European real estate market convergence

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Rahul Srivatsa
Aberdeen Asset Management,
Bow Bells House, 1 Bread Street,
London,
EC4M 9HH,
England
Tel: +44 20 7463 6529; E-mail: Rahul Srivatsa@Aberdeen-asset.com

Stephen L. Lee
Cass Business School,
City University London,
106 Bunhill Row,
London,
EC1Y 8TZ,
England
Tel: +44 20 7040 5257; E-mail: Stephen.Lee.1@city.ac.uk

Aberdeen

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Abstract

This paper uses the concepts of β-convergence and σ-convergence to evaluate empirically the hypothesis of rent and yield convergence in seven European office markets during the period 1982 - 2009. Because of the introduction of a single currency in January 1999, the analysis is carried out sequentially, first for the overall sample period and then the periods before and after the introduction of the single currency. The results indicates that irrespective of the time period considered there is not enough statistical evidence of β-convergence in either rents or yields but evidence of significant σ-convergence in rents and yields in the European office markets under review. Additionally, we find some evidence that the introduction of the single currency in 1999 has led to increasing signs of convergence, especially in the Continental European markets.

Keywords: European Office markets, Beta, Sigma Convergence

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Introduction

Adam et al. (2002) argue that "financial markets are integrated when the law of one price holds." Given this definition, real estate market integration implies convergence of rents and yields on properties that are domiciled in different countries and generate identical cash flows, see Adjouté and Danthine (2003), Baele et al. (2004) and Bekaert and Harvey (1997), among others.

In reality, the law of one price could not hold true in the case of different assets, ie. different real estate market indices, which are not based not on the same underlying properties. In addition, the law of one price does not necessarily hold true in the presence of market frictions. Nonetheless, even if the underlying assets are not identical, comparing property rents and yields across different countries gives insight into the degree of synchronicity between markets. That is a positive co-movement between property cash-flows in different countries could then be due to similarity of the underlying assets, to common shocks, or to a mixture of both effects.

In order to test the law of one price Adam et al. (2002) used the concepts of beta-convergence and sigma-convergence to demonstrate the process of financial market integration in the euro area countries. In this paper we used this same approach to examine the speed (by means of the beta (β)-convergence) and level (by means of the sigma (σ)-convergence) of convergence in rents and yields in seven European office markets.

The only other work to test for convergence of rents and yields using the concepts of β-convergence and σ-convergence in the European direct real estate market is a paper by McAllister (2008) using annual data for 24 European cities over the period from 1990 to 2006. This paper extends the work of McAllister (2008) in a number of significant ways. First, McAllister used data from a number of different service providers whereas we use data from a single source. Thus, we avoid issues as to the comparability of the data sources. Second, we use quarterly instead of annual data, which allow us to break the data down into the period before and after the introduction of the single currency, without loss of degrees of freedom. Third we use data denominated in local currencies and US dollars to examine the impact of exchange rate on the results. Finally, McAllister used the β-convergence approaches of Barro and Sala-i-Martin (1991, 1992) and Sala-i-Martin (1994)[1] which compares the extent of convergence at only two points in time, the initial and final period, whereas we use the approach of Adam et al. (2002) which uses the whole data set. Thus, this approach should provide a clear-cut assessment of the extent of convergence between European real estate markets.

The rest of the paper is structured as follows. Section 2 reviews the previous studies on European real estate market convergence. The next section presents the empirical framework for this study. Section 3 discusses the data. In Sections 4 and 5 we report

Previous studies

Eichholtz et al. (1998) were first to examine convergence in securitised real estate within Europe over the period 1984 to 1996 and found that there is a significant 'continental' factor in European securitised real estate markets, which appears to have increased in strength from the early 1990s with the completion of the Single European Market and the move towards European Monetary Union (EMU). However, in a follow up study Brounen and Huisman (2007) using monthly data from 1997 to 2007 find that six countries have become less related to the European factor, namely Austria, Belgium, the Netherlands, Spain, Switzerland and the UK. In contrast, France, Germany, Italy and Sweden have become more dependent on the European factor. In other words, convergence across the European real estate markets is not a forgone conclusion and indeed divergence is possible.

1 For a review of the literature see Armstrong & Vickerman (1995)

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A series of papers by Grissom and Lizieri (2003) Lizieri et al. (2003) and McAllister and Lizieri (2006) studied the integration of European stock markets and real estate security markets before and after the establishment of EMU. Using monthly data and a battery of statistical tests the authors find that while the wider stock markets show evidence of convergence in returns, real estate security markets showed less and slower integration, which the authors attribute to the small size of the real estate markets and the local nature of the holdings in the property company portfolios. In addition, the authors find that there is increasing evidence of integration in countries of the 'core' Eurozone relative to 'non-core' Eurozone countries and non-Eurozone countries.

Yang et al. (2005) studied the integration of European real estate security markets before and after the establishment of EMU using daily data for nine European countries and variance decomposition methodology. Again like previous studies Yang et al. (2005) find that the larger Eurozone countries (Germany, France and the Netherlands) showed greater integration than the smaller Eurozone countries (Belgium and Spain). In addition, the authors find that the countries outside the single currency (Denmark, Switzerland and the UK) exhibited little change in integration following the introduction of EMU.

Andrews and Lee (2008) used the time-varying integration score approach of Akdogan (1996, 1997), as extended by Barari (2004), and monthly data over the period 1990:1 to 2007:12 to examine the extent of global and regional integration by regressing the returns of each country on a global and regional index for nine European countries namely, Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK. The results' indicate that both the level of global and regional integration for real estate securitised markets in Europe has on average increased since 1990, although the effect varied from country to country. For instance, France and the UK, the two largest securitised real estate markets in Europe show the highest levels of global and regional integration. In contrast, Belgium, Germany and Spain, which are substantially smaller in size, show little integration with the rest of world or with the other countries of Europe, with their returns mainly driven by domestic factors. Lastly, the securitised real estate markets in Italy, the Netherlands, Sweden and Switzerland have become more integrated with the rest of the world but not with other countries within Europe.

Using time-varying parameter modelling techniques with monthly data over the period 1990 to 2007 Lee (2009) finds that from 1990 to 1998 the returns of the UK securitised real estate were more influenced by the US market than the other countries in Europe. However, from autumn 1998 to 2004 the short-run movements in the return of the UK securitised real estate market became increasingly associated with movements in the other countries in Europe market rather than the US. But since 2004 the returns in the UK real estate have once again started to diverge from those of most countries in Europe, ie. the UK is not integrated with the rest of Continental Europe.

In the direct real estate market Lee (2007) found in increase in the average correlation between European office markets using the cross-sectional dispersion approach of Solnik and Roulet (2000) over the period from 1989 to 2005. However, results varied depending on whether the countries had adopted the Euro. For instance, the nine countries (Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Spain, and Portugal) that are part of the single currency showed the highest average correlation over the period. In contrast, the three countries that did not adopt the Euro (Denmark, Sweden and the UK) displayed a much lower correlation with the other countries in the sample and showed little or no change over the period.

Using the Johansen cointegration technique and direct real estate market data from the Property Portfolio Research (PPR) database over the period 1990:Q1 to 2006:Q4 Brookes and Tsolacos (2007) examined the co-integration in each of the pairs of the three CBD office markets in New York, London and Paris. Brookes and Tsolacos (2007) find that the Johanson test suggests that in the long-run the three cities move together and as such any diversification benefits will only be achieved in the short-run. The strongest link is between

London and New York, while the Paris office market barely adjusts to movements in the other two markets, which implies that the real estate returns of London shows greater links with those in New York than Paris.

Brookes and Tsolacos (2008) also examined the co-integration between New York, London and Tokyo using quarterly data from the PPR database over the period 1990:Q1 to 2007:Q4. The authors find that similar results to that for New York, London and Paris that in the long-run New York, London and Tokyo move together and that the strongest links are between New York and London.

Jackson et al (2008) examined the total returns and rental data of New York City and the City of London office sub-markets to test the hypothesis that the two largest financial centres behave in a similar fashion. Using Johansen cointegration techniques and Granger causality tests the authors find that while the nominal total returns of the New York City and the City of London sub-markets display strong long run relationships and causal links, the same was not true for the nominal rental series. The lack of significant findings in the rental data leading the authors to speculate that it is the yield movements between the two markets which is influencing capital and therefore total returns, an argument that the authors could not pursue due to lack of yield data. In other words, Jackson et al (2008) suggest that the strong links observed between the two markets in returns may be originating through investor behavior rather than any similarities in the office stock, due to the fact that New York and London are two of the largest and most liquid international office markets. Nonetheless, the authors found strong cointergation between the real rents of the two sub-markets, which suggests that common economic factors do still play an important role.

McAllister (2008) used the β-convergence and σ-convergence tests of Barro and Sala-i-Martin (1991, 1992) and Sala-i-Martin (1994) to examine converge in European office markets in 24 cities over the period from 1990 to 2006. The convergence tests were also performed on a sample of 27 US cities in order to provide a benchmark against which to compare the results in Europe. McAllister (2008) found no significant decrease in the standard deviation of rental levels over the period, ie. the author found no statistical evidence of σ-convergence, although there was some evidence of increasing stability in Eurozone cities. In addition, the author finds no statistical evidence of β-convergence in the level of rents in 2006 compared to the rental levels of 1990 among all 24 European office markets, although the author finds a significant relationship when non-Euorzone cities were excluded. Similar results were also found in the US data.

Since there are systematic effects that may lead to persistent disparities between economies, McAllister (2008) modified the basic Barro regression in line with the work of Barro and Sala-i-Martin (1991), to control for the 'natural' dispersion of rents due to the different positions of the city office markets in the global hierarchy as measured by the Global World Cities Study Groups measure of global importance. The results indicating strong statistical evidence of β-convergence across all European cities, once the 'natural' dispersion of rents was accounted for.

By way of a contrast, McAllister (2008) finds a marked drop in the dispersion of European initial yields (capitalisation rates) including or excluding non-Eurozone cities, indicative of sigma convergence. Also consistent with the sigma convergence pattern McAllister (2008) finds significant evidence for beta convergence in the yields of all 24 European office markets or the Euozone markets.

Models of convergence

The most common measures of convergence are β-convergence and σ-convergence. The concept of β-convergence enables identification of the speed at which shocks are eliminated on the individual financial markets. The concept of β-convergence originated in the economic growth literature. Following the approach advocated by Adam et al. (2002), we make use of this concept to determine the speed of convergence of rents and yields of the underlying real estate market series. This measure involves estimating the following regression (in time series or panel frameworks)

$$\Delta \mathbf{R}_{\mathbf{i,t}} = \alpha_{\mathbf{i}} + \beta \mathbf{R}_{\mathbf{i,t-1}} + \sum_{\mathbf{l=1}}^{\mathbf{L}} \gamma_{\mathbf{i,t-l}} \Delta \mathbf{R}_{\mathbf{i,t-l}} + \varepsilon_{\mathbf{i,t}}$$

where R i , t represents the rent (yield) spread of specific real estate market indices between country i and the European benchmark rent (yield) at time t, Δ is the difference operator, α_i is the country-specific constant, and $\varepsilon_{i,t}$ is the white-noise disturbance. The lag length L is based upon the Schwarz information criterion; the maximum length is taken as 4 since we are using quarterly data. The size of β is a direct measure of the speed of convergence in the overall market. A negative beta coefficient signals the existence of convergence, and the magnitude of the beta coefficient expresses the speed of convergence, i.e. the speed of elimination of shocks to the yield differential vis-à-vis Europe. Thus the higher the absolute value of the beta coefficient, the higher the speed of convergence. The β coefficient can take values ranging from 0 to -2. The closer the absolute value of the β coefficient to 1, the higher the speed of convergence, and if β = 0 or β = -2, no convergence is observed β values from 0 to -1 indicate monotonous convergence, while fluctuating convergence occurs for values from -1 and -2.

Sigma (σ)-convergence occurs when the dispersion of the levels of a given variable between different countries tends to decrease over time. The concept is derived from the literature of real convergence (Barro and Sala-i-Martin 1992) and originally concerned the cross-sectional dispersion of income. In the present context, the degree of real estate market convergence increases when the cross-sectional standard deviation of rents or yields is trending downward. The lower σ is, the higher the level of convergence that has been reached. In theory, full integration is reached when the standard deviation is zero, while high values of σ reflect a very low degree of integration.

Sigma-convergence, a calculated by the cross-sectional standard deviation (σ), in the variable of interest according to the formula:

$$\sigma_{\mathbf{t}} = \sqrt{\left(\frac{1}{\mathbf{N}-1}\right)\sum_{\mathbf{t=1}}^{\mathbf{N}} \left[\log(\mathbf{y_{it}}) - \log(\bar{\mathbf{y}}_{\mathbf{t}})\right]^2}$$

where y_{it} is the rent (yield) on real estate market i at time t, and $\bar{y}_t$ is the cross-section mean yield at time t. By definition, σ takes only positive values.

Beta and sigma convergence are complementary, but not excludable. Beta (β)-convergence is a necessary, but not a sufficient, condition for sigma (σ)-convergence to take place. In fact, β-convergence could even be associated with σ-convergence (see Quah, 1993 and Sala-i-Martin, 1996). So both concepts must be tracked concurrently in order to show convergence.

Data and summary statistics

The data used in this paper is from Aberdeen Property Investors' (API) proprietary database, which collects property-level data for key centres globally. The data used here is for seven major European office markets' in the prime CBD areas of Brussels, Amsterdam, Madrid, Milan, Paris, Frankfurt and London, over the period from Q4:1982 to Q3:2009. The average, standard deviation and correlation of rental growth and yields are shown in Tables 1 and 2, respectively.

Table 1 shows that the office markets in Europe do not display a straight risk return trade-off as the markets with the greatest and smallest average rental growth, Milan and London, did not have the highest and lowest variability which is shown by Madrid and Brussels. Table 1 also shows that there exists weak positive correlation between the occupier markets, with the highest link between Paris and Madrid and lowest link between London and Brussels.

Table 1: mean and SD and correlation of rental growth within major European office markets (Q4 82 - Q3 09)

	Brussels	Amsterdam	Madrid	Milan	Paris	Frankfurt	London
Mean	1.19	0.88	1.29	1.63	1.02	0.76	0.62
SD	2.12	2.14	5.58	5.16	3.76	3.26	4.76
Correlation	**Brussels**	**Amsterdam**	**Madrid**	**Milan**	**Paris**	**Frankfurt**	**London**
Brussels	1.00	0.21	0.38	0.37	0.36	0.30	0.13
Amsterdam		1.00	0.40	0.16	0.30	0.34	0.16
Madrid			1.00	0.47	0.63	0.55	0.47
Milan				1.00	0.49	0.32	0.14
Paris					1.00	0.53	0.50
Frankfurt						1.00	0.24
London							1.00

Source API

Table 1: mean and SD and correlation of yields within major European office markets (Q4 82 - Q3 09)

	Brussels	Amsterdam	Madrid	Milan	Paris	Frankfurt	London
Mean	6.63	7.10	6.80	5.73	5.66	5.15	5.72
SD	0.57	0.79	1.70	0.38	0.67	0.26	0.90
Correlation	**Brussels**	**Amsterdam**	**Madrid**	**Milan**	**Paris**	**Frankfurt**	**London**
Brussels	1.00	0.66	0.67	0.71	0.86	0.59	-0.06
Amsterdam		1.00	0.92	0.71	0..56	0.15	-0.12
Madrid			1.00	0.75	0.60	0.20	-0.28
Milan				1.00	0.70	0.42	0.09
Paris					1.00	0.73	-0.07
Frankfurt						1.00	0.02
London							1.00

Table 2 shows that the market with the largest average yield over the sample period was Amsterdam, while Frankfurt showed the lowest yield. The market with the highest variability in yields, as measured by its standard deviation, was Madrid and Frankfurt showed the lowest variability. Table 2 also shows that there exists a higher correlation in European yields than for rental growth, with an average correlation of 0.41 for yields compared with 0.35 for rental growth. The two markets which show the strongest link are Madrid and Paris (0.92) and the lowest between London and Madrid (-0.28). The most notable feature of the correlation coefficients in Table 2 is the very low correlation between London and all other office markets in Europe, averaging only -0.07, which suggest that the yields in London are isolated from the rest of Europe.

Beta convergence results

Rents

The results of the β-convergence analysis for the pooled and individual regressions of the rental data are given in Panel A of Table 3. The result of the pooled regression for the full sample period shows that the beta coefficient is negative (-0.43); hence there is an indication of convergence of European rents. However, the beta value is much lower than the -1, which would indicate complete convergence. Indeed, upon testing the coefficient, with Wald's test, it was found to be statistically significant from -1. This indicates that these real estate markets have not shown statistical evidence of convergence in rents over the sample period. This supports the previous findings of McAllister (2008).

Table 3: pooled and individual beta coefficients of European office rents 1982-2009 and pre and post introduction of single currency Q1 99

Panel A Pooled	**1982 - 2009**	**1982 - 1998**	**1999 - 2009**
Beta	-0.43	-0.35	-0.55
Panel B Individual	**1984 - 2009**	**1984 - 1998**	**1999 - 2009**
Amsterdam	-0.54	-0.41	-0.77*
Brussels	-0.65	-0.59	-0.58
Frankfurt	-0.56	-0.38	-0.77*
Madrid	-0.72	-0.23	-1.09*
Milan	-0.66	-0.69	-0.56
Paris	-0.57	-0.59	-0.55
London	-0.37	-0.32	-0.54

Note: * Indicates insignificantly different from -1 at the 5% level

Next we broke the data down into the period before and after January 1999 to examine the impact of the introduction of the single currency. By doing so, the analysis would separate any impact the geopolitical forces might have had in the property market. The first sub-period shows similar results to the overall results analysis, with beta coefficient still weak (-0.35) and Wald's test indicates the coefficient to be statistically different from -1. This suggests that the European markets did not show significant signs of convergence prior to 1999 Q1. In addition, when analysed for the post 1999 period, the European rental market still do not show evidence of significant convergence. However, the beta coefficient has improved (-0.55), which could indicate an increasing replacement opportunities for business space within these markets .[2]

[1] A number of robustness test were also performed. First, following McAllister (2008) we include a dummy variable to account for the extent of financial services in the country. Next, we carried out a separate pooled analysis for the core European office markets, ie. Amsterdam, Brussels, Paris and Frankfurt. Finally, all the analyses were repeated after converting the data into US Dollars. The results for the all these pooled regressions are all qualitatively and quantitatively the same as those in Table 3 and so to save space are not reported here, but are available upon request.

The pooled analysis has established that the overall European office market has not shown any signs of convergence in rental growth over different time periods. However, it is possible that this may vary across individual markets based on the inter-linkages and interactions the market may have in a global and European context. Thus, we performed individual regressions for each country for the three time periods mentioned above.

Panel B of Table 3 summarises the results from the individual regressions with varying results. The results commonly indicate that the rents in European office markets were not convergent during the time periods 1984-2009 and 1984-1999. This probably indicates a period when in the European economy localisation was a key theme. However, this changes during the post EMU period with Madrid, Frankfurt and Amsterdam showing signs of convergence with the European average. Interestingly, Brussels, Milan, Paris and London, have shown no signs of convergence in rental values with the rest of Europe. This may suggest the development of different tiers within the European office market, supportive of the findings of Andrews and Lee (2008).

Table 4: half-life for a shock in the European rental market to dissipate: quarters

Country	1982 - 2009	1982 - 1998	1999 - 2009
Amsterdam	0.89	1.31	0.47
Brussels	0.66	0.78	0.80
Frankfurt	0.84	1.45	0.47
Madrid	0.54	2.65	0.29
Milan	0.64	0.59	0.84
Paris	0.82	0.78	0.87
London City	1.50	1.80	0.89

Table 4 supports this contention by indicating the market's ability to absorb shocks to the system as measured by the Half-life, defined as the period during which the magnitude of a shock becomes half of the initial shock. The results suggest that the ability of European real estate markets to absorb shocks in European occupier markets has improved over time. For instance, Madrid took more than 2 quarters to absorb shocks before the introduction of the single currency, but now takes only about 4 weeks to absorb shocks. However, absorption in the Milan office market is now slower to before the introduction of the single currency. While, the London City market is the slowest to absorb changes in Europe, which may be due to its global rather than European linkages, in line with the findings of Brookes and Tsolacos (2007, 2008); Lee (2007, 2009), and Andrews and Lee (2008).

Yields

The results for the pooled regression of European yields are reported in Panel A of Table 5 and are similar to those for rents in Table 3 but are in sharp contrast to those of McAllister (2008). For the overall period the beta coefficient is negative (-0.56), however, it is significantly different from -1. Thus, this initially suggests that on a pan-European basis there is not enough evidence to suggest any convergence in pricing. Indeed even breaking the time period into the period before and after the introduction of the single currency the regression are still very similar to those for the rental data in Table 3.

However, there is a stronger evidence of convergence in yields when the Core European office markets, ie. Amsterdam, Brussels, Paris and Frankfurt are analysed, with Western Europe used as benchmark. For the time periods before and after the introduction of the single currency, the beta coefficients of the pooled regression are both insignificantly different from -1, which points towards a stronger pricing relationship within Continental Europe, supportive of the findings of McAllister (2008).

Table 5: Pooled and Individual Beta Coefficients of European Office Yields 1982-2009 and Pre and Post Introduction of Single Currency Q1 99

Panel A	1982 - 2009	1982 - 1998	1999 - 2009
All Europe	-0.56	-0.54	-0.63
Core Europe	-0.86*	-0.89*	-0.82*
Panel B Individual	**1982 - 2009**	**1982 - 1998**	**1999 - 2009**
Amsterdam	-1.04*	-1.12*	-0.92*
Brussels	-0.89*	-0.89*	-0.91*
Frankfurt	-0.66	-1.06*	-0.66
Madrid	-0.37	-0.31	-0.79*
Milan	-0.62	-0.70	-0.85*
Paris	-0.71	-0.60	-1.07*
London	-0.45	-0.41	-0.52

Note: * Indicates insignificantly different from -1 at the 5% level

The most prominent feature in Panel B of Table 5 are the dramatic shifts in size and the significance of the beta coefficients before and after the introduction of the single current. For instance, the beta coefficients of Madrid, Milan and Paris moved from beta coefficients of -0.47, -0.63 and -0.60, respectively, which were all significantly different from -1, to values -0.79, -0.85 and -1.07 respectively that are now insignificantly different from -1, indicative of complete integration of the Madrid, Milan and Paris office market yields with the rest of Europe post EMU. In contrast, the beta coefficients of Brussels and Amsterdam were insignificantly different from -1 before and after the introduction of the single currency The beta coefficients of London, meanwhile, shows little change in the period before and after the introduction of the single currency (-0.49 and -0.52 respectively), both values of which is significantly different from -1. This suggests that London pricing was unaffected by the introduction of the Euro and that yields in London have not converged with the rest of Continental Europe, as suggested by the correlation coefficients in Table 2. Lastly, the beta values of Frankfurt moved from a value of -1.06, which was insignificantly different from -1 before the introduction of the single currency to a value of -0.66 post EMU that is significantly different from -1, which suggest that convergence is not a given within Europe and that divergence is possible, supportive of the findings of Brounen and Huisman (2007).

Table 6: individual beta coefficient of European office yields from 1982-2009 pre and post the single currency Q1 99: core countries

Country	1982 - 2009	1982 - 1998	1999 - 2009
Amsterdam	-1.12*	-1.24*	-0.95*
Brussels	-1.08*	-1.02*	-0.72*
Frankfurt	-0.64	-0.61	-0.76*
Paris	-0.85*	-1.14*	-1.04*

Note: * Indicates Insignificantly different from -1 at the 5% level

With initial evidence pointing to Continental European integration, a Core Europe benchmark is used with only Amsterdam, Brussels, Paris and Frankfurt included. The individual beta coefficients in Table 6 indicate a stronger degree of convergence between Core European office investment markets, with Paris and Amsterdam Brussels showing the least evidence of divergence from their Continental neighbours.

Sigma convergence results

Sigma convergence attempts to capture the cross-sectional volatility of a variable over time. Thus, a variable which is converging, for a particular cross-section, will have a downward sloping sigma curve that eventually heads to zero. In addition, σ-sigma convergence is useful, since one can observe periods of convergence or divergence through time. The results for sigma (σ)-convergence in the rents and yields in the sampled markets are shown in Figures 1 and 2, respectively.

Figure 1: Sigma Convergence analysis for European office rents (in local currency)

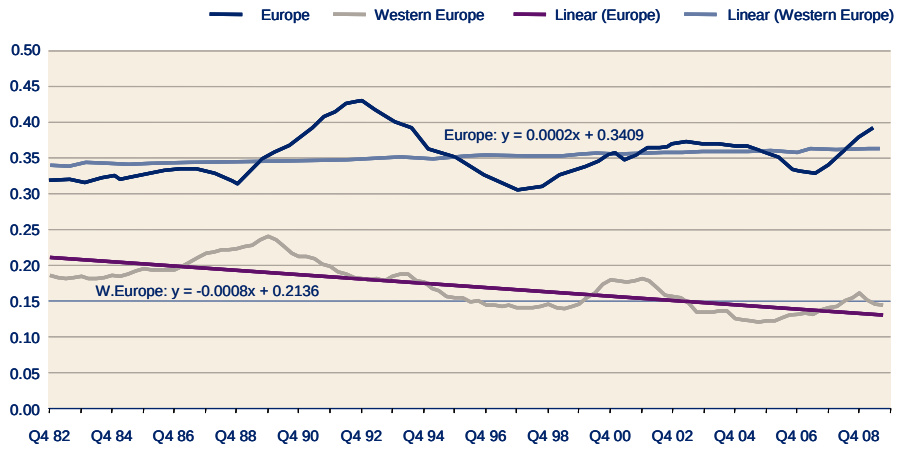
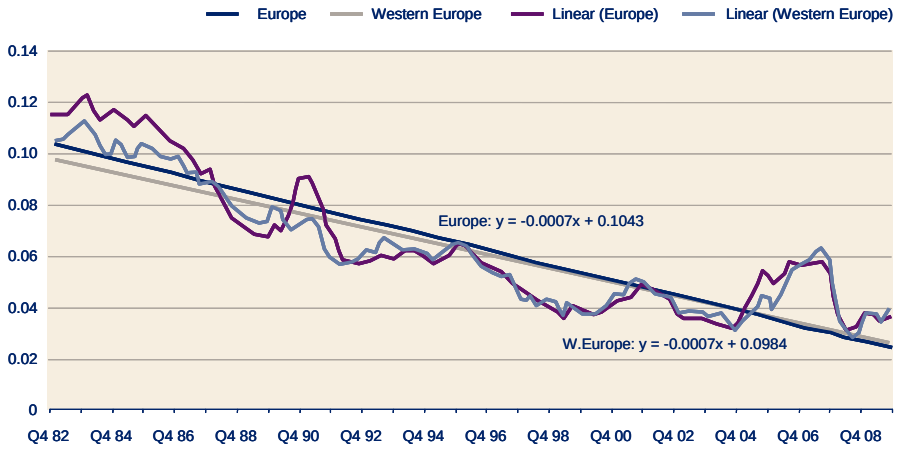


Figure 1 shows the results of regressions of the quarterly cross-sectional sigma (σ) values against time. The results for Europe, as a whole, present evidence of significant divergence, at the 1% significance level, but at less than 0.02% per quarter. However, in line with the results in the previous section and the findings of McAllister (2008) there is significant evidence of sigma (σ) convergence in the countries of Western Europe, ie. excluding London, at a rate of 0.08% per quarter. This implies that the City of London office market is behaving in a totally different way from continental Europe, which provides more support to the findings of Brookes and Tsolacos (2007, 2008); Andrews and Lee (2008) and Lee (2007, 2009) that London is probably more influenced by the global economy, especially the US economy, rather the Europe.

Figure 1: Sigma Convergence analysis for European office yields 1982 to 2009



In contrast to the results in Figure 1, Figure 2 shows evidence of sigma (σ)-convergence in office yields in both Europe as a whole and Western Europe. The regression results in both samples of yields against time indicate a strong downward slope and are significant at the 1% level. Nonetheless, the coefficients indicate that the speed of convergence is no more than 0.07% per quarter. This supports the findings of McAllister (2008) that yields in Europe are converging, albeit very slowly.

Discussion

The results in the previous section indicate that yields and in particular rents in the seven European office markets studied here have not converged, although the evidence for yields is much stronger than for rents especially since the introduction of the single currency. The stronger linkages in yields rather than rents can be explained by the substantial increases in cross-boarder real estate investment across Europe and the property investment market's dependency on a global capital markets. For instance, data from Jones Lang LaSalle (JLL) show that cross-border capital flows are now an established component of the European direct real estate investment market growing from €23.6bn in 2000 to €173bn by 2007, a growth rate of 39% per annum (Jones Lang LaSalle, 2008). Indeed, by the end of 2007 cross-boarder investment accounted for the majority of European direct real estate investment. For instance, in 2007 cross-border investment as a proportion of the total has risen to 63% compared with 37% for 2000. Since 2007, however, European commercial real estate investment volumes have fallen sharply with the figure for 2009 at €69.2bn down by 39% on 2008 and just below the figure for 2001 (Jones Lang LaSalle, 2010). The extent of cross boarder investment is also down compared with a high of 63% in 2007 but still represents about 50% of the total transactions (Jones Lang LaSalle, 2010).

The lack of evidence in European rent convergence is hardly surprising for at least two reasons. First, previous studies show a strong link between the rental growth in European countries and the countries GDP (see; Giussani, et al., 1993 and D'Arcy et al., 1997, among others). However, the evidence for convergence in GDP in the European Union is mixed. For instance, Barro and Sala-i-Martin (1991, 1995), Veiga (1999), Hoen (2000), Yin et al. (2003) study σ-convergence of real GDP per capita among different samples of countries in Europe and provide evidence for convergence, especially in the 1980s. By way of a contrast, Neven and Gouyette (1994), Neven (1995), López-Bazo et al. (1999), Barrios and Strobl (2005), Cappelen et al. (2003); Basile et al. (2001) and Zarotiadis and Gkagka (2010) among others reject the convergence hypothesis for the European Union, indeed a number of studies suggest that European GDP is now divergent! The main reason for the contradictory results arises from using dissimilar time periods, especially if the authors included the period from the 1980s until the 1990s, which showed strong evidence of convergence, as a result of the oil price shocks, but did not include the data since 2000 that now shows evidence of persistent divergence.

Second, Worzala and Bernasek (1996), argue that while economic integration will result in a single market for individual goods and services the special characteristics of commercial real estate makes it unlikely that a fully fledged single real estate market will result. Indeed the property market is one of the few areas of commercial and social life unaffected by edits from Brussels in the drive towards European economic integration. One major reason for this lack of legislation is the complexity of the market making standardisation within the EU. Consequently, Worzala and Bernasek (1996) suggest that this is leads to inefficiency within the real estate market and the absence of standard pricing. Hence, office rental values in Europe are unlike to be convergent for the foreseeable future.

The results above have a number of important implications for the development of an effective pan-European investment strategy. First investors need to complete a thorough review of the characteristics of each market. As it is the differences in market characteristics which can have important implications as the level of risk and return that investors can reasonably expect to see in each market as local market conditions with local constraints will determine the supply and demand and hence local market rental values. Second, there are differences in way local markets absorb information which suggests the markets will display differing

property cycles. Such cyclical differences open up the possibility that managers can effectively exploit timing strategies across European real estate markets. That is, enter and exit certain markets in anticipation of up and down movements in real estate returns. Lastly once implemented a pan-European will need to be constantly monitored. As any changes in the characteristics of a market are likely to have a profound effect on the risk and return that investors can expect in the future.

Conclusion

The extent of synchronization between European real estate markets is crucial for appropriate portfolio selection. This paper uses the concepts of β-convergence and σ-convergence to evaluate empirically the hypothesis of rent and yield convergence in seven European office markets during the period 1982-2009. Because of the introduction of a single currency in January 1999, the analysis is carried out sequentially, first for the overall and then the periods before and after the introduction of the single currency. The results indicates that irrespective of the time period considered there is not enough statistical evidence of β-convergence in either rents or yields but evidence of significant σ-convergence in rents and yields in the European office markets under review. Additionally, we find some evidence that the introduction of the single currency in 1999 has led to increasing signs of convergence, especially in the Continental European markets.

References

Adam, K.T., Japllei, A. Menichini, M. Padula, and Pagano, M. (2002) Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union, European Commission, pp. 1–95.

Armstrong, H. and R. Vickerman, editors (1995) Convergence and Divergence Among European Regions, (London, Pion).

Andrews, M. and Lee, S.L. (2008) The Integration of Securitised Real Estate Markets in Europe, a paper presented at the Asian Real Estate Society Meeting, Shanghai, China, July

Barrios, S., Strobl, E. (2005) The Dynamics of Regional Inequalities, Economic Papers of the European Commission 229, Brussels.

Barro, R. and X. Sala-i-Martin (1991) Convergence Across States and Regions, Brookings Papers in Economic Activity, **1**, 107-182.

Barro, R. and X. Sala-i-Martin (1992) Convergence, Journal of Political Economy, **100**, 223-251.

Barro, R.J., Sala-i-Martin, X. (1995) Economic Growth, McGraw Hill, New York

Basile, R., de Nardis, S., Girardi, A. (2001) Regional Inequalities and Cohesion Policies in the European Union, ISAE Working Paper, No.23.

Brookes, C. and Tsolacos, S. (2007) The Integration of European and US Real Estate Markets, A Paper Presented at the ERES Annual Meeting, June

Brookes, C. and Tsolacos, S. (2008) Integration of International Office Markets and Signal Extraction, Journal of Real Estate Portfolio Management, **14**, 4, 351-361

Brounen, D. and Huisman, R. (2007) Continental Factors Revisited: Evidence from International Property Shares, A paper presented at the European Real Estate Society Meeting London, June

Cappelen, A., Castellacci, F., Fagerberg, J. and Verspagen B. (2003) The Impact of EU Regional Support on Growth and Convergence in the European Union, Journal of Common Market Studies, **41**, 4, 621-644.

D'Arcy, E., McGough, T. and Tsolacos, S. (1997) National Economic Trends, Market Size and City Growth Effects on European Office Rents, Journal of Property Research **14,**

Eichholtz, P.M.A., Huisman, R. Koedijk, K. and Schuin, L. (1998) Continental Factors in International Real Estate Returns, Real Estate Economics, **26**, 493-509.

Giussani, B., Hsia, M. and Tsolacos, S (1993) A Comparative Analysis of the Major Determinants of Office Rental Values in Europe, Journal of Property Valuation and Investment **11**, 157-73.

Grissom, T. and Lizieri, C. (2003) Exchange Rate Regime Impacts on Real Estate Securities Returns, Presented at the European Real Estate Society Meeting, Helsinki

Hoen, A.R. (2000) Convergence and Divergence in the European Union, Paper presented at the 40th European Congress of the European Regional Science Association, Barcelona.

Jackson, C., Stevenson, S. and Watkins, C. (2008) NY-LON: Does a Single Cross-Continental Office Market Exist? Journal of Property Investment and Finance, **14**, 2, 79-92

Jones Lang LaSalle (2008) European Capital Markets Bulletin 2007 and views of 2008, February

Jones Lang LaSalle (2010) European Capital Markets Bulletin 2009, February

Lee, S.L. (2009) Is the UK Real Estate Market Converging with the Rest of Europe?, Journal of European Real Estate Research, **2**, 1, 18-32

Lizeri, C., McAllister, P. and Ward, C. (2003) Continental Shift? An Analysis of Convergence trends in European Real Estate Securities, Journal of Real Estate Research, **25**, 1, 1-21.

López-Bazo, E., Vayá, E., Mora, A.J, and Suriñach, J. (1999) Regional Economic Dynamics and Convergence in the European Union, Annals of Regional Science, **33**, 343-370.

McAllister, P. (2008) *Integration and Convergence in European Office markets: An Empirical Analysis*, Presented at the ERES Annual Conference, Krakow, Poland

McAllister, P. and Lizieri, C**.** (2006) Monetary Integration and Real Estate Markets: the Impact of the Euro on European Real Estate Equities, *Journal of Property Research*, **23,** 4, 281-304.

Neven, D.J. (1995) Regional Convergence in the European Union, Journal of Common Market Studies, **33**, 47-65.

Neven, D.J. and Gouyette, C. (1994) Regional Convergence in the European Community, CEPR Discussion Paper 914, London.

Quah, D. (1993) Galton's Fallacy and Tests of the Convergence Hypothesis, Scandinavian Journal of Economics, **95**, 4, 427-443.

Sala-i-Martin, X. (1994) Cross-sectional Regressions and the Empirics of Economic Growth, European Economic Review, **38**, 107-182.

Sala-i-Martin, X. (1996) The Classical Approach to Convergence Analysis, Economic Journal, **106**, 1019-1036.

Veiga, F.J. (1999) Real Convergence in the European Union, CEEG, Documento de Trabalho 2/1999, Universidade do Minho.

Worzala, E. and Bernasek, A. (1996) European Economic Integration and Commercial Real Estate Markets: An Analysis of Trends in Market Determinants, Journal of Real Estate Research, **11**, 2, 159-81.

Yang, J., Kolari, J.W. and Zhu, G. (2005) European Public Real Estate Market Integration, *Applied Financial Economics*, **15**, 13, 895-905.

Yin, L., Zestos, G.K., Michelis, L. (2003) Economic Convergence in the European Union, Journal of Economic Integration, **18**, 1, 188-213.

Zarotiadis, G. and Gkagka, A. (2010) Switching from Convergence to Divergence in the European Union: A Case Study, Society for the Study of Economic Inequality, ECINEQ Working paper 2010-164.