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Essays on Migration and Risk Aversion

Janis Umblijs

Department of Economics

Trinity College

University of Dublin

Thesis Submitted to Trinity College, University of Dublin in fulfilment of the requirements for the degree of Doctor of Philosophy (Ph.D.)

2013

Declaration

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The first essay in this thesis has been published as a University of Oxford International Migration Institute Working Paper. Paper number 54, April 2012.

Summary

In this thesis I develop the theoretical and empirical literature linking risk aversion and migration. The thesis consists of three chapters exploring this theme from a variety of perspectives. The first chapter looks at the relationship between risk aversion and migration flows; the second investigates how risk preferences influence remittance behaviour; and the third tests the relationship between risk aversion and entrepreneurship among migrants.

The first essay looks at the effect of migrant networks and risk attitudes on the dynamics of migration. This essay proposes a theory that links risk aversion, the size of expatriate networks, migrant characteristics and the timing of migration. It shows that, as the size of networks increases over time, finding employment becomes less uncertain, inducing more risk averse individuals to migrate. Given that recent research suggests a negative relationship between risk aversion, entrepreneurial potential and cognitive ability, the model predicts a decrease in the quality of these 'unobservable' characteristics as networks grow larger. In addition, the dynamic relationship between network size and uncertainty leads to the following hypotheses: when migrant networks are more effective in helping new arrivals, more individuals will migrate, they will migrate sooner *and* at a faster rate. I use the German Socio-Economic Panel Study (SOEP) data to provide

empirical support for the predictions of the theoretical model.

The second essay investigates the relationship between remittances and individual risk preferences. Using a unique representative survey of immigrants in Greater Dublin, Ireland, the research finds a positive and significant relationship between risk aversion and remittance behaviour. Risk-averse individuals are more likely to send remittances home and are, on average, likely to remit a higher amount, after controlling for a broad range of individual and group characteristics. Sensitivity analysis reveals that this relationship is especially significant for remittances sent outside the household and for migrants from Africa. The results provide support for the emerging literature which suggests that remittances are, in some cases, used as self-insurance.

The third essay utilises a novel vignette adjusted measure of risk preferences in the domain of work to investigate the link between risk aversion and entrepreneurship in migrant communities. This essay is part of an emerging literature which empirically tests the relationship between risk aversion and migration. The work contributes to the literature by proposing a domain specific risk measure which, after vignette adjustment, can be utilised to study heterogeneous populations such as migrants. I use a self-evaluation measure in the domain of work, adjusted for differential item functioning using vignettes, to test the relationship between risk aversion and entrepreneurship. Using a representative household survey of the migrant population in the Greater Dublin Area, I find a significant negative relationship between risk aversion and entrepreneurship. In addition, I find that the vignettes improve the significance of the results, as they correct for differential item functioning between entrepreneurs and non-entrepreneurs, as well as different migrant groups.

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Chapter 1

Introduction

In a recent conference on international migration,[1] Guillermina Jasso from New York University, delivered a key note speech on the frontiers of migration research. Professor Jasso identified the study of 'migrant energy' as an important avenue of research, which describes individual characteristics that go beyond the observed variables such as education and work experience. In the economics' literature these attributes are more often referred to as 'unobservable characteristics' and are attributes that are not easy to measure but have an important impact on predicting future labour market outcomes of migrants.

The following three essays aim to push back this frontier of research by looking at an 'unobservable' characteristic important to the study of migration; risk aversion. Risk aversion has long been identified as both a key component in the migration decision and a good proxy for a wide variety of other 'unobserved' characteristics such as cognitive ability and determination.

The first essay develops the theory linking risk aversion and migration by looking at how

[1] 3rd TEMPO Conference on International Migration, 4-5 October 2012

risk preferences could determine migrant selection in a dynamic setting. The essay proposes a theory that links risk aversion, the size of expatriate networks, migrant characteristics and the timing of migration. Assuming that finding employment becomes less uncertain as migrant networks grow, the model predicts an increase in the level of risk aversion of the average migrant as networks increase in size. When applying this principle to a dynamic setting, the theory predicts that when migrants are more reliant on networks for finding work, more individuals will migrate; they will migrate sooner and at a faster rate. A migrant sample from the German Socioeconomic Panel survey, which contains measures of individual risk aversion, provides empirical evidence that individuals migrating when networks are larger will, on average, be more risk averse than individuals migrating when networks are smaller, after controlling for a range of observable characteristics.

Migration flows can also have an impact on the sending country, most notably in the form of remittances, which are estimated to be around US$ 372 billion a year[2]. Because remittances can make a significant contribution to development in migrant source countries, understanding why people send money home is important in order to encourage these financial flows. Using a unique representative household survey of migrants in the Greater Dublin Area, the second essay examines the relationship between individual risk aversion and remittance behaviour. I find a positive and significant link between risk aversion and remittance behaviour. Risk-averse individuals are more likely to send remittances home and are on average, more likely to remit a higher amount, after controlling for a broad range of individual and group characteristics. The results provide support to the emerging literature which suggests that remittances are, in some cases, used as self-insurance, and

[2]World Bank estimate for 2011 World Bank Group (2011).

that more risk averse individuals are more likely to remit in order to self-insure against future uncertainty in the receiving country.

The third essay in this PhD dissertation investigates the relationship between risk aversion and entrepreneurship among migrants. The chapter develops a novel vignette adjusted measure of risk preferences in the domain of work to investigate the link between risk aversion and entrepreneurship in migrant communities. Self-evaluation measures are increasingly being used to measure individual risk preference, but often suffer from Differential Item Function (DIF), where respondents interpret the self-evaluation scale in different ways. Using a representative household survey of the migrant population in the Greater Dublin Area, the research finds a significant negative relationship between risk aversion and entrepreneurship. In addition, it is found that the use of vignettes improves the significance of the results, as they correct for differential item functioning (where respondents interpret the self-evaluation scale in different ways) between entrepreneurs and non-entrepreneurs, as well as different migrant groups.

The empirical analysis in this thesis was conducted using the German Socioeconomic panel data as well as a tailor made representative survey of the migrant population in Greater Dublin, where I was a team member and participated in data collection. Being a part of the survey design and implementation team allowed me to develop a unique vignette adjusted measure of risk aversion which counters the bias introduced by DIF when intercultural comparison is required. Furthermore, the unique combination of risk preference and remittance data made it possible to investigate, for the first time, the role that individual risk preferences play in remittances behaviour.

The three essays provide new perspectives on migration motives in a dynamic context;

investigate the role that risk preferences play in remittances behaviour and business formation; and develop a more precise measure of risk aversion relevant for migration research. This work makes a number of novel contributions to our understanding of unobservable characteristics and migration, and by doing so is a part of an emerging literature which is pushing back the frontiers of migration research.

Chapter 2

The Effect of Networks and Risk Attitudes on the Dynamics of Migration

2.1 Abstract

Two central concerns for policy makers are the manageability of the rate of migration and the qualities of incoming migrants. This paper addresses these issues by proposing a theory that links risk aversion, the size of expatriate networks, migrant characteristics and the timing of migration. As the size of networks increases over time, information increases the expected probability of finding work, inducing more risk averse individuals to migrate. Given that recent research suggests a negative relationship between risk aversion, entrepreneurial potential and cognitive ability, the model predicts a decrease in the quality of these 'unobservable' characteristics as networks grow larger. In addition, the dynamic relationship between network size and risk aversion leads to the following hypotheses: when

migrants are more reliant on networks for finding work, more individuals will migrate, they will migrate sooner *and* at a faster rate. I use German Socio-Economic Panel Study (SOEP) data to provide empirical support for the predictions of the theoretical model.

2.2 Introduction

Two main concerns for policy makers regarding migration are the manageability of the rate of immigration, and the qualities of incoming migrants. The aim of this paper is to shed light on these issues by looking at the underlying mechanisms that could explain how migrant networks develop and how the average characteristics of individuals in these networks change over time. This paper contributes to the economic literature on migration in the following ways: by modelling the link between network size and unobservable characteristics directly, by proposing a new theory of how networks develop over time, and by providing policy relevant predictions about factors that could influence the rate at which migrant networks are formed.

When looking at labour market outcomes, observable characteristics such as education and work experience explain only around 20 -35% of the variation in earnings (Card, 1999). This suggests that other characteristics, which often cannot be observed in the data, have a significant impact on wages. Given this unexplained 65 - 80%, it is no surprise that 'unobservable' characteristics have received a significant amount of attention in the literature (Dostie and Leger, 2009; Batista, 2008; Rooth and Saarela, 2007). In addition, recent research in behavioural economics has identified risk aversion as one of the best proxies for other important 'unobserved' qualities. For example, (Dohmen et al.,

2010) find that risk aversion is negatively related to cognitive ability and work by (Ekelund et al., 2005) suggests that individuals with lower levels of risk aversion are more likely to become entrepreneurs, holding other factors constant.

These 'unobservable' characteristics are therefore important when looking at the impact of migration on the labour markets of receiving countries. The determinants of whether migrants have above or below average characteristics (relative to the sending country population) is the central theme of the seminal work of Borjas (1987), and those based on it. The theoretical model in Borjas (1987) makes predictions about the scale and 'quality' of migrants, based on the relative distributions of income and returns to schooling, at home and abroad.

This paper takes an alternative approach to looking at selection on unobservable characteristics, by focusing on another important parameter: migrant networks. Migrant networks can influence selection by altering the information individuals in the sending country have regarding the migration decision, therefore reducing the risk associated with finding work abroad. The idea that risk is an important parameter was first proposed by Sjaastad (1962) and Harris and Todaro (1970) who suggest that migration is an investment decision involving risk. Therefore, only individuals with a certain level of risk aversion will be prepared to migrate when faced with a given combination of migration costs; wage differentials between home and abroad; and the expected probability of finding work upon arrival. I extend this reasoning by allowing migrant networks to influence the risk surrounding the migration decision. More specifically, I assume that networks increase the probability of finding work, therefore reducing the unemployment risk faced by future migrants.

Assuming that there is heterogeneity in risk preferences among the sending population,

at any given level of unemployment risk some will be prepared to move, others will find it too risky, and at the margin there will be individuals who are indifferent between staying and migrating. The corresponding level of risk aversion for indifferent individuals is referred to in the model as the cut-off level of migration. I model the cut-off level directly by deriving the Arrow-Pratt measure of absolute risk aversion using migration costs, wage differentials and probability of finding work. [1] Given that networks increase the expected probability of finding work, by providing improvrd information on job prospects for later arrivals, the cut off level of risk aversion will decrease as networks grow larger. This reduction in the cut off level will then encourage more individuals (that were previously too risk averse to migrate) to make the move from the sending to receiving country. As more recent arrivals were not prepared to migrate earlier when the risk was greater, they are by definition more risk averse than previous migrants. The model, therefore, suggests a positive relationship between the size of networks and the average level of risk aversion [2].

The model can be extended to incorporate dynamic aspects of the migration process, by using the mechanism that links networks and risk. A key feature of this extension is that, each additional migrant will encourage a different number of individuals to migrate in the next period, if we assume that risk preferences are normally distributed in the sending country. For example, the first migrant will encourage fewer individuals to migrate than a later migrant, even though both reduce the risk of being unemployed by the same amount,

[1] The advantage of using the Arrow-Pratt measure is that it can be calculated directly from the main parameters of migration costs, wage differentials and probability of finding work. This reflects the analogy of migration being like a lottery, with a given sunk cost, a possibility of a pay-out and a corresponding probability of receiving this pay-out.

[2] Recent empirical literature suggests that migrants are indeed more risk loving than non-migrants regarding internal migration (Jaeger et al., 2010) and international migration Gibson and McKenzie (2009). I explore this relationship in more detail.

holding other parameters in the model constant [3] .

While the rate of migration is affected by the distribution of risk preferences, it is also influenced by the extent to which the marginal migrant is able to reduce the expected risk of potential migrants in the receiving country. When there is a heavier reliance on networks for improving the prospects for finding work, each additional migrant will reduce the risk by more than if networks were less important. Assuming that risk preferences are normally distributed, the dynamic consequence of a stronger network effect is to increase the rate at which the 'cut off' level of risk aversion is reduced, compared to when networks are less important. Using the model outlined above, we simulate this effect and show that when people rely more on networks, more individuals will migrate, they will migrate sooner and at a faster rate. The dynamic element of the migration process has some similarities with the model proposed by Carrington et al. (1996), the three major differences in this paper are that risk is included in the model, the relationship between networks and migration rates is accounted for and risk preferences are acknowledged as playing an important role in the migration decision.

To conclude the theoretical part of the paper, I look at the relationship between risk aversion and education. By including the network variable in the Roy-Borjas model and assuming that risk aversion and observable characteristics are negatively related, a number of testable implications can be derived [4]. First, growing networks result in a gradual decrease in the average education level of migrants. Second, growing networks result in a

[3]The difference in migration rates between these two periods is caused by the fact that there are more individuals towards the middle of the risk preference distribution than on the left tail of it, Assuming that individuals on the left tail of the distribution are extremely risk loving and individuals on the right tail are extremely risk averse.

[4]I assume that the initial condition of no networks is characterised by positive selection in education.

gradual increase in the average level of risk aversion in the migrant population. Third, the rate of migration will increase over time.

The hypotheses derived from the theoretical model could be useful for policy makers in a number of ways. First, if there is a relationship between risk aversion and other important characteristics, earlier migrants will have a higher level of these desirable characteristics than later arrivals. This suggests that policies to attract migrants from a wider range of countries could result in the average migrant having a higher level of unobserved human capital, as the number of individuals of any given nationality will be smaller. Second, the extent to which each arrival can reduce the risk of failure for later migrants could also be influenced by policy. For example, integration policies that result in migrants relying less on other network members to find work could reduce both the scale and rate of migration, as suggested by the simulation in this paper.

In order to empirically test the hypotheses that arise from the theoretical model, I use German Socio-Economic Panel Data (SOEP), to look at the relationship between the size of expatriate networks and the level of risk aversion for foreign born individuals arriving in Germany between 1960 and 2000. The SOEP includes a number of questions designed to capture the risk preference characteristics of respondents and also contains information on a large number of socioeconomic characteristics. When controlling for other determinants of risk attitudes and the year of arrival, I find that there is a statistically significant negative relationship between the size of the network and the willingness of migrants to take risks, as predicted in the model. The magnitude of this effect is significant when compared to other characteristics which traditionally have been shown to determine risk preferences, such as gender and education.

The rest of the paper is organised as follows. Section 2.3 introduces the model and presents comparative statics, Section 2.4 develops the model in a dynamic framework, Section 2.5, provides empirical support for the hypotheses derived from the theory, and Section 2.6 summarises the main theoretical and empirical findings of the paper, concluding with policy implications.

2.3 Network Size and Risk Preferences: Comparative Statics

In this section I show how the 'cut-off' level of risk aversion is derived. This level determines who will migrate and who will stay in the home country in any given time period. Assuming that risk preferences play an important role in the migration decision, this section shows that a lower level of risk will be associated with more risk averse individuals migrating[5].

Instead of interpreting risk preferences as a component of migration costs, I derive the Arrow-Pratt measure of absolute risk aversion explicitly from the costs, benefits and expected unemployment risk facing potential migrants. This allows a link to be made between relative prospects at home and abroad and the characteristics of migrants, vis-à-vis the source country population.

I assume that the factors that influence the decision to migrate are: the cost of migration (C), the probability of finding employment (α_t), and the wage differential between

[5] Recent theoretical articles have linked risk aversion and migration in a variety of different ways. Heitmueller (2005) links risk aversion of migrants with the choice of destination country, where the countries differ in terms of welfare provision. Wang and Wirjanto (2004) use a stochastic model based on the investment literature to investigate the impact of risk attitudes and uncertainty on the timing of migration decisions. They conclude that in the presence of uncertainty at home and abroad, those with average levels of risk aversion will migrate first.

home and abroad (B). I assume that all individuals in the source country face the same levels of α_t, C, B in any given period and that C and B do not vary over time. The invariance of B over time relates to the assumption that the marginal migrant does not significantly affect the wage in the host country and a fixed C suggests that the physical costs of migration do not change as the network size increases. The aim of the theory in this chapter is to improve our understanding of how migrant networks develop in the short to medium term, before actual wages are influenced by the increase in the supply of the labour force. Given that migration rates are often rapid and networks develop quickly, it is reasonable to assume that the driving force of the migration process is not changes in actual wages, which occur in the medium to long term, but rather the increase in information flows from migrants to individuals in the home country. These information flows occurs almost instantaneously and increase along with networks. I later discuss the consequences of relaxing some of these assumptions.

I propose a two country model where individuals in the sending country have expected lifetime utility $U(W)$ if they decide not to migrate. I assume this is known with certainty, which is intended to approximate the notion that individuals know a great deal about the job market at home relative to foreign countries and are able to predict their future wealth (if they don't migrate) relatively accurately. [6]. The expected lifetime utility of wealth for a migrant is, however, not known with certainty, as there is less available information about the labour market in the receiving country.

The parameters W, B, C, α_t correspond to the conditions involving a gamble, where an individual's risk preference is determined by the acceptance of a lottery with a given cost,

[6] This assumption is applicable to a pull migration process, where the main motivation to migrate is the prospect of higher wages abroad and not uncertainty in the sending country.

payoff and probability of winning. This combination can be used to determine the Arrow-Pratt measure of absolute risk aversion for the case of migration. In order to calculate the absolute level of risk aversion, I assume that all individuals have the same level of wealth W. Given that wealth W benefit B and cost C of migration are invariant, the question of interest is: what level of α_t combined with the other parameters would make an individual indifferent between their current level of wealth W (which is known with certainty) and the expected (uncertain) level of wealth from migration? This level of indifference can be written as:

$$U(W) = (1 - \alpha_t)U(W - C) + \alpha_t U(W + B - C) \tag{2.1}$$

Individuals have heterogeneous risk preferences, therefore $U(W)$ in (2.1) will differ between individuals even though W is assumed to be the same for everyone. Assuming a standard, concave, twice differentiable utility function in wealth $U(W)$, the Arrow-Pratt measure of absolute risk aversion can be written as $\rho = -U''(W)/U'(W)$. This implies that the level of risk aversion varies due to the differences in the concavity of individual utility functions. A Taylor expansion can be used to find $-U''(W)$ and $U'(W)$ for(2.1):

$$U(W) = U(W) + \alpha_t BU'(W) - CU'(W) + U''(W)((1 - \alpha_t)C^2 + \alpha_t(B - C)^2)/2$$

The relationship of interest is between the level of risk α_t and the timing of migration decisions. Therefore, holding other factors constant, (while assuming α_t varies over time), the marginal level of absolute risk aversion at time t can be written as:

$$\rho_t^* = (\alpha_t B - C)/(C^2/2 + \alpha_t B^2/2 - \alpha_t CB) \tag{2.2}$$

Where the marginal level of risk aversion ρ_t^* can be interpreted as a cut off level of risk aversion at time t. Therefore, the decision rule for individual i at time t is to migrate, ceteris paribus, when:

$$\rho_i < \rho_t^*$$

Where ρ_i is an individual's level of risk aversion and ρ_t^* is the level of risk aversion of the marginal individual, who is indifferent between migrating and staying at time t (the cut-off level of risk aversion). Given the formulation of the Arrow-Pratt measure, higher levels of ρ correspond to greater degrees of risk aversion. Therefore, the above inequality states that people in the source country that are less risk averse than the cut-off level, at time t, will migrate at time t. Individuals more risk averse than the cut-off level will stay in the home country.

2.3.1 Interpretation of Migrant Networks

The network effect in the theoretical model in this chapter is most closely related to the impact of networks and information flows. The network effect is considered as the marginal effect of the current stock of migrants on the, *expected* probability of finding work for future migrants. This marginal effect is evenly distributed among the individuals left in the source country population. In other words, the expected probability of finding work abroad of all individuals at home, is shifted by the same amount for everyone as a

result of migrant networks. As we are concerned about the perceived probability of finding work for potential migrants in the sending country, information flows from networks in the receiving country to individuals in the sending country provide the stimulus for future migration.

There is evidence to suggest that this information channel plays an important role in the migration decision. Recent empirical work has highlighted the importance of information flows on migration. (Pedersen et al., 2008) show how information flows can reduce the 'cultural distance' between the sending and receiving country and encourage future migration. The authors look at country comparisons of migration trends in OECD countries and find that, in addition to economic and linguistic factors, information flows from networks are an important determinant of migration flows. This Network effect is explained by the important role in immigration on reducing costs of acquiring information on policies and institutions in the destination country. Using a field experiment to vary the flow of information from the receiving to the sending country, Batista and Narciso (2012) demonstrate that increased information flows increase remittance flows from migrants in Greater Dublin, Ireland. In terms of theoretical contributions, Bertoli (2010) shows that information from migrant networks can influence uncertainty about wages abroad which in turn has an effect on migration rates and migrant selection, and Elsner et al. (2012) propose a theory in which better flow of information from migrant networks results in migrants moving earlier and doing better in the host country, compared to when networks are not as effective at spreading information.

In the theoretical framework in this chapter, expected probability of finding work for potential migrants is driven by the flow of information, where larger networks in the

receiving country increase the flow of information regarding the probability of finding work. This increased information about the availability of work in the receiving country encourages more individuals to migrate from the sending to the receiving country. I first assume that each new migrant increases the information flow regarding job availability by an equal amount, I relax this assumption by allowing decreasing marginal information flows as migrant networks increase in section 2.4.3.

2.3.2 Networks and Migrant Self Selection

Network effects can be introduced in Equation (2.2) if we assume that networks impact on the level of risk α_t in the receiving country, which determines the threshold level ρ_t^*. It is reasonable to assume that the probability of finding work for a recent migrant depends, to a large extent, on the help she can expect to receive from the expatriate community abroad. This is acknowledged by the literature on network effects, which suggests that networks play an important role in attracting future migrants. The assumptions that a larger network of expatriates in the source country increases the probability of finding work α_t, and that the stock of migrants is increasing over time, leads to the following proposition:

Proposition 1. *As the expected probability of finding work in the foreign country increases, the average level of risk aversion in the total migrant population will also increase.*

Proof. If there is a positive relationship between α and ρ_t^*, the first derivative of ρ_t^* with respect to α_t is:

$$\frac{d\rho_t^*}{d\alpha_t} = \frac{B(C^2/2 + \alpha_t B^2/2 - \alpha_t CB) - (\alpha_t B - C)(B^2/2 - CB)}{(C^2/2 + \alpha_t B^2/2 - \alpha_t BC)^2}$$

The denominator is non-negative and is equal to 0 only in the specific case when $\alpha_t = 1$ and $B = C$ (see Appendix A). The numerator is positive when:

$$B(C^2/2 + \alpha_t B^2/2 - \alpha_t CB) > (\alpha_t B - C)(B^2/2 - CB)$$

$$B > C$$

I assume that the outcome in the foreign country is not known with certainty, therefore $\alpha_t < 1$. In other words, no individual knows with certainty that they will find work abroad. Furthermore, assuming rational behaviour, even the most risk loving individual will not migrate if the total cost of migration is equal to or greater than the benefit. Therefore, given that ρ_t^* is bounded by the inequalities $(B > C)$ and $\alpha_t < 0$, ρ_t^* increases as α_t^* increases for all possible values. From this, it can be show that if at least one extra individual migrates in response to a positive shift in ρ_t^* then the average level of risk aversion will also increase.

If:

$$\alpha_{t=1} < \alpha_{t=2} < \alpha_{t=3} \ldots . < \alpha_{t=i}$$

Then given the restriction $B > C$:

$$\rho^*_{t=1} < \rho^*_{t=2} < \rho^*_{t=3} \ldots . < \rho^*_{t=i}$$

and

$$\frac{\sum \rho^*_{t=i}}{n_{t=i}} < \frac{\sum \rho^*_{t=(i+1)}}{n_{t=(i+1)}}$$

Where $n_{t=i}$ is the number of individuals in the source country at time $t = i$. □

The above shows that if network size increases over time, both the probability of finding work and the average level of risk aversion will increase over time as well.

2.4 Network Effects and Rates of Migration: Dynamic Simulation

So far the theory has suggested that with growing networks, the average level of risk aversion of migrants will gradually increase. This suggests that there is a difference between early and later migrants [7]. As well as investigating how risk preferences of migrants change over time, the theory outlined above can be used to make predictions about rates of migration. Importantly, the rate of migration will depend on how risk preferences are distributed in the home country. Assuming that risk preferences are normally distributed [8], I explore how the rate of migration changes as migrant networks in the receiving country increase the probability of finding work.

Assuming that risk preferences are normally distributed in the sending country [9], the proportion of individuals that will migrate at the given levels of W, α_t, C, B is given by the probability that an individual has a lower level of risk aversion than ρ_t^*:

$$P(Z < (\mu - \sigma_{\rho_t^*}))$$

[7] The difference in characteristics between early 'pioneers' and later followers has been explored in the literature. See for example (Bauer et al., 2002; De Haas, 2010)

[8] Empirical studies by Hartog et al. (2002) and Jaeger et al. (2010) suggest that risk attitudes follow a close to normal distribution.

[9] (Dohmen et al., 2005) find that the response to the general risk question in the SOEP, are approximately normally distributed

This gives the proportion of the source country population that will migrate, with $\mu - \sigma_{\rho_t^*}$ denoting the threshold level of risk aversion in terms of standard deviations from the mean. Assuming that at the initial time period $t = 0$ the corresponding standard deviation for a normally distributed population is $\mu - \sigma_{\rho_{t=0}^*}$, the lightly shaded area D in Figure 2.1 gives the proportion of migrants that migrate at $t = 0$. If the expected probability of finding work α_t increases in order to shift the ρ_t^* one standard deviation to the right, then the number of people that move between period $t = 0$ and $t = 1$ is given by the darker shaded area E. Therefore, the total proportion of the individuals in the receiving country at time $t = 1$ is given by the combined area of D and E. Figure 2.1 illustrates that, even when ρ_t^* has a constant rate of increase, the rate of migration will not be constant over time.

Given the shape of the normal distribution curve, the rate of increase will be greater or equal to one, until half of the source country population has migrated. This is demonstrated by area E being larger than area D. To summarise, Figure 2.1 shows that: $\rho_{t=1}^* > \rho_{t=0}^*$, $D < E$ and the rate of increase is greater than one when $0 \leq P(Z < z) \leq 0.5$.

2.4.1 The Rate of Migration as a Function of Networks

So far I have assumed that the level of α_t increases over time by exactly the amount required to induce a one standard deviation change in ρ_t^* over that time period. In this section, I look more explicitly at the dynamic interaction of network effects and risk. The two are related because I assume risk is a function of networks in the previous time period and networks are a function of risk in the current time period. The effect of the size of the network is lagged because the impact of an increase in network size due to new arrivals,

will only affect the migration rate in the next time period. This can be written as:

$$\begin{cases} M_t = h\left(B, C, \rho_t^*\right) \alpha_t \\ \alpha_t = f\left[g(M_{t-1})\right] \end{cases} \tag{2.3}$$

In this system of equations M_t is the number of migrants in the source country at time t, and the level of uncertainty α_t is a function of the number of migrants in the source country in the previous time period M_{t-1}. The number of migrants in the source country at any given time is a function of costs, benefits, marginal risk aversion and risk. Given that migration costs and benefits are fixed, it is the changing level of risk α_t, governed by network effects, that drives the migration process.

Equation(2.3) can be written as a dynamic system of equations, where the proportion of individuals in the receiving country at time t is determined by the threshold level of risk ρ_t^* and is given by the following cumulative distribution:

$$M_t = \phi(Z_{\rho_t^*}) \tag{2.4}$$

Where $\phi(Z_{\rho_t^*})$ is the standard normal density function. $Z_{\rho_t^*}$ is the standard deviation of the threshold level of risk aversion, relative to the mean level of risk in the sending country, and can be written as:

$$Z_{\rho_t^*} = \frac{\rho_t^* - \overline{\rho}}{\sigma_\rho}$$

$\overline{\rho}$ is the mean level of risk aversion in the sending country and σ_ρ denotes one standard deviation. Given that these two population parameters are fixed, the stock of migrants at

time t is determined by the threshold level of risk aversion. This, in turn, is determined by the threshold level condition, as derived in section 2:

$$\rho_t^* < (\alpha_t B - C)/(C^2/2 + \alpha_t B^2/2 - \alpha_t CB) \tag{2.5}$$

As discussed above, the parameters B and C are constant over time, therefore, changes of the threshold level ρ_t^* are governed by α_t, the probability of finding work in the receiving country. In turn, this probability is affected by the size of networks, this can be expressed as:

$$\alpha_t = \frac{\underline{\alpha} + M_{t-1}X}{2} \tag{2.6}$$

where $M_{t-1}X_t/2$ is the network effect of α_t, and $M_{t-1}X$ takes a value between 0 and 1. This is split into two components. The first component M_{t-1}, is the size of the network, lagged by one time period, I call this the 'Network Scale Effect' as it is the effect that the size of the network has on the probability of finding work for new arrivals. The second component X, is the marginal effect of M_{t-1} on α_t. I call this the 'Network Impact Effect', because it tells us the extent to which each migrant can increase the probability of finding work for new arrivals.

Even with no networks in the receiving country, I assume that there is a certain level of risk, which is given by $\underline{\alpha}/2$, which has a value between 0 and 1 and gives the level of α_t at time $t = 0$. This gives the probability of finding work even if there are no migrants in the receiving country [10].

[10] $\underline{\alpha}$ plays two important roles. First, it provides the initial condition for the first iteration of the simulation, and second it ensures that some individuals in the sending country will never migrate irrespective

The dynamic process is set in motion by the initial level of risk $\underline{\alpha}/2$ (Equation 2.6), which results in a specific threshold level ρ_t^* (Equation 2.5) that leads to all individuals that are more risk loving than the threshold to migrate and make up the stock of migrants at time t given by M_t (Equation 2.4). In the next time period the level of risk will be determined by the network in the previous time period M_{t-1}, which brings us back to Equation 2.6.

2.4.2 Strong and Weak Network Effects

So far I have assumed that the Network Impact Effect(X) is a predetermined value. However, it could well be the case that in some migration processes each migrant can reduce risk by a great deal while in other cases the marginal effect is small. In order to see how changing the strength of this effect impacts on the dynamics of migration, I simulate the migration process using equations 4 to 6, first with a low and then a high value for X. The results are displayed in Figure 2.2 and show the changing proportion of migrants living in the receiving country over a given time period. In Figure 2.2, the solid line denotes strong network effects and the broken line shows the outcome when Network Impact Effects are less important (X is larger in the former than in the latter). The results of the simulation show that network effects alter the timing and rate of migration.

As well as demonstrating that stronger networks increase the total stock of migrants, Figure 2.2 also shows that: first, individuals migrate sooner when network effects are stronger; and second, the rate of migration is faster. The former is demonstrated by the fact that the solid line is to the right of the broken line and the latter by the fact

of the strength of the network effect. For example, if the $\underline{\alpha}$ has a low value, even if $M_{t-1}X$ is tending to 1, there will be a proportion of individuals in the source country who will never migrate.

that the slope of the solid line is greater than that of the broken line. This shows that when potential migrants rely heavily on networks to find work, it could lead to a faster rate of migration. This hypothesis is a central contribution of this paper as it suggests that integration policies that reduce the reliance of migrants on networks could not only increase the average 'quality' of migrants but also reduce the rate and scale of migration, holding other factors fixed.

2.4.3 Decreasing Marginal Network Effect

So far I have assumed that each individual decreases the expected risk of unemployment by the same amount, irrespective if the already existing size of the network. It could be conceivable that the marginal network effect diminishes as networks grow. This diminishing influence of networks has been modelled theoretically by (Vergalli, 2008; Bauer et al., 2002) and has been found empirically in articles such as Davis et al. (2002). Many studies in the literature suggest that the network effect has in 'inverse U' shape related to the size of the network. The intuition being that, initially migrants provide positive information, with diminishing marginal effects. At a certain point it futher migration can impact negatively on current migrants incentivising them to provide negative signals for member at home.

I incorporate the insight that the marginal effect of migration could be diminishing, by making marginal individual network effects a negative function of network size. More specifically, I assume that there are a limited number of jobs for potential migrants in the host country and that the positive impact of having more individuals in the receiving country from the source country is counterbalanced by fewer available jobs in the source

country. Figure 2.3 shows a simulation where a 1% point increase in network size reduced the individual network effect by 1%. This decreasing marginal network effect is modelled for a higher (solid line) and a lower (dashed line) initial network strength. Comparing Figure 2.3 to Figure 2.2, it is clear that fewer individuals will migrate and at a lower rate, when marginal network effects are decreasing. However, when comparing strong and weak initial networks, when both have decreasing marginal network effects (as in Figure 2.3), the main conclusions outlined above remain. Namely, that when initial network effects are stronger, more individuals will migrate, at an earlier time and at a faster rate.

2.4.4 Endogenous Wages and Migration Costs

So far we have assumed that the migration costs C and the wage differential B is exogenously determined and constant over time. We can relax these two assumptions by allowing the wage differential and the cost of migration to change over time in response to increases in network. Given that an increase in the supply of labour lowers wages we would expect the wage differential between the home and sending country to decrease over time. Furthermore, given that an increase in the demand for travel routes decreases prices, and migrant networks reduce the psychic cost of being away from home we would expect the cost of migration to also decrease as networks increase over time. Figure 2.5 shows two simulations: where the wage differential and cost of migration decrease by 0.5 percent for every increase in migration equivalent to 1% of the sending country population (the blue line); and where the wage and cost of migration decreases by 0.2 percent for every increase in migration equivalent to 1% of the sending country population (red line). Given that a decreasing wage differential B is a negative factor for potential migrant and a decreasing

cost C is a positive effect the overall result depends on the strength of the relative effects. With the higher wage and cost effect Figure2.5 (blue line) migration increase exponentially, where as with the lower effects the size of the network satbilises much sooner (red dotted line). Therefore the overall effect of endogenising wages and migration costs on migration flows depends on the relative strength of the effects.

2.4.5 Risk Attitudes and Observable Characteristics

A further way to extend the model is to consider the relationship between the selection of migrants based on risk preferences and other characteristics, such as education. While the model so far has focused specifically on risk preferences, the insights of the Roy-Borjas model can provide predictions on selection in terms of other characteristics. While the theory set out above suggests that, the average level of risk aversion increases in the migrant population if networks are growing; whether this migrant group is positively or negatively selected in terms of observable characteristics could be determined by the parameters of the Roy-Borjas model Borjas (1987). In this case, while the traditional Roy-Borjas framework predicts initial selection in terms of observable characteristics, we can predict how the 'quality' of migrants in terms of these characteristics changes as networks grow. These predictions can be made if we know the correlation between those characteristics and risk preferences. I focus here on education, but the same reasoning can be applied to other observable characteristics.

Starting with the initial condition of no networks, migrants will either be positively or negatively selected in terms of education (compared to the source country population) based on whether education is rewarded more highly at home or abroad, (Borjas, 1987).

Therefore, only individuals with a certain level of education will find it advantageous to migrate, either because their high education could command a higher income abroad (positive selection) or because wages for individuals with low education are compensated abroad due to redistribution policies (negative selection)[11].

Taking the case of positive selection in education, the value B in Equation 2.1 would only be sufficiently high for individuals on the right tail of the education distribution, i.e. individuals earning above the average income level. If we relax the assumption that everyone has the same education (and income) in Equation 2.1, then selection in terms of risk preferences will depend on the correlation between education and risk attitudes. If we assume that education and the willingness to take risks are positively correlated, then the first migrants will be positively selected both in terms of education and willingness to take risks. As networks increase and risk is reduced, individuals with a combination of lower education and lower willingness to take risks will now migrate. A marginal reduction in risk will increase the number of individuals willing to migrate, both because more individuals have a marginally lower level of education than the initial condition and more individuals are marginally more risk averse [12]. Alternatively we can say that the joint probability of migrants being marginally more risk averse and having a marginally lower level of education increases as networks increase and risk is reduced. In the case of negative selection, the result of a decrease in risk is less conclusive and depends on the strength of the correlation between risk preferences and education.

These insights can be incorporated more formally in the framework of the Roy-Borjas

[11] In terms of the model in this paper, the parameter B (benefit of migration) in Equation 2.1, could be interpreted as this advantage to migration.

[12] Given that the initial threshold income level is on the right hand side of the income distribution, a marginal shift to the left will increase the number of people willing to migrate

model by interpreting risk attitudes as the variant component of migration costs, where these costs are normally distributed in the source country population. This approach follows the insight provided by Chiquiar and Hanson (2005) and is explicated in Appendix B.

2.5 Empirical Analysis of the Link between Network Size and Risk Preferences

This section proposes to examine the central hypothesis provided by the theoretical model, that when migrant networks are larger, the average migrant will be more risk averse.

2.5.1 Econometric Model

The predictions of the theory are based on a two country model, where the risk attitudes of individuals are relative to the source country population. In reality, migrant communities in the source country often represent a number of nationalities. One would expect the risk preferences between these nationalities to differ because of cultural reasons. Therefore, when looking at migrants from a variety of source countries it is important to account for country specific differences in risk attitudes. To control for these differences, I use a specification with country of birth fixed effects to identify the relationship between network size and willingness to take risks.

I investigate the impact of network size on risk attitudes after controlling for individual determinants of risk attitudes (as found in the literature), the year of immigration and unobserved heterogeneity due to cultural differences between nationalities. The following

equation forms the empirical framework of the analysis:

$$Risk_{ij} = \beta_1 Net_{ji} + \beta_2 Myear_i + \beta_3 \boldsymbol{X_i} + \alpha_j + \epsilon_i$$

where $Risk_{ij}$ is a measure of the willingness of individual i who migrated from country j to take risks. Net_{ji} is the number of foreign born individuals from country j in the receiving country one year before individual i migrates [13]. $Myear_i$ is the year individual i migrated to the receiving country. $\mathbf{X_i}$ is a vector of individual characteristics which have been shown to affect risk attitudes such as age, gender, height, income, self-employment, and schooling. α_j is the country of birth fixed effect to account for cultural differences in risk attitudes, ϵ_i is the error term.

2.5.2 Data Description

I use the 2010 wave of the German Socio-Economic Panel Study (SOEP) which is a representative panel survey of the resident population of Germany, conducted since 1984. Germany is a relevant country to test the impact of migrant networks as the number of foreign born individuals increased dramatically between 1951 and 2000 (see Figure 2.4), the period used in this paper. While the source countries of Turkey, Italy, Former-Yugoslavia, Poland and Greece form the majority of individuals in the data-set, a large variety of countries are represented (see Table 2.6). The variable for the size of the expatriate network between 1951 and 2000 is estimated from a combination of sources [14]. Only individuals

[13] It is lagged by one year to account for the fact that the migration decision is made one year before migration.

[14] I use two main sources to estimate the actual size of the migrant population for the countries and years represented in the data-set; the German Statistical Office, and World Bank International Migrant Stock data. The network size variable is expressed in units of 10,000 migrants.

born outside of Germany are included in the sample, therefore I exclude second and third generation migrants.

As well as having a large sub-sample of migrants, the SOEP also includes a module on risk attitudes which includes questions that gauge the willingness of individuals to take risks. These questions were included in the study after 2004 and include self-evaluation of an individual's 'willingness to take risks, in general'; along with measures of risk preferences in other domains. I use the general self-assessed risk measure, as it has been shown to be the best predictor of an individual's actual general risk taking behaviour[15]. The general measure of risk aversion was found to be especially good predictor for the measure involving real money incentives and therefore suggests that this measure is a valid for the domain of risk preferences in the domain of money. While it has been shown that risk attitudes vary between different domains, the theoretical model being tested in this paper look at risk in the money domain, equivalent to a risky investment decision, which is the domain of risk that the question was designed to capture. The possibility of specific strategies, buy some individuals, involving gambling on smaller stakes that are not translated to larger financial decision, such as migration, cannot be ruled out. Nevertheless, the SOEP measures of risk have been tested using real incentives and capture risk preferences well compared to measures used in other data sets.

In order to test the relationship between network size and risk aversion, the sample contains foreign born individuals who entered Germany after 1960 and before 2000, and who answered at least one of the questions regarding personal willingness to take risks that

[15] Dohmen et al. (2005) test the behavioural relevance of the survey measures by conduction a complementary field experiment on a representative sample of 450 individuals involving real significant monetary payoffs. They find that the general risk question was the best performing questions for predicting real outcomes of risk attitudes.

were included in the SOEP surveys between 2004 and 2009. Looking first at descriptive statistics suggest that there is a negative relationship between network size and willingness to take risks, with a correlation of -0.1374 (*Spearman*; $p < 0.00001$) before controlling for other factors.

2.5.3 Empirical Results

In order to test the theoretical model outlined above, I compare the risk attitudes of individuals that arrive when networks are small, to risk attitudes of migrants that arrive when networks are large. I control for the main characteristics that have been shown to be important determinants of risk preferences in the literature (Jaeger et al., 2010; Dohmen et al., 2010; Bonin et al., 2009, 2007; Ekelund et al., 2005; Cramer et al., 2002). The independent variable is the size of the migrant network one year before migrating.

Columns (1) to (4), in Table 2.1, show the results for OLS regressions. The first specification includes the characteristics that are most often used as explanatory variables in the empirical risk literature, and provides a comparison between this paper and existing research to ensure the validity of the control variables. The R squared and the signs of the coefficients are similar to those reported in the studies mentioned above. For example, older individuals, women and individuals with no schooling are expected to be less risk loving; whereas taller, wealthier and self-employed individuals are expected to be more risk loving. This confirms that the variables used in the specification are valid controls for the sample used.

Column (2), in Table 2.1, includes the dependent network variable with age, gender and height controls. These are individual characteristics that have very limited measurement

error and are unlikely to suffer from reverse causality. In this specification, the network variable is negative and significant. Including other individual controls of wages, self-employment and schooling reduces the magnitude of the effect but does no change the sign or its statistical significance. Finally, Column (4) includes the control for 'immigration year', which captures the time a migrant has spent in Germany. Controlling for the year of arrival does not significantly change the magnitude nor the sign of the coefficient and it remains statistically significant . The OLS specification provides support for the hypothesis that network size and willingness to take risks are negatively related.

Given that an important source of variation in risk attitudes could be due to nationality, I control for countyr of origin, in Columns (5) to (7), in Table 2.1. Column (5), includes the basic characteristics as in Column (2), and shows that the network variable still has a negative sign and is highly significant. Including the other individual level characteristics of wages, self-employment and schooling, shown in Column (6), marginally increases the magnitude of the point estimate and the variable remains negative and statistically significant. Controlling for years of immigration does not significantly alter the magnitude of the network estimate but it does lose its insignificance. This could potentially be due to high correlation between year of arrival and network size when focusing on within country variation, as most countries experienced growing networks. The estimate does, however, suggest that the relationship between network size and risk aversion could be negative even when year of arrival is controlled for.

Looking at the results of the regressions where country of origin is controlled for, suggests that the point estimate on the network variable is approximately -.05. The interpretation of this result is that an increase in the network size by 10,000 individuals

in Germany reduces the average willingness to take risks by 0.05 points on the risk measure scale. While this might appear to be a small magnitude, when considering the rate of migration in Germany this becomes significant. For example, the number of Turkish born individuals increased by around 918,300 between 1965 and 1975, this would suggest a decrease in the willingness to take risks by just under 5 points on the risk scale for this period. This is similar to the magnitude of the difference between being male and female (6.7) or the effect of completing secondary school (5.0).

While the stock of migrants increased in Germany for most nationalities, it was not the case for all countries over the whole time period in question. To ensure that these observations are not driving the results, I restrict the sample only to time periods and countries that saw an increase in the number of migrants. Table 2.2 shows the results when observations are restricted to individuals that arrived at a time when migrant networks were increasing. Columns (1) to (4), in Table 2.2 show that that an increase in the network size by 10,000 individuals in Germany reduces the average willingness to take risks by between 0.03 and 0.05 points on the risk measure scale, depending on the control variables used. These results are comparable to the full sample presented in Table 2.1, with the magnitude of the effects being marginally lower, and the result remaining significant at the 5% level for specification 1 to 3 and 6% for specification 4. Finally, Column (5) controls for the year of migration. As in the case of the full sample the point estimate remains negative and the magnitude increases relative to the other specification, while losing its significance. The results presented in Table 2.2 suggest that the results are not being driven by periods when networks are decreasing in size. As before, the magnitude of the effects is significant in the context of the scale of migration experienced in Germany

over the years in the sample.

2.5.4 Sensitivity Analysis

An important aspect of the German data used in the empirical section is that it mainly comprises of two types of migrants. The first group are often referred to as 'guest workers' and came in response to labour shortages in the 1960s and 1970s, followed by family which was ovserrepresented by female migrants. The second group are ethnic Germans from Eastern Europe who arrived later and migrated for broader reasons beyond purely economic. Given that the theory outlined above is based on labour economic motivations I expect there to be a stronger effect for the guest workers and male migrants are female migrants where overrepresented among those coming for family reunification reasons. Table 2.3 shows the results for the same specifications as outlined above with the addition of a 'guest worker- network' interaction term. The results show that for the interaction term for the network variable and dummy for guest worker, the sign on the coefficient remains negative and has an even higher statistical significance relative to the full sample. The magnitude of the effect has also increased dramatically as can be seen in Table 2.3, Column 3.

Table 2.4 includes the interaction of networks with a dummy variable for being male. The results in 2.4 show that the effect of the network variable is especially significant for male migrants as the statistical significance of the male- network interaction has increased. The sign of the interaction term remains negative as expected and the magnitude is similar to what was found for the network variable in Table 2.2.

Including the interaction terms suggests that the link between networks and risk pref-

erences is especially statistically significant for 'guest-worker' and male migrants. This is the expected result given the strong economic motivation for guest workers and the over representation of women among migrants moving for family reunification reasons.

2.5.5 Alternative Explanations for Results

The theory presented in this chapter is intended to explain how networks develop and how selection in migrants changes in the short to medium term, before actual wages are affected by the increase in the labour force. Unfortunately, monthly migrant data which includes risk characteristics is not available; therefore, long term network migration is used in the empirical part. While the theoretical model provides a good xplanation for the reults discussed above, given that the data is long-term there are other potential explanations. Most importantly, it is possible that the actual level of wages increased during the time frame of the data and that this influenced the selection in migration in other characteristics that might be related to risk preferences. While I control for observable characteristics such as wages, type of employment, gender ect., there could be other unobservable characteristics, found to be significant in other studies, that are driving the results such as the health of migrants (Rubalcava et al., 2008) or willingness to cross cultural boundaries(Bauernschuster et al., 2012).

2.6 Individual Risk Preferences Over Time

The empirical results show that there is a correlation between network size at time of arrival and willingness to take risks, while controlling for other individual characteristics

and the year of migration. Given that the self-assessed risk measure was recorded between 2004 and 2009 an alternative explanation for the results could be that migrants assimilated to native level of risk aversion by becoming more risk loving over time.

It is possible to explore this alternative explanation of assimilation further as the SOEP data-set contains repeated risk measures for migrants, recorded in 2004 and 2009. If the assimilation hypothesis were true one would expect migrants to become more risk loving over these five years. However, after controlling for age effects the data suggest that there was a marginal decrease in the willingness of migrants to take risks in these five years. As shown in Table 2.8, on average a migrant became 4 points less risk loving on the risk measure scale between 2004 and 2009. In fact, there was a decrease in the willingness to take risks in all of the relevant risk domains measured in the survey as shown in Table 2.8 . Therefore, the direction of change in individual risk preferences over time would understate the scale of the main result presented in this chapter, and gives weight to the hypothesis that the negative sign on the network variable in the main regressions are not driven by assimilation effects.

2.7 Conclusion

As the total number of migrants continues to rise globally, policy makers in source countries are becoming increasingly concerned about the rate of migration as well as the level of human capital of recent arrivals. This paper develops a theoretical model to investigate how the average risk attitudes of migrants changes with the size of networks and how networks can influence the rate of migration. The assumption that networks reduce risk

surrounding the migration decision, results in the conclusion that larger networks are associated with a higher average level of risk aversion. Furthermore, assuming that risk preferences are normally distributed in the source country, the link between network size and risk leads to the following testable hypotheses: when networks effects are stronger, more individuals will migrate, they will migrate sooner, and at a faster rate.

The first result suggests that over time the average migrant will be more risk averse. Assuming that risk aversion is negatively related to other desirable characteristics such as entrepreneurial potential and cognitive ability, growing networks will have implications on the average human capital in both the sending and receiving country[16]. There will, therefore, be a negative effect over time for the receiving country and a positive effect for the sending country, in terms of unobservable human capital. A specific policy recommendation for the receiving country leading on form this conclusion is that a larger number of small migrant networks could result in higher levels of human capital, holding other factors fixed. This suggests that a migration policy encouraging diversity could have positive effects.

In terms of migration rates, the results of the simulations suggest that when networks are more important, migrants move sooner and within a shorter period of time. This has relevance for the source country where an unexpected surge in migration could result in shortages of public services, such as housing and welfare. For the sending country, stronger networks suggest a faster 'drain' of human capital. Understanding this relationship could help governments to plan for such instances and devise strategies to avert labour shortages in the sending country and strains on public resources in receiving country.

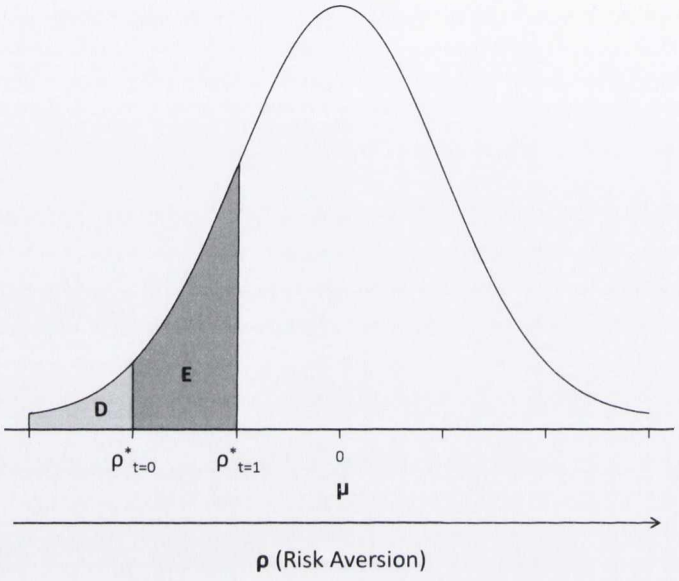
[16]The link between risk aversion and entrepreneurial talent is explored in (Kanbur, 1979; Ekelund et al., 2005; Bonin et al., 2007)

The framework is extended to investigate the relationship between selection on risk attitudes and other observable characteristics, such as education. Under a given set of assumptions, it is shown that in the case of positive selection in education, early migrants will be positively selected in terms of *both* education and risk preferences, with the selection becoming less positive in both characteristics as network size increases. This leads to the conclusion that as networks grow the human capital of migrants in terms of both observable and unobservable characteristics will decrease while the rate of migration will increase.

The link between migrant networks and risk preferences is tested empirically using German Socio-Economic Panel Data. I find that after controlling for other determinants of risk attitudes, and the year of arrival, there is a statistically significant negative relationship between the size of the network and the willingness of migrants to take risks, as predicted in the model. The magnitude of this effect is significant when compared to other characteristics which traditionally have been shown to determine risk preferences, such as gender and education.

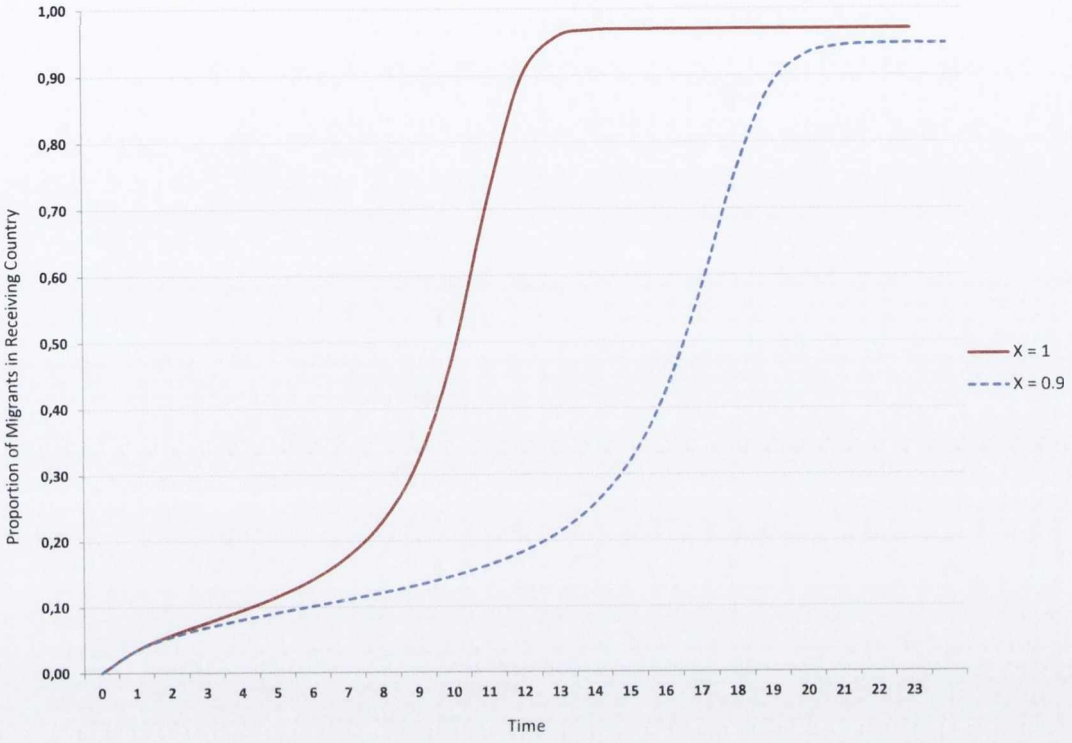
Chapter 2 Tables and Figures

Figure 2.1: Normally Distributed Risk Preferences



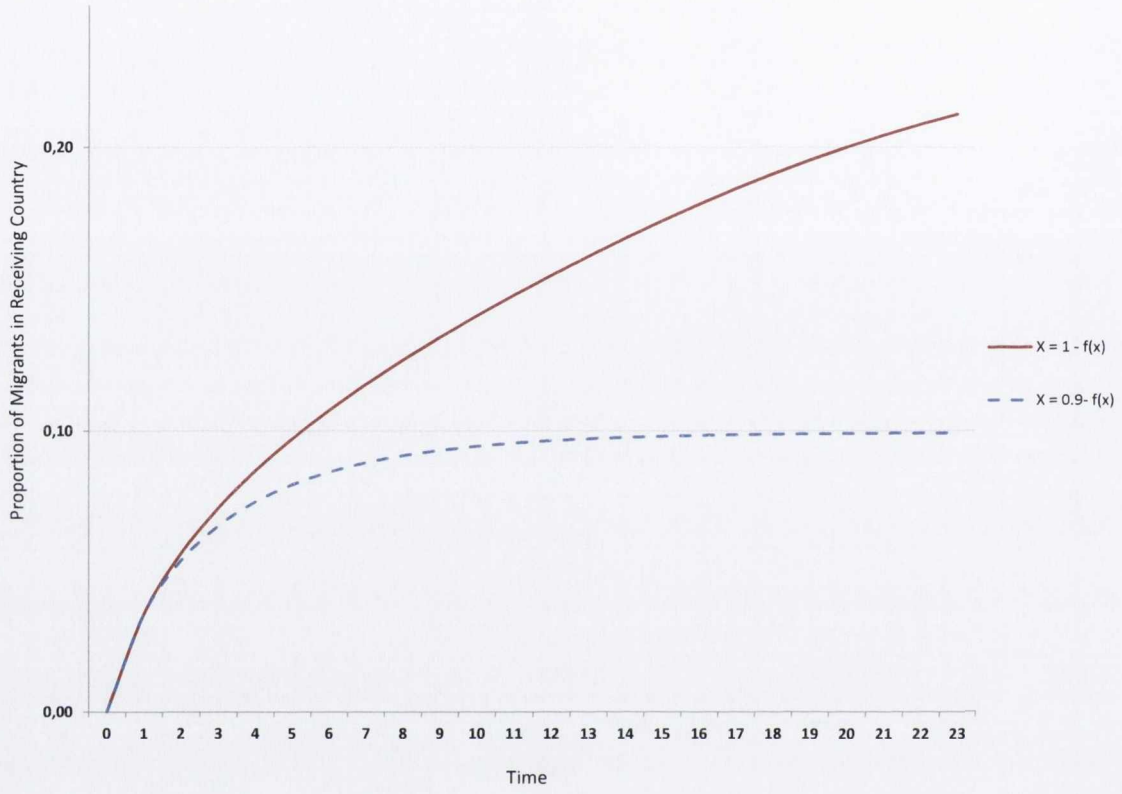
Note: Risk aversion ρ_t^* increases, going from left to right. Area D gives the proportion of migrants that migrate at $t = 0$. If the expected probability of finding work α_t increases in order to shift the ρ_t^* one standard deviation to the right, then the number of people that move between period $t = 0$ and $t = 1$ is given by area E. Area E being larger than area D illustrates the fact that even if risk is reduced at a constant rate (one standard deviation per time period) the rate of migration will increase over time. This is true as long as less than half of the population migrates.

Figure 2.2: Migration Dynamics with Strong and Weak Network Effects



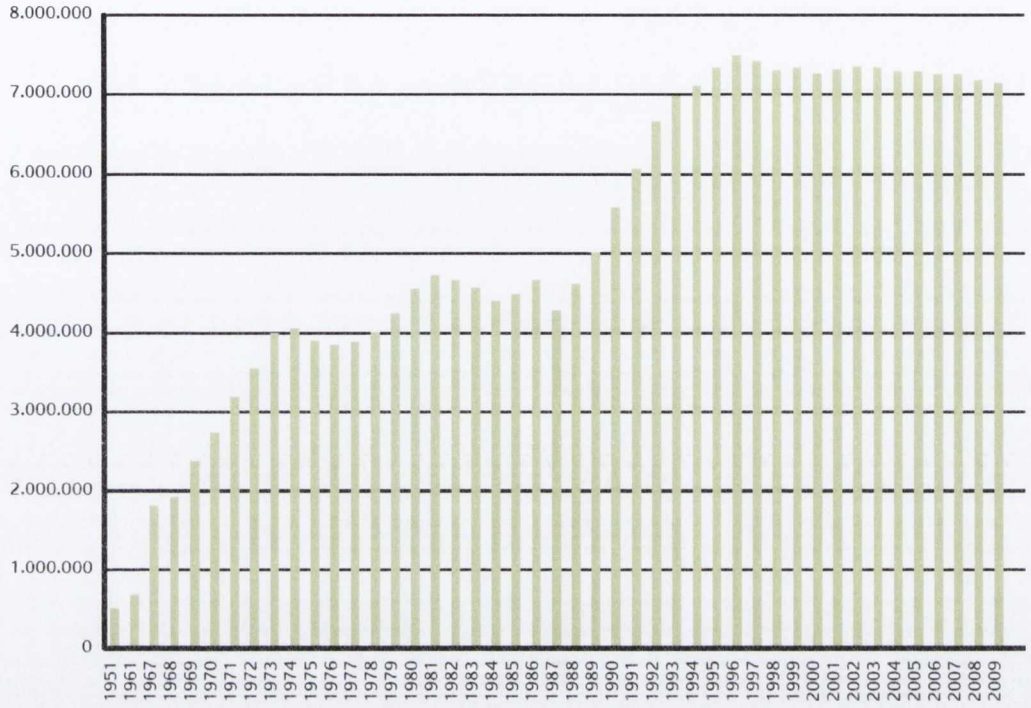
Note: The figure above shows the proportion of individuals that migrate in each time period, with strong (solid red line) and weak (dashed blue line) network effects. In the initial time period there are no migrants in the receiving country ($M_{t=0} = 0$). The level of risk with no networks is assumed to be ($\underline{\alpha}/2 = 0.4$); the wage differential is ($B = 180$); cost of migration is ($C = 50$); the mean Arrow-Pratt level of absolute risk aversion in the sending country is ($\mu = 0,01$); and the risk attitudes are normally distributed with a standard deviation of ($\sigma = 0.002$). For the solid line the individual network effect is $X = 1$, and for the dashed line it is $X = 0.9$. The figure shows that when migrants are more reliant on networks (stronger individual network effect), more individuals will migrate, they will migrate sooner *and* at a faster rate.

Figure 2.3: Migration Dynamics with Declining Network Effects



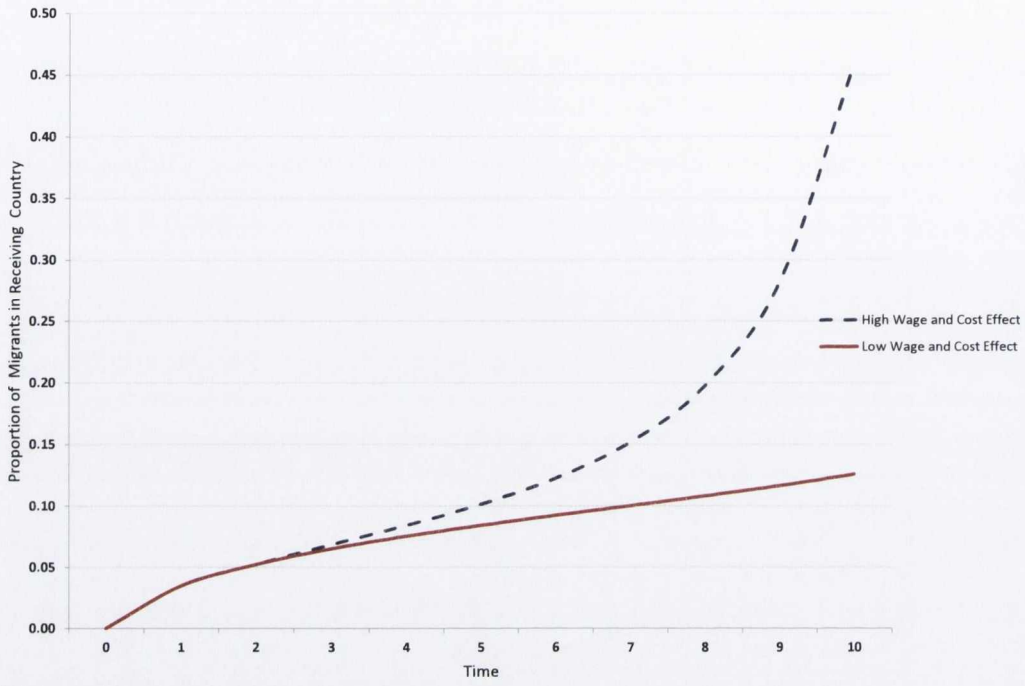
Note: As in Figure 2, $(M_{t=0} = 0)$, $(\underline{\alpha}/2 = 0.4)$, $(B = 180)$, $(C = 50)$, $(\mu = 0,01)$, and $(\sigma = 0.002)$. Different from Figure 2, individual network effects diminish as networks grow. For the solid line the individual network effect for the first migrant is $X = 1$, this effect is reduced by 1% for every 1% increase in the migrant population, and for the dashed line the network effect for the first individual is $X = 0.9$ this effect is also reduced at the same rate. The figure shows that modelling individual network effects as decreasing, reduces the total number of migrants when compared to fixed network effects. However, comparing strong and weak initial network effects leads to the same conclusion as the initial model. When initial networks are stronger individuals will migrate sooner and at a faster rate.

Figure 2.4: Stock of Migrants in Germany, 1951 - 2009



Source: Immigrant Figures, National Department for Migration and Asylum (Ausländerzahlen 2009. Bundesamt für Migration and Flüchtlinge)

Figure 2.5: Migration With Endogenous Wage Diferentials and Migration Costs



Note: $(M_{t=0} = 0)$, $(\mu = 0,01)$, and $(\sigma = 0.002)$. The Figure shows two simulations: where the wage differenence$B$ and cost of migration C decrease by 0.5 percent for every increase in migration equivalent to 1% of the sending country population (the blue line); and where the wage and cost of migration decreases by 0.2 percent for every increase in migration equivalent to 1% of the sending country population (red line).

Table 2.1: Risk Attitudes and Networks. DV: Willingness to Take Risks

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) FE	(6) FE	(7) FE
Network(t-1)		-0.074***	-0.045***	-0.046***	-0.044**	-0.049*	-0.055
		(0.006)	(0.009)	(0.009)	(0.016)	(0.020)	(0.038)
Age	-0.374***	-0.611***	-0.498***	-0.508***	-0.587***	-0.503***	-0.501***
	(0.062)	(0.091)	(0.101)	(0.118)	(0.093)	(0.116)	(0.122)
Female	-3.697*	-7.589**	-4.846*	-4.763*	-9.475***	-6.387**	-6.367**
	(1.426)	(2.185)	(2.378)	(2.277)	(2.092)	(2.029)	(2.098)
Height	0.291**	0.363***	0.240	0.247	0.249**	0.167	0.167
	(0.097)	(0.102)	(0.141)	(0.134)	(0.092)	(0.124)	(0.124)
Wages	2.083**		2.554*	2.545*		2.340	2.350
	(0.783)		(1.116)	(1.102)		(1.201)	(1.177)
Self Employed	2.971***		3.329***	3.336***		3.388***	3.385***
	(0.447)		(0.710)	(0.705)		(0.801)	(0.793)
No School	-7.650***		-5.047*	-5.119*		-5.517*	-5.533*
	(1.580)		(2.207)	(2.087)		(2.393)	(2.476)
Migration Year				-0.046			0.035
				(0.097)			(0.260)
Constant	15.705	21.031	34.031	125.413	40.418*	49.529	-20.175
	(18.369)	(22.677)	(29.172)	(205.166)	(20.012)	(26.738)	(522.674)
Observations	1615	1289	846	846	1289	846	846
R-sq	0.166	0.190	0.206	0.206	0.153	0.187	0.187
Within R-sq					0.153	0.187	0.187
Between R-sq					0.266	0.145	0.147
No Countries	86.000	49.000	41.000	41.000	49.000	41.000	41.000
Avg grp size					26.306	20.634	20.634

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Wages are expressed in EUR 1000's, 'No School' is a dummy variable for not completing secondary education, dependent variable is a measure of 'general willingness to take risks' on a 0 -100 scale, 'Network(t-1)' is the size of the expatriate network one year before an individual migrates, expressed in 10,000 units. The first four columns show OLS specification and columns 5 to 7 show regressions where countries of origin are controlled for.

Table 2.2: Risk Attitudes and Networks, Increasing Networks Only. DV: Willingness to Take Risks

	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE
Network(t-1)	-0.032*	-0.034*	-0.047*	-0.040	-0.055
	(0.015)	(0.015)	(0.022)	(0.021)	(0.049)
Age	-0.568***	-0.550***	-0.556***	-0.487***	-0.483***
	(0.098)	(0.078)	(0.111)	(0.116)	(0.118)
Female	-9.159***	-7.179***	-6.756**	-6.702**	-6.665**
	(2.482)	(1.636)	(2.111)	(1.986)	(2.035)
Height	0.286**	0.228*	0.228	0.191	0.189
	(0.096)	(0.090)	(0.135)	(0.129)	(0.129)
Wages		2.940**	2.270	2.040	2.065
		(1.015)	(1.298)	(1.228)	(1.209)
Self Employed			2.926**	3.067***	3.057***
			(0.875)	(0.851)	(0.837)
No School				-5.815*	-5.847*
				(2.258)	(2.303)
Migration Year					0.090
					(0.308)
Constant	32.232	34.429	41.200	44.687	-133.955
	(20.755)	(18.531)	(28.711)	(27.831)	(610.487)
Observations	1096	1020	764	716	716
Overall R-sq	0.186	0.208	0.210	0.197	0.194
Within R-sq	0.161	0.183	0.192	0.184	0.184
Between R-sq	0.246	0.248	0.165	0.141	0.148
Number of Countries	49.000	48.000	43.000	41.000	41.000
Average Size of Group	22.367	21.250	17.767	17.463	17.463

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Wages are expressed in EUR 1000's, 'No School' is a dummy variable for not completing secondary education, dependent variable is a measure of 'general willingness to take risks' on a 0 -100 scale, 'Network(t-1)' is the size of the expatriate network one year before an individual migrates, expressed in 10,000 units. The sample is restricted to observations to years when the migrant network size was increasing

Table 2.3: Risk Attitudes and Networks, Guest Worker - Network interaction. DV: Willingness to Take Risks

	(1) Risk	(2) Risk	(3) Risk
Network_GW	-0.329*	-0.547*	-0.649*
	(0.154)	(0.202)	(0.252)
Network(t-1)	0.283	0.493*	0.619*
	(0.148)	(0.193)	(0.268)
Age	-0.578***	-0.501***	-0.507***
	(0.077)	(0.121)	(0.127)
Female	-6.694***	-6.183**	-6.270**
	(1.570)	(2.115)	(2.191)
Height	0.186*	0.147	0.146
	(0.084)	(0.122)	(0.122)
Wages	2.931**	2.389	2.355
	(0.882)	(1.218)	(1.173)
Self Employed		3.386***	3.403***
		(0.805)	(0.783)
No School		-5.246*	-5.188*
		(2.198)	(2.255)
Migration Year			-0.145
			(0.298)
Constant	40.950*	50.272	337.326
	(17.740)	(26.227)	(596.529)
Observations	1167	824	824
R-sq	0.178	0.184	0.184
Within R-sq	0.178	0.184	0.184
Between R-sq	0.202	0.133	0.118
Number of Countries	46.000	38.000	38.000
Average Size of Group	25.370	21.684	21.684

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Network _GW is an interaction term for the Network size in the previous time period and a dummy variable for 'guest worker' migrants. All other variables are as described above.

Table 2.4: Risk Attitudes and Networks, Gender-Network interaction. DV: Willingness to Take Risks

	(1) Risk	(2) Risk	(3) Risk
Network_Male	-0.068***	-0.066***	-0.066***
	(0.007)	(0.009)	(0.009)
Network(t-1)	-0.013	-0.020	-0.028
	(0.016)	(0.021)	(0.042)
Age	-0.565***	-0.486***	-0.484***
	(0.082)	(0.125)	(0.131)
Height	0.297**	0.244	0.242
	(0.086)	(0.123)	(0.120)
Wages	2.969***	2.485*	2.493*
	(0.810)	(1.183)	(1.168)
Self Employed		3.297***	3.293***
		(0.772)	(0.766)
No School		-5.300*	-5.317*
		(2.214)	(2.277)
Migration Year			0.050
			(0.286)
Constant	12.950	25.863	-72.783
	(17.136)	(24.513)	(575.401)
Observations	1167	824	824
R-sq	0.179	0.184	0.184
Within R-sq	0.179	0.184	0.184
Between R-sq	0.257	0.209	0.206
Number of Countries	46.000	38.000	38.000
Average Size of Group	25.370	21.684	21.684

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Network _Male is an interaction term for the Network size in the previous time period and a dummy variable for male migrants. All other variables are as described above.

Table 2.5: Summary Statistics of Main Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
Network(t-1)	61.597	59.669	0.052	211.022	3120
Risk	38.319	26.223	0	100	2648
Age	50.695	15.6	19	103	6387
Female	1.493	0.5	1	2	6387
Wages(1000s)	1.174	1.541	0	18	3095
Height	168.401	8.967	127	202	2882
No_School	0.11	0.313	0	1	2021
gdp	2477.572	3892.333	97.158	44871.449	4777

Note: 'Network(t-1)' captures the number of migrants from a given country living in Germany one year before the individual migrated. The two main sources used to estimate the network size the German Statistical Office, and World Bank International Migrant Stock data (Schiff and Sjoblom, 2010). 'Risk' is a re-scaled measure of general willingness to take risks scale taken from SOEP, ranging from 0 to 100, where 0 is the most risk-averse response. 'Wages' are monthly wages measured in thousands of Euros. 'No School' is a dummy variable for individuals who did not complete basic secondary education.

Table 2.6: Number of Observations by Country of Birth

Country Of Origin		Freq.	Percent	Cum.
1	Germany	42713	85.22	85.22
2	Turkey	1766	3.52	88.74
3	Italy	781	1.56	90.30
4	Ex-Yugoslavia	662	1.32	91.62
5	Poland	573	1.14	92.76
6	Greece	555	1.11	93.87
7	Spain	422	0.84	94.71
8	Russia	407	0.81	95.52
9	Kazakhstan	337	0.67	96.20
10	Romania	215	0.43	96.63
11	Eastern Europe	158	0.32	96.94
12	Croatia	118	0.24	97.18
13	Austria	98	0.20	97.37
14	Bosnia-Herzegovina	86	0.17	97.54
15	Czech Republic	77	0.15	97.70
Total		50122	100.00	

Note: Shows the 15 most represented countries of birth in the full sample. Source: German Socio-Economic Panel Study (SOEP)

Table 2.7: Risk Aversion by Country of Birth

	Country of Birth					
	Germany	**Turkey**	**Former Yugoslavia**	**Italy**	**Other**	**Total**
Risk Averse	65%	72%	69%	69%	67%	65%
Risk Loving	35%	28%	31%	31%	33%	35%
N	24,476	474	102	185	1,7858	26,995

Note: 'Risk Averse' refers to individuals that answered between 1-5 on the willingness to take risks question, 'Risk Loving' refers to individuals that answered between 6-10 on the willingness to take risks question. For non-German born this includes all individuals who entered Germany between 1960 and 1995. The countries are Turkey, Former Yugoslavia, and Italy

Table 2.8: Change of Risk Attitudes of Individuals over Time, Migrant Sample

	Risk Measures in Different Domains								
	Risk in General			Risk in Financial Matters			Risk in Occupation		
	Mean	S. Err	. Dev	Mean	S. Err	S. Dev	Mean	S. Err	S. Dev
Risk 09	32.84	0.16	5.91	20.42	0.87	3.27	23.82	0.09	3.43
Risk 04	37.84	0.17	6.33	17.33	0.10	3.57	25.50	0.11	4.14
Diff	**-4.36**	0.01	0.42	**-3.09**	0.01	0.29	**-1.68**	0.02	0.71
t	**-389.25**			**-391.96**			**-88.46**		
P value	**0.000**			**0.000**			**0.000**		

Note: The table shows a comparison of the mean level of willingness to take risk for a panel of individuals, measured in 2004 and 2009 after controlling for the effect of age on the risk measure. The measure is re-scaled from the original data and ranges from 0 to 100, with 0 being the most risk averse. Results are shown for the general measure of risk, and willingness to take risks in financial matters and occupation. Source: German Socioeconomic Panel Study (SOEP)

Chapter 3

Do Migrants Send Remittances as a Way of Insurance? Evidence from a Representative Immigrant Survey [1]

3.1 Abstract

Do migrants send remittances as a way of self-insurance? While this motive is theoretically suggested in the literature, the question of identifying this relationship empirically has only begun to be explored. Using a unique representative survey of immigrants in Greater Dublin, Ireland, we utilise the established link between risk aversion and the purchase of insurance to address the question from a new perspective. We find a positive and significant relationship between risk aversion and remittance behaviour. Risk-averse individuals are

[1] This chapter is based on joint work with Catia Batista; Faculdade de Economia, Universidade Nova de Lisboa, Portugal. CReAM, IZA and NOVAFRICA.

more likely to send remittances home and are, on average, likely to remit a higher amount, after controlling for a broad range of individual and group characteristics. The results suggest that the self-insurance motive is especially significant for remittances sent outside the household (as opposed to members in the household) and for migrants from Africa.

3.2 Introduction

The scale and growth of global remittance flows over the last decade has been unprecedented. Officially recorded remittances to developing countries have quadrupled over the last decade from US$ 85 billion in 2000 to US$ 372 billion in 2011(Ratha and Xu, 2008; **?**), a value three times greater than total official development assistance . While this significant global flow of money has motivated a great deal of research, the reasons behind why people remit are still not fully understood. A myriad of possible motives to remit have been identified in the literature, such as altruism (Agarwal and Horowitz, 2002; Vanwey, 2004), income smoothing (Clarke and Wallsten, 2003; Yang and Choi, 2007) or maintaining good will with the family back home (Amuedo-Dorantes and Pozo, 2006). Understanding which motive dominates in any given context is crucial, as policies designed to support remittance flows can only be effective if the motivation behind these financial flows is fully understood.

In this paper we investigate whether the desire of migrants to insure against uncertain future wages is a motive to send remittances. There is evidence that networks at home often provide financial assistance to migrants in case of negative income shocks in the receiving country and that home networks are able to monitor the financial situation of

the migrant through contacts with network members in the receiving country (Agarwal and Horowitz, 2002; De la Briere et al., 2002; Mazzucato, 2009, 2011). Given that the willingness of network members at home to provide financial assistance in difficult times is likely to depend on past remittances from the migrant, the decision to remit can be viewed as insurance against future negative shocks. While the self-insurance motive is often mentioned, there are few studies that test this motive empirically, notable exceptions being Agarwal and Horowitz (2002); Lucas and Stark (1985); Amuedo-Dorantes and Pozo (2006).

We propose a new approach to empirically address the self-insurance motive, by using the established relationship between individual risk preferences and the purchase of insurance. Given that more risk-averse individuals have a preference for purchasing more insurance, in the migration context, we would expect these individuals to remit more. Therefore, evidence of a statistically significant positive link between risk aversion and money sent home would provide supportive evidence for the self-insurance motive.

In order to test the self-insurance hypothesis, we utilise an experimentally validated measure of risk aversion in a representative sample of migrants in the Greater Dublin Area, Ireland. Our data contains a detailed module on remittance behaviour encompassing a variety of channels and methods of sending money and gifts to social network members in the home country. In addition, detailed individual and household information of the migrants in Ireland as well as key characteristics of remittance recipients are available. This unique combination of remittance and risk preference data allows us, for the first time, to test the self-insurance motive using this approach.

Using our tailored data set, we investigate what impact being risk averse has on both the

probability and amount remitted, controlling for a broad range of individual and network characteristics. We find that there is a statistically significant positive relationship between being risk averse and both the probability and amount remitted. This result remains significant after including a wide range of controls found in the literature, and a range of robustness checks. When testing for heterogeneous effects in our model, we find that the positive link between risk aversion and remittances is especially significant for individuals from Africa, and for instances where remittances are sent outside the household.

The limited empirical literature that exists on the self-insurance motive to remit has focused on identifying a link between remittance behaviour and the level of income (Agarwal and Horowitz (2002); Lucas and Stark (1985)) or wage uncertainty (Amuedo-Dorantes and Pozo (2006)) in the host country. In these studies an increase in remittances in response to a rise in the wages of network members at home, or an increase in wage uncertainty for the migrant, is presented as evidence of self-insurance. Where the former suggests that higher wealth of network members increases the potential payoff from self-insurance and the latter that higher uncertainty for the migrant increases the benefit of insuring against a negative shock. Our approach of looking at risk preferences provides a more direct test of the self-insurance hypothesis and avoids some of the identification issues of the existing literature.

The rest of the article is organised in the following way: Section 3.3, provides a brief overview of the existing literature; Section 3.4 introduces a theoretical framework to clarify the risk preference self-insurance link; Section 3.5 describes the survey design and presents descriptive statistics; Section 3.6 introduces the empirical strategy; sections 3.7 and 3.8 discuss the results; Section 3.9 concludes.

3.3 Existing Literature

This section reviews the existing literature on different motives to remit, paying specific attention to the few articles that have focused on the self-insurance motive.

In the course of attempting to understand the motives behind remittances, three dominant themes in the literature have been identified: altruism, income smoothing and social control. While most studies in the literature acknowledge that altruism plays at least some role in the decision to remit, some have found it to be the main and overriding motive to send money home (Agarwal and Horowitz, 2002). The altruism motive may be a function of the degree of control that migrants have over the use of remittances, as shown by Ashraf et al. (2012) and Batista et al. (2012) in the context of migrants from El Salvador and Mozambique, respectively.

The literature also suggests that altruistic motives for sending remittances are more common for certain groups of recipients than others. A common finding is that remittances sent to the migrant's household members in the sending country are more often motivated by altruism. For example, (Stark and Lucas, 1988) concludes that remittances to family at home are governed by 'mutual altruism' and that more remittances are received from close kin for altruistic purposes in the urban rural context. Vanwey (2004) finds that inter household remittances are motivated by altruism, when money transfers are made to female recipients and to poorer households in Thailand. Outside of the migration literature ,Becker (1981) provides a theoretical framework for why altruism is more likely to occur within family businesses than in the market place.

Closely related to the idea of purely altruistic motives is the motive to send money in response to negative income shocks. Amuedo-Dorantes and Pozo (2011) find that while

income smoothing was not the main motive for remittances to Mexican households, they were able to partly address to problem of stabilising income flows. Using random shock to income from rainfall in the Philippines, Yang and Choi (2007) show that the income smoothing motive is important to the remittance decision, Clarke and Wallsten (2003) also find that remittances can counteract negative income shocks from earthquakes in Jamaica.

A further motive for remittances suggested in the literature is the willingness of the migrant to maintain social control over networks at home or the ability of sending country networks to encourage remittances through links with other individuals in the receiving country. Chort et al. (2012) provide evidence that remittances may act as a fee that migrants pay to get access to sending country network services; Sana (2005) finds negative relationship between increases in social status and remittances in Mexico. Also in Mexico, Roberts and Morris (2003) find that remittances play an important role in maintaining networks in the sending country. Batista and Narciso (2012) corroboratethese findings by presenting experimental evidence that increased information flows between migrants and their networks back home significantly increases the magnitude of remittances.

The strand of literature most directly related to this paper tries to identify the self-insurance motive. The self-insurance mechanism has been identified by comparing income variation in the home and source country and testing which is related to remittances; or by measuring individual wage risk of migrants directly and estimating the impact of this higher risk on the share of income remitted.

The first method for testing the insurance motive of remittances involves looking at the sign of the relationship between income in the home country and money sent home. In this literature it is suggested that a positive relationship between income at home

and remittances indicates self-insurance, and a negative relationship indicates altruism. The intuition is that migrants will increase the amount remitted if networks at home have a larger value when they are motivated by self-insurance, or alternatively they will increase remittances in response to worsening economic situations in the home country when altruism is the dominant factor. Testing this theory empirically Lucas and Stark (1985) find that the insurance motivation dominates while Faini (1994) and Agarwal and Horowitz (2002) conclude that altruism is the main motive.

The alternative way of measuring the self-insurance mechanism is to look at the wage risk of migrants in the receiving country directly. If migrants respond to increases in wage uncertainty in the receiving country by remitting more, this could be evidence of self-insurance against negative shocks for the migrant in the receiving country. While allowing for the possibility of both altruistic and insurance motives Amuedo-Dorantes and Pozo (2006) find evidence that Mexican migrants remit more when faced with higher wage uncertainty, and therefore are driven, at least in part, by self-insurance motives. A problem with this approach is the difficulty of measuring wage uncertainty precisely. The authors use individual characteristics such as legal status, educational attainment, time in the US, work experience, type of job and industry of employment. It is possible, however, that the duration of migration is planned by migrants before leaving Mexico, and that the higher remittances are a result of the migrant knowing that he will return and not uncertainty regarding his wages. In this context it is difficult to disentangle planned temporary migration from income uncertainty making the proxy measure for wage uncertainty imprecise.

An important assumption of the remittances-as-insurance motive is that "migrants

are risk-averse individuals who, in the face of greater income risk, insure themselves by remitting more" (Amuedo-Dorantes and Pozo, 2006, p229). If indeed insurance is an important motive, both the level of uncertainty and individual risk preferences should influence the rate and scale of remittances sent. While Amuedo-Dorantes and Pozo 2006 investigate the effect of individual wage uncertainty on remittance behaviour, we control for the actual level of uncertainty faced by migrants, allowing the impact of individual risk preferences on remittance behaviour to be investigated.

In the context of migration, the probability and scale of remittances sent for self-insurance should be related to individual risk preferences. Given that more risk averse individuals have a higher preference for insurance, a positive relationship between risk aversion and the probability of remitting would provide evidence for a link between sending money home and self-insurance. We allow for the possibility of a variety of motives, including altruism, to drive remittance behaviour. However, our aim is to identify individual and network characteristics where the self-insurance motive is significant. We develop the theoretical link between risk aversion and the decision to remit in the next section.

3.4 Theoretical Framework

We assume that while a variety of reasons to remit exist; the willingness of networks at home to help migrants in difficult times depends on the frequency and amount of remittances sent. In this way remittances act as insurance against potential wage uncertainty.

We present a simple two period model with two states of nature based on (Kreps and Porteus, 1978; Selden, 1978). In the first period, the migrant knows that in period two

he will receive a positive outcome with no loss or a negative outcome where she will incur a loss in the second period. To insure against the possibility of a negative outcome, the migrant has the option of sending remittances home with the expectation that networks in the sending country will reduce the potential loss in the second period. Let (w_i) be the wealth in period $(i = 1, 2)$ (constituted by the wealth at the beginning of the period and an exogenously given income), (y) be the amount remitted with the intention of self-insurance, and $L(y)$ be the loss occurring in the second period with probability (p) (with $L'(y) \leq 0$) . $(\widetilde{w}_2)$ is the risk yielding $w_2 - L(y)$ with probability (p) and (w_2) with probability $(1-p)$.

A risk neutral individual is indifferent between facing the risk $(\widetilde{w}_2)$ and receiving the certain amount $E\widetilde{w}_2 = w_2 - pL(y)$ in the second period. His maximization problem is then the following:

$$\max_y u(w_1 - y) + U(w_2 - pL(y)), \tag{3.1}$$

and the optimal level of self-insurance (y_n) is the solution of :

$$-u'(w_1 - y_n) - U'(w_2 - pL(y_n))pL'(y_n) = 0 \tag{3.2}$$

In this unrisky situation, the concavity of functions (u) and (U) only reflects the desire to smooth consumption over time. Consider now the addition of a zero-mean risk $\widetilde{z}(y)$ taking value $pl(y)$ and $-(1-p)l(y)$ with probabilities $(1-p)$ and p respectively. This risk is insurable since the value of the outcome depends directly on the amount invested by the migrant in period 1. The problem faced by the migrant is then

$$\max_{y} u(w_1 - y) + EU(w_2 - pL(y) + \tilde{z}(y)), \tag{3.3}$$

In this risky situation, the concavity of (U) incorporates both attitude towards risk and the desire to smooth consumption. It can be seen as a special case of Kreps-Porteus preferences in which $(v = U)$. Evaluating the FOC of this problem at optimal effort under risk-neutrality (y_n) shows that the level of remittances that the risk averse agent will send is higher since (U) is a concave function. Therefore, the theory suggests that relative to risk neutral agents, those more risk averse will select a higher level of insurance.

3.5 Data and Descriptive Statistics

We test the theoretical model using a representative data-set of immigrants in the Greater Dublin Area, Ireland. The immigrant survey data was collected as part of an EU NORFACE project, and consists of a representative sample of the immigrant population in the Greater Dublin Area. In addition to detailed information on the migrants, the survey also included tailor made questions designed to capture individual risk preferences.

The household survey was conducted among 1500 immigrants aged 18 years or older, residing in the Greater Dublin Area, who arrived to Ireland between 2000 and six months prior to the interview date, and who were not Irish or British citizensEligibility requirements were set to maximize the probability that migrants still kept contacts outside of Ireland (hence the 2000 arrival threshold) but were already minimally established in Ireland (for six months at least) so that contacts with their networks abroad could provide useful information. British citizens were excluded given the close historical ties between

Ireland and the UK. The survey was conducted between January 2010 and October 2011 by Amarach Research, a reputable survey company with prior experience conducting research surveys in Ireland, under close supervision of our research team.

3.5.1 Ensuring a Representative Migrant Sample

A great deal of care was taken to ensure that the sample of migrants in our survey is representative of the total migrant population, both registered and non-registered, in the Greater Dublin Area. This task was challenging as register data and individual address of non-Irish individuals were not available due to data restriction laws. In order to ensure that the sample is representative, electoral districts EDs were randomly selected (based on migrant densities from the 2006 census), initial addresses within each ED were selected randomly, and consecutive households were also selected based on strict randomisation rules. Furthermore, the respondent within each household was selected randomly and the data was weighted by nationality, age and gender of non-respondents.

The survey was based on a representative sample of migrants residing in the Greater Dublin Area. The sampling framework was the 2006 Census of Ireland, and the Enumeration Areas were randomly selected according to probability proportional to size sampling, where size is defined as the total number of non-Irish and non-British individuals.

Fifteen households were selected within each EA using a random route approach that clearly stated a set of rules to select households in which interviews were to be conducted. In order to ensure a random sample of households within an EA, interviewers visited every fifth house, turning right after each attempt. Instructions on which house to select in specific scenarios, such as tower blocks and cul-de-sacs, were given to interviewers to

ensure that selection within an EA was random and uniform between interviewers. All addresses visited, even when not resulting in an interview, were recorded in order to ensure the survey rules were followed correctly. Non-responses, due to no one being at home at the time of the visit, were minimized by interviewers going back to an address up to 5 times on different days and at different times. While this 5 times 'call back' rule was time consuming, it ensured that non-response was minimized and that a representative sample of migrants was selected, including single dwelling households which would otherwise be under represented. When respondents declined to be interviewed, their characteristics (namely gender, approximate age, nationality and type of dwelling) were recorded to allow for the adjustment of sampling weights.

In the presence of more than one migrant in the household, the individual respondent in each household was also randomly selected based on a next birthday rule. According to this rule, the household member who will next have a birthday closest to the day of the interview was selected. In the case where the randomly selected household member was not at home, an interview with that individual was arranged at a convenient time for the respondent. The design of the survey questions and data collection strategy were carefully developed in order to ensure that our sample is representative of all migrants, including illegal and non-registered migrants. The randomized procedure for selecting addresses within an EA was useful in capturing a representative selection of migrants, including those that were not registered in official data. The legal status of respondents was not asked and this was made clear to the respondents before the survey was administered. In addition, it was made clear to respondents that the data would be anonymised and not used for any purposes other than academic research. In order to maximize trust, interviewers

were chosen from a broad range of backgrounds and received detailed classroom and in-the-field training, followed up by randomized quality checks. The survey methodology was developed to ensure that our sample of migrants reflects the total migrant population as closely as possible, given the restriction on accessing individual level registry or census data. Given the three levels of randomization (electoral district, starting address within EA, and within household) combined with the initial weighting from the 2006 census, and the adjustment for non-respondents, the survey provides a sample which is closely representative of the total migrant population in the Greater Dublin Area, which also includes illegal migrants which might not be captured by census or registry data.

3.5.2 Hypothetical Investment Question

A hypothetical lottery question is used to measure risk preferences in the domain of money. This measure has been used by a number of studies in the literature[2], and has been validated using real monetary payments (Dohmen et al., 2005). The survey includes a number of questions regarding remittances, to encompass all possible channels which could be used to transfer money or gifts to individuals in the sending country. The survey allowed for the possibility of money transfers, money handed over in person (in Ireland or in the sending country) and gifts sent or given in person. The survey also included questions on the frequency and amount remitted and the cost of sending money and gifts home [3]. In addition, data on the characteristics of individuals that receive remittances, including age, gender, country of residence and relationship to respondent is available.

[2]See for example, Van Praag and Cramer (2001); Ahn (2010); Bonin et al. (2007, 2009); Caliendo et al. (2009, 2010); Niimi et al. (2009)

[3]For more detailed information regarding the remittance module see Batista and Narciso (2012)

The economic context of when the survey was conducted between January 2010 and October 2011 is especially relevant for the hypothesis tested in this article. During this time, Ireland was experiencing an economic recession that had an especially negative effect on the employment rates of migrants. This uncertainty in future economic conditions in the country means that the option of self-insurance was especially appealing to some migrants. Indeed, our data show that from our sample of migrants, 73% believed that wages had decreased and 68% believed unemployment had increased in Ireland in the previous 6 months. Other studies conducted in Ireland confirm the difficult job market faced by migrants. Barrett and Kelly (2012) show that immigrant job loss in 2009 was close to 20%, and would be even higher if a significant number of migrants had not returned to their home countries.

3.5.3 Stability of Risk Preferences Over Time

There has been some debate in the economics and psychology literature regarding the stability of personality traits. While Harrison et al. (2007) find that in a representative sample of the Danish population individuals on average become less risk averse after the age of 40; Barsky et al. (1997) and McCrae (1993) find that risk preferences are a stable character trait in adults. McCrae (1993) suggests that changes in individual risk measures for individuals over time found in other studies, are due to measurement error. Given the cross sectional nature of our data-set we cannot directly control for changes in individual risk preferences, in case they do exist. However, given that studies which report changes in risk preferences show a relatively uniform relationship between age and risk preferences between individuals, controlling for respondents age should account for the majority of

individual variation in risk preferences over time.

3.5.4 Descriptive Statistics

Our sample is made up of migrants from a broad range of countries. The three most popular origin countries are Nigeria, Poland and India. All other country groups consist of less than 5% of the sample. Other European Union 'New Member States' are also represented, with the largest groups being Romanians, Lithuanians, and Latvians. The two largest migrant groups in Greater Dublin by world Region of Birth are Africa and Asia. This variety in source countries is relevant for our research question as remittance motives are likely to differ between regions of the world.

Regarding the relationship between risk aversion and the probability of remitting, simple comparison of averages for the total sample shows that a larger proportion of risk averse individuals send remittances compared to risk loving individuals. Table 3.2 shows that while only 27% of risk loving individuals sent remittances, 40% of risk averse migrants sent money to networks in the source country. There is also substantial variety in the probability of remitting between world regions of birth. As shown in Table 3.1, migrants from Africa are the most likely to remit with 40% sending some money home, migrants from Asia are second most likely to remit with 36%. While 31% of EU New Member State migrants remit money home, only 7% of pre-2004 enlargement EU states send remittances home.

3.6 Empirical Methodology

We investigate the relationship between risk aversion and remittances at the extensive and intensive margins, while controlling for a range of characteristics. Stated most simply the equation of interest is:

$$Remittances_i = \beta_1 Risk\ Preference + \beta_2 Individual\ Characteristics + \beta_3 Region\ of\ Birth \tag{3.4}$$

We are also interested if the relationship between risk aversion and remittances is sensitive to the characteristics of the recipients and the country of birth of the migrant.

Starting with the extensive margin, we estimate a probit model with the binary variable of sending any remittances as the dependent variable and risk aversion, together with a broad range of explanatory variables found in the literature, as independent variables. We also include interaction dummies for risk preferences and remittance recipients and region of birth, as these are the most likely sources of heterogeneity in terms or remittance motives. We use the probit specification :

$$Pr(Y_i = 1|\mathbf{X_i}) = \Phi(\beta_1 x_{i1} + \beta_2 x_{i2} + \beta_{12} x_{i1} x_{i2} + \mathbf{X_i}\beta) + \epsilon_i \tag{3.5}$$

where Y_i is a binary variable, where 1 denotes any remittances being sent to the home country in the last year; x_{i1} is the coefficient for the risk measure and $x_{i1}x_{i2}$ is the interaction effect. In our first interaction specification x_{i2} is a dummy variable for the recipient of remittances and for subsequent specifications it is the migrants region of birth; $\mathbf{X}_i$ is a

vector of control variables, including individual characteristics, region of origin dummies, occupation dummies, and a number of variables that could explain remittance behaviour.

We are also interested in the amount of remittances sent, the intensive margin, and use a zero censored tobit model to account for the significant proportion of individuals that have not sent any remittances in the last year. There are a number of alternative solutions to the issue of zero censoring in remittance data. Bettin et al. (2012) suggests double hurdle and heckit models to account for the possibility of different mechanisms influencing the decision to remit and the amount to be remitted. While this has the advantage of accounting for non-remittance due to budgetary constraints, this type of model can be sensitive to identification exclusions. This is especially a problem for data on remittances, as finding realistic variables that affect the decision to remit money, but not the amount, are difficult to conceive of (Amuedo-Dorantes and Pozo, 2006). Therefore, we opt for the tobit model, which accounts for the zero censoring without the identification issues of the selection models. While the Tobit model is the best choice for the data given that it does not require an explicit exclusion restrictions, which are not available in this context, a disadvantage of this approach is that identification is implicitly based on functional form. More specifically our econometric specification is:

$$Y_i^* = \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_{12} x_{i1} x_{i2} + \mathbf{X_i'}\beta + \epsilon_i \tag{3.6}$$

$$Y_i = max(0, Y_i^*)$$

$$\epsilon_i \sim N(0, \sigma^2)$$

where the coefficients of the independent variables correspond to the probit model outlined above, and the dependent variable is the zero censored amount remitted in Euros in the last year. We also investigate the significance of the interactions of risk aversion and the recipient of remittances as well as risk aversion and region of birth, as in the probit model.

3.7 Results

Estimating the model in Equation (3.4) allows us to understand the relation between the willingness to send remittances and individual risk preferences. Table 3.3 presents least squares results showing the relationship between remitting any amount (dummy variable for sending remittances at least once in the last year) and our variable of interest, risk aversion. Column (1) in Table 3.3 shows that without any controls, there is a statistically significant negative relationship between our risk measure and the probability of remitting. The OLS coefficient suggests that a one point increase in an individual's willingness to take risks corresponds to a 1.6% decrease in the probability of sending remittances home. This magnitude is significant considering our scale, as it suggests that moving from the most risk averse individual (with a score of 0) to the most risk loving (with a score of 10) corresponds to a 16% decrease in the probability of sending remittances.

The risk measure remains significant after including a variety of controls, as shown in Columns (2) to (4) in Table 3.3. Comparing Columns (1) to (3) in Table 3.3 shows that

the risk measure remains significant after adding the controls. More specifically, Column (2) includes basic individual level characteristics such as income, gender, education and family status. Column 3 adds region of birth dummies, whereas Column (4) includes industry, religion variables, intended length of stay and year of arrival as well as nationality and residence of partner variables. Irrespective of the specification, the magnitude of the coefficient on the risk measure does not change much in terms the size and remains strongly statistically significant.

The control variables are of interest in their own right as they give an impression of how different factors influence remittance behaviour. Column (4) in Table 3.3 shows that the following variables are significant: risk preferences, monthly income, being married, having children, age, education, dummy variable for Africa, Asia and EU as world regions of birth, being a christian, partner being the same nationality as the migrant, intention to stay longer than ten years, and year of arrival. Looking first at the variables which reduce the probability of remitting, we can see that being married, having children, education, intention to remain long term, and year of arrival all reduce the probability of sending remittances home. Being married to someone living in Ireland and intention to stay for the long term could reflect a strong link to the host country, with a higher level of investment in Ireland reflecting fewer close network members at home and decreasing importance of home networks. Education appears to have a non-linear effect with individuals with only primary education remitting less, but also additional years of education having a negative impact. This could partly be due to students in the sample, as they are more likely to have higher levels of education but not necessarily have the means to send remittances. The strongest positive effect, in terms of magnitude, on the probability of remitting is the

dummy variable for being born in Africa. The OLS coefficient suggests that individuals from Africa are 21% more likely to remit after controlling for the other factors (as can be seen in Column (4) in Table 3.3) a result significant at the 1% level. Other significant positive effects include; income, age, dummy for being born in Asia and EU-12 countries, partner being the same nationality and being a Christian. The income and age variables could reflect increased family budgets that could make remittances more affordable; having a partner of the same nationality could relate to stronger links to the home country that would be lower if the partner was a different nationality to the respondent. The significance of the regional dummies clearly shows that remittance behaviour is culturally sensitive and depends on the country of origin.

We include marginal effects probit results in Table 3.4 using the same specifications as in Table 3.3 for comparison with the OLS results. The results of the OLS and marginal effects are very similar to the Probit estimation. The risk measure, our coefficient of interest, is negative with a value in the range between 16% and 23% as in the OLS specification. Looking at the control variables of the probit specification in Table 3.4, the results also closely match those of the OLS specification with the same variables being significant and having the same signs and marginal values not significantly different from the OLS coefficients. Therefore, we can say that the results are not sensitive to the choice of OLS or probit model and there is a significant positive relationship between risk aversion and the probability to remit.

In Table 3.5 we investigate the heterogeneity of effects across remittance recipient groups. The dependent variable in Columns (1) is remittances sent within the household and the dependent variable in Columns 2 is remittances sent outside the household. All of

the specifications in Table 3.5 are Probit. We define the household living in the home country as being the spouse/partner, parent or child of the respondent, outside the household are friends and the reference group is siblings. Columns 1 in Table 3.5 shows that there is no statistically significant link between risk preferences and remittances when remittances are sent within the household while Column (2) shows that there is a negative statistically significant link when remittances are sent outside of the household.

The results of Table 3.5 suggest remittances sent outside the household are more likely to be motivated by the self-insurance motive given the statistically significant link between risk preferences and remittances for this recipient group, whereas remittances sent within the household are not linked to risk preferences in the same way, perhaps because the main motive for these transactions is altruistic.

In Table 3.6 we look at the importance of the world region of birth on the link between risk aversion and the probability to remit. Column (1) in Table 3.6 suggests that the link between risk preferences and remittance behaviour is most significant for migrants from Africa. The interaction dummy 'being born in Africa and willingness to take risk' is significant at the 1% level in the OLS column without further controls, as shown in Column (1) in Table 3.6 . The coefficient suggests that for African migrants one point increase in the risk measure scale is associated with a 3.8 % increase in the probability of remitting. The other region dummies when interacted with the risk measure are not significant. The coefficient remains significant and the magnitude similar after all of the controls are added, as shown in Column (2) in Table 3.6. The probit specification in Columns (3) and (4) in Table 3.6 show again that the results are not sensitive to whether an OLS estimation method or probit model is used.

As well as the probability of remitting, the relationship between risk preferences and the amount remitted is also of interest. Columns (1) an (2) in Table 3.7 show the tobit results indicating that risk loving individuals remit less. The results suggest that an increase in the willingness to take risks by one unit would result in a decrease of EUR 105 (before controls) and EUR 120 (with controls) sent home in remittances every month. The result is significant at the 5% level (at the 1% level when controls are included). This suggests that more risk loving individuals are less likely to send any remittances home and the amount they send is likely to be significantly lower.

We are also interested in the difference in this relationship when remittances are sent within the household compared to outside the household. We allow for the possibility that remittances to different individuals are sent for different motives. Specifically, we expect that money sent within the household is more likely to be motivated by altruism and not self-insurance. Column (2) in Table 3.8 suggests that sending remittances within the household is positive and significant. This suggests that the insurance motive is not driving remittances flows to family members as for this to be the case we would expect a negative coefficient. Column (1) of 3.8 shows the results for the regressions when the dependent variable is 'remittances sent outside household' . The result in Column (2) suggests that less risk loving individuals are likely to remit less to individuals outside the household. Or alternatively, that more risk averse individuals are likely to remit more to individuals outside the household. A one point increase in the willingness to take risks decreases the average amount remitted by EUR 257, a result significant at the 1% level.

Turning to the intensive margin with regional interactions effects, Table 3.9 shows that the risk measure interacted with Africa as region of origin, is highly significant (1% level)

while interactions with other regions are not significant. The results in Table 3.9 suggests that for African individuals, being one point more risk loving corresponds to remitting between EUR 192 and EUR 261 less per month, depending on the specification. This supports the results on the probability of remitting and suggests that the relationship between risk preferences and remittance behaviour is most pronounced for individuals born in Africa.

3.8 Discussion of Results

Our results suggest that there is a negative link between willingness to take risks and remittances, or alternatively stated a positive relationship between risk aversion and remittances. Given that we control for individual income and other key characteristics this measure is a good proxy for the inherent risk preference of individuals in the domain of money. This type of risk measure has been validated using real monetary incentives for the German Socioeconomic panel study Dohmen et al. (2005), therefore we can be confident that the question is able to capture actual risk attitudes of the individuals in our survey.

These results provide evidence to support the existence of the self-insurance motive for remittances. The self-insurance motive is inherently difficult to identify as it is an informal channel and could be combined with other remittance motives. While we cannot explicitly test that the remittance-risk relationship equates to the self-insurance motive, our results do correspond to findings from smaller qualitative studies. The issue of selective out-migration should also be noted here, especially fro migrants from the New Member States who have high return migration rates. If the most risk loving individuals leave,

then the results would overstate the average level of willingness to take risk among the migrant population. Conversely, if the most risk averse migrants are more likely to return, the our results could understate the average level of willingness to risks among migrants. As it is possible that return migrants take money back with them and we cannot observe this channel of remittances unless they have returned to Ireland, remittance flows could be understated in our results. While acknowledging the issue of selective out-migration in our study, because our definition of 'migrant' is narrower than in may similar studies (someone who has lived in Ireland for more than 6 months but less than 10 years) this bias is likely to be less pronounced than the often used broader definition of migrant as being born outside of the country or having at least one foreign parent.

3.8.1 Inside Household and Outside Household Remittances

We define 'inside household remitances' as money sent to parents and spouses/partners of the migrant and 'outside household remittances' as transfers to friends of the migrant. While not being able to provide a direct link between individual risk preferences and the self-insurance motive, existing literature suggests that money sent to parents and spouses is more likely to be motivated by altruism and therefore should not be linked to individual risk preferences in the way that the insurance motive might be. Therefore we would expect there to be no significant relationship between risk preferences and remittances for our ' inside household' network group while a statistically significant relationship is more likely for remittances 'outside the household' as the self-insurance motive is more likely to be present. It should be noted that the majority of the current literature focuses on insurance for the network member and not the migrant. For example, Lucas and Stark (1985); Yang

and Choi (2007) find that migrants remit more to household members in response to negative shocks to the network members in the sending country. While this increase in remittances can be seen as providing insurance for negative outcomes for the household members at home, it does not provide insurance for the migrant, and as such can be seen as an altruistic motive from the perspective of the migrants. Other empirical work, such as Faini (1994); Agarwal and Horowitz (2002), which focus more directly on the altruism motive to remit to households, have found altruism to be the main motive for remitting to household members.

The results show that there is no statistically significant link between risk preferences and remittances to migrants 'inside the household' while there is a significant positive relationship between risk aversion and remittances for the 'outside the household' network. The fact that we find no link for the close family networks could be because these remittances are motivated by altruism, and the positive significant link for remittances to friends would suggest that the self-insurance motive is present for these financial flows.

3.8.2 Remittances and World Region of Birth

Our results suggest that the risk preference-remittance link is especially strong for migrants from Africa. This would suggest that the remittance for self-insurance motive is strongest for this group of migrants. The importance of the self-insurance motive has been found to be especially significant in studies looking at African migrants. Furthermore, research suggests that networks in many African countries have a great deal of information about and exert control over migrants in destination countries. This information flow acts to ensure that migrants transfer a 'fair' proportion of their income in the form of remittances.

A number of studies have shown that in certain African countries networks of individuals at home have detailed knowledge of the earnings of migrants and that remittances are not just altruistic but used as self-insurance for the migrant. Agarwal and Horowitz (2002) find that networks in Guyana exert significant control over migrants encouraging them to remit more to ensure continued support from the home country; de Brauw et al. (2013) show that an important motive for migrants from Ethiopia is self-insurance; and Hoddinott (1992) find evidence of remittances motivated by the expected future payoffs for migrants from network members in Kenya.

A number of studies suggest that African migrants are motivated by the self-insurance motive due to especially strong ties between network members at home and migrants in the receiving country. While the self-insurance motive could be present for other migrant groups this type of informal agreement appears to be most common for African migrants. Therefore, it is of no surprise that the risk-preferece-remittance link is most significant for African migrants in our sample.

It is also important to mention the specific context of our migrant sample in the Greater Dublin Area. African migrants account for around 40% of our total sample and while we did not know their legal status, it is likely that a substantial part of migrants from this region have come to Ireland seeking asylum. The motives for this type of migration and consequent remittance behaviour is likely to be substantially different from the second largest migrant group which is migrants from the New Member States, which make up 31% of our sample. Two important difference between these two groups of migrants are: the possibility of repeat migration; and the ease of bringing relatives to Ireland. As EU citizens, migrants form the New Member States have very few restrictions on their mobility,

and the mobility of their family and friends, whereas for the refugee group within our sample of African migrants, mobility is much more restricted. This restricted mobility, could therefore result in the increased importance of the remittance channel as a way to support network members at home and also for the migrant to ensure continued support from the home network during long periods away from the sending country. Therefore, we cannot rule out the possibility that the 'Africa' effect we identify regarding self-insurance and migration is closely linked to the channel of migration and the legal status of migrants from Africa.

3.9 Conclusions

The relationship between risk aversion and remittance behaviour was tested using a representative household survey of the migrant population in Greater Dublin, Ireland. We find a statistically significant positive relationship between risk aversion and both the probability and amount remitted. Looking at specific groups within our sample we find that African migrants are more sensitive to the relationship between risk aversion and remittance behaviour. In addition, remittances sent outside the household are more likely to have a significant negative relationship to individual willingness to take risks. This relationship remains significant under different specifications. The results suggests that a one point increase in the willingness to take risks scale decreases the probability of remitting by between 1.6 and 2.2 percentage points and the amount remitted by between EUR 105 and EUR 120 per month.

The results support the theory that the self-insurance motive explains remittance be-

haviour in certain cases. The results also suggest that remittances by African migrants are more sensitive to risk preferences than individuals from other world regions. Furthermore, while remittances sent outside the household are sensitive to risk preferences, those sent within the household do not exhibit the significant negative relationship which would suggest a self-insurance motive. This suggests that the while remittances sent outside the household are guided by the self-insurance motive, money sent to other household members is not, perhaps because altruistic motives are dominant in these cases.

There is an emerging empirical literature investigating the self-insurance motive for remittances and this article provides an innovative approach to investigating this question. The significant and positive link between risk aversion and remittance behaviour provides strong evidence that self-insurance is an important motivation for remittance behaviour and that individual unobservable characteristics can have a significant effect on the amount of money sent by migrants to their home country.

Chapter 3 Tables and Figures

Table 3.1: Percentage of Migrants Remitting by Region of Birth

Region	**Percent remit (%)**
Africa	40
Asia	36
EU(NMS)	31
South America	19
North America	12
EU(OMS)	7
All Average	**33**

Note: The Table shows the percentage of individuals from each World region of birth that have remitted money or sent goods home at least once in the last year. EU(NMS) refers to countries which joined the European Union after 2004, EU(OMS) refers to countries that where in the EU prior to 2004.

Table 3.2: Risk Aversion and Probability of Remitting

	Percentage remit (%)
Risk Averse	40
Risk Loving	27

Note: The Table shows the percentage of individuals that have sent money or goods home at least once in the last year. 'Risk Averse' refers to individuals choosing to invest less than EUR 20,000 in the hypothetical lottery, 'Risk Loving' refers to individuals choosing to invest more than EUR 20,000 in the hypothetical lottery.

Table 3.3: OLS Estimates: Willingness to Take Risks and the Probability of Remitting. DV: Remit Dummy

	(1) OLS		(2) OLS		(3) OLS		(4) OLS	
Risk Lottery	-0.016**	(0.007)	-0.022***	(0.008)	-0.021**	(0.008)	-0.019***	(0.00
Income			0.048***	(0.017)	0.049***	(0.017)	0.042**	(0.01
Female			0.001	(0.031)	0.012	(0.028)	0.007	(0.02
Married			-0.075*	(0.043)	-0.045	(0.040)	-0.231**	(0.10
Children			-0.024	(0.043)	-0.051	(0.044)	-0.080*	(0.04
Age			0.007***	(0.003)	0.006**	(0.003)	0.007**	(0.00
School			-0.041***	(0.010)	-0.037***	(0.010)	-0.033***	(0.00
College			0.113*	(0.058)	0.076	(0.055)	0.060	(0.05
Primary			-0.424***	(0.116)	-0.387***	(0.115)	-0.374***	(0.11
Africa					0.226***	(0.043)	0.209***	(0.05
Asia					0.184***	(0.048)	0.193***	(0.05
North America					-0.064	(0.054)	-0.052	(0.05
EU12					0.163**	(0.078)	0.123*	(0.07
Rest of World					0.034	(0.074)	0.020	(0.06
Manufacturing							0.042	(0.09
Construction							-0.097	(0.07
Communications							0.037	(0.04
Christian							0.157***	(0.04
Muslim							0.011	(0.07
No Religion							0.024	(0.06
Enclave							0.000	(0.00
Partner live Ire.							0.137	(0.10
Partner live Home							-0.064	(0.09
Partner Same Nat							0.112**	(0.05
Irish Partner							-0.039	(0.07
Mother Alive							0.067	(0.06
Stay Long Term							-0.061**	(0.03
Year of Arrival							-0.013*	(0.00
Constant	0.410***	(0.056)	0.762***	(0.132)	0.542***	(0.165)	26.796*	(14.18
Observations	1304		1065		1065		1065	
R-sq	0.008		0.050		0.085		0.121	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides OLS estimates where the dependent variable is a dummy for having remitted any amount in the past year. 'Risk Lottery' is the hypothetical lottery risk question, with higher values corresponding to higher willingness to take risks. 'School' refers to years of schooling, 'College' is a dummy for college being the highest level of education, 'Primary' is a dummy for primary school being the highest level of education. The standard errors in parentheses are robust and clustered by country of birth.

Table 3.4: Probit Marginal Effects: Willingness to take risks and the probability of remitting: DV: Remit Dummy

	(1) Probit	(2) Probit		(3) Probit		(4) Probit	
Risk Lottery	-0.016**	-0.023***	(0.009)	-0.023***	(0.009)	-0.021***	(0.007)
Income		0.051***	(0.017)	0.052***	(0.018)	0.045**	(0.019)
Female		0.002	(0.032)	0.013	(0.030)	0.013	(0.031)
Married		-0.077*	(0.044)	-0.045	(0.042)	-0.269**	(0.123)
Children		-0.022	(0.044)	-0.050	(0.045)	-0.083*	(0.043)
Age		0.007***	(0.003)	0.007**	(0.003)	0.007**	(0.004)
School		-0.043***	(0.011)	-0.039***	(0.011)	-0.034***	(0.011)
College		0.115**	(0.056)	0.079	(0.055)	0.060	(0.053)
Primary		-0.309***	(0.054)	-0.295***	(0.055)	-0.289***	(0.059)
Africa				0.243***	(0.055)	0.227***	(0.063)
Asia				0.213***	(0.064)	0.226***	(0.067)
North America				-0.106	(0.089)	-0.116	(0.086)
EU12				0.209*	(0.116)	0.172	(0.108)
Rest of World				0.053	(0.110)	0.042	(0.104)
Manufacturing						0.059	(0.109)
Construction						-0.086	(0.074)
Communications						0.041	(0.052)
Christian						0.167***	(0.046)
Muslim						0.018	(0.084)
No Religion						0.025	(0.075)
Enclave						0.000	(0.001)
Prn live Ire.						0.165	(0.122)
Prn live Home						-0.063	(0.108)
Prr Same Nat						0.143*	(0.078)
Irish Partner						-0.052	(0.101)
Mother Alive						0.068	(0.067)
Stay Long Term						-0.065**	(0.032)
Year of Arrival						-0.015**	(0.007)
Observations	1304	1065		1065		1065	
Pseudo R^2	0.006	0.039		0.069		0.100	

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides Probit marginal effects estimated at the average. The dependent variable is a dummy for having remitted any amount in the past year. 'Risk Lottery' is the hypothetical lottery risk question, with higher values corresponding to higher willingness to take risks. 'School' refers to years of schooling, 'College' is a dummy for college being the highest level of education, 'Primary' is a dummy for primary school being the highest level of education. The standard errors in parentheses are robust and clustered by country of birth.

Table 3.5: Probit: Willingness to Take Risks and the Probability of Remitting: Reittances Within and Outside the Household

	(1) Inside HH	(2) Inside HH
Risk Lottery	0.006	-0.024***
	(0.004)	(0.004)
Individual Characteristics	Yes	Yes
Region Dummy	Yes	Yes
Religion Dummy	Yes	Yes
Industry Dummies	Yes	Yes
Ireland Variables	Yes	Yes
Observations	920	1046
Pseudo R^2	0.104	0.193
R-sq		

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides Probit marginal effects estimated at the average. In Columns 1 and 2 the dependent variable is amount remitted within the household and in Columns 3 and 4 the dependent variable is the amount remitted outside teh household. For conciseness the other controls from Table 3.3 and 3.4 are included under the headings 'Individual Characteristics, 'Region Dummy, 'Religion Dummy', 'Industry Dummy' and 'Ireland Dummy' The standard errors in parentheses are robust and clustered by country of birth.

Table 3.6: OLS and Probit: Willingness to Take Risks and the Probability of Remitting: Region of Birth Interactions. DV: Remit Dummy

	(1) OLS	(2) OLS	(3) Probit	(4) Probit
Risk Lottery	-0.002	-0.002	-0.002	-0.005
	(0.005)	(0.009)	(0.007)	(0.011)
EU12 * Risk	-0.005	-0.008	-0.005	-0.005
	(0.007)	(0.011)	(0.009)	(0.013)
Africa * Risk	-0.038***	-0.037**	-0.035***	-0.031**
	(0.012)	(0.015)	(0.012)	(0.015)
Asia * Risk	0.003	-0.007	0.003	-0.005
	(0.012)	(0.014)	(0.012)	(0.015)
Region Dummy	Yes	Yes	Yes	Yes
Individual Characteristics	No	Yes	No	Yes
Religion Dummy	No	Yes	No	Yes
Industry Dummies	No	Yes	No	Yes
Ireland Variables	No	Yes	No	Yes
Observations	1304	1065	1304	1065
R-sq	0.051	0.128		
Pseudo R-sq			0.041	0.104

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides OLS results and Probit marginal effects estimated at the average. Variables are same as in Table 6, with the addition of three variables. 'EU12*risk' is an interactive term for the recipient being from an EU New Member State, 'Africa*Risk' is the interaction term of being from Africa and the risk measure. 'Asia*Risk' is the interaction term of being from Asia and the risk measure. The standard errors in parentheses are robust and clustered by country of birth.

Table 3.7: Tobit Regressions. Willingness to take risks and amount remitted: DV Amount remitted

	(1) Tobit	(2) Tobit
Risk Lottery	-121.395***	-104.589**
	(39.975)	(49.882)
Constant	106636.846	-740.395*
	(83754.572)	(401.718)
sigma	2220.776***	2447.270***
	(184.734)	(209.522)
Region Dummy	Yes	No
Individual Characteristics	Yes	No
Religion Dummy	Yes	No
Industry Dummies	Yes	No
Ireland Variables	Yes	No
Observations	1065	1311
Pseudo R-sq	0.018	0.001

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides zero censored Tobit estimates where the dependent variable is the amount remitted in Euros. 'Risk Lottery' is the hypothetical lottery risk question, with higher values corresponding to higher willingness to take risks. Other controls are the same as in Tables 3.3 and 3.4. The standard errors in parentheses are robust and clustered by country of birth.

Table 3.8: Tobit Regressions. Willingness to take risks and amount remitted Outside and Within Household

	(1) Remit Outside HH	(2) Remit Within HH
Risk Lottery	-256.516***	89.359**
	(53.936)	(39.115)
Constant	-2098.452	-3763.748**
	(1402.345)	(1674.944)
sigma	2153.587***	2567.170***
	(153.695)	(274.030)
Individual Characteristics	Yes	Yes
Region Dummy	Yes	Yes
Religion Dummy	Yes	Yes
Industry Dummies	Yes	Yes
Observations	1065	1065
Pseudo R-sq	0.050	0.023

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides zero censored Tobit estimates where the dependent variable is the amount remitted in Euros outside the household in Column 1, and inside the household in Column 2. 'Risk Lottery' is the hypothetical lottery risk question, with higher values corresponding to higher willingness to take risks. For conciseness the other controls from Table 3.3 and 3.4 are included under the headings 'Individual Characteristics, 'Region Dummy, 'Religion Dummy', and 'Industry Dummy' The standard errors in parentheses are robust and clustered by country of birth.

Table 3.9: Tobit Regressions: Willingness to Take Risks and Amount Remitted with Region of Birth Interactions: DV Amount Remitted

	(1) Tobit	(2) Tobit
Risk Lottery	19.089	-25.938
	(48.767)	(55.749)
EU12 * Risk	-71.744	-49.156
	(66.632)	(78.317)
Africa * Risk	-260.768***	-195.477**
	(75.133)	(78.675)
Asia * Risk	15.584	14.449
	(71.453)	(71.512)
Constant	-2017.502***	94074.416
	(328.415)	(77911.596)
sigma	2148.914***	1955.083***
	(134.188)	(111.718)
Individual Characteristics	No	Yes
Region Dummy	Yes	Yes
Religion Dummy	No	Yes
Industry Dummies	No	Yes
Ireland Variables	No	Yes
Observations	1311	1065
Pseudo R-sq	0.008	0.020

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The Table provides zero censored Tobit estimates where the dependent variable is the amount remitted in Euros. 'Risk Lottery' is the hypothetical lottery risk question, with higher values corresponding to higher willingness to take risks. 'School' refers to years of schooling, 'College' is a dummy for college being the highest level of education, 'Primary' is a dummy for primary school being the highest level of education. 'EU12_risk' is an interactive term for the recipient being from an EU New Member State, 'africa_risk' is the interaction term of being from africa and the risk measure. 'asia_risk' is the interaction term of being from Asia and the risk measure. The standard errors in parentheses are robust and clustered by country of birth.

Figure 3.1: Survey Question

LOTTERY QUESTION
Finally, please consider what you would do in the following situation.

Imagine that you had won **100,000 Euros in the lottery**.

Almost immediately after you collect the winnings, you receive the following financial offer from a reputable bank, the conditions of which are as follows:
- There is the chance to **double the money within two years**.
- It is equally possible that you could **lose half of the amount invested within two years**.

You have the opportunity to **invest the full amount, part of the amount or reject the offer**.

L014: What share of your lottery winnings would you be prepared to invest in this financially risky, yet lucrative investment?

Nothing, I would decline the offer	0
100 Euros	1
500 Euros	2
1,000 Euros	3
5,000 Euros	4
10,000 Euros	5
20.000 Euros	6
40.000 Euros	7
60,000 Euros	8
80,000 Euros	9
All 100,000 Euros	10
Missing [Note: Do not read the Missing.]	99

Chapter 4

Migration, Risk Attitudes and Entrepreneurship: Evidence from a Representative Immigrant Survey[1]

4.1 Abstract

Do more risk loving migrants opt for self-employment? We utilise a novel vignette adjusted measure of risk preferences in the domain of work to investigate the link between risk aversion and entrepreneurship in migrant communities. Using a representative household survey of the migrant population in the Greater Dublin Area, we find a significant negative relationship between risk aversion and entrepreneurship. In addition, we find that the use of vignettes improves the significance of the results, as they correct for differential

[1]This chapter is based on joint work with Catia Batista.

item functioning (where respondents interpret the self-evaluation scale in different ways) between entrepreneurs and non-entrepreneurs, as well as different migrant groups.

4.2 Introduction

The deepening economic crisis in many western countries has resulted in a general trend towards increasingly more restrictive policies towards immigration (OECD, 2010). As governments across the world are struggling with growing unemployment rates, there is growing political pressure to increase restrictions on international migration[2]. This political pressure is often based on the popular perception that the presence of migrants reduces employment opportunities for native workers. Increasingly restrictive immigrant policies can, however, be misguided as they ignore the potential positive effects that migrants can have on host economies. In addition to bringing new skills (Kerr and Lincoln, 2010; Hunt, 2009), increasing domestic demand (Somerville et al., 2009) and easing demographic pressures (Lacomba and Lagos, 2010; Bonin et al., 2000), migrants often create jobs by engaging in entrepreneurial activities with positive consequences on social security systems.

This paper suggests that risk preferences are an important determinant of entrepreneurship among migrants, and that there is heterogeneity among migrant groups in terms of unobservable characteristics and in turn their potential labour market outcomes. Predicting which migration flows are likely to result in significant new business creation in the host economy, therefore, requires one to consider unobservable characteristics, with per-

[2]A recent study OECD (2010) found that the majority of OECD countries had, in 2010, increased restrictions on international migration.

haps the most important unobservable characteristic for predicting entrepreneurship being risk aversion. While unobservable characteristics are by definition difficult to quantify, our research provides an improved methodology for measuring domain specific individual risk preferences.

This paper investigates the motives behind migrant entrepreneurship, focusing specifically on the role that risk preferences play in the decision to become self-employed which may potentially generate additional employment opportunities.

We are aware of a single study that looks specifically at risk preferences and entrepreneurship among migrants. Hormiga and Bolívar-Cruz (2012) investigate the link between risk aversion and entrepreneurship in Spain using data from the Global Entrepreneurship Monitor (GEM) survey. The research question of (Hormiga and Bolívar-Cruz, 2012) is closely related to ours, as the authors examine the proposition that the migration experience influences perceptions of risk and, that higher preference for taking risks is a factor in explaining the relatively high rates of entrepreneurship among migrants. The study finds that immigrants to Spain, irrespective of their origin or ethnicity, are more likely to consider entrepreneurship risky and are more likely to start up their own business than native Spaniards. The results provide support for the main hypothesis that more risk loving migrants are more likely to set up a business. A limitation of the study by Hormiga and Bolívar-Cruz (2012) is the indicator that they use. Unlike the survey we use in this paper, which was purposely designed to measure the risk preferences of the immigrant population in our sample, Hormiga and Bolívar-Cruz (2012) use data from a survey that was not designed to capture risk preferences. Indeed, the proxy for risk aversion used by these authors is a question asking whether individuals fear starting a new business. While

fear of starting a business and risk aversion might be related, the concepts are not identical and a fear of starting a business could be a result of a variety of other factors in addition to risk aversion.

This chapter contributes to the literature by examining the risk preferences of immigrants by utilising a tailor made self-evaluation question on risk aversion, adjusted for perception bias using anchoring vignettes. This adjusted measure allows us to measure risk preferences in a more accurate way than previously, as we can drastically reduce bias caused by Differential Item Functioning (DIF), where individuals interpret the response scale in a non-uniform way. This bias is especially pronounced where the characteristic being measured is subjective and related to previous experiences of the individual. This bias is compounded where the population being studied is culturally heterogeneous, as the use of scales has been shown to vary between individuals from different origin countries[3].

The specific measure of risk preferences we use in this paper is risk aversion in the domain of work. Adjusting the self-evaluation measure in this domain for DIF, reduces scale perception bias caused by cultural differences and variation in risk taking experiences in the domain of work. We utilise the vignette adjusted measure of risk aversion to test the hypothesis of a negative relationship between risk aversion and entrepreneurship in migrant communities.

To our knowledge this paper is the first to develop a vignette adjusted self-evaluation measure to improve the comparability of responses in a heterogeneous population. The measure is tested using a tailor made representative survey of the migrant population

[3]A number of articles have highlighted the issue of bias resulting from different use of scales by individuals from different countries and cultural backgrounds, see for example Le (2009); Choi et al. (2009); Teresi et al. (2008); Tennant and Pallant (2007); Culpepper and Zimmerman (2006)

in Greater Dublin, Ireland. Individuals are asked to rate three hypothetical individuals on their willingness to take risks regarding work and are then asked to rate their own willingness to take risks on the same scale. The information from the hypothetical vignettes is used to adjust the self-response answers and reduce the bias caused by DIF.

The empirical results we obtain confirm the existence of a negative relationship between risk aversion and entrepreneurship and show that adjusting for DIF improves the significance of the result. These results also suggest that there is a systematic bias in the use of scales between entrepreneurs and employees as well as between individuals from different countries of birth. A comparison between the adjusted and non-adjusted results shows that vignette adjustment significantly changes the conclusion that would have been reached if the risk scale had not been adjusted.

The rest of the chapter is organised in the following way: section 4.3 provides a literature review of related work; section 4.4 outlines the model we will use to adjust the measure; section 4.5 introduces the survey used and presents summary statistics; section 4.6 presents the results and section 4.7 concludes.

4.3 Literature Review

4.3.1 Risk Aversion, Entrepreneurship and Migration

Given that the earnings risk for self-employed individuals is in most instances higher than for managers (Bonin et al., 2007), risk preferences are often included in theoretical models of entrepreneurship, leading to the general conclusion that entrepreneurs are more risk loving than employees. In an early contribution, Kihlstrom and Laffont (1979) suggest

that individuals decide whether to become entrepreneurs or workers by comparing the risky returns of self-employment with the non risky wage determined in the competitive labor market. In their model, wages adjust to the point where the supply of workers is equal to the entrepreneurial demand for labour. Given the higher variance in earnings for the self-employed, risk averse individuals sort into employment and risk loving ones opt for entrepreneurial activities. This matching of risk loving individuals to the uncertain income prospects from self-employment, is at the heart of most theories of risk preferences and entrepreneurship.

The existing literature has focused on the relationship between risk preferences and occupation choice. The willingness of some individuals to bear a higher level of risk has been put forward as a solution to the 'private equity puzzle' (Moskowitz and Vissing-Jørgensen, 2002). The theoretical question being: why do individuals invest large shares of their wealth in their own firms, despite comparably low returns and high risk? Fossen (2011) provides a solution to the 'puzzle' by allowing for heterogeneity in risk attitudes, where entrepreneurs have a preference for a riskier portfolio of investments. Therefore, according to Fossen (2011), if credit constraints exist, they may not be binding for existing entrepreneurs in their portfolio choice, as they are willing to hold higher portfolios without requiring a risk premium that would be adequate for the more risk-averse remainder of the population. The preferences of risk loving individuals for these risky portfolios means that the ownership probability and the conditional portfolio share of private business equity significantly increase with higher risk-tolerance.

While the role of risk preferences in occupation choice is acknowledged in the theoretical literature, the sources of uncertainty facing entrepreneurs have been modelled in a number

of different ways. For example, Appelbaum and Katz (1986); Sheshinski and Dreze (1976) posit that the risk in entrepreneurship arises primarily from uncertainty regarding demand for products, whereas Kihlstrom and Laffont (1979) suggest that a more important consideration is cost uncertainty in the production function of the self-employed. Irrespective of the source of uncertainty assumed in the models, there is a general consensus that a negative relationship exists between individual risk aversion and the probability of being self-employed. These theoretical approaches provides a useful way to conceptualize the link between risk aversion and entrepreneurship and is the basis for our hypothesis that more risk loving migrants will be more likely to start up their own business.

In addition to the theoretical models, the link between risk aversion and entrepreneurship has been investigated empirically. While the majority of such studies find a significant relationship (Stewart Jr and Roth, 2001), there is variation in the significance and strength of the effects found (Miner et al., 2004). The empirical literature has focused on different aspects of the entrepreneurial experience, and it is therefore not surprising that there is some variation in the conclusions reached. Van Praag and Cramer (2001) find a strong relationship between risk preferences and the probability of being self-employed, in the Netherlands. While Caliendo et al. (2009) also find a negative relationship between risk aversion and entrepreneurship in Germany, this effect is only significant for those coming out of unemployment. In terms of business success, Caliendo et al. (2010) find that there is an inverse U relationship between risk attitudes and entrepreneurial survival, with those in the middle being successful for the longest time. In terms of initial financing, Elston and Audretsch (2011) find that the more risk averse entrepreneurs are more likely to accept a start-up grant in the United States after wealth effects are controlled for. The variation

in the measure is probably due to the different measures used and the country context. Despite this variation, the majority of studies find a positive or inverse U relationship between willingness to take risks and entrepreneurship.

The link between risk aversion and entrepreneurship is especially relevant for the migrant sample used in the study, as there are reasons to believe that migrants are generally more risk loving than non-migrants. Two early contributions by Sjaastad (1962); Harris and Todaro (1970) provide theories explaining why migrants might be more risk loving. The authors model migration as an investment decision under uncertainty, where only individuals with a certain level of risk aversion will be prepared to migrate when faced with a given combination of migration costs; wage differentials between home and abroad; and the expected probability of finding work upon arrival. More recent work has tested this relationship empirically. These articles provide a substantial amount of empirical evidence that migrants tend to be more risk loving than non-migrants[4].

4.3.2 Developing a Vignette Adjusted Measure of Risk Aversion

The empirical literature is increasingly using domain specific self-evaluation measures, with recent examples including Hanoch et al. (2006); Weber et al. (2002); Johnson et al. (2004); Van Soest et al. (2011). This measure has gained credibility following Dohmen et al. (2011) who showed that self-evaluation measures of risk aversion are a strong predictor of real outcomes in that specific domain. While unadjusted self-evaluation measures perform well in homogeneous populations, problems emerge when the sample is comprised

[4]See for example: Wang and Wirjanto (2004) Jaeger et al. (2010) Chen et al. (2003) Bonin et al. (2009) Umblijs (2012).

of individuals from diverse backgrounds, resulting in scale perception bias [5]. In addition, the unadjusted self-evaluation measures could underestimate the link between risk aversion and entrepreneurship, because entrepreneurs are likely to interpret the scale in a systematically different way due to their unique understanding of what counts as risk loving behaviour in the domain of employment.

To overcome these issues, we develop a self-assessed, vignette weighted questions for the specific domain of risk in employment. The addition of vignettes will control for DIF, and allow a comparison between individuals from different cultural backgrounds and other characteristics that could result in different perceptions of the scale. This will address the issue of perception bias in the self-evaluation scale, a problem which hinders inter-cultural comparisons in these kinds of measures [6]. Vignettes were devised in political science to counter the bias of different interpretations of scales when measuring concepts such as political support King et al. (2004) and have recently been utilized in the economics literature [7]. Vignettes control for the effect of perception, by allowing the researcher to compare the individual self-assessment to a fixed hypothetical scenario. This feature of the vignette approach is applicable to self-evaluation measures of risk, which are especially sensitive to perception and scale bias in heterogeneous populations.

[5]For a detailed discussion on scale perception bias see Le (2009); Choi et al. (2009); Teresi et al. (2008); Tennant and Pallant (2007); Culpepper and Zimmerman (2006); Van Soest et al. (2011)

[6]For a review of the literature on differential item functioning, see Wainer (1993); Oshima and Morris (2008)

[7]See for example Van Soest et al. (2011); Kristensen and Johansson (2008); Datta Gupta et al. (2010); Kapteyn et al. (2007)

4.4 Methodology

We use a vignette approach to counter scale bias in our risk measures in the domain of work. We use non-parametric and semi-parametric scale readjustment methods as well as a more sophisticated Compound Hierarchical Ordered Probit (CHOPIT) model in order to compare these results against the non-adjusted measure. Comparing these results will show the effect controlling for DIF can have on the general conclusion regarding the link between risk aversion and entrepreneurship in our migrant sample.

4.4.1 How vignettes work: a hypothetical example

In order to illustrate how the use of anchoring vignettes helps us identify the real unobserved level of risk aversion, we present a hypothetical example. Figure 4.1 shows the distribution of answers for two groups of individuals. For concreteness, we say that group A is comprised of non-entrepreneurs and group B of entrepreneurs. If we define being risk loving as having a value of 4 or more on our 7 point scale, than the distribution of responses would suggest that group A is more risk loving than group B because a larger proportion of respondents in group A selected a value of 4 or higher than in group B. However, in our hypothetical scenario the two groups also differ in what they understand to be risk loving. For example, the entrepreneurs in group B might rank an individual as being risk averse, where someone from group A would consider the same person as risk neutral.

Therefore, in order to compare the real unobserved levels of risk aversion between the groups, a reference point needs to be established. This reference point takes the form of

a hypothetical vignette, the average score of which is represented by the dashed line in Figure 4.1 for the two groups. The figure shows that the two groups scored the same hypothetical individual differently, with group A giving him an average score of 4 and group B a lower average score of 3. Therefore, non-entrepreneurs (group A) considered the hypothetical individual to be more risk loving than entrepreneurs (group B). With the reference point now included, the general conclusion regarding which group is more risk loving is reversed. It is clear from the diagram that a higher proportion of individuals in group B rated their willingness to take risks as being higher than the hypothetical vignette level relative to group A. Therefore we can say that, while entrepreneurs might not rate themselves as being more risk loving than the rest of the population, because of their more conservative perception of what constitutes 'taking risks', their actual (unobserved) level of risk preference is higher than that of non-entrepreneurs. As well as differences in scale interpretation between entrepreneurs and non-entrepreneurs, other factors such as cultural norms and gender could influence the way that an individual uses a self-evaluation scale. Vignettes provide a useful way to counter biases caused by these variations in scale interpretation.

4.4.2 Rescaling responses using vignettes: non parametric approach

The simplest way to use vignettes is to rescale each response based on the relative position of the self-evaluation response to the value given for the hypothetical vignette. As in our survey each individual was asked to score three hypothetical individuals, the responses can be recoded on a 7 point scale according to the relative position of respondent's self-

evaluation relative to the hypothetical vignettes. Therefore, if y_i is the categorical self-assessment for individual i , and z_{ij} is the categorical survey response for respondent i on vignette $j(j = 1, 2, 3)$, the self-evaluation response can be rescaled relative to the vignette in the following way:

$$C_i = \begin{cases} 1 & if \quad y_i < z_{i1} \\ 2 & if \quad y_i = z_{i1} \\ 3 & if \quad z_{i1} < y_i < z_{i2} \\ 4 & if \quad y_i = z_{i2} \\ 5 & if \quad z_{i2} < y_i < z_{i3} \\ 6 & if \quad y_i = z_{i3} \\ 7 & if \quad y_i > z_{i3} \end{cases} \tag{4.1}$$

where C_i represents the value recoded based on vignette responses. This approach provides a straightforward way to adjust responses for DIF without using statistical modelling techniques. However, the main limitation of this approach is that recoding is only possible where vignettes are not tied and are consistently ranked. For example, if a respondent gives all three vignettes the same rank, the adjusted response C_i , will not take a single value, but will take the vector $\{2, 4, 6\}$. The non-parametric solution to the problem is to delete the responses that contain a vector value of C_i. This is not the most efficient use of the information available as a significant proportion of respondents (37% in our sample) have tied vignette responses.

4.4.3 Rescaling responses using vignettes: a semi-parametric approach

An improvement over the non-parametric approach of deleting vector values of C_i is to assign the value from the vector that has the highest conditional probability of being true based on other available data. As above, we assume that C_i can be either a scalar, or a vector. We assume that there is a single unobserved continuous true value that represents the risk preference of all individuals, denoted by C_i^*. We also assume that in cases where C_i is a vector value we can estimate which value has the highest probability of being C_i^* conditional on explanatory variables x_i. We call the upper and lower bounds of the vignette responses thresholds and denote them as τ_c. Therefore, the Equation for C_i (4.1) can be rewritten in the general form:

$$C_i = c \qquad if \qquad \tau_{c-1} \leq C_i^* < \tau_c \tag{4.2}$$

Incorporating the possibility that C_i is a vector variable, yields the following equation:

$$C_i = \{m, ..., n\} \qquad if \qquad \tau_{m-1} \leq C_i^* < \tau_n \tag{4.3}$$

In order to estimate the underlying value for C_i^*, we use a modified version of the ordered probit model in order to break ties when C_i is a vector value. This can be done by utilising explanatory variables x_i to find the value in the vector that is most likely to be the true value of C_i given the available information in x_i:

$$Pr(C_i\{m, ..., n\}|x_i) = \int_{\tau_{m-1}}^{\tau_n} N(C_i^*|x_i\beta)dy. \tag{4.4}$$

Therefore, in the case of scalar values, C_i is selected in the same way as in the non-parametric approach . In the case of a vector value, expression (4.4) provides a probability density for each of the values in the vector, with all of the values together summing to one. Using the probability density of the vector values, the value with the highest probability conditional on characteristics x_i, is selected as the adjusted risk measure for that individual. For our predictor variables x_i we include other measures of risk aversion from our survey. These risk measures include a hypothetical lottery question, risk in the domain of money, and risk in the domain of migration. While our measure of risk in the domain of employment is the most relevant for our study the other two measures are closely correlated and are useful in breaking ties in the cases where vignettes are ordered inconsistently and the adjusted result C_i is a vector.

4.4.4 Econometric Specification Using Adjusted Risk Measure

In order to compare our results with the existing literature, we require entrepreneurship to be the dependent variable and risk aversion to be the independent variable. For this purpose we use the adjusted measure of risk aversion found by utilising the methodology in the above section. The closest article for comparison is Caliendo et al. (2009) who use the German Socioeconomic Panel to investigate the link between risk aversion and entrepreneurship using a range of self-evaluation measures and a hypothetical lottery. The most relevant measure for our purposes is the self-evaluation measure of risk in the domain of work.

We include the adjusted and non-adjusted risk measure in the domain of work using the following specification:

$$y_i^* = \beta_1 risk_i + \beta_2 X_i + \epsilon_i \tag{4.5}$$

Where the above is a probit model with the dependent variable denoting whether an individual is self-employed or not at the time of the survey; $(risk_i)$ represents the risk measure (adjusted or unadjusted in different specifications); and (X_i) is a vector including demographic characteristics (such as age education and marital status); controls related to migration (such as years living in Ireland, the size of the population of individuals from your country living in Dublin), previous entrepreneurial experience before migration as well as industry and region of birth controls.

In order to capture non linearities in the link between risk aversion and entrepreneurship and to make the results comparable to Caliendo et al. (2009), $(risk_i)$ is divided into three categories: *lowrisk* relates to individuals having a value of 1 or 2 on the scale, *mediumrisk* relating to individuals with values 3,4, or 5 , and *highrisk* relating to individuals with values 6 or 7. We include *mediumrisk* and *highrisk* as dummy control variables, using *lowrisk* as a reference point.

4.4.5 Compound Hierarchical Ordered Probit Model

The semi-parametric approach allows us to rescale the risk measure and include it as an independent variable, in order to make the results comparable with other studies looking at risk aversion and entrepreneurship. The CHOPIT model requires the self-evaluated risk measure to be the independent variable. While the semi-parametric approach is the most

efficient for our purposes, a fully parametric approach can provide additional insights into how different subsets of individuals interpret the scale differently and the consequence this has on the significance of individual characteristics.

For the parametric specification of the vignette adjustment procedure we utilise the Compound Hierarchical Ordered Probit (CHOPIT) model as first proposed by King et al. (2004), which is an extension of the ordered probit model that corrects for DIF. This model has been extensively used in the literature to correct self-evaluation measures for differences in scale interpretation. The model explains the self-assessments with an ordered response equation with thresholds that depend on individual characteristics (Van Soest et al., 2011, p 579). In our work we adapt the model presented in King et al. (2004) and Van Soest et al. (2011).

We denote the self-assessment response of individual i with CS_i, which is a value on the initial seven point scale that individuals ranked themselves on. In addition, we assume that the self-assessment value is driven by an underlying, unobservable actual level of risk aversion CS_i^*given by:

$$CS_i^* = X_i\beta + \xi_i. \tag{4.6}$$

where X_i is a set of individual characteristics such as age, gender and dummy variable for being an entrepreneur; ξ_i, as the residual term and is comprised of unobserved heterogeneity in risk preferences and an idiosyncratic noise term affecting subjective self-reporting. We assume that ξ is normally distributed and is independent of X_i, with mean 0. We observe values that correspond to thresholds along the latent index:

$$CS_i = j \qquad if \qquad \tau s_i^{j-1} < CS_i^* \leq \tau s_i^j, \qquad j = 1, ..., 7. \tag{4.7}$$

where the thresholds τ_i^j are given by

$$\tau s_i^0 = -\infty, \qquad \tau s_i^7 = \infty, \qquad \tau s_i^1 = X_i \gamma s^1 + \upsilon_i, \qquad \tau s_i^j = \tau s_i^{j-1} + exp(X_i \gamma s^j), \qquad j = 2, 3, 4, 5, 6. \tag{4.8}$$

In the above equation υ_i follows an $N(0, \sigma_u^2)$ and is distributed independently of X_i. For the non-adjusted self-evaluation risk questions, β and ,$\gamma s_i^j$are not separately identified. In other words Equation (4.5) cannot be identified if the use of the scale differs between different groups. However, if an equation specifying vignette selection were defined, the scale could be adjusted to account for the difference in scale interpretation. This is exactly what is done next. Indeed, the vignettes use the same scale as the self-evaluation questions and can be modelled in a similar way to the response equations:

$$CL_i^* = Z_i \pi + \epsilon_i, \tag{4.9}$$

$$CL_i = j \qquad if \qquad \tau l_i^{j-1} < CL_i^* \leq \tau l_i^j, \qquad j = 1, ..., 7. \tag{4.10}$$

where CL_i^*represents the true unobserved value of vignette L $(L = 1, 2, 3)$; Z_i represents variables that influence the interpretation of a given vignette. Threshold in Equation (4.10) are also modelled in a similar way to the self-response equation with τl_i^j instead of τs_i^j.

The error term ϵ_{il} in Equation (4.9) is normally distributed and independent of ξ_i.

The thresholds are also modelled in a similar way to the response equation but again using different parameters as shown below.

$$\tau l_i^0 = -\infty, \qquad \tau l_i^4 = \infty, \qquad \tau l_i^1 = X_i\gamma l^1 + v_i, \qquad \tau l_i^j = \tau l_i^{j-1} + exp(x_i\gamma l^j), \qquad j = 2,3,4,5,6. \tag{4.11}$$

The key assumption of the CHOPIT model is that there is response consistency between the ranking of vignettes and the ranking of the self- evaluation questions. This assumption means that individuals use the scale in the same way for the vignettes and the self-response questions and that the threshold parameters in Equations (4.8) and (4.11) are equivalent:

$$\gamma s^j = \gamma l^j, \qquad j = 1,..,5. \tag{4.12}$$

As γl can be identified separately from the vignette equation and can be matched to γs based on the assumption of response consistency, β in Equation (4.6) can be identified. Given the way that the thresholds vary between respondents is controlled for by γs, the results of β in Equation (4.6) control for differential item functioning. As mentioned above, while this approach does not result in an adjusted risk measure that can be used as an independent variable, it does provide more detailed insights into the characteristics that affect the use of the response scale beyond what is possible using non-parametric and semi-parametric approaches.

4.5 Data Description

4.5.1 Self Evaluation Measure

The data for the empirical analysis in this chapter comes from the NORFACE funded migrant data set. The data set provides a representative sample of migrants in the Greater Dublin Area, with detailed individual characteristics. The data-set includes a module on risk preferences including vignette adjusted self-evaluation risk measures, designed specifically to address the question in this chapter. More detailed information, regarding the sample and data collection methodology is provided in Section 3.5.1.

The self-evaluation risk measure was administered in order to ensure consistency in the ordering of the vignettes and the way that questions were asked. The questions were piloted at an early phase of development of the survey to ensure that the vignettes were understood in the same way by all individuals. In addition to asking the questions orally, the respondents were given cards with the hypothetical scenario for the questions they were answering so that they could better follow and process all of the information. Great care was taken to ensure that all interviewers asked the questions in a uniform way and were not allowed to influence respondent's answers. The objective was to minimize the ways that the survey questions could be interpreted, while allowing respondents to express their true answers.

The order of the vignette questions was randomised. These questions were immediately followed by the self-evaluation question so that the same scale and context would be transferred from the hypothetical vignettes to the self-evaluation question. The vignette questions on risk perceptions along the work dimension are presented in appendix C.

4.5.2 Stability of Risk Preferences Over Time

The existing literature regarding stability of individual risk preferences over time was discussed Section 3.5.3. In this literature those arguing that risk preferences are a stable characteristic trait suggest that the change in risk preferences, observed by other studies, is due to measurement error. As this Chapter addresses the issue of measurement error in capturing risk preferences, we can look more closely at the relationship between age and risk preferences by comparing our unadjusted with our adjusted risk measure.

The left hand diagram in Figure 4.4 shows the relationship between age and willingness to take risks for our unadjusted measure. The polynomial smoothed plot shows that risk preferences remain relatively stable until the age of around 65 where the average willingness to take risk decreases substantially. The right hand diagram in Figure 4.4 shows the relationship between age and willingness to take risks using the vignette adjusted measure. In contrast to the unadjusted measure, the relationship between age and willingness to take risks shows a general increase in the willingness to take risks from around age 30 and shows far less volatility after age 60, relative to the unadjusted measure. The relatively more stable relationship between age and risk preferences for the vignette adjsuted measure supports the suggestion that changes in risk preferences over time are partly due to measurement error McCrae (1993). More specifically, the graphs in Figure 4.4 shows that in terms of self-evaluation questions, scale perception is sensitive to age and that older individuals are not substantially more risk averse in terms of employment than younger individuals, within our sample of migrants.

4.5.3 Descriptive Statistics

Tables 4.1 to 4.3 provide summary statistics regarding entrepreneurs in our sample. We define entrepreneurs as individuals that have been self-employed at any time during their current stay in Ireland. Following this definition, our sample contains 111 (8% of the total sample) entrepreneurs. Table 4.2 describes the sectors of employment for self-employed individuals in our sample, showing that the highest proportions of entrepreneurs are in the transport, construction and IT sectors.

Looking at world regions of birth, Table 4.3 shows that the three regions where the highest share of self-employed individuals originated from are: South America, North America and Africa. Entrepreneurs from Africa made up the largest group (62 respondents) among the self-employed individuals in our sample.

Table 4.1 shows the difference in means between entrepreneurs and non-entrepreneurs along the most common explanatory variables for entrepreneurial activity found in the literature, namely income, age, years of schooling and gender. The table shows that while the non adjusted self-evaluation risk measure suggests no statistically significant difference between entrepreneurs and the rest of the population, the adjusted measure reveals that entrepreneurs are more risk loving at a 6% significance level.

The summary statistics also show that there is a statistically significant difference between entrepreneurs and non-entrepreneurs along the income, age and gender variables. Table 4.1 shows that the average entrepreneur has a higher monthly income (by EUR 335), is three years older, has a similar amount of education and is more likely to be male than the average non-entrepreneur.

Figures 4.2 and 4.3 show the distribution of responses of entrepreneurs and non en-

trepreneurs for the non-adjusted and adjusted risk measures. The difference between entrepreneurs and non-entrepreneurs is less pronounced in the unadjusted (Figure 4.2) than the adjusted (Figure 4.3) case, suggesting that entrepreneurs rate the hypothetical vignettes in a systematically different way from the rest of the population. The adjusted measure in Figure 4.3 suggests that entrepreneurs are more likely to be medium-to high risk loving (4-6 on the scale) while being less likely to be risk averse (values 1-3) or extremely risk loving (7 on the scale), relative to the rest of the population.

The summary statistics show that vignette adjustment has a significant effect on the distribution of responses and that (on average) more risk loving individuals are more likely to be self-employed when the adjusted measure is used. The next section looks more closely at how the self-evaluation responses were adjusted using the anchoring vignettes.

4.5.3.1 Vignette Responses and Relative Rank Analysis

Table 4.4 provides a breakdown of results after the self-evaluation measure is ranked relative to the vignette responses. The first column in Table 4.4 corresponds to C_i as described in section 4.4.3, the value is the non-parametrically adjusted (or rescaled) self-evaluation measure in the domain of work. In our scale, higher values correspond to a higher willingness to take risks with the adjusted measure having a minimum value of 1 and a maximum value of 7. Where individuals ranked the vignettes consistently[8] and without ties C_i takes a single value. If respondents ranked vignettes inconsistently or ranked at least two vignettes in the same way, a single recoded value cannot be obtained and C_i is a vector. Vector

[8]By consistency we mean that individuals ordered the vignettes as they were designed with the most risk averse hypothetical individual being given the lowest score ect. . The most common ranking was 1,2,3, which reflects the order that was intended by us.

values mean that because of a tied or inconsistently ordered vignette a single rescaled value could not be obtained. However, unless all of the vignettes are incorrectly ordered we can give a range within which the true value lies[9]. The rank analysis in Table 4.4 suggests that after adjusting the self-evaluation risk measures using the vignettes, 63% of the responses were scalar. This corresponds to a reasonable proportion of correctly ordered vignette responses compared to the existing literature[10]. In addition, while there were some inconsistencies or ties in 37% of cases, in the majority of these situations, only two vignettes were ties or mis-ordered. In total, only 9 individuals (0.6%) in the sample mis-ordered all three of the vignettes to the extent that the adjusted value could take any value on the 7 point adjusted scale, as shown by the {1 to 7} category in table 4.4. The high proportion of consistently and nearly consistently ranked vignettes is reassuring as it suggests that the vignettes were correctly understood by the majority of respondents.

4.6 Empirical Results

This section presents the results of the empirical analysis using the non-adjusted, semi-parametric and parametric models. The parametric CHOPIT model will allow us to see how various groups within our sample interpreted the self-evaluation scale. The drawback of the CHOPIT model is that risk preferences can only be on the left hand side of the

[9]For example if an individual ties vignettes 1 and 2, and considers himself less risk loving than vignette 3 but more risk loving than the tied vignettes 1 and 2, the adjusted value will lie between the values of 2 and 5. This is because we know that the value cannot be 1, as he has ranked himself above vignettes 1 and 2, at the same time he cannot be more risk loving than 6 because he is more risk averse than vignette 3. Therefore in this example the individual will have vector $\{2, 3, 4, 5\}$ for C_i.

[10]The percentage of correctly ranked vignettes varies between studies. For example (Hopkins and King, 2010) rank 74 % of vignettes correctly when looking at self-reported vignette adjusted differences in political efficacy between China and Mexico , whereas (Bratton, 2010) has only 37% of consistent and non-tied responses when investigating perceptions of democracy in Africa.

estimation equation and a rescaling of the risk measure, to be used as an independent variable, is not possible using this approach. As we are interested in comparing our results with existing literature we require an adjusted measure of risk preferences; in order to achieve this we use non-parametric and semi-parametric methods to create a vignette adjusted measure which is more versatile and can be used as an independent variable. We present the results of the three approaches below.

4.6.1 Estimation Results Using the Adjusted Risk Measure

As described above, the vignette adjusted variable can be created using either non-parametric or semi-parametric approaches. As a benchmark we start with the non adjusted self-evaluation measure of risk aversion, as shown in Table 4.5. This measure is the value that the respondents gave for their self-evaluation without vignette adjustment. The Table presents marginal effects of the probit specification and shows that there is no significant relationship between the unadjusted measure and being an entrepreneur. The simple probit regression (column 1), shows that the relationship between entrepreneurship and willingness to take risks is not statistically significant. The risk measure variable remains statistically insignificant even after individual characteristics (column 2) and other potential explanatory factors (column 3) are accounted for. Column 3 in Table 4.5 also shows that from the other control variables, years in Ireland, and having entrepreneurial experience in the sending country are the most statistically significant.

Table 4.7 shows the marginal effects of the non-parametrically adjusted measure of risk aversion. The table presents marginal effects of the probit specification with all individuals who ordered the vignettes inconsistently removed. Looking at column (1) in Table

4.7 shows that using this vignette adjustment specification, both the *mediumrisk* and *highrisk* variables are significant at the 1 % level. Having a medium level of willingness to take risks increases the probability of an individual being an entrepreneur by 9 percentage points and having a high level of willingness to take risk increases the probability of being an entrepreneur by 10 percentage points. The magnitude of the coefficients drops slightly to a positive effect of 8 percentage points, after controls are added, for both medium and high risk, and remains statistically significant, in all of the specifications. It is also interesting to note that women are less likely to be entrepreneurs by 6 percentage points. Arriving in Ireland one year later is associated with a decrease in the probability of being an entrepreneur by just under 1 percentage point. Having previous entrepreneurial experience in the home country is correlated with an increase in the probability of being self-employed in Ireland by around 12 percentage points. These results are all statistically significant at the 1% level.

Table 4.8 shows the semi-parametrically adjusted risk measure in the domain of work. This are the rescaled values of respondents relative to the vignette with any respondents who mus-ordered or tied vignettes taken out of the sample. For this measure inconsistently ordered vignettes are allocated to the value with the highest probability of being true (among the vector values) based on the choices made by other individuals with similar characteristics, as described in section 3. Probit regression in column (1) in Table 4.8 shows that the marginal effects of the risk measure on the probability of being self-employed are statistically significant for both the *mediumrisk* and *highrisk* variables. The coefficient suggests that having a medium level of willingness to take risks increases the probability of being self-employed by 7 percentage points, and having a high willingness to take risks

increases the probability of being self-employed by 9 percentage points. Column (2) in Table 4.8 includes controls for basic characteristics used in the literature and the migration specific variables. The results suggest that there is a significant relationship between risk preferences and entrepreneurship even after controlling for all of the variables included in our specification. The addition of the controls does however reduce the significance of the *mediumrisk* variable to a borderline of statistical significance. With the inclusion of all controls (regression 3 in Table 4.8), the results suggest that the having a medium level of risk increases the probability of being self-employed by 6 percentage points, and having a high level of risk increases the probability of being self-employed by 7 percentage points. Year of arrival and previous entrepreneurial experience remain significant. In this specification, the enclave variable becomes statistically significant while the female variable becomes insignificant. The 'enclave' variable is a measure of the concentration of individuals with the same nationality, it is measured as the percentage of migrants in the respondent's area who are from the same country as the respondent. The change in the significance of the female variable could be due to the fact that women have a different perception of risk but are not necessarily more risk averse.

4.6.2 Estimation Results of CHOPIT Model

Table 4.6 shows the results of the CHOPIT model where the risk measure is the dependent variable. Column (1) of Table 4.6 also presents the results of the estimation using the ordered probit model.

Table 4.6 shows that while the non-adjusted ordered probit model appears to be completely insignificant as can be seen in Column (1), after vignette adjustment the relation-

ship between entrepreneurship and risk aversion becomes significant at the 8% level (see Column (2)). The table suggests a positive relationship between willingness to take risks and entrepreneurship in our sample of migrants. In other words, while the self-reported level of risk of entrepreneurs is not statistically different from the rest of the population, their actual level of risk aversion is significantly lower because they interpret the scale in a different way.

The reason the entrepreneur variable in the CHOPIT model is statistically significant while it is insignificant in the probit model is because the vignette equation included in the former, has altered the boundaries, or thresholds, between possible responses. The values for thresholds τ values in Table 4.6 show how (after vignette adjustment) the actual 'unobservable' scale that entrepreneurs use in ranking themselves is different relative to non-entrepreneurs, or in other words, entrepreneurs perceive the self-evaluation scale differently to the rest of the population. The figures for the τ values in column 2 of Table 4.6 show how entrepreneurs perceived that self-evaluation scale. The results in column 2 of the table show that entrepreneurs regarded the most risk averse values of the scale as being more risk loving than non-entrepreneurs (positive sign on τ^1), while considering the more risk loving values as not being as risk loving as the rest of the population (negative sign on $\tau^2, \tau^3$and τ^4). The inflation of low values on the scale and undervaluing of higher values by entrepreneurs, has essentially compressed the actual unobserved scale for this subgroup, relative to other individuals in the sample. The valuation of the vignettes by entrepreneurs, results in a more narrow range of vignette adjusted values than the non-adjusted self-evaluation measure would suggest. An explanation for this compression of the scale could be that self-employed individuals undervalue risky employment decisions

due to their own willingness to take such risks, while at the same time recognising that the risk element in seemingly risk free employment decisions also have to be considered, a point that could be missed by non-entrepreneurs.

Another noteworthy result of the CHOPIT model in Table 4.6 is related to the four variables that are statistically significant for the Ordered Probit (Column 1) but not for the vignette adjusted CHOPIT model (Column 2). The dummy variables for born in Africa, born in Australia being female, and having children, are all statistically significant when the unadjusted measure is used but lose their statistical significance after vignette adjustment. This result suggests that while the scale perception of these groups is statistically different to the rest of the population their actual risk preferences are not. While the unadjusted measure suggests that being female and having children is associated with being more risk averse (Table 4.6, Column 1) the 'actual' vignette adjusted measure (Table 4.6, Column 2) suggests that there is no statistically significant relationship between these two characteristics and being self-employed. Furthermore, while the unadjusted measure suggests that individuals born in Africa and Australia are more risk loving, the adjusted results suggests that there is no statistically significant different in the risk preferences of individuals from these countries.

The results of the CHOPIT model suggests that for certain groups the perceived difference in risk preferences is actually due to differences in scale interpretation rather than actual differences in risk preferences. Conversely, while the unadjusted measure suggested that entrepreneurs don't differ in their risk preferences to the rest of the population, the 'actual' vignette adjusted level suggests that entrepreneurs are in fact more risk loving than the rest of the population,

4.6.3 Discussion of Results

Our results show that while using the unadjusted measure of risk aversion there is no statistically significant relationship between risk aversion and entrepreneurship, the semi-parametrically adjusted measure suggests a positive relationship between the willingness to take risks and being an entrepreneur. These results confirm our prediction that in heterogeneous populations self-evaluation measures can suffer from differential item functioning and that a vignette adjusted measure can counter bias caused by differing interpretations of the self-evaluation scale. Using adjusted measures, our results suggest that having a medium level of risk increases the probability of a migrant becoming an entrepreneur by between 5.5 and 8.3 percentage points, and being a high risk individual increases the probability of becoming an entrepreneur by between 7.1 and 8.2 percentage points (both results being statistically significant).

Comparing our results to Caliendo et al. (2009), who have a much more homogeneous population (predominantly German nationals) and who use an unadjusted self-evaluation measure in the domain of work, shows that the results of that study and ours are nevertheless consistent. Caliendo et al. (2009) find a significant marginal effect of between 0.7 and 2 percentage points for individuals with medium willingness to take risks and a significant positive marginal effect of 4 percentage points for individuals with a high willingness to take risks in the domain of work. While the magnitude of our effect appears to be larger, the statistical significance and direction of the relationship is the same as in Caliendo et al. (2009) when the adjusted risk measures is used in our analysis. While the results of our study and that of Caliendo et al. (2009) cannot be directly compared due to differences in methodology, the results demonstrate that the conclusions from the adjusted risk measure

in our study are closer to other studies in the literature compared to the unadjusted measure which yields statistically insignificant results[11]. Our study provides a more robust and direct estimate of risk aversion than Caliendo et al. (2009) while adding weight to the empirical evidence that more risk loving migrants are more likely to become self-employed.

It should be noted that, similar to many studies of migration, we only observe migrants that were in the country at the time of the field work, therefore selective out-migration could result in an overestimation of the willingness of migrants to take risks if the most risk averse are more likely to return, or vice-versa in the case of risk loving selection in out-migration. While acknowledging the issue of selective out-migration in our study, because our definition of 'migrant' is much more narrow than in may similar studies (someone who has lived in Ireland for more than 6 months but less than 10 years) this bias is likely to be less pronounced than the often used broader definition of migrant as being born outside of the country or having at least one foreign parent.

The results of the different specifications show that the vignette adjustment methods increased the statistical significance of the relationship between risk aversion and entrepreneurship, a relationship that remains significant after controlling for a broad range of characteristics. The results suggest that non-adjusted measures of risk aversion in specific domains suffer from DIF, and therefore are further away from the actual levels of risk preferences than the vignette adjusted measure. Relying on unadjusted self-evaluation measures to investigate the link between risk aversion and entrepreneurship for migrant populations would have in this specific case resulted in the false conclusion that there

[11] Caliendo et al. (2009) look specifically at individuals that have transitioned from unemployment into self-employment and follow a logit specification instead of the probit model used here. The sample and context of the questions is also different, therefore a direct comparison should be viewed with caution.

is no significant link between these two factors. However, the adjusted measure shows that there is a statistically significant relationship between actual risk preferences and entrepreneurship, a relationship which is hidden by variation introduced by differential item functioning within the population of migrants.

4.7 Conclusion

This paper investigates the relationship between risk aversion and entrepreneurship, looking specifically at a migrant population. This focus on motives for self-employment among migrants is especially relevant as entrepreneurship has wider economic benefits for the host country. The fact that some groups of migrants are risk loving, and therefore have high rates of self-employment, is often overlooked when the advantages and disadvantages of migration policies are discussed. As many countries in Europe face tougher economic conditions with growing unemployment, the 'entrepreneurial spirit' of migrants should be considered as a positive effect of migration on the host country. Our results lend support to the hypothesis that there are unobservable factors that encourage entrepreneurship among migrants. More specifically, we find that risk aversion is as, or even more, statistically significant as other observable characteristics such as age, education and gender, in explaining who becomes an entrepreneur among our sample of migrants.

The main challenge of investigating the relationship between risk aversion and entrepreneurship is to ensure that the risk measures being used are comparable between groups of migrants. This paper develops a novel vignette adjusted self-evaluation risk measure in order to counter the problem of different interpretation of our scale between

individuals in our sample, and tests its validity using a tailor made survey of migrants in the Greater Dublin Area, Ireland. Using the vignette adjusted measure, the relationship between risk aversion and entrepreneurship was tested and the results suggest a significant relationship, but only after the measure was adjusted using a series of vignettes. Our analysis suggests that as well as different scale interpretations by individuals from different parts of the world, entrepreneurs also ranked the hypothetical vignettes significantly differently to the rest of the sample. A comparison of non-adjusted models and those using our vignettes adjusted measure showed that using the former would have led to the conclusion that there is no link between risk aversion in the domain of employment and entrepreneurship. The adjusted measure, however, resulted in a significant positive relationship between willingness to take risks and entrepreneurship. The difference in results between the vignette adjusted and non-adjusted measures suggests that while entrepreneurs' *stated* willingness to take risks was similar to the rest of the population, their *actual* level of risk aversion was lower. In this case the vignettes were crucial in obtaining a measure that reflects *actual* preferences more closely.

This paper contributes to the existing empirical literature by developing a method to improve the accuracy of self-evaluation measures of risk aversion, especially when risk in specific domains is being measured. While a number of measures of risk aversion have been used in previous work, the self-evaluation measure is a popular choice and likely to remain prominent as it is simple to administer on a large scale and has been validated by comparison with real monetary incentives. The novel addition of vignettes to the self-evaluation measure improves the accuracy and reliability of the results significantly, with a relatively small additional cost to the survey designer. The addition of vignettes is

especially relevant when considering risk preferences as self-evaluation in this characteristic will inherently be relative, and depend on what the respondent considers to be risk averse and what value she will assign to that subjective level. In addition, the vignette component is important when the sample is diverse and made up of individuals from a variety of cultures as their use of the self-evaluation scale is likely to differ substantially and biases arising from differential item functioning will be magnified.

In addition to the technical contribution, the results suggest that risk preferences are an important determinant of entrepreneurship among migrants and that there is heterogeneity among migrant groups in terms of unobservable characteristics that have a positive effect on business formation. A policy implication leading on from this relationship would be to consider other factors in addition to observable characteristics such as education, age and work experience when designing migration policies. While unobservable characteristics are by definition difficult to identify, our research provides a starting point for identifying proxies that could be related to risk preferences and suggests that some type of migrants may be more likely be risk loving and entrepreneurial. Therefore, predicting which migration flows are likely to result in significant new business creation in the host economy requires one to consider unobservable characteristics, with perhaps the most important unobservable characteristic for predicting entrepreneurship being risk aversion.

Chapter 4 Tables and Figures

Table 4.1: Summary Statistics of Key Variables, by Employment Type

Variable	Entrepreneur Mean	Non-Entrepreneur Mean	Difference (S.E)
Non-adjusted Risk Measure	3.53	3.54	-0.01 (0.95)
Adjusted Risk Measure	4.64	4.39	0.25 (0.06)*
Income (EUR)	1481	1146	335 (0.00)***
Age (Years)	35.47	32.37	3.1 (0.00)***
Years of School	15.07	14.56	0.51 (0.08)*
Female	0.42	0.54	-0.12 (0.01)***

Note: 'Non-adjusted risk measure' refers to the response individuals gave to the self-evaluation question. 'Adjusted risk measure' is the semi-parametrically adjusted value using responses to the three vignettes. Income is given in Euros per month. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 4.2: Entrepreneurs by Occupation

	Ent(%)	**Non- Ent (#)**	**Ent (#)**	**Total(#)**
Transport	41	32	13	45
Construction Sector	22	41	9	50
IT	14	59	8	67
Finance	10	20	2	22
Commerce	8	159	13	172
Unemployed	8	138	11	149
Education	7	30	2	32
Student	6	281	18	299
Other Services	5	240	13	253
Unpaid Housework	5	98	5	103
Health	5	172	8	180
Agriculture Sector	0	4	0	4
Industry Sector	0	41	0	41
Public Administration	0	22	0	22
Retired	0	4	0	4
Other	25	36	9	45
Total	**8**	**1377**	**111**	**1488**

Note: Table shows the percentage of migrants surveyed who are self-employed, by sector of business.

Table 4.3: Entrepreneurs by World Region of Birth,

	Ent (%)	**Ent (#)**	**Total (#)**
South America	14	8	59
North America	12	4	34
Africa	9	31	350
Europe	7	24	341
Asia	3	6	190

Note: 'EU 12' refers to EU member states which joined after 2004, 'Rest of EU15' refers to all other EU countries not part of the 'EU12' group.

Table 4.4: Summary of Relative Rank Analysis

C	N	Prop.
{1}	77	0.052
{2}	117	0.079
{3}	69	0.047
{4}	104	0.07
{5}	391	0.264
{6}	109	0.074
{7}	66	0.045
{1 to 4}	25	0.017
{1 to 5}	25	0.017
{1 to 6}	33	0.022
{1 to 7}	9	0.006
{2 to 4}	190	0.128
{2 to 5}	35	0.024
{2 to 6}	71	0.048
{2 to 7}	19	0.013
{3 to 6}	8	0.005
{3 to 7}	31	0.021
{4 to 6}	14	0.009
{4 to 7}	87	0.059

Note: Number of cases: 547 (37%) with interval value, 933 (63%)with scalar value
Maximum possible C-rank value: 7

Table 4.5: Probit Regressions Using Unadjusted Self-Evaluation Risk Measure. Dependent Variable: Entrepreneur

	(1) Probit	(2) Probit	(3) Probit
Medium Risk Loving	-0.004	0.002	0.004
	(0.022)	(0.015)	(0.015)
High Risk Loving	0.011	0.012	0.013
	(0.024)	(0.020)	(0.020)
Age		0.003	0.003
		(0.005)	(0.004)
Age2		-0.000	-0.000
		(0.000)	(0.000)
English Language		0.014	0.009
		(0.011)	(0.011)
School		0.001	0.001
		(0.003)	(0.003)
Married		0.013	0.013
		(0.014)	(0.015)
Female		-0.031*	-0.031*
		(0.016)	(0.016)
Year of Arrival		-0.009***	-0.008***
		(0.003)	(0.003)
Entrepreneur Experience		0.110***	0.106***
		(0.019)	(0.019)
Live in Migrant Enclave			0.001
			(0.001)
Industry Dummies	No	Yes	Yes
Region Dummies	No	No	Yes
Observations	1495	1326	1326
r2_p	0.001	0.141	0.145

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note:Probit marginal effects estimated at the average. The standard errors in parentheses are robust and clustered by country of birth. 'Entrepreneur' is defined as a respondent who has been self-employed during the current stay in Ireland. 'Medium Risk Loving' is a dummy variable for individuals with values 3,4,5. 'High Risk Loving' is a dummy for individuals with values 6 and 7. 'Entrepreneur Experience' is a dummy variable for having any self-employment experience in the sending country.

Table 4.6: Ordered Probit and Compound Hierarchical Probit (CHOPIT) Model. Dependent Variable: self-evaluated risk measure.

		(1) Ordered Probit		(2) Vignette Adjusted	
μ	**Entrepreneur**	**0.0037**	**(0.10)**	**0.23***	**(0.13)**
	Female	-0.11**	(0.056)	-0.060	(0.070)
	Age	-0.0011	(0.0039)	-0.0018	(0.0049)
	African Origin	0.14**	(0.065)	0.014	(0.083)
	South American Origin	0.21	(0.13)	0.083	(0.17)
	Australian Origin	0.67*	(0.37)	0.47	(0.48)
	From EU12 Countries	-0.065	(0.079)	0.023	(0.10)
	Have Children	-0.23***	(0.063)	-0.055	(0.080)
	Highest Education, College	-0.050	(0.072)	-0.067	(0.091)
	Highest Education, Primary	0.15	(0.20)	-0.067	(0.25)
	Highest Education, Secondary	0.10*	(0.067)	-0.073	(0.084)
τ^1	Intercept			-1.15	(0.18)
	Entrepreneur			**0.30*** **	**(0.096)**
τ^2	Intercept			0.58	(0.095)
	Entrepreneur			**-0.069**	**(0.064)**
τ^3	Intercept			0.57	(0.09)
	Entrepreneur			**-0.062**	**(0.058)**
τ^4	Intercept			0.37	(0.077)
	Entrepreneur			**0.064**	**(0.059)**
τ^5	Intercept			0.54	(0.12)
	Entrepreneur			**-0.062**	**(0.074)**
Vignettes	θ_1			-1.17***	(0.20)
	θ_2			-0.54***	(0.19)
	θ_3			1.41***	(0.20)
Observations	1495			1495	

Standard errors in parentheses

*p<0.10, **p<0.05, ***P<0.01

Note: The standard errors in parentheses are robust and clustered by country of birth. 'Entrepreneur' is defined as a respondent who has been self-employed during the current stay in Irelan. The EU12 countries refers to the New Member States of the European Union and includes Poland, Czech Republic, Slovakia, Slovenia, Hungary, Cyprus, Malta, Lithuania, Latvia, Estonia, Bulgaria and Romania

Table 4.7: Probit Regressions Using Non-Parametrically Adjusted Risk Measure. Dependent Variable:Entrepreneur

	(1) Probit	(2) Probit	(3) Probit
Medium Risk Loving	0.090***	0.082***	0.083***
	(0.031)	(0.032)	(0.032)
High Risk Loving	0.100***	0.082**	0.082**
	(0.036)	(0.033)	(0.033)
Age		0.004	0.005
		(0.004)	(0.004)
Age2		-0.000	-0.000
		(0.000)	(0.000)
School		-0.002	-0.002
		(0.004)	(0.003)
Married		0.000	0.001
		(0.020)	(0.021)
Female		-0.063***	-0.062***
		(0.017)	(0.016)
Year of Arrival		-0.009***	-0.008***
		(0.003)	(0.003)
Live in Migrant Enclave		-0.000	-0.000
		(0.001)	(0.001)
Entrepreneur Experience		0.119***	0.118***
		(0.023)	(0.021)
Industry Dummies	No	Yes	Yes
Region Dummies	No	No	Yes
Observations	928	925	925
r2_p	0.024	0.159	0.160

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Probit marginal effects estimated at the average. The standard errors in parentheses are robust and clustered by country of birth. Individuals with inconsistently ordered vignettes were excluded, resulting in a lower sample size. 'Entrepreneur' is defined as a respondent who has been self-employed during the current stay in Ireland. 'Medium Risk Loving' is a dummy variable for individuals with values 3,4,5. 'High Risk Loving' is a dummy for individuals with values 6 and 7. 'Entrepreneur Experience' is a dummy variable for having any self-employment experience in the sending country.

Table 4.8: Probit Regressions Using Semi-Parametrically Adjusted Risk Measure.Dependent Variable. Entrepreneur

	(1) Probit	(2) Probit	(3) Probit
Medium Risk Loving	0.068**	0.055*	0.055*
	(0.033)	(0.030)	(0.030)
High Risk Loving	0.090***	0.071**	0.071**
	(0.034)	(0.030)	(0.030)
Age		0.004	0.004
		(0.004)	(0.004)
Age2		-0.000	-0.000
		(0.000)	(0.000)
School		0.002	0.001
		(0.003)	(0.003)
Married		0.013	0.015
		(0.014)	(0.015)
Female		-0.029*	-0.028
		(0.017)	(0.017)
Year of Arrival		-0.009***	-0.008***
		(0.002)	(0.002)
Live in Migrant Enclave		0.001*	0.001*
		(0.001)	(0.001)
Entrepreneur Experience		0.113***	0.112***
		(0.016)	(0.016)
Industry Dummies	No	Yes	Yes
Region Dummies	No	No	Yes
Observations	1495	1477	1477
r2_p	0.014	0.157	0.160

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Probit marginal effects estimated at the average. The standard errors in parentheses are robust and clustered by country of birth. Table shows results when the risk measure has been adjusted using a semi-parametric approach. 'Entrepreneur' is defined as a respondent who has been self-employed during the current stay in Ireland. 'Medium Risk' is a dummy variable for individuals with values 3,4,5. 'High Risk' is a dummy for individuals with values 6 and 7. 'Entrepreneur Home' is a dummy variable for having any self-employment experience in the sending country.

Figure 4.1: Non-Adjusted Risk Measure, Entrepreneurs and Non-Entrepreneurs

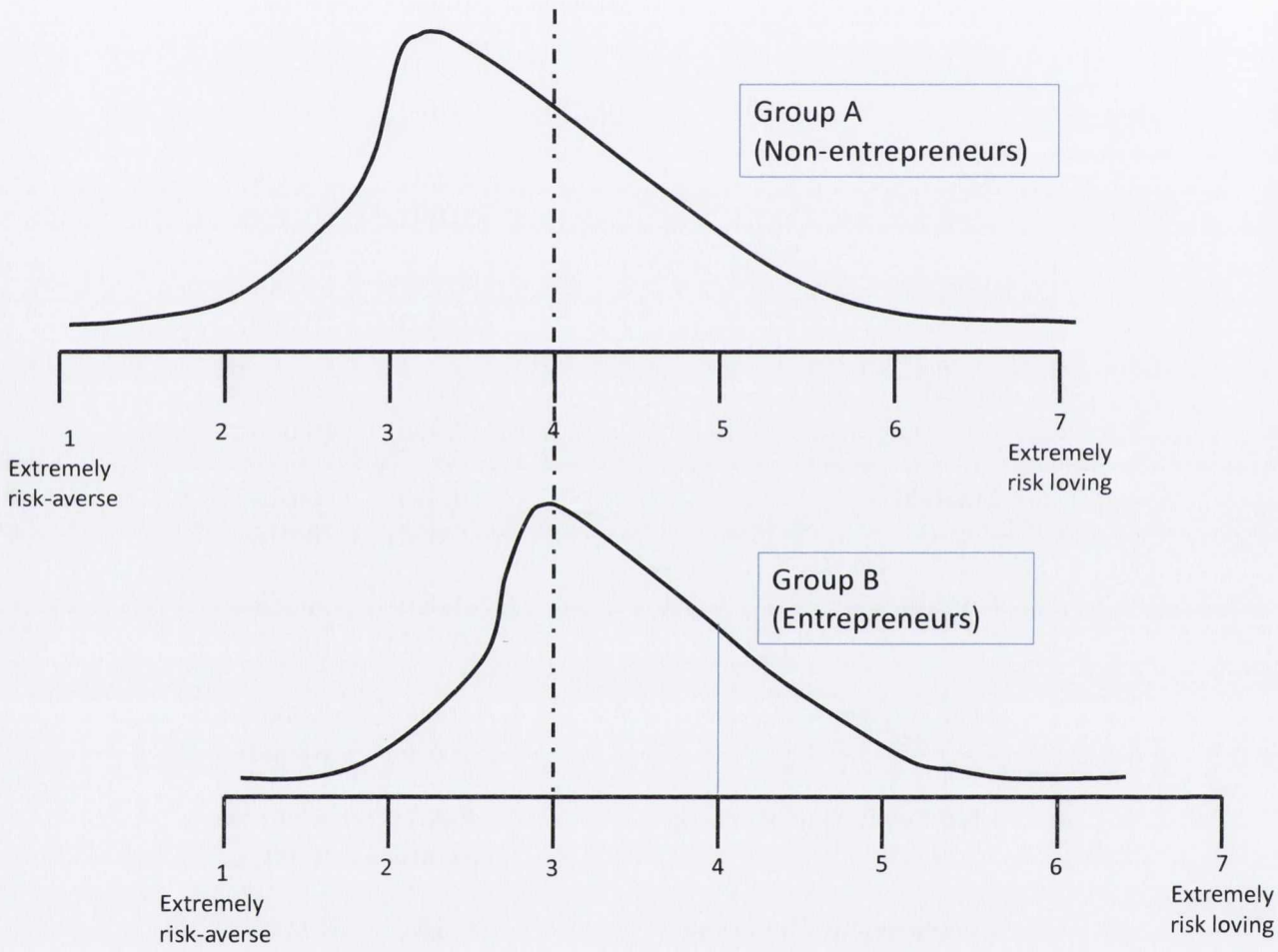


Figure 4.2: Non-Adjusted Risk Measure, Entrepreneurs and Non-Entrepreneurs

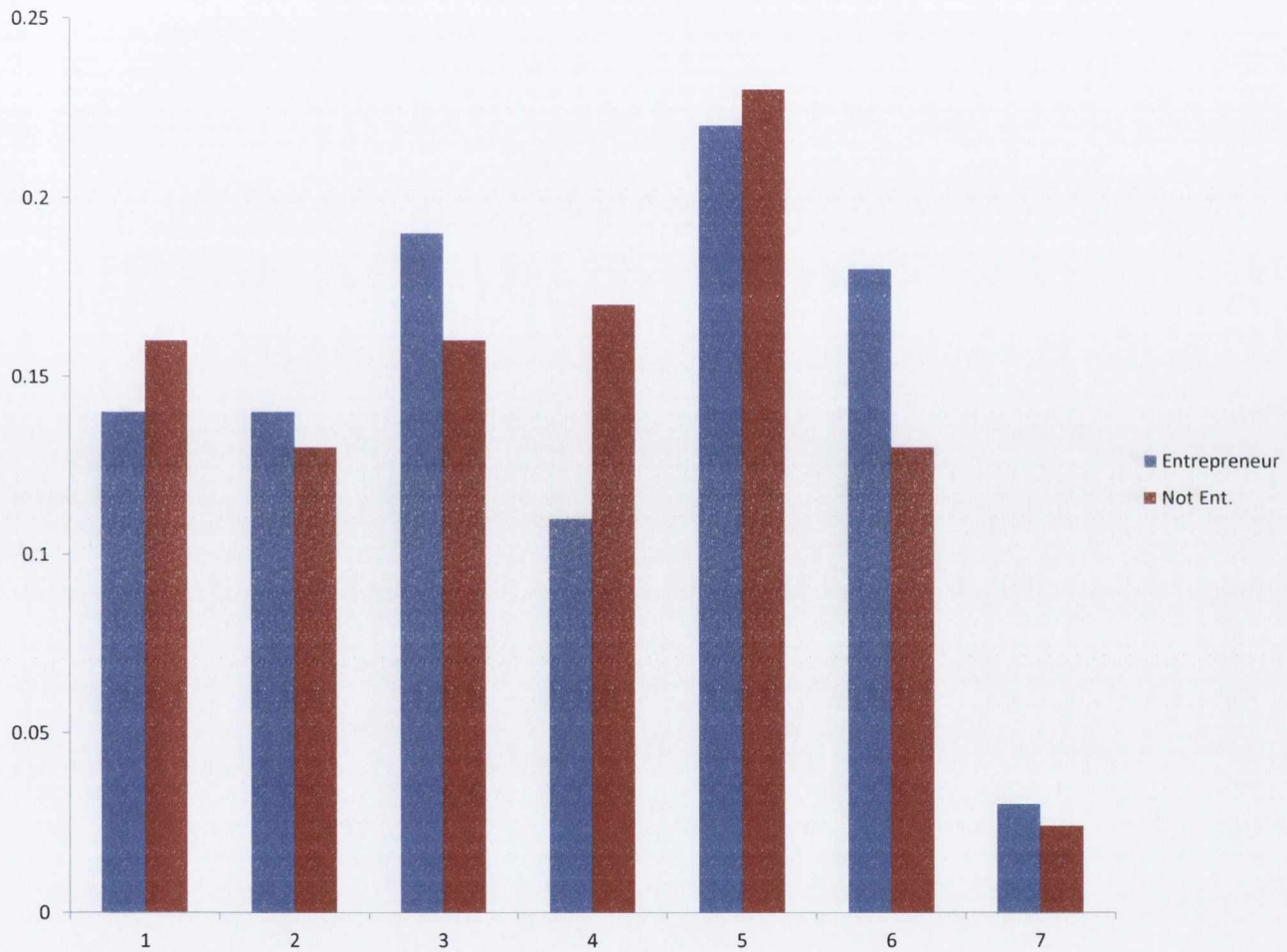


Figure 4.3: Vignette Adjusted, Entrepreneur and Non-Entrepreneur Comparison

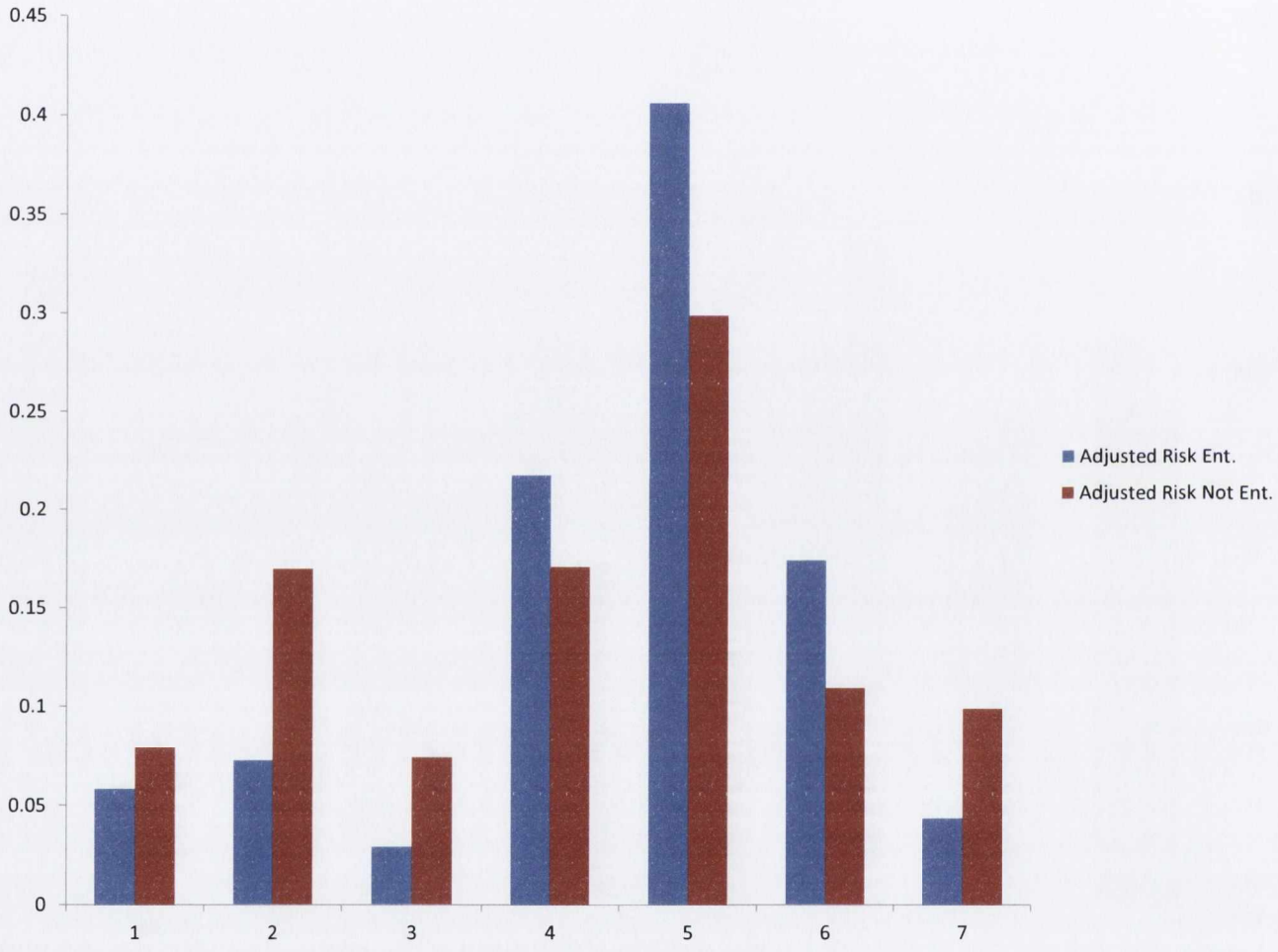
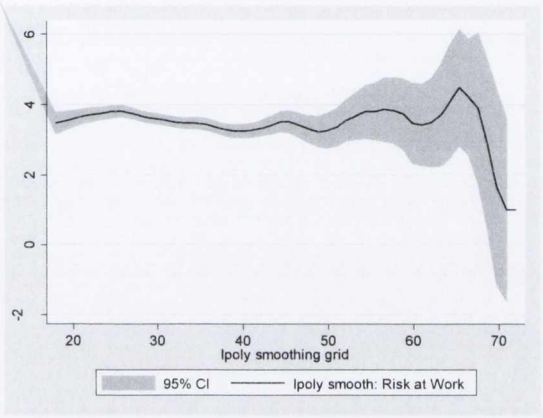
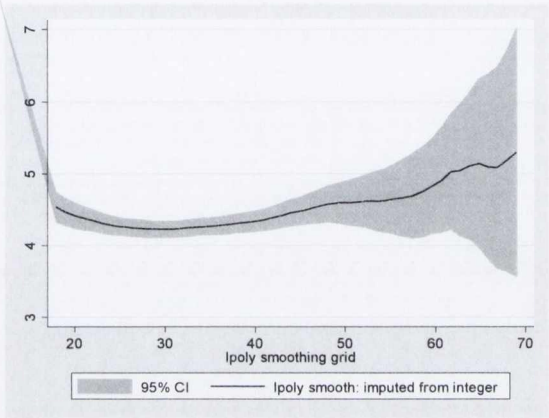


Figure 4.4: Age and Willingness to Take Risks in the Domain of Work: Non-Adjusted and Adjusted Comparison



Relationship Between Age and Willingness to Take Risks Measure: Unadjsuted Measure



Relationship Between Age and Willingness to Take Risks Measure: Vignette Adjusted Measure

Note: The Figure shows the relationship between the self evaluation measure of willingness to take risks in the domain of work, using the unadjusted measure (left hand side) and the vignette adjusted measure (right hand side). A Least Squares Polynomial Smoothing filter was applied, and a 95% confidence interval is shown by the gray shaded area.

Chapter 5

Conclusion

This thesis develops the literature on unobservable characteristics in migration by focusing on individual risk preferences. While the proposition that migrants are more risk loving than non-migrants has been often made, there has been little detailed theoretical or empirical work looking at this relationship. A significant barrier to this area of research has been a lack of data containing a sample of migrants with variables measuring their risk preferences combined with other detailed information. I overcome this limitation by developing a module designed specifically to capture risk preferences which was included in a large-scale representative survey of the migrant population in the Greater Dublin Area. In addition to a range of risk preference questions, the migrant data-set contains detailed information on remittances and other individual as well as household level statistics of interest. In addition to the survey of migrants in the Greater Dublin Area, the first article uses a recent edition of the German Socioeconomic Panel which contains a module for measuring risk preferences and a representative subset of migrants in Germany.

The first essay develops a theoretical model to investigate how the average risk attitude of migrants changes with the size of migrant networks in the host country and how these networks can influence the rate of migration. The theoretical model uses the insight that migrant networks at destination increase the probability of finding work in the host country to predict the magnitude and composition of future migrants. I assume that uncertainty regarding finding work in the source country is an important factor in the decision to migrate and that as uncertainty is reduced more individuals will migrate. The essay develops a dynamic theory of migration which shows that when networks grow over time, the average migrant will be more risk averse and also that the rate of migration will initially increase as the risk surrounding the migration decision decreases. The model is then extended to allow for the possibility of strong and weak individual network effects. The results of the simulations suggest that when networks are strong, migrants move sooner and within a shorter period of time.

The link between migrant networks and risk preferences is tested empirically using the German Socio-Economic Panel Data. I find that, after controlling for other determinants of risk attitudes, and the year of arrival, there is a statistically significant negative relationship between the size of the network and the willingness of migrants to take risks, as predicted in the model. The magnitude of this effect is substantial when compared to other characteristics which have been traditionally shown to determine risk preferences, such as gender and education.

The relationship between risk aversion and migration dynamics identified in this essay is relevant given recent work linking risk aversion with desirable characteristics such as entrepreneurial potential and cognitive ability. If, as suggested by the literature, risk

aversion is positively linked to those unobservable characteristics, growing networks of migrants will have implications on the average human capital in both the sending and receiving country. For the sending country, larger networks may result in increasingly negative selection in terms of unobservable characteristics. Therefore, a specific policy recommendation for the receiving country would be that a larger number of migrant communities from a broader range of countries could lessen the negative selection in terms of unobservable characteristics than the same number of migrants from just one source country.

In terms of migration rates, the results of the simulations suggest that when networks are more important, migrants move sooner and within a shorter period of time. This has relevance for the source country where an unexpected surge in migration could result in shortages of public services, such as housing and welfare. For the sending country, stronger networks suggest a faster 'drain' of human capital. Understanding this relationship could help governments to plan for such instances and devise strategies to avert labour shortages in the sending country and strains on public resources in receiving country.

The second essay in this dissertation investigates the relationship between risk preferences and remittance behaviour using a representative household survey of the migrant population in Greater Dublin, Ireland. The results suggest that risk-averse individuals are more likely to send money home and to send a larger total amount. Looking at specific groups within our sample we find that African migrants are more sensitive to the relationship between risk aversion and remittance behaviour. In addition, remittances sent outside the household (as opposed to members in the household) are more likely to vary with individual risk preferences.

The conclusions from this study are relevant to the emerging literature looking at the insurance motives to remit. Given the theoretical finding that risk-averse individuals will purchase more insurance, the positive link between risk–aversion and remittance behaviour is an indication that, in specific cases, self-insurance motivates individuals to send money home.

Given the importance of global remittances, a better understanding of the range of motives behind these flows could help policy makers promote this significant transfer of funds from developed to developing countries.

The third essay utilises a novel vignette adjusted measure of risk preferences in the domain of work to investigate the link between risk aversion and entrepreneurship in migrant communities. Using the representative household survey of the migrant population in the Greater Dublin Area, which includes questions tailored for this research question, we find a significant negative relationship between risk aversion and entrepreneurship. In addition, we find that the use of vignettes improves the significance of the results, as they correct for differential item functioning (where respondents interpret the self-evaluation scale in different ways) between entrepreneurs and non-entrepreneurs, as well as different migrant groups.

Comparing the results using the adjusted and non-adjusted measures shows that the relationship between risk aversion and entrepreneurship is only significant when the vignette adjusted measure is used. A compound hierarchical ordinal probit model shows that the vignettes correct for difference in the interpretation of the self-evaluation scale. As well as different scale interpretations by individuals from different parts of the world, entrepreneurs also ranked the hypothetical vignettes differently to the rest of the sample.

This essay contributes to the existing empirical literature by developing a method to improve the accuracy of self-evaluation measures of risk aversion, especially when risk in specific domains is being measured. As self-evaluation questions become increasingly prominent as a method of measuring risk preferences the third essay in this thesis provides a way to reduce bias of these measures when the population is heterogeneous and differential item functioning is a cause for concern. In addition, this chapter uses a more accurate and relevant measure of risk preferences than previous work to test a relationship which has been of interest to economist for some time.

In summary, this thesis uses original data to develop our understanding of how risk preferences influence migration dynamics, remittances and business formation in migrant communities. The three essays offer new perspectives on old questions of migrant selection, network formation and economic contribution to host societies. By tackling the difficult, but important, question of the role of unobservable characteristics it is hoped that this work has made a valuable contribution to the existing knowledge on the motives and consequences of international human migration.

For future work, the research conducted in this thesis could be extended by incorporating return migration. The theoretical framework in the first paper could be developed in order to encompass the possibility of return. Modelling the possibility of return migration would be especially relevant to economic migration within the European Union, where transportation costs are relatively low and few legal restrictions exist. The interaction between sending remittances and return migration would also be of interest in order to examine the relationship between the length of stay in the receiving country and remittances sent home.

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Appendix

Appendix A

Find the solution for α, B, C when:

$$C^2/2 + \alpha_t B^2/2 - \alpha_t BC = 0 \tag{5.1}$$

given the constraints:

$$B \geq C \tag{5.2}$$

$$\alpha \leq 1 \tag{5.3}$$

$$(B, C, A) \geq 0 \tag{5.4}$$

Rearranging (5.1) gives:

$$\frac{C^2}{2BC - B^2} = \alpha \tag{5.5}$$

Combining (5.1) and (5.2):

$$\frac{C^2}{2BC - B^2} \leq 1$$

Which, given the constraints (5.2), (5.3) and (5.4), has the unique solution:

$$B = C, \alpha = 1$$

Appendix B

This appendix is based on the Chiquiar and Hanson (2005) interpretation of the Roy-Borjas model and follows the same notation for clarity. The wage distribution for individuals in the home country is given by:

$$ln(w_i) = \mu_i + \delta_i s + \epsilon_i \tag{5.6}$$

where $i = 0$ is the wage distribution in the home country and $i = 1$ is the wage distribution of migrants in the receiving country. w_i is the wage in country i, μ_i is the zero-schooling mean wage in i, δ_i is the return to schooling in i, s is the level of schooling, and ϵ_i captures deviations from mean earnings and is normally distributed. ϵ_0 and ϵ_1 have correlation coefficient $\rho_0 1 > 0$. Schooling is a random variable with distribution:

$$s = \mu_s + \epsilon_s \tag{5.7}$$

where μ_s is mean schooling and ϵ_s is normally distributed.

Combining 12 and 13, an individual will migrate if:

$$ln\left(\frac{w_1}{w_0 + C}\right) \approx (\mu_1 - \mu_0 - \pi) + \mu_s(\delta_1 - \delta_0) + (\epsilon_1 - \epsilon_0) + \epsilon_s(\delta_1 - \delta_0) > 0 \tag{5.8}$$

where C is migration costs and $\pi = C/w_0$ is time-equivalent migration costs. In the context of the model in this paper, variation in π depends on the risk preference of the individual with more risk loving individuals facing a lower migration costs. This

reinterpretation of π allows for heterogeneity in risk preferences to be incorporated into the Roy-Borjas model without major adjustments. This parameter has the distribution:

$$\pi = \mu_\pi + \epsilon_\pi \tag{5.9}$$

where μ_π is the mean migration cost, or in other words the migration cost for the individual with mean risk characteristics; $\epsilon_\pi \sim N(0, \sigma_\pi^2)$. The correlation coefficient for ϵ_π and ϵ_i is $\rho_{i\pi}$ $i = 0, 1, s$. Therefore the probability that an individual migrates to the United States is given by:

$$Pr(v > -[\mu_1 - \mu_0 - \mu_\pi + \mu_s(\delta_1 - \delta_0)]) = 1 - \Phi(z) \tag{5.10}$$

where $\Phi(z)$ is the standard normal distribution function, $v = (\epsilon_1 - \epsilon_0 - \epsilon_\pi)$ and $z = -[\mu_1 - \mu_0 - \mu_\pi + \mu_s(\delta_1 - \delta_0)]/\sigma_v$. This probability gives the rate of migration. Whether individuals will be positively or negatively selected can be determined by using the information in (5.6-5.10). Letting $v' = v/\sigma$ the expected level of schooling for a migrant is:

$$E(s|v' > z) = \mu_s + E(\epsilon_s|v' > z) = \mu_s + \left(\frac{\sigma_s^2}{\sigma_v}(\delta_1 - \delta_0) - \frac{\sigma_\pi \sigma_s}{\sigma_v}\rho_{s\pi}\right)\lambda(z) \tag{5.11}$$

where λ denotes the inverse Mills ratio $\phi(z)/[1-\Phi(z)]$, and $\Phi(z)$ is the standard normal density function. Migrants will have above average education levels relative to the home population if the term in the brackets in (5.11) is positive. Conversely, migrants will have below average education levels relative to the home population if the term in the brackets

is negative. Assuming that that returns to schooling are larger in the receiving than the sending country $(\delta_1 - \delta_0) < 0$, migrants will have below average-average schooling if $\rho_{s\pi}$ is not too negative and above average schooling if $\rho_{s\pi}$ is negative and large in absolute value relative to $\delta_1 - \delta_0$. While it is not possible to know the relative magnitude of $\rho_{s\pi}$, there is significant empirical evidence that more educated individuals are more risk loving, (Cramer et al., 2002; Dohmen et al., 2010; Ekelund et al., 2005; Halek and Eisenhauer, 2001; Hartog et al., 2002). Therefore, it is reasonable to assume that $\rho_{s\pi}$ will be negative, and more educated individuals face a relatively lower 'cost' when faced with a high level of uncertainty. Following the conclusions of Chiquiar and Hanson (2005), it is clear from (5.11) that positive selection in terms of education is more likely the stronger the negative correlation between observable skills and migration costs. In terms of the framework above, positive selection is more likely the higher the positive correlation between education and the willingness to take risks.

The Roy-Borjas framework can also say something about changing levels of uncertainty and the scale of migration. If there is positive selection, a higher value of $\lambda(z)$, will make the second term in (5.11) more positive meaning that selection will be more positive, and the average migrant will be more educated as a result of the shift. Conversely, a lower value of $\lambda(z)$ will make the term in brackets less positive, meaning that selection will be less positive, and the average migrant will be less educated as a result of the shift. If we assume that that the average level of uncertainty is reduced over time and μ_π is decreasing, from 5.10 we can see that the scale of migration will also increase, and the inverse Mills ration $\lambda(z)$ will decrease. If there is positive selection, a decreasing value of $\lambda(z)$ (increasing number of migrants) will mean that selection in terms of education

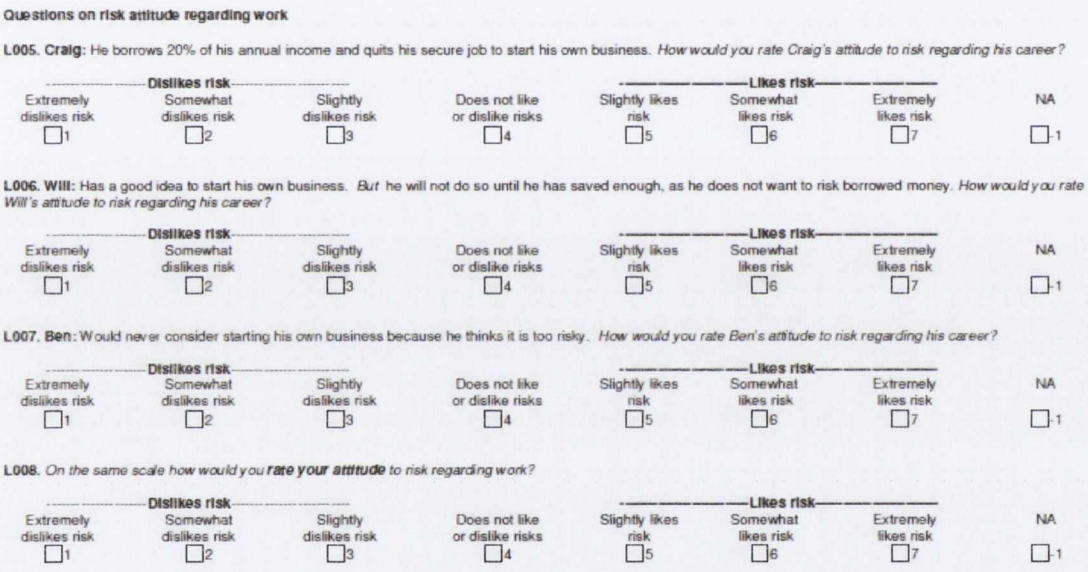
will become less positive and the average migrant will be less educated. Furthermore, given that the initial selection in terms of risk aversion and education occurs from the positive tail of the distribution, a marginal shift to the left will result in an increase in the number of migrants, as the joint probability of having a lower level of education and lower willingness to take risks increases.

If we assume that initially individuals are negatively selected in terms of education, the outcome is more ambiguous, as selection in terms of education will become more positive and selection in terms of willingness to take risks will become more negative. Whether the rate of migration will increase or not will depend on the relative importance of the risk aversion and the education parameter with respect to changes in uncertainty.

The same approach can be applied to look at income in the framework of the Roy-Borjas model. If it is assumed that income is also positively related to the willingness to take risks, as is suggested by the literature, then the conclusions are identical to the case of education.

Appendix C

Figure 5.1: Vignette and Self-Evaluation Questions in Survey



Questions on risk attitude regarding work

L005. Craig: He borrows 20% of his annual income and quits his secure job to start his own business. *How would you rate Craig's attitude to risk regarding his career?*

----------Dislikes risk----------				----------Likes risk----------			
Extremely dislikes risk	Somewhat dislikes risk	Slightly dislikes risk	Does not like or dislike risks	Slightly likes risk	Somewhat likes risk	Extremely likes risk	NA
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐-1

L006. Will: Has a good idea to start his own business. *But* he will not do so until he has saved enough, as he does not want to risk borrowed money. *How would you rate Will's attitude to risk regarding his career?*

----------Dislikes risk----------				----------Likes risk----------			
Extremely dislikes risk	Somewhat dislikes risk	Slightly dislikes risk	Does not like or dislike risks	Slightly likes risk	Somewhat likes risk	Extremely likes risk	NA
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐-1

L007. Ben: Would never consider starting his own business because he thinks it is too risky. *How would you rate Ben's attitude to risk regarding his career?*

----------Dislikes risk----------				----------Likes risk----------			
Extremely dislikes risk	Somewhat dislikes risk	Slightly dislikes risk	Does not like or dislike risks	Slightly likes risk	Somewhat likes risk	Extremely likes risk	NA
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐-1

L008. *On the same scale how would you* ***rate your attitude*** *to risk regarding work?*

----------Dislikes risk----------				----------Likes risk----------			
Extremely dislikes risk	Somewhat dislikes risk	Slightly dislikes risk	Does not like or dislike risks	Slightly likes risk	Somewhat likes risk	Extremely likes risk	NA
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐-1