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Abstract

The article examines the link between the office market and labour market in Germany. In a first step the number of office employees is calculated by referring to occupational labour market statistics. Using a panel analysis with data for the biggest five German metropolises it is shown that office employment is a superior predictor for explaining adjustments in prime and average rents compared to total employment and unemployment rates. Taking vacancy rates also into account, the fit of the model can be further increased. Construction has only a minor impact on prime rents. The study is supplemented with single regressions for the five cities. While adjustments in Berlin and Dusseldorf can hardly be ascribed to office employment, office rents in Frankfurt, Hamburg and Munich react strongly to changes in the labour market.

Key words: office employment, rental adjustment, panel analysis

Introduction

The office market is one of the most relevant markets for institutional investors like open-ended funds, insurances and pension funds. According to recent estimates the office space in Germany in the seven biggest metropolises is worth approximately 450 billion Euros (Junius, 2010). Changes in market conditions, like rents and vacancy rates, are therefore very important for investors. A plethora of articles have analysed the determinants of office indicators like Wheaton and Torto (1994), Hendershott (1996), Hendershott, MacGregor and Tse (2002) and Ling and Naranjo (2003). Rabianski and Gibler (2007) give an overview of this topic. However, the literature typically focuses on Anglo-Saxon countries like the United States, the United Kingdom or Australia. In contrast, analyses for the German market are scarce. Recently, Kurzrock, Rottke and Schiereck (2009) have explored the factors that determine the returns of office buildings. Nitsch (2006), too, has analyzed the relevance of location and building characteristics for the determination of rents in a German metropolis.

Unlike in these studies, this article focuses on the drivers of changes in rents over time. For most economists and market players it is without question that labour market developments have an important impact on the office market. Since the demand for office space is determined by the number of employees and the office space per employee the importance of the labour market is obvious. Given that only about 30 percent of all employees work in offices it seems necessary to take into account only office employment and not total employment in an analysis of the office market. Additionally, it is not reasonable to assume that macroeconomic shocks like recessions have the same impact on office workers and, for example, service agents. Typically office workers are well qualified and

companies probably will be more cautious to hire and fire office workers. Yet, in contrast to the United States office employment data are not provided by official statistics in Germany.

Hence, in a first step the number of office workers in Germany is calculated and then applied to an analysis of the office market. To the best of the author's knowledge this is a new approach to office market analyses for the German market. Data for the market of the top five economic metropolises (Berlin, Dusseldorf, Frankfurt, Hamburg and Munich) on a quarterly basis has been provided by JonesLangLaSalle.

The article has two key aims: Firstly, by conducting a panel data analysis the explanatory power of office employment is analysed and compared with other employment market indicators, like the unemployment rate. Secondly, single regressions are used in order to test whether the German cities react differently to changes in employment. Given the different economic focus of the German metropolis – for instance, Berlin relies on public administration while Munich on an export-oriented industry – this is an important aspect for investors.

The article is structured as followed. In a first step the number of office workers in Germany is calculated by referring to occupational employment statistics provided by the Federal Employment Agency (Bundesagentur für Arbeit). Furthermore, additionally used data are explained. Then panel regressions for the main office metropolises as well as single regressions for these cities are presented. Finally, the main results are summed up.

Office Employment in Germany

The Federal Employment Agency provides quarterly occupational employment statistics for all cities and county districts which have a

regional office of the Agency. This statistic is the basis for calculating the number of office workers. In the literature two methods have been advocated for estimating office employment. Dobberstein (1997) analysed the micro-census, a detailed sample which among other things offers detailed information about working conditions, and reported for over 1,000 occupations ratios for office workers. Her work is very detailed but has not been updated since 1997. Another approach goes back to Troll (1994) who identified 48 occupational groups who typically work in offices. This approach is less sophisticated, but as Dobberstein (1997) showed both calculation methods deliver comparable results. Therefore, in this analysis Troll's approach was used, however with slight modifications. As the classification of occupational statistics has changed since 1994, we include 51 occupational groups instead of 48.

The statistics of the Federal Employment Agency only include employment covered by the statutory unemployment insurance, so that office workers who are civil servants or self-employed are missing. With respect to civil servants this is only a minor drawback since their number is very stable over time. Self-employed office workers are of greater interest but quarterly data is missing. Dobberstein computed the number of self-employed on a data basis that is available every four years. Consequently, this kind of office work has to be neglected.

Table 1 shows the number of office workers in Germany and in the 5 cities which are analysed in the following.

Table 1: Office Workers in Germany as of 30 June 2009

Occupational group	Group No.	Office workers	
		Total	Top 5 Cities*
Managers of small enterprises in agriculture, hunting, forestry and fishing	031	2,356	98
Agronomists and related professionals	032	9,717	372
Mechanical engineers	601	153,008	18,455
Electrical engineers	602	156,113	25,542
Civil engineers	603	122,915	22,945
Cartographers and surveyors	604	9,220	1,165
Mining engineers, metallurgists and related professionals	605	5,620	338
Architects, engineers and related professionals not elsewhere classified	606	26,020	4,154
Research and development managers	607	217,463	31,111
Physicists, mathematicians and astronomers	612	23,910	4,077
Mechanical engineering technicians	621	106,324	12,767
Production and operations managers in construction	623	50,023	6,371
Civil engineering technicians	624	23,389	1,949
Mining and metallurgical technicians	625	6,648	178
Chemical and physical science technicians	626	27,393	4,176
Physical and engineering science technicians	627	30,011	2,326
Technicians	628	368,374	46,917
Production and operations managers in wholesale and retail trade	681	514,509	62,089
Finance and sales associate professionals	683	27,996	5,701
Securities and finance dealers and brokers	691	578,528	126,530
Statistical, mathematical and related associate professionals	692	8,216	1,122
Statistical and finance clerks	693	34,399	6,437
Insurance representatives	694	187,499	54,263
Transport clerks	701	101,587	21,090
Travel attendants and travel stewards	702	66,467	19
Advertising and public relations managers	703	108,333	36,232
Securities, finance and estate dealers and brokers	704	15,298	4,788
Business services agents and trade brokers not elsewhere classified	705	28,705	6,118
Entrepreneurs and Business Managers	751	363,019	66,685
Business consultants	752	148,926	40,955
Accountants	753	163,839	32,516
Legislators and senior government officials	761	3,607	219
Senior Administrators	762	132,917	28,265
Senior officials of humanitarian and other special-interest organisations	763	15,73	4,081
Accounting and book-keeping clerks	771	39,919	8,023
Bookkeepers	772	178,077	32,604
Cashiers and ticket clerks	773	127,938	11,978
Computer assistants	774	530,068	114,139
Office clerks	781	3,833,268	589,020
Stenographers and typists	782	261,261	52,324
Data entry operators	783	28,62	5,359
Other office clerks	784	188	32,830
Judges	811	7,005	1,405
Legal professionals not elswhere classified	812	683	186
Lawyers	813	43,558	16,700
Legal and related business associate professionals	814	2,349	288
Authors, journalists and other writers	821	66,769	21,468
Philologists, translators and interpreters	822	6,853	1,902
Librarians and related information professionals	823	44,353	9,734

Government social benefits administrators	863	24,412	4,342
Economists	881	91,125	17,440
Housekeepers and related workers	922	5,251	597
Total		**9,317,588**	**1,619,371**

* Berlin, Dusseldorf, Frankfurt, Hamburg, Munich

Source: Federal Employment Agency, own calculations

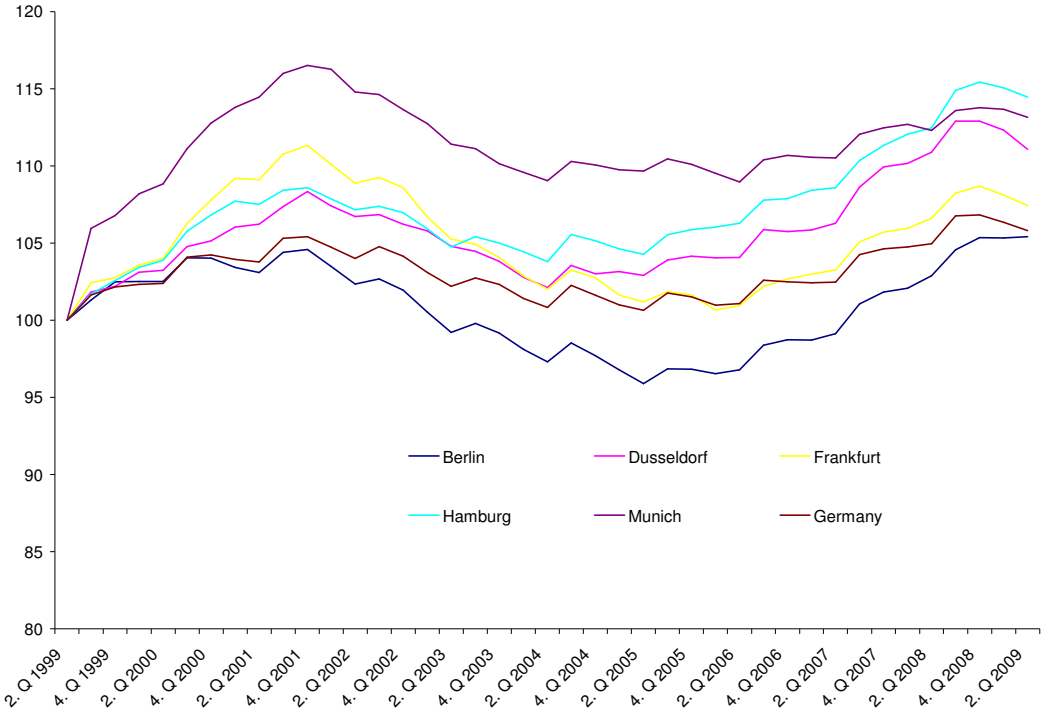
The table includes data for all relevant 51 occupational groups as well as the corresponding classification number of the Federal Employment Agency. Office clerks constitute the largest group, followed by all kinds of computer assistants and wholesale and retail managers. All in all, in the second quarter of 2009, 9.3 Million socially insured employees worked in offices. Among them, 1.6 Million or 17.4 percent worked in the 5 top cities Berlin, Dusseldorf, Frankfurt, Hamburg and Munich which stresses the importance of these locations for investors. According to these figures, 34 percent of all employees in Germany work in offices. With regards to the five cities, the share varies between 39 percent (Berlin) and 54 percent (Frankfurt).

The data for office work covers the period of the second quarter 1999 to the second quarter 2009. During this 10 year period office employment has increased in Germany as well as in all regarded cities (figure 1). The period covers a complete business cycle. At the beginning of the period employment spiralled mainly because of the new chances in the IT-industry. With the burst of the new economy bubble, however, employment plummeted. Since the middle of the century, office employment has recovered and reached a new peak at the end of 2008. Only recently employment stagnated because of the financial crisis.

On average office employment increased by 5.4 percent in the corresponding period. All metropolises have outperformed this increase, although Berlin only slightly. Hamburg (+14.1 percent), Munich (+13.1

percent) and Frankfurt (+11.1 percent) are the locations with the most impressive employment growth.

Figure 1: Development of office employment (index: 2nd quarter: 1999=100)



Source: Federal Employment Agency, own calculations

Other data

In addition to office employment we also take into account total employment and the unemployment rate which are both freely available at the Federal Employment Agency. Office market data has been provided by JonesLangLaSalle, an international realtor. The office indicators cover prime rents, average rents and the vacancy rates. Furthermore, JonesLangLaSalle provided data on office building completions. All data cover the period from the 2nd quarter of 1999 to the 2nd quarter of 2009.

Panel Data Regressions

Tests for unit roots indicate non-stationarity of all relevant variables. Therefore, first differences are used. The Fisher-Test as proposed by Maddala and Wu (1999) as well as the Hadri-Test (Hadri, 2000) for a restricted and hence balanced data set indicate stationarity for first differences. Additionally, the Hausman-Test suggests the application of random-effects models. However, regressions with fixed-effects did not deliver different results. Furthermore, dummy variables have been used to control for seasonal effects.

In a first step solely employment variables are used as regressors for changes in prime rents. The results are presented in table 2.

Table 2: Regression results for changes in prime rents

	Regressor (first difference)		
	Office employment	Total employment	Unemployment rate
t	.0001371*** (0.0000377)	.0000459*** (0.0000132)	-.4031101*** (0.1376342)
t_{-2}	.0001383*** (0.0000428)	.0000538*** (0.0000185)	-.2038614 (0.136894)
t_{-6}	-.0000851*** (0.0000307)	-.000025 (0.0000184)	-.0727267 (0.1447497)
R^2	0.2799	0.1760	0.0840
Obs.	160	160	160
This table reports the results for a random-effects panel model with changes in prime rents as the dependent variables and changes in employment variables as independent variables. In all cases a contemporaneous and a lagged regressor were considered. ***/**/* indicate significance on 0.01/0.05/0.1 levels, respectively. Standard errors are in parenthesis.			

As it turns out, changes in employment have a contemporaneous as well as a temporally delayed effect on prime rents. Given the fact that companies need time to adjust their office space demand to changes in their staff this is not surprising. According to the results, changes in employment two quarters ago have a greater impact than contemporaneous employment

developments. Also statistically significant is the change in employment six quarters ago, but with a change in the prefix. This suggests an overshooting in the office market. For instance, improvements in the labour market could stimulate construction activities which lead to excess supply a few quarters later. Such changes in prefixes are typical for markets with cyclical behaviour.

Compared to office employment, total employment is less useful for predicting changes in prime rents. Although all coefficients are significant, changes in office employment are generally more relevant in an economic sense since coefficients are greater. Additionally, the coefficient of determination is 10 percentage points higher. While total employment has some explanatory power for prime rents, changes in the unemployment rate fail as a predictor. Only the contemporaneous change in the unemployment rate has a significant effect on prime rents. Nevertheless, since unemployment rates are more timely available than employment data, researchers should not neglect this early indicator.

In addition, the model with office employment has been extended by a variable which captures newly completed office space (in 1,000 square metres) and by considering different levels of vacancy rates. Inspired by Brounen and Jennen (2009) who analyse the asymmetric behaviour of the rental adjustment process, the model differentiates whether the vacancy rate is above or below the corresponding vacancy rate. Results are reported in table 3.

Table 3: Regression results for an extended model of changes in prime rents

	(I)	(II)	(III) $vac_t<vac_{mean}$	(IV) $vac_t>vac_{mean}$
Office employment (t)	.0001371*** (0.0000377)	.0001407*** (0.0000379)	.0001763* (0.0000953)	.0000882*** (0.0000301)
Office employment (t_{-2})	.0001383*** (0.0000428)	.0001332*** (0.0000432)	.0001995* (0.0001073)	.000074** (0.0000345)
Office employment (t_{-6})	-.0000851*** (0.0000307)	-.0000848*** (0.0000307)	-.000082 (0.0000824)	-.00000067 (0.0000316)
Construction (t)		.0016731 (0.0011256)		
Construction (t_{-1})		-.0000747 (0.0011279)		
Constant	.0315073 (.1404374)	-.0151148 (0.134244)		
R^2	0.2799	0.2927	0.3696	0.2667
Observations	160	160	47	113

This table reports the results for a random-effects panel model with changes in prime rents as the dependent variables. All variables are in first differences and t stands for the considered time period of the independent variable. vac_t represents the current vacancy rate while vac_{mean} stands for the mean of the vacancy rate for each regarded city. ***/**/* indicate significance on 0.01/0.05/0.1 levels, respectively. Standard errors are in parenthesis.

To simplify the comparison, model (I) just repeats the results of table 2. Considering construction in the regression does not clearly improve the fit of the model. The coefficient of determination solely increases by 2 percentage points. Furthermore, the construction activity is not a significant variable for explaining changes in prime rents. At first, this result seems to contradict economic wisdom since an increase in supply should have a negative impact on rents. However, office rents are not corrected for different qualities. As newly constructed office space typically has a higher quality and therefore a higher rental price, a positive impact on prime rents

can be supposed. Both effects superimpose each other, so that construction seemingly has no significance for explaining rental price adjustments. It is worth to point out, however, that the coefficients for office employment do not alter if construction is included into the model. This suggests a robust relationship between changes in office employment and rental adjustments.

Differentiating between cases in which the vacancy rate is above and below the average rate alters the results significantly. Given vacancy rates below the mean level, the coefficient of determination increases to a value of 0.3696 which is remarkably high for a regression with first differences. On the other hand, for vacancy rates above the mean level the coefficient of determination is considerably lower. This confirms the results of Brounen and Jennen (2009) for the U.S. market. If vacancy rates are low, additional demand for office space will put pressure on rents while in a setting with high vacancy rates additional demand can be absorbed by existing office space.

So far the analysis concentrated on prime rents. In addition, it was carried out for average rents. Economically, one could expect that fundamental factors like office employment have a greater explanatory power for average rents than for prime rents. Since prime rents are more volatile, it seems likely that speculation and short-term effects, like location decisions of major enterprises, have a greater impact on this market indicator. However, the results of the regression which are reported in tables 4 and 5, do not confirm this expectation. On the whole the coefficients of determination are comparable for regressions with prime rents and average rents suggesting that demand changes can explain an equal share of fluctuations. However, two differences are noticeable. Firstly, the model fit is better if the change in office employment two quarters ago is taken into

account instead of the change one quarter ago (as with prime rents). Secondly and in contrast to prime rents, a change of sign with respect to the employment regressors for average rents is missing. Accordingly, the broad market does not overreact to demand changes but the smaller prime market. Thus, the fact that the prime rent cycle is much more pronounced than the cycle for the whole market can be ascribed to the different reaction to office employment. In addition, construction is a significant regressor for average rents but with positive prefixes. Hence, quality-driven rent increases dominate the effect of an additional supply in the office market.

Table 4: Regression results for changes in average rents

	Regressor (first difference)		
	Office employment	Total employment	Unemployment rate
t	.0001042 (.0001309)	.0000778 (.0000452)	-.3187114 (.4089081)
t_{-1}	.0005464 *** (.0001334)	.0001239*** (.0000461)	-.4922331 (.406547)
t_{-6}	.000088 (.0000818)	.0000899** (.0000395)	-1.36166** (.4366629)
R^2	0.2645	0.1799	0.0786
Observations	162	162	162
This table reports the results for a random-effects panel model with changes in prime rents as the dependent variables and changes in employment variables as independent variables. In all cases a contemporaneous and a lagged regressor were considered. ***/**/* indicate significance on 0.01/0.05/0.1 levels, respectively. Standard errors are in parenthesis.			

Table 5: Regression results for an extended model of changes in average rents

	(I)	(II)	(III) $vac_t<vac_{mean}$	(IV) $vac_t>vac_{mean}$
Office employment (t)	.0001042 (.0001309)	.0001161 (.0001284)	-.0001768 (.0002686)	.0002585* (.0001557)
Office employment (t_{-1})	.0005464 *** (.0001334)	.0005333*** (.0001308)	.0009264** (.0002695)	.0003523** (.0001587)
Office employment (t_{-6})	.000088 (.0000818)	.0000671 (.0000801)	-.0000788 (.0001777)	.000101 (.0001289)
Construction (t)		.00998*** (.0033481)		
Construction (t_{-1})		.0070358 ** (.003353)		
Constant	.3151216 (.3934441)	.3434518 (.3908462)	.0867785 (.938159)	.4806884 (.435557)
R^2	0.2645	0.3092	0.3942	0.2292
Observations	162	162	47	115

This table reports the results for a random-effects panel model with changes in average rents as the dependent variables. All variables are in first differences and t stands for the considered time period of the independent variable. vac_t represents the current vacancy rate while vac_{mean} stands for the mean of the vacancy rate for each regarded city. ***/**/* indicate significance on 0.01/0.05/0.1 levels, respectively. Standard errors are in parenthesis.

Single Regressions

The most important advantage of a panel analysis is the possibility to make use of a broader data base. Hence, results are more robust and reliable. However, for investors and practitioners panel analyses are only of limited interest since they want to invest in specific locations. Therefore, single regressions for the relationship between office employment and office rents are presented. These regressions also give information about the similarity of the big five German cities. Results for prime rents are summarized in table 6.

Table 6: Single regressions for prime rents

	Berlin	Dusseldorf	Frankfurt	Hamburg	Munich
Office employment (t)	.0001235 (0.000088)	.0000903 (0.0001418)	.0003464*** (0.0001351)	.0001566 (0.0001074)	.0000883** (0.000416)
Office employment (t_{-2})	.0000341 (0.0001012)	.0002367 (0.0001509)	.0002427* (0.0001419)	.0001985 (0.000123)	.0000426 (0.000041)
Office employment (t_{-6})	-.0000726 (0.0000665)	-.000005 (0.0001392)	-.0002010* (0.0000991)	-.000268*** (0.0000916)	-.0000009 (0.000019)
Constant	.0017678 (0.265217)	-.0281063 (0.2848066)	-.1708795 (0.3789359)	.1708842 (0.3276106)	.2508323* (0.135673)
R^2	0.2683	0.1987	0.5726	0.4629	0.4641
Observations	32	32	32	32	32
This table reports the results for single regressions with changes in prime rents as the dependent variable and changes in office employment as the independent variable whereby t stands for the considered time period of the independent variable. ***/**/* indicate significance on 0.01/0.05/0.1 levels, respectively. Standard errors are in parenthesis.					

First of all, the signs of the coefficients for the cities are all equal which stresses the robustness of the regressions. Nevertheless, the range of values is relatively wide. As one can conclude from the coefficient of determination, changes in prime rents are not mainly driven by office employment in Berlin and Dusseldorf. With above average and persisting high vacancy rates the office market in these cities reacts barely to changes in market demand. Unfortunately, time series are too short to account for time periods with above and below average rates of vacancy, respectively. By contrast, more than 50 percent of prime rent fluctuations in Frankfurt can be explained by changes in office employment. In Frankfurt the vacancy rate is high, too, but it is much more volatile over time which

allows for rental adjustments to market demand. Munich and Hamburg exhibit high values for the coefficient of determination, too, but the coefficients are generally lower for Munich indicating a minor economic relevance.

Regressions were also conducted for average rents. Since panel regressions indicated a significance of construction activities, this variable was additionally taken into account. As table 7 shows, the coefficients of determination for Frankfurt, Hamburg and Munich are significantly higher than for Berlin and especially Dusseldorf. Especially the results for Munich are outstanding since two third of the changes in average rents can be explained by changes in office employment and changes in construction activities.

Table 7: Single regressions for average rents

	Berlin	Dusseldorf	Frankfurt	Hamburg	Munich
Office employment (t)	-.0002386 (.0004962)	.0004097 (0.0004082)	-.0003189 (0.0003642)	-.0003086 (0.0003375)	.0000046 (0.0003577)
Office employment (t_{-1})	.0009929* (.0005324)	-.0001449 (0.0004269)	.0010762*** (0.0003568)	.0009673** (0.0003487)	.0008666** (0.0003594)
Office employment (t_{-6})	-.0000773 (.0002983)	.0006489 (0.0004121)	-.000048 (0.000214)	.0001279 (0.0002264)	-.0000573 (0.0001168)
Construction (t)	.0043156 (.0184913)	-.0075976 (0.0150778)	.0098575 (0.0064096)	-.00042424 (0.0103377)	.0162062*** (0.0042353)
Construction (t_{-1})	-.00649 (.186205)	-.002341 (0.015661)	.0094722 (0.0063966)	-.00123532 (0.0100921)	.0135523*** (0.0043576)
Constant	.916048 (1.484691)	.2633969 (0.8211041)	.2845198 (0.9329625)	-.1553646 (0.8450226)	1.562785* (0.7644896)
R^2	0.3290	0.1738	0.4861	0.4416	0.6728
Observations	32	32	32	32	32

This table reports the results for single regressions with changes in average rents as the dependent variable and changes in office employment and construction as the independent variables whereby t stands for the considered time period of the independent variable. P-values of the coefficients are in parenthesis.

Conclusion

The analysis explores the linkage between the labour market and the office market for the top five German cities. Not surprisingly, office employment is a better predictor of changes in office rents than the unemployment rate or total employment. Models with office employment can explain up to 10 percentage points more of the fluctuations in office rents. In cities like Frankfurt and Munich, movements in office employment can explain more than 50 percent of rental adjustments. Furthermore, the analysis shows that changes in employment affect the office market with a time lag whereby only minor differences between average rents and office rents occur. For researchers who want to predict the development of office market indicators the labour market, therefore, gives valuable information. The analysis also demonstrates that construction activity is of minor importance for explaining rental adjustments, at least with respect to prime rents. Probably construction has overlapping effects on rental prices: On the one hand additional supply puts downward pressure on prices, on the other hand newly built offices have a higher standard and hence higher prices. As a consequence, construction is in most models not a significant regressor. Vacancy rates, however, are an important factor for rental adjustments. If vacancy rates are low, rental adjustments are significantly stronger when office employment increases. Seemingly, if vacancy rates are high additional demand is absorbed by vacant office space. Thus, this analysis confirms a recent study by Brounen and Jennen (2009) for the U.S. market.

Given the relevance of labour market developments for the office market and the lack of reliable office market indicators in Germany – especially with respect to other major cities - real estate research should put more effort in the uitilisation of labour market data.

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