Co-movement of house price cycles – a factor analysis

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Abstract

Due to globalisation and monetary integration the macroeconomic conditions for industrial countries have become more and more equally. Based on a factor analysis we examine if the synchronisation of business cycles also affected the co-movement of house prices in OECD-countries for the period of 1990 to 2010. As it turns out, the integration of housing markets has accelerated in the last decade. We can identify a strong global factor as well as a regional factor. However, some countries like Germany, the Netherlands and Japan seem to be uncoupled from the global trend. Furthermore, the co-movement of markets with greater proximity is generally stronger. Although globalisation seems to foster the integration of housing markets, monetary integration has only a minor effect. We illustrate our results by referring to methods well-known from cluster-analysis.

Key words: house prices, co-movement, factor analysis

Introduction

Residential property markets turned out to be extremely volatile in the last years. Between 2000 and 2006 prices surged in the majority of OECD countries while since 2007 – beginning with the financial crisis – house prices started to plummet. Yet investors are increasingly interested in residential property. Compared to commercial property residential property offers a different risk-return profile. For instance, residential property is more likely to deliver an inflation-hedge (Demary and Voigtlaender, 2011). As a consequence, cross-border investments are likely to increase in the next years (Just, 2010). Therefore, the diversification of residential property risks becomes more important. One way of pooling risks is to invest internationally. This, however, presupposes that house price cycles are not fully correlated because otherwise specific risks cannot be diminished.

Given that the residential property market is dominated by private households who only seldom invest cross-border, house price cycles are less likely to be synchronised. On the other hand, the world economy is more and more integrated implying highly synchronised business cycles and interest rate developments. Since growth rates and interest rates are important determinants for house prices (Demary, 2010), a co-movement of cycles cannot be ruled out. Especially the monetary integration in the European Union is expected to have an effect on the synchronicity of real estate cycles.

Against this background the co-movement of house price cycles in OECD countries will be examined in the following. We use a factor analysis to detect which countries follow a global trend and which countries are uncoupled. In addition, we distinguish between the periods 1990-2000 and 2000-2010 in order to evaluate whether integration of real estate cycles has increased. This allows also for an impact assessment of the monetary

integration on housing markets. To illustrate our results, we refer to techniques well-known from cluster analysis.

The paper is structured as follows. After a brief literature review we present the data used for the factor analysis. Since we focus on cycles, we use the Hodrick-Prescott filter to detrend the house price indices. Afterwards, we perform a sequential factor analysis for the pre and post 2000 period and illustrate them inter alia by using a dendrogram. In order to evaluate the integration process we measure the virtual distances of countries by referring to factor loadings. The article ends with a conclusion.

Literature review

There is a rich and growing literature on the convergence of macroeconomic conditions in industrial countries and emerging countries. For instance, Furceri and Karras (2008) perform a correlation analysis and found out that the synchronicity of business cycles in the EU has increased since the introduction of the Euro. Kose, Otrok and Prasad (2008) analysed the convergence of business cycles for industrial countries, emerging countries and developing countries. Their dynamic factor analysis shows that between 1985 and 2005 the convergence within emerging countries and industrial countries increased, but between these two groups decreased. Therefore, they suppose a declining significance of a global trend. In general, most analyses demonstrate that business cycles align to each other, but there is a discussion on the extent and scope of this process. De Haan, Inklaar and Jong-A-Pin (2008) offer a literature review on this topic for the countries of the European Union.

With respect to real estate markets, Eichholtz et al. (1998) are the first to analyse the convergence for real estate stocks. They concluded that European real estate stocks follow a continental trend. In the following

authors concentrated on the effect of monetary integration on the convergence of real estate markets. Lizieri et al. (2003), Yang et al. (2005) and McAllister and Lizieri (2006) present mixed results on this topic. Lizieri et al. (2003) show that the integration advances, but slower compared with the wider equity market. Yang et al. (2005) and McAllister and Lizieri (2006) demonstrate that integration between larger countries is stronger than between smaller EU-countries. Brookes and Tsolacos (2008) and Jackson et al. (2008) use cointegration tests to demonstrate that the office markets of metropolises like New York and London co-move. Srivatsa and Lee (2010) also use office market data but for 7 major European cities. With the concept of β- and σ-convergence well-known from development economics (Barro and Sala-i-Martin, 2003) they show that integration has increased in the last years. Table 1 gives an overview of the literature.

All in all, there is a consensus in the literature that co-movement has increased since 2000 but there is uncertainty about the degree of integration. Besides factor models and analyses also var-analyses, models with Kalman-filters and the concept of of β- and σ-convergence have been employed. A drawback of the literature, however, is its focus on securitised real estate and office markets. Only the IMF (2004) and Igan et al. (2010) analyse the co-movement of housing markets. The IMF (2004) demonstrates that house price cycles follow a strong global factor while Igan et. al. (2010) concentrate on the linkages between house price cycles, business cycles and credit cycles.

Table 1: Literature on the convergence of real estate markets

Authors	Object	Data	Method	Period	Result
Eichholtz et al. (1998)	Securitised real estate markets	Europe, Asia-Pacific and North America	Factor analysis	1984-1996	Significant continental factor
Lizieri et al. (2003)	Securitised real estate markets and equity markets	8 European countries	Factor analysis, VAR analysis, Granger causality tests	1990-2002	Integration of real estate markets is weaker compared to the wider equity market
IMF	Residential real estate	OECD countries	Dynamic factor model	1980-2004	Strong global factor
Yang et al. (2005)	Securitised real estate markets	9 European countries	VAR analysis	1994-2002	Evidence of increasing integration after EMU for larger countries but not smaller countries
McAllister and Lizieri (2006)	Securitised real estate markets	11 European countries	Correlation analysis, two-factor model	1993-2004	Increasing evidence in core Eurozone
Brookes and Tsolacos (2008)	Office markets	New York, Tokyo, London	Cointegration test	1990-2007	Cointegration between cities
Jackson et al. (2008)	Office markets	New York, London	Cointegration test and Granger causality test	1988-2004	Cointegration between cities
Lee (2009)	UK securitised real estate market	UK, United States and European countries	Test of time-varying convergence with Kalman filter	1998-2004	UK market was after EMU influenced by EU countries, but before EMU and after 2004 more strongly by the US-market
Srivatsa and Lee (2010)	Office markets	7 European cities	β- and σ-convergence	1982-2009	No statistical evidence of β-convergence, but statistical evidence of σ-convergence in rents and yields
Igan et al (2010)	Housing markets	OECD countries	Dynamic factor model	1981-2006	Strong co-movement of house price cycles; property cycles lead credit cycles

We want to add to the literature by analysing house price co-movement with a factor analysis. Especially, we want to assess the impact of

monetary integration on housing markets which has not been addressed so far. In addition, we aim at identifying outliers in order to improve portfolio selection. Last but not least we present innovative ways of illustrating the results of the factor analysis.

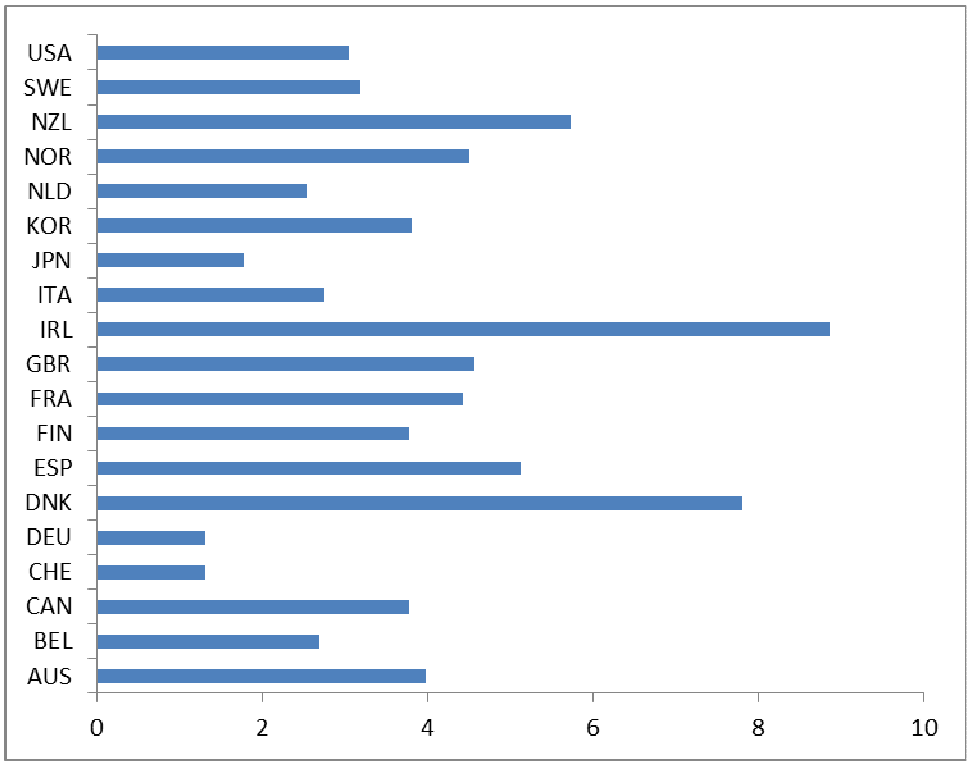
Data and methodology

We use the house price index databank of the OECD for our analysis. A detailed description of this collection of house price indices can be found in Girouard et.al (2004). Our analysis includes 19 OECD countries and the period 1990q1 to 2009q4. Since we aim at measuring the co-movement of house price cycles we have to detrend our data. Thus, we make use of the Hodrick-Prescott (HP) filter to separate the trend from the cyclical component. Witkiwiecz (2002) gives an overview of the HP filter and its relevance for real estate market analysis. Darvas and Szapáry (2007), for example, also use the HP filter for preparing their analysis of the synchronization of business cycles between new and old EU members. The intensity of the cycles differs significantly. We calculate the standard deviation of the cyclical component and divide it with the mean value of the trend component. Thus, we can compare the amplitude of the house price cycles. Germany and Japan have a very flat cycle during the period of 1990 to 2009 while UK and France are more volatile. The results can be found in figure 1.

In the following we perform a factor analysis in order to evaluate the co-movement of the house price cycles. In a first step we only take into account the period of 2000q1 to 2009q4. We calculate the Kaiser-Meyer-Olkin (KMO) measure to assess the appropriateness of using factor analysis on the data. In the next step we run the factor analysis. In general, the fewer factors we need to explain the variance of data, the greater is the

co-movement of the cycles. Afterwards, we conduct the same analysis with data for the period of 1990q1 and 1999q4 and compare the results for evaluating the process of convergence. Since monetary integration was introduced in 1999, we can assess the effect of a common currency for the Euro-countries. By choosing to divide the data in a pre and post 2000 period, we allow for a longer adjustment period of real estate markets. Demary (2009) for example shows that interest changes have a time-delayed effect on house prices.

Figure 1: Standard deviation of house price cycles in per cent of mean trend



Source: OECD, own calculations

Factor analysis for the period of 2000 to 2009

The starting point for our analysis is the measure of sampling adequacy test by Kaiser, Meyer and Olkin (Kaiser, 1974) for the period of 2000q1 to 2009q4. High values of this test indicate that the partial correlations among the variables are small. The results can be found in table 2.

Table 2: Kaiser-Meyer-Olkin measure of sampling adequacy, period 2000q1-2009q4

Variable	kmo
usa	0.8633
jpn	0.3870
deu	0.6188
fra	0.8295
ita	0.7023
gbr	0.7286
aus	0.5658
can	0.7198
bel	0.7691
dnk	0.7004
esp	0.7637
fin	0.7724
irl	0.7856
nld	0.4852
kor	0.2912
nor	0.7124
nzl	0.6751
swe	0.7401
che	0.6710
Overall	0.7070

The overall value for the test is 0.7070. According to Kaiser (1974) this result is “middling” and therefore the dataset is appropriate for a factor analysis. With values below 0.5 the data would be inappropriate for a factor analysis. Be aware that the spread of kmo-values for the individual countries is very large, ranging from 0.86 for the United States to 0.29 for Korea. By eliminating countries with low kmo-values the results for the factor analysis could be increased but this would contradict the aim of the study. After all we are particularly interested in countries that do not follow the global trend.

In a next step we perform the actual factor analysis. We use the method of principal factors and conduct our analysis with the statistical package Stata. Table 3 summarises the results.

Table 3: Share of variance explained by factors, period 2000q1-2009q4

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	10.17018	6.88882	0.5520	0.5520
Factor2	3.28136	0.91735	0.1781	0.7301
Factor3	2.36401	0.99736	0.1283	0.8584
Factor4	1.36665	0.90016	0.0742	0.9326

Four factors have Eigenvalues of more than 1.00 indicating that they can explain more than the variance of one variable. The first factor can explain more than 55 percent of the variance of the data and is thus the most important factor. The second factor can explain additional 17 percent, the third factor 12 percent. Table 4 presents the factor loadings with respect to the four relevant factors.

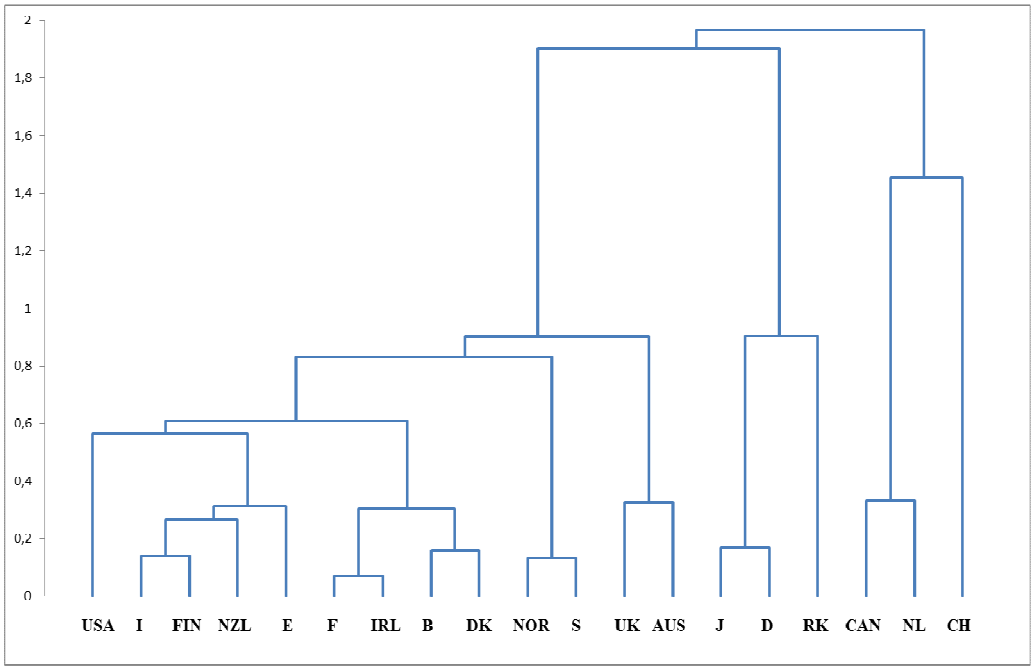
Table 4: Factor loadings, period 2000q1-2009q4

Variable	Factor1	Factor2	Factor3	Factor4
usa	0.8679	-0.1589	-0.4032	0.0658
jpn	-0.0057	0.8545	0.4108	-0.0378
deu	-0.0425	0.8692	0.2940	0.0559
fra	0.9705	-0.0178	-0.1655	0.1268
ita	0.8764	-0.1783	0.0322	0.4071
gbr	0.7801	-0.1598	0.4611	0.1445
aus	0.1135	-0.3356	0.8789	0.0153
can	0.6520	-0.2866	0.3887	-0.5283
bel	0.9205	0.2462	-0.0658	0.0705
dnk	0.9323	0.1641	-0.1305	-0.0475
esp	0.8800	-0.3394	-0.1174	0.2826
fin	0.8139	-0.2329	0.0541	-0.3466
irl	0.9227	-0.0048	-0.1561	0.2180
nld	0.4416	0.7651	0.0130	0.3245
kor	0.0374	-0.2103	0.7482	0.4921
nor	0.7506	0.3300	0.1755	-0.4400
nzl	0.8558	-0.4296	0.0439	-0.1139
swe	0.8447	0.3480	0.1962	-0.2587
che	-0.6695	-0.4658	0.2967	0.0129

Most countries exhibit a high factor loading with respect to factor 1. Given that this factor has the highest explanatory power, we can call this a global factor. Lizieri, McAllister and Ward (2003) offer a similar interpretation within their factor analysis. Given this interpretation, Switzerland, Germany, Korea and Japan are uncoupled from the global trend. The second factor is more difficult to interpret. Neighbour countries like France and UK,

Germany and the Netherlands, or Sweden and Norway exhibit likewise loadings concerning this factor. However, the relationship is flawed with examples like Finland and Sweden or Germany and Belgium.
Nevertheless, it seems clear that this factor has a regional meaning so that we define this factor as the regional factor. Factor 3 and 4 are idiosyncratic factors.
Tables 3 and 4 display the main results of the factor analysis. However, the tables are not very demonstrative and it is hard to identify outliers and clusters directly. Therefore, we display the results additionally with a dendrogram. A dendrogram is a tree diagram used to illustrate the arrangement of clusters produced by hierarchical clustering. We cluster our results by measuring the city-block distance between the countries according to the differences in the factor loadings. Hence, we use the factor loadings to measure virtual distances. A comparable approach was used by Wilding (2002). For the dendrogram we make use only of the first three factors which capture 85 percent of the variation in the data.
Roughly speaking, we can identify two groups of countries as can be concluded from figure 2. The first group is left in the dendrogram and includes countries from the United States to the United Kingdom. These countries follow a global trend and feature relatively similar house price cycles. The second group which can be found on the right hand side includes Japan, Germany, the Netherlands, Australia, Korea and Switzerland. These countries are uncoupled from the global trend and exhibit more heterogeneous price cycles as the length of the vertical lines indicate. Among this group are countries with great geographical distances to the rest of the countries like Korea and Australia, but also European countries like Germany and the Netherlands.

Figure 2: A dendrogram based on factor loadings



A comparison with the 1990s

In addition to analysing the co-movement of house price cycles in the 2000s we want to assess if the housing markets have become more integrated. Thus, we perform an additional factor analysis for the period of 1990q1 to 1999q4 in order to compare the two periods. Table 5 summarises the results.

In contrast to the results for the period 2000-2009 the explanatory power of the factors for the pre 2000 period is weaker. The first factor only explains 31 per cent of the variance of the data, the second one 22 per cent and the third one additional 18 per cent. For the later period we needed 4 factors to explain 93 per cent of the variance, in this period it takes roughly 6 factors. Consequently, integration of housing markets was weaker in the 1990s.

For a more detailed comparison of the results we refer once again to the methods of cluster analysis and make use of the fact that we can explain in both periods roughly 93 per cent of the variation in the data. Based on

these models we calculate the city-block distances between the countries. Thus, we take the factor loadings as axis intercepts and can allocate for each country a point in a 4-dimension (post 2000) and 6-dimension (pre 2000) space, respectively. By comparing the distance between each country and the mean distances we can evaluate whether integration of housing markets has increased. Table 6 presents the results of the calculations.

Table 5: Share of variance explained by factors, period 1990q1-1999q4

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.32909	1.57703	0.3105	0.3105
Factor2	3.75206	0.74787	0.2186	0.5291
Factor3	3.00419	1.09830	0.1750	0.7042
Factor4	1.90590	0.72204	0.1110	0.8152
Factor5	1.18386	0.24612	0.0690	0.8842
Factor6	0.93774	0.43886	0.0546	0.9388

Table 6: City-block distances of countries based on the factor loadings

	USA	JPN	GER	FRA	ITA	UK	AUS	CAN	BEL	DEN	ESP	FIN	IRL	NED	KOR	NOR	NZL	SWE	SUI
USA	0 0																		
JPN	2,81 3,06	0 0																	
GER	2,65 2,29	0,26 3,04	0 0																
FRA	0,54 3,07	2,59 2,24	2,43 1,38	0 0															
ITA	0,80 2,52	2,74 2,03	2,58 1,86	0,73 1,55	0 0														
UK	1,03 2,23	2,03 2,45	2,11 3,00	0,98 2,19	0,81 2,55	0 0													
AUS	2,26 1,85	1,83 3,06	1,99 1,57	2,33 1,76	2,16 1,59	1,39 2,03	0 0												
CAN	1,73 1,23	2,31 2,80	2,53 1,64	1,80 1,53	1,62 2,41	1,00 2,46	1,62 0,76	0 0											
BEL	0,80 2,24	2,12 3,22	1,96 1,76	0,47 2,68	0,90 2,84	1,15 2,97	2,39 2,05	1,85 2,40	0 0										
DEN	0,77 2,91	2,18 2,30	2,21 2,92	0,43 2,51	1,02 2,67	1,26 2,24	2,39 2,39	1,73 2,81	0,28 2,81	0 0									
ESP	0,70 2,32	2,93 0,89	2,77 2,71	0,62 2,02	0,44 1,63	1,00 2,09	2,03 2,26	1,60 2,34	0,89 2,99	0,90 2,33	0 0								
FIN	1,00 3,45	2,57 2,49	2,60 3,09	1,06 2,34	0,89 3,04	1,00 2,14	1,99 2,77	0,73 2,66	1,12 2,85	1,00 0,64	0,97 2,92	0 0							
IRL	0,61 2,96	2,61 2,37	2,45 3,32	0,16 2,65	0,60 2,69	0,99 1,87	2,38 2,61	1,84 2,87	0,49 2,35	0,47 2,27	0,48 2,95	1,11 1,93	0 0						
NED	2,03 1,94	1,30 3,46	1,14 2,15	1,69 2,25	1,48 2,62	1,89 1,51	2,60 1,31	2,49 1,65	1,33 2,39	1,61 3,01	1,72 2,97	2,08 2,71	1,53 2,39	0 0					
KOR	2,46 2,79	1,98 1,35	2,05 3,20	2,40 2,30	1,67 2,47	1,43 2,26	0,81 2,76	2,07 2,33	2,58 3,79	2,69 2,72	2,05 1,11	2,33 2,89	2,27 3,00	2,28 2,92	0 0				
NOR	1,69 2,48	1,92 2,85	1,95 2,86	1,48 3,10	1,62 3,39	1,39 1,56	2,46 1,87	1,02 2,43	1,01 2,83	1,05 1,71	1,81 2,91	0,84 1,70	1,50 2,47	1,67 1,61	2,76 2,61	0 0			
NZL	0,91 2,42	2,59 3,06	2,62 2,63	0,98 3,43	0,80 3,32	1,02 3,50	1,80 2,69	1,11 2,39	1,03 2,82	0,91 1,75	0,67 2,81	0,48 2,12	1,02 3,68	2,08 3,16	2,35 2,52	1,32 1,94	0 0		
SWE	1,45 2,78	1,79 0,93	1,82 2,92	1,24 2,03	1,39 2,44	1,24 1,89	2,37 2,20	1,29 2,81	0,77 2,52	0,81 1,58	1,58 1,17	0,84 1,97	1,26 2,09	1,59 2,91	2,67 1,87	0,31 2,32	1,09 3,04	0 0	
SUI	2,60 2,39	2,15 2,79	2,01 1,09	2,66 1,67	2,49 2,20	2,05 1,65	1,50 1,44	2,13 1,88	2,72 1,69	2,72 1,17	2,36 2,01	2,32 2,28	2,71 2,73	2,94 1,92	1,89 2,75	2,79 2,32	1,94 2,89	2,70 1,86	0 0

period 2000 - 2010
period 1990 - 2000

The mean distance between countries was 2.4 in the 1990s but 1.64 in the 2000s. Hence, distances or differences between cycles diminished by 31 per cent. Thus, housing markets have integrated considerably since the 1990s. With regards to Euro-countries the reduction amounts to 37 per cent. It is striking that the distances between the countries of the Euro-zone were slightly larger (2.42) in the 1990s but decreased stronger in the 2000s. Nevertheless, the monetary integration had seemingly only a minor effect on the integration of the housing market. Likewise to commercial property markets other factors, especially the integration of the world economy, seem to boost the co-movement of housing markets.

Figure 3: Changes in distances based on factor loadings between the pre and post 2000 period

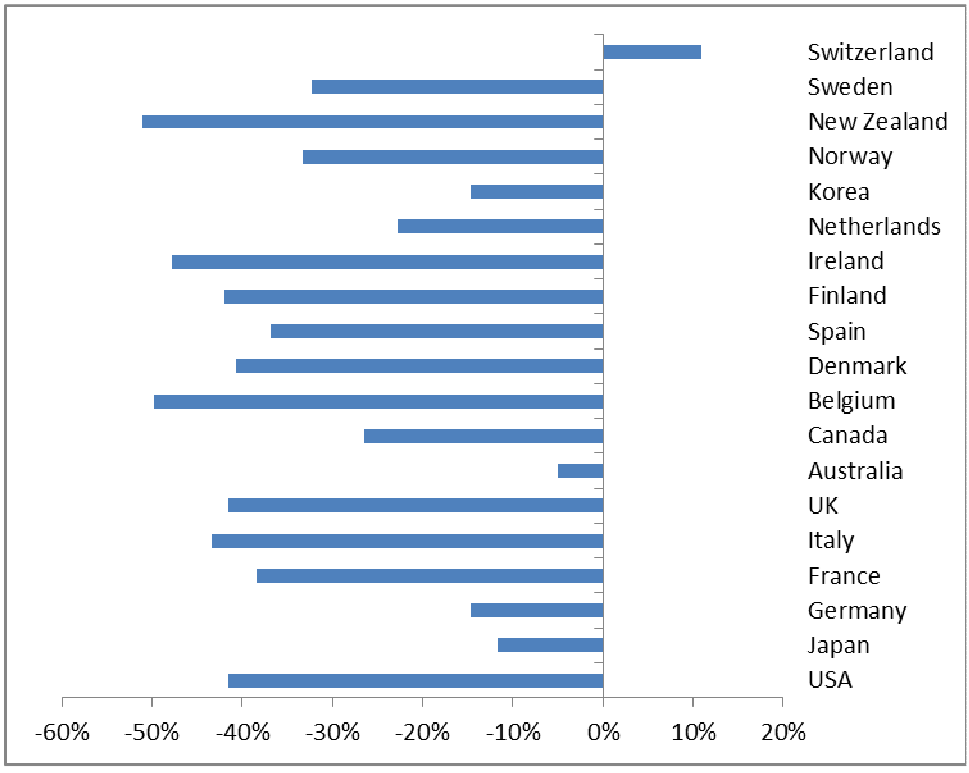


Figure 3 offers an overview of average changes in distances between the regarded countries. In contrast to the study of Yang et al. (2005) we find out

that especially smaller EU countries like Belgium and Ireland have integrated considerably. Remarkably, New Zealand diminished distances by 51 per cent, but Australia only by 5 per cent. Only one country, Switzerland, increased the distances to other countries.

A brief discussion of the results

The comparison of the results for both periods indicates that the co-movement intensified since the 1990s. However, monetary integration has seemingly only a minor effect on the integration of housing markets. The main factors that are expected to boost integration in the EMU are the convergence of business cycles and the common monetary policy. However, differences in interest rates for mortgages have not only narrowed in the EMU but world wide. Central banks tend to follow each other in setting base rates in order to avoid changes in currency exchange rates. In addition, studies like Kose, Otrok and Prasad (2008) demonstrate that business cycles in industrial countries co-move in general, irrespective of the EMU. Since trade barriers and capital controls have not only been lifted in the EU, the integration of the world economy has intensified. Thus, business cycles converge even without a common monetary policy. As a consequence, the EMU has only a light effect on the integration of housing markets. Interestingly, our results suggest that particularly smaller EU countries show signs of increasing co-movement. Yang et al. (2005) and McAllister and Lizieri (2006) by contrast, concluded that larger EU countries intensified the co-movement of real estate price cycles. This difference can be referred to the different property classes which have been focused. From a theoretical perspective, yet, it seems straightforward that smaller countries integrate faster since spill-over effects are more important for smaller countries than larger countries.

With respect to investors, the outliers identified for the period 2000-2009 are particularly interesting. By selecting countries that feature different cycles, a pooling of risk is possible. The dendogram illustrates which combination of countries offer a high potential for risk minimisation. From an economic perspective, the reasons for the differences are central. Obviously, the geographical distance is relevant since among the outliers are countries like Korea and Australia which are far away from Europe and North America. However, Switzerland, Germany and the Netherlands are at the heart of Europe. These countries have, though, structural features in common. For instance, they have a low homeownership rate. High homeownership rates often go hand in hand with more volatile housing markets since self-occupants tend to have a higher marginal consumption rate. Increases in prices have an effect on the lifetime income leading to an additional demand for residential property. Since landlords have a lower marginal consumption rate, this effect is weaker for countries with low homeownership rates. Another structural similarity between the outliers is the dominance of fixed rate mortgages (Voigtlaender, 2009). Fixed mortgages imply that the disposable income of households is less dependent on interest rate changes. Thus, the demand for housing is less volatile, too.

It is behind the scope of this article to analyse the reasons for the uncoupling of the global trend in depth. Future research on the effects of structural differences on housing cycles, however, seems to be promising.

Conclusion

The integration of housing markets has increased since the 1990s. Similar to commercial property markets price cycles follow a global trend. Another

similarity to studies on commercial property is the minor impact of the EMU on real estate market integration. Nevertheless, we can demonstrate that the co-movement has increased within the EU stronger than with respect to all countries. Additionally, smaller EU countries show stronger signs of co-movement than larger ones. Other studies find contrary evidence. Given that small countries have stronger linkages to foreign countries – for example, because of the need to import – the stronger co-movement of smaller countries seems plausible.

Uncoupled countries like Germany, Korea, Switzerland and Australia can be identified on the one hand by geographical distances and on the other hand by structural specifics, like a low homeownership rate. Future research should analyse this linkage in greater depth.

A crucial question for investors is how co-movement will evolve. Since globalisation deepens and business cycles converge due to coordinated monetary and fiscal policies – first of all in the EU because of the debt crisis – housing market are likely to become more and more synchronised. Additionally, cross-border investments will contribute to this development. Hence, investors should pay more attention to county choice than in the past.

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