\left(\frac{y(\varepsilon) - p(\varepsilon)}{r+s}\right)$$

$$p(\varepsilon) - b = [r + s + \theta q(\theta)\Pr(\varepsilon \geq \varepsilon_R)]\frac{\beta}{1-\beta}\left(\frac{c}{q(\theta)\Pr(\varepsilon \geq \varepsilon_R)}\right)$$

$$p(\varepsilon) = (1-\beta)b + \beta[y + \theta c]$$

Appendix B

Appendix for Chapter 3

B.1 Derivation of wages for recipient and non-recipient workers

From (3.5)

$$E^{nm} - U^{nm} = \frac{rU^{nm} - \bar{z}}{\theta q(\theta)} \tag{B.1}$$

then f.o.c. implies

$$E^{nm} - U^{nm} = \beta \left[E^{nm} - U^{nm} + F^{nm} - V \right] \tag{B.2}$$

We can then write:

$$\frac{rU^{nm} - \bar{z}}{\theta q(\theta)} = \beta \left[\frac{rU^{nm} - \bar{z}}{\theta q(\theta)} + \frac{y - w^{nm}}{r + \lambda} \right] \tag{B.3}$$

and

$$(1 - \beta) \frac{rU^{nm} - \bar{z}}{\theta q(\theta)} = \beta \left[\frac{y - w^{nm}}{r + \lambda} \right] \tag{B.4}$$

By simple algebra we obtain:

$$rU^{nm} = \bar{z} + \frac{\beta}{1 - \beta} \theta q(\theta) \frac{y - w^{nm}}{r + \lambda} \tag{B.5}$$

From (3.5) and (3.1) we obtain:

$$E^{nm} - U^{nm} = \frac{1}{r + \lambda} \left[w^{nm} - rU^{nm} \right] \tag{B.6}$$

$$F^{nm} - V = \frac{1}{r+\lambda}\left[y - w^{nm} - rV\right] \tag{B.7}$$

and by substituting into (B.2) we have:

$$w^{nm} = (1-\beta)\, rU^{nm} + \beta y \tag{B.8}$$

Then, taking into account (B.5):

$$w^{nm} = (1-\beta)\left[\bar{z} + \frac{\beta}{1-\beta}\theta q(\theta)\frac{y - w^{nm}}{r+\lambda}\right] + \beta y \tag{B.9}$$

which simplifies into (3.9).

The wage equation for recipient workers is similarly derived taking into account that:

$$rU^{m} = (\bar{z} + \tilde{z}) + \frac{\beta}{1-\beta}\theta q(\theta)\frac{y - w^{m}}{r+\lambda} \tag{B.10}$$

and

$$E^{m} - U^{m} = \frac{1}{r+\lambda}\left[w^{m} + \tilde{z}(1-t) - rU^{m}\right] \tag{B.11}$$

$$F^{m} - U^{m} = \frac{1}{r+\lambda}\left[y - w^{m} - rV\right] \tag{B.12}$$

Derivation of average wage is obtained by taking into account that

$$F^{e} = \frac{c}{q(\theta)}$$

and that the f.o.c. are now expressed in terms of average values.

B.2 Derivation of equations 3.10 and 3.11

By noting that:

$$F^{nm} = \frac{y - w^{nm}}{r+\lambda} = \frac{c - q(\theta)\,\alpha F^{m}}{(1-\alpha)\, q(\theta)} \tag{B.13}$$

and

$$F^{m} = \frac{y - w^{m}}{r+\lambda} = \frac{c - q(\theta)(1-\alpha) F^{nm}}{\alpha q(\theta)} \tag{B.14}$$

we can then obtain equations 3.10 and 3.11 by simple substitutions in the job creation condition.

B.3 The model with risk-averse workers

Risk-averse workers value remittances more if unemployed and the introduction of these transfers modifies their outside option. Let $\bar{z}$ denote the domestic support for the unemployed and $\tilde{z}$ denote income from remittances. Then $z^m = (\bar{z} + \tilde{z})$ and $z^{nm} = \bar{z}$ are the unemployment incomes for the worker in a migrant and non-migrant family respectively. Similarly, $y^m = (w^m + \tilde{z})$ and $y^{nm} = w^{nm}$. The remaining value functions which summarize unemployed and employed workers' asset values are then respectively

$$rU^i = \ln(z^i) + \theta q(\theta)\left[E^i - U^i\right] \tag{B.15}$$

$$rE^i = \ln(y^i) + \lambda\left[U^i - E^i\right] \tag{B.16}$$

for a worker in a family of type $i = m, nm$. (B.15) says that the asset value of unemployed worker of type i depends on the unemployment income and the probability of finding a job, $\theta q(\theta)$. (B.16) says that the asset value of employed worker of type i depends on the employment income and the exogenous probability of losing a job, λ.

As in Ortega (2000), we assume that firms are not able to discriminate *ex ante* between an unemployed migrant and non-migrant since only information concerning the average characteristics of workers is available when the vacancy is opened. This implies that firms will open the same vacancy for the non-recipient and recipient unemployed. In the home economy, households will bargain over two different wages and the wage for workers with migrants in the family will be higher than that of workers in non-migrant families since they have a higher 'threat point'.

In equilibrium all firms enter the market until the asset value from a vacant job, V, is zero. By manipulating the two Bellman equations for the firms and the zero profit assumptions, we can determine the *job creation curve* JC:

$$p[f(k) - (r+\delta)k] - w^i - \frac{(\lambda + r)pc}{q(\theta)} = 0\,;\ i = nm, m \tag{B.17}$$

Aggregating over $i = nm, m$, (B.17) applies to the average wage $w = \alpha w^m + (1 - \alpha) w^{nm}$ as well.

During the bargaining stage, the partners agree on a way to share the rents. Wages are determined as the solution to a Nash bargaining problem. We now concentrate on the expected values. Given that the firm surplus is equal to $F^e - V$ and the worker surplus is $E^e - U^e$, the wage is contracted by following the maximization problem:

$$w = \arg\max \left[E^e - U^e\right]^{\beta} \left[F^e - V\right]^{1-\beta} \; ; \; i = nm, m \tag{B.18}$$

where $0 \leq \beta \leq 1$ is the bargaining power of workers. By solving the maximization problem, we obtain:

$$\ln\left(\frac{w + \tilde{z}}{\bar{z} + \tilde{z}}\right)(1 - \beta)(y - w) = \frac{\beta}{w + \tilde{z}} \tag{B.19}$$

If we rearrange the free-entry condition

$$w = \frac{pyq(\theta) - (r + \lambda) c}{q(\theta)} \tag{B.20}$$

we can then write the following equation in function of θ :

$$\ln\left(\frac{\frac{pyq(\theta) - (r+\lambda)c}{q(\theta)} + \tilde{z}}{\bar{z} + \tilde{z}}\right)(1 - \beta)\frac{q(\theta)}{c(r + \lambda)} = \frac{\beta}{\frac{pyq(\theta) - (r+\lambda)c}{q(\theta)} + \tilde{z}} \tag{B.21}$$

To complete the matching model with capital, the evolution of unemployment is given by

$$\dot{u} = \lambda(1 - u) - \theta q(\theta) u \tag{B.22}$$

In the steady state $\dot{u} = 0$ and we arrive at the *Beveridge Curve* (BC):

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{B.23}$$

(B.20), (B.21) and (B.23) give steady-state values for θ, w and u, where w is the average wage in the economy. The definition $\theta = \frac{v}{u}$ (the 'labour market tightness' parameter) gives the vacancy rate and completes the description of the steady-state equilibrium [1].

[1] $$w = \arg\max \left[E - U\right]^{\beta} \left[F - V\right]^{1-\beta}$$

$$\beta \ln (E-U) + (1-\beta) \ln F$$

First order condition:

$$\frac{\beta}{E-U}\left(\frac{1}{w+z}\right)\frac{1}{r+\lambda+\theta q(\theta)} + \frac{1-\beta}{F}\left(-\frac{1}{r+\lambda}\right) = 0$$

By noting that

$$F = \frac{y-w}{r+\lambda}$$

and

$$E-U = \frac{\ln(w+\tilde{z}) - \ln\left(\bar{z}+\tilde{z}\right)}{r+\lambda+\theta q(\theta)}$$

we obtain:

$$\ln\left[\frac{w+\tilde{z}}{\bar{z}+\tilde{z}}\right](1-\beta)(y-w) = \frac{\beta}{w+\tilde{z}}$$

and since

$$y-w = \frac{c}{q(\theta)(r+\lambda)}$$

we can write

$$\ln\left[\frac{w+\tilde{z}}{\bar{z}+\tilde{z}}\right](1-\beta)\frac{c}{q(\theta)(r+\lambda)} = \frac{\beta}{w+\tilde{z}}$$

The next step requires a substitution of the wage derived from the free entry condition:

$$w = \frac{pyq(\theta) - (r+\lambda)c}{q(\theta)}$$

We now have a relation which depends only on θ

$$\ln\left(\frac{\frac{pyq(\theta)-(r+\lambda)c}{q(\theta)}+\tilde{z}}{\bar{z}+\tilde{z}}\right)(1-\beta)\frac{q(\theta)}{c(r+\lambda)} = \frac{\beta}{\frac{pyq(\theta)-(r+\lambda)c}{q(\theta)}+\tilde{z}}$$

Our model is given by the following relations in the unknowns $\theta, u, k.$:

$$\ln\left(\frac{\frac{pyq(\theta)-(r+\lambda)c}{q(\theta)}+\tilde{z}}{\bar{z}+\tilde{z}}\right)(1-\beta)\frac{q(\theta)}{c(r+\lambda)} = \frac{\beta}{\frac{pyq(\theta)-(r+\lambda)c}{q(\theta)}+\tilde{z}} \tag{B.24}$$

$$u = \frac{\lambda}{\lambda+\theta q(\theta)} \tag{B.25}$$

$$f'(k) = r+\delta \tag{B.26}$$

B.3.1 Credit Market Imperfections

Without some constraint on the ability to raise finance for investment, remittances can affect the unemployment income, but they would have no effect on the capital stock. Firms would choose the optimal level of capital stock (per efficiency unit of labour) at $k = k^*$ However, as discussed in the introduction, the lack of formal channels to obtain credit that characterizes many developing and transitional countries can generate financial constraints for firms. We therefore assume that firms cannot raise sufficient finance to pay for their optimal choice of capital. With credit constraints $k < k^*$, remittances now play a dual role. First, they relax the constraints and enable the firm to get closer to its optimal capital stock. To see this 'investment effect' algebraically, we differentiate the equilibrium condition (B.21) with respect to k to obtain

$$\frac{d\theta}{dk} = -\frac{\left\{\left[\frac{\bar{z}+\tilde{z}}{A+\tilde{z}}\right]\left[\frac{1}{\bar{z}+\tilde{z}}Cpy'(k)\right] - \left(-\frac{\beta py'(k)}{(A+\tilde{z})^2}\right)\right\}}{\left\{\frac{\bar{z}+\tilde{z}}{A+\tilde{z}}\left[\frac{1}{\bar{z}+\tilde{z}}B\right]C + \ln\left[\frac{A+\tilde{z}}{\bar{z}+\tilde{z}}\right]Cq'(\theta) - \left(-\frac{\beta}{(A+\tilde{z})^2}\right)B\right\}} > 0$$

by noting that the denominator is always negative and the numerator is positive in presence of credit constraints.

The second effect of remittances is to increase the search utility. The 'search effect' can move in both directions since:

$$\frac{d\theta}{d\tilde{z}} = -\frac{\frac{\bar{z}-A}{(A+\tilde{z})\left(\tilde{z}+\bar{z}\right)}Cq(\theta) + \frac{\beta}{(A+\tilde{z})^2}}{\frac{B}{(A+\tilde{z})}Cq(\theta) + \ln\left[\frac{A+\tilde{z}}{\bar{z}+\tilde{z}}\right]Cq'(\theta) + \frac{\beta}{(A+\tilde{z})^2}B}$$

and the numerator can be both positive and negative. In particular, if β is small enough then the search effect is negative. [2]

[2]We now want to show that $\frac{d\theta}{d\tilde{z}} < 0$ and $\frac{d\theta}{dk} \geq 0$

We totally differentiate equation (B.24) to see these two effects analytically. We first concentrate on the search effect and a similar analysis applies to the investment effect:

$$\frac{\partial F}{\partial \theta}\frac{d\theta}{d\tilde{z}} + \frac{\partial F}{\partial \tilde{z}} = 0$$

Suppose that variables θ, k and z refer to a post-migration state with remittances and in the pre-migration state without remittances they take values $\bar{\theta}$, $\bar{k}$ and $\bar{z}$.

The model is completed by assuming there is a given proportion of workers and entrepreneurs in the economy that receives remittances. Recipient workers use remittances to increase their consumption, while entrepreneurs use the income streams to ease firm's credit constraints [3]. Let us call γ the proportion of recipient workers and $(1-\gamma)$ the proportion of entrepreneurs. In a steady state, per capita

Let us call

$$\frac{pyq(\theta)-(r+\lambda)c}{q(\theta)}=A>0$$

and

$$\frac{q'(\theta)pyq(\theta)-q'(\theta)[q(\theta)py-pc(\lambda+r)]}{(q(\theta))^2}=B<0$$

$$(1-\beta)\frac{1}{c(r+\lambda)}=C>0$$

with

$$q'(\theta)<0$$

Then:

$$\frac{d\theta}{d\tilde{z}}\left\{\frac{\bar{z}+\tilde{z}}{A+\tilde{z}}\left[\frac{1}{\bar{z}+\tilde{z}}B\right]Cq(\theta)+\ln\left[\frac{A+\tilde{z}}{\bar{z}+\tilde{z}}\right]Cq'(\theta)-\left(-\frac{\beta}{(A+\tilde{z})^2}\right\}\right)B+$$

$$+\left\{\left[\frac{\bar{z}+\tilde{z}}{A}\right]\left[\frac{\bar{z}-A}{\left(\bar{z}+\tilde{z}\right)^2}\right]Cq(\theta)+\frac{\beta}{(A+\tilde{z})^2}\right\}=0$$

That is:

$$\frac{d\theta}{d\tilde{z}}=-\frac{\frac{\bar{z}-A}{(A+\tilde{z})\left(\bar{z}+\tilde{z}\right)}Cq(\theta)+\frac{\beta}{(A+\tilde{z})^2}}{\frac{B}{(A+\tilde{z})}Cq(\theta)+\ln\left[\frac{A+\tilde{z}}{\bar{z}+\tilde{z}}\right]Cq'(\theta)+\frac{\beta}{(A+\tilde{z})^2}B}$$

[3]For simplicity we assume that all entrepreneurs are recipients

capital stock rises by $\tilde{z}(1-\gamma)/\delta = \bar{k}$[4] until such a point where $k = k^*$.

The complete model with migration now consists of (B.20), (B.21) and (B.23) and capital stock given by:

$$\begin{aligned} k &= \bar{k} + \tilde{z}(1-\gamma)/\delta = \bar{k} + \tilde{k}, \quad \text{if } \bar{k} + \tilde{k} \leq k^* \\ &= k^*, \qquad\qquad \text{if } \bar{k} + \tilde{k} \geq k^* \end{aligned} \tag{B.27}$$

We can now summarise our results as a proposition:

Proposition

Remittances have two opposite effects on the unemployment rate: First, given risk-averse workers, they increase the search utility and, for low values of β the unemployment rate rises. Second, they relax the credit constraint facing firms, raising the capital stock towards its optimal level and reducing the unemployment rate. When remittance income is sufficiently high, the optimal capital stock is reached and any further increase only has the first search effect.

B.4 Calibration

The complete model, with remittances is summarised as[5]:

[4] Using $\dot{k} = -\delta k + i$ where i is investment.

[5] We assume $\alpha = 1$ and $t = 1$.

$$BC \quad : \quad u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{B.28}$$

$$WC \quad : \quad w = (1-\beta)z + \beta p + c\theta \text{ where} \tag{B.29}$$

$$z = \rho w + \tilde{z} \tag{B.30}$$

$$JC \quad : \quad p[f(k) - (r+\delta)k] - w - \frac{(r+\lambda)pc}{q(\theta)} = 0 \tag{B.31}$$

$$k^* \quad : \quad f'(k) = r + k \tag{B.32}$$

Thus require functional forms and possibly some parameter values for $q(\theta)$ (from $m(u,v)$) and $f(k)$, and values for the following parameters in the model: p, δ, λ, c, β, ρ, ξ and η. The functional form for the matching function, $m(u,v)$ is

$$m(u,v) = v\left[1 - exp\left(-\frac{v}{u}\right)\right] \tag{B.33}$$

and hence

$$q(\theta) \equiv \frac{m(u,v)}{v} = [1 - exp(-\theta)] \tag{B.34}$$

and for $f(k)$ we choose

$$f(k) = pk^{\gamma} \tag{B.35}$$

thus requiring the calibration of a new parameter, γ.

B.4.1 Calibration of λ

We calibrate λ to data observations of u, v (and hence $\theta = \frac{v}{u}$), denoted by $\hat{u}$, $\hat{v}$ and $\hat{\theta}$), respectively. Then from (B.28) we arrive at the calibrated value:

$$\lambda = \frac{\hat{u}\hat{\theta}q(\hat{\theta})}{1-\hat{u}} \tag{B.36}$$

B.4.2 Calibration of γ, β and c

To calibrate these parameters we use data for the composition output between wages, capital and the firm's economic rent. First write (B.31) as

$$pf(k) = w + p(r+\delta)k + (r+\lambda)\frac{pc}{q(\theta)} \tag{B.37}$$

which decomposes output into the wage plus capital costs plus the firm's rent, this last term being $(r+\lambda)J$, where J is the value of an occupied job. Suppose we have data on these components of output as shares of output; i.e., data on $\frac{(r+\lambda)J}{pf(k)} = \hat{R}$, say, $\frac{w}{pf(k)} = \hat{W}$, say, and $\frac{p(r+\delta)k}{pf(k)} = \hat{K}$, say.

Consider first the calibration of γ. We calibrate the model assuming no credit constraints. Then with our functional form (B.35) $k = k^*$ where using (B.32)

$$k^* = \left[\frac{\gamma}{r+\delta}\right]^{\frac{1}{1-\gamma}} \tag{B.38}$$

Hence we arrive at the familiar result that $\hat{K} = \frac{f'(k^*)}{f(k^*)} = \gamma$. To compute k^* in the model we require δ and r, the latter being assume exogenous. We assume we have a microeconometric estimate of $\hat{\delta}$, the depreciation rate, and for $\hat{r}$, the interest rate.

Next consider the calibration of c. This is obtained from our definition of $\hat{R}$ as

$$c = \frac{q(\hat{\theta})\hat{R}f(k^*)}{(\hat{r}+\lambda)} \tag{B.39}$$

Since everything on the right-hand-side of (B.39) is calculated or observed at this point, we therefore have a calibrated value of c.

Finally we use (B.29) to calibrate β. Put $z = \rho w$ in the pre-migration state and assume we have data $\hat{\rho}$ for ρ. Let $y(k) = p(f(k) - (r+\delta))$ as in the main text of the paper.[6]. Then from the definition of $\hat{W}$ and (B.29) we obtain the calibrated value of β as

$$\beta = \frac{(1-\hat{\rho})\hat{W}pf(k^*)}{\left[y(k^*) + pc\hat{\theta} - \hat{\rho}\hat{W}pf(k^*)\right]} \tag{B.40}$$

Note that we can choose our units such that in this baseline calibration the productivity parameter $p = 1$.

Table D.1 gives our choice of estimates or observations and the resulting calibrated values used for the simulations in the paper.

[6]With optimal investment, $y(k^*) = p(f(k^*) - k^*f'(k^*))$ which is the marginal product of labour.

B.5 Data Appendix

B.5.1 Definitions of variables included in the model and data sources

Dependent variables

Unemployment rate - Definitions vary slightly by country but typically relate to the number of unemployed divided by the economically active population. Main source: International Labour Organisation (ILO). These data are used if there are any inconsistencies with the other sources, which include the World Bank's World Development Indicators (WDI), the International Monetary Fund's International Financial Statistics (IFS) and Turnham and Erocal (1990).

Investment - Gross Capital Formation as a percentage of GDP. Source: WDI.

Explanatory variables

Remittances - Total amount of workers' remittances received in country as recorded in the Balance of Payment Statistics in current US$ as a percentage of GDP. Source: WDI.

Money Supply - Money and Quasi Money (M2) as a percentage of GDP. Source: Easterly-Sewadeh and WDI.

Openness - Total trade as a percentage of GDP. Sources: Easterly-Sewadeh and Penn World Tables (PWT).

Fiscal Policy - Budget deficit as a percentage of GDP. Source: IFS.

Real interest rates - Nominal interest rate minus the inflation rate. Source: WDI.

Aid - Aid as a percentage of GNI. Source: WDI.

Appendix C

Appendix for Chapter 4

C.1 Taxation on wages and remittances

In this section we derive the wage for recipient and non-recipient workers under the assumption that both wages and remittances are taxed.

The wage for non recipient is obtained by the following maximization problem:

$$w = \arg\max \left[w\left(1-t\right)\right]^{\beta}\left[y\left(k\right)-w\right]^{1-\beta} \tag{C.1}$$

By taking the natural log of the above expression, we obtain:

$$\beta \ln\left[w\left(1-t\right)\right] + \left(1-\beta\right)\ln\left[y\left(k\right)-w\right]$$

and the f.o.c. simplifies to:

$$w = \beta y \tag{C.2}$$

Similarly, the wage for recipient workers is obtained by the following maximization problem:

$$w = \arg\max \left[\left(w+\tau\right)\left(1-t\right)-\tau\right]^{\beta}\left[y\left(k\right)-w\right]^{1-\beta} \tag{C.3}$$

from which we obtain:

$$w = \beta y + \left(1-\beta\right)\tau\left[\frac{t}{1-t}\right] \tag{C.4}$$

and the migration condition becomes:

$$w_0 - w_s - \tau + \frac{1-e}{e}\tau\left[\theta q(\theta)(1-\beta)\frac{t}{(1-t)} + (1-\theta q(\theta))\right] - G(m) = 0 \quad \text{(C.5)}$$

As for the case presented in the main text, we obtain that an increase in the level of unemployment increases the expected utility of migration. Similar conclusions follow.

C.2 Extension with Human Capital Formation

In chapter 4, we have assumed exogenous skills and we can probably argue that the migration opportunities of high skilled (brain drain) is likely to have a negative impact on the human capital stock in the sending economy. Of course, in case of firms' credit constraints there will also be a beneficial effect due to the increase in physical capital, but this may not be enough to offset the brain drain. In Kugler and Lotti (2005)[1], we model the effect of migrant remittances on job creation and human capital formation, given physical capital and migration prospects. In this section, we present a parallel development of the idea that migration affects individuals' incentives. We show the impact of remittances on, both, human and physical capital formation. Our future work will then endogenize migration in presence of both physical and human capital decisions (as in chapter 4 of this thesis) and then be in a position to offer a contribution to the literature on brain drain (gain).

Individuals choose their level of education taking into account the positive impact of remittances on human capital formation. As in Stark and Wang (2001), we adopt the idea that migration can be a substitute for subsidies on education and assume that remittances decrease the cost of education. We then assume a given proportion of remittances that are consumed and invested in education[2]. In this sense, remittances can be seen as a form of subsidy to education.

[1]Paper available on request.

[2]As clarified in Faini (2005), only empirical analysis can resolve the issue on the amount of remittances used for "unproductive" and "productive" purposes.

If we assume the following production function:

$$y_{ij} = Ak_j^{\alpha} h_i^{1-\alpha} \tag{C.6}$$

where k_j is the physical capital investment of firm j and h_i is the human capital investment of individual i, the individual maximizes:

$$\begin{aligned} & \max_{h_i,} \left\{ c - \frac{h^{\Psi}}{\Psi(\gamma + s\tau_i)} \right\} \\ s.t. \quad c \quad = \quad & \left\{ \bar{q} \left[A_1 \beta k^{\alpha} h^{1-\alpha} + (1 - s_i)\tau_i \right] + \left(1 - \bar{q}\right) \tau_i (1 - s) \right\} \end{aligned} \tag{C.7}$$

where c is consumption, s is the exogenous proportion of remittances invested in education, γ is the ability of the individuals and $\bar{q}$ is the endogenous probability of finding a job in the domestil labour market. The level of remittances τ_i is of course zero for non recipient individuals.

We assume there are frictions in the labour market and the probability of finding a job is derived as before[3]. The difference is that now human capital formation induces more job creation leading to even higher human capital supply. Firms invest in physical capital once they hire a worker with human capital h. For simplicity we limit the analysis to the case where all stayers are recipients[4]. For this reason, from now on, we consider identical firms and individuals. The optimal level of capital is obtained by the standard maximization process:

$$f'(k) = \alpha A k^{\alpha - 1} h^{1-\alpha} = r + \delta \tag{C.8}$$

Clearly, it depends on human capital formation.

From the job market conditions we obtain the level of human capital as a function of the probability to find a job:

$$h = \{\bar{q}\alpha A \beta k^{\alpha} [\gamma + s\tau]\}^{\frac{1}{\Psi - (1-\alpha)}} \tag{C.9}$$

[3]Please refer to chapter 4 of this work.

[4]This will not affect our results. It is possible to show a general case by assuming two different levels of human capital, but this will not be relevant for the point we would like to discuss.

and since

$$\bar{q} = \left[\frac{(1-\beta)A}{c}\right]^{\frac{\Psi-(1-\alpha)}{2(1-\alpha)-\Psi}} \left[(1-\alpha)A\beta k^{\alpha}(\gamma + s\tau)\right]^{\frac{(1-\alpha)}{2(1-\alpha)-\Psi}} \tag{C.10}$$

the level of human capital in the source economy is:

$$h = \left(k^{\alpha}\Omega\right)^{\frac{(1-\alpha)}{\Psi-(1-\alpha)}} \left[\Gamma^{\frac{(1-\alpha)}{2(1-\alpha)-\Psi}} \left(k^{\alpha}\Omega\right)^{\frac{(1-\alpha)^2}{(2(1-\alpha)-\Psi)(\Psi-(1-\alpha))}}\right] \tag{C.11}$$

with

$$\Gamma = \frac{(1-\beta)A}{c} \quad \text{and} \quad \Omega = (1-\alpha)A\beta(\gamma + s\tau)$$

Finally, the optimal stock of physical capital is a function of remittances:

$$k = \left[\left(\frac{\alpha}{r+\delta}\right)^{\frac{1}{((1-\alpha))}} \Omega\right]^{\frac{1}{\Psi-(1-\alpha)}} \left[\Gamma^{\frac{1}{2(1-\alpha)-\Psi}} (\Omega)^{\frac{(1-\alpha)}{[2(1-\alpha)-\Psi](\Psi-(1-\alpha))}}\right] \tag{C.12}$$

From the above expression we can see that the optimal level of capital stock is a function of the level of remittances even in the absence of credit constraints. This is the case since the level of investment of the firms depends on the level of human capital in the economy which is affected by remittances. In order to say something more about the sign of this relationships and the properties of the equilibrium, we need to make particular assumptions about our parameters α and Ψ . This goes behind the purpose of this section which aim was to show that if we introduce human capital, then the analysis of chapters 3 and 4 could offer a valuable contribution to the literature on remittances and brain drain. In particular, if we assume a positive relationship between remittances and physical capital then the condition for remittances to have a positive impact on the labour market of the source economy is more relaxed. Opposite results are obtained in case of a negative impact of remittances on the optimal level of physical capital.

To say something more about the possibility of brain drain (gain), we need to be able to calculate the average level of human capital in the economy once migration opportunities are introduced. We will also leave this to future research.

Appendix D

Tables and Figures

Table D.1: **Data and calibrated values**

Data	
Parameter	Value
$\hat{u}$	0.10
$\hat{v}$	0.10
$\hat{r}$	0.03
$\hat{\delta}$	0.1
$\hat{\rho}$	0.3
$\hat{K}$	0.3
$\hat{R}$	0.05
Calibrated Parameters	
Parameter	Value
λ	0.072
γ	0.3
c	0.4512
β	0.5547

Table D.2: **Descriptive Statistics for Countries in Dataset**

	Unemployment models			Investment models		
	Sample Period	$\bar{u}_{it}$	$\bar{r}_{it}$	Sample Period	$\bar{i}_{it}$	$\bar{r}_{it}$
Barbados	1987-2002	15.8	2.31	1987-2002	16.29	2.31
Belize	1994-1997	12.5	2.31	1984-2003	24.08	3.73
Columbia	1976-2003	11.5	1.07	1986-2003	18.61	1.54
Croatia	1994-2002	13.4	2.67	1994-2003	23.44	2.68
Dominican Republic	1992-2001	16.4	7.23	1991-2003	22.36	7.55
Ecuador	1990-2003	9.2	3.41	1990-2003	21.73	3.41
Egypt	1977-1984, 1990-2002	7.8	8.24	1977-2003	23.85	8.19
Greece	1981-1997	7.8	2.28	1976-1990	25.06	2.31
Honduras	1996-2002	4.7	6.09	1987-2003	28.30	4.10
Jamaica	1976-1985	25.6	1.88	1976-2003	23.89	5.25
Mexico	1981-1988, 1992-2003	3.4	1.04	1993-2003	22.36	1.29
Morocco	1986-2003	17.9	6.97	1978-2003	23.37	6.76
Nicaragua	1992-2002	14.4	4.80	1992-2003	29.63	5.29
Pakistan	1981-2002	5.0	4.72	-	-	-
Paraguay	1990-2001	7.0	1.33	1990-2003	23.09	1.40
Peru	1991-2001	7.9	1.04	1991-2000	21.32	1.00
Portugal	1980-1998	6.7	6.40	-	-	-
SriLanka	1991-2001	11.5	6.21	1978-2001	24.97	5.51
Turkey	1983-2001	8.6	2.23	-	-	-
All Countries	1976-2003	10.3	3.78	1976-2003	23.36	4.37

Notes: Pakistan and Turkey are excluded from the investment models because of a lack of data on interest rates in these countries, whilst there is no information on aid to Portugal.

Table D.3: **Panel Estimates of Unemployment in Developing Countries**

	(1)		(2)	
	FE	**GMM**	**FE**	**GMM**
u_{it-1}	0.724	0.498	0.721	0.484
	(0.059)	(0.094)	(0.060)	(0.092)
r_{it}	-0.119	-0.0121	-0.102	-0.091
	(0.083)	(0.152)	(0.075)	(0.099)
r_{it-1}	-	-	-0.028	0.006
			(0.114)	(0.145)
m_{it}	0.017	0.037	0.032	0.030
	(0.013)	(0.029)	(0.027)	(0.026)
m_{it-1}	-	-	-0.012	0.008
			(0.029)	(0.025)
d_{it}	-0.050	-0.004	-0.035	-0.040
	(0.052)	(0.079)	(0.060)	(0.083)
d_{it-1}	-	-	-0.028	0.063
			(0.051)	(0.044)
o_{it}	-0.017	-0.004	-0.010	0.011
	(0.008)	(0.024)	((0.014)	(0.021)
o_{it-1}	-	-	-0.010	-0.027
			(0.015)	(0.017)
Constant	4.905	-0.019	5.122	-0.019
	(1.127)	(0.061)	(1.186)	(0.066)
R^2	0.921	-	0.922	-
AR(1)[pvalue]	-	0.027	-	0.023
AR(2)[pvalue]	-	0.456	-	0.461
Sargan[pvalue]	-	0.438	-	0.497
NT	260	241	260	241

Notes:

1. The explanatory variables in the table are as follows: u denotes the unemployment rate, r remittances as a percentage of GDP, m the money supply as a percentage of GDP, d the budget deficit as a percentage of GDP, and o is a measure of openess. See the data appendix for further details of the definitions and sources of these variables.

2. Heteroskedasticity robust standard errors are in parentheses.

3. One step robust estimates are reported for the GMM models which are estimated in first differences. The instrumental variables are the levels of period t-2 and t-3 for lagged unemployment, remittances, money supply, budget deficit and openess. AR(1) and (2) are Lagrange Multiplier tests for first and second-order serial correlation. Sargan is a Chi-squared test of the over-identifying restrictions.

Table D.4: **Panel Estimates of Investment in Developing Countries**

	(1)	(2)		(3)	
	FE	**FE**	**GMM**	**FE**	**GMM**
i_{it-1}	-	0.680	0.651	0.681	0.653
		(0.039)	(0.057)	(0.038)	(0.057)
r_{it}	0.759	0.189	0.095	0.361	0.368
	(0.148)	(0.075)	(0.175)	(0.148)	(0.202)
r_{it-1}	-	-	-	-0.215	-0.438
				(0.156)	(0.178)
n_{it}	-0.023	-0.033	-0.034	-0.038	-0.045
	(0.028)	(0.026)	(0.035)	(0.025)	(0.035)
n_{it-1}	-	-	-	0.001	0.006
				(0.019)	(0.023)
a_{it}	-0.011	0.022	-0.084	0.052	-0.084
	(0.014)	(0.073)	(0.137)	(0.081)	(0.139)
a_{it-1}	-	-	-	-0.076	-0.125
				(0.036)	(0.046)
Constant	14.693	5.078	-0.047	5.160	-0.060
	(0.416)	(0.696)	(0.070)	(0.670)	0.086
R^2	0.475	0.723	-	0.727	-
AR(1)[pvalue]	-	-	0.002	-	0.002
AR(2)[pvalue]	-	-	0.644	-	0.420
Sargan[pvalue]	-	-	0.179	-	0.290
NT	277	261	245	26	245

Notes:

1. The explanatory variables in the table are as follows: i denotes gross capital formation as a percentage of GDP, r remittances as a percentage of GDP, n the real interest rate, and a aid as a percentage of Gross National Income .

2. Heteroskedasticity robust standard errors are in parentheses.

3. One step robust estimates are reported for the GMM models which are estimated in first differences. The instrumental variables are the levels of period t-2 and t-3 for lagged unemployment, remittances, money supply, budget deficit and openess. AR(1) and (2) are Lagrange Multiplier tests for first and second-order serial correlation. Sargan is a Chi-squared test of the over-identifying restrictions.

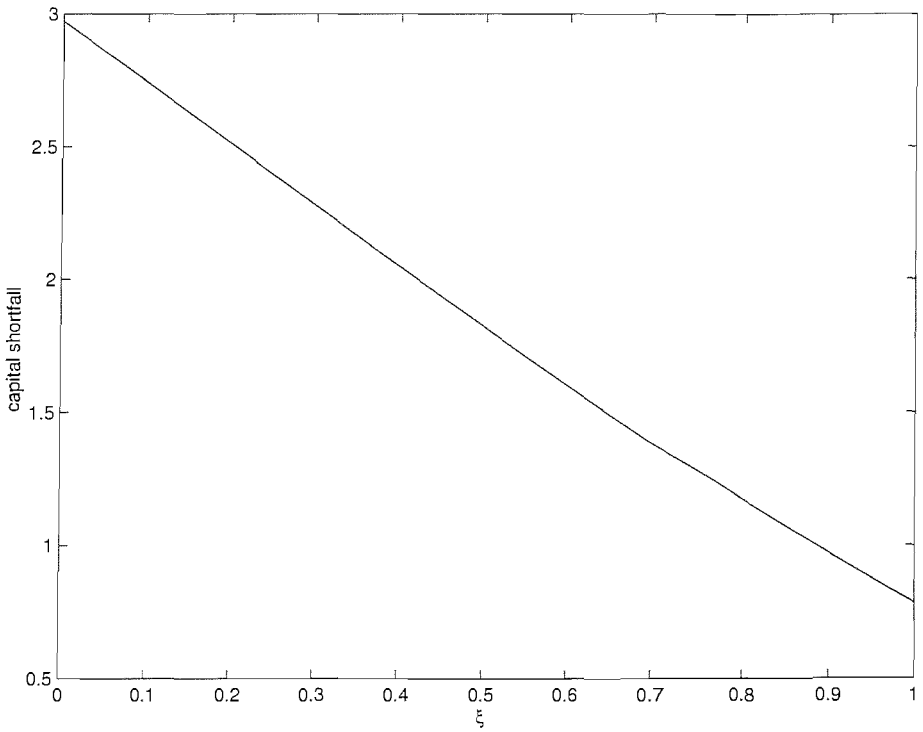

Figure D.1: **The Effect of Remittances on the 'Capital Shortfall'** $(k^* - k)$: $\bar{k} = 0.1k^*$.

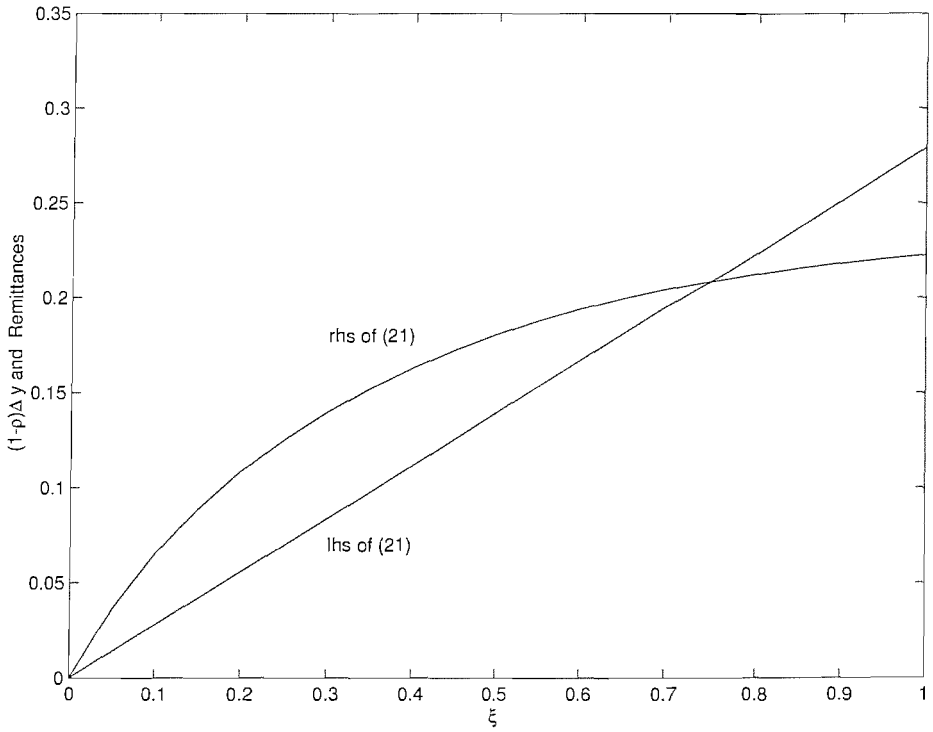

Figure D.2: **The Effect of Remittances on Condition (3.21):** $\bar{k} = 0.1k^*$.

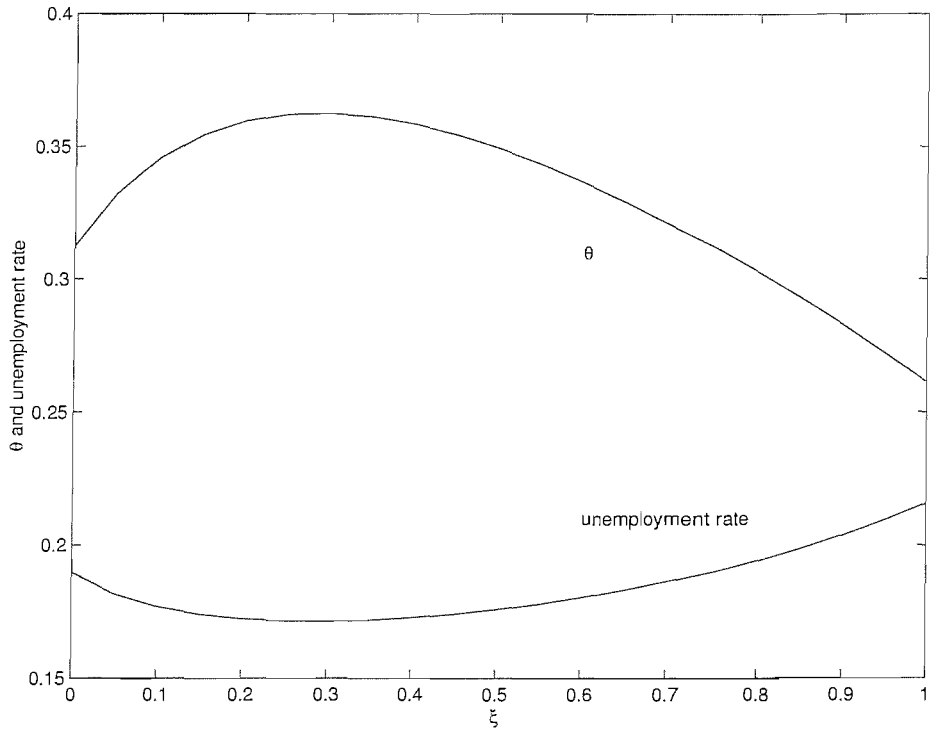

Figure D.3: **The Effect of Remittances on the Unemployment and Labour Market Tightness: $\bar{k} = 0.1k^*$.**

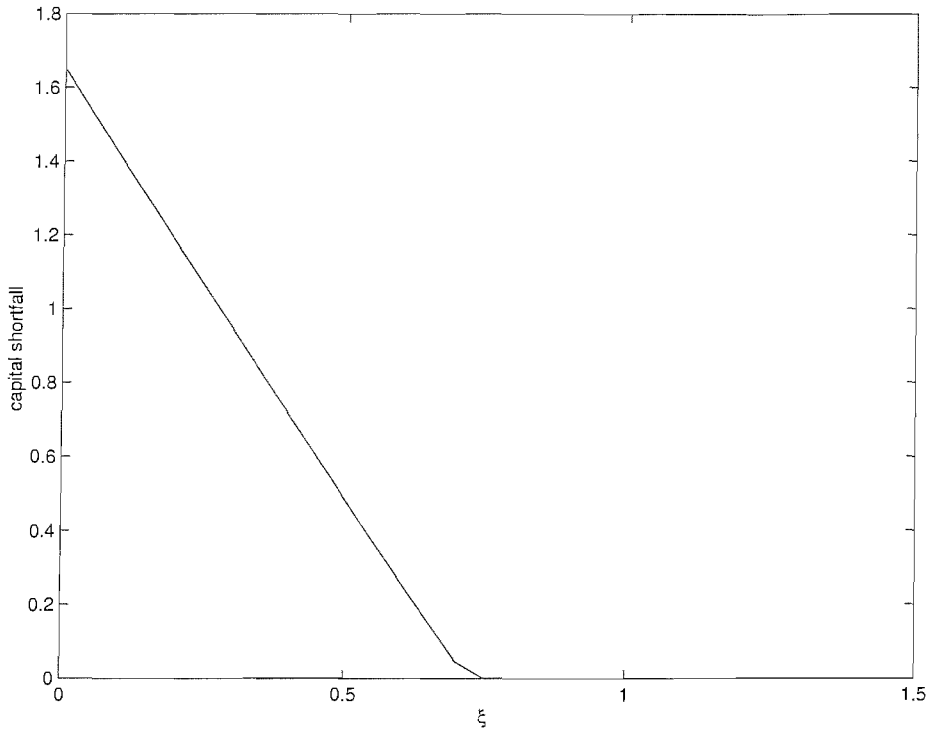

Figure D.4: **The Effect of Remittances on the 'Capital Shortfall'** $(k^* - k)$**:** $\bar{k} = 0.5k^*$**.**

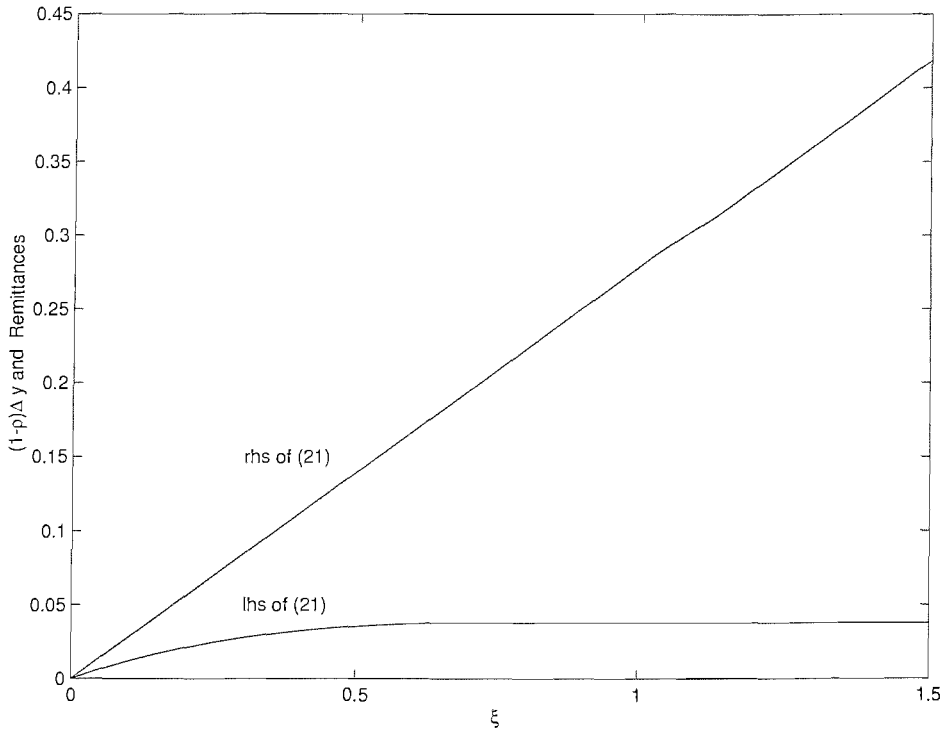

Figure D.5: **The Effect of Remittances on Condition (3.21):** $\bar{k} = 0.5k^*$.

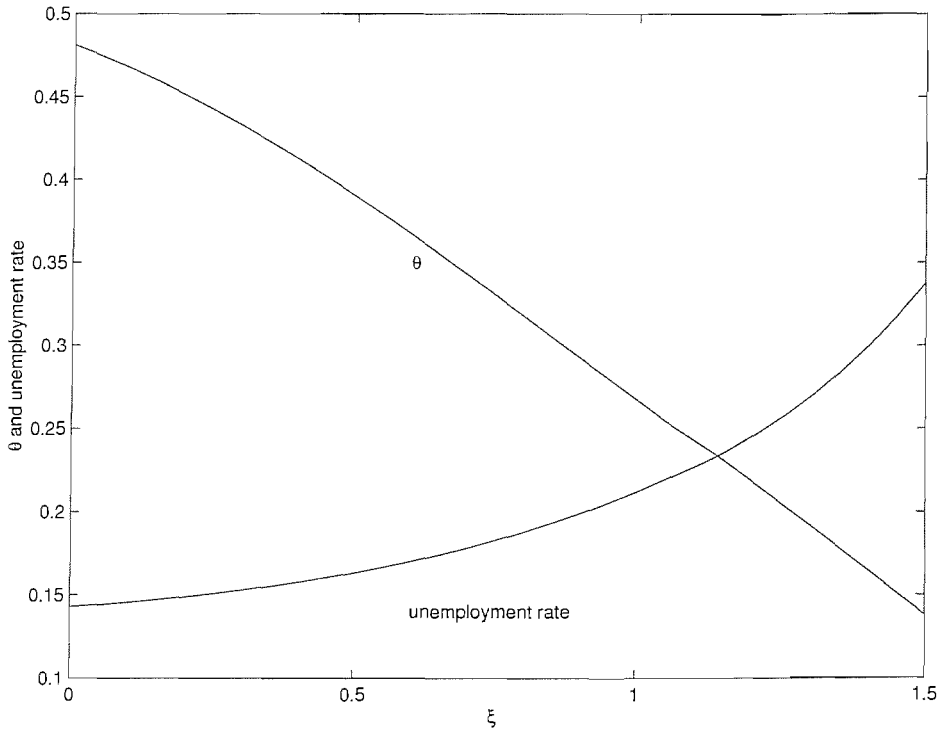

Figure D.6: **The Effect of Remittances on the Unemployment and Labour Market Tightness:** $\bar{k} = 0.5k^*$.

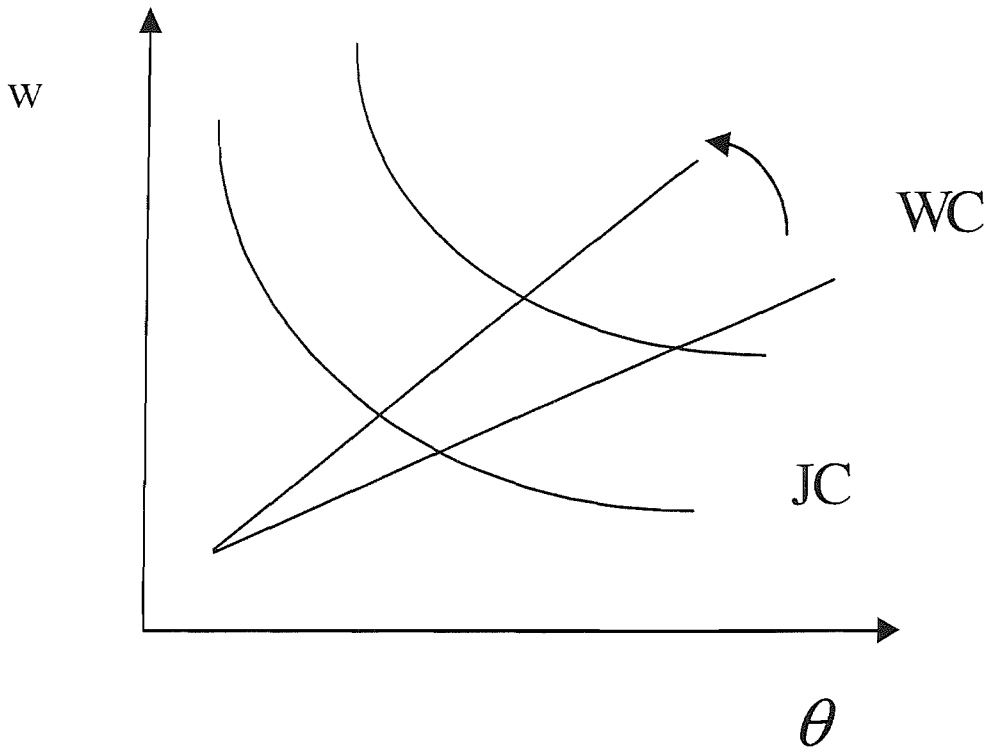

Figure D.7: **The Effect of an Increase of Capital on Labour Market Tightness.**

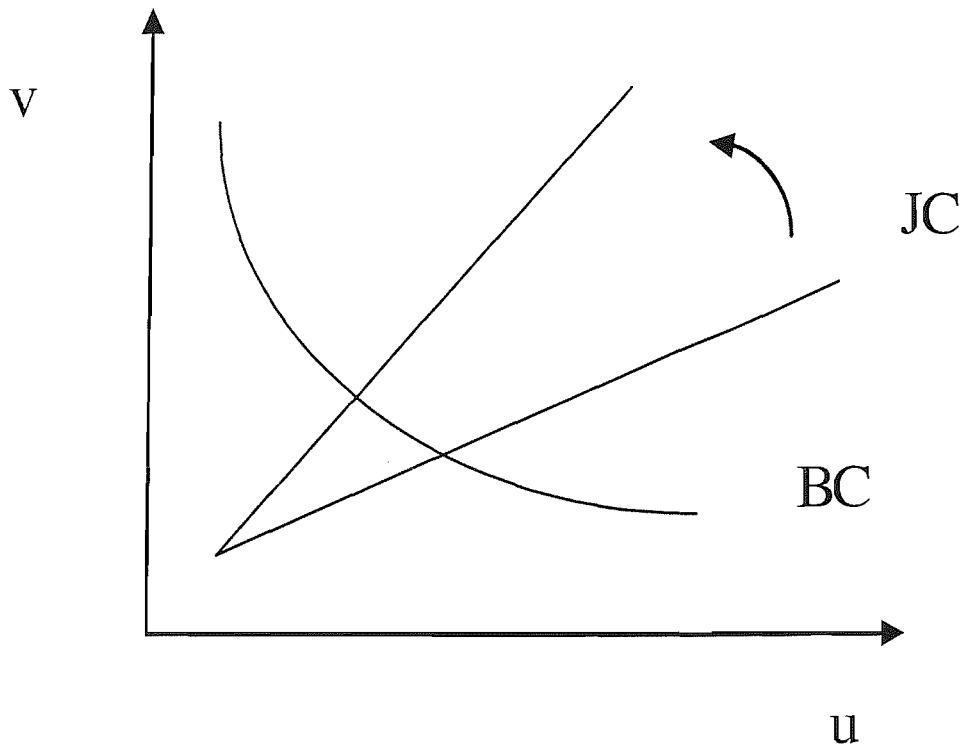

Figure D.8: **The Effect of an Increase of Capital on Unemployment and Vacancy Rate**

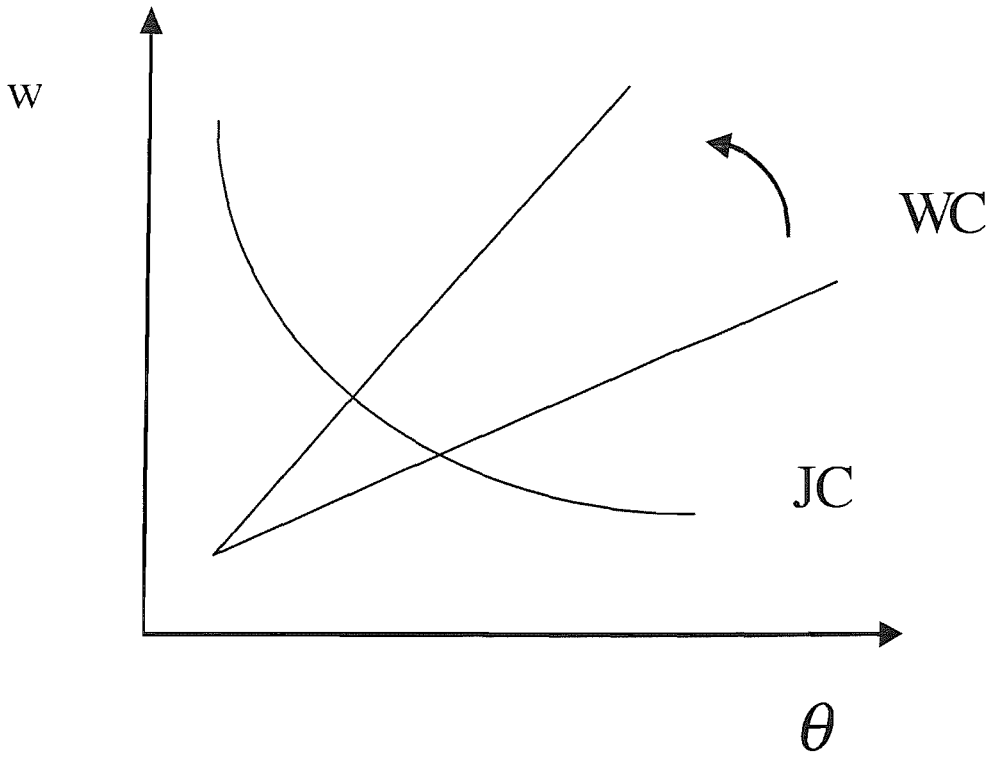

Figure D.9: **The Effect of an Increase of Unemployment Benefits on Labour Market Tightness.**

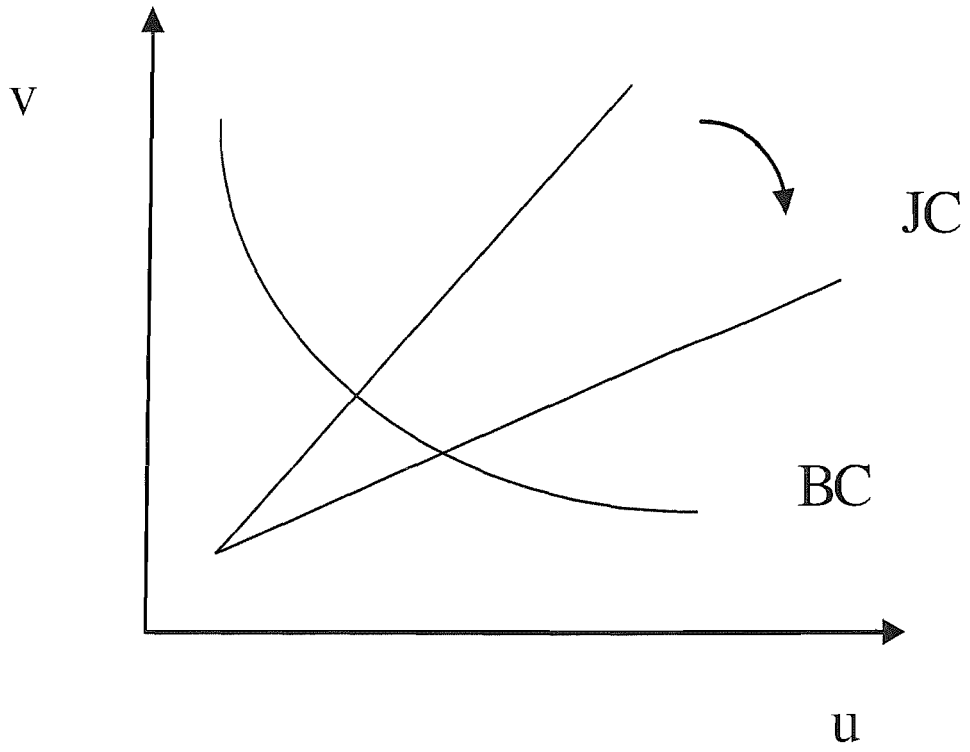

Figure D.10: **The Effect of an Increase of Unemployment Benefits on Unemployment and Vacancy Rate**

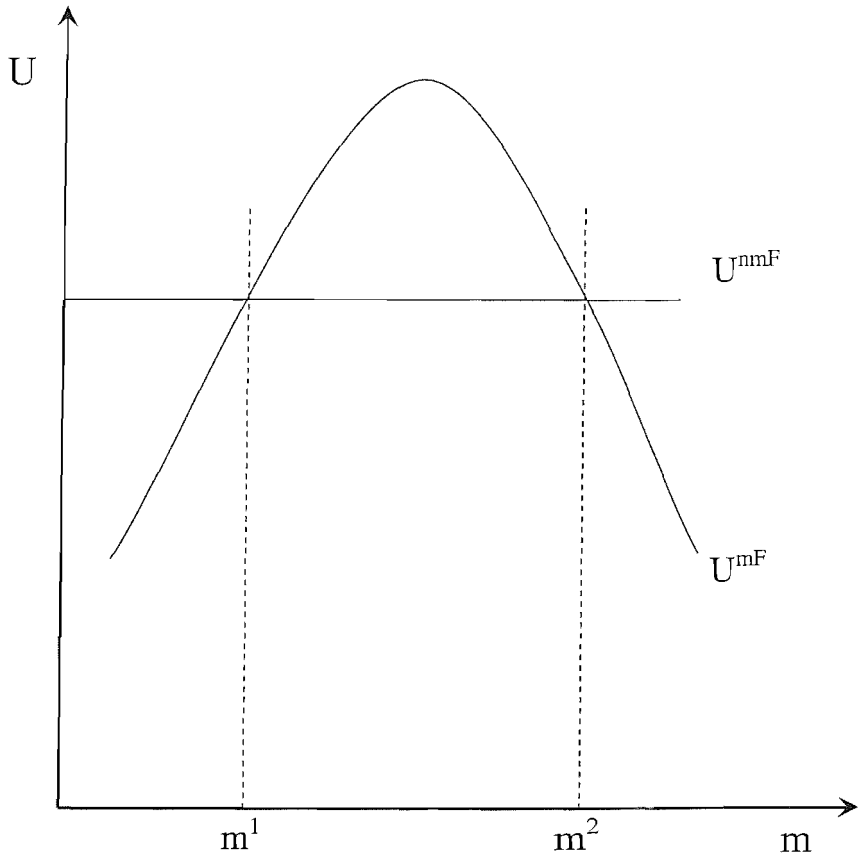

Figure D.11: **Migration without Credit Constraints**

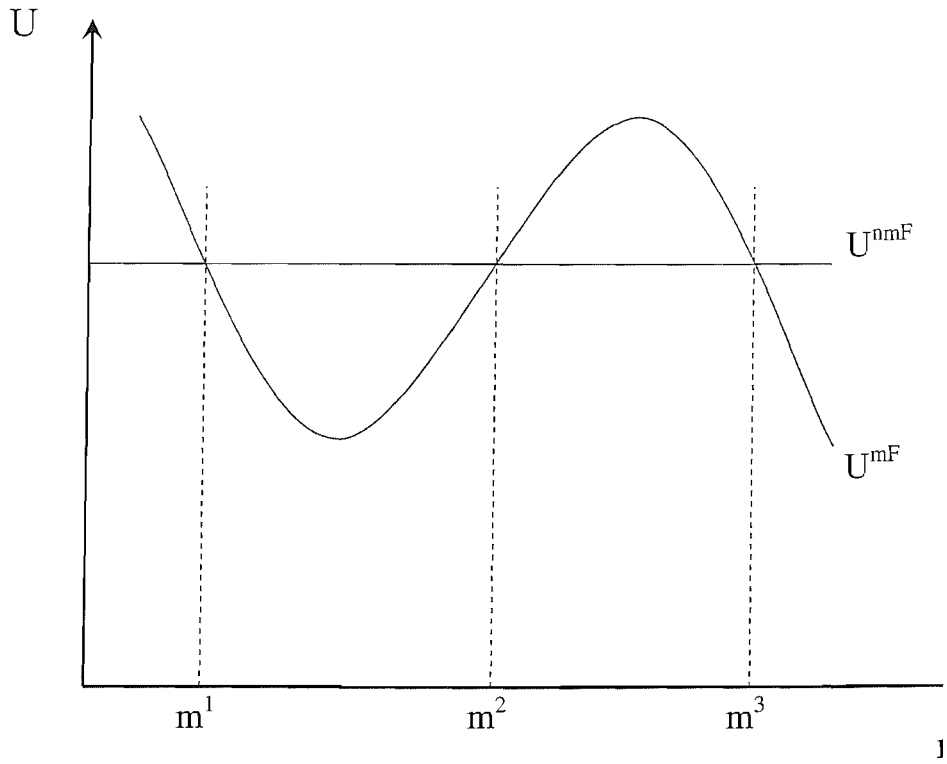

Figure D.12: **Migration with Credit Constraints**

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