Regional Housing Market Spatial Dynamics in Central Europe

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Abstract: The Central European countries have experienced a decade of economic growth succeeding the departure from a state-commanded regime. Development of the markets together with subsequent economic integration provoked a fundamental reconstruction within their economies. This paper focuses on the real estate sector and its response to the economic change. Specifically, we explore the spatial dynamics of the residential housing market empirically at the regional scale. The research question is whether different regions respond differently to economic growth and how this difference could be explained. The spatiotemporal variation in housing investment representing the supply side of the market is tested against spatially varying indices that theoretically determine the demand side of the market. In the first part we document the relationships in observed levels between the housing investment, two economic variables (unemployment and average income) and two demographic variables (natural and migration change). In the second part we focus on the growth patterns. Techniques employed belong to the framework of spatial econometric analysis. Models are estimated by means of ordinary least squares, spatial lag and spatial error model. All procedures are applied for the housing markets in the Czech Republic and Slovak Republic during the decade 1997-2007.

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Introduction

Residential housing markets have been dramatically transformed during the last two decades in the post-socialist Central European countries. Transition has fundamentally changed their social and economic frameworks, from one based on the allocation managed by the state to one relying on the market principles, gradually introduced since the 1990s. Both the demand and the supply side of the market have been deeply changed. Previously dominating institutional actors disappeared or transformed into various actors with narrowed interests and functions in the market. These enabled to succeed through stages shifting real estate market in one closer to standard composition and functions, even though standards vary. Stephens (2003) reminds a large diversity in the housing finance systems in the market economies. Three groups are recognized. In the English-speaking countries, high levels of owner-occupation are supported by liberalized finance systems. In southern Europe, high levels of owner-occupation are attained without well developed housing finance systems. Germany exhibits a stratified housing finance system that limits access to mortgage finance and this contributes to a lower level of owner occupation. Real estate markets had to be built from the fundamentals in the Central Europe and this process has not been smooth. Virtually no transition country succeeded in rapidly developing a legal system and institutions that would be highly conducive to the preservation of private property and to the functioning of markets, according to Svejnar (2002). The history of the regions` housing sector has been determined largely by its role in the socialist orthodoxy, one which designated housing as a social rather than an economic sector, a right to which all citizens were entitled (Hegedüs, Tosics and Mayo 1996). Privatization has during several years replaced a former structure with large segments of rented state, communal and cooperative owned housing by private owner occupation. Privatization was divided into restitution, large-scale privatization and small-scale privatization (Garner and Terrell 1998). The level of home-ownership is an important factor in shaping the nature of a housing system with wider societal implications (Stephens 2003). Additional space was needed for the creation of financial intermediation mechanisms enabling the construction of the institutional infrastructure for the investment flows into housing sector on new principles. The temporal gap between the declining non-sufficient schemes and establishment of the new ones lasted several years. Construction of new housing plays a critical role in the economy. Housing construction typically leads recessions and recoveries (Mayer 2000). The Slovak and Czech statistics illustrate a decline in the number of completed dwellings after a peak was reached in the year 1980 (48.2-thousand in the Slovak Republic; 80.7-thousand in the Czech Republic). A breaking point appears ten years later (33.4-thousand in Slovakia in 1989; 44.6-thousand in the Czech Republic in 1990), followed by a sharp fall until the mid-1990s (6.2-thousand and 13.0-thousand in 1995). Since the year 1996 an increase is registered again (16.5-thousand; 41.6-thousand in 2007) at the levels corresponding with the levels in the early 1990s). Housing construction as an economic sector has collapsed during the gap. The opposite dynamics was in private investment. In Slovakia we observe the minimum (26%) in 1980. Since the year 1989 (32%) it increases to reach 85% in 2006. In the Czech Republic only 13% of dwellings were completed in the private sector in 1965. A price explosion was a natural response developed in conditions of almost no supply on the new-created market. The situation became extremely difficult with relevant social consequences. In the transition experienced by these countries, the housing sector has a critical role both because of the importance of the sector itself and because of its importance in supporting broad economic and social goals to which its performance is linked (Hegedüs, Tosics and Mayo 1996). The research on housing in these countries is mostly sociological (Gajdoš 1996 and 1998, Lux and Sunega 2007, Mikeszova 2007).

Social differentiation externally transforms the environment for the residential housing market at the disaggregated scale of individual households. Only a thin minority of them was able to exploit the opportunities created by the changing economy. Majority of the demand-creating population suffered from the real income decrease and job loss, for which structural conversion was mostly responsible. Wages have been recovering in Central and Eastern Europe since the year 1991, seven years after the start of transition they remained at 82% of their starting level (Boeri and Terrell 2002). The transition literature reports lower income for people in rural areas, compared with urban dwellers. The reason for it is that market developments tend to progress more rapidly in cities than in rural areas. Even people living in cities can be expected to have more opportunities for accumulating income (Verhoeven, Jansen and Dessens 2009). If unemployment rates for manual workers display large regional disparities Hughes and McCormick (1987) see little prospect that these will be significantly reduced as a result of geographic labor mobility in the absence of support to the incentive for and willingness of households to migrate for job-related reasons. Observing the situation from the demand side of the market, housing commonly became an inaccessible good. The labor market winners from the transition have been, so far, workers who are young, educated, living in urban areas, with skills enabling them to exploit the opportunities offered in the emerging private sector. The losers are generally individuals with the opposite characteristics (Boeri and Terrell 2002). On the supply side of the market, the housing sector could not offer any attractive opportunity while conditions of extreme uncertainty lasted. There were no incentives to risk an investment of existing private capital resources.

The differentiation in performance of the regional economies is rather a reintroduced than a new phenomenon in the post-socialist area. It may be understood as a counterpart to the social differentiation in the aggregated scale. Number of issues relating to the causes for regional disparities, the efficiency of labor market mechanisms such as wage flexibility, migration and new firm creation in equilibrating regional labor markets and appropriate policies to deal with the uneven development of regions in transition arise (Huber 2007). The economic differences have been present under previous regime; however, covered by means of the equalizing allocation of wealth. Under the former system, the Central and East European countries maintained the most equal distributions of income in the world (Garner and Terrell 1998). In new conditions the differences have been fully uncovered. In an analogy with the adapting individuals and households, only selected regions could exploit the opportunities offered by the transition to the market.

Firstly, these were the regions of major economic concentrations and management, in Central Europe without exception the capital city agglomerations. A relatively advantageous position can also be attributed to the regions accessing the developed infrastructure, commonly very limited as a heritage of economically lagging socialism. Musil (1993) predicts very soon that reintroduction of market will increase concentration in growth centers, that national capitals will play a greater role, that hierarchies and dynamic frontier zones may arise. In remaining territory, the transition brought unemployment across these countries. Especially, the manufacturing sector lost a large part of economic justification for production in state of inability to compete with foreign actors met at the liberalized markets. The labor force localized according to the needs of previous economic regime could not be directly used in the new economic structures. Transition from planned economies to market-oriented economy involves a substantial reallocation of labor, from one typically concentrated in heavy industry (Boeri and Terrell 2002). As an unavoidable consequence, the employment level and the average income level disparities have been established and developed further to indicate the conditions in which different regional economies found themselves during the transition with their population. But simultaneously with the region`s transition also traditional market regimes were reshaped. Dual career pathways of employment and home ownership, assumed to be normative have been affected by structural changes including the shift from manufacturing to service and information-based occupations, organizational restructuring with an emphasis on short-term contractual working arrangements and fluctuations in the economy (Winstanley, Thorns and Perkins 2002).

Returning back to the empirical territory intended for research in this paper, several state reconfigurations took place during the early 1990s in the Central Europe. One of these that will be crucial here was the disintegration of Czechoslovakia. The Czechoslovak state had existed, with the exception of the WWII period, since the year 1918. Later, since 1968 it had taken a form of a federation consisting of two states. The federal state was finally divided and independent countries were created from the constituent parts, the Czech Republic and the Slovak Republic in 1993. It is widely believed to have been conditioned by the more negative economic developments in Slovakia than the Czech Republic. The unemployment rates in Slovakia and in the Czech Republic support that view (Garner and Terrell 1998). Despite disintegration, the countries have followed parallel trajectories and a decade later joined together the European Union, members of which they have been since 2004. As a welcome research opportunity, this micro-geopolitical development in the Central Europe, together with the integration into the space of international investment flows created a unique condition for the development of their regional structures, differentiated by inherited economies and factors remodeling them according to the need of the new market.

Summing up the motivations for this paper, there are serious reasons to expect that the residential housing market, which has been created during the last two decades in the Central

Europe including its spatial dimension witnesses an interesting spatial economic process that is responsible for the creation of the regional economic structures, potentially stable for a long time. Lux and Sunega (2007) support the thesis with an indication that housing tenure has a significant effect on potential internal labor migration, even after controlling for the effect of other factors related to labor migration in the Czech Republic. The early literature on regional development in the transition was often concerned with the issue to what degree the legacies of socialism were responsible for the rapid development of regional disparities and stressed that disparities in underlying growth factors were large in transition countries already pre-transition (Huber 2007). Murphy, Muellbauer and Cameron (2006) provide a review of recent empirical research on the relationship between the housing market and regional migration in Britain, the US and Europe. A similar study on British regional system can be found in Cameron and Muellbauer (2001). Regional data are used to explore the relationship between unemployment and earnings, and the interactions of labor and housing markets. Property markets have always been cyclical, and economists have explored the causes and consequences of cyclicality, linkages among real estate investment, mortgage credit, and aggregate business cycles (Case and Quigley 2008). Wheaton (1999) demonstrates that different types of real estate have different cyclic behavior. In ordinary times, the housing sector plays an important role in the economic and social affairs, accounting for 10-20% of the total economic activity in most countries and 20-50% percent of reproducible wealth according to Hegedüs, Tosics and Mayo (1996). The relationships among economic opportunities reflected by unemployment and income variation (Lundberg 2004), demographic dynamics reflected by migration and natural movement, and the housing market are expected to display a significant change having relevant interpretation. The evidence of predictions from theoretical general models can be found in numerous empirical studies focusing on regional economic growth, reviewed by Fingleton and Lópes-Bazo (2006). Included empirical specifications exclude interactions across regions, which have been considered isolated economies, while theoretical and empirical arguments suggest that regions, as well as not being homogeneous, are also not independent. Jones and Leishman (2006) argue that the market is best conceptualized as a system of interlinked local markets: The extent of common dynamics and lead/lag relationships is likely to be partly contingent on the extent of local linkages through household migration. Böheim and Taylor (2002) find a direct relationship between employment status and residential mobility. Changing job and moving house are positively correlated. An unemployed individual in their study is more likely to move than an otherwise similar employee. While relevant factors can be isolated and probably even ranked them in importance to households, it is the interconnections between the different factors that shape individual and household decisions and precludes the feasibility of accurate quantitative models of residential mobility, in words of Winstanley, Thorns and Perkins (2002).

A decision for the housing location made by a household is determined by various factors and motivations, which should be grouped as social, economic and environmental as probably the most important. Residential location decisions are linked to market processes (land development, building supply, residential real estate market, labor-market, daily travel market) as well as to demographic processes such as aging, job changes, divorces, marriages, births, deaths (Vandersmissen, Seguin, Theriault and Claramunt 2009). The social networks are traditionally more spatially embedded in Europe. On other hand, there is a necessity to consider the economic factors, the opportunities of securing an acceptable living standard and its improvement for which migration from economically weaker to stronger regions may be needed. In core we get to the problem of labor force mobility. Authors on both sides of the housing and labor markets literature note both the interaction between the two and the potential central role of migration as an equilibrating force (Jones and Leishman 2006).

In this study, our intention will be to keep the residential housing market supply in the center of attention. Migration between regions plays a central role in the workings of regional housing and labor markets. As such, it has often been said that the relatively low level of labor mobility is connected with the poor performance of some regional labor markets, while the persistence in regional unemployment is perhaps one symptom of this inefficiency (Murphy, Muellbauer and Cameron 2006). Their review also suggests that contiguity effects and the commuting/migration trade-off are important. The objective in our study will be to test several relationships expected to be valid within the empirical regional structures and especially, to test for the presence of spatial effects in the mechanism.

The first research question is whether the regional housing supply level is directly related to the regional economic performance and the regional demographic dynamics in the two Central European countries. More specifically, we would like to know if the housing investment intensity is directly related to the average unemployment, income, migration and natural increase levels, and if these relationships change with the ongoing transition process. Housing starts are a flow variable, representing the change in the stock of housing. Thus, starts should be a function of other flow variables, including the change in house prices. In balancing supply and demand, house prices ensure a spatial equilibrium for households within a housing market, citing Mayer (2000). Our intuitive expectation is that with the gradual evolution of the real estate market and life-cycle based change in the economically active population the relationships will be more significant in consequence of a recognized necessity to adapt to the economic realities. Connection to globalization may also be expected to facilitate a convergence in intermediation systems (Stephens 2003). Our special concern is in the related question if there are any significant spatial effects present in the observed regional structures. We are interested if the housing supply level in one region is significantly related to the housing supply level in a set of neighboring regions that are expected to share at least similar qualities in the factors driving the background regional differentiation mechanism. Hypothetical externalities may exist from various reasons. The economic advantage of a region economically well performing can be shared by the surrounding regions thanks to commuting. The population which uses the economic opportunities located in the well performing region can access it from the neighboring regions while also using additional advantage of potentially lower prices on the real estate market (Lundberg 2004). Such situation is commonly developed around the largest agglomerations. The suburbanization observed also in the regional scale has been documented in both countries. Suburban zones are in the process of quick change especially in the major metropolitan areas in Central and Eastern Europe (Kahrik and Tammaru 2008). Their Estonian survey indicates that people younger than 35, well educated, having considerably higher than average income and children have the highest odds of moving.

The environmental motivations can have similar effect as the economic. The source for environmentally caused spatial externalities is that neighboring regions share a similar environment since the primary landscape potential only exceptionally does not have a contiguous gradient. Possible reasons for existence of significant spatial effects in housing supply may be found in consumption and in production patterns. As a mean income level increases in a region, some part of it potentially flows also into the surrounding space affecting its income level. The effect from private sector in a successful region can have a form of new companies owned by the actors from neighboring regional economies. Spatial effects are not necessarily positive. A negative spatial effect occurs when the high housing supply level in a region is indicated to be developed in expense of the neighboring regions. In some aspects it can be strategically important whether the regional residential housing supply tends to be linked positively or negatively to that in the neighboring territories.

The second question considered with the housing supply is if the hypothesis of conditional convergence is valid in the spatial dynamics aspect. We are interested if regions with high initial level of housing investment grow faster or slower in compare to the regions with a low level of housing investment. Focusing on the growth patterns instead of the levels of housing supply we test whether the growth in a better performing region tends to spill-over in other regions in proximity. The answer will also suggest if there is a process responsible for the existence of spatial disparities in the background. Theoretically, evidence for divergence is intuitively expected during the transition captured by the empirical data. Regional housing supply growth should be negatively related to the initial unemployment rate and positively related to the regional income level. It should be closely related with the population movement changing labor supply. The regional change mechanism is an aggregation of decisions on individual livelihood strategies, rather complicated by the limited labor mobility in the Central Europe. It is expected that the probability of receiving income enabling a certain living standard is a crucial determinant of migration interaction patterns, secondarily affecting fertility levels. These are in demography described primarily in social and cultural terms, recognizing an urban and a rural scheme historically cross-determined.

Besides the socio-economic mechanism, our interest is in search for spatial effects in regional differentiation. The spatial autocorrelation concept is a basis on which the empirical investigation is built in search for spatial dimension of the process changing the regional economies. Our central concern will be expressed in the construction of the two dependent variables, the housing investment intensity per population and its growth. As the explanatory variables we include economic indicators capturing the level of regional economic performance (unemployment and average income), which should indicate the regional earning potential. We also add demographic dynamics (migration and natural movement) structured in its two components. The fifth artificial variable is entered with an objective to capture expected spatial interaction, an interregional interaction potential summing the effect of population size of a region with the effect of all other regions in the regional system separated from it by distance. We considered it to be a proxy to accessibility, potentially relevant in explanation of regional housing supply.

The empirical analysis will be based on the two regional systems. The Czech regional system consists of 77 districts and the Slovak regional system consists of 72 units after a minor correction for non-consistencies among districts explained below. Temporally, the period covered by our data will allow estimation of the models constructed during the period 1998-2005 for the Czech and the period 1997-2007 for the Slovak economy.

This paper is formally organized into the introductory and four remaining parts. In the following the model will be conceptualized theoretically and will be formalized. In the third part the results will be presented, as they appear by the optics of the model estimation. We will interpret and discuss these results. Summarization can be found in the concluding part.

Methods and data

Housing supply is one of the two major components meeting on the housing market. Edelstein and Tsang (2007), relying on their extensive theoretical review, describe the market as a simultaneous system of two equations. The demand function subsumes that rent cycles and property value cycles are related and affected by national-macro, regional, and local economic shocks. The supply function assumes that builders maximize profits by choosing the optimal level of housing investment and explains cyclical patterns of housing investments as a function of property values and exogenous cost shifters. The housing supply actors saturate the demand with new constructions and reconstructions of existing housing stock. According to Dipasquale (1999), housing supply is the outcome of complicated decision making by builders and the owners of existing housing. However, there is little direct evidence that permits to observe the behavior of housing suppliers. Also in case of new supply, there is no standard data set that permits to observe the behavior of builders of new housing. The interplay between the demand and the supply creates the market price of housing. Therefore, housing price would be ideal measure; however available at the scale needed only in the Czech Republic. Adapting to the practical data limitations we accommodate housing starts as a dependent variable in regression focused on the housing supply side

$$H_{i,t} = DS_{i,t} / P_{i,t}$$

where $H_{i,t}$ is the average annual regional housing investment intensity, $DS_{i,t}$ is the total number of dwellings started in the region i during the year t; and $P_{i,t}$ is the responding mid-year region`s population. In order to define a dynamic version to the first variable $h_{i,t+T}$ we consider a ratio of the two horizons in annual regional housing intensities

$$h_{i,t+T} = H_{i,t+T} / H_{i,t}$$

Based on above definitions of the level and growth alternatives of the housing supply we specify, considering the mentioned group of independent variables the two empirical models

$$H_{i,t} = f^H (U_{i,t}; I_{i,t}; M_{i,t}; N_{i,t}; A_{i,t})$$

$$h_{i,t+T} = f^h (H_{i,t}; U_{i,t}; I_{i,t}; M_{i,t}; N_{i,t}; A_{i,t})$$

where $U_{i,t}$; $I_{i,t}$; $M_{i,t}$; $N_{i,t}$ and $A_{i,t}$ are the vectors of economic, demographic and accessibility explanatory variables considered. The detailed specification for construction of these will be given below: $U_{i,t}$ is the registered unemployment rate in a region *i* in a year *t*; $I_{i,t}$ is the annual average nominal income; $M_{i,t}$ is the net migration per mid-year region`s population; $N_{i,t}$ is the net natural increase per mid-year region`s population; $A_{i,t}$ is the accessibility proxy, the sum of simulated interactions between a region *i* and all regions *j* in the n-regional system

$$A_{i,t} = \Sigma_{i,j=1}^{n} (P_{i,t} . P_{j,t} / d_{ij}); i \neq j$$

where d_{ij} is the physical or other distance separating a region *i* from a region *j*.

The housing supply measure in presented general form relies strictly on total number of dwellings started during the year focused and relates it to the mid-year region`s population. Lack of housing market structure may be a major source of biased results; however, we will only register for its presence in this study and potentially will control for it in later research.

According to Andersson and Gråsjö (2009) it is nearly impossible to estimate a regional economic model without spatial autocorrelation, since it is caused by underlying spatial dependence among observations. The common spatial models acknowledge such dependence but do not indicate the mechanism by which it arises. Theoretical development and the use of spatial econometric techniques are reviewed in Florax and Van der Vlist (2003). For empirical calibration we will use three formalization variants based on the compare between ordinary least squares (OLS) estimation and two spatial regression estimation techniques, spatial lag model and spatial error model. We do not estimate spatial cross-regressive alternative. These differ in the nature of approach towards the spatial effects. In the first alternative to the OLS model, technically the statistical relationship is searched between the value in a region in focus and the average value in a group of surrounding regions. In the second alternative the spatial covariance among the residuals from the OLS model is focused. Calibration will uncover which of the three is appropriate in the cases considered. Correct specification is important, since each spatial specification (substantive or nuisance) produces rather different interpretations (Fingleton and Lópes-Bazo 2006). The spatial error model can arise because of measurement problems in the data or because of omitted variables. A common cause of this is the fact that much of spatial data is collected for political or administrative units rather than economically defined units such as functional economic areas (Bernat 1996). Here we also work in such regional frameworks. Anselin (2003) reminds, that spatial autoregressive lag and error models commonly applied in spatial econometrics are perhaps too simplistic and leave out other possibilities for mechanisms through which phenomena or actions affect actors and properties at other locations.

The applied specification of neighborhood will be based on spatial contiguity. The queen contiguity of at least one common point of the borders dividing the two regions will be the criterion. The spatial matrix **W** entering the alternative models will be constructed as a queen neighborhood of first order for both regional systems The OLS model, the spatial lag model and the spatial error model to be calibrated can be formalized as

$$H_{i,t} = \alpha^H + \beta^H{}_U U_{i,t} + \beta^H{}_I I_{i,t} + \beta^H{}_M M_{i,t} + \beta^H{}_N N_{i,t} + \beta^H{}_A A_{i,t} + u^H$$
$$h_{i,t+T} = \alpha^h + \beta^h{}_H H_{i,t} + \beta^h{}_U U_{i,t} + \beta^h{}_I I_{i,t} + \beta^h{}_M M_{i,t} + \beta^h{}_N N_{i,t} + \beta^h{}_A A_{i,t} + u^h$$

$$H_{i,t} = \alpha^H + \rho^H \mathbf{W} H_{i,t} + \beta^H{}_U U_{i,t} + \beta^H{}_I I_{i,t} + \beta^H{}_M M_{i,t} + \beta^H{}_N N_{i,t} + \beta^H{}_A A_{i,t} + u^H$$
$$h_{i,t+T} = \alpha^h + \rho^h \mathbf{W} h_{i,t} + \beta^h{}_H H_{i,t} + \beta^h{}_U U_{i,t} + \beta^h{}_I I_{i,t} + \beta^h{}_M M_{i,t} + \beta^h{}_N N_{i,t} + \beta^h{}_A A_{i,t} + u^h$$

$$H_{i,t} = \alpha^H + \beta^H{}_U U_{i,t} + \beta^H{}_I I_{i,t} + \beta^H{}_M M_{i,t} + \beta^H{}_N N_{i,t} + \beta^H{}_A A_{i,t} + \lambda^H \mathbf{W} \varepsilon^H + u^H$$
$$h_{i,t+T} = \alpha^h + \beta^h{}_H H_{i,t} + \beta^h{}_U U_{i,t} + \beta^h{}_I I_{i,t} + \beta^h{}_M M_{i,t} + \beta^h{}_N N_{i,t} + \beta^h{}_A A_{i,t} + \lambda^h \mathbf{W} \varepsilon^h + u^h$$

The first two OLS models are standard linear combinations of individual effects without considering any spatial effects explicitly. The spatial lag models in the second group add additional terms to the first specification, which consist of the spatial autoregressive parameters ρ and spatial weight matrix **W** related to the dependent variables $H_{i,t}$ and $h_{i,t}$. In case that a significant parameter ρ is found then a significant spatial effect in the system will be indicated. If the value of ρ is positive it will be interpreted as a spill-over of housing supply in a region to surrounding regions. If the value of ρ is negative it will indicate the regional housing supply in expense of surrounding space. The spatial error models in the last couple apply a decomposition of the disturbance u^H and u^h into a spatially autoregressive error ε, its parameters λ and spatial weight matrix **W**. A significant spatial error parameter λ indicates a spatial covariance in the OLS disturbances. This may indicate omission of a significant individual or a complex spatial factors in play. Covariance implies the existence of a spatial multiplier. For an error process, a shock in the error at any location will be transmitted to all other locations following the multiplier expressed in equation $[\mathbf{I} - \lambda \mathbf{W}]^{-1} = \mathbf{I} + \lambda \mathrm{W} + \lambda^2 \mathbf{W}^2 +$

… The same principle applies to spatial autoregressive processes in dependent variable and predictors (Anselin 2003). Technically, we use the Geoda 0.9.5-i5 (2004) environment for calibration purposes, applying all three alternative estimation procedures.

The datasets used in the empirical calibration for the Czech regional system are provided by the Czech Statistical Office. A limit to these data is that not all explanatory variables are available for the period between 1997 and 2007 requested. The average annual income is available only between the years 1998 and 2005 at the scale needed. Later horizons are inconsistent in consequence of methodological change. The data used in empirical calibration for the regional system in the Slovak Republic are provided by the Statistical Office of the Slovak Republic and the Ministry of Construction and Regional Development of the Slovak Republic. In this case all variables are available for the years between 1997 and 2007. In order to make the regional systems comparable the five districts, of which the city of Bratislava is composed, and analogously the four districts in the city of Košice were merged. The 72-region system therefore differs from the official 79-unit regionalization. However, this update does not remove another problem remaining with both regional frameworks, the population size varying significantly among individual units. In case of the Slovak regional system the mean population corresponding to the period 1997-2007 is 74.8-thousand, the minimum is 12.6-thousand and the maximum is 435.0-thousand. In case of the Czech regional system, the minimum population size during the same period 1997-2007 is 42.3-thousand, the maximum is 1,180.0-thousand and the mean is 133.2-thousand inhabitants. Tab. 1 illustrates further variations in descriptive statistics for the 77 and 72 units as indicated annually.

The source information on the number of started dwellings $DS_{i,t}$ is obtained from the quarterly report from municipalities with construction office. A dwelling is a room or group of rooms with equipment arranged in a functional unit for permanent living. Dwellings started in a year are those that started to be constructed in a reference year according to the building permission (Statistical Office of the SR). It should be reminded that the problem of internal differentiation remains. Dwellings are considered as universal units, what introduces extensive probability of later explanation difficulties, since, for example, private investment into one-family homes across the country has certainly different set of explanatory factors if compared to the speculative developments in urban agglomerations. In this stage our model focuses on those factors that these have in common.

Two regional economic performance indices, $U_{i,t}$ and $I_{i,t}$ are standard, although having some difficulties, too. The rate of registered unemployment is calculated from the number of disposable applicants and the number of economically active persons for a previous year from the labor force sample survey. In Slovakia, an applicant is a citizen, who is placed into the register of applicants for a job in a territorial district where he resides (Statistical Office of the SR). In the Czech Republic, a similar definition was replaced in 2004, since when it has been constructed from the number of reachable unemployed job applicants. The labor force in the denominator consists of the number of employed citizens, the employed EU citizens, the working foreigners from third countries with permission to work or trade license and the reachable applicants. Average income is defined as the average gross monthly wage per accounted employee consisting of the wages and salary bases, supplementary and additional wage or salary payments, bonuses and remunerations, wage and salary substitution, awards for working readiness and other components, which were part of the pay before tax, insurance and deductions. Employment and wages by enterprise reporting are surveyed in the framework of economy monitoring. The source information is obtained from the annual report completed by all enterprises and organizations with at least 20 employees. Employees are included in the district, where the real workplace is located in Slovakia. In the Czech Republic, the data on income are organized on basis of the location of headquarters (Czech statistical office). Annual value of wages is constructed from quarter-year wages. A serious limit to these data is the difference in reporting regional unit, which can add some problems to interpretation in case that income will be indicated as a significant factor for housing supply.

The two demographic dynamics indices $M_{i,t}$ and $N_{i,t}$ are the least problematic in methodological aspect. Net migration is the difference between the number of immigrants and the number of emigrants. As a source for migration statistics the statistical questionnaires completed in case of change of permanent residence in the country or at immigration from, or emigration to foreign country are used. A problem with migration is varying reporting discipline of households. This deformation is discussed in literature on suburbanization. Natural increase captures the difference between the number of the live-born children and number of the deceased. The information base for vital statistics is the system of civil registrations of live born children of mothers with permanent residence in the Slovak Republic and the Czech Republic, and civil registrations of deaths of persons with permanent residence in these countries.

The fifth measure, regional accessibility proxy should be taken as experimental, inspired by Andersson and Gråsjö (2009) reviewing potential of opportunities for interaction, closely related to gravity models based on the interaction of masses. Interaction modeling is an important theoretical concept capturing spatial relationships among the units organized in a regional system. In practice it is mostly used in transport research. Interaction modeling relies basically on magnitudes of interacting entities and a factor decaying the interaction between them, usually physical or temporal distance. Our artificial predictor is constructed to measure expected interaction intensities among different regional populations *i* and *j*. Distance separating them is measured as $d_{ij} = [(x_i – x_j)^2 + (y_i – y_j)2]^{1/2}$ between the centroids` coordinates [$x_i; y_i$] and [$x_j; y_j$] of the regions *i* and *j*. The final value summarizes all expected interactions between the region *i* in focus and all remaining 71/76 regions *j*. Such accessibility proxy captures on one hand regional populations and location within the physical space differentiated by distance.

The set of five predictors outlined enters as factors expected to be significant in explanation of the observed housing supply level and dynamics patterns. Since some practical limits to these data persist, especially with the economic opportunity variables, we try to avoid at least some of them by the standardized vectors $H_{i,t}; U_{i,t}; I_{i,t}; M_{i,t}; N_{i,t}$ and $A_{i,t}$.

Results

The housing supplies expressed by the investment intensities display an unstable development in both countries. The Fig. 1 illustrates the evolution of the H_t since when the two countries replaced the former federation until 2008. The countries depart from practically the same extremely low level and generally follow a similar pattern. While the Czech housing supply is a leading and more stable one, the Slovak supply lags and is more volatile. During the years illustrated an increasing trend is obvious. Both countries arrive at the similar levels, 5.8-times higher for the Czech and 6.4-times higher for the Slovak market in the year 2008. The clear trend is disturbed by instabilities. In case of the Czech market a peak appears in 1998 at the level of $H_{1998}=3.40$ followed by a decrease ending at the level of $H_{2001}=2.83$. A succeeding increase phase then lasts until the level of $H_{2006}=4.24$ is reached and the trend returns to a decrease. In the Slovak market we observe an analogous peak at the level of $H_{1998}=3.20$ followed by a shorter and deeper decrease until the level $H_{2000}=1.83$. The market again after 2006 decreases and also additionally decreases between 2002 and 2003 and there is a steep increase since 2007.

A segment from this evolution can also be based on data which are decomposed into the regional units, starting with the year 1997 and ending with the year 2007. The descriptive indices in Tab. 1 witness that means follow a similar temporal pattern, identifying the sub-periods in a cyclical behavior identifiable in the regional scale. Relying on the Moran`s *I*, we observe an increasing spatial autocorrelation for $H_t$ in Slovakia between *0.13* and *0.55*. In case of the Czech regional system Moran`s *I* is stable, between *0.31* and *0.33*.

Considering the set of independent variables, we focus on the unemployment rate first. A decade 1997-2007 shows the stable Czech rate and the more volatile Slovak rate. Mean regional unemployment in the Czech Republic has doubled until 2003, reaching *10.0* percent. Last four years show a decrease to the level *6.9* percent. The Czech Republic, unique among the Central and Eastern European countries, experienced a long period of low unemployment (Boeri and Terrell 2002). The Slovak labor market departed from a 3-times higher level, reached a peak at *21.3* percent in 1999 and since 2001 decreased to reach *9.5* percent in 2007. Spatial autocorrelation of the U_t values shows a stable positive level between *0.66* and *0.65* in Slovakia, and *0.49* and *0.57* in the Czech Republic. In contrast to unemployment, average income is less spatially correlated, but the trend is increasing between *0.19* and *0.32* in Slovakia, and *0.26* and *0.31* in the Czech Republic. As Blanchflower (2001) finds, also in Eastern Europe higher levels of unemployment reduce income. The same processes appear to be at work in the West and the East.

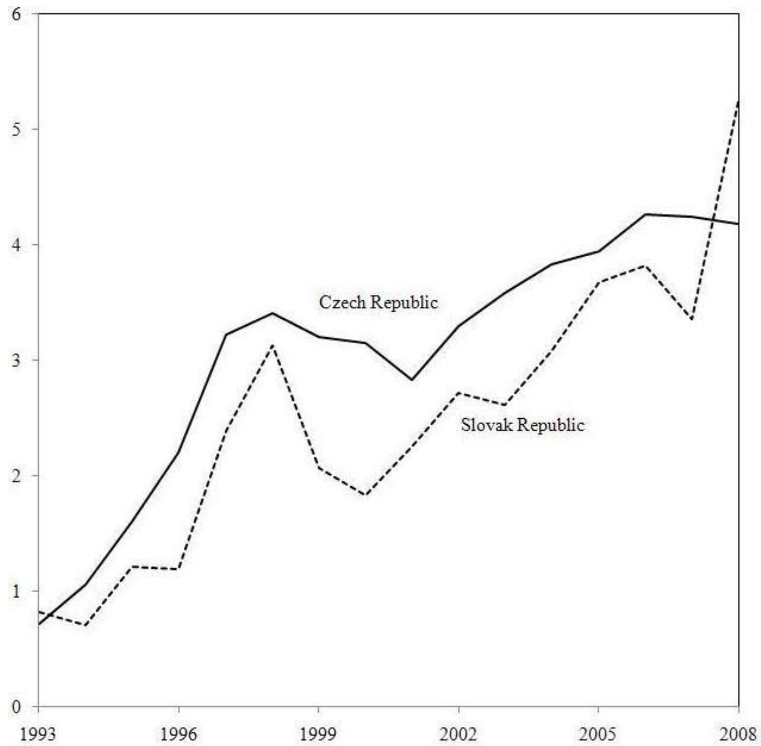

Fig.1 Housing investment intensity level H_t in the Czech and the Slovak Republic, 1993-2008.

Considering the mean regional net migration rate, temporal pattern appears reverse to economic indices. The Slovak regional system was stable in the aspect of migration dynamics, displaying a stable growth between *0.3* and *1.0*. The Czech regional system in average increases its dynamics more dramatically, departing from the level of *1.6* and ending at the level of *7.4* in 2007. Spatial autocorrelation temporally also increases at low positive values: the Slovak regional system between *0.22* and *0.37*, the Czech system between *0.18* and *0.47*. Regional natural population dynamics displays again a sharp contrast between the two countries. During the same decade, the Czech mean increases from the negative level of *-2.0* to reach *1.0* in 2007. Simultaneously, the Slovak mean decreased from the level of *1.4* and since the year 2001 oscillates close to the zero level, ending at the *-0.3* decrease in 2007. Both national systems display a decrease in spatial correlation, according to Moran`s *I*. The Slovak system decreases between *0.68* and *0.53*, the Czech system between *0.36* and *0.14*.

Fig. 2 Regional housing starts per population $H_{i,t}$ in the Czech Republic and Slovakia,1997-2007.

The objective of the OLS model calibration in the first stage is to find linear relationship between the housing investment intensity approximating the housing supply and potential explanatory variables introduced. Considering the limit of average income data availability we estimate model parameters during the period between 1997 and 2007 in the Slovak Republic, and during the shorter period between 1998 and 2005 in the Czech Republic.

According to the first series of OLS equations, a noticeable increase in variability explained by the model appears during the periods focused. The R^2 values in general increase between $R^2_{1997}=0.17$ and $R^2_{2007}=0.79$ in the Slovak model, between $R^2_{1998}=0.35$ and

R^2_{2005}=*0.75* in the Czech model. An exception in the first system is the period 2001-2002, when R^2 gets lower value *0.42*. The Czech system similarly decreases to the level of *0.41* in the year 2000. During the time we observe a growing predictability of regional differentiation according to the set of predictors entering calibration. Without any spatial econometric terms in this stage, the housing supply can be explained by the two economic, the two demographic variables and the accessibility proxy. The housing investment intensities are modeled on an annual basis, without application of any temporal lag between the factors and the dependent variable, the model is simultaneous.

Unemployment has a significant negative effect on housing supply with the exception of the Czech model in 2005. In both countries an extreme value for β_u is found in the year 1999 (*-0.56* in the Slovak and *-0.41* in the Czech model). Since 1999 the effect caused by a diminishing average unemployment rates approaches zero, but stays significant. It means that regions with high unemployment tend to have lower housing supply level than regions with low unemployment. This regularity applies for both countries in similar way.

In contrast to unemployment, the effect of average income is found insignificant in most of the estimations. An exception is indicated in Slovak models for the years 2003 and 2005-2007, when we get positive values of β_i between *0.32* and *0.24*. The result suggests, that in compare to availability of jobs, the income paid is statistically less important in both countries and this effect changes with time. We observe a growth in the value of parameter β_i. In case of the Slovak models income appears significant at the end of the period estimated. According to the Slovak case we may conclude, that with decreasing unemployment significance of average income differentiation gains the importance in explanation of the housing supply. Development of the parameter value is similar in the Czech model series.

According to the results, migration is besides unemployment the second generally significant factor. Again, one exception is the Slovak model for the year 1997, in which migration is not found a significant predictor. The values of migration parameter β_m are positive all the time and its effect grows to reach the same level of *0.87* in 2007 in the Slovak model and in 2005 in the Czech model. It means that the effect of migration intensity on the housing supply is positive. The more a region attracts migrants, the more its housing investment is activated. The market demand-supply relationship also strengthens with time for both of the national markets in similar way. Natural population dynamics is the second demographic factor expected theoretically to affect the demand side of the housing market on which the supply should be reacting. Natural increase rate is indicated as a significant predictor in all of the Slovak models. Simultaneously it is found insignificant in all of the Czech models. With time the effect of natural dynamics slightly weakens with β_n between *0.27* and *0.21*. It means that if natural dynamics is positive it has a significant effect on demand on which supply obviously reacts, as observed in Slovakia. If natural dynamics is negative, as in the Czech Republic, its effect is statistically insignificant. Positive natural dynamics level was only entered in last two years; therefore, significance of the demographic predictor can be expected in forthcoming period.

The last considered, accessibility proxy variable is indicated as significant in three model cases. In the 2001 and 2007 Slovak models, as well as in the 2005 model for the Czech Republic. What is even more complicated, in Slovakia the effect is estimated with negative parameter values while in the Czech case it is positive. A technical interpretation is that larger regions and regions closer to larger regions tend to have lower housing supply than smaller regions and regions far from larger regions in Slovakia. In the Czech case this is turned reverse. If we observe the development of parameter value we will see a systematic oscillation around zero value in both countries. Statistical significance is only reported in case of the models mentioned.

Based on the OLS results, in preparation for further research by means of the two alternative spatial econometric tools, we explore potential source of problems with spatial heterogeneity. The assumption of constant parameter estimates in case of spatial heterogeneity indicated will not be valid. Therefore a series of tests is offered on the OLS residuals (Lundberg 2004). Normality is a null hypothesis in the Jarque-Bera test (*JB*). It should be rejected in case that its probability exceeds a threshold. We use $p>0,05$. Non-normality is unfortunately the case in all of our models with exception of the 2006 and 2007 Slovak models and the 1999 Czech model. For heteroskedasticity the Koenker-Bassett (*KB*) test is applied. In case of normal errors the Breuch-Pagan (*BP*) test should be sufficient. The null hypothesis of homoskedastic errors is rejected if the value $p<0,05$. The Slovak models have heteroskedastic errors indicated between 2003 and 2007, the Czech models in 1998 and 2001 to 2004. Spatial autocorrelation relying on Moran`s *I* is indicated as significant in case of the 2004 and the 2006 to 2007 Slovak models, and the 2005 Czech model. In all other cases it is insignificant. A specification strategy should be based on robust Lagrange multiplier tests: LM_ρ for spatial lag and LM_λ for spatial error alternative. The Lagrange multiplier tests have null hypothesis of no spatial correlation against the alternative as the correct specification. The tests suggest that both alternatives are applicable in the 2002 and

2005 Slovak models. The LM_ρ is significant in the 2006 and 2007 Slovak models. The value of LM_λ is found significant in the 2002 Czech model. According to these results we should consider to be valid all of the OLS results except the mentioned cases where we should search for some spatial effects. Since the values of LM_ρ appear more significant than LM_λ in 2002 and 2005, the spatial lag model estimation should be used. To summarize, according to the Lagrange multiplier test the spatial lag alternative should be estimated in the years 2002, 2005-2007 in Slovakia, and the spatial error alternative in 2002 in the Czech Republic. Since we have the problem with non-normal and heteroskedastic errors, reliability of these recommendations is questionable. To solve it practically, a strategy of creation relevant subgroups of regions is found in literature. In this paper, we will again only register the problem and its solution will be left for further research. It is not surprising that both countries with high probability consist of several spatially divided regimes. In a further step we should focus on finding a method allowing a robust aggregation of currently used regions into optimal subgroups. Lundberg (2004) used a subgroup of municipalities in the capital city region estimated separately from the rest of Sweden.

All the spatial models improve performance of the regression in terms of R^2. The spatial lag models for Slovakia, in all the LM_ρ suggested cases, estimate significant positive values for the parameter ρ. It means that the regional housing supply levels are significantly related with the housing supply levels in the surrounding regions. The housing supply tends to spill-over into the neighboring space in the Slovak regional system during the years identified. The parameter values linked to predictors generally remain similar. During the time remaining no significant parameter values ρ are found, supporting the robust Lagrange multiplier tests suggestions. The spatial error model in 2002 for the Czech Republic indicates an insignificant λ parameter value. It means that despite the positive LM_λ, the result supports no spatial effect spreading across the Czech regional system. On other hand, the parameter λ is significantly positive in four additional models despite the negative Lagrange multiplier tests recommendations: the 2004, 2006 and 2007 Slovak models, and the 1998 Czech model. Again, remaining predictors hold similar effects. The significant positive λ values indicate that the housing supply did spread across the regional systems in those years via an omitted spatial effect. Our findings support Murphy, Muellbauer and Cameron (2006). Their housing market comparisons with contiguous regions are also important. As they explain, given the commuting option, people may choose to live in regions with lower housing costs and commute to the contiguous region with higher house prices for work. They find that good labor market opportunities in contiguous regions have a considerable influence on migration.

Turning attention on the second model specification, we observe a deep decrease in model performance. The estimation for the 1998 to 2007 period, covered by dataset displays R^2 at the level of *0.16* in the Slovak version and the level of *0.32* in the Czech version of the dynamic model specification. In both countries, a significant negative effect is indicated from departing levels of regional housing supply. The interpretation says that there is a convergence taking place (Lundberg, 2004). Regions with relative high housing supply level in 1998 have grown less until 2007 than regions with relative low housing supply level. In both countries a significant negative effect is found also in relationship to unemployment. Regions with high unemployment in 1998 have grown less until 2007 than low unemployment regional units. In addition, there is a positive effect of migration dynamics significant in the Czech system. Income, natural increase and accessibility proxy are found insignificant. Before search for the spatial effects, non-normal errors are indicated by the *JB* probability values. The *KB* values indicate homoskedastic OLS errors. Spatial covariance is significant in the Slovak model and the Lagrange multiplier tests recommend the OLS regression estimates. In spite of that, the parameters ρ and λ are found positive in case of the Slovak model, while unemployment is no longer significant in both alternatives and a positive effect of migration is indicated.

In order to search for regularities in connection to the overall dynamics illustrated in the Fig. 1, the basis period between 1998 and 2007 is divided into the sub-periods of decrease and increase, following a seemingly cyclical behavior. In Slovakia the period of decrease lasts until 2000 and in the Czech Republic until 2001. The succeeding sub-period of increase is defined between 2000 and 2006 for the Slovak and between 2001 and 2006 for the Czech model. The OLS estimations are then re-run for the sub-periods. Dynamic model specifications display a slight increase in model performance. The decrease sub-periods are explained better (*0.25* for the Slovak and *0.35* for the Czech model) than the increase sub-periods (*0.23* for the Slovak and *0.30* for the Czech model). In all cases, housing supply level at the departing point is indicated significantly negative. Convergence is therefore supported also for the sub-periods. Unemployment rate at the departure is again with significant negative effect in all cases except the decrease sub-period in the Slovak regional system. Migration is indicated with significantly positive effect in all cases except the increase sub-period in the Czech Republic. Natural dynamics is significantly positive for the Slovak decrease sub-period. Neither average income nor accessibility proxy, were identified relevant factors affecting regional growth of housing investment intensity.

Considering spatial effects also in these regression models, the *JB* test values indicate non-normality in all cases except the Czech increase sub-period. The *KB* test values indicate heteroskedastic errors based on the OLS residuals in case of the Slovak decrease sub-period model. Spatial covariance is indicated generally insignificant. The robust Lagrange multiplier test values recommend the OLS estimations in all of the models with exception of the Czech increase sub-period. The spatial lag model is suggested as the correct alternative to the OLS estimation. In spite of it, the insignificant value for the parameter ρ is found. On other hand, the significant positive λ is found in case of the Czech decrease sub-period. It means that relevant spatial effect is found only in case of the housing supply change during the sub-period of decrease in the Czech model for the years 1998 to 2001 with the housing level and migration in 1998 as remaining significant effects.

Extension

Dynamical patterns temporally aggregated previously in several years lasting periods will additionally be tested by means of the same methodological approach. In this extending section we will present the results of the tests based on annual model reformulation, explaining annual difference $\Delta H_{i,t+1} = H_{i,t+1} - H_{i,t}$ instead of the previously used growth ratio to avoid numerous missing values appearing in case of annual $h_{i,t+T}$

$$\Delta H_{i,t+1} = \alpha^{\Delta H} + \beta^{\Delta H}{}_H H_{i,t} + \beta^{\Delta H}{}_U U_{i,t} + \beta^{\Delta H}{}_I I_{i,t} + \beta^{\Delta H}{}_M M_{i,t} + \beta^{\Delta H}{}_N N_{i,t} + \beta^{\Delta H}{}_A A_{i,t} + u^{\Delta H}$$

$$\Delta H_{i,t+1} = \alpha^{\Delta H} + \rho^{\Delta H}\mathbf{W}\Delta H_{i,t+1} + \beta^{\Delta H}{}_H H_{i,t} + \beta^{\Delta H}{}_U U_{i,t} + \beta^{\Delta H}{}_I I_{i,t} + \beta^{\Delta H}{}_M M_{i,t} + \beta^{\Delta H}{}_N N_{i,t} + \beta^{\Delta H}{}_A A_{i,t} + u^{\Delta H}$$

$$\Delta H_{i,t+1} = \alpha^{\Delta H} + \beta^{\Delta H}{}_H H_{i,t} + \beta^{\Delta H}{}_U U_{i,t} + \beta^{\Delta H}{}_I I_{i,t} + \beta^{\Delta Hh}{}_M M_{i,t} + \beta^{\Delta H}{}_N N_{i,t} + \beta^{\Delta H}{}_A A_{i,t} + \lambda^{\Delta H}\mathbf{W}\varepsilon^{\Delta H} + u^{\Delta H}$$

The extension is estimated, concerning the limits of data available, during the period 1998-2007 for Slovakia and the period 1999-2006 for the Czech Republic. Right-hand side of the model remains unchanged in compare with the former version explaining the growth $h_{i,t+T}$.

The performance of the annually based dynamical model varies extensively according to the levels of R^2, between *0.12* and *0.78* in the Slovak model and between *0.22* and *0.48* in the Czech case. Peaks of the highest explanation levels are identified in the years 1999, 2003 and 2007 while a peak of the lowest explanation appears in 2001 for the Slovak regional system. In the Czech regional dynamics a positive peak appears in the year 2001 at the level to which it recovers a half-decade later. If compared with the development pattern of the levels H_t in the Fig.1 it becomes clear that the positive peaks are linked to the breaking decrease intervals. A smooth development of the Czech market during the period 2001-2005 also has reflection in a smooth development of the explanation level in this estimation.

Interpreting the OLS calibration result, convergence hypothesis for the regional housing supply change is again supported by the results presented in the Tab.3. We observe significant negative values for the parameter $\beta^{\Delta H}{}_{H}$ with exception of the Slovak market in 2001 and 2004, when it is significantly positive, and the Czech market between 2002 and 2003. Again a comparison with the trend observed in the Fig.1 suggests that both of the regional systems in general converge, but during the sub-periods of continuing increase tend to register divergence. This is the case of all above mentioned years. Reason for such behavior remains hidden. Concerning unemployment, a varying significance of its negative effect on the housing supply change is displayed. The first economic variable has lost significance more specifically between 2000 and 2002 as well as 2004 and 2006 in Slovakia. In the Czech market the same lost appears between 2000 and 2001 plus between 2003 and 2005. The comparison with the trend for mean housing supply we can conclude that the effect expressed by the parameter $\beta^{\Delta H}{}_{U}$ is in general stronger during the periods when the market is slowing down and weakens when the market speeds up conversely. The second economic variable, average income stays most of the time insignificant, except the 2005 model for Slovakia and the 2002 model for the Czech Republic, when the effect of average income is positive. Supporting the findings above, income tends to be identified as a significant positive factor influencing the housing supply change only exceptionally, but the reason for it is unclear in this case. In Slovakia it happens during the period of unemployment insignificance, while in the Czech market simultaneously with a significant unemployment effect. Natural population change is another problematic predictor. While it is significantly positive in four of the Slovak models for the years 1999-2000, 2002 and 2007, it is significantly negative in the 2005 Czech model. No direct reason for such behavior appears from visual search for any regularity. Interpretation is much more straightforward in case of the second demographic variable. Migration is significantly positive almost in all of the cases modeled. The exceptions are found in the 2001, 2004 and 2005 models for Slovakia and the 2000, 2002 models for the Czech Republic. Without the last case, all of these insignificancies appear simultaneously with the insignificant unemployment. Therefore, we may conclude that our results find an indirect support for the hypothesis of short connection between the influence of regional unemployment and migration.

Searching for spatial effects in our models, the Jarque-Bera test indicates problems with normality in many of the years in both regional systems. In some cases the Koenker-Bassett test also adds the problem with heteroskedasticity. The values of Moran`s I are significantly positive only in case of the 2000 Slovak model and the 2001-2002 and the 2005 Czech models. Robust Lagrange multiplier tests suggest in all of the cases sufficiency of the OLS estimation, except the 2005 model in Slovakia and the 2000 model in the Czech Republic, when the spatial lag alternative should be estimated instead. The parameter ρ is subsequently found significantly negative in the Slovak model for the year 2005 and positive in the same year in the Czech Republic. It means that only in one of the years focused a significant spatial effect appears within the two regional dynamics. The reasons for opposite direction and temporal location remain unexplained. Estimating the second alternative, parameter λ in the spatial error model is identified significantly positive in 2000 and negative in 2004 for Slovakia, positive in 2001-2002 and 2005 in the Czech Republic. A justification for the observed patterns remains beyond interpretation possibilities offered by the set of spatial phenomena included in the current analysis.

Conclusions

The two countries, former federal republics of one state, depart from the same level and generally follow a similar pattern in development of the housing supply. Declining housing production and investment is not unexpected and can be considered as a consequence of the collapse of the previous state-subsidized monopolistic housing production chains (Hegedüs, Tosics and Mayo 1996). It appears that two distinct housing systems are emerging among the transition economies: one with distinct parallels with the southern European countries and one that shares some of the characteristics of Germany (Stephens 2003). It is unclear to which of these the two empirical markets would belong but we observe similarities as well as differences between the two. The Czech supply appears to be leading and more stable in compare to the Slovak supply development. Increase is a major trend while the sub-periods of a cyclical behavior are also identifiable. During the same time we observe that regional unemployment displays an inverse dynamics. While the Slovak regional system remains stable in migration aspect, the Czech system increases dramatically. Regional natural population dynamics is in contrast between the two countries since the Czech regions increased from the negative level while the Slovak regions decline from the positive levels. The countries of Central and Eastern Europe have experienced significant employment adjustment, rapid structural change and high unemployment, most of which is long term

(Boeri and Terrell 2002). The growth poles are surrounded by economically depressed regions, often one-company towns, where job opportunities are scarce and unemployment is high. Equilibrating forces are too weak to alleviate the imbalances. Labor mobility is relatively low due to an underdeveloped housing market, according to Rutkowski (2006).

During the transition a growing predictability of regional differentiation according to the set of predictors is observed. Unemployment is a significant negatively affecting factor, except the last Czech model estimated. Diminishing unemployment in conditions of economic growth approaches zero effect but stays significant. Regions with high unemployment tend to have lower housing supply level than regions with low unemployment. Average income is found an insignificant factor, except some Slovak models in the end of the estimated period. In compare to availability of jobs, the income is statistically less important but it grows with time. Income differentiation gains the importance in explanation of the housing supply with decrease in unemployment significance. Migration is significant factor except the first Slovak model and its effect grows. The effect of migration on housing supply is positive. The more a region attracts migrants, the more its housing investment is activated and the market supply response strengthens with time. Natural population dynamics is indicated generally significant predictor in one country while absolutely insignificant in the other. Positive natural dynamics has positive significant effect on demand on which supply obviously reacts. If natural dynamics is negative, the effect is statistically insignificant. To complete the predictors` interplay, larger regions and regions closer to larger regions tend to have lower housing supply than smaller regions and regions far from larger regions in one country while it is reverse in the other country. This comes from the development pattern with systematic oscillation between positive and negative effect in both countries.

The regional housing supply levels are significantly related with the housing supply levels in surrounding regions according to four ρ parameters. The housing supply tends to spill-over to the neighbors in the Slovak system in the latter years. The spatial error parameter λ is also significant for the latter Slovak models, as well as the first Czech model. This indicates that the housing supply did spread across the regional systems early in case of the Czech regional system and late in case of the Slovak regional system.

Estimating the second model a decrease in model performance appears. Significant negative effect is indicated from departing levels of regional housing supply suggesting that convergence is taking place in the regional system regarding the housing market. Relative high housing supply level regions grow less than regions with relative low housing supply level. Again a significant negative effect is found in relationship to unemployment. Regions with high unemployment grow less than low unemployment regional units. In addition, there is a positive effect of migration significant only in the Czech regional dynamics. Both spatial effects are significantly positive in the Slovak regional dynamics. Basic period is then divided in two sub-periods. The market decrease and increase follow a cycle, in Slovakia breaking in the year 2000, in the Czech Republic in the year 2001. The specification causes only a mild increase in performance. Convergence is again supported for both sub-periods in two countries. Unemployment rate has significantly negative effect except the decrease sub-period in the Slovak regional system. Migration has significantly positive effect except the increase sub-period in the Czech system. Natural increase is significantly positive in the Slovak decrease sub-period. Considering spatial effects, relevant spatial effect is found only in case of the sub-period of decrease on the Czech side.

The performance of the annually updated dynamical model varies in obvious relationship with the general development of the markets pointing at peaks and smooth intervals. Regional convergence in the aspect of regional housing supply change is supported, except the sub-periods of continuing increase, when systems tend to turn divergent. Negative influence of unemployment on housing supply change looses significance according to the market dynamics. The effect is generally stronger during the periods when the market is slowing down and weakens when the market speeds up. Income tends to be identified as a significant positive factor influencing the housing supply change only exceptionally. Migration has a significant positive influence in general while there is a short connection found between the influence of regional unemployment and migration. Substantive spatial effect is found significant in 2005 for both countries having an opposite direction.

Spatial differences in residential construction and house prices have led many researchers to focus on the local aspect of the housing market (Saks 2008). His work suggests that heterogeneity may be important also in another direction. He finds that national economic conditions play out differently across different types of areas. A hypothetical link should probably be done between his conclusions and persisting problems with regression models indicating also spatial heterogeneity in the relationships modeled. Search for correct specification strategy remains beyond scope of this paper and should be focused in a step following presented research.

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		Czech Republic					Slovak Republic				
		Mean	SD	Min	Max	Moran´s *I*	Mean	SD	Min	Max	Moran´s *I*
Housing investment rate (*H*)	1997	3,092	1,673	0,656	11,867	0,306	2,524	1,363	0,492	6,830	0,134
	1998	3,490	1,796	0,846	11,872	0,152	2,944	2,143	0,562	15,618	0,241
	1999	3,418	1,824	0,531	10,727	0,093	1,932	1,176	0,195	5,866	0,264
	2000	3,248	1,443	0,577	10,190	0,260	1,762	1,095	0,306	6,566	0,278
	2001	3,070	1,747	1,106	12,016	0,193	2,322	1,405	0,462	6,880	0,195
	2002	3,371	2,311	0,770	16,076	0,262	2,647	1,678	0,500	8,867	0,372
	2003	3,720	3,023	0,762	22,582	0,250	2,407	2,211	0,367	17,352	0,382
	2004	3,702	3,017	0,601	22,041	0,295	2,732	3,029	0,270	23,836	0,355
	2005	3,770	3,315	0,618	21,824	0,440	2,794	2,834	0,081	15,359	0,582
	2006	4,082	2,796	0,565	19,462	0,350	3,154	3,151	0,000	19,889	0,623
	2007	3,930	2,450	0,806	15,094	0,333	3,030	2,942	0,164	18,279	0,547
Unemployment rate (*U*)	1997	4,600	2,192	0,563	11,198	0,494	13,890	5,439	3,271	25,960	0,660
	1998	6,328	2,661	1,003	13,794	0,535	17,500	6,653	3,981	33,250	0,658
	1999	8,740	3,302	2,239	17,873	0,599	21,270	7,371	5,816	37,400	0,640
	2000	9,109	3,867	2,891	20,990	0,633	19,398	6,130	5,036	32,020	0,625
	2001	8,551	3,953	2,522	21,302	0,650	20,494	7,127	4,319	35,455	0,643
	2002	9,191	3,972	2,525	21,357	0,646	19,323	7,850	4,010	37,218	0,631
	2003	9,984	4,154	2,847	22,309	0,651	17,130	6,942	3,236	30,635	0,656
	2004	9,355	3,863	2,793	22,777	0,623	14,735	6,356	2,842	28,663	0,669
	2005	9,200	3,754	2,654	22,001	0,601	13,034	6,387	2,094	29,245	0,660
	2006	8,396	3,586	2,335	20,537	0,576	10,914	6,134	1,882	28,344	0,683
	2007	6,875	3,040	1,754	17,552	0,565	9,467	5,794	1,624	27,046	0,653
Average nominal wage (*W*)	1997	-	-	-	-	-	8373	988	6890	12608	0,194
	1998	10561	1012	9244	14522	0,264	9033	1107	7540	14055	0,223
	1999	11403	1156	9915	15836	0,265	9705	1192	7959	15183	0,168
	2000	12076	1195	10601	16923	0,283	10388	1400	8292	16739	0,267
	2001	13086	1308	10990	18404	0,294	11173	1560	8853	18629	0,257
	2002	13936	1380	11869	19901	0,328	12360	1758	9609	20779	0,223
	2003	14905	1407	12973	21073	0,328	13245	1997	10227	22742	0,279
	2004	15926	1495	13862	22443	0,326	14504	2222	11050	24934	0,280
	2005	16660	1619	14580	23792	0,308	15619	2514	11996	27705	0,273
	2006	-	-	-	-	-	17044	2742	13121	30656	0,272
	2007	-	-	-	-	-	18493	2997	13984	32895	0,323
Net natural increase (*N*)	1997	-2,047	1,655	-8,893	1,610	0,356	1,349	3,453	-3,996	11,127	0,682
	1998	-1,703	1,467	-6,707	1,674	0,311	0,800	3,623	-5,691	12,570	0,631
	1999	-1,925	1,443	-7,052	1,154	0,363	0,747	3,364	-5,122	10,714	0,670
	2000	-1,664	1,329	-6,328	1,315	0,298	0,498	3,350	-4,812	10,737	0,637
	2001	-1,600	1,103	-4,531	0,973	0,270	-0,296	3,325	-8,600	8,417	0,613
	2002	-1,374	1,184	-4,081	2,529	0,269	-0,181	3,197	-5,606	8,596	0,676
	2003	-1,658	1,083	-4,625	1,204	0,252	-0,213	3,049	-5,929	8,014	0,589
	2004	-0,935	0,997	-3,968	0,960	0,208	0,222	3,086	-5,448	8,459	0,602
	2005	-0,584	1,022	-2,559	2,972	0,141	-0,035	2,916	-5,448	8,292	0,609
	2006	0,146	1,160	-2,717	4,091	0,152	-0,130	2,948	-5,331	8,431	0,603
	2007	1,006	1,197	-1,830	5,326	0,140	-0,279	3,058	-6,956	7,588	0,526
Net migration rate (*M*)	1997	1,566	2,263	-2,289	11,446	0,177	0,317	1,745	-2,756	6,203	0,220
	1998	1,645	3,207	-2,840	19,800	0,158	0,621	2,143	-3,723	6,549	0,072
	1999	1,510	3,540	-1,948	23,780	0,202	0,473	2,060	-3,636	7,981	0,027
	2000	1,267	4,018	-4,399	26,371	0,181	0,224	2,170	-5,522	11,290	0,211
	2001	0,139	4,645	-17,239	24,748	0,085	0,161	2,188	-3,225	10,599	0,225
	2002	1,323	4,751	-13,132	26,062	0,274	0,173	3,291	-4,814	19,108	0,226
	2003	2,708	4,855	-3,453	24,257	0,302	0,383	2,993	-5,193	14,784	0,255
	2004	1,917	6,407	-8,807	34,204	0,243	0,596	3,091	-4,428	17,273	0,296
	2005	3,446	7,085	-5,009	41,950	0,396	0,434	3,492	-4,085	20,485	0,307
	2006	3,761	7,506	-11,895	43,926	0,296	0,617	3,606	-3,353	22,205	0,286
	2007	7,393	9,598	-6,615	50,222	0,466	1,027	4,639	-4,532	31,191	0,366

Tab.1 Descriptive values.

	Slovak Republic											Czech Republic							
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	1998	1999	2000	2001	2002	2003	2004	2005
OLS model																			
R^2	0,173	0,371	0,430	0,542	0,423	0,423	0,735	0,677	0,663	0,708	0,787	0,346	0,483	0,407	0,513	0,521	0,566	0,635	0,744
α^H	0,389***	0,166**	0,34***	0,065	0,278**	0,153	-0,038	-0,030	-0,043	-0,009	-0,039	0,299***	0,347**	0,325***	-0,105	0,042	0,063	0,051	0,051
β^H_U	-0,336**	-0,351***	-0,56***	-0,336***	-0,408***	-0,303***	-0,165***	-0,188***	-0,188***	-0,167***	-0,18***	-0,292***	-0,407***	-0,269***	-0,287***	-0,275***	-0,229***	-0,231***	-0,106*
β^H_I	-0,094	0,020	-0,046	0,031	0,127	0,163	0,166**	0,024	0,324**	0,345***	0,235**	-0,076	-0,113	-0,071	0,115	0,179*	0,093	0,079	-0,117
β^H_N	0,274**	0,21**	0,392***	0,318***	0,248**	0,291***	0,124***	0,19***	0,225***	0,163***	0,213***	-0,019	0,085	-0,051	0,068	-0,011	0,091	0,011	-0,043
β^H_M	0,203	0,198***	0,305***	0,715***	0,591***	0,664***	0,602***	0,61***	0,69***	0,676***	0,873***	0,438***	0,576***	0,462***	0,747***	0,52***	0,415***	0,559***	0,871***
β^H_A	-0,270	-0,043	-0,011	-0,069	-0,352**	-0,225	-0,085	-0,017	0,030	-0,094	-0,181**	0,076	0,044	0,086	-0,013	-0,098	-0,050	0,054	0,222**
Specification tests based on OLS																			
JB	7,983**	503,189***	10,653***	11,12***	14,445***	11,234***	326,057***	122,192***	93,144***	1,396	1,501	8,69**	4,211	9,12**	103,205***	134,56***	79,288***	43,45***	87,585***
BP	7,118	67,464***	11,493**	9,808*	11,788**	8,554	285,91***	178,09***	64,967***	15,567***	10,07*	16,953***	6,023	10,602*	48,462***	60,717***	150,184***	82,204***	9,925*
KB	6,797	9,771*	7,704	6,586	8,058	5,749	48,072***	48,42***	19,288***	15,461***	11,671**	12,384**	6,316	7,656	14,325**	16,201***	46,443***	31,448***	3,127
Moran`s I	1,519	1,917*	1,115	1,559	1,493	0,587	0,264	2,97***	0,524	2,66***	2,139**	1,824*	-0,574	0,470	0,366	1,791*	-0,340	-0,009	2,037**
LM_ρ	0,678	0,020	0,037	0,998	0,153	13,867***	1,306	0,239	11,651***	11,022***	9,563***	0,579	2,322	1,523	0,012	2,987*	0,316	0,528	0,044
LM_λ	0,302	0,200	0,705	0,092	0,011	10,124***	0,883	3,583*	5,895**	0,692	0,396	1,700	0,493	1,123	0,020	4,461**	0,005	0,048	0,984
Spatial lag model																			
R^2	0,190	0,388	0,442	0,554	0,433	0,469	0,737	0,683	0,694	0,773	0,821	0,356	0,505	0,412	0,513	0,522	0,575	0,641	0,750
ρ^H	0,160	0,186	0,153	0,167	0,151	0,315**	0,074	0,126	0,283**	0,427***	0,31***	0,146	-0,221	0,094	0,001	-0,023	-0,156	-0,131	0,148
α^H	0,337***	0,141*	0,289***	0,031	0,217*	0,084	-0,044	-0,042	-0,071	-0,051	-0,054	0,248***	0,446***	0,29***	-0,105	0,046	0,086*	0,072	0,026
β^H_U	-0,31**	-0,327***	-0,518***	-0,307***	-0,369***	-0,216**	-0,155***	-0,168***	-0,125*	-0,087*	-0,133***	-0,26***	-0,481***	-0,243***	-0,286***	-0,28***	-0,26***	-0,258***	-0,080
β^H_I	-0,096	0,000	-0,034	0,029	0,144	0,127	0,158**	0,014	0,247**	0,257***	0,143*	-0,067	-0,108	-0,072	0,115	0,18*	0,100	0,090	-0,121
β^H_N	0,254**	0,2***	0,37***	0,303***	0,252**	0,236***	0,122***	0,183***	0,194***	0,139***	0,191***	-0,015	0,078	-0,046	0,068	-0,010	0,090	0,004	-0,022
β^H_M	0,195	0,185***	0,285***	0,682***	0,575***	0,577***	0,589***	0,591***	0,561***	0,512***	0,773***	0,447***	0,553***	0,46***	0,747***	0,523***	0,431***	0,574***	0,829***
β^H_A	-0,270	-0,055	-0,030	-0,096	-0,371**	-0,228	-0,093	-0,023	0,053	-0,096	-0,186***	0,001	0,131	0,051	-0,013	-0,084	0,031	0,117	0,133
Spatial error model																			
R^2	0,185	0,393	0,450	0,550	0,438	0,423	0,735	0,711	0,663	0,748	0,805	0,389	0,495	0,407	0,514	0,538	0,579	0,637	0,755
α^H	0,391***	0,197**	0,354***	0,078	0,25**	0,153*	-0,041	-0,032	-0,046	0,010	-0,003	0,274***	0,359***	0,325***	-0,106	0,051	0,058	0,050	0,059*
β^H_U	-0,332**	-0,379***	-0,575***	-0,342***	-0,402***	-0,301***	-0,165***	-0,187***	-0,19***	-0,146**	-0,174***	-0,247***	-0,425***	-0,269***	-0,288***	-0,279***	-0,232***	-0,235***	-0,121**
β^H_I	-0,089	0,004	0,000	0,045	0,215	0,163	0,165**	0,020	0,335***	0,293***	0,162*	0,010	-0,128	-0,071	0,113	0,231**	0,061	0,070	-0,100
β^H_N	0,271**	0,214**	0,408***	0,321***	0,289**	0,29***	0,128***	0,167***	0,229***	0,159***	0,179***	-0,044	0,091	-0,051	0,069	-0,038	0,097*	0,015	-0,040
β^H_M	0,191	0,172**	0,276***	0,683***	0,569***	0,66***	0,605***	0,63***	0,705***	0,526***	0,813***	0,502***	0,528***	0,462***	0,748***	0,522***	0,422***	0,554***	0,845***
β^H_A	-0,267	-0,071	-0,067	-0,087	-0,396**	-0,224	-0,084	0,016	0,016	-0,062	-0,147**	-0,093	0,099	0,086	-0,001	-0,262*	0,080	0,095	0,147
λ^H	0,140	0,230	0,226	0,164	0,223	0,011	-0,059	0,398***	-0,042	0,503***	0,402***	0,357**	-0,206	0,001	-0,018	0,240	-0,261	-0,109	0,253*

Dependent variable: regional housing supply level $H_{i,t}$

Level of significance: *** = 1%; ** = 5%; * = 10%

Tab 2. Determination of the housing supply levels.

	Slovak Republic			Czech Republic		
	1998-2007	1998-2000	2000-2006	1998-2007	1998-2001	2001-2006
OLS model						
R^2	0,155	0,252	0,232	0,315	0,346	0,300
α^h	0,254**	0,124	0,424***	0,29***	0,215***	0,527***
β^h_H	-0,357**	-0,664***	-0,524**	-0,45***	-0,519***	-0,669***
β^h_U	-0,259**	0,030	-0,326**	-0,163**	-0,149**	-0,288**
β^h_I	0,059	0,194	0,244	0,115	0,114	0,232
β^h_N	0,09	0,309**	-0,034	-0,095	0,151*	-0,21*
β^h_M	0,205*	0,376***	0,554**	0,223**	0,368***	0,428
β^h_A	0,031	-0,039	-0,039	0,023	-0,152	0,429*
Specification tests based on OLS						
JB	249,185***	32,013***	6,301**	3686,968***	721,651***	3,241
BP	12,644**	35,108***	9,884	37,142***	91,504***	3,505
KB	2,514	17,554***	9,03	2,156	11,455*	3,929
Moran`s I	2,319**	1,79*	1,182	0,564	1,947*	0,719
LM_ρ	2,4	0,823	2,928*	0,009	0,011	4,128**
LM_λ	0,932	1,573	2,059	0,016	0,578	3,333*
Spatial lag model						
R^2	0,218	0,264	0,253	0,315	0,367	0,311
ρ^h	0,314**	0,169	0,198	0,009	0,214	0,147
α^h	0,18*	0,077	0,369**	0,289***	0,17**	0,464***
β^h_H	-0,384**	-0,669***	-0,545***	-0,45***	-0,503***	-0,672***
β^h_U	-0,205*	0,01	-0,303**	-0,162**	-0,138**	-0,292**
β^h_I	0,059	0,196	0,175	0,114	0,092	0,206
β^h_N	0,08	0,311**	-0,014	-0,095	0,151*	-0,19*
β^h_M	0,186**	0,381***	0,485**	0,222**	0,352***	0,408
β^h_A	0,008	-0,051	0,004	0,023	-0,13	0,421*
Spatial error model						
R^2	0,209	0,286	0,247	0,315	0,379	0,301
α^h	0,256**	0,083	0,478***	0,29***	0,216***	0,524***
β^h_H	-0,396**	-0,66***	-0,573***	-0,45***	-0,533***	-0,672***
β^h_U	-0,2	0,039	-0,325**	-0,163**	-0,107	-0,292**
β^h_I	0,084	0,194	0,178	0,115	0,117	0,221
β^h_N	0,065	0,374***	-0,042	-0,095	0,126	-0,201*
β^h_M	0,176*	0,402***	0,456*	0,223**	0,379***	0,437*
β^h_A	-0,014	-0,021	-0,003	0,021	-0,176	0,419*
λ^h	0,318**	0,295*	0,205	0,02	0,293**	0,051

Dependent variable: regional housing supply growth rate $h_{i,t}$
Level of significance: *** = 1%; ** = 5%; * = 10%

Tab.3 Determination of the housing supply growth rate.

	Slovak Republic										Czech Republic							
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	1999	2000	2001	2002	2003	2004	2005	2006
OLS model																		
R^2	0,329	0,781	0,334	0,117	0,275	0,637	0,303	0,436	0,250	0,527	0,335	0,423	0,472	0,259	0,218	0,218	0,234	0,478
$\alpha^{\Delta H}$	0,429***	0,872***	0,561***	0,61***	0,466***	0,308***	0,322***	0,54***	0,416***	0,554***	0,686***	0,926***	0,229***	0,403***	0,072	0,4***	0,512***	0,783***
$\beta^{\Delta H}_H$	-0,326***	-1,018***	-0,617***	-0,307	-0,531***	-0,395***	0,721***	-0,629***	-0,556***	-1,272***	-0,613***	-0,884***	-0,477***	0,085	-0,249*	-0,582***	-0,648***	-1,036***
$\beta^{\Delta H}_U$	-0,308***	-0,161***	-0,144	-0,227	-0,239*	-0,135***	-0,064	-0,066	-0,167	-0,285***	-0,267***	-0,179	-0,104	-0,214**	-0,113	-0,075	-0,092	-0,169**
$\beta^{\Delta H}_I$	-0,026	0,016	0,168	0,156	0,105	0,093	-0,2	0,271**	0,277	0,059	-0,061	-0,143	0,088	0,355***	0,061	-0,045	0,259*	-0,182*
$\beta^{\Delta H}_N$	0,106	0,181***	0,248**	0,008	0,382***	0,066	0,052	0,038	0,086	0,233***	-0,003	-0,033	0,138*	-0,089	0,041	-0,065	-0,225**	0,129*
$\beta^{\Delta H}_M$	0,193**	0,121***	0,436***	0,102	0,385**	0,755***	-0,239	0,113	0,691***	0,998***	0,28**	0,185	0,85***	-0,169	0,564***	0,307**	0,708***	0,578***
$\beta^{\Delta H}_A$	0,003	-0,003	-0,111	-0,37*	-0,152	-0,024	0,107	0,1	-0,245*	-0,145	-0,044	0,202	-0,104	-0,078	-0,03	0,248	-0,058	0,25*
Specification tests based on OLS																		
JB	484,125***	14,941***	5,071*	15,394***	8,868**	43,135***	3,721	103,057***	5,448*	3,716	14,964***	9,466***	1,236	1,469	42,215***	85,991***	2,768	36,877***
BP	75,205***	8,137	25,093***	5,906	7,684	143,204***	12,521*	56,661***	19,735***	17,577***	13,198**	34,522***	12,25*	32,948***	125,47***	25,427***	5,262	66,644***
KB	11,032*	5,86	21,776***	4,115	5,916	51,553***	8,048	15,9**	12,507*	13,172**	8,199	23,24***	12,066*	26,261***	48,555***	7,764	4,868	25,978***
Moran`s I	1,195	1,432	2,279**	0,253	1,216	-1,418	-1,382	0,057	0,531	0,791	-0,754	0,024	2,087**	2,375**	0,489	-0,524	3,128***	0,594
LM_ρ	1,085	0,817	0,049	0,121	0,321	1,019	0,655	8,796***	0,12	2,724*	0	4,533**	0,738	1,029	0,089	2,749*	0,133	0,378
LM_λ	1,398	1,373	0,197	0,064	0,1	3,79*	2,166	5,244**	0,118	2,209	0,236	2,499	2,689	2,574	0,063	3,416*	1,634	0,206
Spatial lag model																		
R^2	0,329	0,781	0,364	0,120	0,285	0,640	0,328	0,484	0,250	0,535	0,349	0,453	0,475	0,276	0,218	0,222	0,295	0,480
$\rho^{\Delta H}$	0,017	-0,031	0,244*	-0,077	0,143	-0,087	-0,234	-0,349**	0,012	-0,164	-0,171	-0,278*	0,089	0,164	-0,03	-0,095	0,319**	0,066
$\alpha^{\Delta H}$	0,425***	0,898***	0,452***	0,653***	0,42***	0,334***	0,405***	0,724***	0,411***	0,63***	0,776***	1,063***	0,209***	0,354***	0,078	0,431***	0,357***	0,736***
$\beta^{\Delta H}_H$	-0,328***	-1,02***	-0,622***	-0,299	-0,528***	-0,386***	0,806***	-0,664***	-0,559***	-1,289***	-0,618***	-0,841***	-0,478***	0,081	-0,253*	-0,58***	-0,736***	-1,03***
$\beta^{\Delta H}_U$	-0,307***	-0,16***	-0,184	-0,231	-0,225*	-0,131***	-0,08	-0,08	-0,167*	-0,283***	-0,282***	-0,123	-0,101	-0,197**	-0,116	-0,072	-0,093	-0,171**
$\beta^{\Delta H}_I$	-0,028	0,012	0,133	0,146	0,087	0,095	-0,199	0,309***	0,278	0,073	-0,043	-0,147	0,079	0,36***	0,064	-0,043	0,248*	-0,179*
$\beta^{\Delta H}_N$	0,107	0,182***	0,26**	-0,008	0,341***	0,057	0,054	0,054	0,088	0,241***	-0,004	-0,058	0,13*	-0,089	0,04	-0,066	-0,188**	0,123*
$\beta^{\Delta H}_M$	0,192**	0,12***	0,43***	0,094	0,362**	0,757***	-0,279*	0,201*	0,692***	0,976***	0,273**	0,21	0,85***	-0,184	0,568***	0,309***	0,689***	0,584***
$\beta^{\Delta H}_A$	0,002	-0,005	-0,134	-0,372**	-0,143	-0,009	0,097	0,055	-0,246*	-0,137	-0,079	0,173	-0,134	-0,151	-0,026	0,245	-0,107	0,253*
Spatial error model																		
R^2	0,336	0,784	0,380	0,120	0,285	0,664	0,453	0,453	0,250	0,528	0,356	0,427	0,503	0,307	0,218	0,239	0,314	0,478
$\alpha^{\Delta H}$	0,456***	0,871***	0,608***	0,619***	0,491***	0,291***	0,366***	0,511***	0,416***	0,559***	0,698***	0,924***	0,257***	0,431***	0,072	0,407***	0,534***	0,784***
$\beta^{\Delta H}_H$	-0,346***	-1,028***	-0,648***	-0,284	-0,538***	-0,394***	1,158***	-0,583***	-0,553***	-1,278***	-0,608***	-0,872***	-0,475***	0,064	-0,249*	-0,605***	-0,796***	-1,037***
$\beta^{\Delta H}_U$	-0,329***	-0,164***	-0,202	-0,223*	-0,22*	-0,126***	0,003	-0,06	-0,167*	-0,289***	-0,283***	-0,183*	-0,086	-0,277***	-0,113	-0,087	-0,098	-0,171**
$\beta^{\Delta H}_I$	-0,038	0,031	0,117	0,118	0,092	0,081	-0,199*	0,324***	0,275	0,049	-0,046	-0,141	0,139	0,397***	0,061	-0,038	0,313**	-0,181*
$\beta^{\Delta H}_N$	0,107	0,19***	0,299**	-0,02	0,35***	0,079**	-0,019	0,058	0,086	0,232***	-0,001	-0,039	0,068	-0,106	0,041	-0,073	-0,237**	0,128*
$\beta^{\Delta H}_M$	0,181**	0,119***	0,405***	0,096	0,329**	0,793***	-0,515***	0,163	0,692***	0,996***	0,236**	0,198	0,875***	-0,161	0,564***	0,308***	0,715***	0,579***
$\beta^{\Delta H}_A$	-0,019	-0,006	-0,155	-0,349*	-0,145	-0,018	0,004	0,044	-0,245*	-0,141	-0,045	0,218	-0,226	-0,236	-0,029	0,284*	-0,204	0,244*
$\lambda^{\Delta H}$	0,134	0,162	0,337**	-0,09	0,166	-0,352*	-0,769***	-0,295	-0,009	0,045	-0,237	-0,103	0,321**	0,317**	-0,005	-0,235	0,38***	0,019

Dependent variable: regional housing supply change $\Delta H_{i,t+1}$

Level of significance: *** = 1%; ** = 5%; * = 10%

Tab. 4 Determination of the housing supply change.