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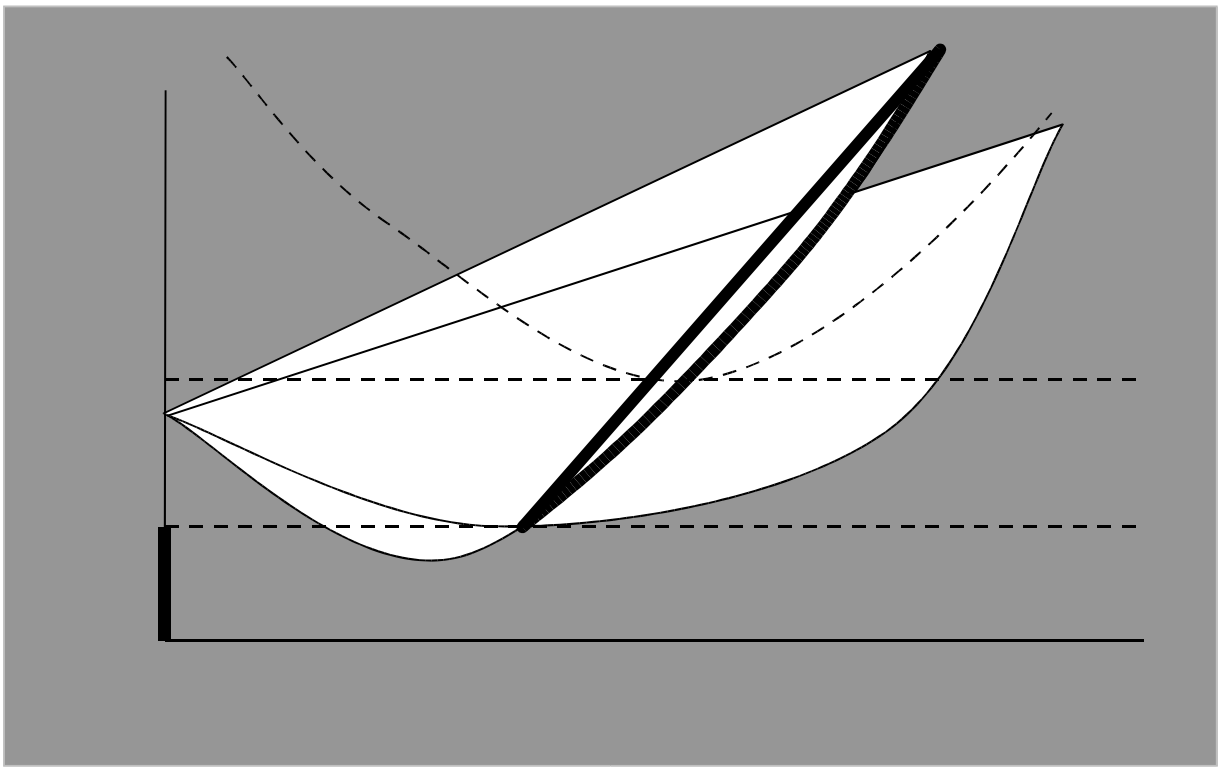

2005

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NATÁLIE REICHLOVÁ *

Abstract

According to Abraham Maslow's motivational theory, human action is motivated by five groups of human needs. The model introduced in this paper exploits Maslow's theory to explain migration flows between regions. In the model, movement from one place to another influences migrant's utility through three various ways. First, through change in wage caused by different wage levels in each location. Second, through changes in utility connected with individuals safety needs and finally, through disarrangement of individual's social networks. When safety and social needs are added to the model, equilibria arise in which wage differential between regions persists.

JEL Classification: J61, F22, I31, O15

Keywords: agent-based modeling, decision making, migration, motivation, networks

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Can the Theory of Motivation Explain Migration Decisions?[1]

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According to Abraham Maslow's motivational theory, human action is motivated by five groups of human needs. The model introduced in this paper exploits Maslow's theory to explain migration flows between regions. In the model, movement from one place to another influences migrant's utility through three various ways. First, through change in wage caused by different wage levels in each location. Second, through changes in utility connected with individual's safety needs and finally, through disarrangement of individual's social networks. When safety and social needs are added to the model, equilibria arise in which wage differential between regions persists.

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1. INTRODUCTION

Traditional way how to explain migration flows from one region to another is to employ homo oeconomicus and let him compare economic conditions in different regions. Massey (1993) introduces following form of the model[2] where rational agent decides according to the expected net return to migration given by the equation:

$$ER(0) = \int_0^n \left[E_d(t)Y_d(t) - E_h(t)Y_h(t)\right] e^{-rt} dt - C(0)$$

where $ER(0)$ is the expected net return to migration calculated just before departure at time 0. E_d is probability of employment at the destination, Y_d is income in case of employment in destination country. E_h is the probability of being employed in the country of origin and Y_h is income

[1]Great acknowledgement goes to Petr Švarc who wrote the program for simulation model.

[2]Model presented here is simplified - possibility of deportation is not taken into account.

in case of employment in the country of origin. $C(0)$ is the sum of all costs that the migrant must bear if he decides to leave home region. An individual will migrate on condition that $ER(0) > 0$. For $ER(0) < 0$ he will stay in home region and in case that $ER(0) = 0$, he is indifferent. The potential migrant goes to the country with the highest $ER(0)$. In connection with this model Massey writes[3]:

> "Migration occurs until expected earnings (the product of earnings and employment rates) have been equalized internationally (net of the costs of movement), and movement does not stop until this product has been equalized."

Hence for homogenous agents and zero unemployment rates model predicts wage equalization caused by migration flows from low-wage countries to more prosperous ones.

There exists extensive literature that reflects the fact that social ties and social networks play an important role in migration decision. However, it usually reflects only networks created in destination areas. In such case migration networks are seen to help potential migrants to find jobs, accommodation and to adapt to new environment. For empirical evidence see e.g. Pedersen, Pytlikova and Smith (2004), Rotte and Vogler (1998) or Bauer, Epstein and Gang (2002). An interesting model of network migration is presented by Heitmueller (2003). Contrary to most authors he argues that incumbent migrants' population may actively influence future migration flows, yet the coordination failure causes inability to achieve Pareto efficient point. Epstein and Gang (2004) examined migration networks and herd effects, phenomenons that are caused by imperfect information available to potential migrants who instead of relying on their own private information follow signals given by previous migrants.

Our model regards social networks as an important factor influencing migration. In contrast to previous models we consider not only social network created in destination but we see individual as part of social network even in his home region. We base our theoretical model on Maslow's motivational theory that suggests that wages, social networks and feeling of stability provided by home region may be key features affecting migration decision.

In the next section we describe some empirical findings that motivated the development of the model. Third section describes Maslow's theory of motivation. Section 4 associates motivational theory with migration behaviour. In section 5 migration models are introduced and section 6 presents results of the simulations. Section 7 concludes.

[3] Massey (1993) pp. 435

2. MOTIVATION OF THE MODEL

2.1. European experience

It seems that migration flows especially in Europe are much less intensive and, as concerns migration, people in Europe are less sensitive to wage and unemployment levels than predicted by economic theory[4].

In 2000 only 255,000 people (0.1% of the total EU population) changed their official residence between two countries[5]. During years 1991 to 2001 a total of 38% of EU citizens changed their residence. 68% of this number moved within the same town or village and 36% moved to another town in the same region. 21% moved to another region in the same member state and only 4.4% moved to another member state[6]. (See Table 1)

	moved within last 10 years	within the same town or village	to another town within the same region	to another region within the same country	to another country within the EU
Austria	30	63	38	38	13
Belgium	35	70	42	19	6
Denmark	57	69	40	30	5
Finland	59	66	37	24	6
France	42	60	49	29	6
Germany	36	66	38	18	3
Greece	29	63	14	27	2
Ireland	28	69	28	19	13
Italy	20	61	30	18	2
Luxembourg	39	51	54	39	20
Netherlands	53	70	37	27	7
Portugal	25	73	25	11	4
Spain	32	74	33	12	3
Sweden	56	82	38	26	5
United Kingdom	52	75	30	19	4
EU-15	38	68	36	21	4

Table 1: Mobility within EU-15 (in %) (Eurobarometer (2001))

Taking into consideration prevailing GDP (see Table 2) and unemployment gaps (especially on regional level), even moving costs are not able to explain such reluctance to move.

[4] e.g. Seija (1998)

[5] Commission of the European Communities (2002)

[6] Some people moved more than once within the ten year period.

EU regions with lowest GDP per capita		EU regions with highest GDP per capita	
Guyane, France	12136	Inner London, United Kingdom	66760
Dytiki Ellada, Greece	12338	Région de Bruxelles - Capitale, Belgium	49644
Anatoliki Makedonia, Thraki, Greece	12521	Luxembourg	45026
Réunion, France	12726	Hamburg, Germany	39766
Notre, Portugal	13017	Ile-de-France, France	37267
Extremadura, Spain	13033	Wien, Austria	36602
Ipeiros, Greece	13116	Berkshire, Buckinhamshire and Oxfordshire, United Kingdom	34251
Acores, Portugal	13364	Provincia Autonoma Bolzano-Bozen, Italy	33783
Centro, Portugal	13342	Stockholm, Sweden	33487
Thessalia, Greece	13709	Oberbayern, Germany	33453

Table 2: EU-15 regions with highest and lowest GDP per capita in PPS (2002) (Eurostat (2005))

The moves across borders connected with the change of residence are at quite a low level. However, commuting is turning to be increasingly important factor of labour mobility across EU borders and is generally the most frequent form of geographic mobility undertaken by EU citizens (see Table 3).

	A	B	DK	FIN	F	GER	IRE	I	LUX	NDL	P	SPA	S	UK
Austria						15528		300						
Belgium					5348	5712			22100	16740				
Denmark						1339							500***	
Finland													600***	
France*						61084		352	41500			1438		2702
Germany	5388	582	1141		591				14800	16534				
Ireland														9000***
Italy	1600***				687									
Luxembourg		382			108	298								
Netherlands		6200				16573								
Portugal												3000***		
Spain**					762						1000***			
Sweden			2500***	320***										
United Kingdom							2500***							

Table 3: Cross-border commuting in the European Union in 1999[7] (European Commission (2001))

Altogether 83% of all commuters[8] come from only four countries - France, Germany, Belgium and Italy. Half of all cross-border commuters

[7] *without 964 commuters between Paris-London

**without 1.270 commuters between Gibraltar and Spain

***data based on company surveys, expert talks, recently published scientific studies etc.

[8] included countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom, Norway, Switzerland, Andorra, Liechtenstein, Monaco and San Marino

originate from France alone. The commuters' countries of destination are even more concentrated, with 70.9% commuting to Switzerland, Germany and Luxembourg.

Low mobility of the European labour force induced European Commission to support survey[9] concerning among others the obstacles of movement within EU. 11% of survey respondents said that they had thought about making the move but had given up the idea. The most often quoted reasons for immobility were family considerations and language barriers. 29% of respondents said that they have lack of information about the opportunities and 18% found difficult to find an appropriate job in another member state (see Figure 1).

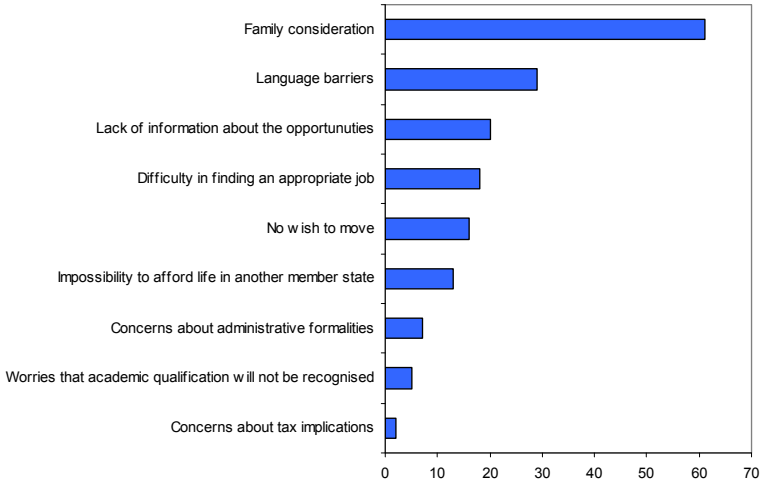

Figure 1: Reasons for giving up the idea of moving to another member state

According to quoted survey the main reason for giving up the idea to move to another member states are hindrances related to family life.

We can see that the existence of social ties is crucial factor in migration decision making. Social ties usually do not considerably influence person's everyday decisions concerning consumption, spending or saving. Hence an individual behaves correspondingly to economic theoretical models. However, when deciding about migration, social factors importantly influence final solution.

2.2. Enlargement of the European Union

Before 2004 enlargement many objections were raised against full introduction of free movement of labour for 10 new countries that actually led

[9] Internal Market Scoreboard No.11, November 2002

to the implementation of transitional period. The reasons for this measure were prevailing doubts about possible migration wave from new member states.

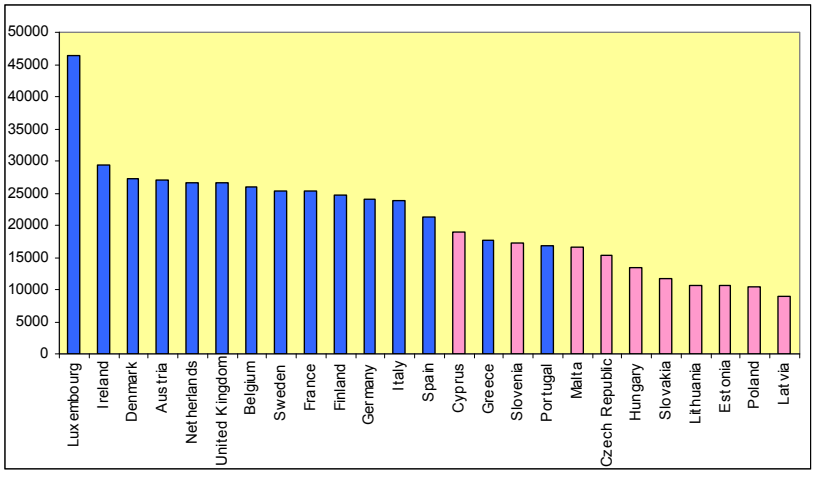

Figure 2: GDP per capita in PPS (2003) (Eurostat - Statistical yearbook 2004)

Comparison of economic indicators (see figure 2) led many people to conclusion that massive immigration wave to EU-15 states is unavoidable. Figure 3 shows regional level of GDP per capita for all 25 EU member states. We can see that in 2002 there were 6 countries that had regions with GDP lower than 50% of EU average. All of them were new member states - Estonia, Hungary, Latvia, Lithuania, Poland and Slovakia.

However, latest information does not show significant intensification of migration flows to countries that did not implement transitional period for free movement of people. According to OECD (2005) latest available data for the United Kingdom show that between May and December 2004 there were in total 133 000 work permit applicants from new member countries. Of these, nearly 40% were already in the United Kingdom before 1 May 2004.

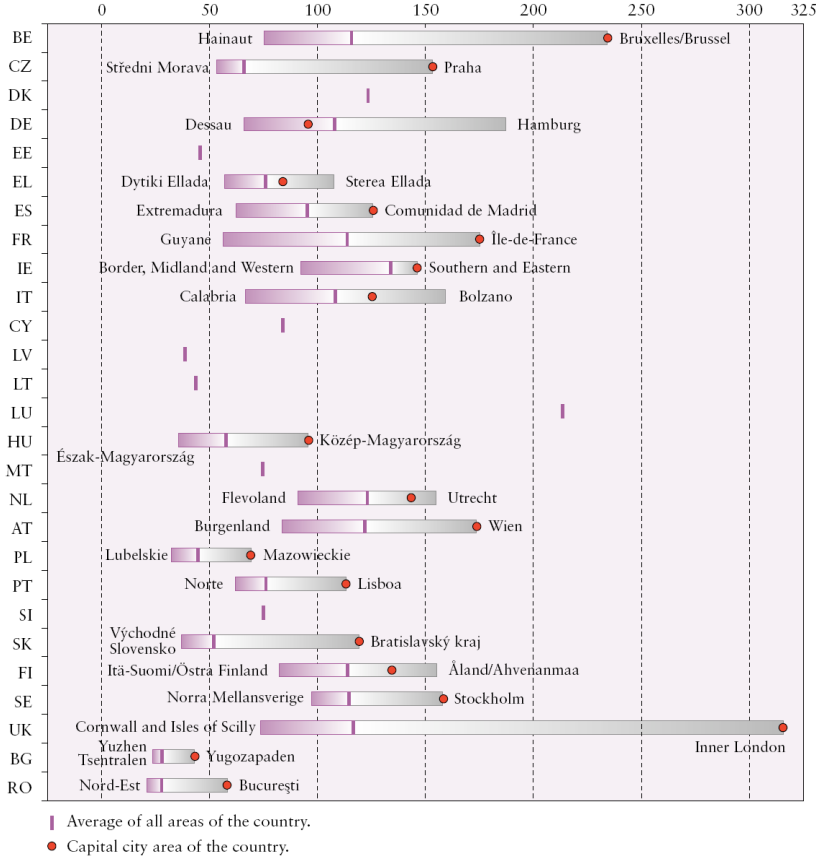

Figure 3: GDP per inhabitant in PPS (2002) NUTS 2 level in % of EU-25 average - EU-25 = 100 (Eurostat, Regions:Statistical yearbook 2005)

Similar fears that led to implementation of transitional period for free movement of people were raised prior to southern enlargement in 1981 and 1986. As well as for eastern enlargement huge migration waves did not occur.

Our model suggests that migration does not arise because the standard of living in the new member countries is so high that people are not only concerned in income maximization but also in "social utility" maximization. Their utility is also influenced by social ties they do have and that would be lost in case of migration into foreign country. Hence, the wage gap needed to motivate migration is quite large because it must exceed lost utility from social ties. The reason that bounds inhabitants in their home country is therefore their good standard of living and social ties.

3. THEORETICAL BACKGROUND

The model presented in this paper is based on the theory of motivation introduced in 1950s by Abraham H. Maslow. In the book "Motivation and personality[10]" Maslow presented five sets of human needs that drive human behaviour. These needs have been organized into hierarchy of relative dominance according to their appearance in human life.

First type of needs that ensure survival of individual are physiological needs such as hunger, thirst, appetite for some specific food (salt, sugar, vitamins...), sexual desire etc. In case that all needs a man can have are unsatisfied, the individual is above all dominated by these needs. All human capacities such as intelligence, memory and physical abilities serve only to one purpose - to satisfy physiological needs.

One of the main purposes of society is to ensure low incidence of physiological emergencies. Hence, situations when people starve or thirst are quite scarce in todays normally functioning peaceful societies. The question that arises is what motivates people when their physiological needs are satisfied.

Immediately after the physiological needs are gratified to some extent, other needs emerge that govern the organism. And when these new needs are satisfied, other (higher) needs come out once again. According to Maslow, safety needs are directly superior to physiological ones. Into the category of safety needs we may include desire for security, stability, dependency, protection, freedom from fear, from anxiety and chaos, need for structure, order, law, limits and so on[11]. Similarly to physiological needs, safety requirements completely dominate human organism in case the lower needs are satisfied and safety needs are not. Individual is seeking safety and stability and uses all abilities to achieve it. Manifestation of safety needs is for example general preference for familiar, known things rather than unfamiliar, obscure and unknown ones.

When the above mentioned needs are relatively well gratified, belongingness and love needs emerge. And the whole process of satisfaction starts over again. People long for friends, spouses, children, wish to be integral part of their family, clique, tribe, nation etc. We can observe unfavourable implications of loosing one's roots, one's territory, one's neighbourhood.

The two highest layers of human motivation are the esteem needs and the need for self-actualization. Esteem needs are demonstrated as longing for self-respect and reputation, the desire to be recognized and appreciated by others. People need to have the feeling of usefulness and of freedom and independence. Self-actualization means the need to do what an individual personally is "fitted for", what he is talented for.

[10] Maslow (1954)
[11] Maslow (1954)

4. MOTIVATION THEORY AND MIGRATION

Let us now discuss how Maslow's motivational theory conforms to migration behaviour. We have five stages of fulfillment of needs that the individual can experience. The first situation is when physiological needs are not gratified. Then the only desire is to achieve additional sources of nourishment. Individual will move into another location provided that this step decreases hunger or thirst.

Second, the individual has enough food but lives in unsafe, threatening surroundings where his life is endangered or the environment is chaotic and unpredictable. Then he or she will move to another location if the level of safety, predictability and order grows through such a step. Nevertheless, this move will not be done if the new safe place does not provide enough sources to guarantee gratification of physiological needs.

On the other hand, safety needs are an important factor binding people to their native land. The territory they are living in is familiar, majority of people they are dealing with are known, they have social status that is connected with some duties and rights, they can communicate with other people using their native language, they are well oriented in cultural customs and they know their rights and acceptable ways of behaviour. Unfamiliar and sometimes hostile environment in destination country disturbs safety and stability requirement and thus decreases benefit from migration.

Third, both safety and physiological needs are fulfilled but the individual suffers from absence of family, friends or colleagues. Social needs may encourage migration especially in cases when some of the family members already moved to new destination looking for work or safety and they left their families behind. The reunification of families is known as a fundamental stimulus of migration flows. On the other hand, the same strong force that motivates people to follow their relatives to foreign country inclines them to stay in their native land, surrounded by their families, friends, neighbours, working colleagues and their own nation.

Fourth factor that might motivate people to migration is their longing for esteem, reputation or glory. People will move if this step is followed by improved social status or attainment of fame. But moving may result in loss of hardly achieved position in social network as well.

The last motive for movement may, according to Maslow's theory, be the desire for self-actualization – the tendency to exert own talents and geniuses.

When a person decides to move, he must consider consequences of this step. There are many arrangements how to proceed and accordingly to disrupt or conversely attain level of fulfillment of social and safety needs. Movement to another country will disrupt safety and order in person's life more that movement within one's own country or, at least, to culturally close environment. Nevertheless, the violation might be less serious for people who either know somebody in the new destination or who are well

acquainted with the new surroundings. This may depend on education, language abilities, accessibility of information etc. The existence of ethnic cluster in destination may importantly decrease social loss caused by migration.

In our analysis we will simplify Maslow's approach and employ only three motives. Furthermore, we assume that there are only two levels of decision making[12]. At the first level only physiological needs are taken into account. When an individual reaches some threshold level of saturation of physiological needs, safety and social needs occur. If wage exceeds the threshold an individual seeks to secure all needs simultaneously.

The analysis of the two levels of decision making allows us to compare migration patterns in poor and developed countries and explain different migration behaviour of their citizens.

5. DESCRIPTION OF THE MODEL

Following section is devoted to the description of the model. In the model, an agent is equivalent to individual whose characteristics were described above. There are presented three models that incorporate three factors influencing utility of agents. First model takes into consideration only physiological needs and supposes that they are not satisfied for any income level. Hence the only interest of every agent is to maximize wage[13]. Second model adds need of safety that is represented by higher utility levels achieved in home environment compared to other regions. With number of periods spent in foreign environment additional utility acquired thanks to living in home environment gradually decreases. However, stability needs are activated only if wage exceeds certain threshold level. Third model examines situation when agents' utility is positively influenced by wage, safety and proximity of socially valuable individuals.

An environment the agents are situated in composes of three regions. Each region has 20 times 20 cells and is convoluted into the torus shape[14]. Toruses represent three regions with various wage levels. The ground for torus shape is non-existence of borders on its surface. The presence of borders might bias results because when placed in border cell the agent would have only five neighbouring cells instead of Moore neighbourhood[15] the other agents do have. This would decrease agent's potential utility from social contacts[16].

[12] Empirical findings confirm the existence of some hierarchical arrangement of human needs but there still does not exist clear evidence about the exact structure of the pyramid. See Alderfer (1969).

[13] We take wage as an instrument that allows agents to fulfil physiological needs (acquire food and beverages).

[14] see Figure 1.

[15] Moore neighbourhood is defined as eight neighbouring cells on grid.

[16] In reality, social environment has no such boundary positions.

Figure 4: Torus

Wage level in each region i at time t is given by equation[17]:

$$w_{it} = \frac{W_i}{n_{it}}, \quad i = A, B, C$$

where W_i is predefined wage parameter and n_{it} is number of agents present in region i at time t.

There are 399 agents. At the beginning of simulation 133 agents are placed in their home region and their exact position is determined randomly. It is possible to start different runs with identical initial distribution of agents.

5.1. Simple Model

The first model is based on assumption that agents are maximizing their utility only through maximization of their wage. Such situation occurs when an agent has not fulfilled physiological needs. In the model we simplify the problem of hunger-satisfaction into wage maximization task.

Utility of agent j at time t can be expressed as

$$u_t^j(w) = w_{it}$$

where w_{it} is wage an agent receives in region he is present in at time t. Agents have perfect information about their utility in each cell and choose cell with highest utility. In case of equal utilities cell is chosen randomly unless one of these cells is current location. In that case no movement is made.

5.2. Model with safety needs

In the second model we assume that presence in home region is valuable because safety needs are being fulfilled. However, if wage is below threshold value only physiological needs are taken into account and only wage is maximized. Utility function of agent j at time t is defined as

[17] Labour supply effect of immigration leads to a lower wage in receiving region. For background to this assumption see e.g. Bauer, Zimmermann (1999) pp.48.

$$
\begin{aligned}
u_t^j(w,b) &= \begin{cases} (1+w_{it})^{1-\alpha}(1+b_t^j)^{\alpha} & \\ \text{if agent is in home region} & \\ & \text{for } w_{it} > T \\ (1+w_{it})^{1-\alpha} & \\ \text{otherwise} & \end{cases} \\
u_t^j(w,b) &= w_{it} \qquad\qquad \text{for } \; w_{it} \leqq T
\end{aligned}
$$

where w_{it} is wage level in region the agent j is present in, $\alpha \in \langle 0,1\rangle$ is parameter of utility function indicating sensitivity to safety needs. T is threshold value of wage. For wage lower than T an agent is interested only in wage maximization[18]. For wage higher than T agent appreciates also the fact that he can spend his time in home region (safety needs activated). Benefit from living in home region is expressed by b_j variable.

$$b_t^j(\tau^j) = \frac{1}{\tau^j + 1}$$

where τ^j is number of periods agent j spent abroad. We assume that additional utility gained from living in home region decreases with time spent abroad.

5.3. Model with safety and social needs

In model with safety and social needs agent appreciates living in home region as well as direct contact with other agents that are socially valuable to him (social needs are activated).

Social value of agent k for agent j can be written as

$$
\begin{aligned}
s_t^{jk} &= s_{t-1}^{jk} + \sigma \quad \text{if } k \text{ is present in } j\text{'s Moore neighbourhood in period } t \\
s_t^{jk} &= s_{t-1}^{jk} - \sigma \quad \text{if } k \text{ is not present in } j\text{'s Moore neighbourhood in period } t \\
s_t^{jk} &= 1 \qquad \text{for } s_{t-1}^{jk} + \sigma > 1 \\
s_t^{jk} &= 0 \qquad \text{for } s_{t-1}^{jk} - \sigma < 0 \\
s_0^{jk} &= 0 \qquad \text{for all agents}
\end{aligned}
$$

where $t = 1, 2, 3...$ is time variable and $\sigma \in \langle 0,1\rangle$ is coefficient that determines speed of establishment and abandonment of social ties between agents. Utility function is again specified separately for different wage lev-

[18] In Maslow's approach the physiological needs are not fulfilled and hence all other interests apart from physiological ones are not activated.

els.

$$u_t^j(w,b,S) = \begin{cases} (1+w_{it})^{1-\alpha-\beta}(1+b_t^j)^{\alpha}(1+S_t^j)^{\beta} \\ \quad \text{if agent is in home region} \\ \qquad\qquad\qquad\qquad \text{for } w_{it} > T \\ (1+w_{it})^{1-\alpha-\beta}(1+S_t^j)^{\beta} \\ \quad \text{otherwise} \end{cases}$$

$$u_t^j(w,b,S) = w_{it} \qquad \text{for } \; w_{it} \leq T$$

where $S_t^j = s_t^{j1} + s_t^{j2} + ... + s_t^{j8}$ and $j1, j2..., j8$ are cells in Moore neighbourhood of agent j. Parameter $\beta \in \langle 0, 1 \rangle$ expresses sensitivity to social variable. T is physiological threshold. Below this wage level of agents are interested only in wage level.

First period in which agents make their decision about migration may be postponed (to allow them to create social ties with other agents).

6. COMPUTER SIMULATIONS

To be able to compare results of different models published in this paper, we start simulations mentioned here with the same initial distribution showed in Figure 5. There are 3 regions A, B and C marked as Grid: A, Grid: B and Grid: C. Wages in regions A, B and C are indicated below each region together with number of agents of each colour[19] present in given region.

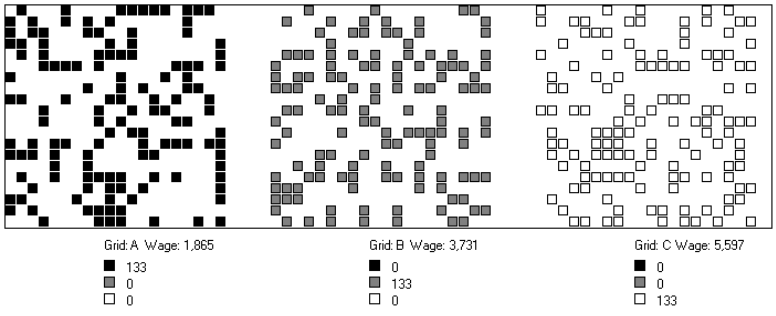

Figure 5: Initial distribution of agents

The agents decide one after another and distribution is depicted when all of them made their decision in given period.

[19] Black agents have region A as a home region, grey agents have region B as home region and white agents have region C as home region.

6.1. Simple model

We begin simulations with following wage parameters:

$$W_A = 250 \qquad W_B = 500 \qquad W_C = 750$$

Within first period 136 agents moved from their home region to another[20] and wages equalized in all three regions. See Figure 6.

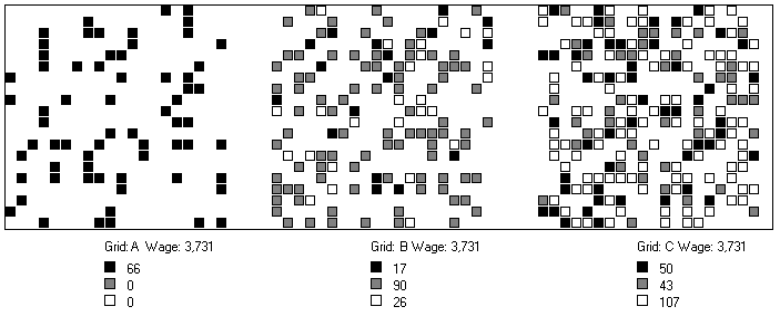

Figure 6: Simple model - stable state

If agents are not able to find stable state because their number is integral figure, multiple equilibria appear. This is the case e.g. for initial wage parameters $W_A = 100$, $W_B = 201$ and $W_C = 302$. See Figure 7.

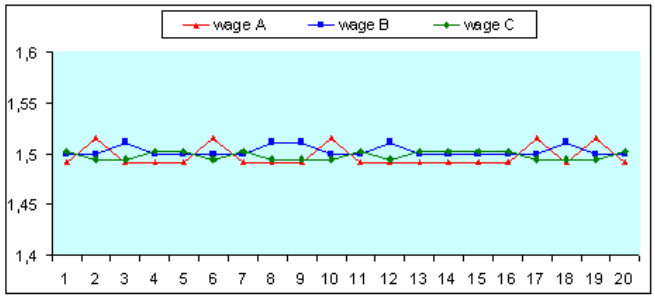

Figure 7: Simple model - development of wages in case of multiple equilibria

For all initial wage parameters W_A, W_B and W_C, the final wage levels will be either equalized or reach multiple equilibria state for the simple wage maximization model.

6.2. Model with safety needs

Figure 8 depicts stable distribution in case that safety needs are added to the model and wage parameters are set to $W_A = 250$, $W_B = 500$, $W_C = 750$ and $\alpha = 0.3$. Threshold $T = 0$.

[20] A → B: 17, A →C: 50, B → C: 43, C → B: 26

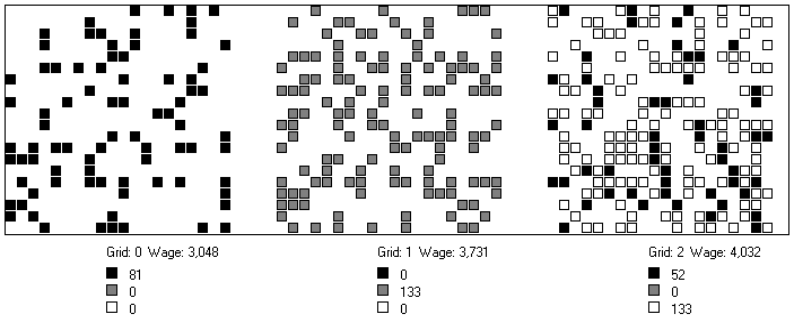

Figure 8: Model with safety needs - stable state

We can see that for coefficient $\alpha = 0.3$, wages are not equal in stable state. Stable state was achieved after two periods when 56 agents moved from both regions A and B to region C in the first run (highest wage was still in region C). In the following step all grey agents moved back to their native region whereas some black agents migrated to region C. When compared with simple model, the addition of safety needs caused re-emigration of grey agents to their home region and hence lower diversity of agents in region B. Wage differentiation partially survived.

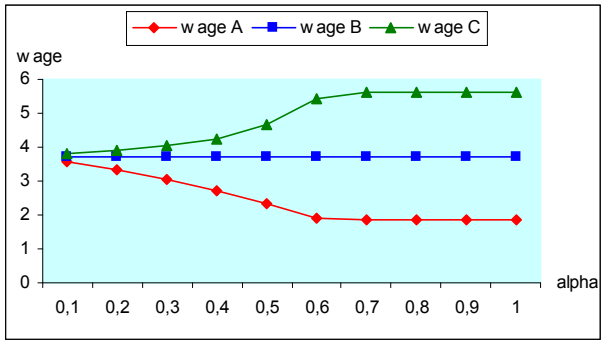

Figure 9: Model with safety needs - wage levels in stable state for different alphas

Figure 9 summarizes final wages in all three regions for various alphas, wage parameters $W_A = 250$, $W_B = 500$, $W_C = 750$ and $T = 0$. We see that for $\alpha \geq 0.7$ the influence of safety needs is so strong that no migration occurs at all. For wage parameters $W_A = 250$, $W_B = 300$ and $W_C = 350$ is this breaking point $\alpha = 0.4$.

On condition that we employ threshold $T = 3.5$, the dynamics of the system changes as well as final allocation of agents showed in Figure 10.

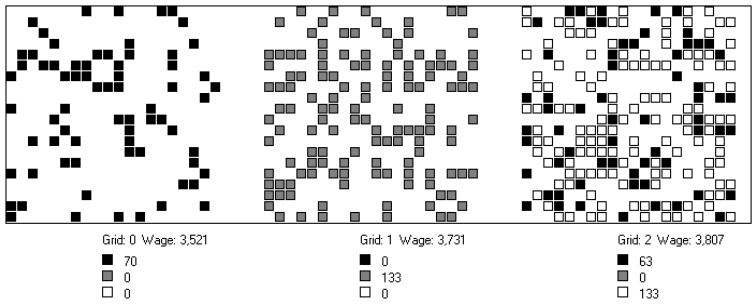

Figure 10: Model with safety needs - T = 3.5

It took 13 (instead of 2) periods to find stable state and there were totally 778 migration moves made. Final wage levels exceeded threshold $T = 3.5$ in all three regions. With the exception of first two periods only black agents migrated and influenced final stable state. Because agents were leaving region with wage below 3.5 and headed for region with higher wages, final wage in region A was above given threshold and wage levels were less varied than for simulation without threshold.

6.3. Model with safety and social needs

6.3.1. α set to 0

Let us first consider the case when $\alpha = 0$ hence agents' utility is not influenced by the region they stay in (safety needs are not included). The decision of agents depends on the value of coefficient β and P - number of periods the first decision is postponed for. Let us compare stable states for agents beginning their decision in the first period ($P = 0$) and after ten periods ($P = 10$) (Figure 11). Wage parameters are again $W_A = 250$, $W_B = 500$ and $W_C = 750$, parameter $\beta = 0.3$, speed of establishment of social ties $\sigma = 0.1$ and $T = 0$.

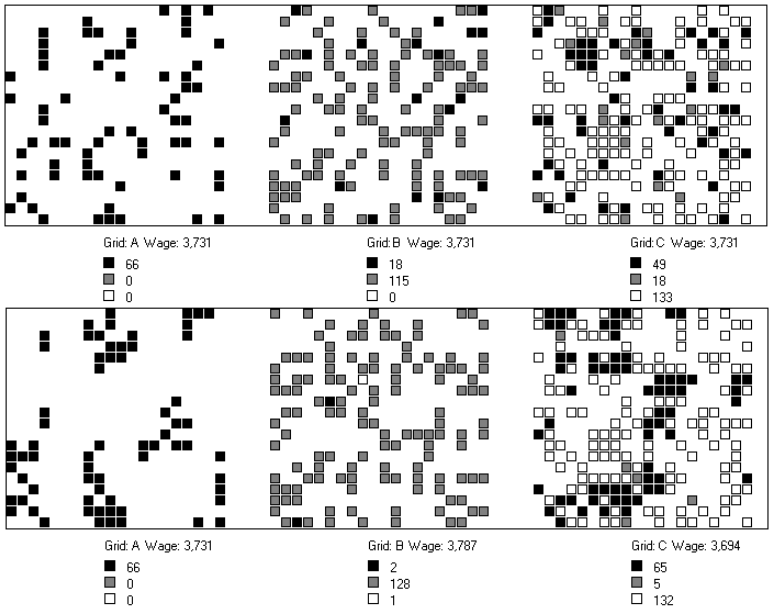

Figure 11: Model with social needs - stable state in case of P=0 (top) and P=10 (bottom)

In simulation with the first decision made in the initial period 85 agents moved in the first period and their migration equalized wages in regions. We can see that as against the model with safety needs (Figure 10) 18 grey agents find it beneficial to stay in region C. This is caused by fact that in the first period social ties are so weak, that agents are able to equalize wages and then they do not have any motive to move further because social ties from the first period are equalized by new social ties established in new location and they gradually strengthen.

Postponement of first decision until tenth period led to slightly lower migration in the first decision making period (tenth period in the real time). Number of migrating agents in periods 10 to 15 were 79, 23, 9, 1, 0. It is interesting that in the first decision-making period so many black agents moved to region C that wage in region A rose to 4.098 that was the highest wage level of all regions. The reason may be the joint movement of socially tied agents. Agents maybe followed some of their socially valuable agents that already moved when wage advantage of region C was important. Stable state wages are slightly different in the three regions for 10 period postponement.

postponed for	0 periods	w_A	= 3.731	$w_B = 3.731$	$w_C = 3.731$
	10 periods	w_A	= 3.731	$w_B = 3.787$	$w_C = 3.694$

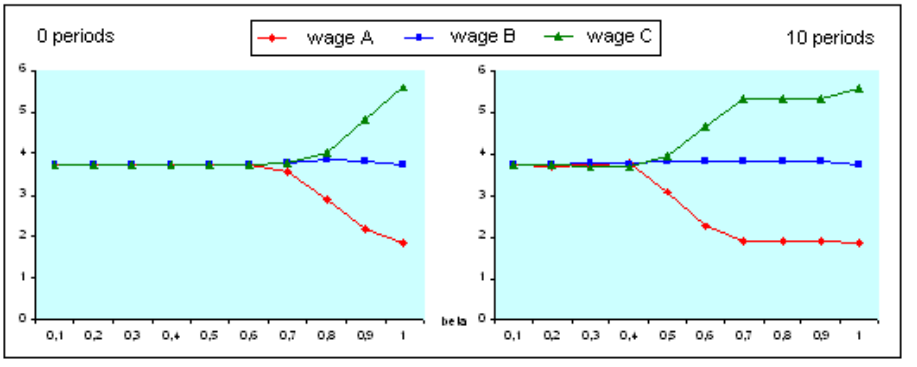

Figure 12: Model with social needs - wage levels in stable state for different betas and postponement 0 and 10 periods

For identical values of coefficient β higher variation in wages appears when the first decision is potponed (see Figure 12). Postponement enables agents to establish social ties. Hence agents in whose Moore neighbourhood other agents are present are less motivated to move to region with high wages. In case of movement, contribution of socially valuable neighbours would be lost.

Figure 13: Model with social needs - T = 3,5, first decision postponed for 10 periods

Let us now discuss identical simulation with threshold $T = 3.5$. and postponement P = 10. Migration flows intensified - 158 moves were made in comparison with 112 in case of zero threshold. In stable state highest wage level was achieved in region A whereas without threshold highest wage was in region B. (This is not a rule for all initial states.)

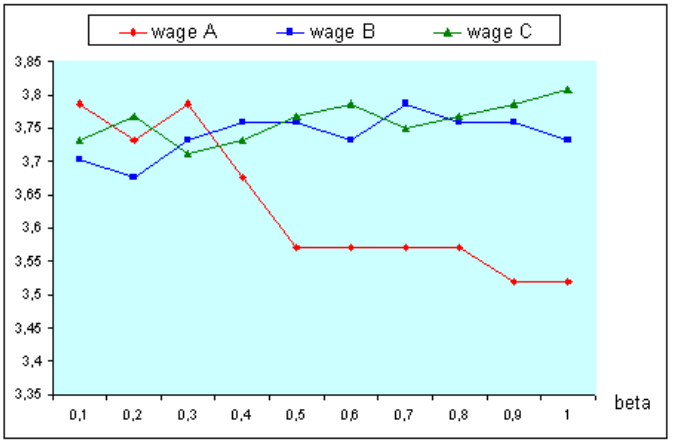

Figure 14: Model with social needs - wages in stable state for different betas, T = 3.5, P = 10

Figure 14 shows simulations with threshold 3.5 for 10 period postponement. Maximal wage difference is achieved for $\beta = 1$. Wages are $w_A = 3.521$, $w_B = 3.731$ and $w_C = 3.807$. Compared to zero threshold case ($w_A = 1.865$, $w_B = 3.731$ and $w_C = 5.597$ for $\beta = 1$) the existence of threshold leads to significant wage equalization. The higher is the threshold T the closer are final wages to equal wages case.

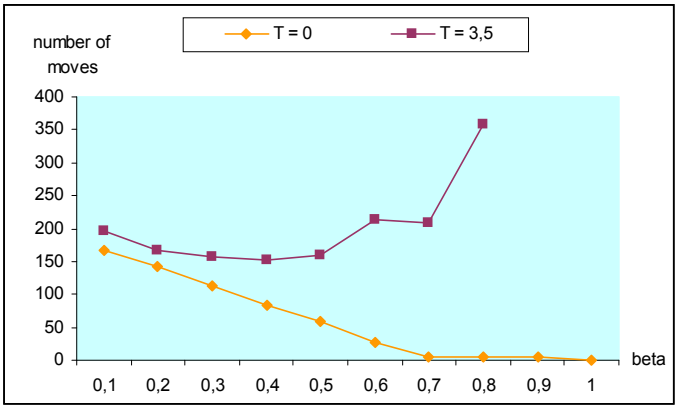

Figure 15: Model with social needs - number of moves needed to achieve stable state for different betas, P = 10; T = 0 and T = 3.5

It is also intriguing to observe number of moves needed to achieve stable state. In case of zero postponement agents reach stable state after one period for both $T = 0$ and $T = 3.5$. In case of 10 period postponement it takes usually more than two periods to find stable state and for $T = 3.5$ and for β equal 0.9 and 1 the stable state was not achieved even after 500

periods. Figure 15 shows number of moves needed to reach stable state for 10 period postponement.

6.3.2. Safety and social needs included

Let us now discuss model with both safety and social needs active. Wage parameters are again set to $W_A = 250$, $W_B = 500$ and $W_C = 750$ and coefficients $\alpha = 0.3$ and $\beta = 0.3$. Speed of establishment of social ties $\sigma = 0.1$ and threshold $T = 0$ and postponemnt $P = 10$ (see Figure 16).

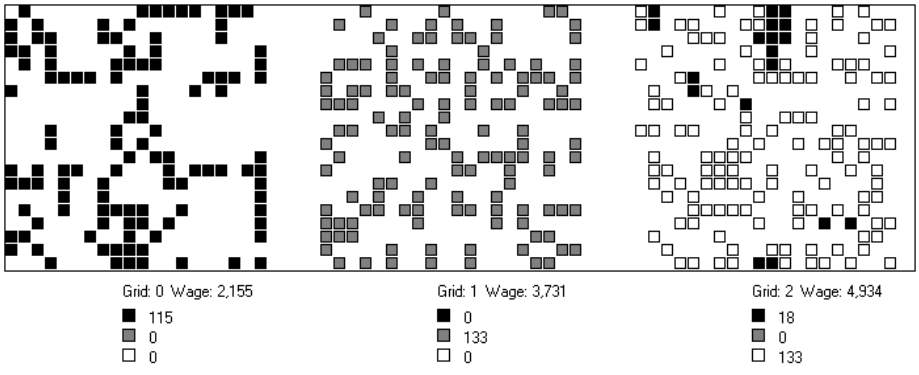

Figure 16: Model with safety and social needs - P=10, T=0

When decision was postponed until tenth period, only 8 agents migrated in this period, followed by 1, 1, 3 and 5 agents in subsequent periods. Then the system reached stable state with zero migration. Wage level in region B remains unchanged. We can see that combination of social ties created within first ten periods and safety needs leads to some kind of "conservatism" - agents are less mobile and less willing to leave their home region. Agents from region with lowest wage moved to the region with highest wages.

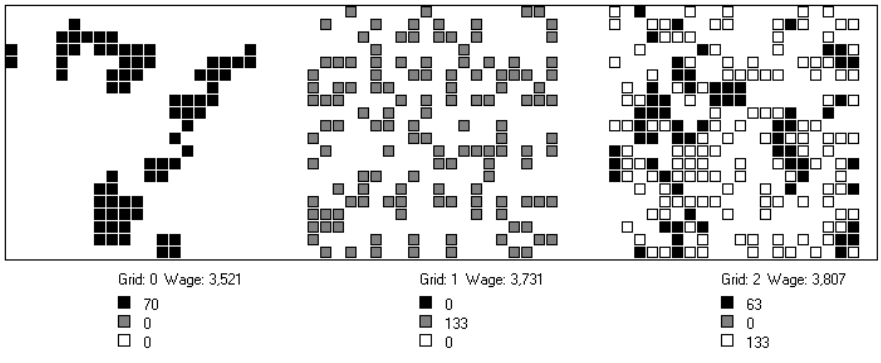

Figure 17: Model with safety and social needs - T = 3.5, P = 10

For threshold $T = 3.5$ and $P = 10$ (Figure 17) an intriguing situation occured that we already saw in Figure 15. Here again stable state was not reached even for 1000 periods elapsed[21]. Wages stabilized at the same level as in model with safety needs and $T = 3.5$, they were less equalized than in model with social needs and $T = 3,5$.

7. CONCLUSIONS

Migration literature often mentions social aspects of life as highly influential as concerns migration decision-making. Social costs of movement and, on the other hand, benefits from supportive ethnic clusters in destination area are frequently noticed. There are many studies dealing with social networks in destination area but social costs of movement are only rarely included into analysis. Our approach allowed us to examine impact of social ties on migration flows.

What is more, our model reflects the fact known and recognized by psychologists but scarcely used in economics. That is general preference for known, familiar and predictable environment. In case of migration we can express this psychological phenomenon as general preference of living in native country compared to life abroad.

In comparison with other migration models we are able to explicitly work with preference for known, familiar environment and appreciation of proximity of friends, family and other socially tied individuals. These factors are in majority of models hidden under the all inclusive term "barriers". In fact, to disclose real factors influencing migration may be crucial for policy measures aimed at migration.

The model leads to following conclusions:

1. If agents include safety and social needs into decision making then wages in all regions either exceed minimal physiological threshold or are equalized in stable state.

2. If agents include safety needs into decision making then wages may remain unequalised in stable state.

3. If agents include social needs into decision making then wages may remain unequalised in stable state.

4. The more important are social and safety needs, the lower convergence of wage levels due to migration occurs.

In the real world this would mean that:

1. People should move from countries where wages are below physiological threshold.

[21] Migration flows settled on 2 agents making their moves in each period.

2. If people appreciate living in home country compared to foreign country and their income is higher then physiological minimum then migration flows might stop even if the wage differences between states (regions) exist.

3. If people appreciate proximity of people they well know and their income is higher then physiological minimum then migration flows might stop even if the wage differences between states (regions) exist.

The implications for real world economies are quite apparent. First, if countries provide social security benefits above the physiological threshold, people in their decisions take into account also other than economic factors. Hence, people are less mobile, less willing to move from current location due to economic reasons.

Second, real migration flows depend on individual valuation of social ties and safety. These features might be largely determined by cultural habits and customs. Therefore, identical wage differences might induce different migration flows in various regions.

Third, wage differences may persist even though no barriers to migration exist. The way to induce mobility of people then lies in reduction of native country preference through e.g. language education or support of international social ties.

The model offers many ways for further use and also many possible refinements. First, finding of real-world coefficients for the model might be quite demanding but worthwhile task. The initial distribution might be enriched by predefined social ties (substituting family relations) and at the same time, some percentage share of agents might be placed in other than home region simulating already existing ethnic clusters. Another possible improvement is identification of each particular agent that would allow us to observe how agents in socially tied groups react and behave. Finally, the implementation of some kind of dynamising element in the developing economies could enrich our knowledge further.

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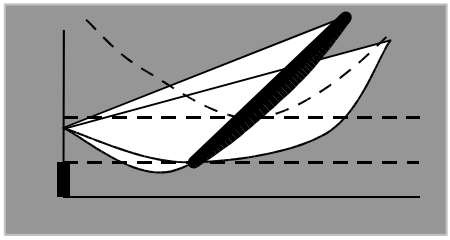

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