

The Polish Migration to Norway The Dynamic and Regulation Policy

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Summary

Rich countries use foreign labour and migration to address labour shortages and aging society problems. Between 2004 and 2014, the number of immigrants in Norway doubled. The figure grew from 348 940 to 759 185 immigrants constituting 14.9% of the total population. Immigrants from Poland make up the largest immigrant group in Norway with a total of 84 000 persons 13.2% of total immigrants in Norway. The Polish immigrant community has grown exponentially to over 12 fold in the last ten years. If the immigration rate of growth persists the migrant will double again in ten years and reach between 24 % and 30 % of the total population. In this way Norway is heading towards a major demographic change due to the nature, pattern and scope of immigration that has taken place since 2004. Despite these trends, economic and social policies are often based on the assumption of stable population composition and sustainable population growth. Policy and decision makers seem unprepared to meet these imminent demographic realities in the near future.

This research aims to enhance the understanding of and gain insight into the process of migration growth that leads the Polish migrant group to become the largest immigrant community in Norway. Through this improved understanding and insight the study will: (a) Provide a better understanding of the underlying structure that influence and govern Polish migration dynamics, (b) allow policy makers to understand why migration trends rise, what can be expected of migration trends in the future, and how can migration be regulated. What happened? Why? How to regulate? The main research questions are as follows. Why and how did Polish migrants rapidly rise? How can migration flow be regulated?

Migration literature emphasizes the need for multi-disciplinary and inter-disciplinary approaches to study issues and theories of migration. The lack of a dynamic model that captures the internal and integral effects of key variables that influence migration in a complex environment, constructed a foundation for applying system dynamics (SD) as the methodological approach for this study. The SD philosophy is based on the premise that the behavior of any system or entity is primarily caused by its structure. As a result, an SD integrative model (explanatory) has been constructed. The model captures the dynamics of Polish migration and reflects the inter-connectivity and the underlying feedback structure behind Polish migratory patterns of behavior. The model is a representation of a group of hypotheses about what happened and why. The model is based on and integrated from a representation of how the real system works within the

frameworks of different relevant migration theories. The overall research objective is to produce a better understanding of the dynamics of Polish migration and pose questions regarding some of the existing theories and hypotheses. Model validation ultimately allows for evaluation and testing of the different theoretical hypotheses about how the model structure produces the observed behavior (comparing model simulation outcome to historical data).

Based on model validation and testing, the study shows that the model is able to replicate the historical behavior of Polish migrants for the right reasons. The model is used as a foundation to design policy that explores how Polish migration flows can be controlled. Historically, the majority of migration policy has aimed to control and regulate entrance (inflow). However, statistics show that these policies achieve little success in arresting the growing rate of migration. The policy considered in this study aims to regulate migration outflow by initiating an incentive compensation program to encourage excess migrants to return home. Feasibility analysis and implementation constraints are included in the policy - both of which are envisaged as vital criteria in evaluating the recommended policy.

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Chapter 1: Introduction

Economic and demographic differences have influenced the shape of labour mobility and migration across Europe during the last decade. Rich societies in Europe are experiencing rapid population aging and in the last decade many of these countries have been confronted with stagnation and a decline of their native labour forces. Labour shortages, especially in the low skilled labour market segment, have increased rapidly. Statistics shows population ageing will continue to grow. Many countries have addressed labour shortage and aging society problems through a strategy of migration and foreign labour mobility. As shown in the population pyramid (Figure 1: left), Norway is experiencing an aging population with a high percentage of the population falling in the 40-95 age categories. These age categories have grown rapidly over the last few decades (Figure 1: right). The higher population in the age category 20-66 is attributed to 358 421 labour migrants (16% of labour force - Statistics Norway SSB).

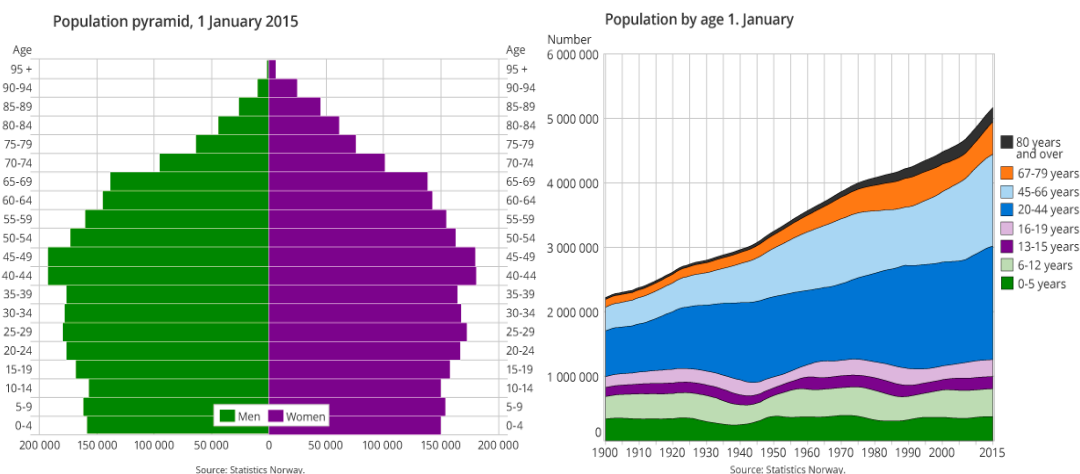


Figure 1: Norway rapid aging population trend

Since 2004 ten Central and Eastern European countries (CEE) have joined the European Union (EU). The enlargement of the EU has removed barriers between nations and has opened old EU member state labour markets to CEE labour forces. It which allowed labour to move and work freely triggered a wave of mass movement of labour across Europe since World War II. Controlling the migration flows in the EU is a controversial issue that raises questions about the effectiveness of national policy and regulation in controlling migration. Furthermore, it questioned the migration effect on the stability and sustainability of the labour market and welfare state. After European Union enlargement, the inflow of citizens from the ten new member states increased substantially to the Nordic countries. Norway became a primary destination among the Nordic countries for CEE labour migrants. By the end of 2014 there were 633 110

immigrants (12.4 % of population) and 126 075 Norwegian born to immigrant parents in Norway (together they constitute 14.9% of population) (Figure 2: left). Immigrants from Poland make up the largest immigrant group in Norway with a total of 84 000 person 13.2% of the total immigrant population (Figure 2: right-SSB data).

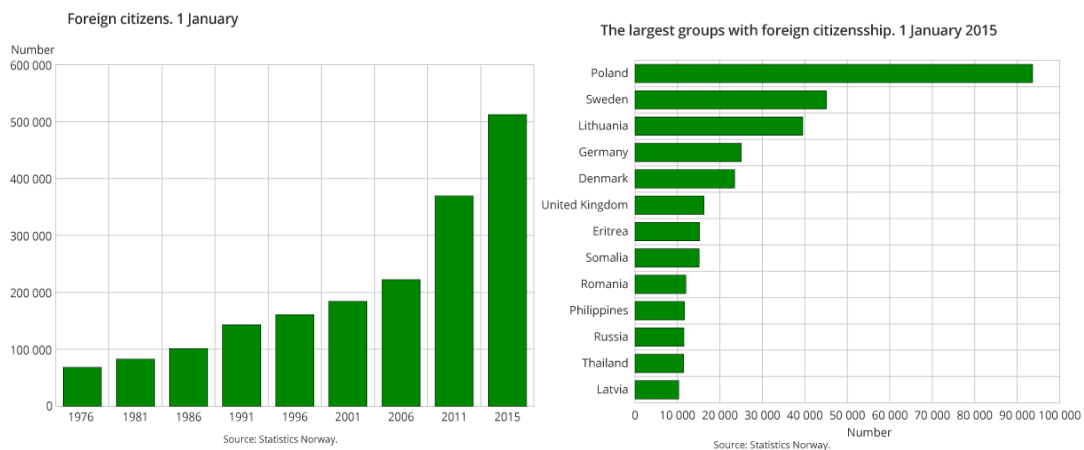


Figure 2: The rapid increase of migrant in Norway specially form Poland

Since the EU enlargement in 2004, the number of immigrants has doubled growing from 289 104 immigrants (6% of population) and 59 836 Norwegian born to immigrants (together they constitute 7.6 % of population) to 759 185 persons (14.9% of population). Moreover, over this ten year period, 80% of the increase in Norway's population is attributable to immigration (Figure 3: left)

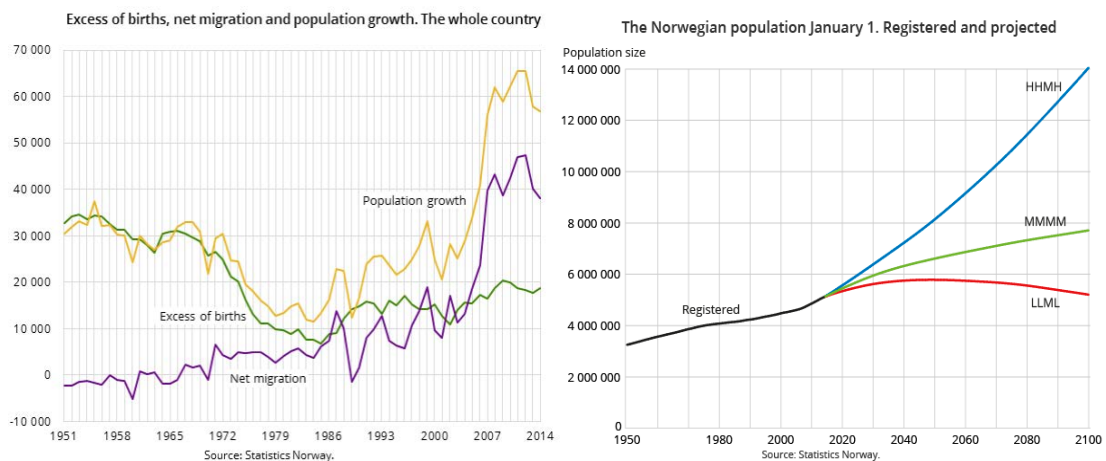


Figure 3: Norway population growth rate and prediction scenarios

Despite these trends, economic and social policies are often based on the assumption of stable population composition and sustainable population growth. Therefore, policy and decision makers are unprepared to meet the demographic realities in the future. Polish immigrants have grown exponentially to over 12 fold in ten years and the total number of immigrants has doubled in the same period. In this way, Norway is heading towards a major demographic change due to the nature, pattern and scope of immigration that

has taken place since 2004. Public and social debates about immigration issues have become an everyday topic of conversation in Norway. If the immigration rate of growth persists, it will double again in ten years reaching between 24% and 30 % of the total population. This figure excludes the effect of the low Norwegian population growth rate of 1.2% relative to that of immigrants 2.1% (SSB data). Most of the population trends predictions (Figure 3: right) are based on what is called black box models. These models are based on the traditional dependent-independent relationships, and uses either trend-based extrapolation (Howe and Jackson 2006) or quantitative analysis techniques mainly econometrics (Brunborg and Cappelen 2009; Hatton and Williamson 2003, 2006). Howe and Jackson find that most US and European countries have based migration projection on a little theory and undefinable methodology. Recent study in Norway (Brunborg and Cappelen 2009) has considered economics and other factors in their migration projection model. Basically, these models identify the causal impact of the number of variables on migration and tested it against sample data. The test is to measure if these variables are capable of explaining migration over time and between countries (as measured by R squared). Longhi et al (2004) conducted an extensive review on 165 wage impact of migration studies for many OECD countries. They found that the majority of the estimated variables vary widely from one study to another and sometimes within the same study. Two possible explanations have been identified: either the conducted econometrics analyses were inappropriate, or there are other variables that need to be included.

The major weaknesses of these kinds of models are that they ignore the interdependency and the mutual causality nature of the relationship between these variables. In addition, the projection model building process ignores how these variables interact in a highly complex and dynamic real world. Moreover, the modeling approach ignores the underlying dynamic structure that creates the pattern of behavior of these variables. Consequently, regulating the immigration flows (and its effect on the stability and sustainability of the labour market and the welfare state) is a major challenge for the Norwegian policy maker. Given the rapidly changing migratory trends and composition within Norway, it is important for policy makers to:

- *Question the demographic (particularly migration) assumption and projections on which economic, welfare, and migration policies are based.*
- *Consider the existence of underlying feedback structures that produces the migratory pattern of behavior and understand that this structure is critical for policy options.*

- *Consider the fundamental historical and recent changes in regional population and migration trends.*
- *Explore new ways to control and regulate the migration flows.*

1.1 History of Polish Migration to Norway

In the 1980s a few thousand Polish political refugees moved to Norway. In the 1990s, after the collapse of communist regime, thousands of short term and seasonal workers came to Norway via bilateral agreements and worked temporarily in the agriculture sector (Freiberg 2012). In 2004, Poland membership in the EU opened the door for large-scale labour migration inflows to Norway. This massive move changed the migratory landscape in Norway from humanitarian migration dominance to intensive labour migration. Polish migrants are hired to work in specific sectors mainly: Construction, Manufacturing, Agriculture, and Low skilled services (Freiberg et al 2013). Norway has become the most attractive destination for Polish migrants due to:

- *High standards of living: HDI **94** rank (1), Quality of life Index QLI **175** rank (11)¹*
- *High wage level: **65820** USD constant price (2004, OECD Statistics)²*
- *High Life expectancies: **80** years and aging population (2004, World Bank Data WBD)*
- *High Per-capita GDP: **56627** USD current price and GDP grows by **5%** (2004, WBD)*
- *Low unemployment rate: **4.5** % and high female employment (SSB data)*
- *High demand for labour in Construction, - ordered index grows **50%** 2004 and reach **125%** 2007 – (2010 is a base year- SSB data)*

1.2 Characteristics of Polish Potential Migrant

Since 1990 the Polish economy and labour market has shifted and transformed from one characterized by government intervention and public sector dominance towards a market driven economy. Prior to this shift the majority of the workforce was employed in the protected industrial sector and labour intensive agriculture sector. The restructuring of the economy leads to a large number of the workforce being retrenched and displaced. These individuals where then was left to struggle in the new liberal economy (Freiberg, 2012). The unemployment rate was very high and it reached 19% in 2004³. Despite the Polish economy's successful transition to a market economy, the per-capita GDP was 6639 USD (*current price*) and the GDP growth rate was 4% (2004, WBD). The Polish wage level was 11,939 USD (*constant price*) (2004, OECD), which

¹ HDI Human Development Index (UNDP annual report). QLI data www.numbeo.com

² OECD Organization for Economic Co-operation and Development

³ Central Statistical Office of Poland

stood at about 20% to 25% of the average level in the EU countries. Due to these conditions and the characteristics of the Polish labour force of - high unemployment rate, and lower wages - Poland had a huge number of potential labour migrants ready for a rapid emigration once opportunities became available. For the following reasons Poland will be the migration model prototype:

- Polish migrants are the largest migrant group in Norway.
- Data about Polish migrants is available from different sources allowing cross examination for data reliability.
- Polish migrants are the largest migrant group within the Scandinavian countries and in many European countries - where the size of the Polish migrant community is similar to Norway. This allows for estimation and comparison of some of the model parameters value.

1.3 What Is The Problem?

Large numbers of migration studies (including those conducted in Norway) are theoretical and descriptive in nature (Arango 2000; Castles 2008; Massey et al 98; Freiberg 2012, 2013). These studies add to the store of knowledge about migration by providing updated statistics, trends, and fresh arguments (Russel 2000; de Hass 2014). However, models developed based on research and existing theories have not progressed beyond a description of causal relationships between key variables. Most empirical studies use data and statistical analyses to measure the impact of migration on wages and employment in the host countries and the impact of remittances on receiving countries (Longhi et al 2004; Borjas 2005; Reed and Latorre 2009). The majority of empirical studies are measurements of a vector of independent variable's effect on a dependent variable. The findings and contributions of these studies are merely descriptive in nature and they do not provide a solid foundation for policy analysis and design.

The existing approach and research design need operationalization and dynamism to handle the complexity of migration and to test the existing theories and hypotheses. At present the research lacks a dynamic model that captures: (a) the reality of the real world - how exactly the Polish migration rise (b) the migration decisions and (c) shows the internal and integral effects of key variables on migration. These deficiencies indicate the need for a new approach. Building on that, this research is an attempt to overcome the impediments of current research methods. Labour migration in general, and Polish migration in specific, is a new-old phenomena new for Norway and old - if we may generalize - because it follows a similar pattern and behavior of previous

labour migrations in the world. This type of migration may be considered the first migratory stage as it is a male dominated labour migrant economy (*Figure 1: left page (1) shows a higher percentage of male to female in Norway*). Historically, first stage labour migration is often followed by a second wave of family formation and family unification types of migration. This means that if the government intervenes via new regulation to stop the inflows of labour migration it will be faced with other types of migrations inflows.

When Polish workers started arriving after 2004, within the framework of the EU's free movement of labour and services, they were able to move, work and acquire social rights for varying periods of time. Migration became a controversial and hotly debated issue in Norwegian policy. Government, politicians, pressure groups, employers, and recruitment agencies thought that cheap flights and internet based communication make work in another country no longer had to involve a permanent relocation or any mental or social re-orientation towards the receiving country. Rather, these groups envisioned a transitional and circular migration pattern similar to guest and seasonal workers (Freiberg 2012). Moreover, recruitment practices and the high costs of living and accommodation in Norway gave the impression that migrants would be incentivized to engage in temporary and circular migration to maximize the migration benefits of the economic differences between Norway and Poland. However, the opposite of that is what is happening. Controlling the migration flows and migrant choices regarding whether to settle or go back home is far beyond the current government policy. The secretary general of Nordic Council of Ministers stated:

“Although the new labour migration has been welcomed in the Nordic countries, it has also become evident that a huge influx of migrant workers can have unforeseen effects on the stability and sustainability of the Nordic labour market models and welfare states. Even if the possibilities for controlling the flows of migrants within the common European labour market are scarce, there is still a considerable room for national policies and regulations (Freiberg et al 2013)”.

These concerns trigger an alarm signal regarding future trends of labour migration and the need for an understanding of the underlying structure that governs the migratory pattern of behavior, as well as the need to explore ways to regulate it. The flows of labour migrants from CEE countries to Norway, in particular Poland, raise challenges to the Norwegian social-economic system. These challenges include economic, social, and legal factors, which highlight the issues of:

- *Migration Growth: What is the underlying structure that governs and shapes the pattern of migration behavior?*
- *Migration Prediction: What factors contribute to the rise in migration flows and how do they interact with each other to produce current and future trends?*
- *Migration Policy: How can migration flows can be regulated?*

1.4 Research Question

The research question is: Why and how did Polish migrants rapidly rise? How can migration flows be regulated?

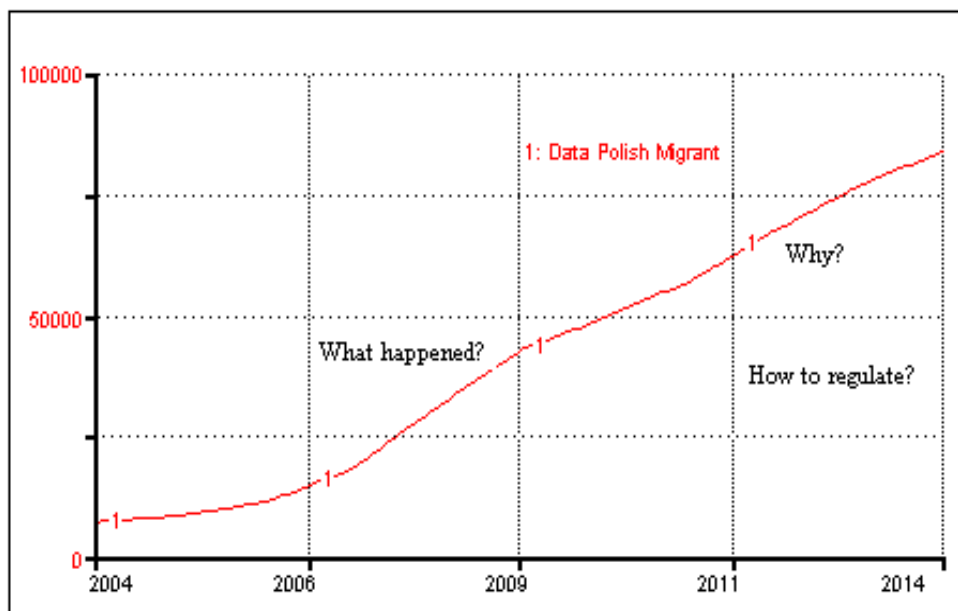


Figure 4: The rise of Polish migrant in Norway: The problem reference mode

Reference mode is the historical trend of the dynamic problem that this study attempts to explain and reproduce this trend (pattern of behavior) for the right reason.

The objective of this research is to enhance the understanding of and gain insight into the growth and development process of Polish migration which lead to the Polish migrant group becoming the largest immigrant group in Norway. Through this improved understanding and insight the study will: (a) provide a better understanding of the underlying structure that influences and governs Polish migration dynamics and (b) inform policy makers: why migration trends rise, what can be expected of migration trends in the future, and how can migration can be regulated. What happened? Why? How to regulate?

1.5 Why System Dynamics “The Research Methodology”

The Research Position: Migration research tries to answer questions about the initiation, continuation, assimilation and impacts of migration. There is no single, unified theory of immigration that simultaneously addresses all of these issues. Instead, a number of theories or hypotheses have been developed to explore each of these various questions (Borjas 1989). The lack of an integrated migration theory and data, as well as the mathematical difficulty of modeling migration processes has hindered the study of migration (Brettell et al 2008). Literature on international migration identifies various types of migration and emphasizes the need for an interdisciplinary approach to study issues and theories of migration. Answering the aforementioned questions triggers the need for a research approach that draws upon theories of the causes of migration. These theories may come from more than one discipline (involving multi-disciplinary inquiry) or they may combine perspectives from at least two disciplines (inter-disciplinary) (Brettell et al 2008). Three types of migration have dominated the study of migration: labour migration, settler migrants, and refugees. The increasing diversification of migration types and processes requires a theory that incorporates a variety of perspectives, levels and assumptions that provide synthesis of key concepts and theories of migration to generate a complete framework of migration system (Messay et al 1993; Russel 2000; Arango 2000; Brettell et al 2008). Researchers attempting to describe, explain and model the key factors that influence migration have often argued that a comprehensive or universal migration theory is unachievable because migration is too complex and diverse a phenomenon (de Hass 2014). There is no single theory or model that captures the full complexity and dynamics of migration owing due to the following:

- *The increasing diversity of migration flows, mixed migration flows, and migration motivation in the new global political economy.*
- *The fact that existing migration theories and models developed to explain migration are complementary rather than exclusive.*
- *Data problems: availability, measurement of the migrant quantity, defining the variables, and variables measurement.*
- *Empirical work is either disconnected from theory or the existing theories are hardly testing the questions they are supposed to test.*
- *Models developed based on the existing theories of migration have not progressed beyond a description of the complexity of causal relationships between key variables in migration systems.*

- *Existing research methodology needs an operational and dynamic approach that handles the migration complexity and tests existing theories and hypotheses.*

The following is a specific example from the literature (pertaining to Norway) which highlights the strengths or weaknesses of the current research approach in migration. Brunborg and Cappelen (2009) have forecasted migration to Norway by building an econometrics model that is based on a migration and economic theoretical foundation. Most official population forecasts produced by statistical offices are based on an ad-hoc simple trend-based extrapolation of migration including Statistics Norway SSB (Brunborg and Cappelen 2009). Their model considers migration as a function of the unemployment rate and income level in Norway relative to the average in OCED countries. The econometrics estimation outcome then used to forecast net immigration to Norway based on unemployment and relative income level forecasts. This is a classic way of applying an econometrics approach in migration literature. A few remarks about this and those econometrics approaches are:

1. Unemployment and relative income level forecasts are based on ad-hoc simple trend-based extrapolation. This brings us back to square one making the modeling as a second order trend-based extrapolation.
2. Unemployment and relative income level are necessary conditions for migration to happen. It does not matter how attractive Norway is as a destination country. Without job availability, migration will not happen. Job availability is a sufficient condition for migration to occur.
3. Migrants have been recruited to fill low-skilled jobs in domestic labour market sectors. Therefore, job availability in these sectors is critical in determining migration and needs to be considered in the model.
4. The size of the migrant community and its impact on migration risk and attractiveness and tendency to settle are other important variables that need to be included in the model. Including these variables will make the model significantly more complex.
5. The effect of these variables on migration is different and makes the mathematical formation of the model equation more sophisticated. Unemployment, income level and job availability have independent effects on migration. This means, migration may happen due to any reason represented by these variables (e.g. people could migrate because of low unemployment rate; relative high income or job opportunities). While community size effect on migration risk and attractiveness have a dependent effect. The effect of the community size on migration risk is dependent on its effect on migration attractiveness. This means, as risk goes down the attractiveness goes up and vice verse.
6. Even though the above remarks are considered in building the econometrics model, the type of the relationship further weakens and complicates this modeling approach. The relationship described in the econometrics model, in general, is the classic dependent-independent relationship: migration (dependent variable) is a function of relative income level (independent variable). What is missing here is that migration will come back and influence the factors that brought it up in the first place. Migration will impact unemployment, relative income level, job availability, etc. in a mutual causation

fashion. The relationship is not dependent-independent, rather it is inter-dependency relationship.

7. Constructing an econometrics model that captures the interdependency relationship and considers the inter-connectivity between the variables affecting migration is very complex if not an impossible task.
8. Understanding the relationships and the underlying structure that drives migration is critical in order to gain confidence in measuring and forecasting future migration trends. This study will introduce a different approach that overcomes this kind of complexity.

Several researchers have studied migration in Norway. Freiberg (2012) explores ways in which Polish migrants adapted and assimilated into Norwegian society. He identifies factors and the processes that influenced Polish migrant settlement in Norway. A wider study (Freiberg et al 2013) that includes all labour migrants from (CEE countries) was conducted based on an in-depth migrant survey. The study was conducted among Polish labour migrants in Oslo, Copenhagen and Reykjavik. These surveys offer rich source and available data describing the different patterns, directions and compositions of migration flows. The study analyzes and discusses wages, working conditions (social dumping) and temporary staffing and recruitment agency issues among labour migrants in Nordic labour markets. Furthermore, it explores future policy development and the challenges that policy makers face regarding the sustainability of the Nordic labour market models and welfare states. Ryndyk (2013) applies social inquiry tools to study the social patterns of Polish migrants in Norway and integration challenges. Several studies focused on integration and assimilation issues amongst Polish migrants. Cieleń (2011) used qualitative research methodology to study the role of labour unions in Polish integration. Kmite (2011) focused for Lithuanian workers in Norway using a case study and interview method. Narum (2008) studied female Polish migrants also using a case study and interview method.

These studies and others contribute to the Polish migration knowledge base by providing updated statistics, trends and theoretical arguments and analysis. These studies (descriptive in nature) are based on surveys, interviews, case studies and social inquiry methods that provide rich qualitative and quantitative data and information. Even though the majority of studies related to Polish migrants in Norway focus on assimilation issues of migration, they provide detailed information about other aspects of migration issues. These studies offer insight into factors that affect migration decisions such as moving in, wages, working conditions and settling-in concerns. They provide information that highlights factors related to the initiation and continuation of migration. The quantitative and qualitative data and analysis conducted in the aforementioned studies serve this study by providing the opportunity to:

- Compare and test the reliability of the aggregated data and statistics
- Define and quantify (measure) soft variables (e.g. migration risk)
- Identify how decisions related to migration are made

Yet, the findings and conclusions of these studies are limited due to the sample size. Therefore, it is hard to generalize the findings as well as it misses (or get a sense of) the whole picture. Further studies are needed to address other aspects of the migration issue. These studies do however form a foundation for effective empirical study. This study aimed to build on the existing literature concepts and hypotheses by applying a System Dynamics approach that:

- Builds a bridge between theoretical and empirical analysis
- Incorporates quantitative and qualitative data and analysis
- Stands in-between the aggregated (Macro) level (the whole picture) and the detailed (micro) level that is related to how the real system works.
- Defines important variables and measurements
- Formulates a causal relationship between key variables that drive and control migration
- Formulates a model that unifies these different theoretical arguments and hypotheses
- Explores policy options related to migration issues

Methodological Foundations: The need for an operational and dynamic approach that captures the internal and integral effects of the key variables on migration in such a complex environment constructs a foundation for applying system dynamics (SD) as the methodological approach for this study. The SD discipline uses a simulation modeling to study social systems that (a) contain complex relationships involving multiple feedback loops that are responsible for endogenously-generated dynamics, (b) can be represented in terms of interacting stocks and flows, and (c) contain nonlinear structural relationships and time delays that generate behavior for which analytical solutions have not been developed or are known not to exist (Wheat 2010). The SD approach incorporates empirical research with relevant theoretical research in a quantitative and qualitative model. The SD philosophy is based on the premise that the behavior of any system or entity is principally caused by its structure. Model validation will ultimately evaluate different theoretical hypotheses about how the model structure produces its behavior by comparing model simulation outcome to historical data (Forrester, 1994; Sterman 2000; Wheat 2010).

Multi-disciplinary and inter-disciplinary approach: System Dynamics provides a comprehensive approach to the study of migration. Constructing a migration SD based model will integrate a variety of migration theories that come from different disciplines (multi-disciplinary e.g. Economics, Sociology, Demography). In addition, it will incorporate a synthesis of theoretical arguments and hypotheses as well as utilize diverse empirical methods (inter-disciplinary). Moreover, SD will construct a foundation to explain, organize and distill migration literature in a more compact and operational model. The multi and inter-disciplinary approach provided by SD addresses problems facing migration research such as:

- *Clear Identification of variables and concepts.*
- *Lack of unified theory to explain and cover the migration phenomena.*
- *The inability to test different, theories, hypothesis and policies*

This research aims to construct an SD integrative model that captures the dynamics of Polish migration. The model will reflect the inter-connectivity and the underlying feedback structure behind the patterns and behavior of Polish migration. The model will be a representation of a group of hypotheses about what happened and why, based on how the real system works within the framework of different relevant migration theories. The overall objective of the research is to produce a better understanding of the dynamics of Polish migration and question some of the existing theories and hypotheses. Further, the model will be a foundation for a policy design face that aims to explore how to control Polish migration flows.

Scope of the study “Model boundary”: This study covers the Polish migration to Norway from 2004 to 2014. The model explains only the labour migration other types of migration are not included but are represented as a constant fraction in the model. Short term migration (the number of Polish migrants who work and stay in Norway for less than six months and are not registered as residents) is also excluded from the model. The Polish migrant death outflows are excluded, due to the number is relatively small that it has insignificant impact. Labour shortages and the forces that drive and influence it are not modeled. The model aims to replicate the actual data of the Polish migrant Stock and Polish migration inflows. Further model boundaries will become clear on the detailed discussion of the model in chapter three. Data used, variables, and parameter definitions are well documented in the iThink⁴ version of the model (in the map mode). Some variables have been estimated using econometrics method (regression), and are documented as such in the appendix.

⁴ A computer simulation-based model-building produced by isee systems <http://www.iseesystems.com>

Chapter 2: A Bridge between System Dynamics and Migration Theories

Social, economic, political, and demographic factors are the root causes of international migration. The constant and persistent structural changes in the socio-economic, political and demographic within societies effectuate changes to the reasons and motives for migration. Migration research provides numerous theories based in various disciplines that explain why people migrate and the consequences of that migration.

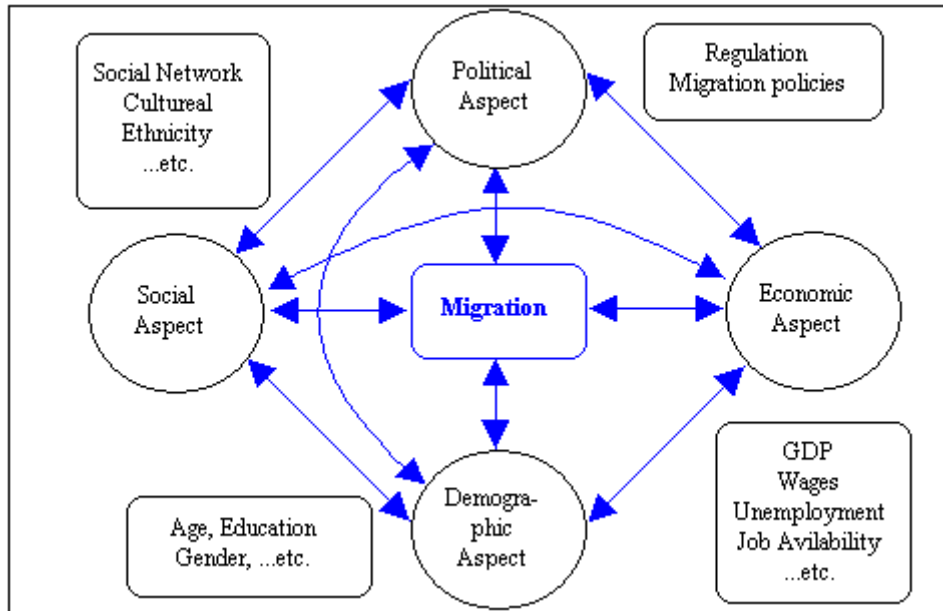


Figure 5: A dynamic perspective for understanding international migration

The explanations of migration in highly complex and dynamic social, political, demographic, and economic environments require rethinking the migration theories from a dynamic perspective. A perspective acknowledges and considers migration as a result of interactions between political, social, economic and demographic disparities between nations. Yet migration affects back all these aspects in a mutual causation within that dynamic and complex environment (Figure 5). Migration is dynamic in the sense that causes and consequences of migration are linked by a feedback process that reflects an existence of underlying structure responsible for shaping migratory patterns and behavior.

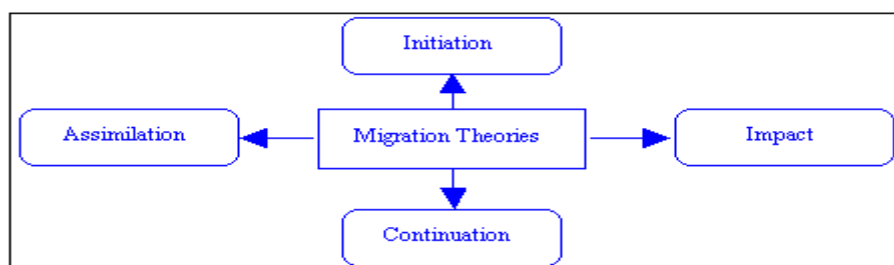


Figure 6: Issues of Migration theories

Migration theories address four major issues or questions of migration (Figure 6): initiation, continuation, assimilation and its impact in the host and sending countries (Borjas 1989; Bodvarsson 2009; Jessica 2008). The focus and boundary of this study is to understand the process of migration. The following is a representation of migration theories that deal with initiation and continuation of migration from a SD perspective. Perspective identifies migration as a dynamic interaction between factors that create, and are affected by migration in mutual causation of inter-dependency relationships. This perspective reflected by an underlying feedback structure governing the migratory pattern and behavior.

2.1 Push and Pull Theory of Migration

The push-pull theory argues that migration is closely related to ‘push-pull’ factors between origin and destination countries. Economic difficulties such as low wages, high unemployment rate, poverty, and political repression push people to migrate from their home countries. Better economic opportunities in other countries such as high wages, low unemployment and better welfare systems attract migrants to those countries. Concepts from push-pull theory form the cornerstone of geographical thought on migration (Russel King 2012, White and Woods 1980) and provided the hypotheses upon which future migration research and theorization was built (Russel King 2012, Boyle et al. 1998). Push-pull theory, draw and formulate four hypotheses about the causes of migration. These hypotheses are mapped in the following causal link relationships:

- (1) *Economic Difficulties* -----(+)-->*Push factors* (2) *Push factors* -----(+)-->*Migration*
 (3) *Economic Opportunities* -----(+)--> *Pull factors* (4) *Pull factors* -----(+)-->*Migration*

These four links are interpreted as (1) economic difficulties add to the push factors, (2) push factors increase migration, (3) economic opportunities add to pull factors, and (4) pull factors increase migration. Combining these causal links together in one feedback structure generates a representation of theoretical arguments of mutual causation. The following Causal Loop Diagram CLD (Figure 7) demonstrates the SD representation of push-pull theory. Push factors encourage migration outflows from the sending country due to economic difficulties.

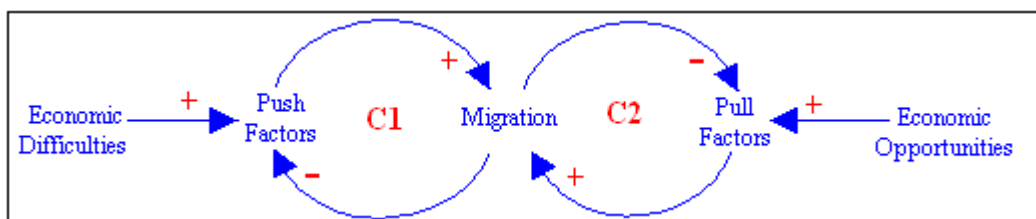


Figure 7: System Dynamics representation of Push and Pull theory

Migration outflows release pressure on the economic condition in the sending country thereby lowering push factors. Diminished push factors reduce the migration outflows counteracting Loop C1. Pull factors attract more migration inflows to the host country. Rising migration inflows result in fewer available jobs and less attraction for migration. Lower pull factors reduce migration inflows counteracting Loop C2. The changes in the size of migrant inflows and outflows depend on, and are determined by the interaction between these causal feedback loops. In other words the relative strength of these two loops will shape the pattern of migration between the two countries. Push-pull theory helps to explain the initiation factors of migration but does not provide insight about who migrates and migrant flows size (Brettell et al 2008). The push-pull model dominated migration thinking up until the 1960s if not later and reflects on the neoclassical economics paradigm (Russel King 2012).

2.2 Neo-classical Economics Theory of Migration

The neo-classical economics theory proposes that international economic disparities at both macro and micro levels encourage individuals who seek opportunities to invest their human capital to do so wherever the highest returns to migration are rewarded (Massey et al 1998, Freiberg 2012). This theory assumes that individuals who respond to international differences in wages and unemployment are rational utility-maximizing agents. Migration decisions are thought to be based on the rational calculation of expected benefits relative to the psychological, social and material costs of moving (Boreas 1989, Freiberg 2012). The neo-classical model produces several hypotheses regarding the causes of migration. These hypotheses are represented in the following causal relationships.

1. *Wages Differences* -----(+)--> *Migration* -----(-)--> *Wages Differences*

2. *Unemployment Differences* -----(+)->*Migration* -----(-)->*Unemployment Differences*

The main causes of international migration are differences in wages and unemployment between sending and receiving countries. In other words, elimination of wage and unemployment differentials will end international migration. Migrants will not migrate if such differences do not exist.

3. *Labour Supply* -----(-)-> *Wages* -----(-)-> *Emigration* “outflow” -----(-)-> *Labour Supply*

4. *Labour Demand* -----(+)->*Wages* ----(+)-> *Immigration* “inflow” ----(-)-> *Labour Demand*

International migration is influenced by labour market mechanisms. This means that labour supply and demand determine migration flows size between sending and receiving countries as well as the point where migration ceases. Combining these causal relationships (Figure 8) with explicit and implicit theoretical hypotheses

constitutes a complete causal feedback structure that explains migration between sending and receiving countries.

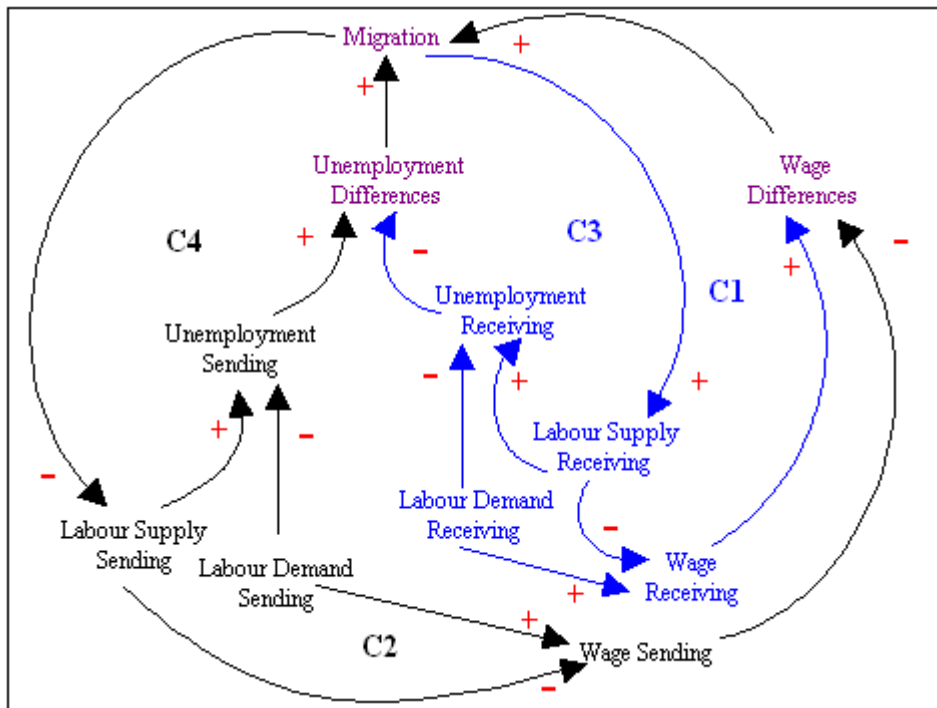


Figure 8: System Dynamics representation of Neo-classical theory

The wage differences between sending and receiving countries encourage labour movement. Rising migration in the receiving country increases its labour supply which in turn pressures wages lower than it was. Lower wages reduce the wage gap which in turn leads to a decrease in migration inflows to the receiving country (Loop C1). Wage differences encourage migration out of the sending country thereby reducing the labour supply. Lower labour supply pushes wages up, resulting in smaller wage differences. The lower wage gap reduces migration from the sending country (Loop C2). The unemployment loops follow a similar pattern to the wage loops. The unemployment gap between countries stimulates migration flows. Higher migration inflows increase the receiving country's labour supply thus reducing the unemployment gap and eventually lowering migration inflows (Loop C3). The same mechanism is applicable in the sending country where more migration outflows reduce the labour supply and lessen the unemployment gap. Smaller gap reduces migration outflows (Loop C4). The extensive critical commentary on the neo-classical approach has mainly been directed at its unrealistic assumption of the individual as a rational decision-maker. Moreover, the theory ignores the personal, family or socio-cultural factors and political barriers related to migration. All these and other factors encouraged scholars to look for other theoretical frameworks (Russel King 2012).

2.3 Dual Labour Market Theory of Migration

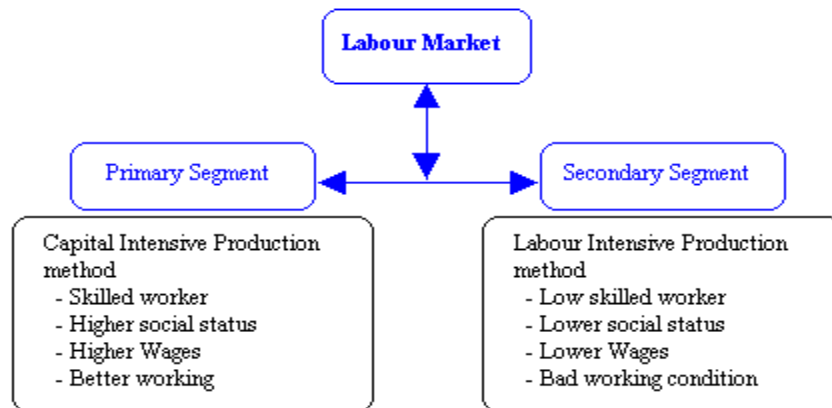


Figure 9: Labour market structure in advanced society

The dual labour market theory rests on three general hypotheses (Figure 9). Firstly, the economy contains two sectors: a primary high-wage sector and a secondary low-wage sector. Secondly, the primary sector is characterized by high skilled workers, better working conditions and higher social status. The secondary sector is characterized by low skilled workers, bad working conditions and lower social status. Lastly, workers in the secondary sector display patterns of job instability such as: frequently moving between jobs and moving regularly into or out of unemployment and labour force participation (Michael 1974).

According to dual labour market theory - as discussed by Piore in *Birds of Passage* (1979) - labour migrant and economic advanced countries is the main cause of international migration. The characteristics of advanced industrial societies create a demand for both highly skilled and lower skilled workers. Migration is not caused by push factors in sending countries but rather by pull factors in receiving countries. The theory presents the following three possible explanations of the demand for foreign workers in modern industrial-societies: general labour shortages, the need to fill the bottom positions in the job hierarchy, and the labour shortages in the secondary segment of labour market (Jennissen, 2004). Demographic and social changes in modern societies lead to relatively small inflows of natives who are less motivated to take jobs at the bottom of job hierarchy. Therefore, labour shortages at the bottom of job hierarchy compel employers to recruit foreign workers (Massey et al 1993). Labour migration is largely demand based and initiated via employer recruitment in developed societies or by governments acting on their behalf. The demand for workers from other countries is structurally built-in to the needs of the modern economy and is expressed through recruitment practice rather than wage offers (Massey et al 1993, Russel King

2012). From a feedback perspective the dual market model may be reflected in the following causal links relationships:

1. *Advanced Society* ----- (+) ----> *Living Standard* ----- (+) ----> *Low skilled job*

The rising living standard in the advanced society creates a permanent demand for low skilled jobs in the secondary labour market.

2. *Low skilled job* ---- (-) -> *Motivation* ---- (+) -> *Native workforce* ---- (-) -> *Labour Shortage*

Native workers are less motivated to take jobs in the secondary labour market sectors which increase labour shortages in this market segment.

3. *Labour Shortage* ----- (+) ----> *Migration* ----- (-) ----> *Labour Shortage*

As a result of labour shortages in the secondary labour market, employers are compelled to recruit foreign workers. The following CLD (Figure 10) summarizes the joint effects of these causal links in a complete causal feedback structure. Higher economic growth creates a permanent demand for low skilled jobs in the secondary labour market. Labour shortages force employers to recruit migrant workers to fill these vacant jobs eventually reducing labour shortages (Loop C1). After a period of time migrants contribute to economic growth. Higher growth triggers more demand in the secondary labour market which promotes the recruitment of more migrants (Loop R1). Moreover, higher economic growth further increases the living standard which applies upward pressure on labour demand in secondary labour market and stimulates more migrant inflows (Loop R2). Finally, the higher standards of living and the over representation of migrant workers in the secondary labour market segment drive native workers away from job positions in these sectors. Consequently, the demand for secondary labour market jobs increases as does the pressure to recruit more migrants (Loop R3).

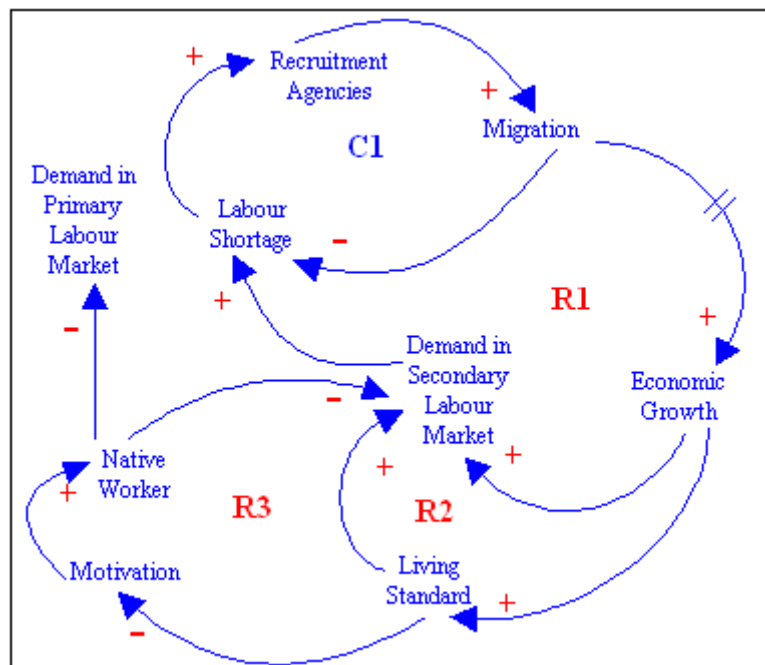


Figure 10: System Dynamics representation of Dual market theory

2.4 Network Theory of Migration

Network theory argues that international migration is a self-sustaining and network driven phenomenon. Migrant networks are sets of dense connections and ties that connect migrants, former migrants and non-migrants in origin and destination countries through linkages of kinship, friendship and shared community origin and identity (Massey et al 1993). As a result of large inflows of international migrants, migrant networks are formed thereby reducing the costs and risks of movement as well as increasing the rewards. Network expansion stimulates additional migration that further reinforces and expands the networks and so on (Massey et al 1998). Migrant networks provide a durable, valuable and efficient channel for the flow of resources that provide newcomers with information and social support for moving and getting started. These networks disseminate information about work opportunities to newcomers while also feeding information to employers, telling them about the applicants thereby reducing the risks and cost associated with hiring (Waldinger and Lithcter, 2003). These networks serve employers who can rely on the informal networks of staff members in recruitment practice. Staff members can guarantee that newcomers perform satisfactorily thereby reducing hiring process time and cost (Freiberg 2012). Migrant networks help potential migrants by, for instance, financing travel, arranging accommodation, finding jobs and providing information about access to social security (Jennissen 2004). Migration networks lower the economic, social and psychological costs of subsequent migration. These networks increase the probability of employment and decreases migration risks and the probability of deportation. Networks also make migration extremely attractive as a strategy for risk diversification. When migrant networks are well developed they put jobs within easy reach of community members and provide a reliable and secure source of income. The self-perpetuating dynamics of networks that occur through the progressive reduction of costs may also be explained theoretically by the progressive reduction of risks. Every new migrant expands the network and reduces the risks of movement for all newcomers eventually making it virtually risk-free and costless to migrate (Massey et al 1993). In other words, the formation and establishment of this form of social capital enlarges the expected net return of migration and increases motivation and ability to migrate. The network theory introduces a model that includes several hypotheses about the self-perpetuating dynamics of migration. These hypotheses are demonstrated in the following causal relationships:

1. *Migration Inflows* ----- (+) --> *Migrant Accumulation* ---- (+) --> *Migrant Community Size*
2. *Migrant Community Size* ----- (+) --> *Social Network*
3. *Social Network* ---- (-) -> *Migration Cost* ---- (-) -> *Migration Inflows* ---- (+) -> *Migrant*

4. *Social Network* ----- (-) --> *Migration Risk* ----(-)--> *Migration Inflows* --- (+)-> *Migrant*
 5. *Social Network* ---(+)--> *Migration Reward* ----(+)--> *Migration Inflows* ---(+)-> *Migrant*

Linking these causal relationships together (Figure 11) constitutes a complete causal feedback structure that explains the migration Process.

As a result of large migration inflows the migrant community becomes larger and migrant social networks are formed. Social networks reduce physical and psychological migration risks thus encouraging more potential migrants to migrate (Loop R1). Expanding social networks provide more information about the host country's culture, job opportunities and access to social services etc. Which in-turn attracts more potential migrants and further increases migration inflows (Loop R2).

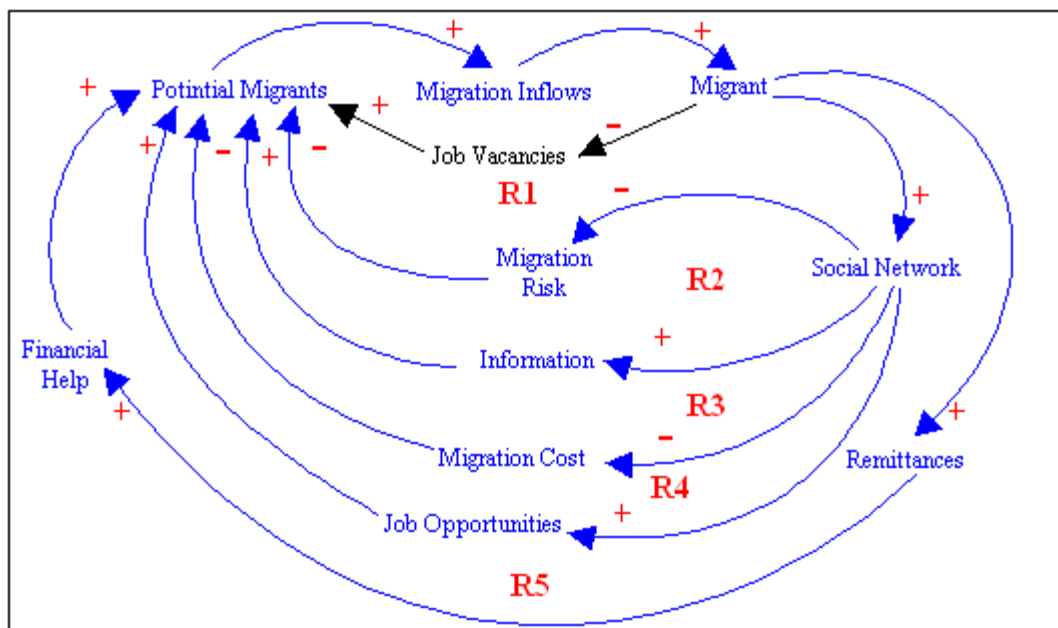


Figure 11: System Dynamics representation of Network theory

Additionally, social networks significantly reduce migration costs thereby attracting more potential migrants and stimulating migration inflows (Loop R3). Larger social networks provide more job opportunities that attract more potential migrants and lead to greater migration inflows (Loop R4). Finally, the growing number of migrants increases migration rewards (remittances) that provide financial assistance to potential migrants and in turn this further increases migration inflows (Loop R5).

2.5 Institutional Theory of Migration

According to the institutional theory, as a result of the large inflows of migrants, institutions and organizations (profit, non-profit, legal and illegal) will be established.

These institutions produce a kind of migration industry (consisting of clusters and networks of travel agents, lawyers, bankers, labour recruiters, brokers, interpreters and housing agents, as well as human smugglers and traffickers) which aims to promote and facilitate the continuation of migration for profit (de Haas 2010). These profit based organizations provide services and support such as transport, labour contracts, documents, dwellings or legal advice for migrants as well as other assistance. This supports and strengthens material linkages between countries. For instance, when travel between sending and receiving country increases, cheap and frequent flight connections are established. In this way the moving cost of future migrants is lowered (Jennissen 2004). Non-profit organizations also spring up in order to help migrants settle into the host society. Such organizations provide counseling, social services, shelter, legal advice, and even insulation from immigration law enforcement authorities. Over time individuals, firms, and organizations become well-known to immigrants and become institutionally stable. These institutions constitute another form of social capital that migrants can rely on and draw upon to gain access to foreign labour markets (Massey et al 1993). These organizations become embedded in migrant networks and strengthen cultural and social linkages between countries. This social capital formation further lowers the risk of migration and helps the migrant to assimilate within the host society thereby reinforcing the migration process.

2.6 Polish Migration Theoretical Framework

This section will demonstrate how the aforementioned theories of international migration - from which various hypotheses were derived and have been identified - can be integrated into one theoretical framework that explains how the initiation and continuation of migration between Norway and Poland has occurred. Applying both combinations of theoretical hypotheses, and what happened in the real world is an attempt to explain rising Polish migration to Norway from a system dynamics perspective.

Starting with push-pull theory and neo-classic theory:

Before joining the EU in 2004 Poland had a high unemployment rate (19%), low per-capita GDP (6,639 USD) and low average wage (11,939 USD). These indicators constitute push factors that pressured the Polish unemployed workforce and paved the way for a massive migration movement. The situation in Norway was characterized by lower unemployment rate (4.5 %), a higher per-capita GDP (56627 USD) and a higher average wage (65820 USD). These indicators represent strong pull factors for migration. Furthermore, the average wage differences and the unemployment gap

between Norway and Poland in 2004 were very high. Wages in Norway were 5.5 times the average Polish wage and the Polish unemployment rate was 4,2 times the Norwegian unemployment rate. Yet, once the door was opened for labour migration the flow of Polish migrants to Norway were relatively weak - 1576 migrants in 2004 and 3271 migrants in 2005. Wage and unemployment differences are a necessary condition for migration but not a sufficient condition.

The dual market theory provides an essential piece of the puzzle in explaining the Poland-Norway migration situation. The highly developed Norwegian socio-economic and political system creates labour shortages in the secondary labour market segment. The higher standards of living (High per capita GDP: 56 627, High Living standard HDI: 94,4 and High quality of life Index: 175,09) makes the native labour force reluctant to take lower skilled, lower status, and lower paying (3D) jobs (difficult, dangerous, dirty job). In addition, the higher standards of living create more demand for low skilled jobs such as housekeeping, child and elderly care, restaurant, entrainment and etc. Additionally, the higher life expectancy (81 years) creates labour shortage in elderly care and health sector. Moreover, the higher percentage of women participating in the labour force increases and pressures the demand for childcare and housekeeping. Furthermore, rapid economic growth, especially in the construction sector in Norway, (GDP growth rate: 5.1%, new construction ordered index grew 50% in 2004 and reached 125% 2007) lead to an increase in the demand for a low skilled and hardworking labour force to meet the rising labour demand. It is worth noting that the construction sector is characterized by project management syndrome whereby construction projects suffer from cost and schedule overruns. As such, this sector needs a continuous flow of flexible and mobile workers. Foreign labourers are highly mobile - estimates suggest that immigrants in EU countries are 11 times more likely to move than natives (Somerville and Sumption 2009). Unlike natives, foreign workers work longer hours including overtime on weekdays and weekends. Together, these factors create constant pressure on the demand for a low skilled workforce and constitute the first element of the sufficient condition for the rapid growth in Polish migration.

In summary, Norway has sustained a high demand for labour in several industries such as construction, manufacturing and services. These jobs require few formal skills and are usually found low on the status ladder of domestic labour markets. Moreover, these jobs often pay significantly lower wages making them less desirable to the natives. Demographic and social changes in Norway create difficulties for employers to recruit domestic workers to fill these jobs. As a result small inflows of natives are willing to take jobs at the bottom of job hierarchy. Consequently, demand for extensive foreign

recruitment increases so as to fill these gaps. After the opening of borders to new EU members labour migrants from CEE countries have been recruited to fill the gap in these jobs specifically, in construction and low skilled service sectors. Polish labour migrants are largely demanded based and initiated by the employer's recruitment practices or by recruitments agencies acting on their behalf (Freiberg et al 2013).

Further developing could be added to the dual market theory in which, process of segmentation will occur within the already segmented secondary labour market. This process will work in two parallel channels: firstly within the same ethnic migrant group (e.g. Polish migrant), and secondly among the ethnic migrant group as a whole. The first segmentation occurs as a higher representation of migrant labour in a specific sector (Construction) will increase the flow of newcomers to this sector. This will shape the patterns of migration flows within that migrant group. Statistics show that Polish males are hired mainly to work in the construction sector, while females are hired to work in cleaning services (Freiberg et al 2013). Consequently, the second segmentation will occur among the different ethnic groups whereby the concentration of such ethnic migrant group in specific sector will shift such group to dominate the sector. Statistics show that migrants are recruited to fill shortages in the secondary labour market. Within that segmented market some ethnic group's e.g. Polish migrants are concentrated (segmented) in the construction sector, while Swedish migrants dominate the health care sector and Pakistani migrants dominate the taxi driver sector. Research in the United States and the United Kingdom show that employers often deploy common racial, ethnic or national stereotypes when seeking to hire a specific migrant group for a specific type of job based on real or imagined characteristics of different national groups (Freiberg 2012).

Another level of segmentation will occur within these market segments between genders within the same migrant ethnic groups or the migrant group as a whole. In conclusion, the market segmentation re-produces segmentation within itself, resulting in more segments between ethnic migrant groups, inside the same ethnic group, and between genders inside migrant groups.

The network theory provides another important argument to explain the Poland-Norway migration situation. According to the social network theory, the process of migration is a self-sustaining phenomenon. As a result of the large inflows of migrants, migrant networks are formed. Newcomers are linked through kinship, friendship, and common identity. Migrant networks help potential migrants by reducing the costs and risks involved in migration (effect on risk). Networks also help potential migrants

increase rewards by financing the journey, finding job and accommodation, and supporting access to social security (effect on attractiveness). According to the Polonia survey that was conducted in Norway among Polish immigrants, 25% of male and 65% of female migrants stated that their main reason for coming to Norway was because a friend or family member was already in Norway. More than 80% of subjects reported that they knew someone in Norway before arriving themselves (Freiberg et al 2013). Polish migrants who come to Norway faced a high degree of risk in the early stage of migration (particularly 2004 and 2005). New migrants do not know the language and often have a low level of education and poor English language skills. They rely mainly on their native Polish migrant community to help them with work necessarily communications. In addition, Norway is a very expensive country so accommodation and financial support are big issues in the decision to migrate. Newcomers rely on the support of their native community for accommodation and financial assistance during the early stages of their arrival. The capacity to accommodate newcomers is directly and strongly related to the size of the Polish community. In conclusion, the size of the Polish community is a critical factor affecting Polish migration inflows to Norway. A larger Polish community reduces migration risk on one hand, and on the other increases migration attractiveness. These two variables are the second sufficient conditions for the potential migrant to migrate.

Another major effect of the social networks can be traced to what is called the tendency to settle. As the social network grows, a small ethnic community is formed. This community is characterized by: strong ties between members such as a common purpose, shared difficulties, shared social status and in some cases even working the same job. This shared identity initiates the development of shared new values within the migrant community and create ties to the new society that they live in. In most cases, this will be reflected in an increased tendency to settle. As the social networks expand, the average residence time will also increase which in turn lower the migration outflow.

Institutional theory provides a further contribution to the argument. As a result of the large inflows of migrants, institutions and organizations (profit and non-profit) are established. These organizations provide services and support for migrants. Large inflows of Polish migrants will results in the establishment of business networks which are parallel to and are strengthened by social networks. These business networks create linkages between the Polish migrant community and labour market actors. Employers and recruitment agencies are tied to and have relied on these networks in recruiting practice. Since 2004, temporary staffing and recruitment agencies in Norway have

boomed. From 2004 to 2008 the number of employees recruited by these agencies has risen from about 17 000 to 40 000 individuals per year (Freiberg et al 2013). These networks consist of mediators, subsidiaries, and subcontractors. They provide support, information, and sometimes training to migrants thereby reducing the cost and risk of migration on one hand, and on the other relieving employers of traditional employer responsibilities while decreasing production costs. These agencies have initiated the growth and expansion of Polish migration flows. As the stock of migrants rise, the social and business networks (migratory networks) expanded. The accumulation of migrants and the migratory networks expansion further lowers the risks and costs of migration. This has constituted a powerful positive feedback mechanism, giving rise to further migration. This higher representation of Polish workers serve the employers and recruitment agencies that rely on informal networks of staff members to recommend job seekers and guarantee that recruits would perform satisfactorily (Freiberg et al 2013). The increased representation of Polish workers in the Norwegian labour market altered the perception of employers and recruitment agencies about the effectiveness and productivity of Polish workers. Moreover, potential Polish migrants would get positive impressions about job opportunities and the likelihood of assistance from the Polish migrant community when they get in Norway thus increasing migration.

However, it will be always a certain limit or ceiling that prevents the social and business networks from reaching maximum and sustaining continued growth. When the network reaches a certain size it will start producing negative effects relative to the growing size of the community. As migrant numbers increase, the probability of finding jobs decreases and unemployment starts to rise. The number of unemployed Polish migrants relative to the community size will give a negative impression about lower job opportunities to potential migrants. In this way the wheel turns in the opposite direction and reduces migration. Furthermore, the attitude towards immigrants, the competition between new and old migrants for limited job opportunities, and the pressure on wages will create an unpleasant environment which may significantly reduce migration attractiveness and increased migration risks.

2.7 Synthesis

Based on these different theoretical arguments, a system dynamics perspective evolved to combine the aforementioned theoretical hypotheses and arguments in one picture. Constructing a unified theoretical framework based on the SD perspective will significantly contribute to an understanding of the underlying structure behind the rapid growth of Polish migration in Norway. On the other hand it will provide an

understanding of the fundamentals of the underlying feedback structure that drive migration phenomena in general. The following causal loop diagram consolidates the SD views of the different theoretical arguments discussed above. The SD perspective will be presented in a story telling fashion starting from the left side with the following CLD.

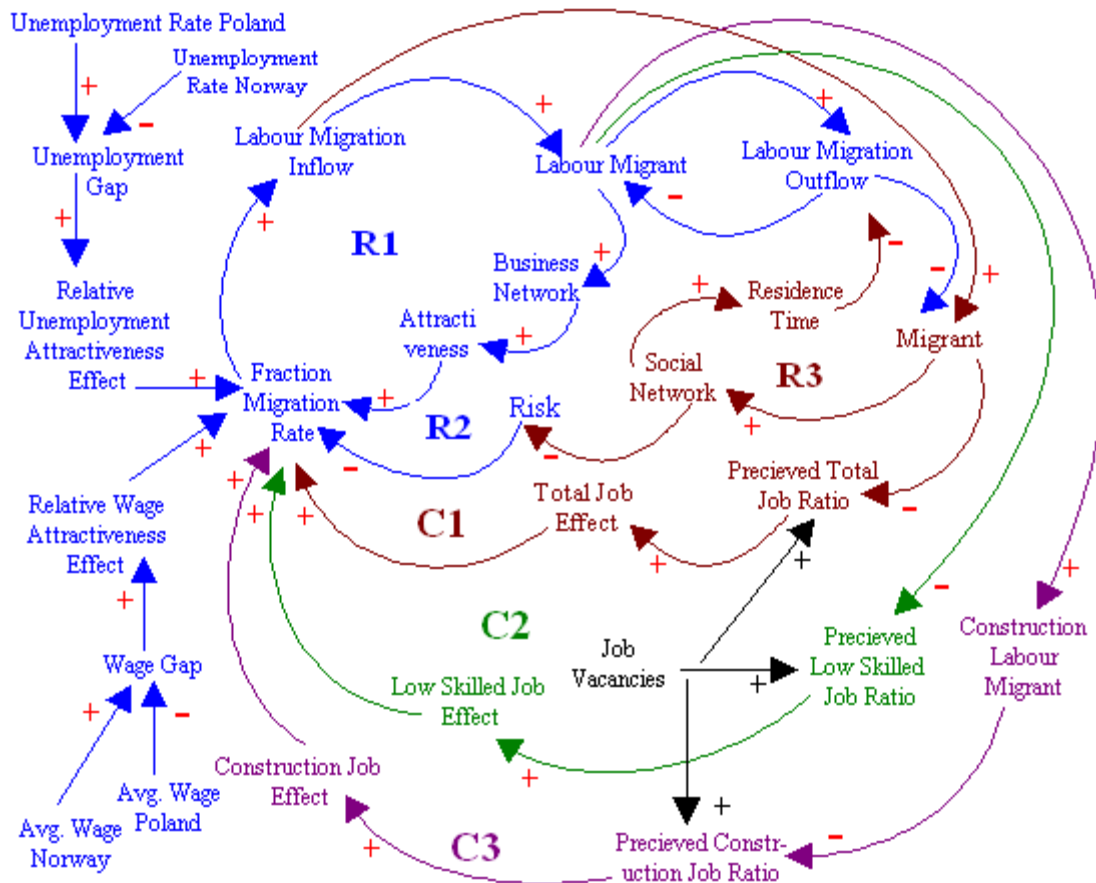


Figure 12: The overall feedback structure for Norway and Poland

The unemployment and wage gaps between Norway and Poland push out and pull in Polish citizens to migrate to Norway. These gaps increase the relative wage and unemployment attractiveness effect on propensity to migrate. Consequently, a higher fraction of Polish laborers (represented by fraction migration rate) migrate leading to an increase in labour migration inflows. Higher Polish labour migration inflows increase the size of Polish community in Norway which in turn leads to the formation of migratory networks. Growing business networks increase migration attractiveness encouraging more potential Polish migrants to move to Norway. Higher attractiveness raises the fraction migration rate thereby increasing labour migration inflows. More inflows raise the labour migrant level which further expands the business network (reinforcing Loop R1). More migrants expand the Polish social network thereby

reducing migration risk and encouraging more potential migrants to move to Norway. Lower risk raises the fraction migration rate which leads to higher labour migration inflows. Higher inflows raise the labour migrant level which increases the migrant level and leads to a bigger social network (Loop R2). The larger social network results in longer resident time which reduces labour migration outflows and accordingly keeps migrants at a higher level than it would be (Loop R3). The demographic and economic changes in Norway create a labour shortage (represented by the job vacancies) in the labour market which increases demand for Polish migrants. A fraction of Polish migrants will take jobs in primary labour market sectors. Note that a few highly skilled Polish workers will find jobs in the primary sector as well. Statistics show that some Polish migrants work in different primary jobs - this is consistent with the dual market theory. The increased number of Polish migrants who take jobs in the primary sectors decrease job vacancies available in the primary labour market (represented by the perceived total job). Lower perceived total job will reduce the effect of job opportunities on propensity to migrate (represented by total job effect). Lower total job effect reduces the fraction migration rate which lowers labour migration inflows thus eventually reduces the migrant level as shown in (counteracting Loop C1). The same mechanism will occur in the secondary labour market. The majority of Polish labour migrants will take jobs in low skilled job sectors. More Polish labour migrant workers decrease available low skilled job vacancies (represented by the perceived low skilled job). Lower perceived low skilled job will reduce the effect of low skilled job opportunities on propensity to migrate. The decrease in the low skilled job effect reduces the fraction migration rate which decreases labour migration inflows. Lower inflows add less to the labour migrant level (Loop C2). A fraction of Polish labour migrants will work in the construction sector (segmentation within this secondary labour market segment). The increase in Polish construction workers will decrease available construction job vacancies (represented by the perceived construction job). Lower perceived construction job will reduce the effect of construction job opportunities on propensity to migrate. The decrease in the construction job effect reduces the fraction migration rate which decreases labour migration inflows thereby, adding less to migrants level (Loop C3).

Based on this SD conceptual framework a conclusion can be drawn that the dynamic interactions between these feedback loops in a chain of cause-effect will result in a cumulative process that produces the Polish migratory patterns of behavior. Changes in the size of the Polish migrant stock depend on and are determined by the interaction between these six causal feedback loops. In other words, the relative strength of these loops will shape the patterns of migration between Poland and Norway.

A synthesis of the discussed theoretical arguments demonstrates the complementarities of different migration theories in explaining migration. The feedback perspective of migration makes it clear that the causes and consequences of migration are linked through a feedback structure responsible for shaping the migratory behavior. The SD approach shows how a number of theories of international migration (from which various hypotheses have been identified) can be mapped into one unified theoretical framework.

The SD approach moves from a conceptualization face to an empirical face in order to test and validate these set of theoretical hypotheses against real world data. Constructing an SD based simulation model is the second building block in testing, validating and predicting these theoretical arguments. Modeling the above theoretical framework will provide an explanation and understanding of the rising Polish migratory patterns and pave the way for exploring policy options that may contribute to regulating it. In addition, the SD explanatory model will provide a basis for exploring both quantitative and qualitative analysis of the real data against the theoretical framework. The next chapter is the operationalization of this synthesized theoretical framework where migration dynamics will be modeled as they have occurred in the real world. The SD explanatory model articulates how things really work by mapping the physical flows of migrants together with the associated information flows that represent their decisions to migrate.

Chapter 3: Why Does Polish Migrant Increase? The Explanatory Model

The explanatory model is the operationalization of the last chapter’s synthesized theoretical framework. The explanatory model aims to articulate the process of migration growth that lead to Polish migrants being the largest immigrant group in Norway. The model provides a mathematical explanation of Polish migration processes and identifies, both quantitatively and qualitatively, the underlying structure that influences and governs Polish migration patterns of behavior in Norway. Figure 13 shows that Polish migrant stock (the total number of Polish migrants in Norway) is the accumulation of incoming Polish migrants (migration inflow) minus the outgoing Polish migrants (migration outflow).

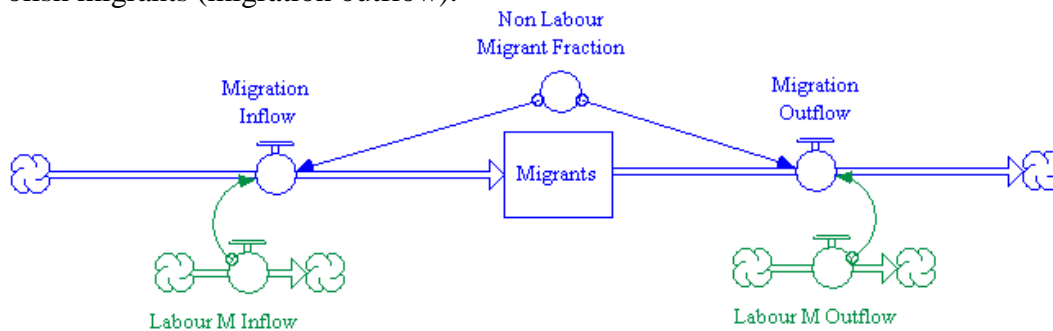


Figure 13: The Polish migrant stock and flows diagram SFD

The Polish migrant stock increases via migration inflow (newcomers per year) and decreases via migration outflow (Polish migrants leaving per year). These flows are respectively determined by labour migration inflow (labour m Inflow) and labour migration outflow (labour m outflow) adjusted by the Non labour migrant fraction. The non labour migrant fraction represents the number of migrants who accompany labour migrants as spouses; a family member or migrant who comes for any other reason except working.

$$\text{Non Labour Migrant Fraction} = 1 - (\text{Employed Polish Migrants} / \text{Polish Migrants})^5$$

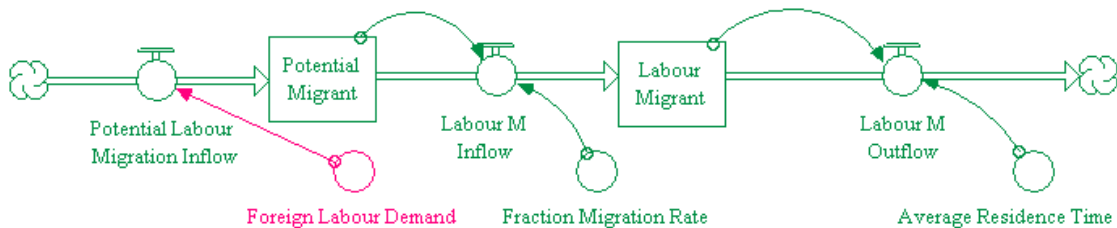


Figure 14: The Polish labour migrant and potential migrant SFD

Figure 14 demonstrates that the Polish labour migrant stock is the accumulation of: (a) Polish labour migration inflow which depends on the fraction migration rate multiplied

⁵ (Non labour migrant fraction is Calculated based on the year 2004).

by potential migrant stock, minus (b) Polish labour migration outflow which is a product of the labour migrant stock divided by average residence time. Potential migrant stock is the accumulation of potential labour migration inflow. Potential labour migration inflow is determined by foreign labour force demand which depends on job needed due to labour shortages in Norway. Foreign labour demand represents the total number of migrants required to fill the available jobs in Norwegian labour market. This variable is the sum of the total low skilled foreign labourers needed to fill the available jobs in the secondary labour market segment each year, added to foreign labour needed to fill the available jobs in primary labour market segment per year. Foreign labour demand for the primary sector is calculated according to the percentage of total jobs available for migrants ($Total\ Job * Total\ Migrant / Total\ Norwegian's\ Population$). The fraction migration rate is determined by a composition of factors that affect the potential migrant's decision to migrate. The fraction migration rate is divided into two sets of variables derived from and based on different theoretical hypotheses situated in the various migration theories. The first set represents variables drivers associated with labour reasons (push-pull theory, neo-classical theory and dual labour market theory) (Figure 15: left). The second set represents variables drivers associated with overall migration purposes including labour (social network theory and institutional theory) (Figure 15: right).

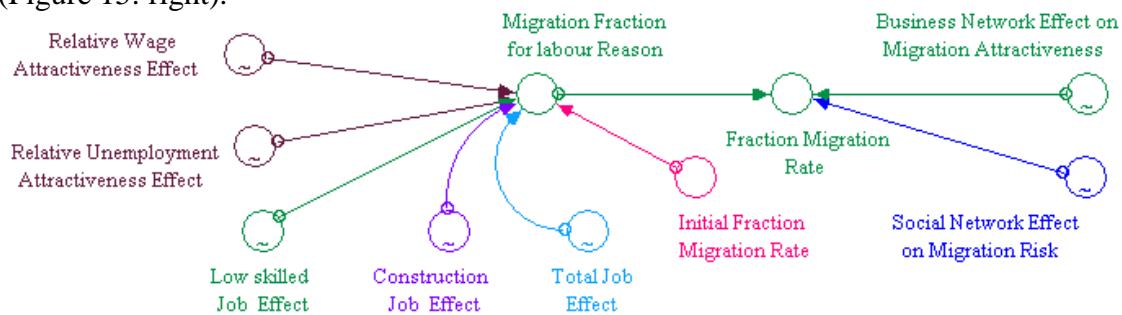


Figure 15: Variables influences fraction migration rate

The first set of variables (labour concerns) consists of the initial fraction migration rate and the effect of five variables on this initial fraction. The initial fraction is calculated based on the year 2003. It is the Polish migration inflow divided by Polish migrant ($Initial\ Fraction\ Migration\ Rate = Migration\ Inflow / Migrant$)

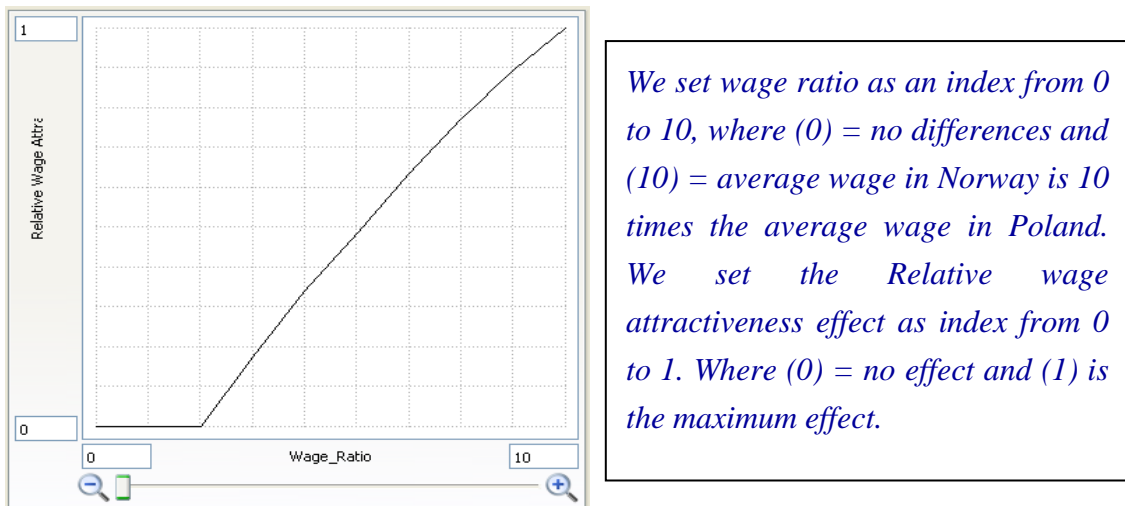
1.1 The Relative Wage Attractiveness Effect

The relative wage attractiveness effect on the initial migration fraction represents how differences between the average wage in Norway and Poland (wage gap) affect decisions to migrate. A wider wage gap between the two countries increases the propensity to migrate (relative attractiveness) thereby raising the initial fraction

migration rate. Consequently, migration inflow rises adding more Polish migrants. Migration, among other factors, causes an improvement in the Polish wage level. The improvement in the Polish wage level relative to the Norwegian wage level reduces the wage gap which in turn lowers the propensity to migrate. Therefore, the initial fraction fall down reduces migration inflow which adds less to migrant stock. As the gap narrows the migration inflow slows and stops for wage reasons. The relative wage attractiveness effect is modeled as a function of the wage ratio:

$$\text{Relative wage attractiveness} = f(\text{wage ratio}).$$

The wage ratio (gap) is a product of Norway's average wage relative to Poland's average wage in a year base ($\text{Wage Ratio} = \text{average wage Norway} / \text{average wage Poland}$). Note that there will be always a wage gap between the source and host countries (minimum gap). In other words there is always a degree of tolerance around wage differences represents no change in migration decisions. This means that people will not migrate until a significant wage difference exists. This study assumes that the wage gap narrows as the wage ratio approaches the value of 2. The following graph function⁶ (Figure 16) represents the relationship between the wage ratio and the wage relative attractiveness effect.



We set wage ratio as an index from 0 to 10, where (0) = no differences and (10) = average wage in Norway is 10 times the average wage in Poland. We set the Relative wage attractiveness effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect.

Figure 16: Wage ratio and relative wage attractiveness effect relationship

⁶ SD use graph function to model linear or nonlinear relationship between two variables as a base for the measurement, if such measurements are not available. The reason is mathematical model often omit significant variables because they are unmeasured or immeasurable. Omitting such variables is equivalent to say they have ZERO effect. SD stress that mathematical model should be based on the best information that is readily available and the design of the model shouldn't be postponed until all parameter have been accurately measured which maybe will never happen (Forrester, 1961).

The graph shows no effect on the relative attractiveness to migrate until the wage ratio becomes higher than 2. At 2 relative attractiveness starts to increase linearly as the ratio rises to reach the maximum effect. Three important issues need to be considered in formulating the graph function: (a) the slope, (b) one or more specific points and (c) the shape. The shape and slope of the graph are based on the estimated relationship derived from the actual data. A correlation and regression analyses has been conducted to these variables, which results in a form close to the graph in figure 16. The points are chosen based on the regression result, available information and judgment. A detailed method for the relationship estimations is included in Appendix 1.

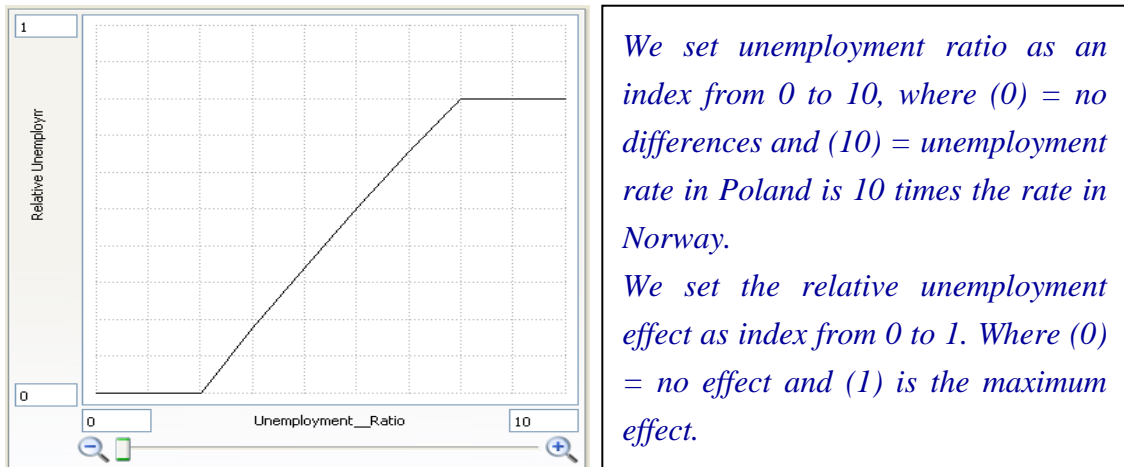
Relative attractiveness of wage is a necessary condition, for potential Polish migrants who are willing to migrate whenever opportunities appear for them, to become a migrant. As wage differences increase, willingness to migrate also rises. As the gap narrows, the willingness to migrate will decrease.

1.2 The Relative Unemployment Attractiveness Effect

The relative unemployment attractiveness effect on the initial migration fraction represents how unemployment differences between Poland and Norway (unemployment gap) affect a potential migrant's decision whether to migrate. A bigger gap increases the propensity to migrate which raises fraction migration rate. As a result, migration inflow increases, which adds more Polish migrants. Higher Polish migrants reduce Poland's unemployment rate which causes the unemployment gap to narrow. Consequently, the propensity to migrate decreases slows migration inflow for unemployment reasons. Relative unemployment attractiveness effect is modeled as a function of Unemployment ratio

$$\text{Relative Unemployment attractiveness} = f(\text{wage ratio}).$$

The unemployment ratio is a product of Poland's unemployment rate divided by Norway's unemployment rate in a year base. It is worth noting that there will always be an unemployment gap between the source and host countries (minimum gap). There is always a degree of tolerance around unemployment differences value a minimum gap that represents no change in migration decisions. This level of tolerance is the reasonable unemployment level that economists accept as a low unemployment rate. This is expressed by the term 'one digit unemployment rate'. This study assumes that the unemployment gap narrows when the unemployment ratio approaches (2). The following graph function (Figure 17) illustrates this relationship.



We set unemployment ratio as an index from 0 to 10, where (0) = no differences and (10) = unemployment rate in Poland is 10 times the rate in Norway.

We set the relative unemployment effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect.

Figure 17: Unemployment ratio and relative Unemploy. Attractiveness relationship

There is no effect on relative attractiveness to migrate when the unemployment ratio remains within the acceptable level. As the ratio increases beyond (2), relative attractiveness increases, reaching a satisfactory level at 0.8. Thereafter relative attractiveness ceases to increase as a result of the fact that at such a high unemployment rate, labour migration is not on its own a viable solution for unemployment. Given that migration is not a possibility for every unemployed person, the unemployed population will engage domestic political channels to solve unemployment. Besides, the shape and slope of the graph is based on the estimated relationship of the actual data. A correlation and regression analyses has been applied to these variables, resulting in a close form similar to the above graph. A detailed description of the method used to estimate this relationship is included in Appendix 2. The relative attractiveness of unemployment effect is another necessary condition for potential Polish migrants to become migrants. As unemployment differences increase willingness to migrate increases. As the gap narrows willingness to migrate will decrease. The relative attractiveness effect of wage and unemployment are necessary conditions for migration to occur based on labour reasons.

The first set of sufficient conditions come from job availability, which modeled as a three variables effects: one for primary labour market segment's (total job effect) and two for the secondary labour market segment's (low skilled job effect and construction job effect). The effects of these variables are a function of job ratios. Job ratio is the number of jobs available in each labour market segment relative to the number of migrants working in that segment. This reflects perceptions about job opportunity of the newcomers which will be passed through formal-informal, social-business networks of: native workers, employers and recruitment agencies. The higher ratio indicates more job opportunities relative to the number of Polish workers, which increases migration

opportunities perception. This, leads to a process that takes place via three different channels working in the same direction:

- (A) Business sector and temporary staffing agencies will recruit more migrants to fill vacant jobs based on Polish representation in these labour market segments.
- (B) Polish workers will propose to their relatives and friends about migration opportunities in these market segments.
- (C) Potential Polish migrants will be willing to migrate for the advantage of job opportunities in these market segments where native Polish migrants dominate.

The higher ratio creates the perception of increased migration opportunities, causing more migration inflow thus adding more migrants. More migrants reduce the ratio, indicating that there are less job opportunities, which drives the wheel in the opposite directions. As the migrants increases the ratio decreases reducing migration inflow.

1.3 The Low Skilled Job Effect

Figure 18 demonstrates that the low skilled job ratio is a product of low skilled job vacancies per year (a fraction of job vacancies) divided by labour migrants. This ratio represents the number of low skilled jobs available relative to the number of Polish labour migrants.

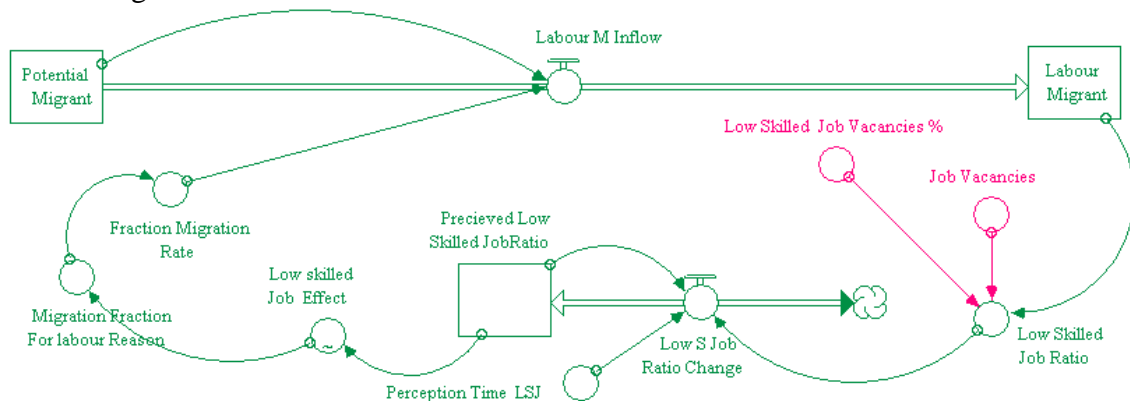


Figure 18: Low skilled job effect on migration fraction for labour reasons SFD

Information about job vacancies is published on a monthly basis so it takes some time for perceptions about the ratio to adjust. The adjustment process will take place over a time delay defined as perception time for low skilled job (Perception Time LSJ *set to the value of one month*). Change in perception is formulated as the incremental difference between the actual and perceived value divided by adjustment time. It is the smoothed⁷ value of the incremental accumulation of the low skilled job ratio. The

⁷ Why smooth? Because full and immediate action is seldom taken on a change of incoming information, there is a tendency to delay action until the change is insistent (Forrester, 1961).

perceived low skilled job ratio represents the smoothed number of low skilled jobs available per year relative to the number of Polish labour migrants. The low skilled job effect on the initial migration fraction represents how the perceived low skilled jobs available relative to the number of Polish labour migrants affects a potential migrant's decision. According to the dual market theory, demand for low skilled workers in the advanced society leads to an increase in the recruitment of foreign workers so as to fill the bottom positions in the job hierarchy. A greater number of available low skilled jobs push up the low skilled job ratio which adds to perceived low skilled job ratio. A high perceived ratio increases the low skilled job effect (Polish low skilled worker's propensity to migrate) which pushes up the migration fraction. A higher fraction increases the labour migration inflow which adds more labour migrants. More labour migrants reduce the low skilled job ratio indicating fewer job opportunities which drives the wheel in the opposite direction. A lower ratio reduces the perceived ratio which pressures the low skilled job effect down until it reaches (0). At this level migration stops due to the lack of available low skilled jobs. The low skilled job effect is a function of the perceived low skilled job ratio. The following graph function (Figure 19) represents the relationship between the two variables.

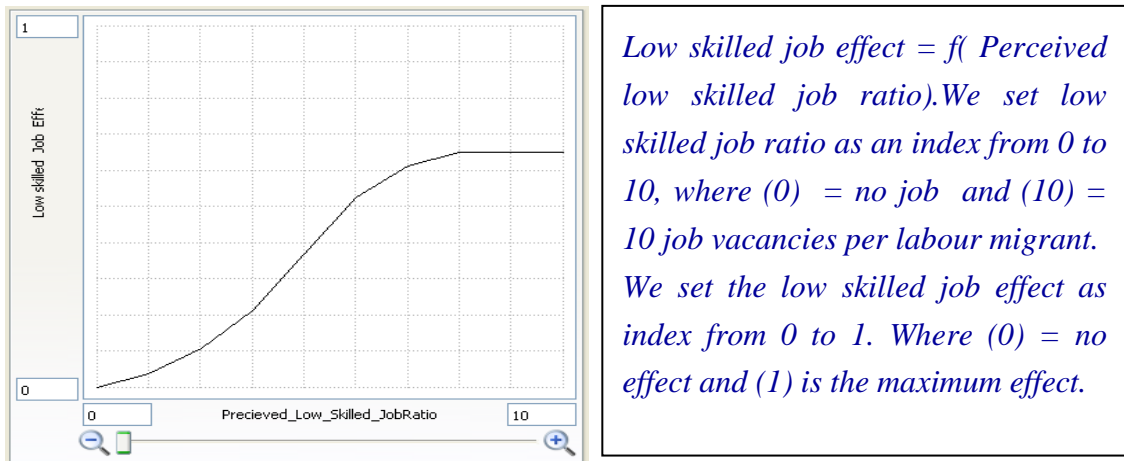


Figure 19: Perceived low skilled job ratio and low skilled job effect relationship

There is no effect on the propensity to migrate when the perceived ratio equals (0). As the perceived low skilled job ratio increases the propensity to migrate will slowly start to increase forming an S shaped curve. This is because when the number of jobs available relative to the number of labour migrant reaches around 8 (8 new job vacancies in front of each Polish worker), it will be high enough ratio that makes the propensity to migrate at the a maximum level which points it will no longer increase. In other words, the propensity to migrate due to low skilled job ratio will not maintain persistent growth. This study sets the maximum effect at 0.65 because Polish migrants are mainly recruited to fill jobs in low skilled sectors. Therefore, a higher percentage of

low skilled workers will migrate as a result of the higher ratio. On the other hand the shape and slope of the graph is based on the estimated relationship derived from the actual data. A correlation and regression analyses was performed to these variables, resulted in close form similar to the above graph. Details of the estimation method are included in Appendix 3.

1.4 The Construction Job Effect

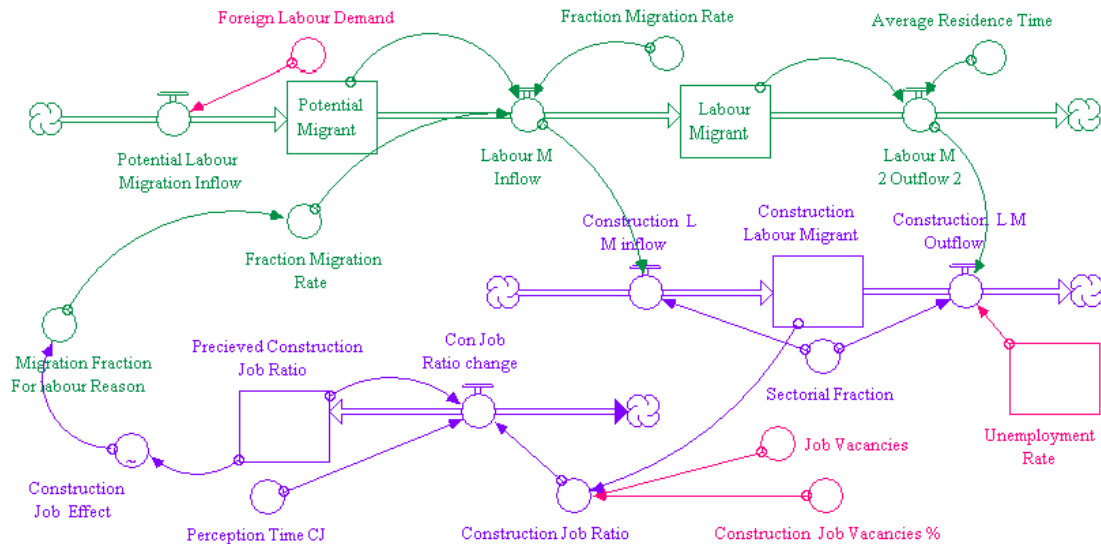


Figure 20: Construction job effect on migration fraction for labour reasons SFD

Figure 20 shows the construction job effect modeled in a similar fashion to the low skilled job effect. The construction job effect represents segmentation within the secondary labour market. Construction labour migrant is the total number of Polish construction labour migrants in Norway. This stock represents the accumulation of the construction labour migrant coming-in (*inflow*) minus construction labour migrant going-out (*outflow*). Construction labour migration inflow is a product of labour migration inflow multiplied by sectorial fraction (*Sectorial Fraction = Employed Polish in Construction / Employed Polish based on year 2008*). The construction labour migration outflow is determined by labour migration outflow multiplied by sectorial fraction and adjusted by the number of registered unemployed Polish construction workers. The construction job effect is a function of the perceived construction job ratio. The perceived construction job ratio is the smoothed value of the construction job ratio (*Construction Job Vacancies/ Construction Labour Migrant*) adjusted by perception time (*Perception Time CJ*). According to the dual market theory, more job vacancies in the construction sector leads to an increase in the perceived construction job ratio. A higher perceived ratio raises the Polish construction worker's propensity to migrate (construction job effect). Consequently, the fraction migration rate increases, which in turn increases construction labour migrant inflow adding more construction labour.

More Polish construction workers reduce the construction job ratio. Lower ratio decreases the perceived construction job ratio indicating less job opportunities and driving the wheel in the opposite direction. As the perceived construction job ratio declines, the propensity to migrate decreases until it reaches (0) at which point migration stops due to the lack of available jobs in construction sector. Note that migration to work in the construction sector may stop but migration to work in other sectors or for other reasons will continue. The construction job effect is a function of the perceived construction job ratio. The following graph function (Figure 21) represents the relationship between these two variables.

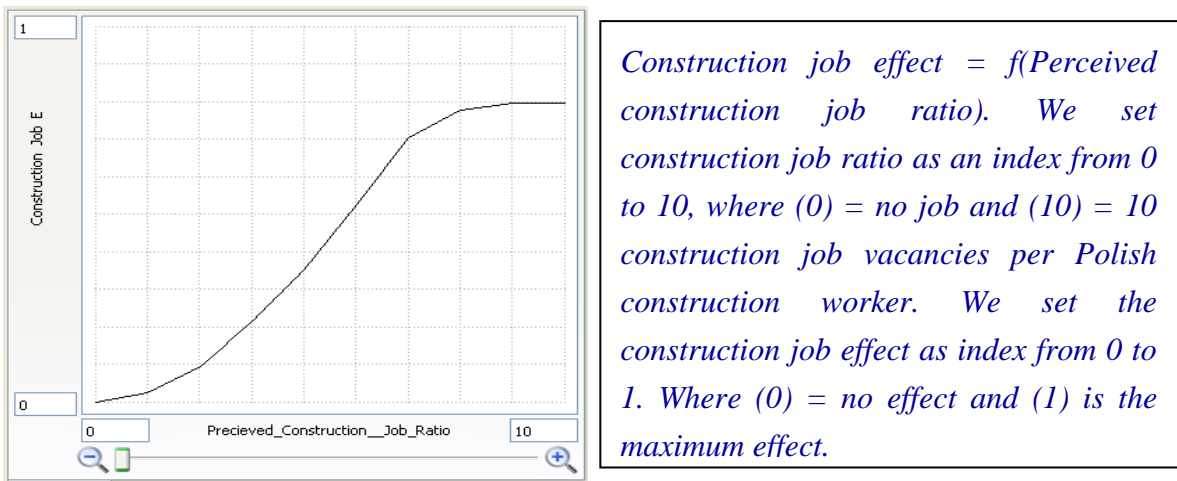


Figure 21: Perceived construction job ratio and construction job effect relationship

There is no effect on propensity to migrate when the perceived ratio equals (0). As the perceived construction job ratio begins to raise, propensity to migrate (construction job effect) will slowly start to increase forming an S shaped curve. This is because when the number of jobs available relative to the number of construction labour migrants reaches around (8), the ratio will be high enough to induce propensity to migrate reach a maximum point at which point it will no longer increase. Propensity to migrate due to construction job ratio will not grow forever. This study sets the maximum effect to 0.8 because Polish construction migrants are the dominant group within Polish labour migrants, whom according to statistics are the dominant migrant group in construction sector. Polish migrants have been recruited mainly to fill job positions in the construction sector. Therefore, there are a higher percentage of construction labourers that migrate due to higher perceptions of the construction job ratio. Furthermore, the shape and slope of the graph is based on the relationship estimated from real world data. A correlation and regression analyses has been executed to these variables, resulted in a close form similar to the above graph. Details regarding the estimation method are attached as Appendix 4.

1.5 The Total Job Effect

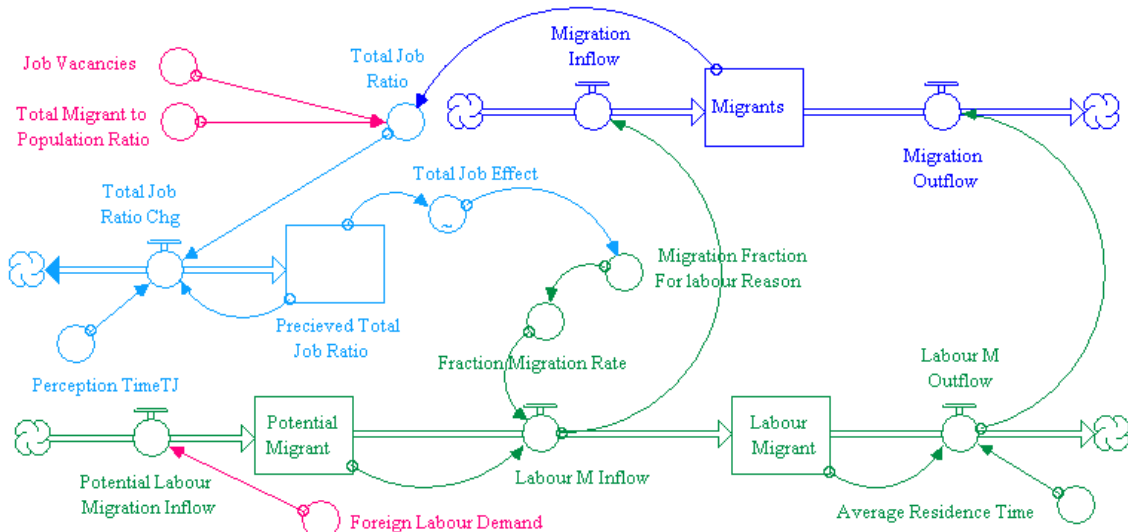
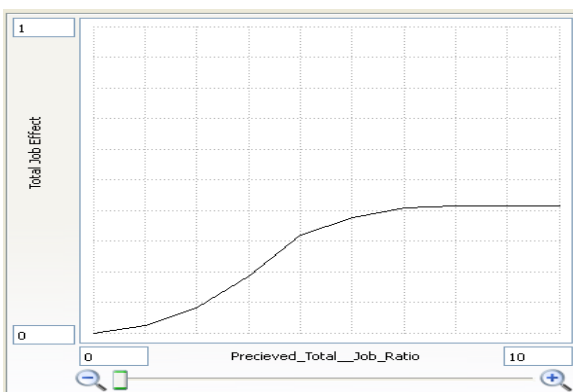


Figure 22: Total job effect on migration fraction for labour reasons SFD

Figure 22 demonstrates that the total job effect modeled similarly to the low skilled job effect. Total job effect is a function of the perceived total job ratio which is the smoothed value of the total job ratio adjusted by perception time. Total job ratio is a product of job vacancies available for migrants (*Job vacancies*total migrant/total population*) divided by Polish migrants. According to the dual market theory, the characteristics of advanced industrial societies create demand for both highly skilled and lower skilled workers. Building on that, more job vacancies in the primary labour market sectors increases the perceived total job ratio. High perceived ratio raises the total job effect (propensity to migrate of Polish worker). A stronger total job effect leads to a higher migration fraction which increase labour migration inflow and ultimately add more Polish migrants.



Total job effect = f(Perceived total job ratio). We set total job ratio as an index from 0 to 10, where (0) = no job and 10 = (10) job vacancies per migrant. We set the total job effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect.

Figure 23: The relationship between perceived total job ratio and total job effect

More Polish migrants relative to available jobs leads to a reduced ratio indicating fewer job opportunities and driving the wheel in the opposite direction. A lower total job ratio

reduces perception which pushes down the propensity to migrate until it reaches (0). This indicates that migration has stopped due to a lack of available jobs in the primary labour market. Total job effect is a function of the perceived total job ratio. The above graph function (Figure 23) represents the relationship between these two variables. There will be no effect on the propensity to migrate when the ratio equals (0). As the perceived job ratio increases, propensity to migrate (total job effect) will slowly start to increase forming an S shaped curve. This is because when the number of jobs available relative to the number of migrants reach (4), the ratio will be high enough to induce propensity to migrate to reach a maximum point at which point it will no longer increase. The propensity to migrate will reach a maximum at around (0.4). This maximum is estimated with reference to the maximum estimation of construction and low skilled job effects. Polish migrants are mainly recruited to fill jobs in the secondary labour market. Therefore, a lower percentage of Polish labour migrants will migrate when the total job ratio increases. Furthermore, the shape and slope of the graph is estimated with reference to real world data. Correlation and regression analyses have been conducted to these variables, which resulted in a close form similar to the above graph. Details regarding the estimation method are included as Appendix 5. The following CLD shows the combined effects of the first set of variables on the fraction migration rate for labour considerations.

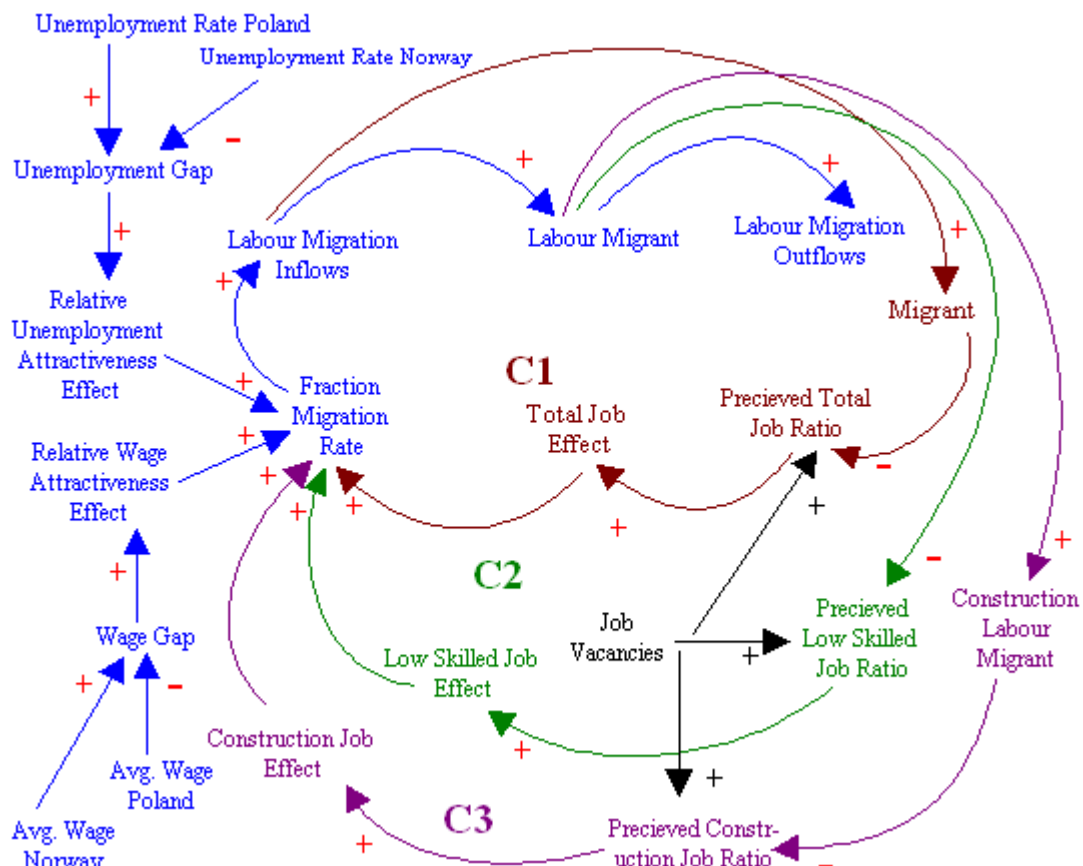


Figure 24: Combined effect of the first set of variables on fraction migration rate

The effects of these five variables on the initial fraction migration rate are modeled and formulated as a combined additive formulation. The reason is, each variable effect should be considered as an independent effect on the initial fraction. In other words, the migration decision could be taken based on any one reason (effect) represented by these five variables. That is, a decision to migrate may be taken due to unemployment reason; wage considerations or job opportunities in any labour market segment.

The second set of variables that affects the fraction migration rate is the networks effects (Figure 25). As the Polish migrant community grows, social and business networks are formed. Migrant networks help potential migrants by reducing the costs and risks involved in migration (effect on risk). Additionally, the networks assist potential migrants achieve increased migration rewards by financing their journeys, helping with job and accommodation or providing information about access to social security etc. (effect on attractiveness).

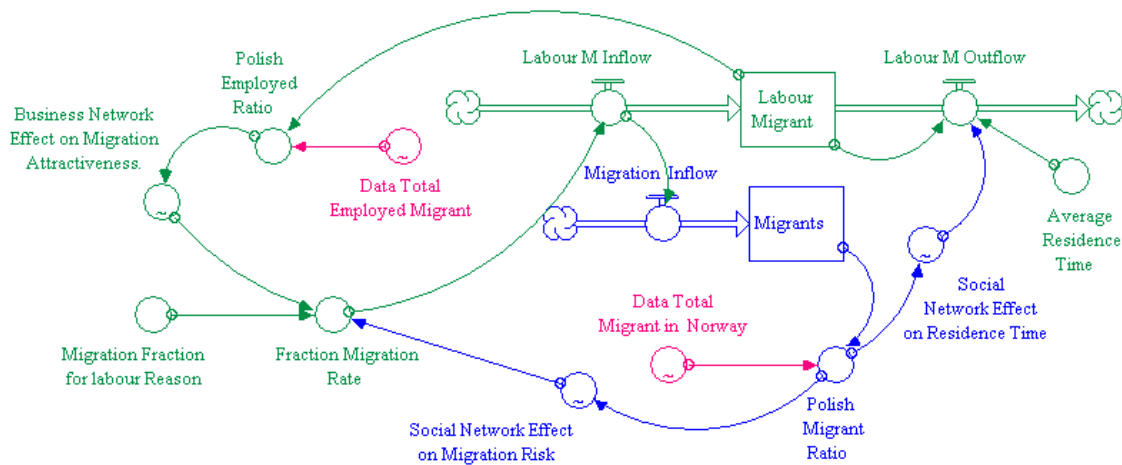


Figure 25: Social and business networks effect on fraction migration rate SFD

3.6 The Social Network Effect on Migration Risk

The social network effect on migration risk is the first variable in the second set of variables that affects the fraction migration rate. Polish migrants who came to Norway in the early stage of migration - particularly during 2004 and 2005 when Poland joined the EU - faced a high degree of risk. They face language barriers as they often have a low level of education and poor English language skills. They therefore rely mainly on fellow Polish migrants to help them with work-related communications. Additionally, Norway is an expensive country, so accommodation and financial support are of great

concern in migration decisions. Newcomers rely on the support of their native community in terms of accommodation and financial assistance during the early stages of their arrival. The capacity to accommodate newcomers is directly and strongly related to the size of the Polish migrant community. Accordingly, the size of the Polish migrant community is a critical factor for posting Polish migration inflow. In the model Polish migrant ratio represents the size of the social network (*Social Network size = Polish migrant ratio*). It is an indicator of the strength and size of the Polish migrant community and its relative influence both within the migrant community and Norwegian society at large. Migration risk is a function of the Polish migrant ratio $Risk = f(\text{Polish migrant ratio})$. Polish migrant ratio is the percentage of Polish migrants relative to the total number of migrants ($\text{Polish migrant ratio} = \text{Polish Migrant} / \text{Total Migrant}$). To measure the social network impact on migration risk this study assumes that risk can be expressed as an index varying from (0) to (1), where, (1) represents the highest degree of risk and (0) the lowest (Figure 26). No matter how big the social network is there will always be a certain degree of risk involved with migration decision due to uncertainties around finances, accommodation, psychological and other risk factors. At the other end of the scale there will always be pioneers willing to take the migration risk no matter how high it is. There will always be a number of migrants who migrate regardless of the risk involved in migration (e.g. refugees). For these reasons 0.3 is set as the minimum degree of risk and 0.8 as a maximum.

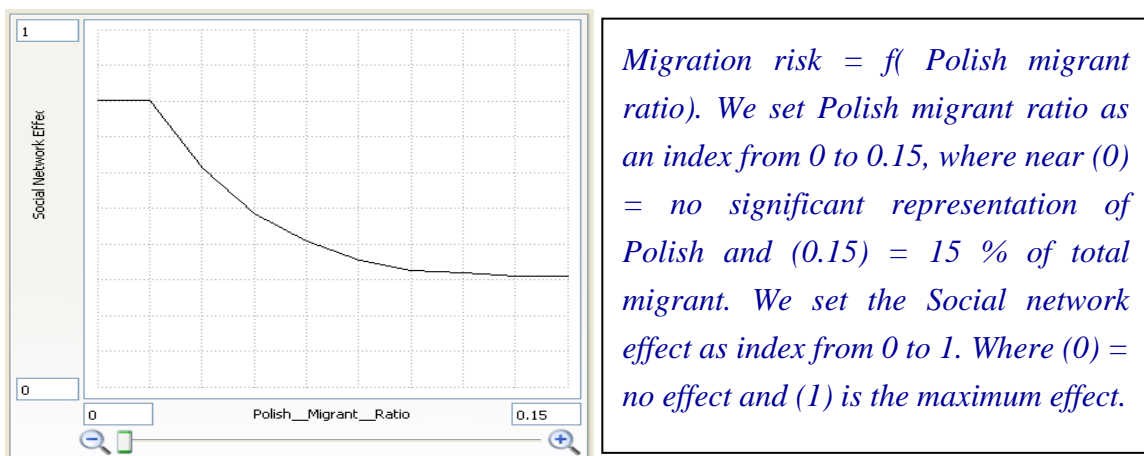


Figure 26: Polish migrant ratio and social network effects relationship

This study assumes that risk will decrease in an exponential decay as the Polish migrant ratio increases. As the migrant community expands, migration risk will drop rapidly in the beginning then, risk decreasing rate will slow down to reach the minimum value at (0.3). The above graph (Figure 26) function represents the relationship between these two variables. Details regarding estimation methods are described in Appendix 6.

3.7 The Business Network Effect on Migration Attractiveness

The business network effect on migration attractiveness is the second variable in the second set that affects the fraction migration rate. It is modeled in the same way as the social network effect. The Polish employed ratio is a reflection and measurement of the business network size (*Business Network Size = Polish Employed Ratio*). Migration attractiveness is a function of the Polish employed ratio (*Attractiveness = f(Polish employed ratio)*). The Polish employed ratio is a product of employed Polish migrants relative to the total number of employed migrants (*Polish Employed Ratio = Employed Polish Migrant / Total Employed Migrant*). As the number of Polish employed migrants increases relative to the total number of employed migrants, the Polish employed ratio will rise. Higher ratio raises employer and recruitment agency perceptions about the effectiveness and productivity of the Polish worker. Furthermore, potential Polish migrants will perceive a greater number of job opportunities in Norway and expect greater support and assistance from their native Polish migrant community. Consequently, the fraction migration rate raises leading to an increased flow of migrants which adds more migrants.

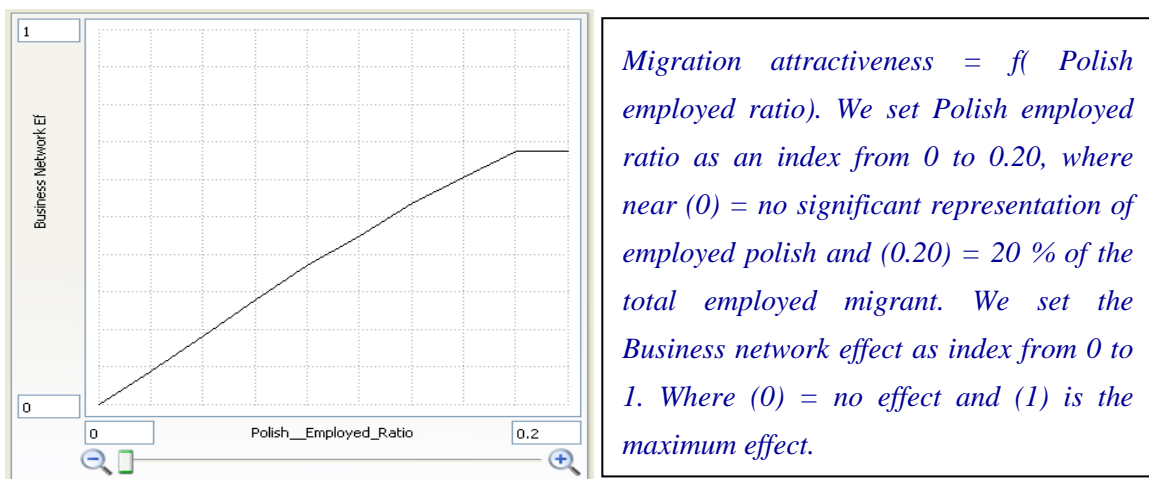


Figure 27: Polish employed ratio and business network effects relationship

Figure 27 demonstrates that attractiveness can be expressed as an index varying from (0) to 1 where (1) represents the highest degree of effect and (0) represents the lowest. Attractiveness is limited from exceeding a certain maximum value irrespective of the size of migrant community because of such factors as job availability, attitudes toward immigrants, and other factors. This study sets 0.67 as the maximum value that attractiveness could reach no matter how big the business network is. This study also assumes that attractiveness will increase as a goal seeking function. The shape and slope of the graph represents the relationship between these two variables is estimated

of actual data. A correlation and regression analyses has been performed to these variables, resulted in a close form similar to the above graph. Estimation methods are detailed in Appendix 7.

A larger Polish community reduces migration risk and on the same time increases migration attractiveness. The network effect on migration risk and attractiveness are the second set of sufficient conditions that influence potential migrants to migrate. Despite the higher migration fraction for economic and labour reasons, migration risk and attractiveness due to the social and business network effects controlled the number of potential migrants from flooding into the country in 2004 and 2005. Statistics show that in despite of the higher tendency to migrate from Poland (huge differences in wage and unemployment, higher job opportunities), migration inflows were small in the beginning. Furthermore, the higher inflows in the following years are statistically associated with the expanding size of the migrant community. As the size of the community expanded, the wheel works at full power causes the exponential growth in Polish migration.

The effect of these two variables on the fraction migration for labour reasons is formulated as a combined multiplicative formulation. These variables were formulated as multiplied formula rather than formulated additively because they are correlated and dependent on one another. Therefore, as the risk decreases, the attractiveness increases due to the growing community size. In other words, attractiveness would not increase if the risk was high and at the same time, risk will not decrease if attractiveness is low.

3.8 The Social Network Effect on Residence Time

Last but not least, the labour migrant stock decreases via labour migration outflow which depends on, labour migrant stock divided by average residence time and the effect of social network on residence time. Another major effect of the social network can be traced to what may be termed as the tendency to settle. The average residence time (*calculated from data = 5.89 years*), in which a migrant stays in the country, before moving out rises as the number of migrants increases and the migrant community expands. Migrant exit usually occurs only when associated with unemployment. The decision to leave the country will depend, among other things, on expectations around finding a job. These expectations increase as the migrant community expands. On average, the migrant's perception around job availability will take time to change before a decision to leave the country is reached. Furthermore, a longer length of stay gives migrants a better chance to find job and/or obtain certain

social services, e.g. unemployment benefits. These outcomes are the direct impact of a large migrant community who are willing to support newcomers in accessing social services and finding work. A larger Polish community (strong social network effect) increases the tendency to settle which lowers migration outflow. Decreased migration outflows will keep the migrant level higher than it would be. To measure the social network effect on residence time (Figure 28), we calculated a factor that is multiplied by average residence time as indicator for tendency to settle. For example, when the factor equals (2), the average residence time will double. This study sets the social network effect as an index from (0) to (6) where (0) = no effect and (6) is the maximum effect. A factor of (6) means that the average residence time increases (6) times. Note that tendency to settle is limited from infinite growth (e.g. the life expectancy is the maximum value). In the model (6) is the maximum value (which will be around 36 years) as a direct effect of growing Polish community.

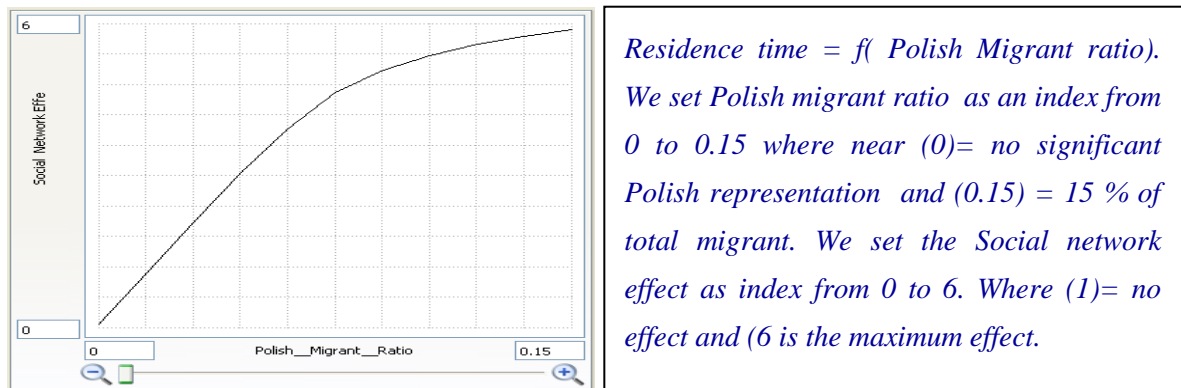


Figure 28: Polish migrant ratio and social network effects on residence time

The shape and slope of the graph is based on the estimated relationship of the actual data. A correlation and regression analyses were used to estimate the relationship between the two variables and resulted in a close form similar to the above graph. Detailed method for the estimations of the relationship is in appendix 8.

3.9 Analysis: Why did the Polish migrant stock increase so rapidly?

The following CLD shows the feedback structure underlying the rise in Polish migration to Norway. This pattern of migration behavior is the outcome of interactions between six major feedback loops that represent the combined effects of all the variables discussed in this chapter. Firstly, the wage and unemployment gaps constitute the necessary conditions for Polish migration. Note that, the loops for these two variables remain open due to the limitations of this study on one hand, and the insignificant effect of the number of Polish migrants in Norway relative to the total number of Polish migrants in the rest of the world in the other. There are three

reinforcing feedback loops that accelerate and give rise to migration patterns of behavior in Norway.

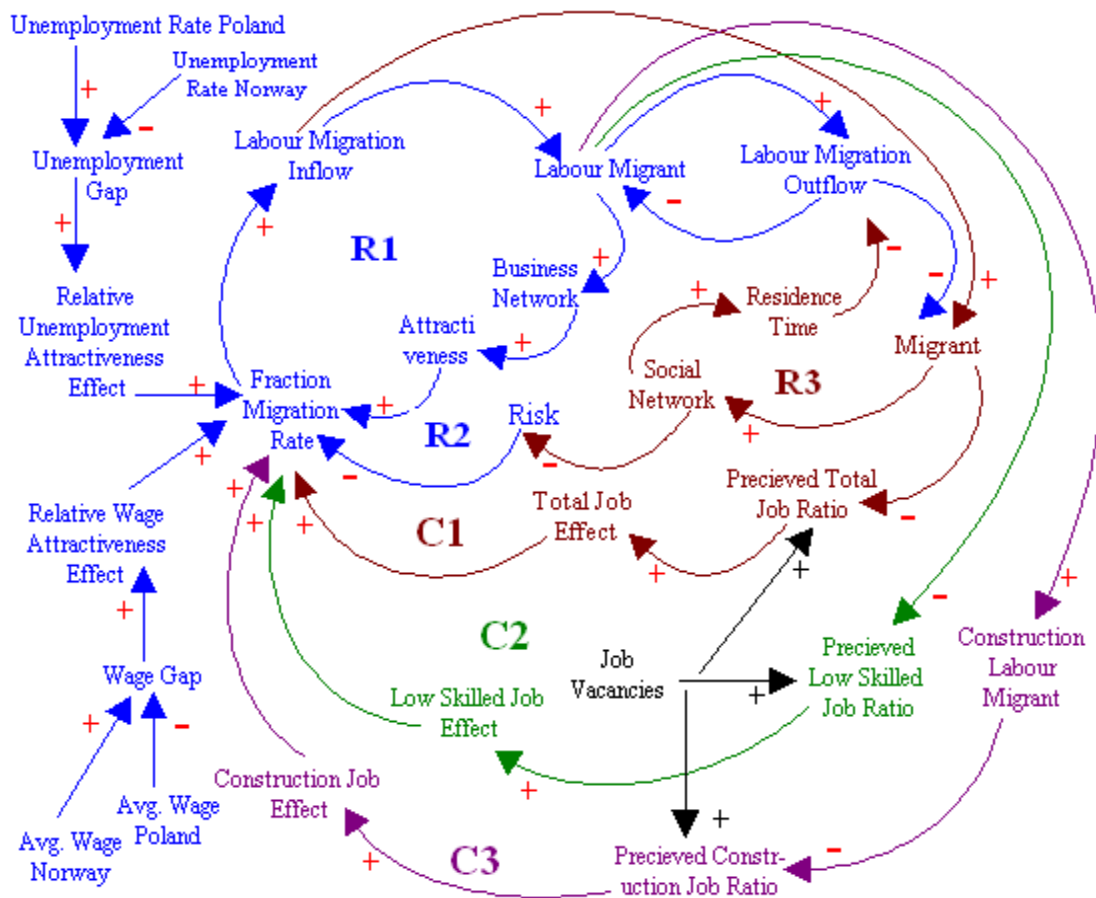


Figure 29: The overall simulation model underlying feedback Structure

Loop R1 represents business network effects on migration attractiveness. Greater labour migrant community generates a strong and wider formal-informal business networks which adds to migration attractiveness. Higher attractiveness raises the fraction migration rate leading to further increases in labour migrant inflows adding more migrants. More labour migrants result in a bigger business network and so on. Loop R2 represents the effect of social network on migration risk. An enlarged Polish community creates strong social networks that reduce migration risk. Lowered risk increases the fraction migration rate which raises labour migration inflow. More inflows add to migrant level, which further the expansion of the social network and so on. Loop R3 represents the social network effect on residence time. A bigger social network encourages migrants to stay longer in the country leading to longer residency time. Longer residence time reduces the labour migration outflow which keeps the labour migrant numbers at a higher level than they would be. The combined effects of these three reinforcing feedback structures give a strong structural reason for the rapid rise in Polish migration. Loop C1 represents the total job effect (primary labour market

segment) on the fraction migration rate. A higher number of job vacancies in the primary labour market increase the perceived total job ratio which pushes the total job effect upward. Higher total job effect increases the fraction migration rate which raises labour migration inflow. More inflow adds to migrant level which reduces the perceived total job ratio. Lower perceived ratio reduces the total job effect which decreases the migration fraction and so on. Loop C2 represents the low skilled job effect (the secondary labour market segment) on the fraction migration rate. Greater number of low skilled job vacancies increases the perceived low skilled job ratio which raises the low skilled job effect. This in turn pushes the fraction migration rate up, which increases labour migration inflow adding more labour migrants. More labour migrants reduce the perceived low skilled job ratio which pushes down the low skilled job effect. The weaker low skilled job effect reduces the migration fraction and so on. Loop C3 represents segmentation within the secondary labour market segment. A greater number of construction job vacancies increase the perceived construction job ratio which raises the construction job effect. Stronger construction job effect drives the migration fraction up thereby increasing labour migration inflows which add more construction labour migrants. A greater number of construction migrants reduce the perceived ratio which results in a weaker construction job effect and so on. The result of these loops interaction is the migration behavior depicted in Figure 30.

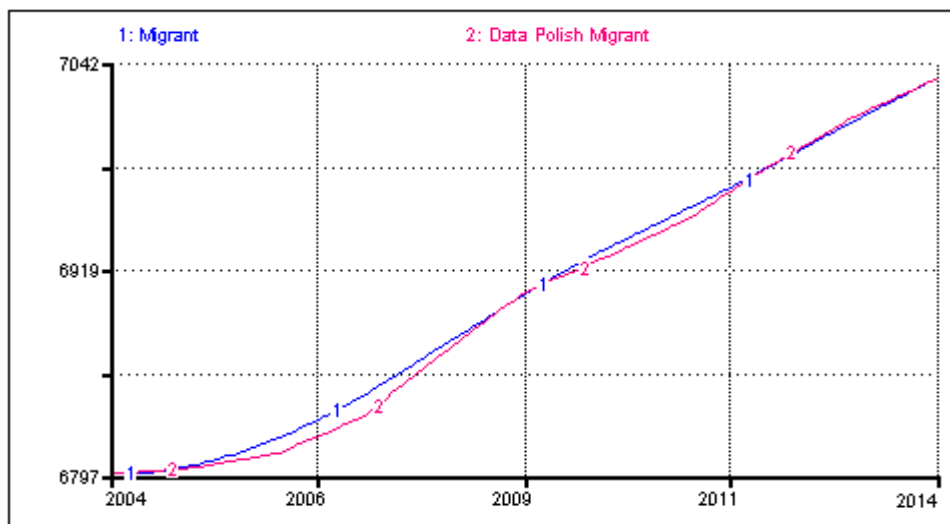


Figure 30: Polish migrant in Norway simulated vs. actual data

Loops C1, C2, and C3 are relatively weak in the early phases of the migration process and it gain strength as the migrant stock increases. Empowering the counteracting loops result in what is termed a shift in loop dominance. The three reinforcing loops dominate the migration process in the early phases, adding more and more to the migrant level. The relative strength of these reinforcing loops dominates and overrules the effect of the counteracting loops. Moreover, labour shortages and the high demand for Polish

Polish migration patterns of behavior for the right reasons. Subsequently, the model enables the simulation of various future scenarios of the continuing conditions and policy options. To gain confidence in the model as hypotheses that explain what happened and why, in addition to comparing the model's behavior with historical data (Figure 30), SD model validation includes a battery of tests aimed at evaluating hypotheses about how the model's structure produces its behavior (Wheat, 2010). This study conducts model validity tests based on formal procedures outlined by Barlas (1996, 2006) and Sterman (2010). Details regarding the validity tests are documented in Appendix 9. Furthermore, the SD simulation based model provides an interactive laboratory where the user and reader can perform these tests by him/herself. The user or reader can repeat most of the conducted tests in the model interface. The following is a brief representation of the validation results.

Direct Structure Validity Tests:

The model was constructed by mapping how the real system works. The mathematical representation of each relationship has been formulated according to information and data collected from the real world system. Theoretical frameworks outlined in the literature were extensively used and reflected in the model's structure, involving each relationship. Model construction has been an iterative process whereby model structure and relationships have been modified and/or changed during testing. Most of the initial stocks and parameters value were based on real world data. Except for the social network effect on migration risk, the estimated parameters specially, the graph function were all estimated using real world data. The social network effect was derived using available information and judgment. All of the parameters used in the model have a meaning in real life and pass the dimensional consistency test. The unit consistency test is a built in function of iThink modeling software that automatically checks unit consistency automatically. The model passes these tests.

Structure-Oriented Behavior (Indirect Validity Tests):

These tests have been conducted assuming that all other variables except those under consideration are held constant (*ceteris paribus*). The test is measuring and evaluating the effect of changing the tested parameter value on migrant stock and migration inflow.

First: Extreme condition tests have been conducted with the model in steady state condition as well as normal system state. The tests results confirm that model generated behavior are consistent with the anticipated real system behavior under the same extreme conditions. Furthermore, the results show that the unemployment and wage differences cannot generate the observed migratory behavior no matter how much you

increase these values (under steady state mode). This indicates that wage and unemployment differences are a necessary condition for migration.

Second: Behavior sensitivity tests have been carried out only in the normal system state. The model shows sensitivity to changes over 20% of the value of the tested parameters. However, the real system would exhibit a similar sensitivity to the corresponding parameters. Furthermore, the sensitivity tests outcome have showed changes in magnitude but the patterns of behavior remain the same. The graph function sensitivity tests were conducted by changing the shape and the slope of the graph. All test results show a different degree of sensitivity ranked either very sensitive, little sensitivity or no sensitivity. All these results show changes in magnitude but patterns of behavior remain the same.

Third: The integration method test showed no significant changes in the model's behavior due to changes in time step or integration method.

Fourth: The boundary adequacy test indicated that the model's pattern of behavior is not affected by parameter values or external conditions (numerical change but pattern of behavior remains the same), but instead by the underlying feedback structure and the dynamic interactions between its loops. The model structure creates the observed behavior endogenously.

Behavior Validity Tests:

First: The model generates and replicates the historical behavior of the real Polish migrant stock in Norway with a high degree of accuracy both qualitatively and quantitatively (Figure 30 page: 46). Furthermore, the model closely replicates the historical behavior of other important variables. The shape is closely similar but the magnitude and some face shift have happened to some of the variables (Figure 32).

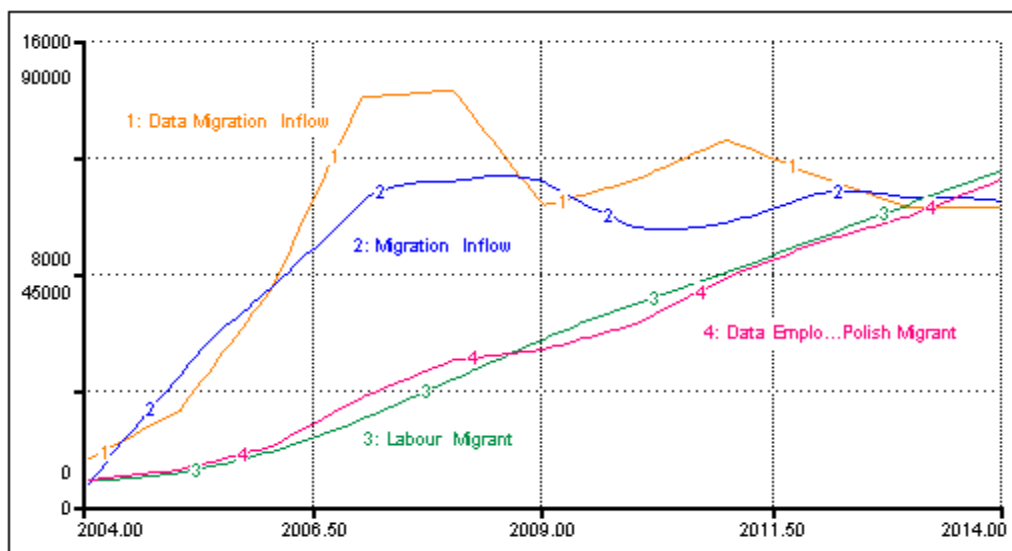


Figure 32: Polish migration inflow and Polish labour stock simulated vs. actual data

Second: Validation aims to evaluate hypotheses about how the model's structure produces its behavior. Cutting loops or variable effects that represent a particular hypothesis provide the means to test that hypothesis. Assuming that all other variables and loops except those under consideration are held constant (*ceteris paribus*), the null hypothesis can be stated as follows:

Cutting loop or variable under consideration has no effect on migrant stock and migration inflow.

The result shows that in all 8 cases the null hypothesis is rejected. This indicates that the model, as a group of hypotheses, may be responsible for the observed patterns of behavior. Furthermore, cutting the loops or variables provides a fundamental insight into why the counteracting mechanisms represented by loops C1, C2 and C3 (Figure 29 page: 45) fails to prevent the exponential growth of Polish migrants. A close analysis of each loop together with the unemployment and wages relative attractiveness effect reveals the following. Despite the improvement in wage level and unemployment rate in Poland, the unemployment and wage ratios did not change. This reduces and delays the counteracting effects that both variables would otherwise have on migration growth. In addition, the structurally labour shortage in Norway constitutes a constant pressure on the demand for foreign labour thereby defusing the counteracting mechanism of loops C1, C2, and C3. In spite of the effect of these counteracting mechanisms slows down migration inflow (Figure 32 page: 49), the counteracting loops remained weak and could not stop the rapid growth of the Polish migrant stock.

3.11 Limitations of The Model

Firstly, the model does not include the negative effects of social and business networks. When the networks reach a certain size they may introduce counteracting negative effects on migration attractiveness leading to a reduced propensity to migrate and also increased tendency to leave resulting in reduced average residence time.

Secondly, due to the dominance of labour migration in this migratory stage, the model excludes the dynamics of other types of migration. Historically, following the labour migration stage, a second wave of migration entailing family formation and reunification is initiated. This will keep the migration patterns at the same high level even after the completion of the first phase (*Figure 1 page: 1 shows that the number of*

male is more than female in Norway). These two limitations reduce the prediction accuracy of the model and initiate the need for further research to include these variables. However, this study assumes that the counteracting side effects of the social and business networks in reducing the migrant stock will be partially compensated for by an increase in the second wave of migration.

Thirdly, the feedback substructure for the migration effect on unemployment and wages in Poland is not included in the model. Lastly, the Norwegian labour shortage feedback substructure is also excluded from the model. These two substructures form part of the wider boundaries that related to the impact of migration on Poland and Norway. Including these substructures will provide a wider perspective in the study of migration and this should be considered in future research. The scope of this study does not allow for the inclusion of these important dynamics.

Chapter 4: How to Regulate Polish Migration? The Policy Model

The explanatory model identifies two possible scenarios (Figure 33) that predict Polish migration trends up until 2030. The first scenario is based on the condition that job vacancies remain constant at 2014 levels. In this scenario the Polish migrant level reaches 186 622 in 2030 compared to 84 000 in 2014 (increases over 2.4 fold in 16 years). The second scenario is based on the condition that job vacancies follow the trend evidenced in previous years. In this scenario the Polish migrant level reaches a maximum of 127 046 at year 2022 (almost doubled) and then drops to 106 851 in 2030. In Norway discussion around the growing number of migrants focuses predominantly on assimilation and to some extent on the impact of migration on the welfare state.

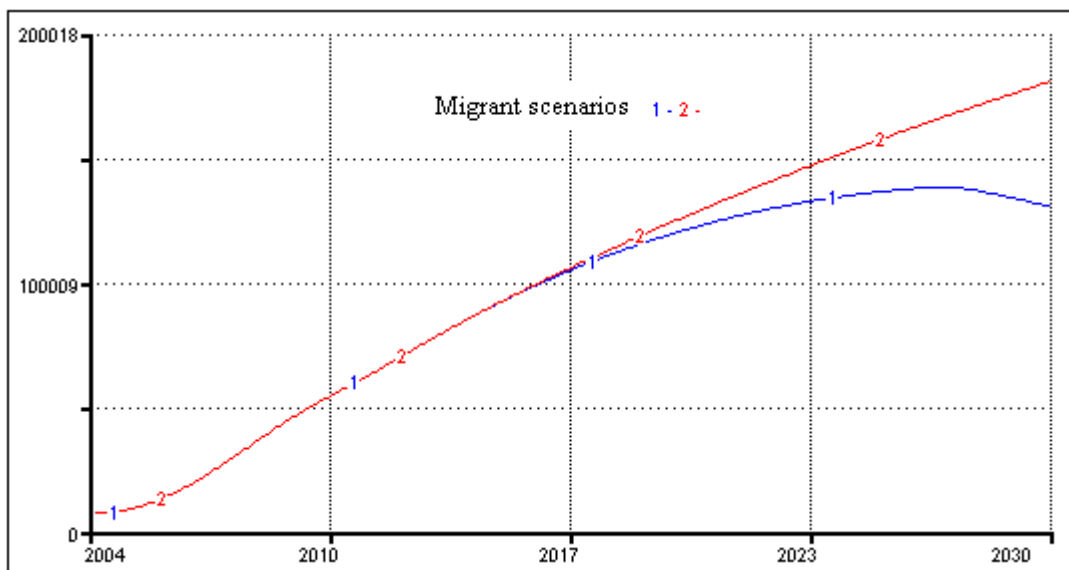


Figure 33: Migration predictions scenarios, Explanatory model simulation result

4.1 The Current Policy

Since 1970's, a large number of changes to laws and regulations have taken place in an attempt to restrict and regulate immigration to Norway. The following is a brief outline of major regulations adopted since 2004 (Ådne, Jørgen and Terje, 2011):

- In 2004 New CEE countries joined the EU and gained easier access to Norway. Some transition rules were put in place in order to limit migration.
- A more restrictive policy was introduced in 2006; foreigners who had arrived on tourist visas and then applied for family reunion were less likely to be granted residence.
- 2008 saw a tightening of the rules related to family reunion; authorities made it more difficult for family members to enter if the ability to provide for the family was not evidenced.

- *2009 transitional restrictions affecting CEE countries that joined EU in 2004 were lifted.*

Despite these regulations, statistics show no noticeable changes in migration behavior can be linked to changes in the migration policy. Most policies concerning migration in Europe and worldwide are aimed at regulating entrance (inflow). However, these policies show no signs of decreasing the migration rate. These policies take the form of changing regulations or issue new ones that restrict the flow of migrants. The consequences of migration policies are hard to predict and test. In general, the cost and time wasted resulting from ineffective decisions and policies are huge and sometimes irreversible. SD model based policy analysis will provide policy makers with the chance to test policies and interact with the migration system in a learning environment before applying these policies in the real world. Furthermore, SD model based policy takes feasibility and implementation aspects into consideration when recommending policy. The policy model allows policy makers to consider the following questions: How can migration flows be regulated to achieve the desired quantity of migration? How do we implement this policy aim? How effective is the chosen policy?

A major question facing policy makers concerns the desired quantity of migrants that fulfill the demographic and labour market needs of Norwegian society. Determining the desired level of migrants in Norway is a complicated issue that depends on the desired demographic composition. It is a highly political, humanitarian and social issue. Many variables contribute to the future shape of Norwegian demographics, including fertility rate, life expectancy, pensioners to labour force ratio and labour shortages etc. For simplicity, this study assumes that policy makers set a desired level of Polish migrants that are thought to be appropriate for the needs of Norwegian society.

The proposed policy is based on projections of Polish migration produced by the explanatory model in the two scenarios described above. In brief, the recommended policy aims to control the Polish migration outflow. An incentive compensation program is proposed to encourage excess migrants to return to Poland. Feasibility analysis and implementation constraints are considered in the proposed policy. Both are vital criteria for evaluating the recommended policy. Based on the goal set by policy makers as to the desired number of Polish migrants, a compensation program policy will be developed to regulate migration outflow. The basic idea is to offer compensation incentive to targeted potential return migrants (unemployed migrants who have worked in Norway for at least 10 years) to encourage them to return to Poland. Figure 34 shows the proposed policy 'Wishful Thinking'. The program will be financed using the unemployment benefit program and the pension fund. The main actors in the recommended policy are:

- (1) Ministry of Justice-Public Securities- Department of Migration.
- (2) Norwegian Labour and Welfare Organization (NAV). The policy will be executed by NAV.
- (3) Committee on labor and social affairs (Norwegian parliament).

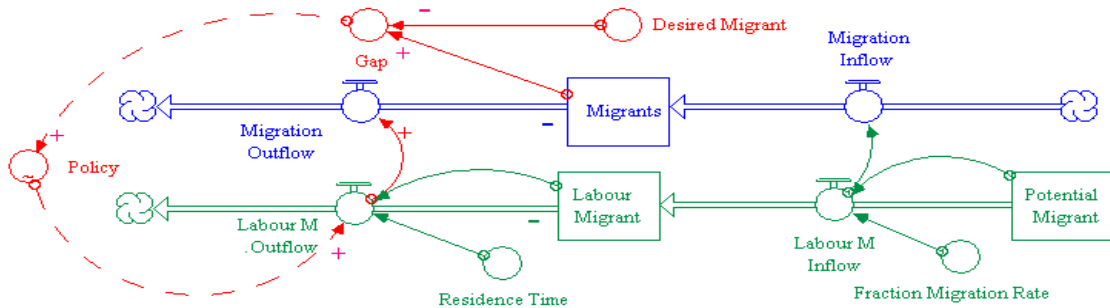


Figure 34: The ‘Wishful Thinking’ policy to control migration outflows SFD

4.2 Policy Approval Process

The following figure shows the process of policy approval and the central role of the Department of Migration (Ministry of Justice). A discussion will be held between members of the Department of Migration, NAV and the Committee on Labour and Social Affairs (Norwegian Parliament). A new committee will be established with members from these departments. Research will be conducted to identify the appropriate and affordable compensation amount, followed by a survey among the Polish migrant community to determine the compensation amount that is acceptable to Polish migrants and Norwegian’s government. Once the committee is satisfied with the policy draft it will be sent to the Norwegian parliament for approval. NAV will be the execution agency for the new policy and will establish a new department to carry out the program.

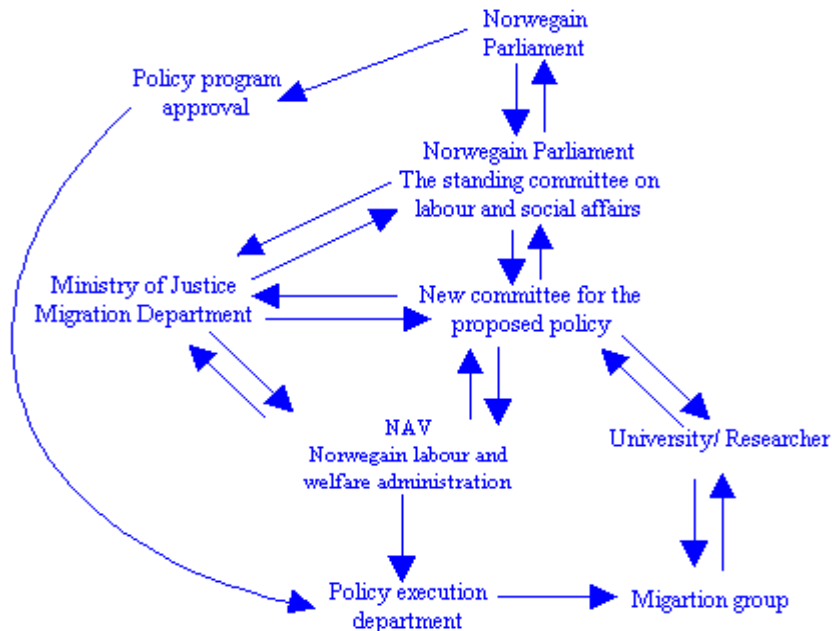


Figure 35: A flow chart demonstrates the complexity of the policy approval process

4.3 The Compensation Incentive Policy

The initial compensation will be a one-time payment of (a) two years unemployment benefits plus (b) the pension that the migrant accumulated in pension fund. Concern around the rising level of migrants in a community is closely related to the argument that migrants increase the burden on the welfare system. This position is implicitly based on the assumption that there is a high unemployment rate in the country and in particular among migrants. Based on the aforementioned assumption, this study proposes that targeted potential return migrants are unemployed migrants who have lived and worked in Norway for at least 10 years. Residence time is adopted as selection criteria because migrants who have worked for at least 10 years have would have accumulated enough pensions to make the compensation amount attractive. In addition, they are likely to have family members living with them in Norway which increases the number of return migrants relative to the amount of compensation. Policy makers can choose different criteria, e.g. the salary level, the number of children they have, the education level, language skills etc. Given that the targeted migrants are unemployed they are entitled to unemployment benefits for two years. According to regulation the unemployment benefit is up to 65% of the average salary over the last three years. Hence that the targeted migrant would have worked for ten years, the amount of pension accumulated will be sufficiently attractive to incentivize the migrant to return to Poland. The policy's main aim is to control migrant outflow. This study assumes that it is a good idea to pay the accumulated pension plus two years of unemployment benefits as a once-off payment to migrants who are willing to leave the country. The program may incentivize some migrants to return to Poland and use the money to start a small business and take advantage of the difference in living standards (lower prices in Poland) to have a better life.

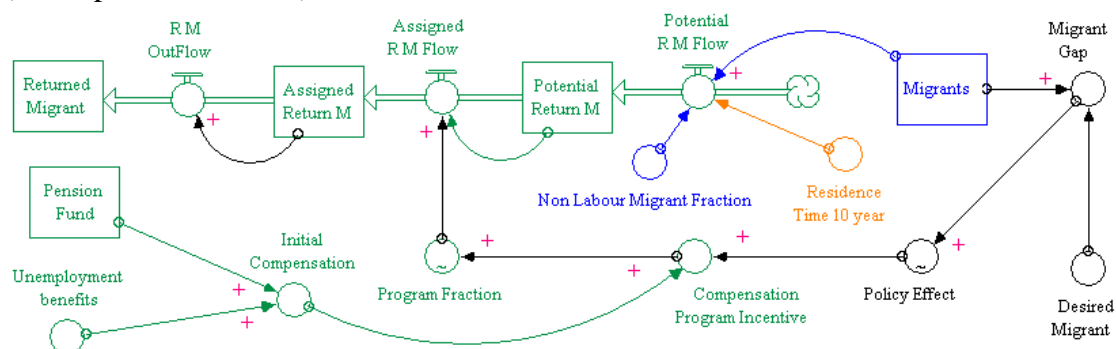


Figure 36: The compensation incentive policy SFD

Figure 36 demonstrates that the potential migrant group is labour migrant (Migrant adjusted by non labour migrant fraction) divided by resident time set at 10 years. A fraction of potential migrants will accept the compensation and be assigned to the return program. The assigned return migrant is dependent on the potential return

migrant and the program fraction. The program fraction is determined by the compensation program incentive which is a product of initial compensation and the policy effect. The policy effect is controlled by the policy maker decision. The initial compensation is the sum of unemployment benefits (2 years) and pension (accumulated over 10 years). The willingness of the policy maker to close the gap between the desired migrant level and the actual level is represented by the policy effect which controls the compensation amount. Assigned return migrants will return to Poland after a stipulated period that fulfills the program requirement.

4.4 The Policy Effect

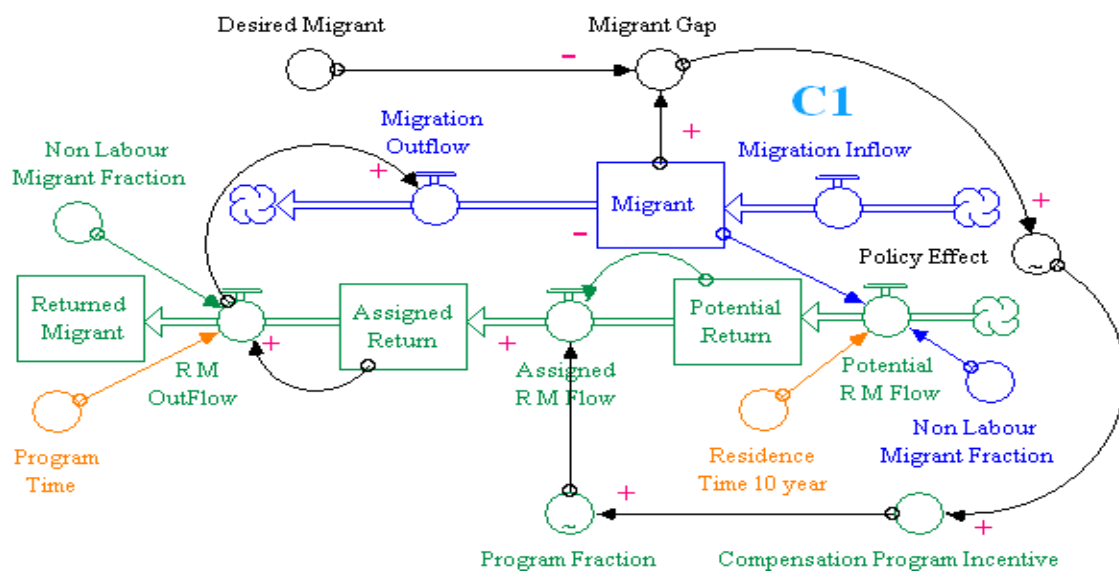


Figure 37: SFD that demonstrate how the recommended policy work

The policy maker's willingness to close the gap between the desired migrant level and the actual level pressure him/her to increase the initial compensation program incentive. The compensation amount will increase to a level that he/she thinks is appropriate and acceptable to the potential return migrant. The presence of a bigger gap and a higher tendency by the policy maker to close it will push up the amount of compensation. The higher compensation amount raises the program fraction which increases the assigned return migrants. More assigned return migrants increase the return migrant outflow which raises the migration outflow. Higher migration outflow reduces the migrant stock which reduces the gap and so on (counteracting loop C1- Figure 37).

4.5 The Policy Resources

The basic resources required to implement the proposed policy are human resources and financial resources (Figure 38).

Human Resources: NAV will be the executing agency responsible for the program. A new department will be formed at NAV to carry out the program. The number of staff responsible for administrative and financial tasks is determined and adjusted by the hiring rate. The hiring rate is determined by indicated staff which depends on the number of assigned migrant cases that each staff member can process.

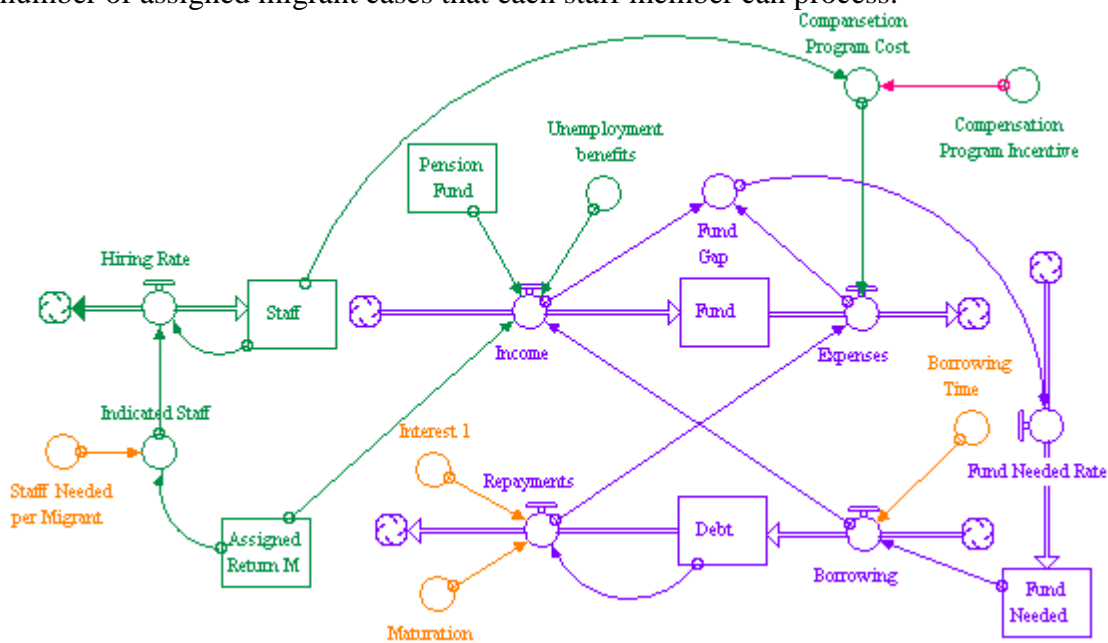


Figure 38: Human and financial resources needed for the policy SFD

Financial Resources: A fund will be established to finance the program. The fund will initially begin by taking out a loan in order to initiate the program. The fund increases by income and decreases by expenses. Income is derived from the unemployment benefits and the accumulated pensions received as once-off payments into the fund. Expenses are determined by the amount of compensation program costs, which is the human resource costs plus the compensation amount paid to each assigned migrant. The fund deficit (the difference between expenses and income) will be covered by a loan. The matured debt plus the interest charged will be added to the expenses.

4.6 Measuring Policy Effectiveness

The SD policy model allows policy makers to test the feasibility of each policy scenario he/she chooses to simulate (e.g. changing the desired number of migrants, changing the compensation amount and/or changing the simulation period). The decision and policy makers will be able to review the outcome of each scenario that he/she chooses to simulate. The model interface provides an interactive learning environment to test and evaluate policy options.

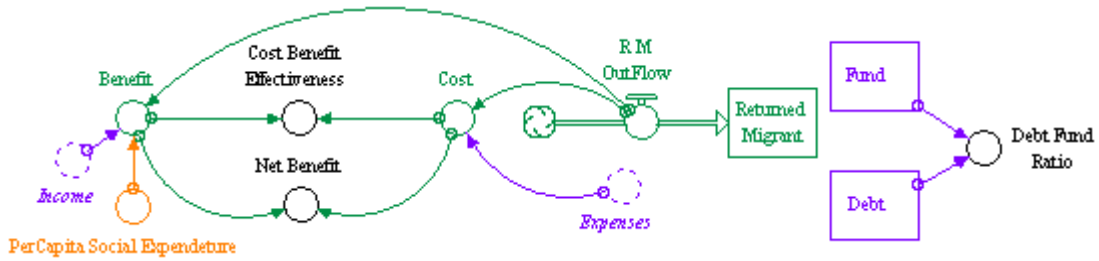


Figure 39: Policy feasibility and effectiveness SFD

The following are the main indicators used to measure policy feasibility:

Debt Fund Ratio (Debt / Fund): As an indicator of policy program effectiveness, this ratio measures the effectiveness of each krone borrowed relative to the fund.

Cost Benefit effectiveness (Cost / Benefit): As an indicator of policy program effectiveness, this variable measures the effectiveness of each krone spent on the program relative to the benefit achieved.

Net Benefit (Benefit - Cost): This variable indicates the direct gain or loss of one returned migrant as a result of the policy program.

Net income (Income - Expenses): This indicator measures the continuous present value of the program’s net income.

Total number of the returned migrants: This variable indicates program achievements in terms of the total number of returned migrants as a result of the policy program.

4.7 Policy Result

The following graph demonstrates the simulation results of different policy scenarios: Simulation run number 1 (blue line) is the migrant level without any policy action.

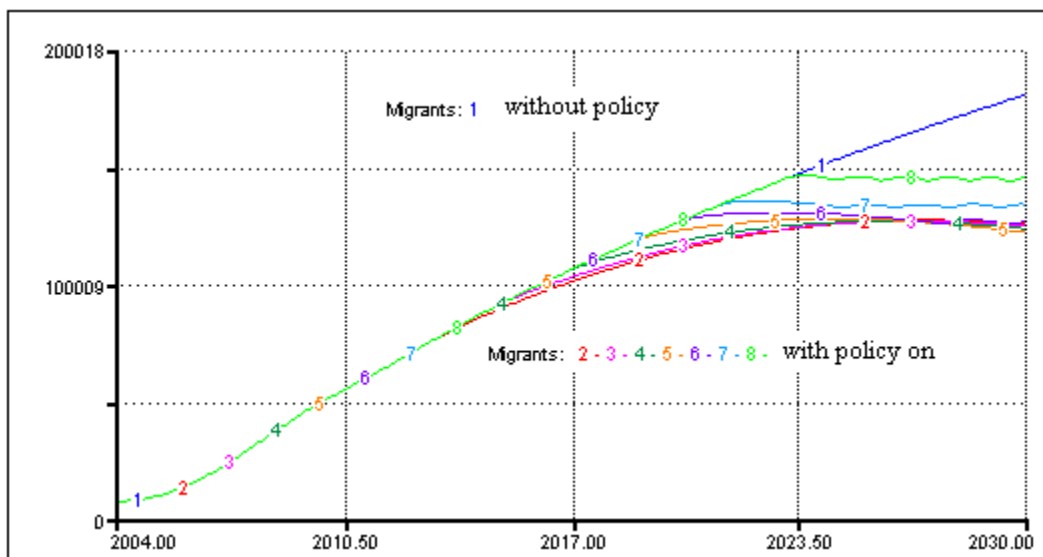


Figure 40: Simulation results with and without policy action

This figure is based on the assumption that job vacancies remain at the 2014 level.

Simulation runs numbers 2 to 8 show migrant level under different policy options that are based on various desired level of migrants. Simulations may also be repeated with the compensation incentive set at various levels.

4.8 Implementation Constraints

Passing laws and regulations:

Migration is a hot topic in the public domain. Implementing a return migration policy will be controversial issue between political parties especially when it includes the allocation of funds. Many politicians support the argument that migrants are a burden and exert pressure on the country's welfare system especially in difficult economic cycle. On the other side, many consider the return option a morally complex issue. In addition, paying compensation to implement the policy adds complications to an already complicated issue.

Funding:

Funding is a political rather than economic decision because the compensation will be paid out regardless of policy action but will be paid over a longer period in the case of no policy. The direct beneficial outcome of the policy may be costly to start with but when indirect benefits are included it becomes less costly and more attractive. For example, the average social capital expenditure is over 70000 NOK per person/year and per-capita health care expenditure is around 35000 NOK per person/year.

Human resources, executing agencies, coordination:

The responsibilities and tasks assigned to NAV may create difficulties and coordination problems. The processes, documentation, signing documents, legal conflicts, time to leave the country and other administration issues may create difficulties and coordination problems.

Targeted population and selection criteria issues:

The residence time criteria (10 years) may contradict the fact that it is hard to encourage migrants to leave after such a long time period. However, the criteria for selecting the target population will be set by the policy makers. Criteria, may include salary level, number of children the potential migrants have, their education level, working skills, language proficiency, number of times the migrant has registered as unemployed, period of unemployment, number of times the migrant has depended on the social system etc. Any criteria chosen will be subject to constant critique and debate.

Eroding goal syndrome:

The policy depends on both migrant responsiveness to the incentives offered and on the desired level of migrants that policy makers set. The recommended policy will be a compromise between the Migration Department and the migrants. This may lead to eroding goal syndrome (Figure 41) whereby the policy maker increases the level of desired migrants when he/she fails to achieve the previous goal.

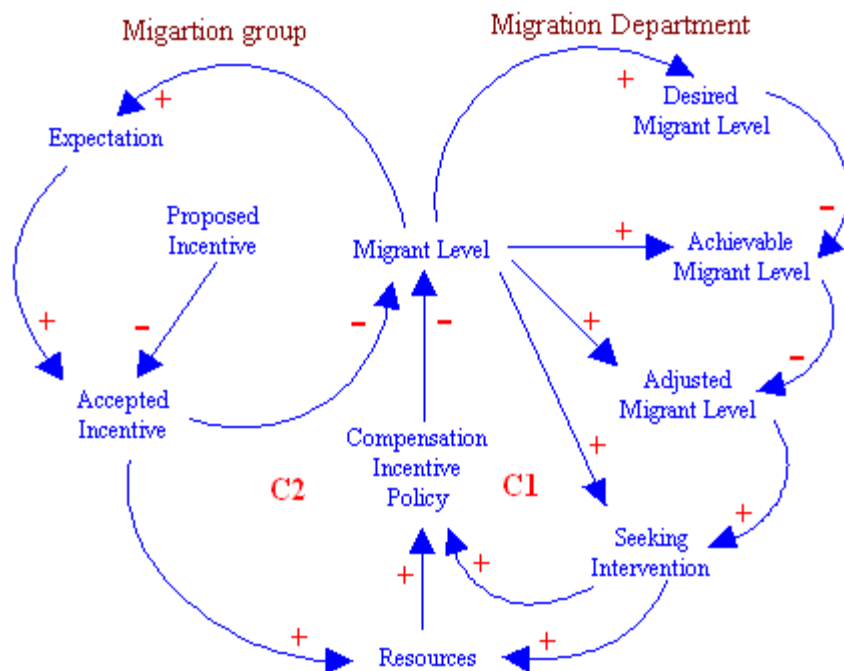


Figure 41: Eroding goal phenomena CLD

Undesired consequences:

(a) Increase migration inflows for the incentive attraction:

The policy will be adapted when the level of migrants increases beyond the Norwegian social-economic system absorption capacity. This implicitly assumes that, less available jobs and a high unemployment rate. In other words, it will no longer be attractive for more potential migrants to make the move. Besides, not every migrant will be qualified for the selected criteria. The compensation is like an early retirement offer, similar to the way private businesses used to lay off their undesired workforce.

(b) Controlling the return of migrants to Norway:

Controlling the return of migrants to Norway once they have taken the compensation is a similar problem as preventing illegal migration. Policy makers can set up counter measures to prevent this from happening. For example migrants who have accepted the compensation offer will be required to pay back the compensation in the event that he/she wants to return to Norway. However, who implement the departure of the migrants and who control that they leave and do not come back is a major constrain for this policy and need further investigation.

Conclusion

Two forces are responsible for the observed growth of the Polish migrant group in Norway. While one tended to feed migrant stock, the other opposes this tendency aiming to slow that growth. The dynamic interaction between these reinforcing and counteracting forces in a chain of cause-effect resulted in the rapid growth of Polish migrants. The combined effect of these reinforcing feedback structures, represented by the social and business network effect on migration risk, attractiveness, and residence time presents strong structural causes for the rapid rise in Polish migration.

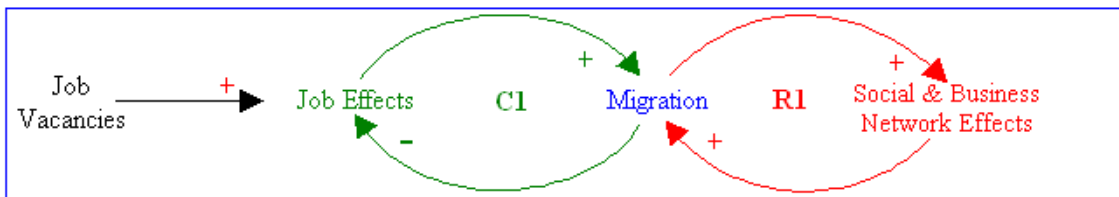


Figure 42: Forces responsible for the rapid growth of Polish Migration

The accumulation process resulting from these reinforcing feedback structures empower the counteracting feedback structures represented by construction, low skilled and total job effects on the propensity to migrate added to the effect of relative wage and unemployment attractiveness. These counteracting feedback structures are relatively weak in the early phase of the migration process. Even though they gain strength as the migrant stock increases, they remain relatively weak and are dominated by the reinforcing structures. Empowering the counteracting loops will result in what is termed a shift in loop dominance. The relative strength of the reinforcing feedback structures has dominated and overruled the counteracting feedback structures effect leading to further and further increases in migrant level. The dynamic interaction between these reinforcing and counteracting feedback loops produces the exponential growth of Polish migrants. Despite the enhancement in the Polish wage level and unemployment rate, the unemployment and wage ratios did not change thereby reducing and delaying the counteracting effects of both variables to halt the rapid migration growth. In addition, the structurally built-in labour shortages in Norway apply constant pressure on the demand for foreign labour defusing the counteracting mechanism effect. In spite of this counteracting mechanism has been on work (as it halts the migration inflow - Figure 32 page: 49). However these counteracting structures remain weak and could not stop the rapid growth of the Polish migrant group.

The explanatory model gives two possible scenarios on predicting Polish migrant trends until 2030. The first scenario is based on the condition that job vacancies remain

constant at the 2014 level. Consequently, the counteracting feedback structures will remain weak and overruled by the reinforcing structures. Second scenario is based on the condition that job vacancies follow the trend it takes from the previous years. Therefore, a shift in loop dominance will take place and the counteracting feedback structure will become the dominant structure which will bring down migrant level (Figure 33 page 52).

Regulating migration flows is a complex task. Policy makers face difficult decisions with legal, political, economic, social, humanitarian, and moral implications. However, the proposed policy introduces an approach to deal with this kind of complexity. It considers feasibility and implementation constraints in designing the policy. The policy model allows policy makers to pre-test different scenarios related to each desired migrant level and evaluate each chosen policy scenario. Moreover, policy makers will get the possibility to redesign the policy. This is an inherent feature of SD methodology in building and designing policy that involves policy and decision makers' participation in drawing, designing and evaluating policy. The idea of offering incentives can be developed further into different forms, e.g. provide tax reduction for short term labour migrants or provide training and/or education programs for the targeted group. An incentive program should be considered as a two sides of one coin so that incentive policy options could also include de-incentive policy options. This means that another policy alternative is to tighten regulations in order to put pressure on migrants to leave. The basic idea found in the nature of the inflow (entrance) versus the nature of the outflow (leaving). Inflow tended to add to the migrant stock so controlling inflow will not reduce the migrant stock, rather it will add less migrants. (the nature is adding). On the other hand, outflow tended to subtract from the migrant stock (the nature is subtracting) so regulating outflow will reduce the migrant stock which is the policy goal. To conclude, controlling entrance will not necessarily reduce the migrant number but rather add fewer migrants, while regulating the outflow positively reduces the migrant stock.

Further research needs to be performed so as to extend the model, overcome the model limitations, and explore alternative policies that overcome the implementations constraints associate with the proposed policy. Extending the model to include all migrant groups in Norway is necessary to provide a solid foundation for a migration policy that policy makers can be relied on. Such an extension will also provide the opportunity to test the model's ability to explain migration as a global phenomenon rather than treat it as an isolated interaction between two countries.

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Appendix 1: Measuring the relative wage attractiveness effect

The statistical analysis approach of measuring the relationship:

Relative wage attractiveness effect represents the propensity to migrate of Polish migrant due to wage differences (Gap) between Norway and Poland. Wage differences are expressed in terms of wage ratio which is the average wage in Norway relative to Poland. Propensity to migrate influences a fraction “migration fraction” of potential Polish migrant. Therefore, wage ratio impact on migration fraction represents relative wage attractiveness effect.

Migration fraction is a function of wage ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration fraction, as the Dependent variables⁸:

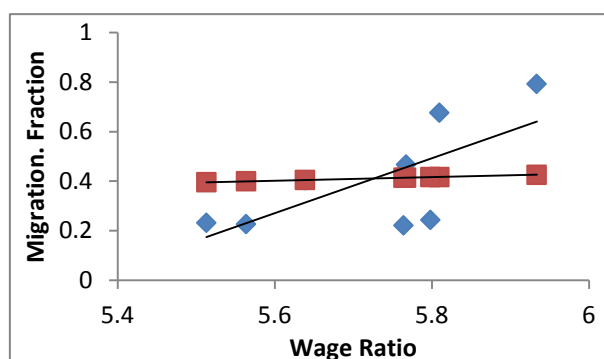
Migration fraction = Migration inflow / Migrant

- Wage ratio as the Independent variables⁹:

Wage Ratio = Average Wage Norway / Average Wage Poland

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.897085
R Square	0.804762
Adjusted R Square	0.661905
Intercept	0
Coefficients Un. Ratio	0.071841
<i>t Stat</i>	5.37156
<i>P-value</i>	0.00103



The regression result shows that it is a high degree of correlation ($R = 0.89$) between the wage ratio and the migration fraction. It is a positive relationship which means that an increase in the wage ratio will increase the migration fraction by the coefficient value “slope”. The result confirms a strong relationship “high R Square” with significant level of 95% as shown by P value and T test. We compare the regression result for “Poland –Norway” with a selected different countries that characteristics with the same Polish migratory pattern (represented by the migrant level). Regressions analysis conducted the same as above. The following is the results summary:

⁸ Data from SSB Table: 07822 and 05184 - (2004-2013) <http://www.ssb.no/>

⁹ Data from Organization for Economic Co-operation and Development (OECD) (2004-2013) <http://stats.oecd.org/>

Wages data used are in USD with fixed exchange rates and constant prices of 2012. It is the average annual wages per full-time and full-year equivalent employee.

Country	Migrant 2013 ¹⁰	Multiple R	R Square	Adj. R Squ.	Coefficients	t Stat	P-value
Norway	76662	0.90	0.80	0.66	0.07	5.372	0.00104
Belgium	67926	0.98	0.97	0.84	0.04	15.804	0.00000
Netherlands	86541	0.99	0.98	0.86	0.05	21.313	0.00000
Sweden	75323	0.96	0.91	0.79	0.02	9.166	0.00002

The regression result shows that the selected countries have almost similar estimation and graph pattern. The only difference is in the degree of the graph line steepness “the slope”. Norway has the highest coefficient value “higher slope” while Netherlands and Belgium have the same steep. Sweden has less steep curve. Norway higher slope may reflect the higher Relative wage attractiveness effect due to the higher average wage compared to the other countries.

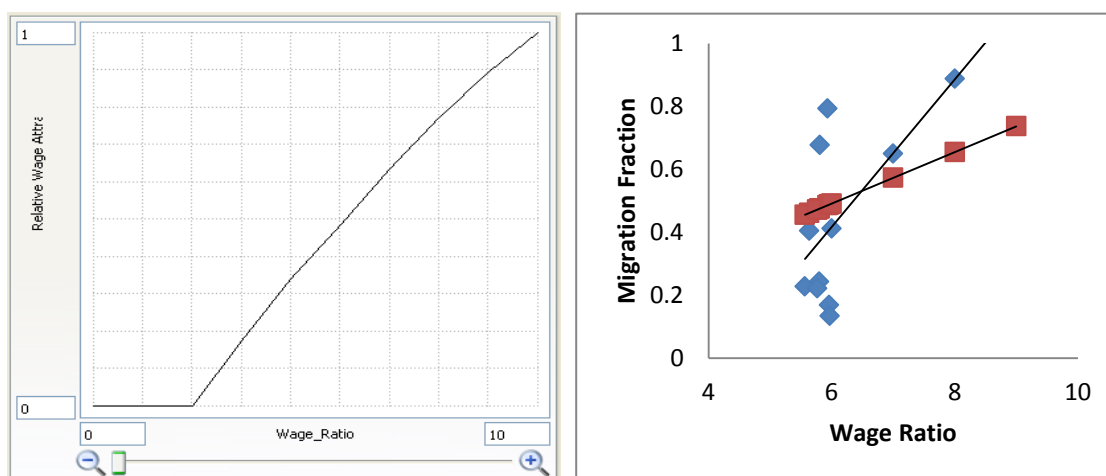
The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be based on the above estimated relationship from the actual data. The relationship is defined as follows: *Relative wage attractiveness effect = f(wage ratio)*. We set wage ratio as index from 0 to 10, where (0) = no difference exist and (10) = Norway average wage is ten times Poland average wage. We set the Relative wage attractiveness effect as index from 0 to 1. Where (0) = no effect and (1) maximum effect.

Note that it will be always a wage gap between the sources and host countries (minimum gap). In other word it will be a tolerance degree of wage differences which represents a no changes in the propensity to migrate. This means people will not migrate until a significant wage differences exists. We assume that the gap will be closing up when it approach (2). This is important for statistically measuring the relationship between these two variables which will show in the equation that shapes the curvature of the graph line. The intercept for Y axis (Relative wage attractiveness effect) will be zero when the ratio is below 2. This has a significant effect on the estimation of the coefficient value “slope” and in testing the relationship between these variables. The R and R square value is low without that assumption.

We use the estimated regression equation to extrapolate the graph trend that is relative to wage ratio index scale (*the following right side graph*). Then we normalize the wage attractiveness effect graph to a similar shape based on the graph extrapolation that results from applying the estimated regression equation. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*left side graph*):

¹⁰ Data from (OECD) Migrant, Migration Inflow, and wages (2004-2013) <http://stats.oecd.org/>



It will be no effect on the propensity to migrate when wage ratio < 2, then it will increase linearly as the ratio raise to reach the maximum effect. The relative wage attractiveness effect increases in linear steepness similar to the Coefficients “slope” measured by the regression as shown above. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on the model behavior. Changing the slope and the shape of the estimated graph function shows no sensitivity. It also shows a little changing on the magnitude but the model produce the same pattern of behavior.

Appendix 2: Measuring the relative unemployment attractiveness effect

The statistical analysis approach of measuring the relationship:

Relative unemployment attractiveness effect represents the propensity to migrate of Polish migrant due to unemployment differences (Gap) between Norway and Poland. Unemployment differences are expressed in terms of unemployment ratio which is the Poland unemployment rate relative to Norway. Propensity to migrate influences a fraction “migration fraction” of potential Polish migrant. Therefore, unemployment ratio impact on migration fraction represents relative unemployment attractiveness effect. Migration fraction is a function of unemployment ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration fraction, as the Dependent variables¹¹:

Migration fraction = Migration inflow / Migrant

- Unemployment ratio as the Independent variables:

Unemployment Ratio = Unemployment Rate Poland¹² / Unemployment Rate Norway¹³

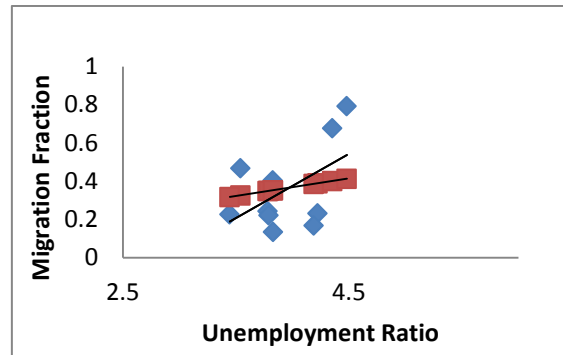
The following is the result of the correlation and regression analyses to the relationship:

¹¹ Data from SSB Table: 07822 and 05184 - (2004-2013) <http://www.ssb.no/>

¹² Data from Central Statistical Office of Poland - (2004-2013) <http://stat.gov.pl/>

¹³ Data from SSB Table: 08517 - (2004-2013) <http://www.ssb.no/>

<i>Regression Statistics</i>	
R	0.877264
R Square	0.769592
Adjusted R Square	0.658481
Intercept	0
Coefficients Un. Ratio	0.092121
<i>t Stat</i>	5.4828
<i>P-value</i>	0.000389



The regression result shows that it is a high degree of correlation ($R = 0.87$) between the unemployment ratio and the migration fraction. It is a positive relationship which means that an increase in the unemployment ratio will increase the migration fraction by the coefficient value. The result confirms a strong relationship “high R Square” with significant level of 95% as shown by P value and T test.

We compare the regression result for “Poland – Norway “with a selected different countries that characteristics with the same Polish migratory pattern (represented by the migrant level). Regressions analysis conducted the same as above. The following is the results summary:

Country	Migrant 2013 ¹⁴	Multiple R	R Square	Adj. R Squ.	Coefficients	t Stat	P-value
Norway	76662	0.88	0.77	0.66	0.09	5.483	0.00039
Belgium	67926	0.94	0.89	0.77	0.09	8.053	0.00004
Netherlands	86541	0.97	0.95	0.82	0.06	12.253	0.00000
Sweden	75323	0.92	0.84	0.72	0.04	6.486	0.00019

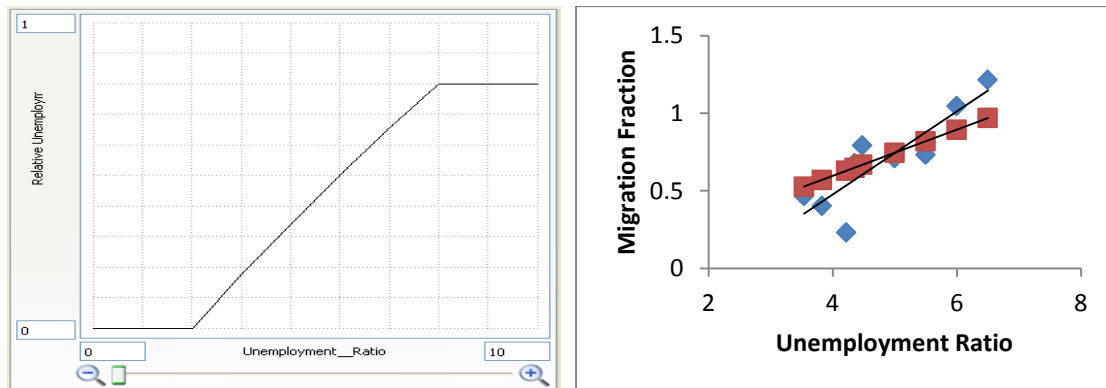
The regression result shows that the selected countries have almost similar estimation and graph pattern. The only difference is in the degree of the graph line steepness “the slope”. Belgium and Norway have the same coefficient value “same slope” while Netherlands and Sweden have less steep curve.

The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be based on the above estimated relationship from the actual data. The relationship is defined as follows: *Relative unemployment attractiveness effect = $f(\text{unemployment ratio})$* . We set unemployment ratio as index from 0 to 10, where (0) = no difference exist and (10) = Poland unemployment rate is ten times Norway unemployment rate. We set the Relative unemployment attractiveness effect as index from 0 to 1. Where (0) = no effect and (1) maximum effect. Note that it will be always an unemployment gap between

¹⁴ Data from (OECD) Migrant, Migration Inflow, and unemployment rate(2004-2013)

sources and host countries (minimum gap). In other word, it will be a tolerance degree of unemployment differences which represents a no changes in the propensity to migrate. This tolerance degree is the reasonable unemployment rate that economist accept as a low rate. This expressed in the term *one digit* unemployment rate. Build on that, this study assumes, the gap will be closing up when it approach (2). This is important for statistically measuring the relationship between these two variables which will show in the equation that shapes the curvature of the equation line. The intercept for Y axis (unemployment attractiveness effect) will be zero which has a significant effect on the estimation of the coefficient value and in testing the relationship between these variables. The R and R square value is low without that assumption. We use the estimated regression equation to extrapolate the graph trend that is relative to unemployment ratio index scale (*the following right side graph*). Then we normalize the relative unemployment attractiveness effect graph to a similar shape based on the graph extrapolation that results from applying the estimated regression equation. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*the left side graph*):



It will be no effect on the propensity to migrate when unemployment ratio < 2 , then it will increase linearly as the ratio raise to reach the maximum effect. The relative unemployment attractiveness effect increases in linear steepness similar to the coefficients measured by the regression as shown above. It will reach a satisfactory level at 0.8 and stop increasing due to: If the unemployment rate increases to that high, migration will not be the solution for the unemployment problem. The unemployed population will start a political struggle to solve that problem rather than try to migrate, which is not a possibility for every unemployed person. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on the model behavior. Changing the slope and the shape of the estimated graph function shows no sensitivity. It also shows a changing on the magnitude but the model produce the same pattern of behavior.

Appendix 3: Measuring the low skilled job effect

The statistical analysis approach of measuring the relationship:

Low skilled job effect represents the propensity to migrate of Polish migrant due to changing in Low skilled job ratio. Propensity to migrate influences a fraction “migration fraction” of potential Polish migrant. Low skilled job ratio impact on migration fraction represents the low skilled job effect.

Migration fraction is a function of low skilled job ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration fraction, as the Dependent variables¹⁵:

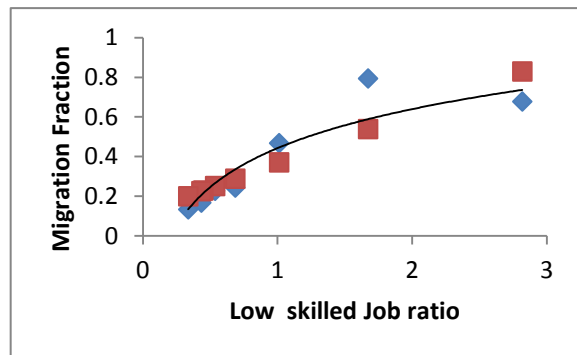
Migration fraction = Migration inflow / Migrant

- Low skilled job ratio as the independent variables:

Low Skilled Job Ratio = Low Skilled Job Vacancies¹⁶ / Employed Polish¹⁷

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.868536
R Square	0.754355
Adjusted R Square	0.713414
Intercept	0.114775
Coefficients Un. Ratio	0.253324
<i>t Stat</i>	4.29249
<i>P-value</i>	0.00513



The regression result shows that it is a high degree of correlation (R= 0.86) between the low skilled job ratio and the migration fraction. It is a positive relationship which means that an increase in the low skilled job ratio will increase the migration fraction by the coefficient value. The result confirms a strong relationship “high R Square” with significant level of 95% as shown by P value and T test.

¹⁵ Data from SSB Table: 07822 and 05184 - (2004-2013) <http://www.ssb.no/>

¹⁶ Data from NAV Table: 22 (2001-2013)

<https://www.nav.no/no/NAV+og+samfunn/Statistikk/Arbeidssokere+og+stillinger+-+statistikk/Ledige+stillinger>

¹⁷ Data from SSB Table: 07184 and 0 6478 (2006-2013) <http://www.ssb.no/>

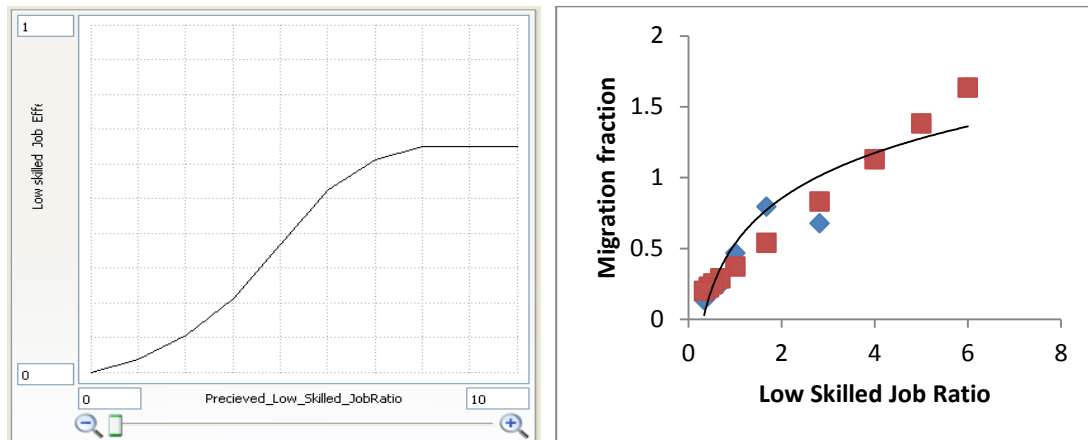
The data for the employed Polish migrant used only from 2006. The reason is the employed polish migrant data shows some inconsistency compared to other data from SSB. In some years the number of employed polish migrant is more than the total number of polish migrant. It may be mixed with short term employed Polish migrant data, or it could be other reasons. However we use the available data. Moreover we use the data from 2006 due to the fact that the number of employed polish migrant in 2004 and 2005 were very small so the ratio was very high which affect the result of the regression. So when we use the data from 2006 the result come in consistency with the estimation for the construction job effect . Also the result comes in compatible with the migration theory finding.

The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be based on the above estimated relationship from the actual data. The relationship is defined as follows: ***Low skilled job effect = $f(\text{Perceived Low skilled job ratio})$***

Perceived low skilled job ratio is the smoothed value of the incremental accumulation of low skilled job ratio ***Perceived ratio = $\text{ratio}(t) - \text{ratio}(t-1) / \text{Adjustment time}$***

We set low skilled job ratio as an index from 0 to 10, where (0) = no job and (10) = ten low skilled job vacancies per employed Polish. We set the low skilled job effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect. We use the estimated regression equation to extrapolate the graph trend that is relative to low skilled job ratio index scale (*right side graph*). Then we normalize the total job effect graph to a similar shape based on the graph extrapolation that results from applying the estimated regression equation. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*left side graph*):



It will be no effect on the propensity to migrate when the ratio equal 0, then it will increase in form of S shape growth, (*increases slowly initially; then increases rapidly, approaching an exponential growth rate as in the J-shaped curve; but then slowly stabilizes*) as low skilled job ratio increases reaching maximum effect around (0.65). Propensity to migrate due to low skilled job ratio will not grow forever. The maximum set to (0.65). The reason is Polish migrant is mainly recruited to fill low skilled job position in secondary labour market segment. Therefore, it is a higher percentage of the low skilled labour will migrate as a result of higher perceived low skilled job ratio. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on the model behavior. Changing the slope and the

shape of the estimated graph function shows little sensitivity. This insignificant sensitivity was a little changing on the magnitude but the model produce the same pattern of behavior.

Appendix 4: Measuring the construction job effect

The statistical analysis approach of measuring the relationship:

Construction job effect represents the propensity to migrate of Polish migrant due to changing in construction job ratio. Propensity to migrate influences a fraction “migration fraction” of potential Polish migrant. Therefore, Construction job ratio impact on migration fraction represents the construction job effect.

Migration fraction is a function of construction job ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration fraction, as the Dependent variables¹⁸:

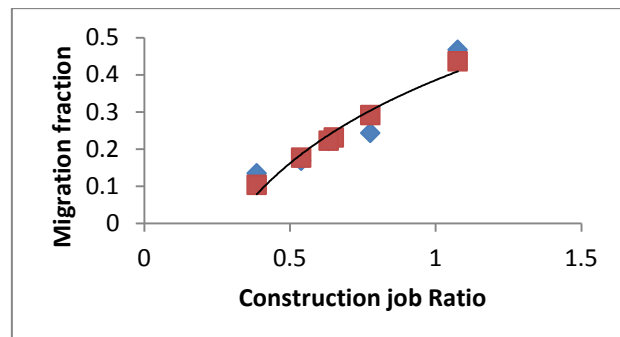
Migration fraction = Migration inflow / Migrant

- Construction job ratio as the independent variables:

Construction Job Ratio = Construction Job Vacancies¹⁹ / Construction Polish Worker²⁰

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.9676052
R Square	0.936259
Adjusted R Square	0.920324
Intercept	0.082147
Coefficients Un. Ratio	0.4814352
<i>t Stat</i>	7.66516
<i>P-value</i>	0.00155



The regression result shows that it is a high degree of correlation ($R = 0.96$) between the construction job ratio and the migration fraction. It is a positive relationship which means that an increase in the construction job ratio will increase the migration fraction by the coefficient value. The result confirms a strong relationship “high R Square” with significant level of 95% as shown by P value and T test.

The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be

¹⁸ Data from SSB Table: 07822 and 05184 (2004-2013) <http://www.ssb.no/>

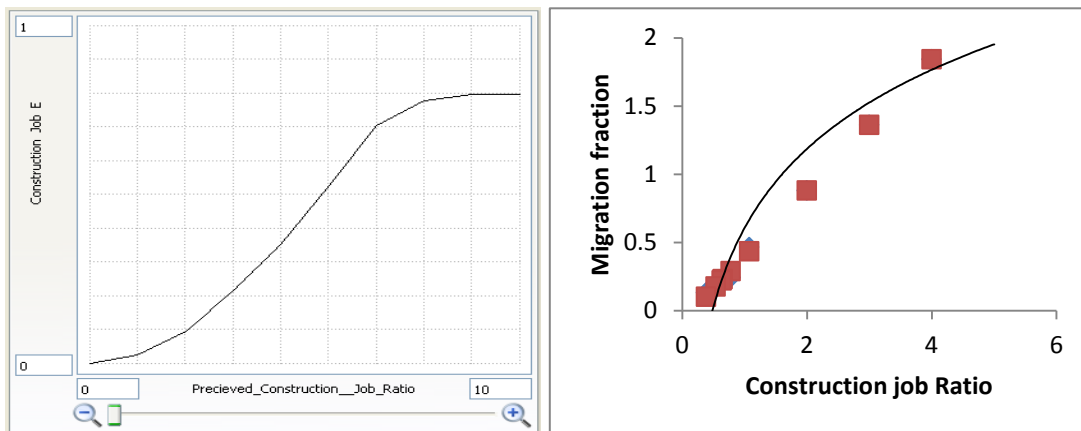
¹⁹ Data from NAV Table: 22 (2001-2013)

²⁰ Data from SSB Table: 08435- (only available from 2008-2013) <http://www.ssb.no/>

based on the above estimated relationship from the actual data. The relationship is defined as follows: **Construction job effect** = $f(\text{Perceived construction job ratio})$

Perceived construction job ratio is the smoothed value of the incremental accumulation of construction job ratio **Perceived ratio** = $\text{ratio}(t) - \text{ratio}(t-1) / \text{Adjustment time}$

We set construction job ratio as an index from 0 to 10, where (0) = no job and (10) = ten construction job vacancies per Polish construction worker. We set the construction job effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect. We use the estimated regression equation to extrapolate the graph trend that is relative to construction job ratio index scale (*right side graph*). Then we normalize the construction job effect graph to a similar shape based on the graph extrapolation that results from applying the estimated regression equation. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*left side graph*):



It will be no effect on the propensity to migrate when the ratio equal 0, then it will increase in form of S shape growth, (*increases slowly initially; then increases rapidly, approaching an exponential growth rate as in the J-shaped curve; but then slowly stabilizes*) as construction job ratio increases reaching maximum effect around (0.8). Propensity to migrate due to construction job ratio will not grow forever. The maximum set to 0.8 due to: Polish construction migrant is the dominance category of Polish labour migrant. Moreover, Polish migrant is the dominant migrant group in Norwegian construction sector. They recruited mainly to fill the job position in the construction sector. Therefore, it is a higher percentage of the construction labour will migrate as a result of higher perceived construction job ratio. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on the model behavior. Changing the slope and the shape of the estimated graph function shows little sensitivity. This insignificant sensitivity was a little changing on the magnitude but the model produce the same pattern of behavior.

Appendix 5: Measuring the total job effect

The statistical analysis approach of measuring the relationship:

Total job effect represents the propensity to migrate of Polish migrant due to changing in total job ratio. Propensity to migrate influences a fraction “migration fraction” of potential Polish migrant. Therefore, total job ratio impact on migration fraction represents the total job effect.

Migration fraction is a function of total job ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration fraction, as the Dependent variables²¹:

Migration fraction = Migration inflow / Migrant

- Total job ratio as the independent variables:

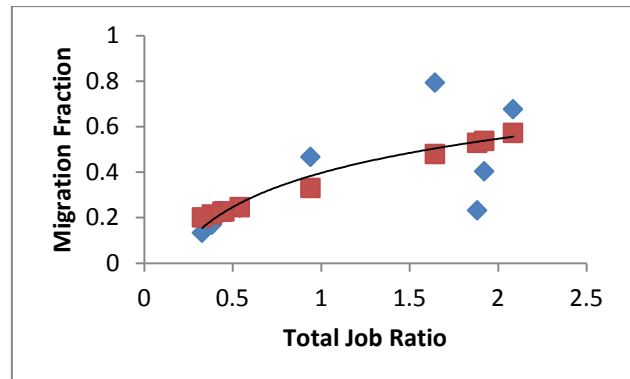
Total Job Ratio = Total Job Vacancies²² / Polish Migrant²³

Total job vacancies are the percentage of job vacancies available to migrant relative to the total population in Norway:

*Total Job Vacancies = Job Vacancies * (Total Migrant / Population)²⁴*

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.686311
R Square	0.471023
Adjusted R Square	0.404901
Intercept	0.133188
Coefficients Un. Ratio	0.21051
<i>t Stat</i>	2.66899
<i>P-value</i>	0.028406



The regression result shows that it is a moderately degree of correlation (R= 0.68) between the total job ratio and the migration fraction. It is a positive relationship which means that an increase in the total job ratio will increase the migration fraction by the coefficient value. The result confirm a fair relationship between the two variables “moderately R Square” with reasonable significant level of 95% as shown by P value and T test. The result is in consistency with dual market theory of migration which indicates that the vast majority of migration happened to fill the gap in secondary

²¹ Data from SSB Table: 07822 and 05184 (2004-2013) <http://www.ssb.no/>

²² Data from NAV Table: 22 (2001-2013)

²³ Data from SSB Table: 05184- (2004-2013) <http://www.ssb.no/>

²⁴ Data from SSB Table: 05184 and 05196- (2004-2013) <http://www.ssb.no/>

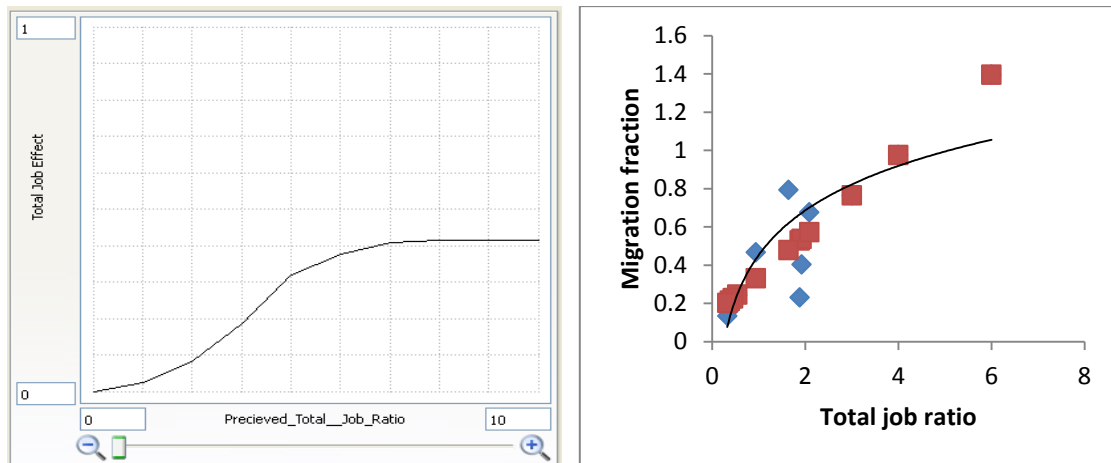
labour market segment rather than primary market segment. Construction and Low skilled job effect have major influence on migration inflows more than total job effect.

The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be based on the above estimated relationship from the actual data. The relationship is defined as follows: **Total job effect = f(Perceived total job ratio)**

Perceived total job ratio is the smoothed value of the incremental accumulation of total job ratio **Perceived ratio = ratio (t) - ratio (t-1) / Adjustment time**

We set total job ratio as an index from 0 to 10, where (0) = no job and (10) = ten job vacancies per Polish migrant. We set the total job effect as index from 0 to 1. Where (0) = no effect and (1) is the maximum effect. We use the estimated regression equation to extrapolate the graph trend that is relative to the total job ratio index scale (*right side graph*). Then we normalize the total job effect graph to a similar shape based on the graph extrapolation that results from applying the estimated regression equation. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The left side graph represents the graph function:



It will be no effect on the propensity to migrate when the ratio equal 0, then it will increase in form of S shape growth, (*increases slowly initially; then increases rapidly, approaching an exponential growth rate as in the J-shaped curve; but then slowly stabilizes*) as total job ratio increases reaching maximum effect around (0.4). Propensity to migrate due to total job ratio will not grow forever. The maximum set to 0.4 as a reasonable estimation compare to the estimated value for both construction and low skilled job effect. The reason is the Polish migrant is mainly recruited to fill the low skilled job position in the secondary labour market sectors. Therefore, it is a lower percentage of the Polish labour will migrate as a result of higher perceived total job ratio in the primary labour market sectors. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on

the model behavior. Changing the slope and the shape of the estimated graph function shows no sensitivity and no changes in the model pattern of behavior.

Appendix 6: Measuring the social network effect on migration risk

The System Dynamic approach of measuring the relationship using the graph function:

Migration research has shown that the process of migration is a self-sustaining and network-driven phenomenon. As a result of large inflows of migrants, migrant networks maybe formed. Migrant network help potential migrants by reduce costs, uncertainties, and risks involved in migration "*Network Theory of Migration*". The Polish migrant whom come to Norway face a high degree of risk in the early stage of migration in particularly in the year 2004 and 2005 when Poland joined the EU. They do not know the language, and they have low education and poor English language. So they rely mainly on the native Polish community to help them in the work necessarily communication. In addition Norway is very expensive country, so accommodation and financial support is a big issue in migration decision. Newcomers rely on the support of their native community in accommodation and financial support during the early stage of their arrival. The capacity to accommodate the new comer is directly and strongly related to the size of the Polish community. In conclusion the Polish community size is a critical factor for posting the Polish migration inflow to Norway.

Social network size is measured in terms of Polish migrant ratio which is Polish migrant relative to total migrant in Norway. The relationship is defined as follows:

Social network effect on migration risk = f(Polish migrant ratio)

- Social network effect on migration risk will be the Dependent variables:
- Polish migrant ratio is the Independent variables:

Polish Migrant Ratio = Polish Migrant / Total Migrant

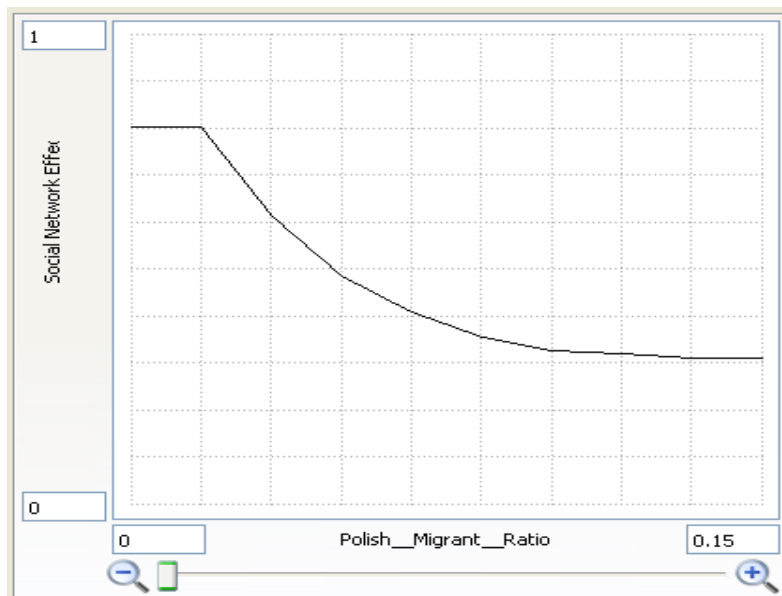
To measure the impact of social network in the risk associated with migration decision Three important issues need to consider in formulating the relationship graph function, (a) one or more specific points, (b) the slope, (c) the shape.

Determine specific points: We set Polish migrant ratio as index from 0 to 0.15, where near (0) = no significant representation of Polish migrant and (0.15) = Polish migrant are 15 % of the total migrant. Social network effect on migration risk can be expressed as index varies from 0 to 1 where, (1) represents the highest degree of risk and (0) is the lowest degree. It will be always a certain degree of risk involved with migration decision due to uncertainties, financial, accommodation, psychological and other

factors. We set 0.3 as the minimum degree of risk involved in the migration decision no matter how big the social network is. We set 0.8 as a maximum degree as it will be always a pioneer whom willing to take the migration risk no matter how high it is. It will always be a number of migrants whom migrate due to different reason regardless the degree of risk involved in the migration “e.g. refugee”.

Determine the slope and shape: This study assumes that risk will decrease in an exponential decay as the Polish migrant ratio increases. As migrant community expands the risk will drop rapidly in the beginning then, the risk decreasing rate will slow down to reach the minimum value at (0.3).

We use judgment and available information to normalize the graph function. The relationship will be represented by the following graph function:



It will be no effect on migration risk when Polish migrant ratio near 0, then it will decrease as an exponential decay function, rapidly decreases initially; then slowly stabilizes as the ratio increases reaching minimum effect at (0.3).

Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing the above relationship form on the model behavior. Changing the slope and the shape of the above graph function shows high sensitivity degree to a linear shape of the graph. However the changing is in magnitude but the model produce the same pattern of behavior. When the migrant community expands to a certain size (critical point) the migration risk will drop very rapidly. Statistics shows that the size of Polish migrant stock has doubled in the first two years then it doubled almost each one and halve years. This could be reflected on a rapid decrease of migration risk as the migrant community rapidly expands.

Appendix 7: Measuring business network effect on migration attractiveness

The statistical analysis approach of measuring the relationship:

Business network effect on migration attractiveness represents the propensity to migrate of Polish migrant due to the expanding size of business network. Business network size is measured in terms of Polish employed ratio which is Polish employed migrant relative to total employed migrant. Propensity to migrate affects migration inflow. Therefore, Polish employed ratio impact on migration inflow represents business network effect.

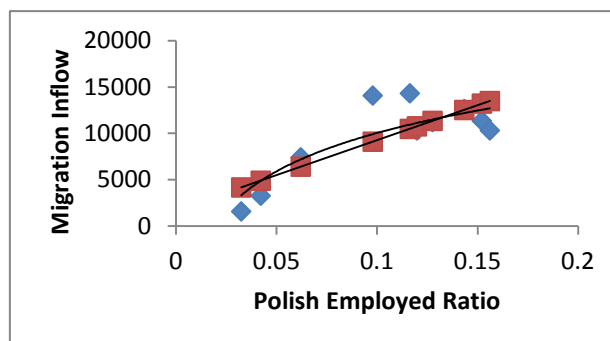
Migration inflow is a function of Polish employed ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Migration Inflow, as the Dependent variables²⁵:
- Polish employed ratio as the Independent variables²⁶:

Polish Employed Ratio = Polish Employed Migrant / Total Employed Migrant

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.787185
R Square	0.619660
Adjusted R Square	0.572117
Intercept	1737.6
Coefficients Un. Ratio	75226.4
<i>t Stat</i>	3.61024
<i>P-value</i>	0.00687



The regression result shows that it is a high degree of correlation ($R = 0.78$) between the Polish employed ratio and the migration inflow. It is a positive relationship which means that an increase in the Polish employed ratio will increase the migration inflow by the coefficient value. The result confirms a moderately strong relationship “R Square” with significant level of 95% as shown by P value and T test.

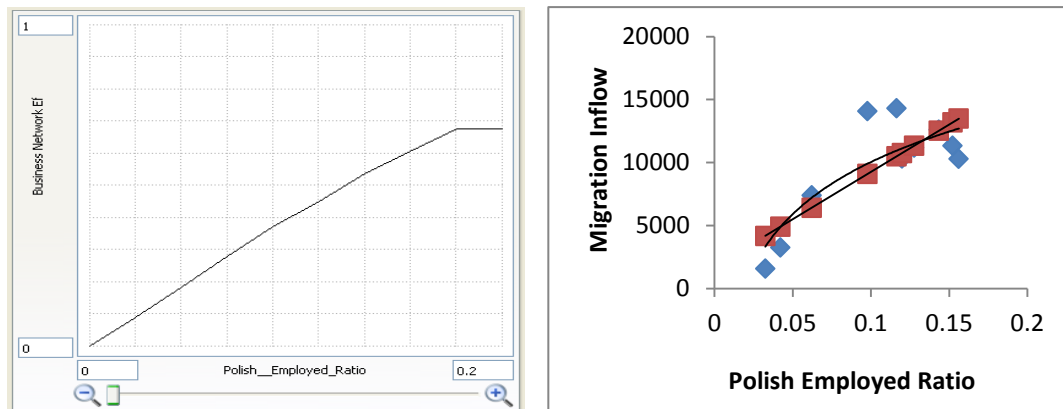
The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be based on the above estimated relationship from actual data. The relationship is defined as follows: *Business network effect on migration attractiveness = f(Polish employed ratio)*. We set Polish employed ratio as index from 0 to 0.20, where (0) = no significant representation of employed Polish and (0.20) = employed Polish are 20 % of the total

²⁵ Data from SSB Table: 07822 and 05184 - (2004-2013) <http://www.ssb.no/>

²⁶ Data from SSB Table: 06478 (2001-2008) and Table: 07284 - (2008-2013) <http://www.ssb.no/>

employed migrant. Attractiveness can be expressed as index varies from 0 to 1 where 1 represents the highest degree and 0 is the lowest degree. We set the business network effect on attractiveness as index from 0 to 1. Where (0) = no effect and (1) maximum effect. Note that, it will be always a certain limit or ceiling that prevents the attractiveness from reaching the maximum value no matter how big the labour migrant community is. For instance job availability, attitude toward immigrant, and other factors will be limiting factors that stop the network effect from growing forever. We set 0.67 as the maximum degree that attractiveness could reach no matter how big the business network is. We use the estimated regression graph (*the following right side graph*) to normalize the business network effect on attractiveness graph to a similar shape. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*the left side graph*):



It will be no effect on propensity to migrate when Polish employed ratio near 0, then it will increase linearly as the employed ratio raise to reach maximum effect. The business network effect on attractiveness increases in linear steepness similar to the slope measured by the regression as shown above. It will reach a satisfactory level at 0.67. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing the estimated relationship form on the model behavior. Changing slope and shape of the estimated graph function shows little sensitivity. This insignificant sensitivity was a changing on the magnitude but the model produce the same behavior.

Appendix 8: Measuring the social network effect on residence time

The statistical analysis approach of measuring the relationship:

Social network effect on residence time represents the tendency to settle of Polish migrant due to the expanding size of social network. Social network size is measured in terms of Polish migrant ratio which is Polish migrant relative to total migrant in Norway. To measure the tendency to settle two concepts need to be considered:

(a) The actual length of stay, which is the time Polish migrant stock takes to drain (*Migrant stock / Migration Outflow*). It means the period of time elapsed if all Polish migrant leave the country in the same outflow pace

(b) The average residence time which is calculated from the registered data of labour migrant by years of residence in Norway.

Dividing the actual length of stay by the average residence time gives us a factor represents the tendency to settle.

$$\text{Length of Stay} = (\text{Polish Migrant} / \text{Polish Migration Outflow})^{27}$$

$$\text{Tendency to Settle} = \text{Length of Stay} / \text{Average Residence Time}^{28}$$

The tendency to settle impact on average residence time will represent social network effect. Tendency to settle is a function of Polish migrant ratio. To statistically measure this relationship we conduct a regression to the following actual data:

- Tendency to settle, as the Dependent variables:

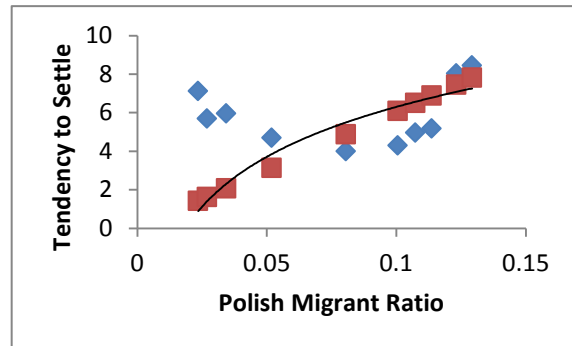
$$\text{Tendency to Settle} = (\text{Polish Migrant} / \text{Polish Migration Outflow}) / \text{Average Residence Time}$$

- Polish migrant ratio as the Independent variables:

$$\text{Polish Migrant Ratio} = \text{Polish Migrant} / \text{Total Migrant}$$

The following is the result of the correlation and regression analyses to the relationship:

<i>Regression Statistics</i>	
R	0.88834
R Square	0.78916
Adjusted R Square	0.67805
Intercept	0
Coefficients Un. Ratio	60.615
<i>t Stat</i>	5.8040
<i>P-value</i>	0.00025



The regression result shows that it is a high degree of correlation ($R = 0.88$) between the Polish migrant ratio and the tendency to settle. It is a positive relationship which means that an increase in the Polish migrant ratio will increase the tendency to settle by the coefficient value. The result confirms a strong relationship “R Square” with significant level of 95% as shown by P value and T test.

The System Dynamic approach of measuring the relationship using the graph function:

Three important issues need to consider in formulating the graph function: (a) the slope, (b) one or more specific points (c) the shape. The shape and slope of the graph will be

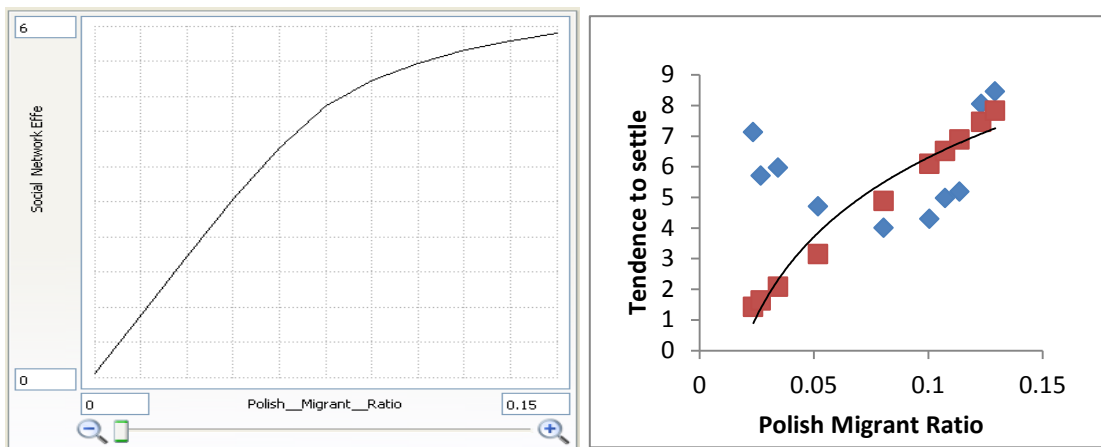
²⁷ Data from SSB Table: 05184, 07822 and 07110 - (2004-2013) <http://www.ssb.no/>

²⁸ Data from SSB Table: 06478 (2001-2008). It is the average period of residence weighted by the number of employed in each residence category. Calculated based on the year 2004(Total employed polish 4837, Settled 4 years and less 1554, Settled 4-6 years 327, Settled 7 years and more 2956)

The weighted average = $(2 \cdot 1554) + (5 \cdot 327) + (8 \cdot 2956) / 4837 = 5.89$ years

based on the above estimated relationship from the actual data. The relationship is defined as follows: *Social network effect on residence time = $f(\text{Polish migrant ratio})$* .

We set Polish migrant ratio as index from 0 to 0.15, where near (0) = no significant representation of Polish migrant and (0.15) = Polish migrant are 15 % of the total migrant. Social network effect on residence time can be expressed as index varies from 0 to 6 where (0) is the lowest degree and (6) is the highest degree. Six means that the average residence time will increase six times due to the expanding Polish migrant community. Note that it will be always a certain limit that prevents the tendency to settle from reaching a higher value “e.g. the life expectancy is the maximum value”. In the model six is the maximum value “which will be around 36 years” as a direct effect of growing Polish community. We use the estimated regression graph (*the following right side graph*) to normalize the social network effect on residence time graph to a similar shape. We use judgment and available information as well as the estimated slope and shape in normalizing the graph function. The relationship will be represented by the following graph function (*the left side graph*):



It will be no effect on the average residence time when Polish employed ratio near 0, then it will increase as a goal a seeking function, increases rapidly initially; then slowly stabilizes as Polish migrant ratio increases reaching maximum effect. Sensitivity test has been conducted (appendix 9 page: 89) to test the effect of changing this estimated relationship form on the model behavior. Changing the slope and the shape of the estimated graph function shows high sensitivity degree to a linear shape of the graph. However the changing is in magnitude but the model produce the same pattern of behavior. When the migrant community reaches a certain size (critical point) the tendency to settle will increase very rapidly. Statistics shows that the size of Polish migrant stock has doubled in the first two years then it doubled almost each one and halve years. This could be reflected on a rapid increase in the tendency to settle as the migrant community rapidly expands.

Appendix 9: Model Validation

Model Validation

Test Type	Test Purpose	The Test
Direct Structure Validity Tests		<i>These tests do not involve simulation</i>
Structure-confirmation test	Comparing the model structure with information (quantitative or qualitative) obtained directly from the real system	Mapping how the real system work is the method applied in constructing this model. The representation of each relationship has been formulated according to information and data from the real system. Literature theoretical framework has been extensively used and reflected on the model structure involving each relationship. It is an iterative process where model structure and relationships have been modified and/or changed.
Parameter-confirmation test	(A) Parameter value is corresponding to real system Data	(1) Most of the parameter value comes from real data about the system (2) Initial Value of stock and the parameter used from real data
	(B) Estimated Parameter value is based on real system Data	The estimated parameter specially the graph function all estimated based on real data except the measurement of the social network effect on migration Risk. It has been measured using available information and judgment.
Direct extreme-condition test	Test Model equations under extreme conditions, resulting in similar value of what would logically happen under a similar condition in real life	All the equation tested under extreme condition by giving zero value to the variables alternately and it all behave logically to what would happened in the e real life.
Dimensional consistency test	checking the equation right hand side unit is equal to the left hand side unit for dimensional consistency	The model passes that test. It is a built in function in itthink software to check unite consistency.

Model Validation

Test Type	Test Purpose	The Test			
Structure-Oriented Behavior		<i>Applying certain behavior tests on model-generated behavior patterns.</i>			
In-Direct Validity Tests		<i>These tests involve simulation</i>			
Extreme-condition test	Assigning extreme values to selected parameters and comparing the model-generated behavior to the observed (or anticipated) behavior of the real system under the same extreme condition.	this test has been conducted to the model in steady state condition and in normal system state. The changes in value for the steady state condition entered manually into the equation due to the fact that the model initialized numerically rather than automatically. The changing in value for normal system state can be repeated in the model interface in which the user interact in a laboratory environment and changing the value and see the results simultaneous. The test measured by evaluating its effect on Migrant Stock & Migration Inflow			
	Parameter and Variables	Steady state		Real system state	
		Expected Behavior	Test Result	Expected Behavior	Test Result
	Total Job Vacancies	Higher Increase	<i>Higher Increase</i>	Increase	Increase
	Construction Job Vacancies	Higher Increase	<i>Higher Increase</i>	Increase	Increase
	Low skilled job Vacancies	Higher Increase	<i>Higher Increase</i>	Increase	Increase
	Migrant Needed	Higher Increase	<i>Higher Increase</i>	Increase	Increase
	Wage ratio	Increase	<i>Increase</i>	Increase	Increase
	Unemployment ratio	Increase	<i>Increase</i>	Increase	Increase
	perception time adjustment for Total job			Not significant Chang	<i>significant when</i>
	perception time adjustment for Construction job			Not significant Chang	<i>it is longer than</i>
	perception time adjustment for Low skilled job			Not significant Chang	<i>6 month</i>

Model Validation

Test Type	Test Purpose	The Test		
Structure-Oriented Behavior		<i>Applying certain behavior tests on model-generated behavior patterns.</i>		
In-Direct Validity Tests		<i>These tests involve simulation</i>		
Behavior sensitivity test	Test Parameters to find which the model is highly sensitive to and asking if the real system would exhibit similar high sensitivity to the corresponding parameters.	The test has been implemented in the normal system state.		
		The test can be repeated in the model interface in which the user can interact in a laboratory setting environment and changing the value and see the results simultaneous		
		The test measured by evaluating its effect on Migrant Stock and Migration Inflow		
		The model shows sensitivity to the changes over 20% in the value of the parameters.		
		However the real system would exhibit a similar sensitivity to the corresponding parameters.		
	Parameter and Variables	Real system state		
		Expected Behavior	Test Result	Behavior Pattern
	Total Job Vacancies	Sensitive	<i>Sensitive</i>	Changing in Magnitude but the same shape
	Construction Job Vacancies	Sensitive	<i>Very Sensitive</i>	Changing in Magnitude but the same shape
	Low skilled job Vacancies	Sensitive	<i>Very Sensitive</i>	Changing in Magnitude but the same shape
	Migrant Needed	Sensitive	<i>Very Sensitive</i>	Changing in Magnitude but the same shape
	Wage Poland	Sensitive	<i>Sensitive</i>	Changing in Magnitude but the same shape
	Wage Norway	Sensitive	<i>Sensitive</i>	Changing in Magnitude but the same shape
	Unemployment rate Poland	Sensitive	<i>Sensitive</i>	Changing in Magnitude but the same shape
	Unemployment rate Norway	Sensitive	<i>Sensitive</i>	Changing in Magnitude but the same shape
	perception time adjustment for Total job	Not sensitive	<i>Not sensitive</i>	Changing in Magnitude but the same shape
	perception time adjustment for Construction job	Not sensitive	<i>Not sensitive</i>	Changing in Magnitude but the same shape
	perception time adjustment for Low skilled job	Not sensitive	<i>Not sensitive</i>	Changing in Magnitude but the same shape

Model Validation

Test Type	Test Purpose	The Test		
Structure-Oriented Behavior In-Direct Validity Tests		<i>Applying certain behavior tests on model-generated behavior patterns. These tests involve simulation</i>		
Behavior sensitivity test	Test Parameters to find which the model is highly sensitive to and asking if the real system would exhibit similar high sensitivity to the corresponding parameters.	The test has been conducted to the graph function as well. The test can be repeated in the model interface in which the user can interact in a laboratory setting environment and changing the the shape and the slope and see the results simultaneous. The test measured by evaluating its effect on Migrant Stock and Migration Inflow. All the results have been changes in magnitude but the same pattern of behavior.		
	Parameter and Variables	Real system state		
		Graph shape & slope	Test Result	Behavior Pattern
	Relative wage attractiveness effect	Less / High slope	<i>Not sensitive</i>	little Changing in Magnitude but same shape
	Relative unemployment attractiveness effect	Less / High slope	<i>Not sensitive</i>	Changing in Magnitude but the same shape
	Social network effect on migration risk	Linear shape	<i>Very Sensitive</i>	Changing in Magnitude but the same shape
	Business network effect on migration attractiveness	Less / High slope	<i>little sensitive</i>	Changing in Magnitude but the same shape
	Social network effect on residence time	linear shape	<i>Very Sensitive</i>	Changing in Magnitude but the same shape
	Low skilled job effect	Less / High slope	<i>little sensitive</i>	little Changing in Magnitude but same shape
	Construction job effect	Less / High slope	<i>little sensitive</i>	little Changing in Magnitude but same shape
	Total job effect	Less / High slope	<i>Not sensitive</i>	No Change
Integration Method test	Check if Model behavior is sensitive to changes in time step and numerical integration method	Cut time step to half, 1/4 and etc. Then simulate, the result is no changes in the pattern of behavior Changing integration method does not affect the Model behavior		
Boundary adequacy test	Check that the model structure creating the observed behavior endogenously.	The model pattern of behavior is not affected by parameter values or external condition (e.g. economic crises in 2008). Rather by the underlying feedback structure and the dynamic interaction between it is loops. The model structure creates the observed behavior endogenously.		

Model Validation

Test Type	Test Purpose	The Test			
Behavior Validity Tests		<i>Applying certain behavior tests on model-generated behavior patterns. These tests involve simulation</i>			
	Does the model reproduce the behavior of interest in the system qualitatively and quantitatively	The model generate and replicate the historical behavior of the real Polish migrant stock trend to Norway with a high degree qualitatively and quantitatively.			
	Does the model generate the various modes of behavior of other variables in the system	The model generate a very close pattern of behavior for most of other variables. The shape is closely similar but the magnitude and some face shifted happened to some variables			
	Testing the hypotheses	We cut the loops or a variables effects that represent one hypothesis to test that hypothesis. The null hypothesis will be: cutting loop or a variable effect no effect on Migrant Stock (MS) & Migration Inflow (MI). The degree of the effect is ranked			
	Loops and Model sub-structure catted	Real system state			
		Null hypothesis	Effect on MS & MI	Effect Degree	Test Result
	Social network effect on migration risk	No effect on MS & MI	increased	very high degree	Reject
	Social network effect on residence time	No effect on MS & MI	reduced	Higher degree	Reject
	Social network effect on migration attractiveness	No effect on MS & MI	reduced	Higher degree	Reject
	Relative wage attractiveness effect	No effect on MS & MI	reduced	High degree	Reject
	Relative unemployment attractiveness effect	No effect on MS & MI	reduced	High degree	Reject
	Construction job effect	No effect on MS & MI	reduced	low degree	Reject
	Low skilled job effect	No effect on MS & MI	reduced	low degree	Reject
	Total job effect	No effect on MS & MI	reduced	Very Low degree	Reject

Appendix 10: Model Equation

- $Continuous_NPV_of_Y(t) = Continuous_NPV_of_Y(t - dt) + (continuous_chg_in_NPV_of_Y) * dt$
 INIT Continuous_NPV_of_Y = 0
 INFLOWS:
 ↔ continuous_chg_in_NPV_of_Y = Net_Income/((1+discount_rate_1)^(TIME-Program_Start_Time))
- $Simulated_Actual_Migrant_Data(t) = Simulated_Actual_Migrant_Data(t - dt) + (In_Flow - Out_Flow) * dt$
 INIT Simulated_Actual_Migrant_Data = 6797
 INFLOWS:
 ↔ In_Flow = Data_Migration_Inflow
 OUTFLOWS:
 ↔ Out_Flow = Data_Migration_Outflow
- $Staff(t) = Staff(t - dt) + (Hiring_Rate) * dt$
 INIT Staff = 15
 INFLOWS:
 ↔ Hiring_Rate = (Indicated_Staff-Staff)/Hiring_Time
- $Assigned_Return_M(t) = Assigned_Return_M(t - dt) + (Assigned_R_M_Flow - R_M_OutFlow) * dt$
 INIT Assigned_Return_M = 0
 INFLOWS:
 ↔ Assigned_R_M_Flow = Policy_Impact*(Potential_Return_M*Program_Fraction*Policy_Condition)
 OUTFLOWS:
 ↔ R_M_OutFlow = Assigned_Return_M*(1+Non_Labour_Migrant_Fraction)/Program_Time
- $Construction_Labour_Migrant(t) = Construction_Labour_Migrant(t - dt) + (Construction_L_M_inflow - Construction_L_M_Outflow) * dt$
 INIT Construction_Labour_Migrant = 1325
 INFLOWS:
 ↔ Construction_L_M_inflow = Sectorial_Fraction*Labour_M_inflow
 OUTFLOWS:
 ↔ Construction_L_M_Outflow = Labour_M_Outflow*(Sectorial_Fraction-Unemployment_Rate)
- $Debt(t) = Debt(t - dt) + (Borrowing - Repayments) * dt$
 INIT Debt = 5000000000
 INFLOWS:
 ↔ Borrowing = Fund_Needed/Borrowing_Time
 OUTFLOWS:
 ↔ Repayments = (Debt/Maturation)+(Debt*Interest)
- $Fund(t) = Fund(t - dt) + (Income - Expenses) * dt$
 INIT Fund = 5000000000
 INFLOWS:
 ↔ Income = Assigned_Return_M*(Unemployment_benefits+Pension_Fund)/PaymentTime+Borrowing
 OUTFLOWS:
 ↔ Expenses = Compansetion_Program_Cost+Repayments
- $Fund_Needed(t) = Fund_Needed(t - dt) + (Fund_Needed_Rate) * dt$
 INIT Fund_Needed = 0
 INFLOWS:
 ↔ Fund_Needed_Rate = Fund_Gap
- $Labour_Migrant(t) = Labour_Migrant(t - dt) + (Labour_M_Inflow - Labour_M_Outflow) * dt$
 INIT Labour_Migrant = 4837
 INFLOWS:
 ↔ Labour_M_Inflow = Fraction_Migration_Rate*Potential_Migrant

OUTFLOWS:

↳ Labour_M_Outflow =
 (Labour_Migrant/(Average_Residence_Time*Social_Network_Effect_on_Residence_Time_Initial_Con))+
 R_M_OutFlow*(1-Non_Labour_Migrant_Fraction))

□ Migrants(t) = Migrants(t - dt) + (Migration_Inflow - Migration_Outflow) * dt

INIT Migrants = Initial_Migrant

INFLOWS:

↳ Migration_Inflow = Labour_M_inflow*(1+Non_Labour_Migrant_Fraction)

OUTFLOWS:

↳ Migration_Outflow = (Labour_M_Outflow*(1+Non_Labour_Migrant_Fraction))

□ Pension_Fund(t) = Pension_Fund(t - dt) + (PensionChange_Rate) * dt

INIT Pension_Fund = 38500

INFLOWS:

↳ PensionChange_Rate = if(TIME <= 2014) THEN
 ((Avg_Migrant_Salary*Pension_%)+(Pension_fund*Interest_Rate)) ELSE (
 Switch*(Avg_Migrant_Salary*Pension_%)+Switch*(Pension_fund*Interest_Rate))

□ Potential_Return_M(t) = Potential_Return_M(t - dt) + (Potential__R_M_Flow - Assigned_R_M_Flow) * dt

INIT Potential_Return_M = 0

INFLOWS:

↳ Potential__R_M_Flow = Migrants*(1-Non_Labour_Migrant_Fraction)/Residence_Time_10_year

OUTFLOWS:

↳ Assigned_R_M_Flow = Policy_Impact*(Potential_Return_M*Program_Fraction*Policy_Condition)

□ Potential_Migrant(t) = Potential_Migrant(t - dt) + (Potential_Labour_Migration_Inflow -
 Non_Polish_Migration_Inflow - Labour_M_Inflow) * dt

INIT Potential_Migrant = 6536

INFLOWS:

↳ Potential_Labour_Migration_Inflow = Foreign_Labour_Demand

OUTFLOWS:

↳ Non_Polish_Migration_Inflow = Non_Polish_Fraction_Migration_Rate*Potential_Migrant

↳ Labour_M_Inflow = Fraction_Migration__Rate*Potential_Migrant

□ Precieved_Construction_Job_Ratio(t) = Precieved_Construction_Job_Ratio(t - dt) + (Con_Job_Ratio_change) * dt

INIT Precieved_Construction_Job_Ratio = 5.070182

INFLOWS:

↳ Con_Job_Ratio_change =
 (Construction_Job_Ratio-Precieved_Construction_Job_Ratio)/(Perception_Time_CJ*Changing_Perception
 Time_CJ)

□ Precieved_Low_Skilled_JobRatio(t) = Precieved_Low_Skilled_JobRatio(t - dt) + (Low_S_Job_Ratio_Change) * dt

INIT Precieved_Low_Skilled_JobRatio = 7.29087

INFLOWS:

↳ Low_S_Job_Ratio_Change =
 (Low_Skilled_Job_Ratio-Precieved_Low_Skilled_JobRatio)/(Perception_Time_LSJ*Changing_Perception
 TimeLSJ)

□ Precieved_Total_Job_Ratio(t) = Precieved_Total_Job_Ratio(t - dt) + (Total_Job_Ratio_Chg) * dt

INIT Precieved_Total_Job_Ratio = 1.881858

INFLOWS:

↳ Total_Job_Ratio_Chg =
 (Total_Job_Ratio-Precieved_Total_Job_Ratio)/(Perception_TimeTJ*Changing_Perception_TimeTJ)

□ Program_Start_Time(t) = Program_Start_Time(t - dt) + (Change_1) * dt

INIT Program_Start_Time = 2004

INFLOWS:

↳ Change_1 = IF(Migrant_Gap>0) THEN(0*Years) ELSE(Years)

- $\text{Returned_Migrant}(t) = \text{Returned_Migrant}(t - dt) + (R_M_OutFlow) * dt$
 INIT Returned_Migrant = 0
 INFLOWS:
 $R_M_OutFlow = \text{Assigned_Return_M} * (1 + \text{Non_Labour_Migrant_Fraction}) / \text{Program_Time}$
- $\text{Unemployment_Rate}(t) = \text{Unemployment_Rate}(t - dt) + (\text{Change_in_Unemployment_Rate}) * dt$
 INIT Unemployment_Rate = 0
 INFLOWS:
 $\text{Change_in_Unemployment_Rate} =$
 $(\text{Unemployment_Rate_Immigrants_Data} - \text{Unemployment_Rate}) / \text{Unemployment_Rate_Adj_Time}$
- Average_Wage_Norway = GRAPH(TIME)

 (2004, 65820), (2005, 67634), (2006, 70229), (2007, 73172), (2008, 74749), (2009, 75477), (2010, 76392), (2011, 79009), (2012, 80680), (2013, 81685)
- Average_Wage_Poland = GRAPH(TIME)

 (2004, 11939), (2005, 11995), (2006, 12088), (2007, 12332), (2008, 12961), (2009, 13017), (2010, 13730), (2011, 13707), (2012, 13540), (2013, 13690)
- Average_Residence_Time = Initial_Residence_Time
 Avg_Migrant_Salary = 370000
 Benefit = $\max(1, (\text{Income} / R_M_OutFlow) + \text{PerCapita_Social_Expenditure})$
 Borrowing_Time = 1/12
 Business_Network_Effect_on_Migration_Attractiveness = GRAPH(Polish_Employed_Ratio)



















 (0.00, 0.00), (0.0222, 0.0889), (0.0444, 0.184), (0.0667, 0.279), (0.0889, 0.371), (0.111, 0.451), (0.133, 0.537), (0.156, 0.606), (0.178, 0.676), (0.2, 0.676)
- Changing_Average_Wage_Norway_Data = 1
 Changing_Average_Wage_Poland_Data = 1
 Changing_Construction_Job_Data = 1
 Changing_Low_Skilled_Job_Data = 1
 Changing_Perception_TimeLSJ = 1
 Changing_Perception_TimeTJ = 1
 Changing_Perception_Time_CJ = 1
 Changing_Total_Job_Data = 1
 Changing_Unemployment_Rate_Norway_Data = 1
 Changing_Unemployment_Rate_Poland_Data = 1
 Compensation_Program_Cost =
 $(\text{Salary_per_staff} * \text{Staff}) + (\text{Assigned_Return_M} * \text{Compensation_Program_Incentive} / \text{PaymentTime})$
- Compensation_Effect = GRAPH(Compensation_Evaluation)








 (0.00, 0.00), (0.8, 0.00), (1.60, 0.0254), (2.40, 0.0635), (3.20, 0.0889), (4.00, 0.114), (4.80, 0.137), (5.60, 0.149), (6.40, 0.162), (7.20, 0.165), (8.00, 0.168)
- Compensation_Evaluation = $\text{Compensation_Program_Incentive} / \text{Unemployment_benefits}$
 Compensation_Program_Incentive = $\text{Initial_Compensation} * (1 + \text{Policy_Effect})$
- Construction_Job_Ratio = $\text{Job_Vacancies} * \text{Construction_Job_Vacancies_Data} / \text{Construction_Labour_Migrant}$
 Construction_Job_Vacancies_Data = $\max(0, (\text{Construction_Job_Vacancies_Data} / \text{Job_Vacancies}))$
- Construction_Job_Vacancies_Data = GRAPH(TIME)




 (2004, 6718), (2005, 8395), (2006, 10707), (2007, 11042), (2008, 8277), (2009, 6128), (2010, 6069), (2011, 7641), (2012, 7596), (2013, 6176), (2014, 6176)
- Construction_Job_Effect = GRAPH(Precieved_Construction_Job_Ratio)

 (0.00, 0.00), (1.11, 0.0254), (2.22, 0.0952), (3.33, 0.216), (4.44, 0.352), (5.56, 0.527), (6.67, 0.705), (7.78, 0.778), (8.89, 0.797), (10.0, 0.797)
- Cost = $\max(1, \text{Expenses} / R_M_OutFlow)$
 Cost_Benefit_Effectiveness = $\text{Cost} / \text{Benefit}$
- Data_Employed_Polish_Migrant = GRAPH(TIME)

 (2004, 4837), (2005, 6738), (2006, 11274), (2007, 20857), (2008, 28055), (2009, 30110), (2010, 35076), (2011, 44080), (2012, 50860), (2013, 55976), (2014, 62976)

-  Data_Migration_Outflow = GRAPH(TIME)
 (2004, 162), (2005, 241), (2006, 311), (2007, 641), (2008, 1300), (2009, 1678), (2010, 1684), (2011, 1864), (2012, 1421), (2013, 1539), (2014, 1539)
-  Data_Migration_Inflow = GRAPH(TIME)
 (2004, 1576), (2005, 3271), (2006, 7401), (2007, 14073), (2008, 14309), (2009, 10323), (2010, 11197), (2011, 12615), (2012, 11339), (2013, 10298), (2014, 10298)
-  Data_Polish_Migrant = GRAPH(TIME)
 (2004, 6797), (2005, 8096), (2006, 10938), (2007, 17747), (2008, 30636), (2009, 42471), (2010, 49309), (2011, 56878), (2012, 67339), (2013, 76662), (2014, 84000)
-  Data_Total_Population = GRAPH(TIME)
 (2004, 4.6e+006), (2005, 4.6e+006), (2006, 4.6e+006), (2007, 4.7e+006), (2008, 4.7e+006), (2009, 4.8e+006), (2010, 4.9e+006), (2011, 4.9e+006), (2012, 5e+006), (2013, 5.1e+006), (2014, 5.1e+006)
-  Data_Total_Employed_Migrant = GRAPH(TIME)
 (2004, 149013), (2005, 159792), (2006, 181444), (2007, 213144), (2008, 241036), (2009, 251134), (2010, 274826), (2011, 307182), (2012, 333972), (2013, 358421), (2014, 358421)
-  Data_Total_Migrant_in_Norway = GRAPH(TIME)
 (2004, 289104), (2005, 301045), (2006, 318514), (2007, 341830), (2008, 380644), (2009, 422595), (2010, 459346), (2011, 500500), (2012, 546732), (2013, 593321), (2014, 593321)
- Debt_Fund_Ratio = Debt/Fund
- Desired_Migrant = 105000
- discount_rate_1 = 0.029
- Foreign_Labour_Demand = Job_Needed/Worker_needed_to_Fill_one_Job
- Fraction_Migration_Rate = Migration_Fraction_For_labour_Reason*(1-Social_Network_Effect_on_Migration_Risk)*(1+Business_Network_Effect_on_Migration_Attractiveness)
- Fund_Gap = Expenses-Income
- Hiring_Time = 2/12
- Indicated_Staff = Assigned_Return_M/Staff_Needed_per_Migrant
- Initial_Fraction_Migration_Rate = 0.09
- Initial_Return_Fraction = Labour_M_Outflow/Labour_Migrant
- Initial_Compensation = Pension_Fund+Unemployment_benefits
- Initial_Migrant = 6797
- Initial_Residence_Time = 4837/533.416117
- Interest = 0.03
- Interest_Rate = 0.028
- Job_Vacancies = Job_Vacancies_Trend*Changing_Total_Job_Data
-  Job_Vacancies_Trend = GRAPH(TIME)
 (2004, 202523), (2005, 238129), (2006, 332304), (2007, 399535), (2008, 358136), (2009, 260301), (2010, 236186), (2011, 247122), (2012, 235763), (2013, 213448), (2014, 197942)
- Job_Needed = (Low_Skilled_Job_Vacancies_%_Data*Job_Vacancies)+(Job_Vacancies*Total_Migrant_to_Population_Ratio)
- Low_Skilled_Job_Ratio = Job_Vacancies*Low_Skilled_Job_Vacancies_%_Data/Labour_Migrant
- Low_Skilled_Job_Available_Data = (Construction_Job_Vacancies_Data*Changing_Construction_Job_Data)+(Low_Skilled_Services_Vacancies_Data*Changing_Low_Skilled_Job_Data)
-  Low_Skilled_Services_Vacancies_Data = GRAPH(TIME)
 (2004, 28548), (2005, 30027), (2006, 21071), (2007, 23846), (2008, 20110), (2009, 14538), (2010, 12797), (2011, 12096), (2012, 14528), (2013, 12664), (2014, 12664)
- Low_Skilled_Job_Vacancies_%_Data = max(0,(Low_Skilled_Job_Available_Data/Job_Vacancies))
-  Low_skilled_Job_Effect = GRAPH(Precieved_Low_Skilled_JobRatio)
 (0.00, 0.00), (1.11, 0.0381), (2.22, 0.108), (3.33, 0.213), (4.44, 0.368), (5.56, 0.527), (6.67, 0.613), (7.78, 0.651), (8.89, 0.651), (10.0, 0.651)

- Maturation = 7
- Migrant_Gap = Migrants/Desired_Migrant
- Migration_Fraction_For_labour_Reason = Initial_Fraction_Migration_Rate*(1+
Relative_Unemployment_Attractiveness_Effect+Relative_Wage_Attractiveness_Effect+
Low_skilled_Job_Effect+Total_Job_Effect+Construction_Job_Effect)
- Net_Benefit = Benefit-Cost
- Net_Income = Income-Expenses
- Non_Labour_Migrant_Fraction = 0.29
- Non_Polish_Fraction_Migration_Rate = 1-Fraction_Migration_Rate
- PaymentTime = 1
- Pension_% = 0.11
- PerCapita_Social_Expenditure = 9962*7.5
- Perception_TimeTJ = 1/12
- Perception_Time_CJ = 1/12
- Perception_Time_LSJ = 1/12
- Policy_Condition = if(Migrant_Gap>1) THEN 1 ELSE(0)
- Policy_Effect = GRAPH(Migrant_Gap)
 (0.00, 0.00), (0.3, 0.00), (0.6, 0.0333), (0.9, 0.0714), (1.20, 0.11), (1.50, 0.151), (1.80, 0.187), (2.10, 0.217), (2.40, 0.24), (2.70, 0.254), (3.00, 0.257)
- Policy_Impact = if(Policy_Switch=1)then(1)else(0)
- Policy_Switch = 1
- Polish_Employed_Ratio = Labour_Migrant/Data_Total_Employed_Migrant
- Polish_Migrant_Ratio = Migrants/Total_Migrant_in_Norway_Data
- Program_Time = 3/12
- Program_Fraction = Initial_Return_Fraction*(1+Compensation_Effect)
- Relative_Unemployment_Attractiveness_Effect = GRAPH(Unemployment_Ratio)
 (0.00, 0.00), (1.11, 0.00), (2.22, 0.00), (3.33, 0.178), (4.44, 0.34), (5.56, 0.505), (6.67, 0.657), (7.78, 0.8), (8.89, 0.8), (10.0, 0.8)
- Relative_Wage_Attractiveness_Effect = GRAPH(Wage_Ratio)
 (0.00, 0.00), (1.11, 0.00), (2.22, 0.00), (3.33, 0.152), (4.44, 0.302), (5.56, 0.457), (6.67, 0.597), (7.78, 0.74), (8.89, 0.876), (10.0, 1.00)
- Residence_Time_10_year = 10
- Salary_per_Staff = 400000
- Sectorial_Fraction = 0.27
- Short_Term_Migration_Inflow_data = GRAPH(TIME)
 (2004, 2874), (2005, 5820), (2006, 13146), (2007, 15072), (2008, 17789), (2009, 15268), (2010, 12098), (2011, 12545), (2012, 16539), (2013, 18066), (2014, 18066)
- Social_Network_Effect_on_Migration_Risk = GRAPH(Polish_Migrant_Ratio)
 (0.00, 0.803), (0.0167, 0.803), (0.0333, 0.613), (0.05, 0.486), (0.0667, 0.41), (0.0833, 0.356), (0.1, 0.327), (0.117, 0.32), (0.133, 0.311), (0.15, 0.311)
- Social_Network_Effect_on_Residence_Time_Initial_Con = Social_Network_Effect_on_Residence_Time
- Social_Network_Effect_on_Residence_Time = GRAPH(Polish_Migrant_Ratio)
 (0.00, 0.0762), (0.015, 1.09), (0.03, 2.08), (0.045, 3.07), (0.06, 3.92), (0.075, 4.65), (0.09, 5.09), (0.105, 5.37), (0.12, 5.60), (0.135, 5.75), (0.15, 5.89)
- Staff_Needed_per_Migrant = 50
- Switch = 0
- Total_Job_Effect = GRAPH(Precieved_Total_Job_Ratio)
 (0.00, 0.00), (1.11, 0.0254), (2.22, 0.0857), (3.33, 0.187), (4.44, 0.321), (5.56, 0.378), (6.67, 0.41), (7.78, 0.416), (8.89, 0.416), (10.0, 0.416)
- Total_Job_Ratio = Job_Vacancies/Migrants*Total_Migrant_to_Population_Ratio
- Total_Migrant_to_Population_Ratio =
Data_Total_Migrant_in_Norway/Data_Total_population*Unit_Conversion

- Total_Migrant_in_Norway_Data = Data_Total_Migrant_in_Norway
- Unemployment_Rate_Norway = GRAPH(TIME)

 (2004, 0.045), (2005, 0.046), (2006, 0.034), (2007, 0.025), (2008, 0.026), (2009, 0.032), (2010, 0.036), (2011, 0.033), (2012, 0.032), (2013, 0.035)
- Unemployment_Rate_Immigrants_Data = GRAPH(TIME)

 (2004, 0.049), (2004, 0.045), (2004, 0.049), (2005, 0.044), (2005, 0.048), (2005, 0.039), (2005, 0.042), (2006, 0.035), (2006, 0.035), (2006, 0.028), (2006, 0.03), (2006, 0.024), (2007, 0.024), (2007, 0.019), (2007, 0.022), (2007, 0.017), (2007, 0.019), (2008, 0.018), (2008, 0.02), (2008, 0.027), (2008, 0.049), (2009, 0.051), (2009, 0.052), (2009, 0.049), (2009, 0.065), (2009, 0.057), (2010, 0.057), (2010, 0.054), (2010, 0.063), (2010, 0.047), (2010, 0.047), (2011, 0.041), (2011, 0.05), (2011, 0.042), (2011, 0.043), (2012, 0.043), (2012, 0.053), (2012, 0.051), (2012, 0.051), (2012, 0.049), (2013, 0.058), (2013, 0.055), (2013, 0.055)
- Unemployment_Rate_Poland = GRAPH(TIME)

 (2004, 0.19), (2005, 0.176), (2006, 0.148), (2007, 0.112), (2008, 0.092), (2009, 0.121), (2010, 0.124), (2011, 0.125), (2012, 0.134), (2013, 0.134)
- Unemployment_benefits = Unemployment_Coverage_Time*Avg_Migrant_Salary*0.65
- Unemployment_Coverage_Time = 2
- Unemployment_Rate_Adj_Time = 1/4
- Unemployment_Ratio =
 (Unemployment_Rate_Poland*Changing_Unemployment_Rate_Poland_Data)/(Unemployment_Rate_Norway*Changing_Unemployment_Rate_Norway_Data)
- Unit_Conversion = 1/1
- Wage_Ratio =
 (Average_Wage_Norway*Changing_Average_Wage_Norway_Data)/(Average_Wage_Poland*Changing_Average_Wage_Poland_Data)
- Worker_needed_to_Fill_one_Job = 1
- Years = 1