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MIGRATION AND RESIDENCY

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A Field Theoretical Model of the Polish Emigration to Other European Countries

Abstract: This article presents a formalized field theory of international migration. Departing from the theories of Kurt Lewin, the author assumes that the valences of different migration targets create a field of attracting forces, which may trigger long-range "locomotions." Moreover, the author hypothesizes that the selection among the different migration targets also depends on the perceived opportunities: the higher the number of vacancies at a target and the stronger the reporting about these vacancies by earlier migrants, the stronger the field of perceived opportunities. A mathematical model based on these theoretical assumptions is tested with data about migration from Poland to other EU countries. The goodness of fit of the model is quite high and seems to corroborate its field theoretical foundations. The model is further explored by simulating its behavior for different scenarios of valences and perceived opportunities. The article finishes with a summary from the perspective of analytical sociology.

Keywords: Poland, international migration, social field theory, analytical sociology, international comparisons

Introduction and Overview

In the 1930s and 1940s the American social psychologist Kurt Lewin (1936, 1951) developed a field theory of individual behavior (Rummel 1975: chap. 3.3). Lewin's departure point was the individual's personal life space, which he assumed to be segmented into subspaces (e.g., school, home, etc.) with positive and/or negative valences, representing related gratifications and/or pains. Consequently, valences constitute a field of attracting or repelling forces, which induce individuals to locomote through their life space. Depending on the individual's characteristics (e.g., age, gender, etc.) the subspaces (e.g., bars, schools, etc.) may be insulated by social or physical barriers in such a way that locomotion to the target-segment is impossible for the individual, or necessitates detours.

It would seem that Lewin's concepts could be used as a theory of migration. For the purpose, individuals' life spaces have to be extended to global scale, with subspaces representing the different destinations of international migration. The pull- and push-factors in Lee's migration theory (Lee 1969) correspond to positive and negative valences, which induce international migration, in Lewin's terminology called "locomotion." Lewin's barriers can be reinterpreted as restrictions by immigration laws or lack of opportunities to work and settle at the destination.

There are many different field theories in the social sciences (Martin 2003: 14): theories of social psychological fields in the tradition of Lewin (May 1972: chap. 3–4); theories of fields of stratification associated with Bourdieu (Hilgers and Mangez 2015; Bourdieu 1985); and field theories of inter-organizational relations, as represented by DiMaggio and Powell (1983). Here we are concentrating on Lewin because his concept of locomotion (Lewin 1951: 39) comes rather close to the idea of international migration. Moreover his ideas of the field are relatively similar to the use of the concept in the natural sciences, where fields are vectors or scalars allocated to points in physical space and time (Weisstein 2009a, 2009b). As demonstrated in the next following section, Lewin's ideas can be used for the development of a formalized field theory of migration, to explain the flow of migrants from a given origin to different destinations.

Thereafter, we test our theory with data on Polish emigration to different countries of the EU. Poland is an interesting case for such a test, as it has a high share of total migration to many of these countries. Moreover, Poland became a member of the EU in 2004 and subsequently profited from a gradual opening of the European labor market. This situation enables us to explain observational data about Polish emigration in 2010 and 2015 relatively well.

The model presented takes two interacting fields into account: one refers to the opportunities at different destinations and the other to valence-induced attracting forces. By varying the main parameters of these fields, it is possible to simulate the effects of parameter changes on Polish migration. It turns out that emigration is a self-reinforcing process that may, however, be slowed by a decrease of the economic valence of the destinations in relation to the valence of the country of origin.

In the final section, I use James Coleman's boat scheme (Coleman 1990: chap. 1) to summarize our migration model. In this scheme, the migrants' decision-making at the micro-level can be related to fields that belong to the macro-level of the analysis. Thus, the present theory is rooted in the tradition of analytical sociology, which uses micro-mechanisms in order to deduce empirically testable associations at the macro-level.

A Field Theoretical Model of Migration[1]

In order to explain the behavior of individuals, Lewin (1936, 1951) assumes that their life space is divided into segments, which have valences and generate a field of attracting forces. As usual in the natural sciences, this field is only indirectly visible by the locomotion of the individuals toward the sources of the field (Rummel 1975: 27–28). Thus there is action at a distance (French 2005): it is not "mystical" but based on human needs such as wealth, recognition, and security, and knowledge about places where these needs can be satisfied (Rummel 1975: 245–246). If Lewin's ideas about individual micro-behavior are transferred to the macro-phenomenon of international migration, the individual life space is world society, segmented into countries with valences like wealth, social security, good climate, decent housing, and so on. As a matter of course, these valences are not absolute but always relative in regard to the social situation of the country of origin. Consequently, we postulate as our *theoretical assumption 1*

[1] For an overview of the mathematical terms used in this and the following sections see appendix 1 at the end of the article.

$$F_D \approx V_D^b, \text{ with parameter } b > 0, \tag{1}$$

a positive correlation between an attracting force F_D to a destination D and its overall valence V_D. The set of all forces $F_{D=1,2,\ldots}$ constitutes a scalar field (Weisstein 2009a), anchored in the destinations $D = 1, 2, \ldots$

As already recognized by Lewin (1951: 261 ff.) the concept of a field of attracting forces implies the possibility of decision-conflicts between different goals/destinations. In this situation, rational choice would imply that all migrants from a given origin would move to the same destination D, that is, the target with the highest force F_D or valence V_D. This is obviously not the case and disqualifies the rational choice approach, among other reasons due to the generally limited number of opportunities at D. In order to resolve such decision conflicts we assume that in a sufficiently short span of time Δt, a potential migrant perceives at most *one* opportunity, which he or she can take advantage of or leave to others. Consequently we postulate as our *theoretical assumption 2*

$$P_D \approx F_D * O_D \tag{2}$$

that the *probability P_D of moving to D* is proportionate to the *probability O_D of perceiving a new opportunity at D* times the attracting force F_D of the said destination D. Thus, if there really exists a perceived opportunity to migrate to D, the probability that this opportunity is taken increases with the attracting force F_D, which in turn depends on the valence V_D of the destination D (see equation (1)).

Equation (2) implies that there is not only a *field of forces $F_{D=1,2,\ldots}$* but also a probabilistic scalar *field $O_{D=1,2,\ldots}$ of opportunities*. Each of the probabilities O_D obviously depends on the *rate H_D of the availability of vacant holes at D* (generally job vacancies). Many of these opportunities are reported to the country of origin by earlier generations of migrants at D. Thus, the higher this *density of contacts C_D* between the origin and the destination D, the higher the probability O_D of the perception of a new opportunity. In sum, we are postulating as our *theoretical assumption 3*

$$O_D \approx H_D * C_D^c, \text{ with parameter } c > 0, \tag{3}$$

a mechanism leading to a form of generalized chain migration (Bartram et al. 2014: chap. 8), which goes beyond traditional family unification.

The previously described fields $O_{D=1,2,\ldots}$ of opportunities and of attracting forces $F_{D=1,2,\ldots}$ affect, in the country of origin, not solely the one individual mentioned in equation (2) but the whole *population of N individuals*. Consequently, in order to calculate the *stream of migrants S_D* from this origin to the destination D we have to multiply equation (2) by N. Thus we postulate as our *theoretical assumption 4*:

$$S_D = N * P_D \approx N * F_D * O_D \tag{4}$$

If F_D and O_D are substituted by the equations (1) and (3), the *theoretical assumption 4* can be re-written as

$$S_D = a * N * V_D^b * (H_D * C_D^c),$$
$$\text{with a proportionality constant } a > 0 \text{ and parameters } b > 0 \text{ and } c > 0 \quad (5)$$

Thus, the stream of migrants S_D to D increases with the population N at the origin, the valence V_D of D, the rate H_D of new vacant holes at D, and the density C_D of contacts with earlier generations of migrants at D. It is important to note that the latter process is self-reinforcing and may lead to a cumulative causation of migration to the target D (Bartram et al. 2014: chap. 11; Fussell 2011).

An Empirical Test of the Model with Polish Data

Operationalization of the Major Concepts

In order to test the previously presented model, we used OECD data about emigration from Poland to other European countries during the years 2010 and 2015. Data referring to the first of the two time points were for calibration and parameter estimation; data related to 2015 were used for model validation. The focus on Poland as the country of origin has two important advantages: (1) the absolute frequencies of Polish migrants to EU countries are in most cases sufficiently high for reliable statistical analyses; and (2) since Poland became a member of the EU in 2004 legal and administrative obstacles to Polish emigration to other EU countries have been systematically removed, ending in 2011 for the last European target countries. This is important since the model tested does not consider this type of obstacle.

The previous theoretical assumption 4 described by the equation (5)

$$S_D = a * N * V_D^b * (H_D * C_D^c) \quad (5)$$

gives an overview of the relevant model variables, which have been operationalized in the following way:[2]

S_D = Stream of Polish migrants per year to different European destinations D, measured in thousand persons. Source for 2010: OECD 2015, Tab. B.1. Source for 2015: OECD 2018, Tab. B.1. If in one of these sources Poland was missing from the list of most important immigrant groups to a destination D, it was assumed that $S_D = 0$. According to the OECD (2015: 266–267) there are various nation-specific systems of counting immigrants, which differ in their reliability. For instance, immigration may be underreported if it is based on registration, which is not compulsory for all destinations D (see: Grabowska-Lusinska 2013: 43 ff.).

N = Population of Poland, measured in million inhabitants. Source for 2010: OECD 2016, "Population." Source for 2015: OECD 2019, "Population."

[2] a, b, c are model parameters and not directly operationalized/measured. Thus their numerical values had to be determined by a statistical estimation procedure, which is described in one of the next paragraphs.

V_D = Rel. valence of the destination D, as compared to the valence of the country of origin, that is, Poland. Assuming that GDP p.c. is a good indicator for general development, which correlates with many other development variables, we operationalized V_D = (GDP p.c. of destination D / GDP p.c. of Poland). This operationalization obviously neglects the valences of non-materialist aspects of quality of life. However, the simplification seems acceptable since Polish emigration is mainly labor migration and consequently economic factors are of great importance (Bartram et al. 2014: chap. 25). Source for 2010: OECD 2016, "Gross Domestic Product." Source for 2015: OECD 2019, "Gross Domestic Product."[3]

H_D = Rate of new vacant holes for migrants at D. Assuming that the number of all immigrants from any country is proportionate to the number of vacancies for migrants, H_D is operationalized as the aggregated number of migrants in a given year from any place in the world to destination D, measured in thousand persons. Source for 2010: OECD 2015, "Total" of Tab. B.1. Source for 2015: OECD 2018, "Total" of Tab. B.1.

C_D = Contact density to earlier migrants from Poland at destination D. The operationalization of C_D is based on the assumption that information about new opportunities at D is not based on advertisements in public media but rather on personal contacts between family members and friends: the bigger the *stock* of earlier Polish migrants at D as related to the total Polish population, the more contacts the average citizen in Poland has in order to get new information about the destination D. Hence C_D is operationalized as the per-mille of the Polish population living at D. Sources for 2010: OECD 2015, Tab. B.5 and OECD 2016, "Population." Sources for 2015: OECD 2018, Tab. B.5 and OECD 2019, "Population." If in one of the migration sources Poland was missing from the list of most important immigrant groups to a destination D, it was assumed that $C_D = 0$.

Parameter Estimation and Tests

Equation (5) contains three parameters: a, b, and c, which have to be estimated by an appropriate regression procedure that fits the model to the observational data. The model structure of equation (5) suggests the use of S_D as the dependent variable, which has, however, a rather skewed statistical distribution. In order to correct this problem we divided the left- and right-hand side of the equation (5) by H_D, which was thus transformed into

$$S_D / H_D = a * N * V_D^b * C_D^c \tag{6}$$

with a new dependent variable S_D / H_D, which can be reinterpreted as the share of Poles in total migration to destination D. Since N does not vary with D, the term $a * N$ can be replaced by a new parameter *const* such that the previous equation (6) is simplified as follows:

$$S_D / H_D = \text{const} * V_D^b * C_D^c \tag{7}$$

[3] The variable name of the OECD-source is misleading: "Gross domestic product" is in this source not GDP but GDP *p.c.*

After another logarithmic transformation we get from equation (7) an equivalent expression

$$\lg(S_D / H_D) = \lg(\text{const}) + b * \lg(V_D) + c * \lg(C_D) \tag{8}$$

which would allow the use of multiple linear regression in order to estimate the unknown parameters. However, this approach leads to data losses because S_D / H_D is for certain cases equal to zero and consequently $\lg(S_D / H_D) = \lg(0)$ cannot be calculated. Thus we preferred to continue with equation (7) in order to do non-linear statistical regressions.

On the basis of the data for 2010, parameter estimation with the non-linear regression module NLR of the SPSS-24 software (Backhaus et al. 2011: 52 ff.) yielded the results summarized in Tab. 1. They explain the effects of the relative valence V_D and the contact density C_D on the relative share S_D / H_D of Poles in the total migration to D. Since the estimates of all parameters are at least 1.9 times greater than the related standard errors, one-tailed z-tests suggest statistical significance on the level $\alpha = 5\%$ or even better. Moreover, the *positive* signs of *b, c*, and *const* all correspond to the theoretical expectations and the adjusted $r^2 = 0.764$ is quite high. This impression of a good correspondence between model and data is further corroborated by Fig. 1a, where none of the analyzed countries substantially deviates from the diagonal line, which represents the perfect model-fit.

Table 1

Parameter Estimates for Explaining S_D / H_D

b: Effect of V_D	c: Effect of C_D	const: Constant	Number of obs.	Adjusted r-square
+1.750 (0.598)	+0.377 (0.095)	+0.019 (0.010)	19	0.746

Legend: Dependent variable: Rel. migration flow S_D / H_D; Model equation: (7); Year: 2010; Sample of destinations: See Tab. 2 (appendix); Start values of the parameters of the non-linear regression: b = 1, c = 1, const = 1. Method: Levenberg-Marquardt; (…): Standard errors of the parameter estimates for b, c, const.

The excellent model-fit of Fig. 1a might be questioned by the fact that the related data were used not only for testing but also for calibrating the model. However, by re-using the parameter estimates of Tab. 1 [4] it is additionally possible to explain a pure validation sample, referring to Polish migration in 2015. As the related Fig. 1b demonstrates, the data for the different destinations are scattered around the main diagonal of perfect correspondence such that the unadjusted [5] $r^2 = 0.752$ is again quite high.

Some Implications of the Model

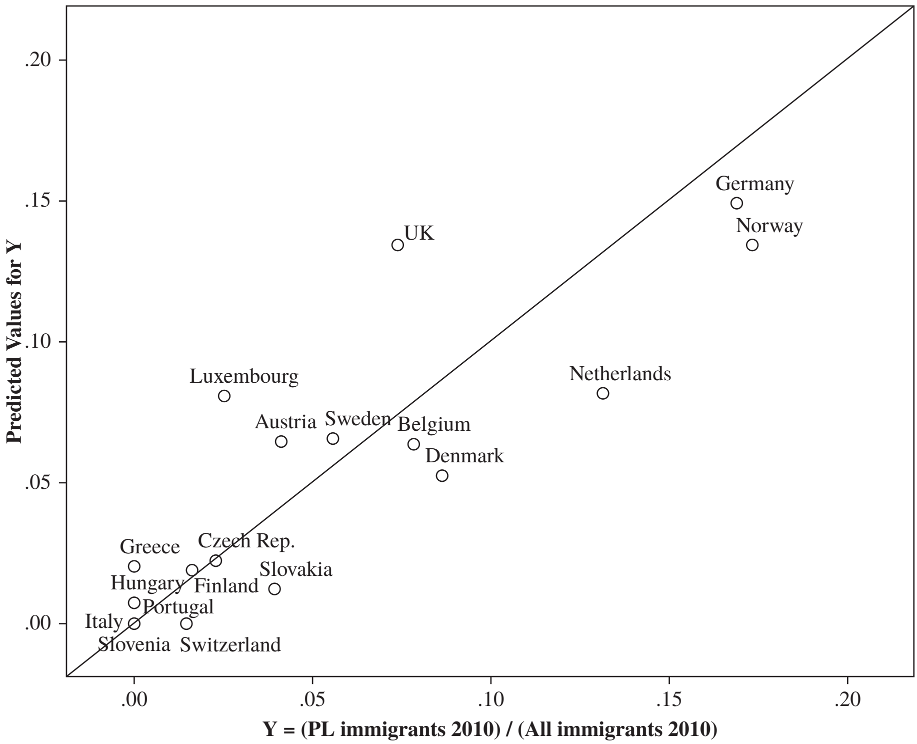
According to equation (5) the stream S_D of Polish migrants to D is proportionate to the annual number of vacant holes H_D, which are available at the destination D. If there are no new vacancies available at D and consequently $H_D = 0$, equation (5) obviously predicts $S_D = 0$. If H_D increases, the stream S_D increases too, where the relation

[4] For long-term analyses const = a * N is not really constant but changes with the population figure N. However, since the population of Poland decreased between 2010 and 2015 only by 1.3%, the estimate of *const* for 2010 could also be used for the predictions in Fig. 1b, which relate to 2015.

[5] For a pure validation sample no adjustment of r^2 is required.

Fig. 1a

The Correspondence Between the Real and the Predicted Shares of Polish Immigrants $Y = S_D / H_D$ in 2010



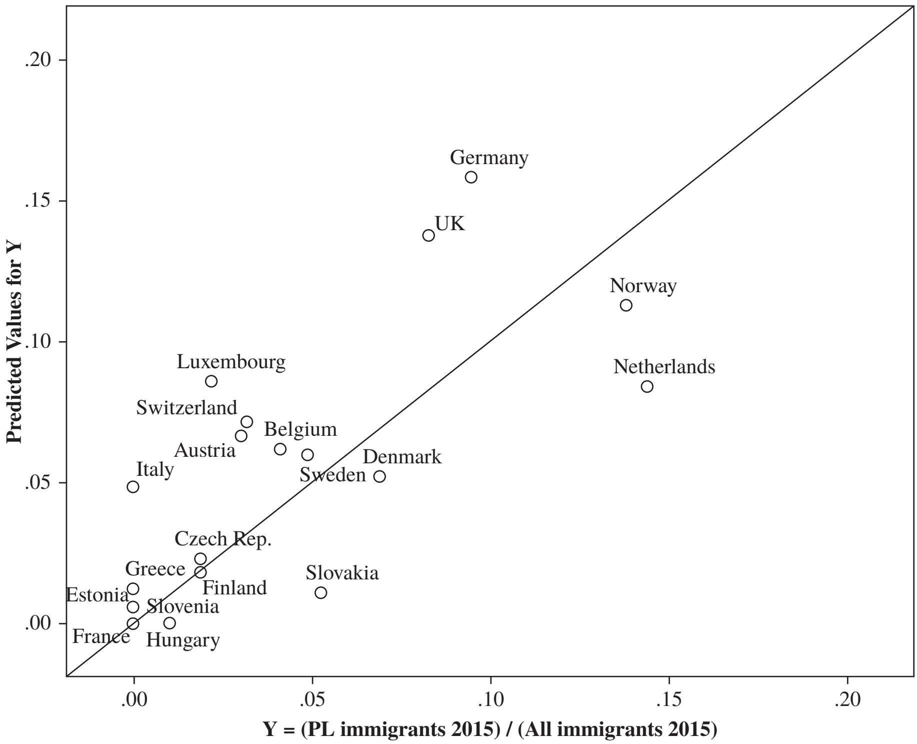
$$S_D / H_D = \text{const} * V_D^b * C_D^c \tag{7}$$

is always maintained. Thus, in order to explore the model, we have to analyze the effects of the variation of the contact density C_D and the valence V_D on the variable S_D / H_D, which corresponds in this article to the share of Poles in the total migration to D.

If the contact density $C_D = 0$, there are no reporters who inform potential migrants at home about new vacancies. As a consequence, the field of perceived opportunities is eliminated and no migration to D takes place (see Fig. 2). This breakdown of the field of opportunities is probably not fully correct, because highly qualified potential migrants may use media publicity as an alternative source of information about new vacancies. However, the literature about chain migration (Bartram et al. 2014: chap. 8) suggests that for many less qualified potential migrants, direct contacts with earlier migrants are still important. If $C_D > 0$, Fig. 2 shows for growing contact densities C_D only "sub-linear" effects because the related parameter $c = 0.377 < 1$ (see Tab. 1). This is plausible, since more reporters at the destination D imply the risk of redundant information about the same opportunities. In spite of these declining effects on migration, C_D is self-reinforcing. The higher C_D, the stronger the flow of migrants to D, which in turn increases the strength of the contact density C_D.

Fig. 1b

The Correspondence Between the Real and the Predicted Shares of Polish Immigrants $Y = S_D / H_D$ in 2015



This leads to Polish societies abroad, as described by White (2018), for the immigration targets Germany, the UK, etc.

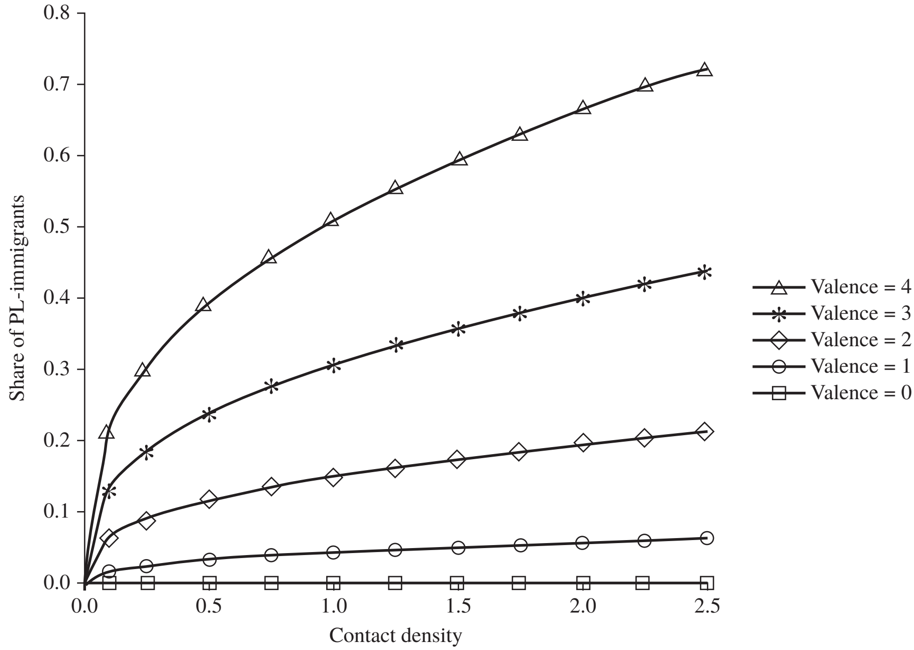
Valence $V_D = 0$ implies — like the above-mentioned situation of $C_D = 0$ — a breakdown of migration: see Fig. 2. This is plausible, since $V_D = 0$ means that destination D has absolutely nothing to offer potential migrants. For $V_D = 1$, the destination's valence is about the same as the valence of the origin. Consequently the migration is weak: according to Fig. 2, generally below the share $S_D / H_D = .06$. For $V_D > 1$, the share of migrants from Poland rapidly accelerates due to the nonlinear impact of V_D on S_D / H_D. According to Tab. 1, the corresponding relation is nearly quadratic and thus implies

$$S_D / H_D \approx V_D^{1.750} \tag{9}$$

The effect of the field of attracting forces is consequently much more important than the effect of the field of opportunities. Doubling the valence V_D implies an increase of the share of Polish migrants S_D / H_D by a factor $2^{1.750} = 3.36$, whereas by doubling the density of contacts C_D the share of Polish migrants in the overall immigration increases only by a factor $2^{0.377} = 1.30$. Consequently, the cumulative causation of the density of contacts C_D (Bartram et al. 2014: chap. 11; Fussell 2011) may slow, if the Polish economy grows faster than the economy of destination D and thus decreases the relative valence V_D of the destina-

Fig. 2

The Share of Polish Immigrants S_D / H_D for Different Valences V_D and Contact Densities C_D



tion. This seems to have happened between 2010 and 2015, when due to a strong increase in the Polish GDP p.c. the average relative valence of the destinations decreased from 1.844 to 1.657 and consequently the average share of Polish migrants S_D / H_D decreased from 0.0489 to 0.0384.

Summary and Outlook from the Perspective of Analytical Sociology

The model presented in this article is rooted in the tradition of analytical sociology (Hedström and Swedberg 1998). It combines plausible but solely hypothetical assumptions about individual behavior with statistically well-documented outcomes at the macro-level. Thus a good way of summarizing our model is to identify its equations as mechanisms in Coleman's boat scheme (Coleman 1990: chap. 1), which typically represents the paradigm of analytical sociology (Hedström and Swedberg 1998: 21 ff.).

On the micro-level of Fig. 3, there is an individual *action-formation mechanism*: It describes the probability

$$P_D \approx F_D * O_D \tag{2}$$

of emigration to D as a function of the attracting force F_D and the probability O_D of perceiving an opportunity to migrate to D. As mentioned earlier, this mechanism avoids decision conflicts in another way than the classical rational choice approach: it assumes that O_D is so small that at a given moment in time at most *one* opportunity for emigration to D = 1 or D = 2 or D = 3, … is perceived. Since the field of attracting forces and the probabilistic field of opportunities describe the situation in which the individual makes his or her decisions, the related equations

$$F_D \approx V_D^b \tag{1}$$

and

$$O_D \approx H_D * C_D^c \tag{3}$$

are, in the terminology of analytical sociology, *situational mechanisms* (Hedström and Swedberg 1998: 23). They form a bridge from the macro- to the micro-level. There is a similar bridge from the micro- to the macro-level: the *transformational mechanism*, which describes the transformation of individual decisions into a collective outcome, that is, the migration stream S_D to the destination D:

$$S_D = N * P_D \tag{4}$$

Thus, taken all together, the transformational, the situational, and the action-formation mechanisms suggest the postulated *macro-level association* of our theoretical assumption (4):

$$S_D = a * N * V_D^b * H_D * C_D^c \tag{5}$$

Fig. 3

The Correspondence Between the Field-theoretical Migration Model and Coleman's Boat Scheme

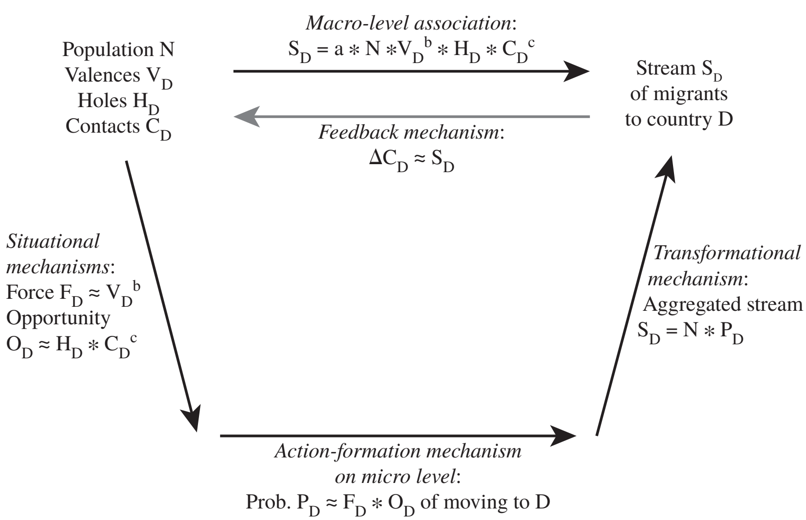


Fig. 3 contains a further macro-mechanism, which is not explicitly conceptualized in Coleman's boat scheme: the *feedback* from the output of the model to its input:

$$\Delta C_D \approx S_D \tag{10}$$

The stream of migrants S_D increases the contact density C_D and the related probability of opportunities O_D. This makes migration a potentially self-sustained process with an ever-growing diaspora at D. However, as we observed for Poland between 2010 and 2015, this process may be decelerated by reducing the relative valence V_D of the destination D. A precise quantitative analysis of this process requires a dynamic simulation model, which will be one of the next steps in this research.

This model has been successfully tested with data about general labor migration, which do not take into account the professional and educational qualifications of the migrating people and the skills required at destination D. With regard to the discussion about brain drain (Bartram et al. 2014: chap. 7), which also concerns Eastern Europe (Grabowska-Lusinska 2013: 42–43), this limitation seems to be unsatisfactory. However, in principle, the present model is also suitable for explaining the streams of particular types of migrants such as unskilled workers or academics. For this purpose, the operationalizations of migrant-streams S_D, vacancies H_D, contact density C_D, and population N at the origin have to be narrowed in such a manner that they comprise only persons and jobs with the characteristics of interest. Similarly, the relative valence V_D has to be refined and adapted, for instance, by taking into account the salaries of the groups analyzed. Thus, the main problem of a more differentiated migration analysis is not the field theory presented in this article but rather the availability of comparable and appropriate data for many different countries.

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Appendix 1: Glossary of Mathematical Terms

a, b, c	Positive model parameters.
C_D	Contact density to earlier migrants from the country of origin at D.
const	Positive model parameter.
D	Destinations, numbered $D = 1,2,3,\dots$.
F_D	Attracting force of destination D.
$F_{D=1,2,\dots}$	Field of attracting forces.
H_D	Rate of availability of new vacant holes at D.
lg	Logarithm to base 10.
N	Number of persons living in the country of origin.
O_D	Probability of a perceived opportunity at D.
$O_{D=1,2,\dots}$	Field of a perceived opportunities.
P_D	Probability of migration to D.
S_D	Stream of migrants from the country of origin to D.
V_D	Valence of destination D in relation to the country of origin.
ΔS_D	Change of the stream S_D of migrants.
Δt	Time interval for a decision about a (non-) migration.
$y \approx x$	Proportionality between two variables y and x: $y = k * x$, where k is a positive constant.

Appendix 2: Data

Tab. 2

The Polish Data for Testing and Estimating the Model

Destination D:	C_D:		V_D:		Y_D:	
	2010	2015	2010	2015	2010	2015
Austria	1.003	1.429	2.032	1.883	0.041	0.031
Belgium	1.291	1.792	1.906	1.724	0.078	0.041
Czech Rep.	0.473	0.516	1.307	1.270	0.023	0.019
Denmark	0.587	0.850	2.029	1.850	0.087	0.070
Estonia	—	0.021	1.022	1.103	—	0.000
Finland	0.057	0.097	1.858	1.589	0.016	0.019
France	0.000	0.000	1.742	1.539	—	0.000
Germany	10.894	17.742	1.958	1.809	0.169	0.095
Greece	0.265	0.245	1.405	1.014	0.000	0.000
Hungary	0.070	0.000	1.046	0.993	0.000	0.000
Italy	0.000	2.597	1.668	1.389	0.000	0.000
Luxembourg	0.070	0.100	4.097	3.876	0.025	0.022
Netherlands	1.364	2.621	2.171	1.897	0.132	0.144
Norway	1.434	2.463	2.852	2.280	0.174	0.139
Portugal	0.000	0.000	1.306	1.119	0.000	0.000
Slovakia	0.145	0.137	1.180	1.120	0.039	0.053
Slovenia	0.000	0.000	1.338	1.192	0.000	0.010
Spain	0.000	0.000	1.570	1.321	0.000	0.000
Sweden	1.062	1.268	2.024	1.826	0.056	0.049
Switzerland	0.000	0.563	2.480	2.410	0.015	0.032
UK	14.286	22.500	1.740	1.585	0.074	0.083

Legend: C_D: Contact density; V_D: Rel. valence of destination; $Y_D = S_D / H_D$ = Relative share of Polish immigrants. For details see section "An Empirical Test of the Model with Polish Data."