Disparities of regional building land prices in Austria, 2000-2018

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Abstract[1]

The increasing cyclicality of house prices and the serious social and economic implications of house price booms have become an intensively discussed topic with a strong focus on urban housing markets. In this paper, we study the land price pattern of a national housing boom in and beyond agglomerations. Convergence and divergence dynamics, regional growth clubs and the spatial diffusion of price booms are investigated. For this purpose, the land prices of 95 Austrian regions between 2000 and 2018 are analysed. The results show that land prices follow a sequence of constant disparities, divergence followed by constant disparities. Agglomerations and tourism-intensive regions are the main drivers of divergence, but a substantial number of peripheral regions with converging land prices were hardly affected by the price boom. Finally, autocorrelation statistics indicate a spread of the urban land price boom towards suburban and other non-urban regions, thereby confirming the ripple-effect hypothesis.

Key words: house price boom, regional disparities, building land prices, Austria, growth dynamics, ripple effects

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Introduction

During the 2000s a global housing boom affected many OECD-countries. Starting with the US-subprime-crisis and globally transferred by mortgage-backed finance products, housing booms around the world ended with the bust of house price bubbles (Aalbers, 2009; Martin, 2011). As of 2012 house prices are on the rise again. Austria did not partake in the primary housing boom in the 2000s but has experienced a secondary housing boom (figure 1). Figure 1 captures these differences between national housing markets but hides regional differences within countries. With the exception of touristic hot-spots, house-price booms have been concentrated in urban agglomerations, triggering or reinforcing the "housing question" regarding the affordability and inclusiveness of urban housing markets (e.g. Martin, 2011; Holm, 2009, Vollmer, 2018; Wachsmuth and Weisler, 2018; Aigner, 2018). Yet little attention has been paid to housing booms - or the lack thereof - beyond the large urban agglomerations and spatial variations (exceptions are e.g. Blanco et al., 2016; Casolaro and Fabrizi, 2018; Van-Hametner and Zeller, 2018). Herein lies the main aim of this paper: to gain deeper insights in the regional variation of a national house price boom.

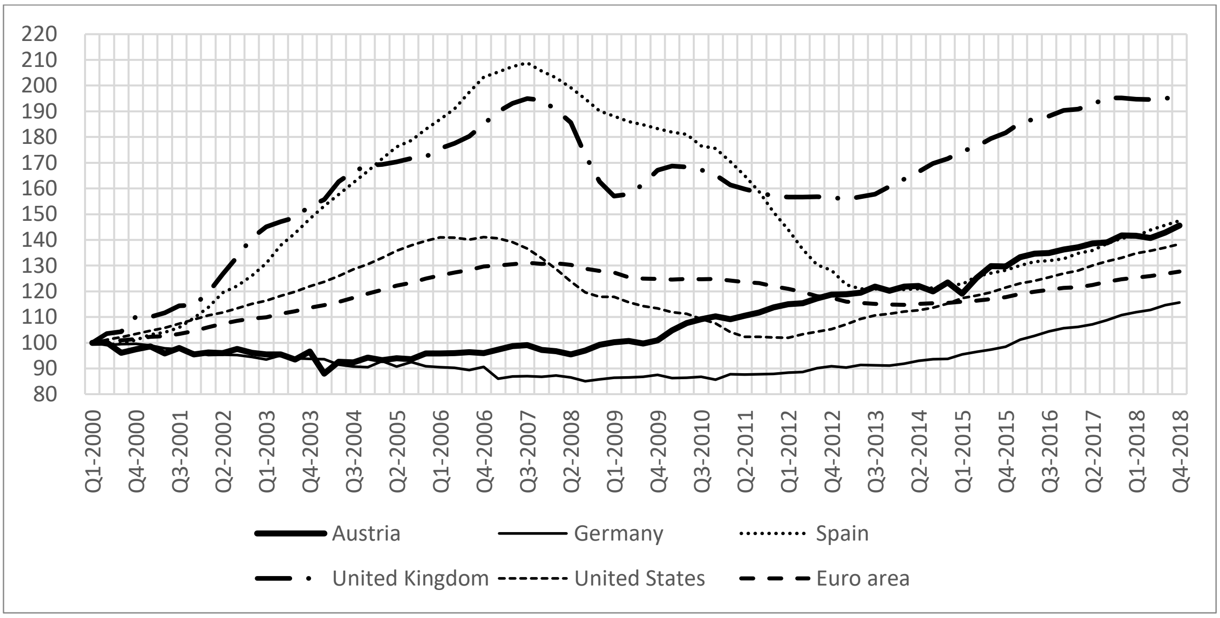

Figure 1: Dynamic of real housing prices in OECD, Eurozone, USA and selected European countries 2000-2018, 2000=100 (OECD-Database)

Also in Austria the debate on house prices and their social implications is limited to the national scale and to Vienna. For instance, the house price indicator of the Austrian national bank differentiates only between Vienna and Austria as a whole; nominal property prices rose by 143% between 2000 and 2019 in Vienna and by about 195% in the rest of the country (ONB residential property price index). Beyond Vienna, hardly any analysis of regional price dynamics exists. As a rare exception, Mundt and Wagner (2017) estimate housing prices for 32 selected districts (most of them in Vienna and other urban regions) based on a hedonic price model and find an increasing heterogeneity in the regional price dynamics in the period 2010-2015. Further, Van-Hametner and Zeller (2018) conduct a comparative study of the housing markets in Linz and Salzburg. Besides these studies with a rather limited spatial focus, no systematic analysis of regional house price dynamics in Austrian exists.

Austria's housing and land market presents a relevant case study for several reasons. Firstly, and as already mentioned above, there are concerns about the dangers of a price bubble in Vienna, but there is hardly any empirical evidence on (excessive) price dynamics beyond the Austrian capital (Schneider and Wagner, 2015). This is relevant as Austria's small structured urban system (Lichtenberger, 2002; Örok, 2009), the decentral economy (Palme, 1995) and the federal organised state (Kanonier and Schindelegger, 2018) might lead us to expect a pronounced regionally differentiated dynamic of land prices. Further, the Austrian housing market is regionally divided in urban markets with a high share of private rental and of public housing, while owner-occupiers dominate markets beyond the urban agglomerations. Finally, the institutional structure of Austrian housing and land markets is quite different from other countries, in particular liberal market economies such as the USA or the UK: a conservative system of housing finance prevents securitization (Springler and Wöhl, 2020) and a large social housing dampens housing costs (Matznetter, 2002; Schwartz and Seabrooke, 2008).

This paper focuses on regional building land prices in the period 2000-2018 as opposed to housing prices. Land is a more homogeneous good compared to housing, which is characterized by very different types and qualities of built structures. In addition, land prices vary more over space compared to housing prices. For instance, the ratio between the most and the least expensive region is about 24 for land prices but only about 3 for apartment prices. In that sense, we argue that building land prices are a more valid indicator to capture regional disparities and price cycles than housing prices. Land prices are influenced by spatial socio-economic developments and land prices in turn affect locational choices of households and firms, thereby shaping regional patterns of economic activity. Having said this, land markets and housing markets are of course intertwined but land seems to play a more prominent role than built structures: Piazzesi and Schneider (2016) observe that the cyclicality of housing stock is predominantly due to changes in land prices and not because of variability in the value of the building stock.

Addressing this research gap on the regional housing dynamic in Austria, this paper addresses the following three research questions:

(1) Do regional land prices converge or diverge over time?
(2) Which structural factors explain differences in regional land price growth rates?
(3) How do land price booms spread over time and space?

The paper is structured as follows: the first section gives an overview on the field of regional house and land price disparities and regional price cycles. Chapter two presents data and methods. Section three comprises the empirical analysis of the three research questions and the final section discusses the results from an Austrian and a general European perspective.

1. Literature Review: Regional Disparities of land prices

Regional price determinants. Research on the determinants of land prices in capitalist systems is a traditional topic in the field of economic geography (Thünen, 1826). Since David Ricardo, the landlords have been regarded with suspicion because in an expanding economic system they reap higher rents without effort, thereby reducing economic efficiency (Heilbronner, 2000). Yet most of the empirical work in geography and regional science uses house prices instead of land prices, and because the two markets are interlinked, housing studies are also of relevance for our paper. Demand for building land can be considered as derived demand for housing and hence determinants of supply and demand for housing are also of relevance for land markets.

Housing and land markets are regional markets, as price levels and changes are fundamentally affected by local supply and demand. An analysis for 100 cities in Germany identified fundamental determinants for real estate prices (Belke and Keil, 2018): on the demand side, the size of the regional market (number of households), age structure and regional infrastructure dominate. Furthermore, based on data from 20 OECD economies Geng (2018) identifies disposable income as an additional relevant demand side factor: A 1% increase in disposable income raises house prices by about 1.5%, suggesting that housing is a superior good. Hence, economic conditions and developments matter for housing price level and dynamics.

Regarding the supply of housing, construction activity, the number of market transactions and the existing housing stock are relevant. Beyond the regional scale, determinants at the national level such as the interest rate policy of central banks affect regional house price dynamics (Fischer et al., 2018; Drechsel and Funk, 2017). Finally, the global scale also matters in regional housing markets due to global phenomena like the Great Recession or internationally oriented real estate investors.

The concept of spatial equilibrium provides a geographical approach to explain structural variations in regional land prices (Glaeser, 2007). Utility of households tends to be equalized across space because regional disadvantages such as a low income level or long commuting times are compensated by low land prices and vice versa. Relocation costs, transaction costs and regulation of housing markets introduce frictions which impede market driven adjustment processes and hence the interregional equilibration of utility. Yet differences between regional prices can also be influenced by factors unrelated to fundamental differences between regions. For instance, international and domestic investors engaging in speculative investment in urban centres (Aalbers, 2019) may widen the gap between cities and other areas beyond the variation as explained by spatial equilibrium models. According to the Austrian national bank's "fundamentals indicator", housing values in Vienna are 21% above the fundamentally justified price level, whereas the respective number for Austria as a whole is 12% (OeNB, 2020).

Economic analysis typically assumes a perfectly inelastic supply of land (Heilbronner, 2000). Under such conditions, land prices are determined solely by the demand for land, which in turn depends on how much money can be earned by using the land; changes in land prices have no repercussions on the supply of land (Samuelson and Nordhaus, 1989). Empirical analysis and practices of zoning policies show that these assumptions are rather unrealistic. Particularly in Austria, over decades local authorities pursued a generous zoning policy, converting green and agricultural land to building land: Between 2006 and 2018, the building land area increased from 2,322km^2 to 3,222km^2 (AEA database). The average annual capital gains due to rezoning in Austria amount to about 2.7 billion Euros (Zens, 2011). Building land reserves as a percentage of total building land are estimated between 25 to 35 percent, increasing from central to peripheral regions (Musil and Pindur, 2008). In consequence, the elasticity of land supply rises from the centre to the periphery.

Convergence of regional housing markets. In regional and urban studies there is an ongoing debate on the issue of convergence or divergence of regional house prices. This topic is relevant insofar~~,~~ as divergent house prices tend to have a negative impact on social mobility and inequality. An increasing spatial gap between locations providing affordable housing and jobs constitutes a challenge for spatial and transport planning (Wood et al., 2016). In addition, disparities in house and land prices could serve as an indicator for socio-economic disparities between regions. A literature review indicates that the empirical studies do not give a clear-cut answer on whether regional house prices converge. This can be shown in particular for the UK, which represents an intensively analysed country regarding house prices (for an overview see e.g. Gray, 2018). For instance, Hamnett (1988) identifies stable house price ranks in the 1970s, while in the following decade the most expensive house price regions (e.g. the south east) grew faster and decoupled from the rest. Other authors stress a high stability in price ranks over a longer time period (Dipasquale and Wheaton, 1996). Beyond a stable rank correlation, some authors see a convergence between neighbouring regions (due to the ripple-effect, Alexander and Barrow, 1994; Cook, 2005 or Holmes and Grimes, 2008), while others emphasise a trend towards divergence and question the local diffusion of land price increases (Drake, 1995; Abbott and De Vita, 2013).

A number of studies suggest that convergence dynamics are influenced by the cyclical nature of real estate markets. A long-term analysis for 1973-2009 identifies a pronounced beta-convergence between UK regions in the downward phases of the real estate cycle (Cook, 2012). Gray (2018) argues that a key to explaining the inconclusive empirical results might lie in the cyclicality of house prices: house price cycles determine the convergence process, as price patterns switch from convergence in a cycle's downturn to divergence in upturns. We refer to this thesis as the “disparities-growth hypothesis”. Yet, studies for other countries have not confirmed a clear correlation between phases of the real estate cycles and a divergence-convergence pattern so far. For instance, Casolaro and Fabrizi (2018) identify five cycles for the Italian regions in the period 1970- 2016. While convergence was uncorrelated to the boom-bust periods for large regions (Northeast, Northwest, Centre, South/Islands), within these regions bust-periods were associated with convergence (ibd.).

The impact of the urban system. Urban agglomerations play a crucial role in the convergence process of regional housing markets (Casolaro and Fabrizi, 2018). Firstly, price cycles start and end in the first tier cities of a country. This suggests that price cycles spread from the agglomerations along the urban hierarchy to mid- and small-term cities and to the surrounding regions. Second, large agglomerations tend to decouple from other regional housing markets, due to their integration in international production- and knowledge-networks and their specialized economic structure. This can be seen for instance in Italian cities: beside structural differences between North and South, city size has a significant impact on the spatial house price gap between agglomerations and other regions. The situation is even more pronounced in the UK, with London’s house price cycles being strongly linked to other financial centres (Lizieri et al., 2000; Fernandez et al., 2016). Furthermore, Holly et al. (2011) confirm, price impulses from London towards the southeast of England. According to the literature, two different patterns of price diffusion from urban centres can be distinguished (Casolaro and Fabrizi, 2018): first, a diffusion that follows the hierarchy of the urban system, and second the neighbourhood diffusion pattern, caused by short-distance-migration and commuters triggering the convergence of housing prices between contiguous regions. (Meen, 1999; Kuethe and Pede, 2011). In what follows, the latter pattern is denoted as the “ripple-effect hypothesis”.

In the following sections, this paper analyses the convergence process of regional building land prices and the determinants of divergent growth dynamics by applying regional classifications, which should capture important elements of regional price dynamics and provide relevant information for spatial planning decisions. Furthermore, we aim to test the “disparities-growth hypothesis” and the “ripple-effect hypothesis”.

2. Data and Methods

Data. The data source for our study is the “Immobilienpreisspiegel” (WKO real estate data), an annual survey published by the Austrian Chamber of Commerce. This database comprises annual building land prices at the level of districts, measured in Euro per square metre. The period of analysis is from 2000 to 2018 (T=19) for 95 districts (n=95), which we interchangeably henceforth call districts and regions. Price data represents average values of registered transactions and is collected by surveys of realtors, and since 2014 their information has been cross-checked with the land registry (WKO, 2019). As a result of these breaks in the data collection process, average land prices in the data set display a substantial decline from 2014 to 2015, while national real estate price indices suggest the continuance of a robust upturn in real estate prices. As a rectification, we applied the national growth rate of the OeNB residential property price index for the year 2015 (4.1%) to all 95 districts. For Vienna, the land price value is estimated as the average of the available Viennese district prices with the exception of the central districts (No. 1-9, 20), as no regional price deflators are available the empirical analysis uses predominantly nominal price data.

In addition to the land price data, three regional typologies are applied throughout the analysis. The typologies capture crucial supply and demand side factors of the building land market: (1) urban-rural typology, (2) demographic typology and (3) economic typology (Table 1).

Urban-rural typology		Demographic typology		Economic typology	
Category	Frequency	Category	Frequency	Category	Frequency
Agglomeration (AG)	8	Population growth high (PH)	24	Human capital intensive regions (HR)	33
Suburban region (SR)	17	Population growth medium high (PMH)	24	Physical capital intensive regions (PR)	25
Regional centre (RC)	25	Population growth medium low (PML)	24	Economic periphery (EP)	37
Tourism intensive rural region (TRR)	12	Population growth low (PL)	23		
Rural region (RR)	33				
Sum	95		95		95

Table 1: Economic, demographic and urban-rural typology (Source: Palme, 1995; Statistik Austria; own calculations; abbreviations are in parentheses)

The Austrian urban-rural-typology differentiates the 2.096 Austrian municipalities in 11 settlement-types, based on the dimensions of settlement structure, traffic accessibility and the role of tourism.[1] This data was aggregated into the following five settlement-types at the district level: (1) agglomerations, (2) suburban regions, (3) regional centres, tourism-intensive rural regions and (5) rural regions. The demographic typology is based on the quartiles of the population growth of districts between 2002 and 2016. Regions in the fourth quartile are classified as “Population growth high” and the regions in the first quartile as “Population growth low”. Finally, in the economic typology (Palme 1995) districts are classified according to a k-means clustering algorithm by their dominant economic structure as (1) human capital-intensive (dominance of service sector), (2) physical capital-intensive regions (dominance of industry or tourism) or (3) economic periphery.

[1] https://www.statistik.at/web_de/klassifikationen/regionale_gliederungen/stadt_land/index.html (9.9.2019)

In addition to spatial heterogeneity, which is represented by the three regional classifications, we also account for temporal heterogeneity and define three sub-periods for the empirical analyses. The periods are defined by differences in land price growth rates: (1) 2000 to 2006, a pre-boom-period, characterised by stagnant land prices; (2) 2006-2012, an early boom-period with an upsurge in land prices; (3) 2012-2018, a late boom period which shows even higher growth rates in land prices. The median compound annual growth rate for the three periods increases from 0.68% to 2.85% and 4.33. Interestingly, measures of variability of growth rates (interquartile range, standard deviation) show a monotonically decreasing variability from the first to the third period under investigation.

Methods. The empirical analysis is best described as explorative data analysis. Descriptive and inferential statistics, parametric and non-parametric statistics, spatial and non-spatial statistics are applied. The use of inferential statistics is motivated by considering the price data as the result of stochastic process. Consequently, the available sample represents just one of all the possible outcomes of the data generating process (Wooldridge, 2014). A limiting factor regarding methodological choices is the relatively small number 95 regions and of 19 annual observations per region.

Regional disparities of land prices (research question 1) are measured by sigma and beta convergence. Sigma convergence occurs if disparities among regional land prices decrease over time, whereas beta convergence takes place if land prices in low price regions show a higher growth rate than land prices in high price regions (Montfort, 2008). For sigma convergence, the analysis is mainly based on the coefficient of variation (CV), i.e. the ratio between the standard deviation and the average. Beta convergence is tested by regressing average annual growth rates of land prices on the original land price level. In order to test for heteroscedasticity due to cross-sectional variability, we calculated a Breusch-Pagan test statistic for each model; in case of a significant result, heteroscedasticity-consistent standard errors are applied.[i]

The analysis of differences in regional growth dynamics (research question 2) uses three different types of analysis: Firstly, simple linear time regression models with heteroscedasticity-and-autocorrelation-consistent (HAC) standard errors are used to identify whether a deterministic linear price trend is present. Secondly, differences between average land price growth rates of different regional categories according to the regional typologies presented in Table 1 are tested by one-way ANOVA models. Thirdly, Chi-square goodness-of-fit tests are applied to test the validity of the notion of growth clubs for different regional categories.

Ripple effects due to land price growth diffusion across regions are addressed in the third research question. Empirically, this question is addressed by analysing regional compound annual growth rates of land prices together with the estimation of coefficients of global and local spatial autocorrelation (global and local Moran's I).[ii]

3. Empirical Results: variations and disparities of regional land prices

The land price boom in Austria took place in a heterogeneous small structured regional system, determined by the pattern of urban agglomerations and regional economic dynamics, which form a spatially differentiated "price landscape". Figure 2 shows that as of 2018 urban agglomerations and tourism intensive regions such as Salzburg, Innsbruck, Kitzbühel or Vienna are the most expensive regions. The lowest land prices can be found in the Eastern economic periphery of Austria: Gmünd, Güssing and Jennersdorf. Vienna's large housing market has been the epicentre of this boom: a rising population, low interest rates, an increasing uncertainty of institutional and private investors as well as speculation have increased the demand for housing (Schneider et al., 2017). Besides demand factors, supply factors also contribute to rising prices in Vienna: As a metropolis it is characterised by a relatively inelastic land supply due to limited reserves and a restrictive zoning policy (Eder et al., 2018). Although price developments in Vienna have been the topic of a heated public debate (Kadi and Verlic, 2019), our data shows even higher prices and stronger increases in a number of other regions.

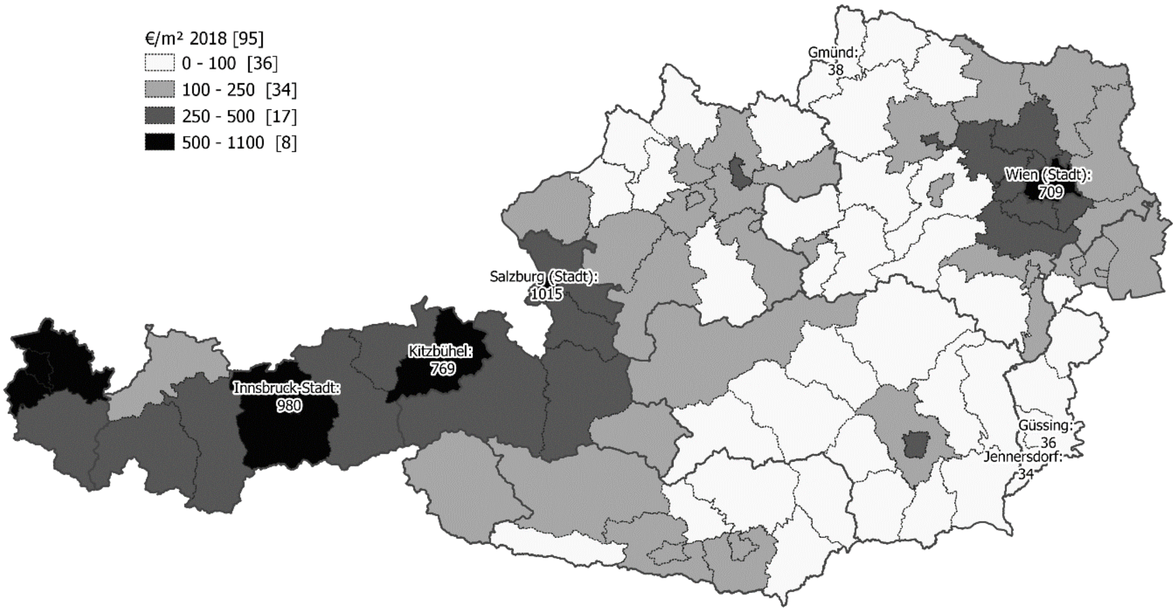

Figure 2: Euro per m² building land, 2018 (WKO real estate date. Number of regions per price interval in square brackets)

3.1 Do land prices converge? Sigma- and Beta-Convergence

Over the period 2000-2018 the housing boom in Austria took place parallel to diverging land prices. Several indicators for sigma-convergence show a trend towards growing disparities in regional land prices: the coefficient of variation rose from 0.79 up to 0.99 – an increase of about 25%. Additional indicators like the standard deviation and the ratio between the highest and lowest-price quintile (P80/P20) confirm this general finding. A regression with HAC standard errors of the coefficient of variation as dependent variable and a time trend as in-dependent variable results in positive and highly significant slope coefficients ($\hat{\beta}$=0.015, p value=0.000), again supporting the result of sigma-divergence for the period 2000-2018. Beyond this general picture, annual data (Fig. 3) reveals a substantial temporal heterogeneity between the three sub-periods: In the early 2000s, coefficients even indicate a slight trend towards convergence, but since 2006, regional land prices have undergone a period of spatial divergence, which lasted until 2014. Since then, the level of spatial price disparities has stagnated for a couple of years and started another slight decline in 2017. In sum, the regional land prices seem to follow a cyclical sequence of more or less constant disparities, sigma divergence and again almost constant disparities.

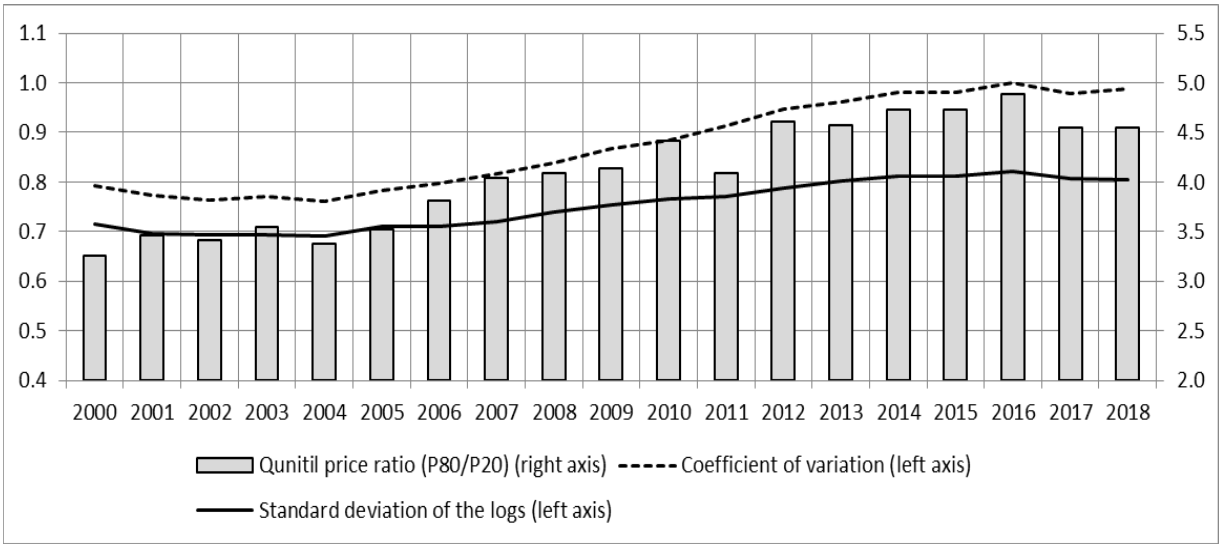

Figure 3: Sigma-Convergence of land prices in Austria, 2000-2018

For the three periods under investigation, the analysis of beta convergence confirms the general sequence identified above. In line with sigma divergence we find statistically significant evidence for beta divergence for the period 2000-2018 (Figure 4 a). A simple linear regression model with the compound annual land price growth rate as response variable and the land price level in 2000 as explanatory variable results in a positive and highly significant slope coefficient. Hence, regions with higher land prices in 2000 experienced a stronger price growth than regions with lower land prices, the opposite of a catching-up process. Again, the three periods reveal a temporal sequence with constant disparities in the first and third sub-periods (fig 4b, c, and d) and a statistically significant divergence between 2006-2012, confirming the results of sigma-convergence analysis.

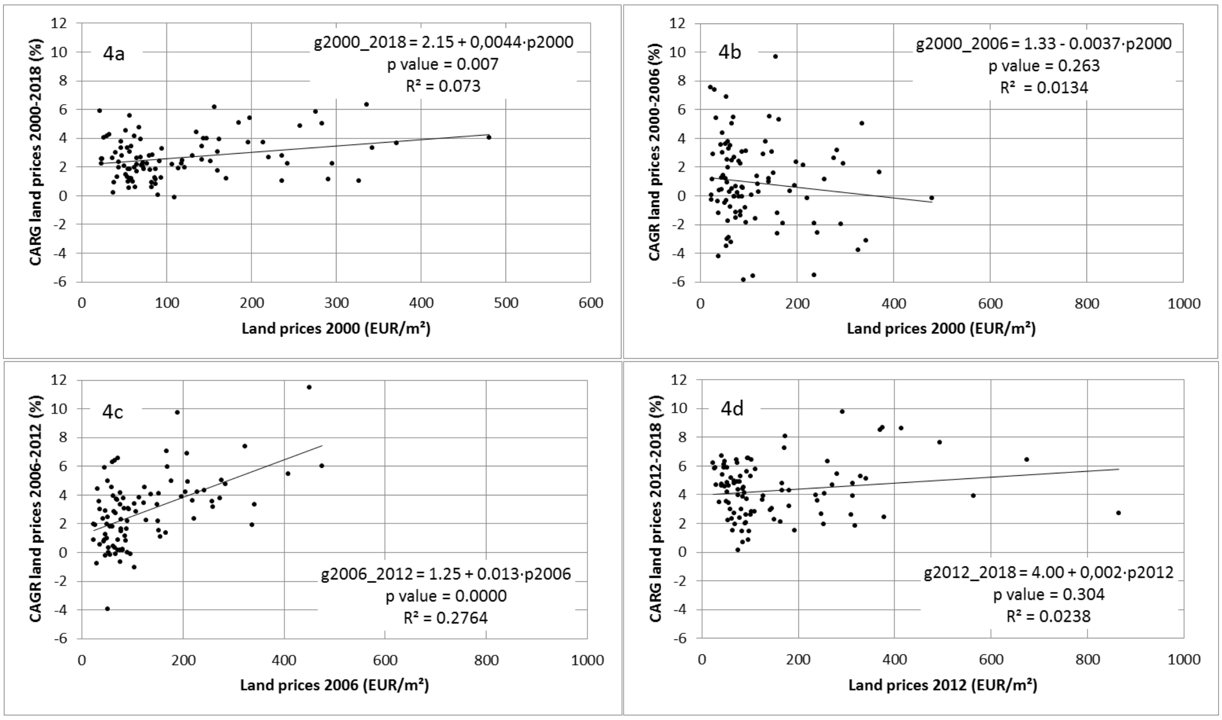

Figure 4 a-d: Beta-Convergence of land prices in Austria. (Notes: CAGR stands for compound annual growth rate. p values refer to the p value of the t test of the slope coefficient. Regression results in Panel 4b are based on robust standard errors; Breusch-Pagan tests for models in panel 4a, 4c and 4d are not significant)

Which regions are the drivers of price increases and divergence? According to Table 2 rural regions, low population growth regions and economic peripheral regions have low land prices in common and display a trend towards sigma and beta convergence. On the other hand, tourism intensive rural regions, population with medium low and medium high growth and physical capital intensive regions experienced a pronounced sigma divergence and to some extent beta divergence as well. The results in Table 2 for the three sub-periods broadly validate the above findings. For the period 2000-2006, all regression coefficients are negative but one, revealing a general process of sigma and beta convergence within regional subgroups. All regional types show a rising coefficient of variation in the period 2006-2012; regional centres experience a significant beta convergence and present an exception to the rule.

In sum, land price dynamics show a sequence of slight convergence, pronounced divergence and again slight convergence, no matter through which “lense” of regional typology we look. While dynamic and/or urban regions were the main drivers of price increases and regional divergence, a substantial number of peripheral/rural regions was not affected by the national price boom and converging forces prevailed.

Typology	Category	Sigma Convergence					Beta Convergence			
		2000	2006	2012	2018	Δ2018-2010	2000-2006	2006-2012	2012-2018	2000-2018
Urban-rural typology	Agglomerations	0.47	0.44	0.59	0.57	0.10	-0.004	0,018**	-0.001	0.005
	Suburban regions	0.54	0.51	0.52	0.56	0.02	-0,015*	0.005	0.000	-0.004
	Regional centre	0.43	0.43	0.48	0.52	0.08	-0.016	-0,015**	0.002	0.001
	Tourism intensive rural regions	0.57	0.53	0.63	0.72	0.15	-0,023*	0.014	0,010**	0.003
	Rural regions	0.36	0.35	0.36	0.34	-0.02	-0,044*	-0.007	-0,034**	-0,026*
Demographic typology	Population growth high	0.58	0.55	0.59	0.63	0.05	-0,010**	0.004	0.002	-0.001
	Population growth medium high	0.67	0.72	0.98	0.98	0.31	-0,000	0,020***	0.000	0,007*
	Population growth medium low	0.60	0.75	0.79	0.84	0.25	0.019	0.007	0.004	0,012**
	Population growth low	0.61	0.52	0.57	0.51	-0.10	-0.027	0.006	-0,031***	-0,017**
Economic typology	Human capital intensive regions	0.64	0.63	0.77	0.77	0.14	-0.006	0,012***	0.001	0.002
	Physical capital intensive regions	0.62	0.62	0.69	0.80	0.18	-0.007	0,009*	0,010***	0.005
	Economic periphery	0.51	0.47	0.53	0.45	-0.06	-0,036**	0.008	-0,026***	-0,017**

Table 2: Sigma and Beta-Convergence of regional typologies (Notes: The numbers in the sigma convergence column represent coefficients of variation; the beta convergence column contains slope coefficients of simple linear regression models which regress the land price growth rate per period on the level of house prices at the start of the prespective period. Robust standard errors were calculated for the following beta convergence models because the BP-test signalled problems with heteroscedasticity: suburban regions 2012-2018, regional centers 2006-2012, rural regions all periods except 2006-2012, population growth medium high 2006-2012. Significance levels: *1%, **5%, ***10%.)

The convergence analysis indicates a positive correlation between growth rates and regional disparities. According to the disparities-growth hypothesis periods of above average growth are associated with widening disparities and vice versa (Gray, 2018). Data for Austria reveals that this correlation is not perfect since the growth in disparities tapers off after 2012 (Figure 3), as the growth rate of land prices continues to rise. A statistical test of the disparities-growth hypothesis is based on the association between the growth rate of the coefficient of variation and the growth rate of the arithmetic mean land price. The resulting correlation coefficient is 0.64 and significant at the 1% level[iii]. To check the robustness of these results, we re-estimated the correlation coefficient using the growth rate of the real estate price index from the OeNB as well as alternative measures of regional disparities (as displayed in Figure 3). All correlation coefficients are between 0.45 and 0.55 and significant at the 5% or the 10% levels. Taken together, we find empirical evidence in favour of the disparities-growth hypothesis for different measures of disparities as well as for land prices and real estate prices.

3.2 Regional pattern of land price growth rates

Based on data for the period 2000-2018 and using the consumer price index as a deflator for the nominal prices, regression models are estimated in order to identify whether a region follows a positive, negative or no deterministic time trend. Empirical results show a positive significant deterministic time trend of the real land price for 37% and a negative significant price development for 17% of the 95 regions. About 46% of all regions do not display a significant real price development in the period under investigation. As a result, 63% of the regions follow either a negative or no time trend which confirms our hypothesis that there is no such thing as a uniform national housing boom.

While agglomerations, suburban regions, touristic hot spots and regions with high population growth and/or human capital intensity dominate the upper end of the land price growth distribution, rural regions with stagnating or declining populations and a status of economic periphery make up the majority at the bottom end. It is interesting to note that 8 of the top 10 regions are located in one of the three western federal states of Vorarlberg, Tirol and Salzburg – touristic and economic hotspots. On the other hand, 5 of the bottom 10 regions are in Lower Austria, and 3 are in the southern federal states of Austria, namely Burgenland, Styria, and Carinthia. This finding reflects to some extent structural features of the Austrian economy in the last decades, namely the stronger economic expansion in the western parts of Austria as compared to some parts in the east and south of Austria.

Top 10 regions			Bottom 10 regions		
Region	Coefficient	p value	Region	Coefficient	p value
Salzburg (Stadt) (AG, PMH, HR)	35.28	0.00	Oberpullendorf (RR, PML, EP)	-0.83	0.00
Kitzbühel (TRR, PMH, PR)	22.59	0.00	Scheibbs (RR, PML, EP)	-0.86	0.04
Graz-Umgebung (SR, PH, HR)	19.05	0.00	Perg (RC, PMH, EP)	-1.04	0.07
Innsbruck (Stadt) (AG, PH, HR)	18.59	0.00	Amstetten (RR, PMH, PR)	-1.10	0.00
Salzburg-Umgebung (SR, PH, HR)	13.90	0.00	Waidhofen a.d. Thaya (RR, PL, EP)	-1.12	0.00
Bregenz (AG, PMH, PR)	13.25	0.00	Murau (RR, PL, EP)	-1.25	0.00
Dornbirn (SR, PH,HR)	12.08	0.00	Zwettl (RR, PL, EP)	-1.30	0.00
Wien (AG, PH, HR)	11.96	0.00	Tamsweg (TRR, PL, EP)	-1.34	0.00
Zell am See (TRR, PML, PR)	9.67	0.00	Sankt Pölten (Land) (SR, PMH, HR)	-1.37	0.00
Innsbruck (Land) (SR, PH,HR)	7.92	0.09	Villach (Land) (RC, PML, PR)	-1.88	0.00

Table 3: Top 10 and bottom 10 regions according to their annual real price growth in 2000-2018 and classification according to regional typologies (in parentheses) (Notes: Coefficients refer to the

slope coefficient of a simple linear regression model on a deterministic time trend. For instance, the coefficient of 35.28 means that each year the land price in the city of Salzburg increased on average by about EUR 35 per square metre. The p value refers to the significance of the slope coefficient. Only districts with a significant coefficient are considered. Abbreviations refer to Table 1.)

Results from Table 3 suggest that land price growth rates differ systematically between different types of regions as defined by the regional typologies presented in Table 1. To test this hypothesis, we ran a one-way ANOVA for each category for the period 2001-2018. Assumptions of homogeneity and normality were evaluated by Bartlett-tests and Shapiro-Wilk tests. Table 4 shows significant results for all three typologies, suggesting that the categories of each classification contribute towards explaining the variation in land price growth. Yet the explained variance for 2001-2018 is below 20% for the urban-rural and close to or below 10% for the other two typologies. Note that the R^2 is relatively low since we consider growth rates instead of levels as our dependent variable. There is a remarkable variability of the explained variance for the different periods, again underlining the temporal heterogeneity of the growth process in land prices. The best fit is observed for the period with accelerating growth in land prices and rising disparities between regional land prices (2006-2012) – in this period of price growth and increasing variance, the differences between the regions are particularly apparent.

	F-test statistic (2001-2018)	Explained variance			
		2001-2018	2001-2006	2006-2012	2012-2018
Urban-rural typology	5.21***	18.9%	11.01%	18.98%	16.34%
Demographic typology	2.78**	8.4%	4.16%	14.85%	5.81%
Economic typology	5.32***	10.4%	1.26%	16.20%	0.97%

Table 4: ANOVA and explained variance. Dependent variable: average annual land price growth rates (Notes: Significance levels*1%, **5%, ***10%.)

A more detailed analysis of differences in land price growth dynamics (tab. 5) shows the conditional distribution of land price growth quintiles given the subcategories of the three regional classifications. As agglomerations, high population growth and a high human capital intensity are presumably associated with strong land price increases, it can be expected that most of the regions belonging to these three categories are located in the fifth quintile of the land price growth distribution. On the other hand, rural regions, regions with low population growth and economic periphery regions may be concentrated in the first and second quintile. These expectations are confirmed, while the pattern is less clear for regions between the extremes (e.g. type "population growth medium high"). A qui-square test for goodness-of-fit for each category against a uniform distribution reveals statistically significant results for the agglomerations, suburban regions and high population growth regions. Hence, these three types of regions can be interpreted as growth clubs, i.e. regions that have similar socio-economic characteristics and follow a distinct growth path of land prices. Because of the small sample size of subgroups the power of the qui-square tests is relatively small and the results should be taken with a grain of salt.

Typology	Category	Land price growth quintiles (2000-2018) 5	4	3	2	1	Sum
Urban-rural typology	Agglomeration	50%	38%	13%	0%	0%	*100%*
	Suburban region	41%	12%	18%	0%	29%	*100%*
	Regional centre	4%	28%	16%	32%	20%	*100%*
	Tourism intensive rural region	33%	25%	25%	8%	8%	*100%*
	Rural region	9%	12%	24%	30%	24%	*100%*
Demographic typology	Population growth high	33%	25%	29%	0%	13%	*100%*
	Population growth medium high	21%	29%	8%	29%	13%	*100%*
	Population growth medium low	8%	17%	21%	17%	38%	*100%*
	Population growth low	17%	9%	22%	35%	17%	*100%*
Economic typology	Human capital intensive regions	33%	24%	18%	15%	9%	*100%*
	Physical capital intensive regions	16%	28%	16%	20%	20%	*100%*
	Economic periphery	11%	11%	24%	24%	30%	*100%*

Table 5: Conditional distribution of land price growth quintiles given regional typologies (Notes: Every quintile consists of 19 regions. Interpretation: 50% of all agglomerations are in the 5^{th} quintile of the land price growth distribution of 2000-2018.)

3.3 Spatial diffusion of the land price boom?

According to the ripple-effect hypothesis, spatial price diffusion is mediated by spatial distance and takes place between regions in spatial proximity (Meen, 1999; Holly et al., 2011; Meen, 2016). For this purpose, we compare the annual growth rates between settlement-types and measure the autocorrelation between all Austrian regions (global Moran's I) as well as for individual agglomerations (local Moran's I).

How does the annual growth rate of regional land prices differ between Vienna, other agglomerations, the suburban regions and other regional types? The results (fig. 5) confirm the role of agglomerations as price drivers: in the first period (2000-2006), Vienna and the other agglomerations experienced the highest growth rates, beside touristic regions. The growth dynamic of agglomerations accelerated further in the second period (2006-2012), but also suburban regions, (to a lower extent) regional centres and peripheral regions experienced increasing growth rates. In the last period (2012-2018), growth rates indicate a spatial shift suggesting the presence of a ripple effect: while the growth rates of agglomerations declined, they remained high or increased even further in suburban regions and in the other regional types.

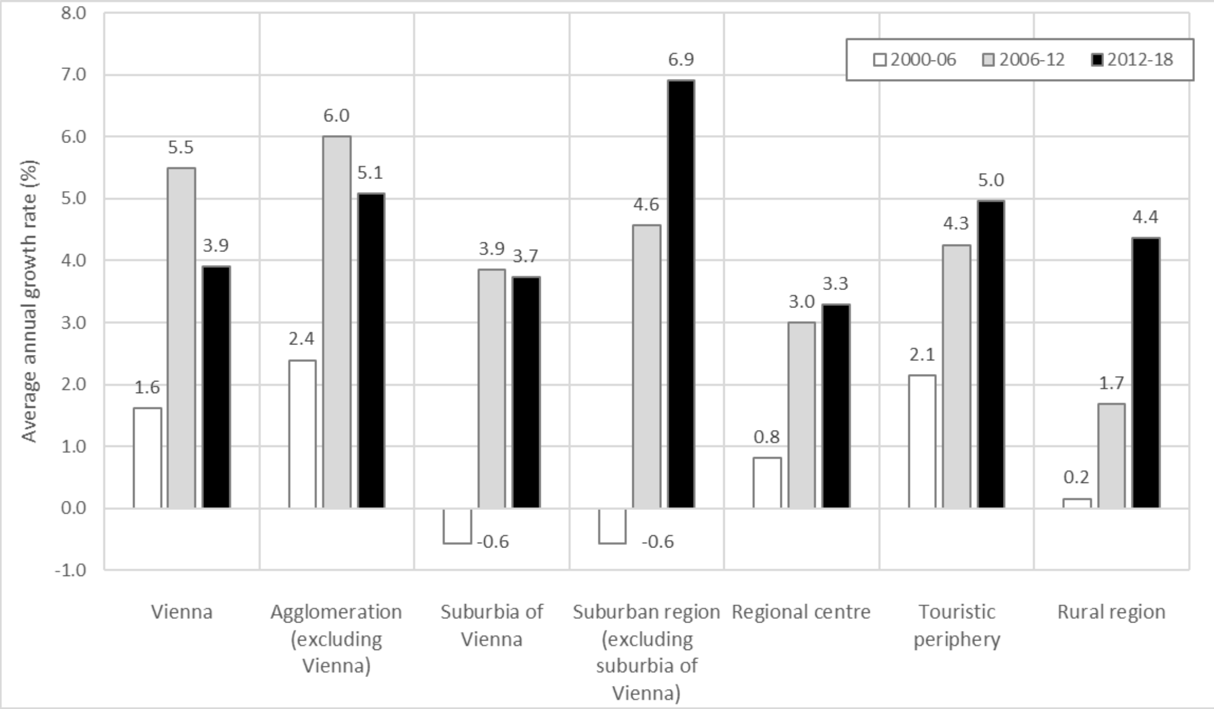

Figure 5: Average annual growth rate for urban-rural types in three periods

This pattern of land price-dynamics is interesting for two reasons: first, our analysis demonstrates that price impulses do not start in just one urban centre (which is the case in London, Gray, 2018). Rather, polycentric impulses seem to be at work, originating also in agglomerations beyond Vienna. Secondly, price impulses seem to spread from agglomerations to suburban regions and further to other regions, which is in accordance with the assumption of the ripple effect. Hence, in a first stage price impulses follow the urban hierarchy and spread out towards the neighbouring and then finally to the more distanced regions in a second phase. Yet touristic regions do not follow this pattern, possible due to the fact that land prices are mainly determined by extra-regional demand.

The spatial diffusion of land prices can be estimated by the spatial autocorrelation (Moran`s I) based on growth rates of land prices. If the value of Moran`s I, increases, regions in spatial proximity (as defined by a spatial weight matrix) become more similar (Burt et al., 2009). Thus, increasing values of Moran`s I may signal the existence of a ripple effect. The results for the global Moran's I, i.e. for all 95 regions, seem to confirm the assumption of a ripple effect: the significant coefficients (9 out of 17 years) show an increase, from 0.12 (2003) to 0.24 (2013) and finally 0.37 (2017).

To evaluate the ripple effects emanating from urban agglomerations, we calculated the local Moran's I (LISA) for the six largest agglomerations in Austria (Table 6). Again, high (low) LISA values describe a situation of spatial clustering of regions with similar (dissimilar) values of the considered variable. A positive (negative) value can be interpreted as a homogenous (heterogeneous) spatial pattern of land price growth. A ripple effect can be inferred if the values of the local Moran's I increase over time. As most values in Table 6 are not significant, they must be interpreted with caution. In the first period, four of six agglomerations show a heterogeneous pattern, which is most pronounced in Salzburg. Only Graz, which is characterised by a substantial slack in the land price market in that period, and Innsbruck with its dynamic, touristic suburbia, display a homogenous pattern. In the following period, four agglomerations and their surrounding regions became more similar in terms of land price growth rates: Innsbruck, Klagenfurt and Vienna show significant, strong positive values, and the negative LISA value of Salzburg increased substantially from -0.92 to -0.02. Linz was almost stable and only Graz turned to a negative value. In the final period, all six urban agglomerations showed values very close to zero. LISA values close to zero suggest that the value in the agglomeration and/ or the value in the surrounding regions is close to the overall average. This can be interpreted as evidence that urban agglomerations lost their role as hot spots of price growth and of a further spatial diffusion of rising price growth throughout the regional land markets.

	2000-2006		2006-2012		2012-2018	
	Local Moran's I	p value	Local Moran's I	p value	Local Moran's I	p value
Graz (Stadt)	0.14	0.51	-0.18	0.45	0.03	0.86
Innsbruck (Stadt)	0.16	0.66	1.10	0.00	-0.01	1.00
Klagenfurt (Stadt)	-0.35	0.39	0.52	0.17	0.00	0.98
Linz (Stadt)	-0.17	0.47	-0.19	0.43	0.03	0.86
Salzburg (Stadt)	-0.92	0.05	-0.02	0.98	-0.01	1.00
Vienna	-0.16	0.70	0.50	0.17	0.14	0.69

Table 6: Local Moran`s I for compound annual land price growth rates in urban agglomerations
(Notes: Local Moran's I coefficients are calculated with power distance weights, i.e. the inverse of the squared distance between regions i and j)

4. Discussion and Conclusions

In this paper we analyse the regional pattern of the Austrian house price boom between 2000 and 2018. Sigma and beta convergence analysis shows a divergence trend for the whole observation period suggesting that the land price boom occurred in parallel with increasing disparities. For the three sub-periods, a cyclical sequence of slight convergence, significant divergence and almost constant disparities can be observed. For the third subperiod results differ between sigma and beta convergence: While the former suggests convergence, the latter indicates an ongoing divergence trend.

Overall, the empirical analysis provides some support for Gray's (2018) disparities-growth hypothesis for the UK. In the case of Austria, there is a significant correlation between growth rates and variance over time. Further, this relation also exists between regions with different price dynamics. Regions with low price growth rates, such as the economic periphery or rural regions, converged, while regions with higher price growth rates experienced diverging regional land prices.

The study finds substantial regional differences in real land price growth rates. Our analysis reveals that agglomerations, suburban regions and touristic hot spots with high population growth and human capital intensity dominate the upper end of the land price growth distribution, whereas rural regions with stagnating or declining populations and a status of economic periphery make up the majority at the bottom end. Thus, the land price dynamics reflect socioeconomic disparities between Austrian regions. Results from an analysis of variance suggest that all three regional classifications contribute towards explaining the variation in land price growth differences but the explained variance is below 20%. While agglomerations, suburban regions and high population growth regions were the main drivers of price growth and rising land price disparities, a substantial number of regions did not experience any land price boom.

Finally, our findings corroborate the ripple effect hypothesis. Initially, the land price boom spread from urban agglomerations to suburban regions and then to more distant regions. Touristic regions followed a different path as their land price dynamics are heavily affected by extra-regional demand-side factors. Remarkably land price dynamics in Austria do not follow a simple centre-periphery diffusion, as other studies suggest (Holly et al., 2011). On contrary, the land price boom originated simultaneously in the polycentric urban system, then spread to neighbouring suburban regions and finally to other regions. The test for global autocorrelation of growth rates shows an increasing homogeneity over time and the six largest agglomerations (local Moran's I) also converge with their suburban regions.

This paper has several implications for further research: first, it shows that the cyclicality of land prices has an important explanatory value for the explanation and interpretation of regional disparities. Secondly, land price booms do not just affect urban agglomerations – from this perspective, the debate on social implications should go beyond the capitals or main agglomerations. Therefore, we suggest linking the qualitative financialisation debate with the quantitative debate on regional disparities: the Austrian case shows that a decoupling of land prices from demand (due to speculation, internationalisation) seems not to be limited to urban centres.

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[i] The HC standard errors are estimated by using the default setting of the function “vcovHC” from the R package “sandwich”.
[ii] We used the R package “spdep” for the calculation of global and local Moran’s I.
[iii] This analysis excludes the observation for 2017 because this observation is highly influential according to diagnostic measures such as DFBETA, DFFIT, covariance ratio or Cook’s distance. The exclusion is justified because other data sources do not support the finding that 2017 was an exceptional year. For instance, the real estate property price index data from the ONB does not provide any evidence that 2017 can be considered as an outlier in the time series. As a result, we assume that our sample data are plagued by some measurement error.