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INTERNAL MIGRATION IN REGIONS OF GERMANY: A PANEL DATA ANALYSIS

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Abstract

The objectives of this paper are to examine the traditional determinants of interregional migration between regions of Germany after reunification in 1989. The period considered is 1993-95 as the high average migratory flows of the earlier period, 1989-92, had settled down to a level of about 12000 to 15000 per month by 1993. Wage convergence has taken place much more rapidly than the convergence in unemployment rates between regions of East and West Germany. Due to wage convergence we find that the relationship between regional wage differences and migration is non-linear. For white-collar workers the relationship is U-shaped while for the blue-collar workers, the relationship is inverted U-shape. The explanation for such a relationship lies in the 'option theory of waiting' and attitudes towards risk under wage convergence. While housing and infrastructure variables do play an important role at the margin, wage convergence can prevent the loss of human capital from East German regions to West Germany.

Panel Data, Wage Differences, Migration, Non-linear and Infrastructure
JEL Classification No: C23, J61, J31 and C31.

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Internal Migration in Regions of Germany: A Panel Data Analysis

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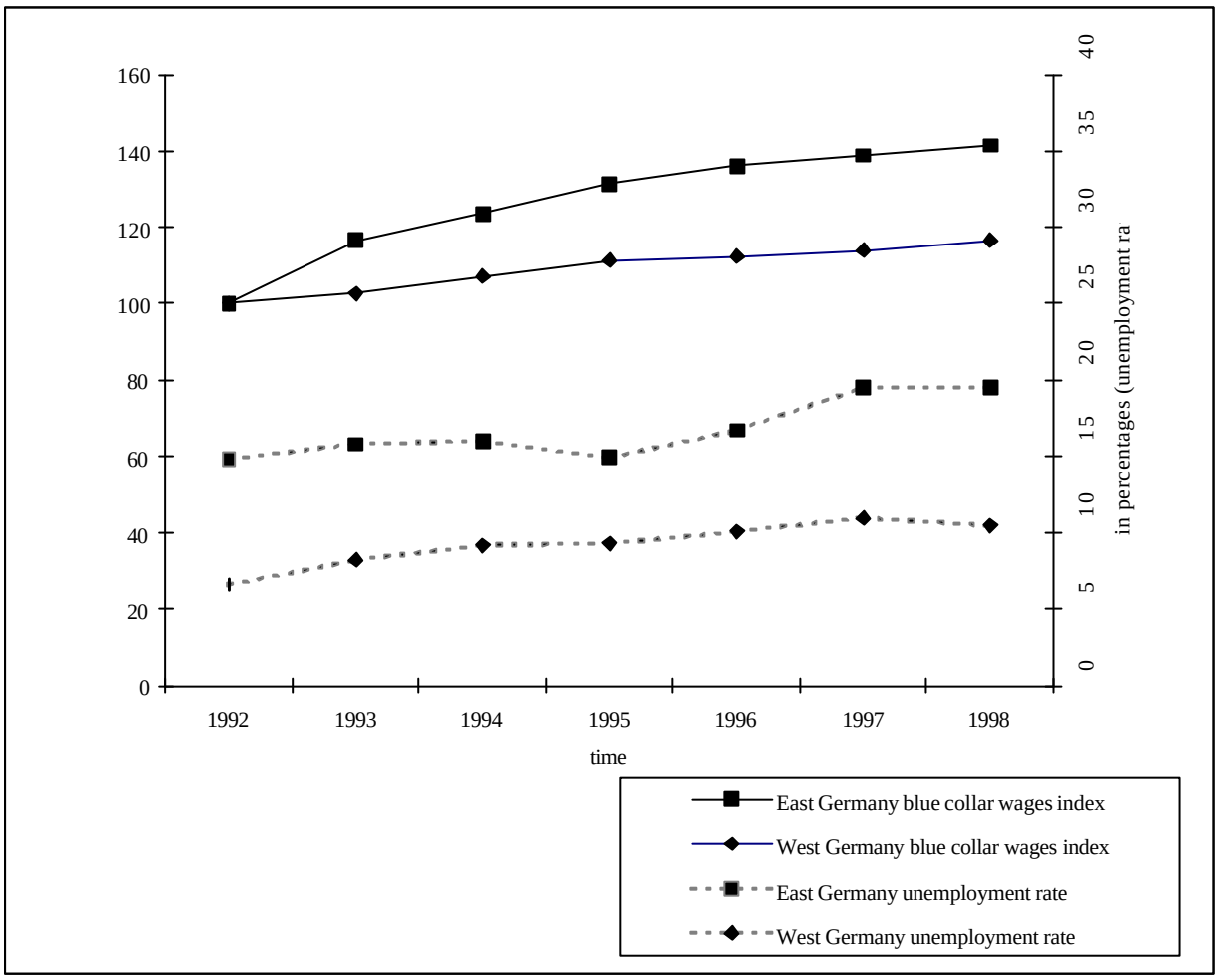
1. Introduction

Many lessons can be learned from the internal migration experience that followed German reunification. Immediately after unification large number of East Germans migrated to West German regions and the figures suggest that such large migration has high costs in terms of loss of human capital for the source regions of East Germany. The average wage gap between Eastern and Western Germany was about 25% and it is narrowing gradually. Wage convergence between East and West German regions has taken place much more rapidly than the convergence in unemployment rates. Unemployment has hovered around 17-18% for the past two years in East Germany while the West German economy has experienced unemployment in the range of 7 to 8%. Graph 1 on monthly wages for West Germany and East Germany from 1992-1998 shows this wage convergence between East and West Germany.[1] Household incomes in East Germany have tripled since unification 10 years ago, but productivity remains only 60% of the West German level. The East German economy grew twice or even thrice as fast as the West German economy in the early years after unification largely due to a building boom.

The convergence of living standards within countries can be brought about by the flow of goods and capital and if this is not sufficient, the adjustment in the labour flows between regions within a country may be a plausible alternative. In Europe, most authors claim that this latter mechanism is pretty weak and labour mobility has remained very low (Decressin and Fatas, (1995)). Low labour mobility is sometimes attributed to varying social security systems in parts of Europe (between East and West Germany before unification), social, cultural and linguistic barriers and other region specific factors. Variations in social security system and linguistic and cultural barriers are less important after unification as East and West Germany have the same language and culture.

[1] Beginning with 100 index for East German and West German wages in 1992, the top line for East German wage index indicates that wages in East Germany have risen considerably faster than those in West Germany which suggests convergence of East German wages to West German wage level for blue collar workers.

Graph 1 West and East Germany: Development of wages and unemployment rates



Source: Statistisches Bundesamt Wiesbaden.

The objectives of this study are to examine the well-known determinants of population/labour migration between regions of Germany after reunification and whether such determinants have radically changed between the pre-unification and post-unification period under the influence of wage convergence between East and West Germany. The chosen period is, therefore, not 1989-92 but 1993-95, when most of the large migratory flows had stabilised to about 12000 to 15000 per month. Most studies use population migration data to study labour migration and this study is not an exception. In our previous study (Leuvensteijn and Parikh (2001)) we used both sets of data to show that the use of either population or labour migration data did not make any significant difference to the results. This study specifically investigates the following issues: Does immigration into region i from region j depend upon differences in wages and unemployment rates? Is there any perverse behaviour among the unskilled and skilled worker groups? Is there a non-linear relationship between migration and

income differences as suggested by attitudes to risk and the option value of waiting approach? Do house ownership versus rental property and distances between regional centres have any effect on the relationship between wage-differentials and migration?

In Section 2, the theory and a review of literature are presented. In Section 3, the data are described while in Section 4 the model and results are discussed. Moreover, the relationship between the wages of white-collar workers and gross flows is presented. In Section 5, summary and conclusions are presented. Appendix 1 provides further information on data used and collected from the German Statistical offices.[2]

2. Theory and Review

Most contributions in the field of labour migration use the Harris-Todaro model as a starting point. In Harris and Todaro (1970) a neo-classical model is developed in which (international) migration is caused by geographic differences in the supply and demand for labour. Regions with a relatively limited supply of labour in relation to capital will generally have a relatively higher wage that will attract a large inflow of labour from low wage regions. This inflow of labour is mirrored by an outflow of capital.

Pissarides and McMaster (1990) have suggested a modification of the Harris-Todaro model to explain net migration defined as total inflows in a region less total outflows from a region. These flows are regional aggregates. A household calculates a gross utility for remaining in the region of residence and a region where they intend to move. A move takes place if the cost of migration is lower than the gross gain of moving. Indeed the gross gain from moving may depend upon a variety of factors namely personal characteristics, of which age and skill are quite important. Both observed and unobserved household characteristics determine the cost of moving. These household characteristics are distributed randomly across the population. Assuming a large population, the proportion of a region's population that moves out is a rising proportion of the gross gain from moving and the proportion that moves in is a declining function of the same gain. The net migration rate is defined as the difference between a region's immigration and emigration expressed as a proportion of its population and it is a rising function of the gain from moving into the region. The gain from moving depends upon relative wages and regional unemployment rates. If a region's wage rises, the gain from moving in rises and the gain from moving out falls and as a result the immigration into the region tends to rise. Regional unemployment also affects the migration in two ways. Firstly, unemployed workers are more likely to move out than the employed ones, because the unemployed have less to

[2] In Appendix 2, we use amenities approach on panel data. These results can be obtained from the authors.

lose than the employed. Hence, if a region's unemployment rises, the net migration rate into that region should fall. Regional unemployment differentials approximate the differences in employment probabilities in regions. In the Harris-Todaro framework it is the expected income based on the probability of employment, which matters under the assumption that individual agents are risk-neutral and not quantity constrained and both unemployment differentials and relative wages can be converted to a single "expected income" variable. As these assumptions of risk neutrality and no-quantity constraint are unlikely to be satisfied in practice, both relative wages and unemployment differentials enter separately in the model specification and empirical estimation. Aggregate unemployment may also have an influence on the gains from migration (Gordon, 1985). If unemployment is higher everywhere the employed may find security in whatever employment they are holding and if they have obtained seniority rights in their present jobs, their gains from moving might be reduced. Unemployment duration can have an effect on net migration. The unemployed worker may be discouraged from moving. If unemployed workers are risk-averse or face liquidity constraints, the gains from moving might be reduced.

Decressin (1994) uses a gross utility approach with amenities (facilities) proxied by the availability of housing, the infrastructure and the natural qualities of individuals and utilises the data on gross migration flows (place to place migration) information. The discouraged worker effect is clearly captured through the regional unemployment rate in regions of Germany. If the regional unemployment rate is very high the person intending to migrate to that region is likely to be discouraged to undertake the move. There are other studies on internal migration that follows the similar approach (Erikson (1989) and Puhani (1999)). Finally, Oswald (1999) analyses the interrelation between the employment and the structure of the housing market and commuting activities in a macro economic framework. In a theoretical approach Oswald shows that homeowners are less likely to migrate (to move) if a negative demand shock occurs in the source region. They will prefer to commute to another region, instead of moving. So the ownership of a house results in a less flexible response to low regional demand for labour. There are three hypotheses that result from this theory: a. Owners of houses are more likely to become unemployed; b. Owners of houses are less likely to move to another job, because they are not willing to leave the region; and c. Unemployed house-owners are less likely to move than unemployed renters. It follows from the above that regions with a relatively high percentage of house owners in the population will have less migration than other regions.

The Harris Todaro model is a macro economic model that corresponds to a micro-economic model described in Borjas (1990). In the model by Borjas, migrants compare the cost of moving to alternative locations while maximising

the expected discounted net return over a certain time horizon. This is measured by the difference between the positive net expected earnings corresponding to individual skills in the region of origin and the region of destination. By subtracting the expected costs of moving one may find the expected net return of migration. The outcome of the micro-economic model differs slightly from that of the macro-economic model. The main difference is that movement of population (labour) between regions is determined by the differentials in wages and in unemployment rates in a macro context while the expected net return of migration is the prime consideration for a household's decision to move to another region. The differences in unemployment rates determine the probability of finding a job in a macro model. Another difference is that in a micro model, high-skilled workers are expected to move more than low skilled workers.

Massey (1993) extends the above micro-economic model of Borjas by focussing on the household as the unit of decision-making instead of the individual. Households are able to diminish the risk of a decrease in income by diversifying the allocation of resources such as family labour. Reasoning from a household point of view is more closely related to population migration than to labour migration that has the individual as the decision-making unit. The decision making process of a household differs from that of an individual. A household can assign members of the family to economic activities in the local economy while sending others to a labour market in a different region. Of course, the existence of unemployment insurance makes it less necessary for the household to diversify the allocation of income sources. Still the households may decide to diversify, because of differences in growth of income between regions. The main conclusion from this analysis is that migration does not necessarily stop when regional differentials in wages or unemployment rates do no longer exist.

Apart from economic variables also social factors are relevant, as described in the network theory. In this theory migration networks are described as sets of interpersonal relations due to kinship, friendship or a shared community of origin. These factors tend to increase labour migration between regions since the networks reduce the asymmetry in information among people living in the destination region and other regions. The quality of the network depends on the time that a person has lived in the region of destination and whether the person is well established. These networks diminish the costs and risks of migration. The costs are diminished since the immigrant usually has a place to live and may obtain a first job through the network of a relative, reducing the probability of not finding a job. Emigration becomes a more reliable source of income since the probability of finding a job increases. The diversification of household labour will eventually become risk-free and costless.

Dixit and Pindyck (1994) and Burda (1993) pointed out that the migration decision can be explained by the option value of waiting since it is characterised

by: a) a fixed cost which is to some extent unrecoverable, b) uninsurable uncertainty and c) the possibility of waiting and postponing the decision and therefore, postponing the payment of the fixed costs. These characteristics mean that the migration decision is sensitive to the option value of waiting. The option value of waiting is explained diagrammatically below.

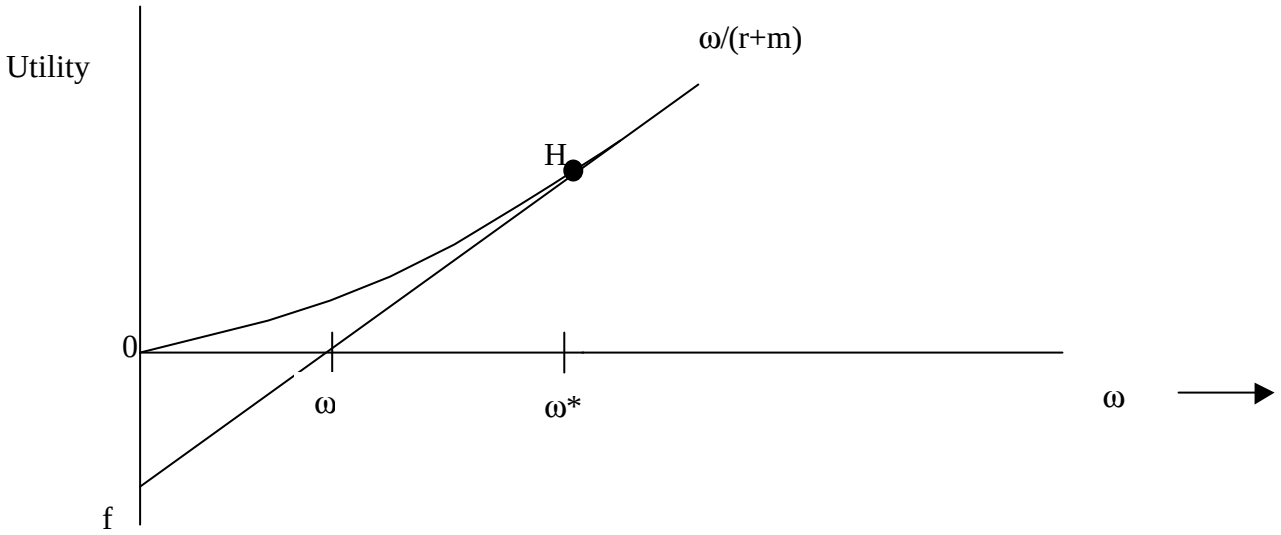


Diagram 1

In the above diagram 1, ω is the present wage differential in logs or utility (U=logW-logW*) differential, r is the discounted rate and m is the rate of wage convergence. Migration cost F is a fixed proportion of utility (f) in the East German regions. The Marshallian trigger is the one where the decision in favour of migration is based on the expected positive net worth. This criterion only accounts for acting right now to get the utility of migrating versus not migrating at all. It does not take into consideration that waiting for a while and then reassessing the decision is also possible. The modified Marshallian trigger would be the one where the option value of migration is equated to that of waiting and this is realised at point H corresponding to the relative wage difference ω*. At any point like ω*, the migrant will be indifferent between the decision of waiting to migrate versus decision to migrate now. The decision to migrate has positive value even when $\omega < \omega^*$ but option to wait has a higher value when $\omega < \omega^*$. In the model, the option value of waiting is negatively related to the discount rate r and positively related to m, the rate of wage convergence. At all points above $\omega > \omega^*$, the decision to migrate will dominate the decision to wait as the former has higher utility than the latter. This can be illustrated by the following example: consider a worker that earns a wage in East Germany and expects to receive a higher wage in West Germany. The waiting time of his decision to move from East to West Germany will play an important

role if the wages of East and West Germany are converging. In this case, waiting to move may increase the worker's wage without any costs of migration. Waiting is also sensible when the migration costs diminish or the value of time of a person decreases. Since a worker not only takes into account the present wage differential, but also the future wage differential and because either the fixed costs of migration or the speed of migration may vary over the wage-structure, non-linear relations between migration and wage differentials may be the most plausible outcome.

Daveri and Faini (1996) found that low unemployment and high wages are both important in encouraging immigration in the Italian regions. However, some studies for other countries not only find that the unemployment rate in the source region has no impact on emigration but also that the wage differential has the opposite sign to the expected one.[3] Decressin (1994) uses migration flows between West German federal states in the 1980s to analyse the determinants of migration and he finds that individuals tend to move from high to low unemployment regions and from low to high wage regions. Burda et al (1998) found a U-shaped relation between household income and the desire to migrate.

Hunt (2000) lists a few explanations for low emigration from East to West. Firstly, daily commuting from East to West is feasible and commuting acts as a substitute to emigration. Secondly, the large early outflows have left behind individuals with large moving costs. Large moving costs tend to deter immigration. Thirdly, cultural differences between East and West Germans reduce migration.

3. The Data

The data on migration flows at the federal state level are from the Statistisches Bundesamt publication. All individuals in Germany must be registered with the new community to which they move. These data aggregate the local level information from the old and new addresses provided by an individual on moving. The wage and unemployment variables are from Statistics Yearbook (Statistisches Jahrbuch). In this study, data on gross population migration flows, unemployment rates, wages of blue-collar and white-collar workers, infrastructure in terms of hospitals and hotel beds in each region were obtained from Statistisches Bundesamt. The cost of living differences between East and West German regions were further considered. In Appendix 1, the exact definition of the different variables is given.

The statistical office in Germany acquires the data on population flows through a yearly census, which amounts to 1 percent of the household population. From

[3] For unemployment, see Lundberg (1991) for Sweden; Pissarides and Wadsworth (1989) for Britain and Bentivogli and Pagano (1999) for the Euro-zone. For wages, see Jackman and Savouri (1992).

this survey information, gross flows of labour migration and population migration can be derived. Since every person has to register while moving to another region, the information on population migration flows is recorded. The Bundesamt also asks a person whether he or she earns a living. If the question is not answered it is assumed that the person does not work.

Table 1. Descriptive statistics of the variables used

Name of the Variable	1993		1994		1995	
	Mean	sd	Mean	Sd	mean	sd
Blue collar wages (logs)	8.179	0.179	8.283	0.1705	8.2733	0.1593
White collar wages (logs)	8.404	0.187	8.45	0.1566	8.5078	0.1399
Unemployment rate (%)	12.021	3.603	12.021	3.955	11.481	3.154
Unemployment rate (log)	2.443	0.308	2.367	0.3583	2.409	0.2503
Hospital beds (per inhabitant)	794.000	122.47	772.59	119.76	751.39	119.8
Hotel nights (number of beds per capita)	0.0209	0.0149	0.0252	0.0149	0.0267	0.0148
Cost of living (index)	117.87	9.7	120.08	10.1	114.34	8.55
Rental price (per square meter) DM	8.220	2.066				
Owned houses per capita	0.146	0.0509				
Rented houses per capita	0.258	0.068				
Population in each receiving region[a] (in log):	15.087	0.876	15.088	0.881	15.055	0.8816
$LogP_{total}$	8.4869	1.0134	8.485	1.0299	8.4961	1.0289
$LogP_1$	8.4997	1.0510	8.4738	1.1115	8.5467	1.1009
$LogP_2$	7.7974	0.9043	7.8448	0.9273	7.8834	0.9402
$LogP_3$	7.1226	1.2045	7.2756	1.2759	7.3183	1.2821
$LogP_4$	6.3279	1.1264	6.2996	1.1795	6.3977	1.1202
$LogP_5$	7.3067	1.3413	7.2253	1.3757	7.2161	1.3378
$LogP_6$	8.2008	1.0571	8.1939	1.1258	8.2059	1.1453
$LogP_7$	6.8326	1.0263	6.8765	1.0278	7.0180	1.0105
$LogP_8$	8.7720	0.8881	8.7707	0.9199	8.7013	0.9439
$LogP_9$	8.7966	0.8732	8.7706	0.9293	8.7927	0.9086
$LogP_{10}$	7.8436	1.2583	7.8285	1.3421	7.7889	1.3219
$LogP_{11}$	5.8941	1.2644	5.8883	1.3276	5.8733	1.3363
$LogP_{12}$	7.4080	1.1395	7.5036	1.1305	7.5751	1.1466
$LogP_{13}$	7.0737	1.0775	7.1243	1.1090	7.1538	1.1410
$LogP_{14}$	7.6045	1.2598	7.6144	1.2787	7.6169	1.2866
$LogP_{15}$	6.8974	1.2647	6.9403	1.2547	6.9240	1.2777
$LogP_{16}$						

[a]. Sixteen regions are: 1. Baden-Wurtemburg, 2. Bayern, 3. Berlin, 4. Brandenburg, 5. Bremen, 6. Hamburg, 7. Hessen, 8. Meckelburg, 9. Niedersachsen, 10.Nordrhein-westfalen, 11. Rheinland-Pfalz, 12. Saarland, 13. Sachsen, 14. Sachsen-anhalt, 15. Schleswig Holstein, 16. Thuringen.

$LogP_i$= Mean of logarithm of immigration from region j to i, i=1,2,……16.

$LogP_{total}$= Mean of Log totals of immigrants in each region.

Table 1 describes the means and standard deviations of various variables. It follows from table 1 that most of the variables do not vary much over time; only the number of hospital beds diminishes rapidly between 1993 and 1995. The

rental price and the per capita owned and rental houses were only available for 1993.

4. The Model and Results

This study following Decressin (1994) uses population migration data. A major consequence of using population migration data instead of labour migration data is an overestimation of labour migration due to the inclusion of migrated retirees, children, students and others migrating because of marriage or divorce or any other reason other than the search for employment. Since most of the discrepancy between labour migration and population is not necessarily related to economic variables like wages and unemployment, the use of these data may underestimate the role of economic variables. Using population data, however, makes it possible to compare the results with that of Decressin, which we shall do at the end of this section.

A model is used in which the log of normalised population migration flows by labour force is used as the dependent variable. Gross migration is defined here as the number of immigrants in the destination region. The use of a net migration measure defined as the difference between emigration and immigration is problematic if emigration and immigration flows are correlated. In addition, a migration model using net migration flows as a dependent variable cannot isolate the various push and pull factors, which are responsible for the gross flows in both directions. It is therefore better to use gross migration flows or gross migration rates as a dependent variable instead of net migration.

$$\log\left[\frac{P_{ijt}}{L_{it}L_{jt}}\right] = b_1 + b_2(LUNEMP)_{it} + b_3U_{ijt} + b_4V_{ist} + b_5WBLUET_{ijt} + b_6WWHITET_{ijt} + b_7HOUSE_{ijt} + b_8DISTANCE_{ij} + u_{ijt} \qquad t = 1993,1994,1995 \qquad (1)$$

In equation 1, the population migration flows are normalised by the labour forces of the source region j and region i of destination and then multiplied by 10^6 before the logs are taken.[4] The log of normalised population migration flows depends on the difference in the unemployment rate in region i and region j ($U_{ijt} = U_{it}-U_{jt}$, where U_{it} stands for unemployment in region i) and the difference between the region i, and the rest of the regions s ($V_{ist}=U_{it}-U_{st}$).

[4] In another study, (Leuvensteijn and Parikh (2001)), we have used population flows normalised by the population in source and destination region and labour flows normalised by the labour force in source and destination regions. These results are similar to the ones obtained in this study.

Increases in either of the relative unemployment rates should decrease immigration; an increase in V_{ist} should decrease migration from j to i as region i becomes less attractive relative to all other regions s; and a high unemployment rate in the destination region will discourage the worker from moving into that region. The following variables were used in equation 1:

-$U_{ijt,}$ on the difference in unemployment rate in region i and region j (U_{ijt} = U_{it}-U_{jt}, where U_{it} stands for unemployment in region i),

-V_{ist}, the difference between the region i and the rest of the regions s (V_{ist}=U_{it} – U_{st}),

- Log of unemployment rate (LUNEMP),

-Log differences of wages of blue-collar workers between source and destination region (WBLUET),

-Log differences of wages of white-collar workers between source and destination regions (WWHITET),

-Differences (in infrastructure measured by) hospital beds (per inhabitant) between source and destination region (HOSP) and differences in number of hotel beds per capita between source and destination region (HOTEL),

-Differences in per capita or per worker rented (PRENTED/RENTED) and owned housing (POWNED/OWNED) between source and destination regions; House variable in equation 1 is based on one of these indicators.

-Rental Price per Square Meter (TMETERP),

-Distance between the main city in the source region and destination region (DISTANCE),

-Differences in Cost of Living Index between East and West Germany[5] (TLIVCOST).

The above equation (1) may be viewed as the demand equation of residents of region j for residence in region i. Demand for residence in i by residents of region j is a function of unemployment rates and wages in region i relative to j as well as unemployment rates in i relative to all other regions s. In panel data analysis, the within regions model is a standard fixed effects model. If fixed effects are correlated with explanatory variables of the model, the random effects model is generally rejected by the test. Time effects in panel data are transitions of discrete changes and, as we have sixteen immigrating regions over three periods, it is the heterogeneity across units, which remains an integral part

[5] All these variables are not used simultaneously but a large numer of these variables are used together in one of the models to examine the joint effects of amenities and other economic variables. We also obtain a restricted form of the equation from the general unrestricted model.

of this study. Regions with higher wages and lower unemployment do not necessarily attract more migrants, as there are other variables such as availability of houses and good infrastructure that might play an important role. In the above model, gross flows between regions are not only a function of differences in unemployment rates and wages of blue-collar and white-collar workers between destination and source regions but also of the unemployment rates and wages in all other regions. The coefficient of wage/salary difference in a region compared with that of the average of remaining regions of blue-collar and white-collar workers did not turn out to be significant and hence this is not used in any of the models. The results will be presented first for each year separately. Next, various models are estimated with pooled data from 15 source regions. Finally, the same is done for 16 immigrating regions.

Firstly, we conducted the analysis using each year and there are sixteen immigrating regions and 15 source regions. In these models, the dependent variable namely the population migration flows are normalised by the labour force of both region of destination and origin first. Then the dependent variable is regressed on unemployment (both in regional differences and as the logarithm of the unemployment rate), white-collar wage differences and blue-collar wage differences between regions, the number of rented houses divided by the labour force and the number of hotel nights per capita and hospital beds per inhabitant. For each year we have 240 observations. In addition, we conducted regression analysis for each immigrating region, (sixteen in all) with 15 observations. In order to analyse the effect of different variables on the migration flows, estimations are carried out using the Generalized Method of Moments (GMM) for the years 1993-1995. By using GMM the estimators are corrected for heteroscedasticity bias and endogeneity of wages and unemployment variables. The equations are estimated using the GMM with instrumental variables in which the lagged unemployment rate (in regional differences and absolute levels) lagged white-collar wage and lagged blue- collar wage differences are used as instruments along with a constant term. These four instruments were needed to correct for the endogenous relationship between unemployment rates, white-collar and blue-collar wage differences on the one hand and population migration on the other. A region with high unemployment and low wages will have a high outflow of persons, which in some cases may reduce unemployment and increase wages. The relationship between the unemployment rate and migration flows and white-collar wage differences and migration flows were the opposite of those predicted by theory. The correction for heteroscedasticity along with endogeneity did not improve the empirical results on the relationship between various variables (Table 2).

Table 2. GMM estimation by years: Dependent variable log (P_{ij}/L_iL_j)

	1993		1994		1995	
	Regression Coefficient	t-stat	Regression Coefficient	t-stat	Regression Coefficient	t-stat
Constant	-23.7571*	(31.7326)	-20.8097*	(27.8829)	-21.3637*	(35.0412)
U	0.6506	(1.1596)	-0.00557	(0.3297)	0.00354	(0.1549)
LUNEMP	1.3089*	(4.0324)	0.06094	(0.1953)	0.2871	(1.1177)
WWHITET	-0.57762	(0.2981)	-0.8951	(0.9667)	-0.8838	(1.0549)
WBLUET	-0.08427	(0.0618)	0.4928	(0.7345)	0.472	(0.7374)
RENTED	-0.1083	(0.31488)	-0.1089	(0.3654)	-0.1163	(0.3956)
WWHITETSQ	-1.0913	(0.7452)	-5.538*	(2.3594)	-1.8654	(0.9534)
WBLUETSQ	3.7671*	(1.9884)	-1.2718	(0.6141)	-3.9077*	(2.4031)
	R^2 = 0.08007		R^2 = 0.1205		R^2 = 0.1285	
	N = 240		N = 240		N = 240	
	SEE = 0.8282		SEE = 0.8049		SEE = 0.8004	

* Significant at 5% level.

In Table 3, we used all 720 observations, which is three years' pooled data for 240 interregional flows.[6] Both unemployment differences and the log of unemployment rate are used in these regressions. In all panel regressions, the distance variable has a correct sign implying that the greater the distance between the destination and source region the less likely is the migration to the destination. Wage differences of white-collared and blue-collared workers between regions' destination and source regions are also used. The impact of skilled workers' wage differences on migration is different to that of unskilled workers' wage differences. Both between, within regions and pooled OLS results have many significant regression coefficients. The Random effects model is rejected by the Hausman test. The Fixed effects model (within region) regression suggests that migration is discouraged by higher level of

[6] Panel data are a special type of pooled cross-section/time-series data in which the same individual units are sampled over time. Four regression results are available for each regression using panel data. The first is the *total,* which is plain OLS on the full panel. The second is the *within estimation* that takes into account the regional fixed effects. The third, *between estimation*, explores the cross-sectional dimension by using the regional means over time. The last regression result is a *random effects* model where the region level fixed effect is assumed to be randomly distributed with a common mean and variance. This approach saves degrees of freedom and at the same time the random effects estimator is a weighted average of between and within estimators.

unemployment in immigrating region than in the source region. The relation between white-collared wage differences and immigration into the region seems to be a U-shaped relationship- a result, which is consistent with the 'option value of waiting' approach. For blue collared workers' wage differences, the relationship is concave or an inverted U-shape. This can be explained by a combination of risk aversion and the option value of waiting approaches. The relationship between wage-difference and migration depends on the expected income gain from moving to another region. If the expected wage gain is decreasing due to wage convergence between regions then a large wage difference between two regions will not result in more migration. In general, the relationship between wage difference and migration is non-linear.

Table 3. Population migration normalised with labour force: Panel study for T=3 and 16 destination from 15 source regions with bilateral flows =240 for each year

	Pooled OLS		Between Regions	
	Regression Coefficient	t-stat	Regression Coefficient	t-stat
Constant	-19.5332*	(3.5567)*	-19.2965**	(213.080)
U	-0.00559**	(1.6247)	-0.0110**	(1.6070)
WWHITET	-0.5453**	(1.6688)	0.4761	(1.1356)
WBLUET	0.1679	(0.5756)	-0.1132*	(2.0685)
WWHITETSQ	0.8405	(1.1179)	0.3385	(0.3049)
WBLUETSQ	-3.6560*	(5.1669)	-3.6024**	(3.2071)
DISTANCE	-0.0029*	(2.6121)	-0.00340**	(19.1010)
	Within Region (FE) (Fixed Effects)		Random Effects (RE) Random	
	Regression Coefficient	t-stat	Regression Coefficient	t-stat
Constant			-19.5720*	(383.124)
U	-0.0175**	(1.7922)	-0.00816	(1.4399)
WWHITET	-3.8662*	(6.7799)	-0.9681*	(2.7796)
WBLUET	3.2949*	(6.3728)	0.55659*	(1.8259)
WWHITETSQ	3.4032*	(3.2387)	1.1104	(1.4447)
WBLUETSQ	-5.8265*	(6.2834)	-3.8824*	(5.4362)
DISTANCE	-0.00259*	(19.9393)	-0.00252*	(26.9005)

RE vs FE χ^2 (6) =57.492, Test rejects the random effects model.

* Significant at 5% level. ** Significant at 10% level.

In Table 4, we have combined three years' data for each immigrating region and hence for each immigrating region from source there are 45 observations. This panel does not distinguish a time dimension at all. It only separates the data by receiving regions from source. In Table 4, regional unemployment differences are used along with the log of wage differences in white-collar and blue-collar between regions and the squares of the log of wage differences of white and blue-collar workers between regions. Results of between regions are not presented in Table 4, as most of the coefficients are insignificant. The random effects regression of Table 4 indicates that migration propensity and blue-collar workers' wage differences have an inverted U-shaped-relationship (Concave) while for the white-collar workers such a relationship is U-shaped (Convex). For skilled workers (white-collar) the attractiveness of migration may depend upon the compensation of moving costs paid by employers. Blue-collar workers are rarely compensated (see also Böheim and Taylor (2000)). For large differences in white-collar workers' wage differences the propensity to migrate could be higher since the net present value of future income streams from migration is positive. The conclusion from tables 3 and 4 is that the non-linear relationship between wage differences and migration is robust. Both fixed effects estimations for source regions and immigrating regions show the same non-linear result.

The non-linear influence of income differences on migration (shown in Table 4) is compatible with a number of alternative models of migration including the option value approach proposed by Dixit and Pindyck (1994) and Burda et al (1998). The opportunity cost of migrating today in addition to the expected net present value of future income gains from migration net of migration costs is referred to as the option value of waiting. The option value of waiting is calculated as the difference between expected net present value from postponing migration and the expected net present value from migrating today. Some migration may be regarded as investment. A forward-looking agent will care not only about the current income differential but also about future income differentials. The migrant will consider the net expected present value of future additional income earned while deciding to migrate. Even if the expected net present value is positive, the prospective migrant may not migrate if the fixed cost of migrating is sufficiently high. Such fixed costs could include pecuniary components associated with physically moving a household from one place to another. If risk aversion were to be introduced in this model, it could change the migration decision.

Table 4. Panel study with 16 immigrating regions each with 45 observations over 3 years
Dependent variable log (P_{ij}/L_iL_j) : 720 observations

	Pooled OLS		Within Regions		Random Effect	
	Regression Coefficient	t-stat	Regression Coefficient	t-stat	Regression Coefficient	t-stat
Constant	-19.5332*	(355.67)			-19.5410*	(272.5)
U	-0.00859**	(1.62)	0.00125	(0.183)	-0.6810	(0.010)
WWHITET	-0.5463**	(1.66)	-2.3826*	(5.884)	-2.0228*	(5.2143)
WBLUET	0.1679	(0.58)	1.9235*	(5.259)	1.5675*	(4.5039)
WWHITETSQ	0.8405	(1.12)	3.1692*	(4.111)	2.7154*	(3.5954)
WBLUETSQ	-3.6560*	(5.16)	-5.6470*	(7.665)	-5.2615*	(7.3116)
DISTANCE	-0.0291*	(27.612)	-0.00289*	(27.723)	-0.00290*	(25.1345)

Hausman Test: χ^2 (6) = 11.902 (P value 0.0642). Random effects are not rejected. Therefore region effects are not strong. * Significant at 5% level. **Significant at 10% level.

Other models with which the non-linear influence of income differences are compatible are models in which it is assumed that agents do not have preferences for living at home or abroad and are risk averse. In this case, the demand for immobility could still influence the desire to migrate. If it is assumed that current place of residence is a normal good then the income effect of higher absolute wages at home implies a lower propensity to migrate. Wealthier individuals might seek to escape impoverishment in East German regions or might show a greater demand for immobility. The effect of income difference on migration is an empirical proposition. In the case of risk aversion, the influence of uncertainty is ambiguous because the uncertainty of income abroad can reduce the attractiveness of desire to migrate.

5. Comparisons with Previous Studies

There are two empirical studies in which the relationship between migration and wage differences for German regions was examined. These studies are Decressin (1994) and Burda (1998). Decressin (1994) found that when other variables are used (such as distance, number of hotel nights, price of rental

houses) besides unemployment and wage differences, the role of the latter two in explaining the relationship becomes insignificant.[7]

Another study that analysed the relationship between wage differentials between regions and migration is Burda et al (1998). They used the Generalized partial linear model and found a U-shaped relationship over the range of income values for a large mass of income distribution in their data. They do not distinguish between skilled and unskilled workers' wages. When the relationship between migration and income is examined for a low range of income, they found also that for certain intervals migration is increasing in household income. For the low range of income, they found an inverse U-shaped relationship. Our results are similar to Burda (1998) excepting that we use wage difference rather than levels.

6. Summary and Conclusions

This study uses gross migration flows data for 16 regions of Germany to identify the factors responsible for explaining interregional migration. We find that unemployment differences and wage differences between regions are important factors in determining migration. However, the relationship between migration flows and regional wage differences is somewhat different compared to previous studies (Burda et al., 1998). We use white-collar and blue-collar wage differences rather than single aggregate of regional wage difference and find that the relationship is non-linear for both groups of workers. For blue-collar workers, the relationship between migration and their wage difference is an inverted U-shape or concave while for the white-collar workers, the relationship seems to be U-shaped or convex. Such a non-linear relationship is consistent with the theory of option value of waiting and risk aversion attitudes of agents and is also supported by the recent convergence in wages between East and West German regions and the decreasing net gains of migration. In addition to the wage differences the other variables of importance are unemployment differences and the level of unemployment and both these variables in this panel

[7] In order to compare his results with ours we estimated the model including these other variables. We found that despite the use of infrastructure and housing variables, the role of the economic variables such as unemployment and wage differences remains significant. This is in contrast to Decressin (1994). Decressin found for West Germany in the period 1977 –1988 that economic variables are no longer significant when other variables are introduced. So economic variables are irrelevant for migration within West German regions, but are relevant for migration between East and West German regions. Further, the results provide strong evidence in favour of a nonlinear relationship between wage differences and migration. Decressin only finds a linear relationship between wage differences and migration. This emphasizes again the difference between migration within West German regions and between East German and West German regions. A factor like wage convergence is less important for migration within West German regions compared to East and West German migration.

data study are significant. Once region effects are controlled for or eliminated by conducting a regression of mean migration flows on each of the meaned explanatory variables, we found that distance and housing also play an important role. In almost all models, distance turns out to be a significant factor in the migration decision. These factors, however, did not affect the non-linear relationship between migration and wage differentials between the regions. One of the major limitations of this study is that we could not account for regional price differences and thereby real wage differences between regions. This aspect was captured to some extent by the East-West cost of living differences and fixed effects in panel data models.

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Appendix: Data Description

In this study, data on gross population migration flows, unemployment rates, wages of blue-collar and white-collar workers, infrastructure in terms of hospitals and hotel beds in each region were obtained from Statistisches Bundesamt. The cost of living differences between East and West German regions were further considered.

The product of the labour force of the region at origin and the region of destination where they move, are used to normalise the gross population interregional migration figures. This procedure is in line to that of Decressin (1994). The adjustment is carried out to take into account the fact that large regions with large populations tend to have large migration in- and out- in absolute terms. It is, however, surprising that such *gross flows of population* are normalised by the product of the labour force in the supplying and receiving regions where data on population of each supplying and receiving regions are available.

The migration from region j to i will be, *a priori,* related to the differences in unemployment rates, the wage-differences of both blue-collar and white-collar workers between regions, the differences in regional cost of living indices, the type of house (owned or rented), the differences in rental prices between regions, and the differences in infrastructure elements like the number of nights spent in hotels and the number of hospital beds. The latter two reflects to a certain extent the available facilities in the region. The distance to be travelled is used as a proxy for the cost of migration. The housing market is a relevant consideration in moving to a new location. In the East German regions subsidies to rents were removed in stages. Rents were still lower in the East but they are slowly converging to Western levels. Limits on rent increases act as a brake on mobility as the sitting tenant on a long-term basis pays a lower rent. Moving costs may rise with greater immigration into the region, as housing tends to become more expensive in the short run in a region attracting large number of migrants. The unemployment rates for the different regions were derived from the Statistisches Bundesamt that uses the following definition of unemployment rate: number of unemployed divided by the labour force in each region (including the unemployed and the self employed) and converted to percentage unemployment rate.

The wages of both blue-collar and white-collar workers are used to analyse the impact of regional differences in wages on population and normalised population migration. For white-collar workers the average monthly salaries for workers in manufacturing industries and trade is used (Kaufmänische und Technische Angestellte). For the blue-collar workers the average monthly gross wage for workers (Arbeiter) was used. Since data were available separately for

the regions of East and West Berlin these figures were weighted by the labour force and aggregated for the Berlin region. Further data on the number of houses both owned and rented, for different regions are used. These data were only available for 1993 and were normalised by the population in the region. In addition, the rental price per square meter of rented property for different regions available for the period 1993-1995 was used. The rental prices indirectly reflect the availability of rental houses. Finally the number of beds in hospitals per inhabitant and the number of nights spent in hotel divided by the population (per capita) was used to account for the infra-structural differences between regions.

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